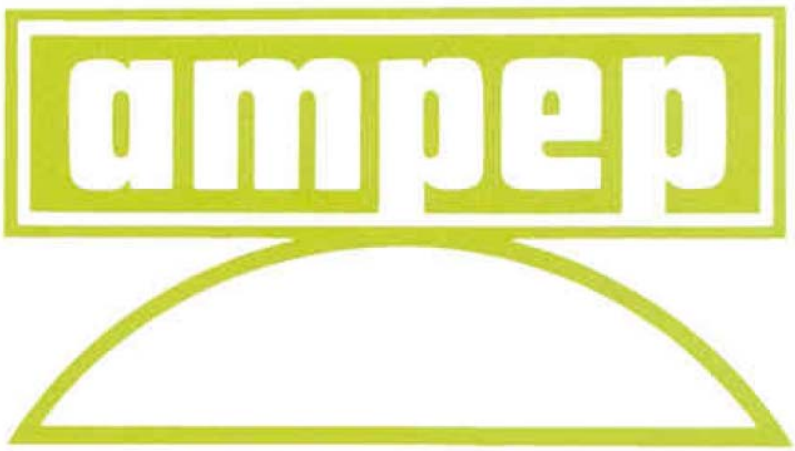
AMPEP AEROSPACE BEARINGS CATALOGUE



SELF-LUBRICATING AND METAL/METAL PLAIN BEARINGS

CONTENTS

For further information refer to detailed index at the beginning of each section.

AMPEP SELF-LUBRICATING & METAL/METAL PLAIN BEARINGS

0.1 THE COMPANY

AMPEP plc is situated in Clevedon, Avon, England. Established in 1963, Ampep has been a subsidiary of Sarma, an SKF Company, since 1988. The company specialises in the design and manufacture of high quality self-lubricating and metal/metal plain bearings for aerospace and industrial markets.

AMPEP bearings are used extensively in fixed wing aircraft and helicopter airframe and flight control systems. In general industry, AMPEP self-lubricating bearings are used in wide range of applications particularly on railway vehicles, high performance racing cars, fighting vehicles, fork lift trucks, marine equipment, valves and power generation equipment.

AMPEP bearings are frequently designed to meet requirements of the specific applications.

Considerable investment continues to be made by the company in advanced technology machine tools, computer aided design and in research and development, in order to maintain the company's leading position in the European self-lubricating plain bearing industry.

Our design department prepares schemes for many of the leading companies in Europe. This design work is regarded as confidential. Every effort is made to ensure the accuracy of our free design advice which is given without prejudice.

Our quality organisation is approved by the Civil Aviation Authority. AMPEP is an M.O.D. approved supplier through third party surveillance to ISO 9002/BS 5750 Part II.

0.2 PRODUCT RANGES - GENERAL INFORMATION

The AMPEP product range includes self-aligning spherical and rod end bearings, journal bearings and rollers, all of which are manufactured in standard and special configurations. Bearings to international standards are offered, including the American Military and A.E.C.M.A. specifications (Association Europeenne des Constructeurs de Materiel Aerospatial). Self-lubricating bearings may contain FIBERSLIP, AMPEP X1, AMPEP XL or one of their derivatives. Metal to metal bearings are constructed from various material combinations including Aluminium Bronze, Steel, and Beryllium Copper. The wide range of non-standard bearing types manufactured to meet specific applications requirements are illustrated in the photoplates contained within this manual.

0.2.1 SELF LUBRICATING BEARINGS

AMPEP lined bearings have many distinct and valuable advantages which provide solutions to a variety of difficult applications. These advantages are as follows:

- Operation without lubrication whilst tolerating many lubricating and non-lubricating fluids.
- A low coefficient of friction.
- A very high bearing stress to mass ratio.
- A high resistance to fatigue and impulse loads.
- Operational over a temperature range outside the scope of most lubricants.
- A high resistance to wear.
- Long life without maintenance.
- High reliability.
- Freedom from stick slip, fretting and brinelling.
- High tolerance to ingested solid and liquid contaminants.
- Controlled pre-load in self aligning types.

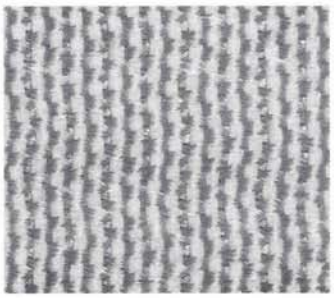
Fail safe characteristics - cases of severe plastic metal deformation and others involving local loss of the p.t.f.e. lining material in the loaded areas are not known to have resulted in seizure or catastrophic failure. Bearings in this emergency condition have continued to operate in the presence of residual p.t.f.e. films and debris although the free play has been exceptionally high.

FIBERSLIP

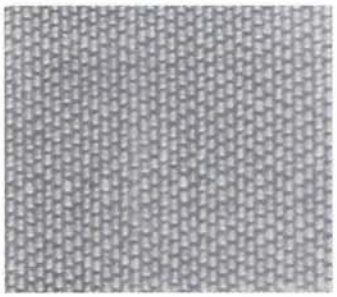
Fiberslip is the original successful bearing material, based on American technology of the early 1960's, incorporated in the standard range of AMPEP aerospace bearings and is a registered trade name. This composite material has a bearing surface of woven p.t.f.e. (polytetrafluoroethylene) which provides a low coefficient of friction and a high degree of chemical inertness. Because of its unique method of construction the poor mechanical properties inherent in bulk p.t.f.e. polymers have been overcome.

Fiberslip fabric is so woven that predominantly multifilament p.t.f.e. yarns are present at the bearing surface (photo 1) while glass and p.t.f.e. are exposed on the reverse side (photo 2). A supporting layer consisting of a glass fibre fabric impregnated with a phenolic resin is bonded under heat and pressure to the Fiberslip fabric to produce the laminate shown in photo 3. This method of construction imparts resistance to cold flow and permits the bearings to operate at unusually high stress levels. Over 5 million bearings have been supplied to worldwide airframe, power plant and equipment producers during the past thirty years.

1



2



3

Bearings containing Fiberslip are capable of meeting the performance requirements laid down in MIL- B-8942.

AMPEP X1

AMPEP X1 is AMPEP's own development of the successful Fiberslip material differing only in textile design but with improved wear characteristics as illustrated in the graphs below. AMPEP X1 is a laminated composite similar to Fiberslip and all standard bearings are available with the AMPEP X1 material incorporated.

AMPEP X1 liner system is qualified to MIL- B-81820 for the relevant bearing size range.

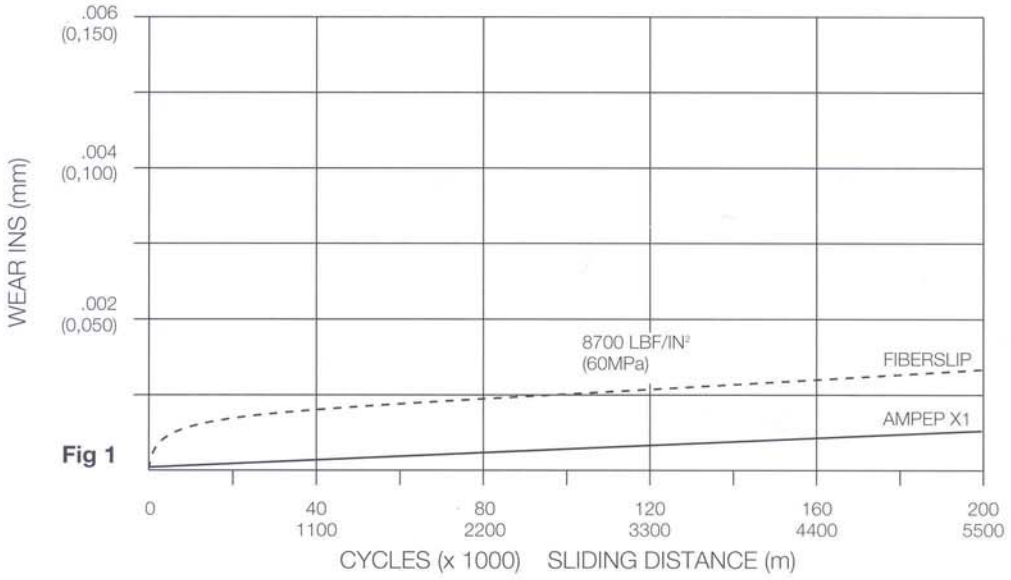


Fig 1

SN 12 SPHERICAL BEARINGS
FIBERSLIP & AMPEP X1
LOAD 6000 LBF
(UNIDIRECTIONAL & CONSTANT)
OSCILLATION ± 25° (100° /CYCLE)
FREQUENCY 10-13.5 CPM
ROOM TEMPERATURE
AV. VELOCITY 1 FPM

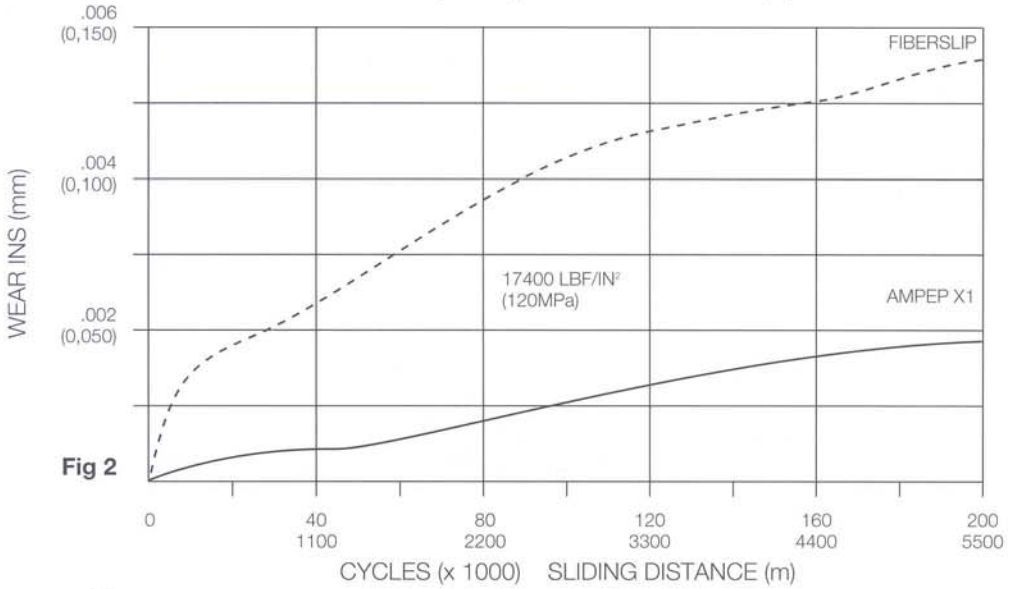


Fig 2

SN 12 SPHERICAL BEARINGS
FIBERSLIP & AMPEP X1
LOAD 12000 LBF
(UNIDIRECTIONAL & CONSTANT)
OSCILLATION ± 25° (100° /CYCLE)
FREQUENCY 10-13.5 CPM
ROOM TEMPERATURE
AV. VELOCITY 1 FPM

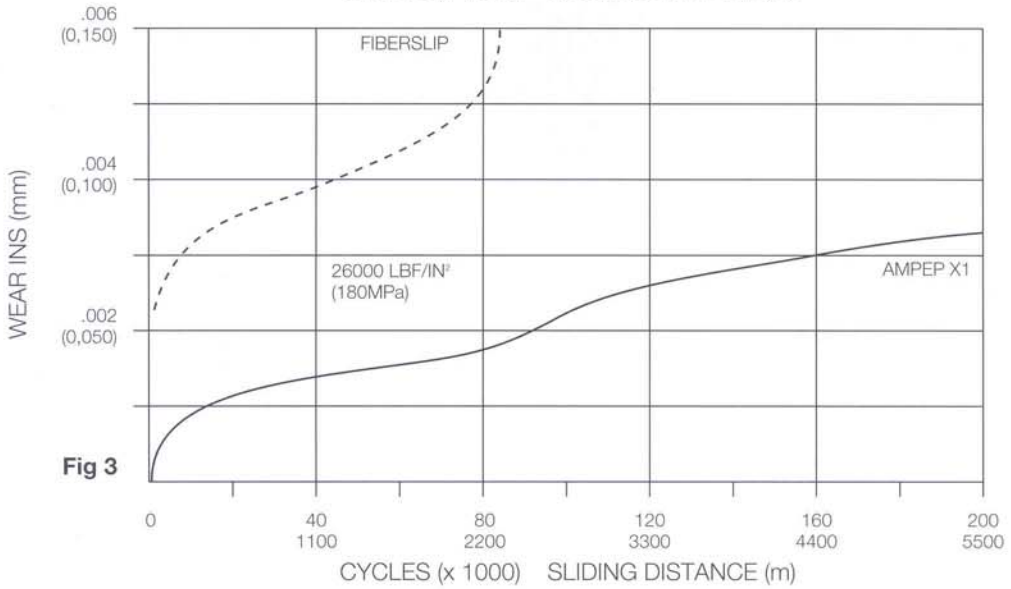


Fig 3

SN 12 SPHERICAL BEARINGS
FIBERSLIP & AMPEP X1
LOAD 18000 LBF
(UNIDIRECTIONAL & CONSTANT)
OSCILLATION ± 25° (100° /CYCLE)
FREQUENCY 10-13.5 CPM
ROOM TEMPERATURE
AV. VELOCITY 1 FPM

AMPEP XL EXTENDED LIFE BEARINGS

XL bearings are the result of an extensive development programme instigated by demands from the intensive flying of modern helicopters. These bearings are aimed at the most arduous applications on the aircraft i.e. main rotor track rods, tail rotor pitch links and main rotor blade dampers.
Test data indicates an improvement of 5-10 times the endurance life over standard Fiberslip and AMPEP X1 bearings when operated at 6Hz and bearing stresses up to ± 5000 lbf/in² (± 35 MPa)
(caused by sinusoidal reversing loads).

Ampep XL Bearing System Patents:

UK. GB 2170279B
France, Germany, Italy: 0189626
U.S.A. 4666318

Average wear of Standard MIL 81820 Bearings and XL series at stress levels of ± 1000-4000 p.s.i. (± 6.9-27.6 MPa)

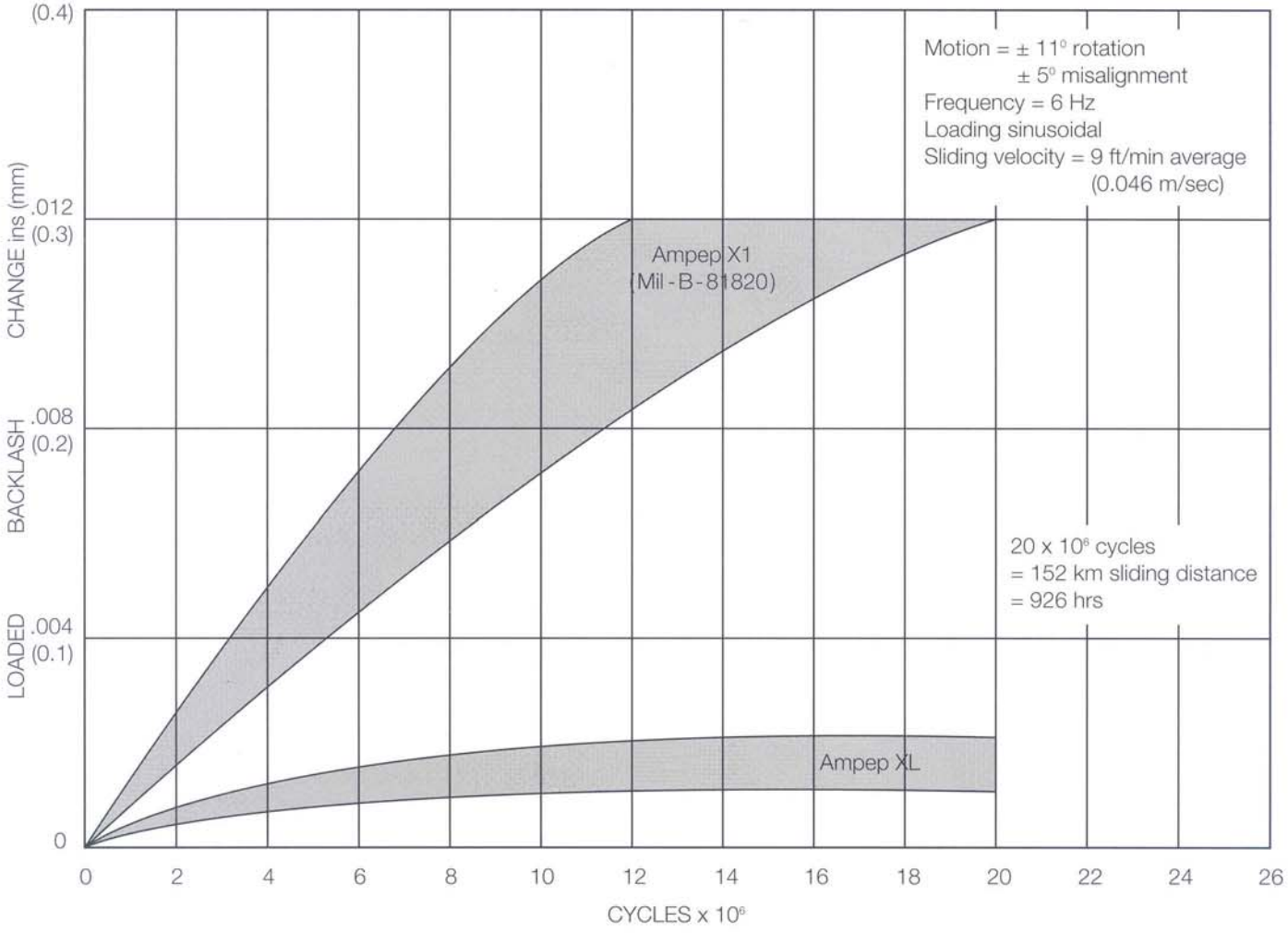


FIG 3A. NOTE

Above graph shows total backlash in a reversing load case, not wear per surface.

Bearings containing the 'XL' friction pair are intended to meet the requirements of MIL-B -81819.

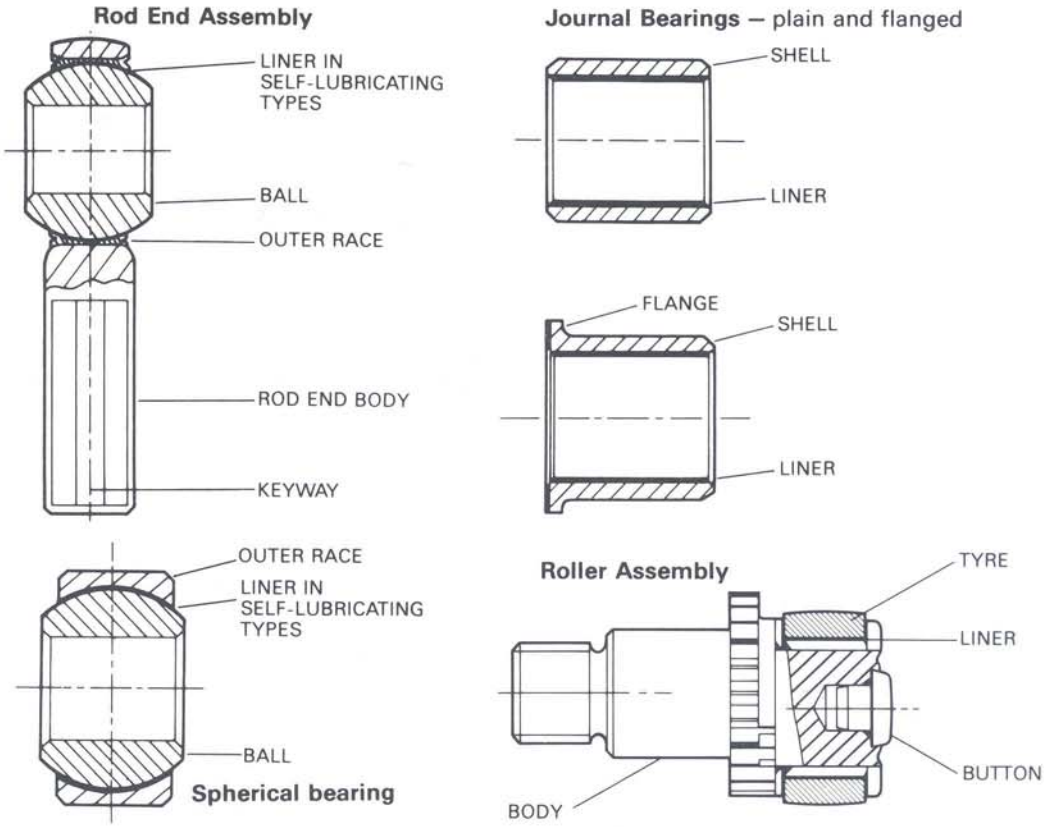
0.2.2 AMPEP METAL TO METAL BEARINGS

Metal to metal spherical bearings are offered in the following combinations.

Outer Race	Ball
Corrosion Resistant Steel	Beryllium Copper
Corrosion Resistant Steel	Corrosion Resistant Steel
Aluminium Bronze	Corrosion Resistant Steel

These may be either grease lubricated or treated with a suitable dry film lubricant.

0.2.3 BEARING CONFIGURATIONS



0.2.4 SPECIAL BEARINGS

In addition to the standard ranges of bearings in this manual, AMPEP has long been regarded as a primary source of specialised bearings and bearing assemblies by European industry for both military and civil projects. Special bearings can be simple variations of standard parts or sophisticated assemblies especially designed to utilize the unique properties of AMPEP materials and the expertise of its design and production engineers, for particularly rigorous applications.

Equipment within the AMPEP factory is capable of handling bearings from the miniature sizes up to assemblies weighing around 250kg. Materials such as titanium, beryllium copper, monel metal, aluminium bronze, tungsten carbide, etc., as well as the carbon, nickel-chrome, and aluminium alloys are employed on the various standard bearing ranges.

Assistance in selecting the most suitable combination of materials, bearing liners, and product configurations for an application is readily available from the AMPEP Technical and Engineering Departments.

0.2.5 LINING SERVICE

In some assemblies it is impracticable to install either a standard or a special bearing and if the component requiring the bearing surface cannot be manufactured by AMPEP, a bearing lining service is offered to customers. Obviously the design and manufacture of such a component must be consistent with the normal bonding procedures and material compatibility. In this respect, the AMPEP Technical and Engineering Departments should be advised of any such design scheme at an early stage to ensure its viability.

0.3
COMPANY
FACILITIES

Technical and Commercial
Our Technical and Commercial Sales Departments are at our works in Clevedon. Qualified Engineers are always available to discuss your requirements, whether it be in the application of a standard bearing or in the design of a special product. This service continues for an indefinite period after the initial supply of our bearings. We are always ready to provide support to our products on the rare occasions when problems occur.

Research and Development
Whilst the original Fiberslip material and unique method of construction is American in origin, AMPEP X1 and AMPEP XL are entirely AMPEP developments.

Microprocessor controlled test rigs are used in the evaluation of new materials. A wide spectrum of operating conditions can be simulated including helicopter rotating assemblies and flap and slat roller applications. Environmental temperatures are controllable from -50°C to + 165°C.

A continuing programme of applied research and development is in progress stimulated by the increasing interest and demand from worldwide airframe and equipment manufacturers for AMPEP products.

Collaborative programmes of testing with various research organisations and within major clients' companies are a commonplace occurrence, as our new materials evolve they will be made readily available for these organisations to conduct their own specific evaluations.

Manufacturing
The manufacture of AMPEP products is carried out at Clevedon where a manufacturing facility of some 7000 square metres has been established. Considerable investment has been made in modern C.N.C. machine tools in order that bearings of the highest quality at an economic price can be manufactured.

Our production techniques are constantly under revue to ensure that the latest methods are employed.

Quality Control
AMPEP is fully approved by the Ministry of Defence and the Civil Aviation Authority as suppliers of proprietary components manufactured to common quality standards and all aerospace bearings, bearing materials and assemblies irrespective of their application are manufactured in accordance with these approvals. A Certificate of conformity under ISO 9002/BS 5750 Part II registration and/or a Civil Aviation Authority Approved Certificate can be issued for all aerospace bearings.

All materials and processes used in the manufacture of AMPEP aerospace bearings are regarded as Class 1 stressed parts, which by definition assumes that failure of the bearing during flight, landing or take-off could place the aircraft and occupants in jeopardy. A Class 1 category requires that only those materials and processes covered by B.S., D.T.D. or D.E.F. STAN, specifications may be used where they exist. For materials and processes where such specifications do not exist, special formal approvals are issued by the Ministry of Defence D. Mat. Aviation under the title of "Approved Firms Schedules" (A.F.S.)

Military aircraft embodying AMPEP bearings manufactured to Approved Firms Schedules in respect of bearing materials and bonding processes are required to receive a D.T.D. 900 approval from the Ministry of Defence when the main contractor has accumulated sufficient test data to establish the fitness-for-purpose of the bearings employed. For A.F.S. and D.T.D. approvals see Section 1.0.2/1. A VITAL PART procedure exists where a higher than Class 1 control is necessary, details of which are available on request.

All bearings are identified by marking and/or by labelling with the AMPEP part number, batch control number, and the inspector's number in accordance with approved aeronautical practice.

SELF-LUBRICATING BEARINGS

SECTION 1.0

TECHNICAL INFORMATION

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INDEX

TECHNICAL INFORMATION

1.0.1 PRODUCT RANGE

The AMPEP product range which contains an AMPEP self-lubricating liner is as follows:-

Spherical Bearings

These are manufactured with corrosion resistant steel balls and outer races containing 'Fiberslip', AMPEP X1, or AMPEP XL liners. Outer races are either chamfered or contain Grumman grooves in their outer race faces for use in staking retention. Parts with cadmium plated or zinc nickel plated outer races are available. A range of low torque bearings is produced which are intended primarily for manual control applications. Details of these metric and imperial dimensioned products which are manufactured to Airbus, Panavia, European and U.S. Military specifications, can be found in Section 1.1.

Rod Ends

Rod Ends are constructed from corrosion resistant steel and contain Grumman grooved cartridge spherical bearings as described above. Cadmium plating is available if required. Details of these products, which are manufactured to U.S. Military specifications and Airbus standards, can be found in Section 1.2.

Journal Bearings

These are manufactured in corrosion resistant steel or light alloy backings, lined in their bores with Fiberslip or AMPEP X1. Flanged types are also available on which the rear face of the flange is lined with 'Fiberslip' or AMPEP X1. Light alloy components are anodised and corrosion resistant steel parts may be cadmium plated if required. Details of these metric and imperial dimensioned products, which are manufactured to meet European, Airbus, Panavia and U.S. MIL specifications, can be found in Section 1.3.

Rollers

In response to the international trends in the aerospace industry towards thinner wing sections and increasing inaccessibility for maintenance purposes AMPEP has developed a range of self-lubricating slat and flap rollers for specific applications.
These items generally possess crown radii to determine the point of contact with the track and can be provided with cantilever stub axle or clevis type mounting arrangements.

Roller tyres in through-hardened specially forged AISI 440 steel are provided to resist the high contact stresses with the track and onset of rolling fatigue failure. These tyres have run successfully against high tensile steel and 6 AL 4V titanium tracks. Static loads considerably higher than those friction tolerated by conventional grease lubricated needle rollers can be sustained but the rolling friction is naturally greater than its rolling element counterpart as a direct result of employing a dry sliding friction pair as a bearing surface.

Nonetheless, as the steel tyre contact friction with the track is always greater than the friction forces at the sliding surfaces no skidding of the tyres has been observed.

For military purposes the sizes most in demand are between 20-30 mm roller outside diameter e.g. the Tornado typically employs predominantly 27 mm rollers and a small quantity of 24 mm components. Larger sizes are proposed for civil aircraft.

AMPEP has provided a test rig dedicated to the development of these products. AMPEP is also participating in the drafting of both metric and imperial standards within the AECMA and MIL standards committees.

The obvious advantage of self-lubricating rollers is freedom from maintenance and thus accessibility is no longer a prime design requirement. Less obvious is their characteristic of maintaining their rolling capability after shock loads as in heavy landings. The rolling friction lies typically between values of 0,05 - 0,10 at the bearing sliding interface. Wear and backlash become apparent with length of service, and the latter process can be adversely affected by the presence of liquid water and deicing fluids. However, corrosion is not a problem as the current constructions are in corrosion resistant and/or cadmium plated materials. Titanium has been used in these constructions for weight reduction as necessary.

The draft standards and technical specifications are couched in terms which acknowledge these attributes and deficiencies and attempts to qualify the performance under these adverse conditions.
AMPEP's active involvement in these developments will ensure the company's technical ability to serve future customer requirements in this field.

Special Products

In addition to the standard range of products, many bearing assemblies have been designed for specific applications. A high proportion of AMPEP production capacity is employed on the manufacture of such products.
Considerable design expertise has been built up over the past three decades which is freely available on request.
AMPEP also provides a lining only service for situations when complete manufacture is not feasible for economic or technical reasons.

ampep

AMPEP DATA SHEET

1.0.1/1b

ISSUE - 9305

SELF-LUBRICATING BEARINGS - TECHNICAL INFORMATION

1.0.2 MATERIALS

1.0.2/1 P.T.F.E. BEARING SURFACES

There are at present two forms of Fiberslip and two forms of AMPEP X1. Fiberslip is denoted by a letter 'B' and AMPEP X1 by 'X1'. Suffixing the 'B' or 'X1' are two digits giving the type of laminate, the differences generally taking the form of varying glass and p.t.f.e. fabric thickness or resin cure states, which exist to simplify production.

Laminate	Thickness (nom.)	Material	Bonding	DTD
B30	0,53 mm (.021in)	AFS 2125	AFS 2069	900/4902
B40	0,30 mm (.012in)	AFS 2125	AFS 2069	900/4903
X1-40	0,30 mm (.012in)	AFS 2236	AFS 2237	900/6011
X1-70	0,50 mm (.020in)	AFS 2238	AFS 2239	900/6015

The AMPEP X1 liner system has been qualified to the American Specification MIL-B-81820 for the related MIL bearing ranges and sizes.

1.0.2/2 STEEL OUTER RACE, JOURNAL BEARING SHELL AND ROD END MATERIALS

The bearing materials may be bonded to most steels but is recommended that the steel should be corrosion resistant or stainless to prevent corrosion of the unbonded areas.
It is not recommended to line electro-plated surfaces or surfaces contaminated by plating, as this tends to lead to unsatisfactory bond strength between the bearing liner and the backing material.
The standard material for steel outer races, shells and rod ends is S80, AMS 5643 or MIL-S-5000 (4340).

S80 Composition
C = 0.12-0.2%
P = 0.03% MAX
Si = 1.0% MAX
S = 0.025% MAX
Mn = 1.0% MAX
Cr = 15.0-18.0%
Ni = 1.0-3.0%

AMS 5643 Composition
C = 0.07% MAX
S = 0.03% MAX
Mo = 0.5% MAX
Mn = 1.00% MAX
Cr = 15.00-17.50%
Ta = 0.45%

Mechanical Properties Brinell Hardness 255/321 HB

0.1% Proof Stress		Tensile Strength				Elongation Percent on Gauge Length
M Pa	lbf/in²	M Pa		lbf/in²		
Min	Min	Min	Max	Min	Max	
633,2	91840	880	1080	127680	156800	12% Min

Mechanical Properties - H1100 Condition

0.2% Proof Stress		Tensile Strength		Elongation Percent on Gauge Length
M Pa	lbf/in²	M Pa	lbf/in²	
Min	Min	Min	Min	
795	115000	965	140000	14%

Mechanical Properties - H1025 Condition

0.2% Proof Stress		Tensile Strength		Elongation Percent on Gauge Length
M Pa	lbf/in²	M Pa	lbf/in²	
Min	Min	Min	Min	
1000	145000	1070	155000	12%

Mechanical Properties - H1150 Condition

0.2% Proof Stress		Tensile Strength		Elongation Percent on Gauge Length
M Pa	lbf/in²	M Pa	lbf/in²	
Min	Min	Min	Min	
724	105000	931	135000	16%

1.0.2 MATERIALS

MIL-S-5000 (4340) Composition
C = 0.38-0.43%
Si = 0.2-0.35%
Mn = 0.65-0.85%
Ni = 1.65-2.00%
P = 0.025% MAX
Cr = 0.7-0.9%
S = 0.025% MAX
Mo = 0.2-0.3%

Mechanical Properties - Condition F

0.2% Proof Stress		Tensile Strength		Elongation Percent on Gauge Length
M Pa	lbf/in²	M Pa	lbf/in²	
Min	Min	Min	Min	
897	130,000	1034	150,000	14%

1.0.2/3 STEEL INNER RACE MATERIAL

The term "inner race" normally applies to the ball member of a spherical bearing assembly but can also refer to specially manufactured sleeves produced with a very high standard of surface finish, to be used as counterfaces in conjunction with Fiberslip type journal bearings. These balls and sleeves are produced from AISI 440 C through-hardened corrosion resistant steel. The hardness of the finished components is in excess of 55 Rockwell C unless otherwise stated and the surface finish of the mating faces is in the order of 0,05 µm (2 µinch) CLA.

The chemical composition of AISI 440 'C' is as follows: C = 0.95-1.2%, Mn = 1.0% MAX, Cr = 16.0-18.0%, Si = 1.0% MAX, Ni = 0.75% MAX, S = 0.03% MAX, Mo = 0.40-0.60%, P = 0.04% MAX. This material complies with A.E.C.M.A. specification FE-PM 43.

1.0.2/4 LIGHT ALLOY JOURNAL BEARING SHELL MATERIALS

The bearing materials may be bonded to most aluminium alloys but the effect of the bonding temperature 438 K (165° C) upon the strength of the alloy should be considered.

Attention should also be paid to the suitability of an aluminium alloy in applications subjected to high temperatures or high stresses as the static compressive strength of the bearing material is greater than most alloys.

All aluminium components will be chromic acid anodised in accordance with DEF STAN 03-24 unless otherwise specified. The standard alloys used for journal bearing shells are DTD 5014 T.F., U.S. Federal Spec QQ-A-225/6.

DTD 5014 T.F. Nominal Composition
2.5% Cu
1.5% Mg
1.0% Fe
1.2% Ni
0.1% Ti

Mechanical Properties - Condition F

0.1% Proof Stress		Tensile Strength				Elongation Percent on Gauge Length
M Pa	lbf/in²	M Pa		lbf/in²		
Min	Min	Min	Max	Min	Max	
310	45000	400	-	58000	-	6%

ASTM B221 and B241 and QQ-A-225/6 Composition
Cu = 3.8/4.9%
Si = 0.5%
Mg = 1.2/1.8%
Zn = 0.25% MAX
Mn = 0.3/0.9%
Fe = 0.5% MAX
Cr = 0.1% MAX

Mechanical Properties

0.2% Proof Stress		Tensile Strength				Elongation Percent on Gauge Length
M Pa	lbf/in²	M Pa		lbf/in²		
Min	Min	Min	Max	Min	Max	
400	58,000	455	-	66,000	-	5%

1.0.3 PROCESSES

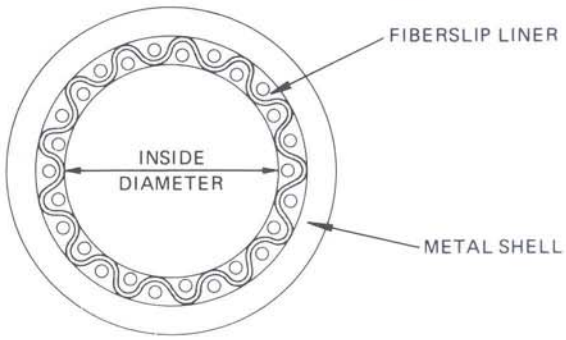
To ensure the consistency of bonding materials and processes, special Ministry of Defence approved procedures are operated in respect of cleanliness, materials, preparation, finishing and shear test acceptance standards.

1.0.3/1 FLAW DETECTION

In accordance with general aerospace practise, bearings are non-destructively tested for flaws by penetrant dye, magnetic flux, chromic acid anodising or visual methods as appropriate. Destructive and performance testing also form part of our standard quality control procedures.

1.0.3/2 MEASUREMENT OF BEARING SURFACES

As the surface of the bearing material is resilient, the normal methods of measurement applicable to metallic components are unsuitable. Different methods can be used: Plug Gauges with suitable radiused leads or non tactile techniques (e.g. Air Gauging). For futher information on lined bore measurement methods and equipment contact Ampep Technical department. All bore sizes are quoted as in standard engineering practice, i.e. the crest to crest dimension of the surface asperities.



1.0.3/3 MACHINING

AMPEP bearings are supplied finished and no attempt should be made to machine either the steel or alloy components nor the woven p.t.f.e. liner, in the interests of minimising risk of damage to a high quality, precision engineered component.

1.0.3/4 PERFORMANCE

A continuing monitoring process is operating whereby standard catalogue spherical bearings are checked for performance characteristics on completion. Over the years this has resulted in continuous product improvement.
Standards - Materials and bearings in this manual comply with National and International standards, together with those drawn up for specific aircraft projects, i.e. Concorde, Airbus and Tornado. Cross references of AMPEP parts in respect of these standard part numbers are included in this publication.

1.0.3/5 CONFORMITY

The degree of perfection achieved in matching the spherical surfaces of inner and outer races in the self-aligning ranges of bearings listed in this manual is a critical factor in achieving the stiffness and uniform wear across the loaded area, i.e. minimum deflection under radial loading,which is an essential requirement in many flying control systems in avoiding control surface flutter or lack of sensitivity in the control system as a whole. The larger the bearing becomes, the greater is the tendency towards loss of conformity and stiffness. Successful techniques for monitoring and adjusting spherical conformance have been developed and are employed on a continuing basis to bearings whose dimensions permit these processes to be carried out effectively.

Special bearings with specific load/deflection and torque requirements are produced for particular customer applications.

1.0.4/1 IMPORTANT DESIGN FACTORS

The ultimate stress level of AMPEP lining materials in compression is in the order of 1030 MPa (150000 lbf/in^2). This is in excess of the yield stress of the more common corrosion resistant steels and light alloys normally used as the outer race materials in the standard bearing assemblies.

Therefore the *ultimate* permissible bearing loads are largely determined by the strength of the metal details employed in the bearing races and not by the bearing laminates.

Recommended operating conditions are a compromise between the ultimate capacities and the required bearing lives in the various sections of the aerospace industry.

The following ultimate and static limit values are based on bearings having AMS 5643 corrosion resistant steel outer races.

Where light alloy or alternative materials are employed, suitable cautionary notes are included within this manual, drawing the attention of design teams to the limitations imposed on the bearings as a result. These reservations apply also to rod end bearings where the threaded rod and eye end become the limiting factors in the bearing assembly.

Ultimate Load Definition
This is the highest stress level which the bearing assembly can accept and still be capable of operation with no detail fractured or broken.

Static Limit Load Definition
This limit load is defined as two thirds of the ultimate load with an additional requirement that the permanent set following one application of the load shall not exceed 0.3% of the bearing outside diameter.

Determination of Limiting Load Levels
The static limit and ultimate load carrying capacity of the steel outer races of the bearings in this manual have been determined from tests performed under strictly controlled laboratory conditions for a single carefully applied load, and DO NOT REPRESENT AIRCRAFT OPERATING CONDITIONS NORMALLY ENCOUNTERED during the life of an airframe. Their inclusion enables design teams to assess the safety margins of bearings in particular applications and specific details of the test procedure relating to metric sizes to European Standards EN2022 and EN2023 can be found in EN2064 (AECMA-CEN).

Static load limits are based on stress levels of 206MPa (30000 lbf/in^2) for aluminium alloy.

For bearings to the American Military Specification MIL-B-81820 incorporating AMS 5643 outer races, the following criteria apply:

Radial Static Limit Load
After the radial load listed on the applicable specification sheet has been applied, the total deflection of the bearing and fixture shall be less than .010 inch for bearings with a bore of 0.375 inch or less, 0.015 for 0.4375 inch and 0.500 inch, 0.017 for .5625 inch and .625 inch and 0.020 for 0.750 inch and up. In all instances, the permanent set shall be less than 0.003 inch.

Axial Static Limit Load
After the axial load listed on the applicable specification sheet has been applied, the permanent set shall be less than 0.005 inch.

Ultimate Load
No fracture of the race or ball or push out of the ball shall occur when 1.5 times the radial or axial load limit is applied.

The AMPEP static limit loads for this range of products are based on two thirds of the 0.1% proof stress of the outer race material. Radial and axial static limit loads are calculated on stress levels of 70000 and 35000 lbf/in^2 respectively.

1.0.5 RECOMMENDED OPERATING LOADS

1.0.5/1 FIBERSLIP LINED BEARINGS

These loads comprise two general types, static and dynamic, which are further subdivided into maximum and mean levels. The recommended stress levels at which the bearings are known to yield adequate performances are given in the following table.

Airframe Category	Unfactored Flying Hours	Operating Cycles *	Recommended Maximum Stress Levels		Recommended Mean Stress Levels	
			STATIC	DYNAMIC	STATIC	DYNAMIC
Military Fixed Wing	3000 - 4000	10000 - 50000	310 Mpa (45000 lbf/in²)	214 Mpa (31000 lbf/in²)	155 Mpa (22500 lbf/in²)	107 Mpa (15500 lbf/in²)
Civil Fixed Wing	30000 - 40000	100000 - 500000	110 Mpa (16000 lbf/in²)	69 Mpa (10000 lbf/in²)	55 Mpa (8000 lbf/in²)	34,5 Mpa (5000 lbf/in²)
Helicopters	500 - 1000	15 - 30 x 10^6	14 Mpa (2000 lbf/in²)	7 Mpa (1000 lbf/in²)	7 Mpa (1000 lbf/in²)	3,5 Mpa (500 lbf/in²)

* Corresponds to an approximate linear distance travelled at the bearing surface of 300 metres (1000 ft), 3000 metres (10000 ft) and 3 x 10^5 metres (1 x 10^6 ft) respectively.

Notes on the use of operating load tables

Recognition of the differing requirements of various categories of the aerospace industry is also acknowledged by major groupings under the headings military fixed wing, civil fixed wing and helicopters.

The recommended stress levels for helicopters are based on an assumption that the bearings are to be used in the main rotating assemblies, i.e. main or tail rotor, where approximately 3 x 10^5 metres (10^6 feet) of sliding at the bearing surface will be required to achieve lives of the order of 500 - 1000 hours. For the pilot's side of helicopter power control circuits or other areas where the required sliding distances are more consistent with fixed wing applications, the operating stress levels may be permitted to rise as considered appropriate. Methods of predicting bearing lives in terms of permissible wear and/or backlash are suggested in the latter part of this manual under Section 1.0.7.

The operating loads recommended in these tables **SHOULD NOT BE USED** for applications on actuator ends and hinge points in undercarriages, lift dumpers, spoilers and airbrakes. These need special consideration due to peak loads of a transitory nature which are a common feature of such equipment. A separate section of recommendations is included for this specific purpose, refer to Sections 1.0.5/4 and 1.0.7/12.

(a) The maximum recommended stress levels should only be invoked for emergency conditions, or for conditions encountered on a few occasions in the life of the airframe.

(b) The everyday operating loads predominating in any application should be consistent with, or less than the values suggested in the right hand column "Recommended mean stress levels".

(c) The values in the tables are based on thirty years experience with all major European aircraft projects commencing with Concorde and assume that most applications will involve an oscillatory movement and reversing loads. A total wear value of 0,125 mm (.005in) has been assumed as the tolerable maximum prior to the onset of flutter at control surfaces.

1.0.5 RECOMMENDED OPERATING LOADS

1.0.5/2 AMPEP X1 LINED BEARINGS

For X1 lined bearings the above operating load table may be used, but the unfactored flying hours and operating cycle columns can be taken as twice the values given or stress levels can be increased as shown in the following table.

Airframe Category	Unfactored Flying Hours	Operating Cycles Ø	Recommended Maximum Stress Levels		Recommended Mean Stress Levels	
			STATIC	DYNAMIC	STATIC	DYNAMIC
Military Fixed Wing	3000 - 4000	10000 - 50000	440 Mpa (63800 lbf/in²)	300 Mpa (43500 lbf/in²)	220 Mpa (31900 lbf/in²)	150 Mpa (21750 lbf/in²)
Civil Fixed Wing	30000 - 40000	100000 - 500000	150 Mpa (21750 lbf/in²)	100 Mpa (14500 lbf/in²)	80 Mpa (11600 lbf/in²)	50 Mpa (7250 lbf/in²)

Ø Corresponds to an approximate linear distance travelled at the bearing surface of 300 metres (1000 ft) and 3000 metres (10000 ft).

1.0.5/3 AMPEP XL EXTENDED LIFE BEARINGS

XL bearings have been developed initially to produce acceptable lives in the most arduous helicopter applications, namely main rotor track rods, tail rotor pitch links and main rotor blade dampers, i.e. where high frequency reversing loads are encountered.

Users may now confidently anticipate a typical service life of 2000 hours for the main rotor track rod bearings and 500 hours for tail rotor pitch links and main rotor dampers, between replacements.

Rig tests indicate that the wear characteristics under these test conditions are essentially linear with accumulated backlash being directly proportional to both stress and service life. The following table provides some guidance. Where customers require more specific recommendations, our Technical Sales Department should be consulted.

Airframe Category	Unfactored Flying Hours	Operating Cycles Δ	Recommended Maximum Stress Levels		Recommended Mean Stress Levels	
			STATIC	DYNAMIC	STATIC	DYNAMIC
Helicopters	500 - 2000	2.5 - 8 x 10^7	70 Mpa (10000 lbf/in²)	35 Mpa (5000 lbf/in²)	14 Mpa (2000 lbf/in²)	7 Mpa (1000 lbf/in²)

Δ Corresponds to an approximate linear distance travelled at the bearing surface of 3 x 10^5 metres (1 x 10^6 ft).

1.0.5 RECOMMENDED OPERATING LOADS

1.0.5/4 LANDING GEAR, SPOILERS, AIR BRAKES AND LIFT DUMPERS

Special consideration is given to the bearings in hinges and actuator ends employed in these applications. Examination of service components has revealed a specific type of interlaminar defect occuring in the extension mode of the actuators. There is at present no satisfactory explanation for this particular phenomenon except that the cause is thought to be due to the peak transitory loads developing when actuators reach the limit of their extension together with any loads developing as a result of locking or over-centre toggle actions frequently found in these applications.

Users are advised to use the Fig.10 graph of cycles versus bearing stress to determine the size of bearing best suited to their requirements. For further information see Bearing Section, 1.0.7/12.

1.0.5/5 CALCULATING BEARING PROJECTED AREAS AND STRESS LEVELS

(a) Stress

$P = \frac{W}{A}$ Where P = Stress or pressure

W = Load

A = Projected area

(b) Projected Area 'A'

Spherical bearings: Area = (H - 4t) x Ø

Where H = minimum outer race width

4t = 1,6 mm or 0.064in (t = liner thickness)

Ø = Ball spherical diameter

Plain Journal bearings: Area = (W - 4t) x B

Where W = minimum journal length

4t = 1,6 mm 0r 0.064in

B = inside diameter

Flanged journal bearings: Use formula as for plain journal bearings but reduce W by the width of the flange and assume the latter carries no radial load.

Thrust faces: $\text{Area} = \frac{\pi}{4}[(A - 2t) + (B+2G)]\ [(A- 2t) - (B+2G)]$

Where A = Minimum flange o.d.

G = Internal recess width

B = Inside diameter of journal bearing

t = 0,4 mm or .016in

't' in the above formulae refers to the liner thickness. 4t is used on bushes and spherical bearings, to allow 2t on each side of bearing, to take account of liner recess and edge effects.

1.0.5 RECOMMENDED OPERATING LOADS

1.0.5/6
NOTES ON BEARING LOAD CAPACITIES, LOAD TABLES AND LIMITING FACTORS

The radial and axial static limit loads are given in the standard bearing specification sheets.

Spherical Bearing Tables

Whilst spherical bearings are not primarily designed to carry axial loads, they do in fact possess an axial load capacity, the bearing tables show axial bearing areas and these should be used in conjunction with the axial bearing pressures which are in all cases half the radial bearing pressures due to the increased shear content of the load on the liner.

Rod End Bearing Tables

The loads quoted in the tables for rod ends are those at which yield of the rod end eye is anticipated when the force is applied axially along the thread. As the yield strength of the rod end eye is almost invariably lower than the strength of the spherical bearing, designers should ensure that the capacity of the rod end is adequate.

The area of a rod end eye may be calculated from the following formula:

$$[.0349r^2\text{Ø} + \frac{HX}{2}] - [HB + 2C^2]$$

Where Ø is in degrees.

$$\text{Sin Ø} = \frac{H}{2r}$$

$$X = \sqrt{(2r)^2 - H^2}$$

H = rod end head width

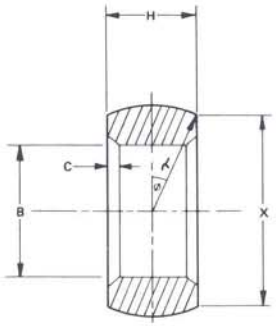
r = half rod end head diameter

B = rod end bore

c = rod end bore chamfer (from recommended housing tables for inch wide series Grooved Spherical Bearings)

When a rod end is subjected to fatigue, 12½% of the ultimate tensile stress should be considered as a maximum stress level unless the Design Authority decrees otherwise.

Rod end bearings are not considered suitable for axially applied loads. Applications which induce bending moments in the threaded sections of the rods must be given special design consideration.



SECTION THROUGH ROD END EYE

Journal Bearing Tables

The static limit loads are not given for individual bearings in the table but can be calculated from the information shown on the standard series data sheets in section 1.3.1.

1.0.6 BEARING CHARACTERISTICS

1.0.6/1 INTERFACIAL VELOCITY

AMPEP p.t.f.e. bearings were originally intended for applications at high bearing stress levels associated with periodic oscillatory movement where rubbing speeds in excess of 0,02 m/second (4 feet per minute) were seldom encountered, however, the increasing use of this type of bearing in the rotating assemblies of helicopters has demonstrated that dry rubbing velocities up to 0,23 m/s (45 feet per minute) are possible in certain special circumstances consistent with acceptable life.

The p.t.f.e. bearing layer is an effective thermal and electrical insulating medium and under dry sliding conditions a pressure/velocity i.e. PV factor of 700 k Pa.m/s (20000 lbf/in^2 ft/min) should not normally be exceeded.

In applications where splash or total immersion in mineral oils, silicone fluids, fuels and non-polar fluids prevail then the PV factors may be substantially increased. The feasibility of hydrodynamic lubrication has also been demonstrated with the bearing material displaying its inherent resistance to corrosion, acceptance of high bearing pressures and a high tolerance of solid contaminants by virtue of the embedability in the relatively soft p.t.f.e. surface. Wear rates under these conditions have been observed to be markedly reduced.

The use of polar fluids such as water, alcohols, glycols and the more sophisticated phosphate esters as heat transfer fluid media, although effective, can result in higher rates of wear and advice should be sought from our Technical Sales Department.

The use of grease in AMPEP bearings is not recommended as this tends to form a viscous film at the bearing interface which promotes stick-slip and also entraps solid contamination in the immediate bearing environment.

1.0.6/2 TEMPERATURE EXTREMES

While exposure to temperatures of 523 K (250°C) results in gradual thermal degradation and carbonisation of the resin binder system the p.t.f.e. surface is largely unaffected and tests have demonstrated the ability to operate in such an environment at a bearing pressure of 70 MPa (10000 lbf/in^2) for over 250 hours. Excursions up to 573 K (300°C) are possible although backlash will develop fairly rapidly under loads sufficient to cause permanent deformations of the p.t.f.e. surface at this high temperature.

Prolonged exposures of 10000 hours at 393 K (120°C) were carried out by British Aircraft Corporation in respect of Concorde applications and the effects on elastic deformation and rate of wear at room temperature were studied. No unacceptable deterioration was reported. The maximum recommended operating temperature for AMPEP X1 and Fiberslip is 523 K (250°C) and the minimum known operating temperature is 223 K (-50°C), although the immersion of bearings in liquid nitrogen at 80 K (-193°C) for freeze fitting is an established practice and no detrimental effect to the Liner Systems and bonding has been reported to date.

1.0.6/3 COEFFICIENT OF THERMAL EXPANSION

For practical purposes the coefficient of thermal expansion of the liner may be regarded as being identical to that of the metal backing due to the relatively thin bearing layer. However, changes in the preloads and torques of larger bearings are noticeable with wide temperature fluctuations due to the entrapment of the p.t.f.e. layer between two highly conforming steel surfaces. As a result preloads and torques tend to increase at high temperature and decrease at low temperatures. This is also combined with changes in the coefficient of friction at the interfaces making assessments of the degree of change somewhat speculative.

At elevated temperatures the increased preload also planishes the p.t.f.e. bearing surface making it very smooth and reflective and on return to room temperature a loss of original preload and torque is frequently observed, although this is not necessarily accompanied by any measurable loss in stiffness.

1.0.6/4 FRICTIONAL PROPERTIES

P.t.f.e. fibres subjected to static loads exhibit no change in filamentary form or structure when the load is removed. However, when relative motion takes place at the p.t.f.e. surface the filaments form a readily identifiable film at the interface, part of which remains on the original bearing surface and the remainder on the metal counterface, analogous to a grease lubricated metal to metal bearing assembly. The similarity between the chemical composition and structure of oils, greases and p.t.f.e. gives rise to speculation as to whether the way in which oil lubricated and p.t.f.e. lubricated bearing surfaces behave in sliding is in fact basically identical, i.e. the rubbing surfaces are separated by a fluid or visco elastic film in shear.

Fundamental differences would appear as stress levels forced counterface and bearing surface into more intimate contact by reduction of lubricant film thickness as in boundary lubrication. Here one expects increasing asperity contact with increasing friction in metal to metal assemblies in contrast to the p.t.f.e. surface where no such contact is possible and therefore friction values should be relatively lower, as is the observed case.

The properties and behaviour of an interfacial p.t.f.e. film with respect to pressure, temperature and rate of shear could explain the dynamic frictional characteristics of bearing assemblies in which it existed - which are principally as follows:

1. Friction decreases at fixed sliding speeds with increasing pressure reaching a minimum at 70 MPa (10000 lbf/in^2).

2. Friction decreases with increasing temperature.

3. Friction increases with increased sliding velocity.

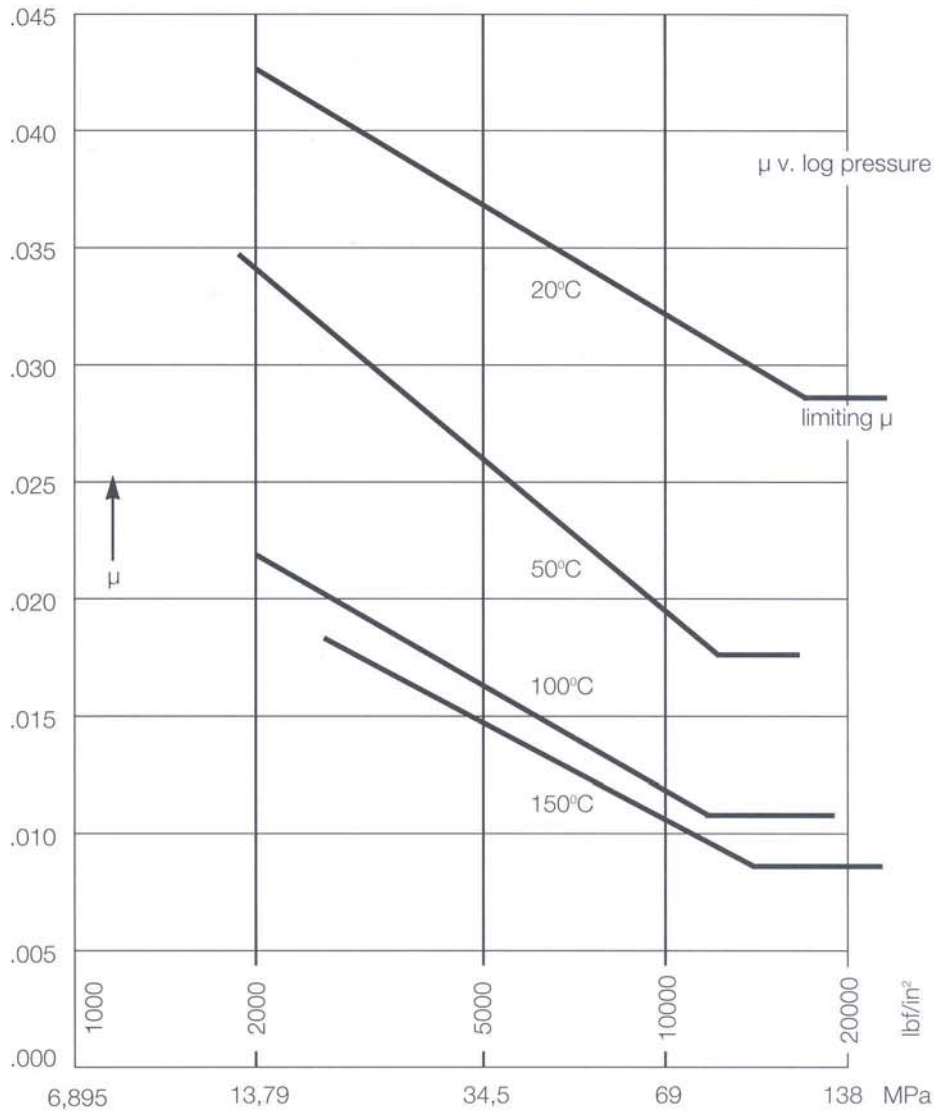
The effect of localised frictional interface temperatures, bulk temperature and rate of shear respectively on the p.t.f.e. film are possible explanations for the observed dynamic frictional characteristics.

Actual values for *drysliding* obtained by experiment are illustrated below showing the effects of temperature and pressure, unfortunately no comprehensive data exists for changes in velocity. The frictional properties of p.t.f.e. are considerably modified by the introduction of contaminant fluids and these are further discussed in the relevant section on the subject.

1.0.6 BEARING CHARACTERISTICS

FIBERSLIP B40 AGAINST GROUND STEEL

Fig 3B SLIDING VELOCITY 0,0006 m/s (.125 fpm)



Cautionary Note

These graphs were prepared from surfaces sliding at 0,0006 m/s (1/8 feet per minute) and values of μ are lower than would normally be expected. Approximately 0,008 m/s (1 to 2 feet per minute) is considered appropriate for most design applications and the order of friction values under these conditions at room temperature is as follows:

34,5 MPa (5000 psi) μ = 0,08
69 MPa (10000 psi) μ = 0,065
138 MPa (20000 psi) μ = 0,055

Static frictional values are slightly higher than dynamic values at temperatures up to 323 K (+ 50°C) but thereafter are almost undetectable.

As a result stick-slip phenomena, as exemplified by judder, audible noise, erratic operation etc., are almost eliminated with the use of AMPEP bearings.

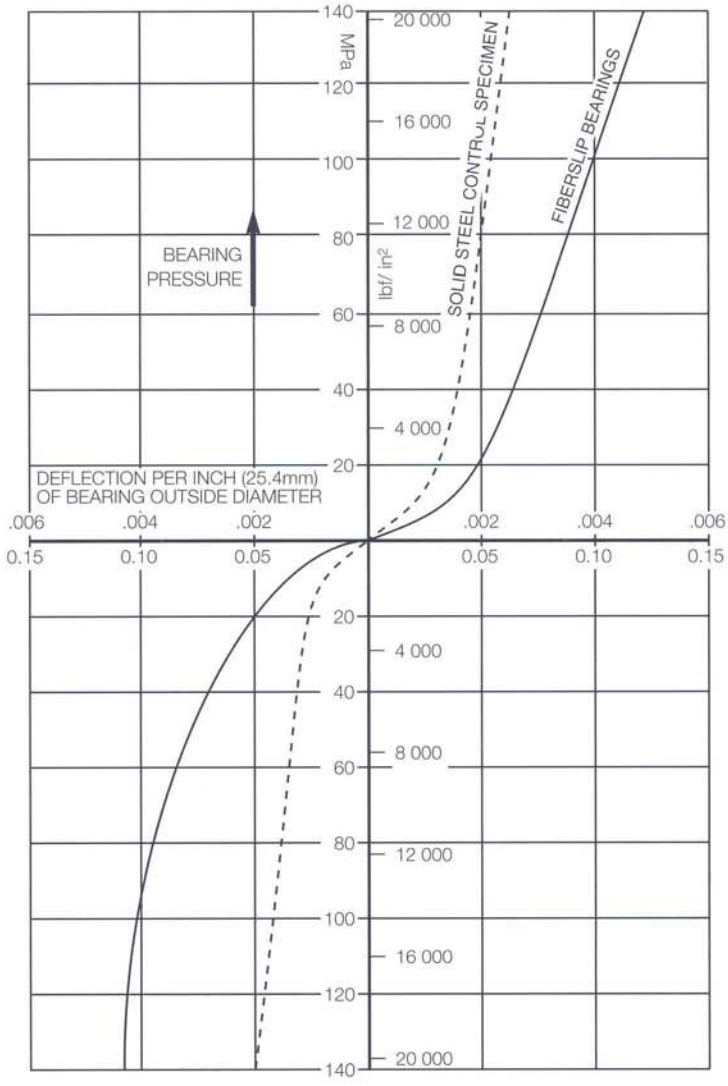
Bearings which have been unused for some time or standing in a completely static state sometimes exhibit noticeable stiction at the first movement but thereafter display normal characteristics. Stick-slip is also displayed on occasions when the sliding direction has changed such as in a spherical bearing altering from rotation to misalignment, but neither of these examples have proved to be any technical obstacle in practice as the normal levels of airframe vibration preclude a completely static operating environment.

1.0.6 BEARING CHARACTERISTICS

1.0.6/5 COMPRESSIVE MODULUS AND BEARING STIFFNESS

Young's Modulus E for AMPEP bearing materials lies between 5200 and 6700 MPa (0.75 and 1 x 1 0^6 lbf/in^2) and is approximately $^1/_{30}$ that of steel and $^1/_{15}$ that of aluminium alloy. Due to the very thin sections of p.t.f.e. liner the measured deflections under load are extremely small when compared to the metal details of the bearing and the surrounding structure into which it is installed. The load/deflection relationship only approaches linearity at bearing stress levels of 27,6 MPa (4000 lbf/in^2) and above. Below this level a lower stiffness is observed due to the woven nature of the uppermost yarns and the displacement in compression of individual p.t.f.e. filaments relative to each other. This gives rise to a characteristic load/deflection curve for bearings in reversing load applications as depicted in the graph below and the measured deflection between ± 27,6 M Pa (± 4000 lbf/in^2) has been termed "soft centre". The latter is typically around 0,09 mm (.0035in) for standard catalogue spherical bearings but lower values can be attained with the acceptance of higher torques and preloads.

In applications where high installed torque values are acceptable, such as structural joints and the majority of power control systems and actuators, the "soft centre" condition may be partially offset by the use of bearings which have been preloaded. It is also possible to employ interference fitted bearings although in practice the necessary variation of interference due to tolerances results in a wide torque spread in the assembled condition.



THE DIFFERENCE IN DEFLECTION BETWEEN THE SOLID CONTROL SPECIMEN AND THE FIBERSLIP BEARING REFLECTS THE HIGH BEARING MATERIAL STIFFNESS AND GOOD INNER TO OUTER RACE CONFORMITY

1.0.6 BEARING CHARACTERISTICS

1.0.6/6 WEAR CHARACTERISTICS

Wear of p.t.f.e. surfaces is a primary function of pressure and sliding distance at the interface at any given temperature. Wear takes place as the p.t.f.e. lubricating film is expressed or ejected from the loaded into the unloaded zones of the bearing as small dark brown flakes of p.t.f.e. debris. This is a normal process and should not cause concern unless a rapid increase in free play or backlash in the bearing becomes apparent. Notes on detection of rapid wear rates for user guidance are given in section 1 .0.8/14.

Wear takes place in AMPEP bearings at high pressure circa 170 MPa (25000 lbf/in^2) in four phases:

(a) A fairly rapid bedding-down phase during which the crests and troughs at the woven surface are levelled and coated by a smooth p.t.f.e. film. Wear values up to 0,025 mm (.001in) may be recorded during this phase depending on the grade of material being employed.

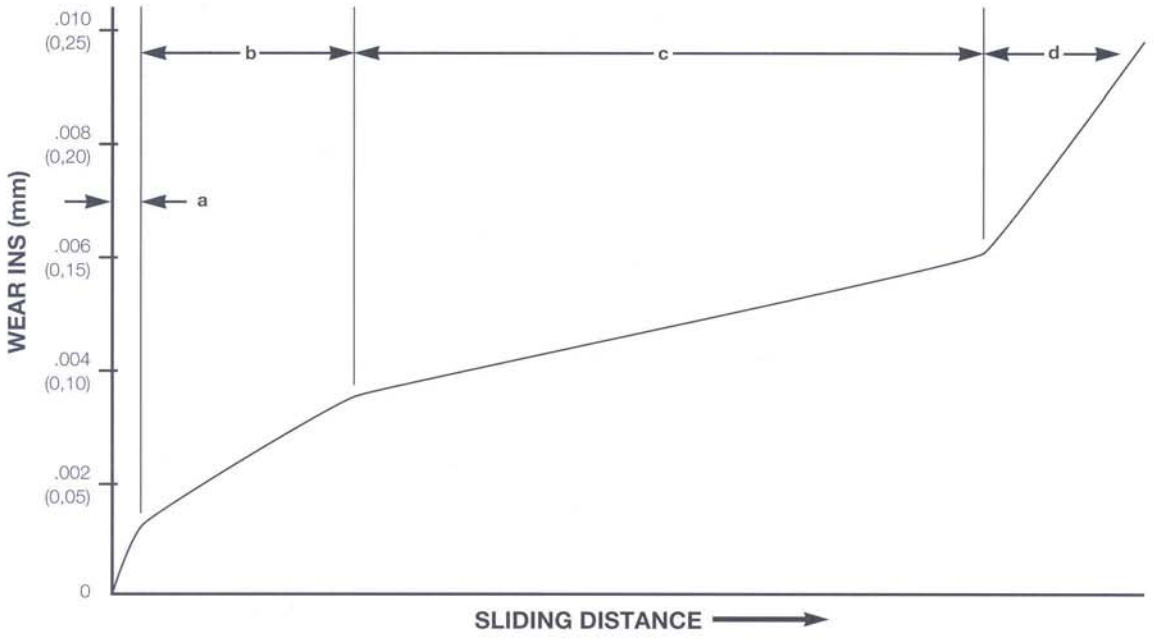
(b) A reduced wear rate between bedding-in and achieving a more stable plateau in phase 3 which can be attained between 0,075/0,125 mm (.003in/.005in).

(c) A lengthy period during which wear values attain 0,15/0,20 mm (.006in/.008in) at a very low rate of wear.

(d) The final phase when wear rate accelerates again and metal to metal contact is a possibility at 0,20/0,40 mm (.008in/.016in) depending again on the type of material employed.

A typical diagrammatic representation for Fiberslip is shown below and the variations in wear rate are due entirely to the composite nature of the bearing layer and the sequence in which the composition of the actual sliding interface changes in composition as wear progresses.

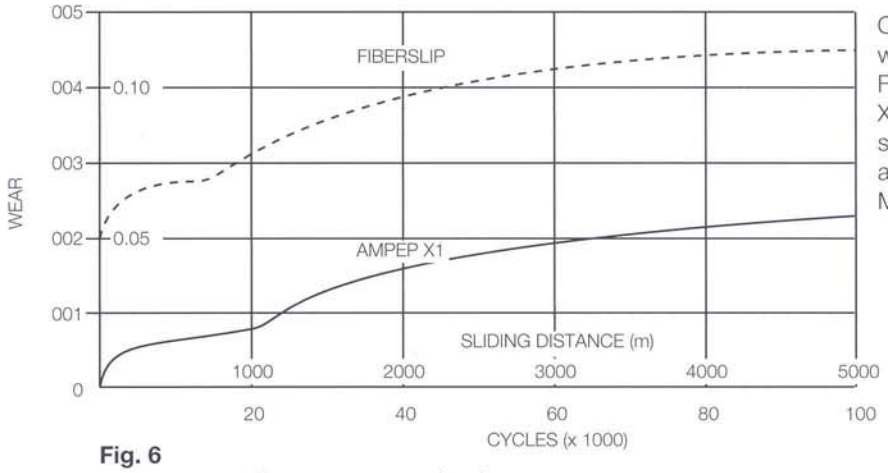
Fig 5



At the lower pressures generally recommended for acceptable lives in aerospace applications these phases are much less distinct and merge into a curve of shallower proportions. The introduction of AMPEP X1 which markedly reduced the bedding-down wear also dulls these distinctions of phase.

Most aerospace applications impose a maximum wear value of 0,125 mm (.005in) in a reversing load situation and therefore user interest is centred on phases a and b. The long life possible between these phases and a completely worn out bearing gives a considerable time scale in which to detect excess backlash in bearing components without the immediate risk of serious failure. Even so, as mentioned earlier in this manual, no cases of metal/metal seizure have yet been witnessed following the liberal distribution of p.t.f.e. debris between the metal surfaces as a result of the normal wear processes.

The wear rate of p.t.f.e. bearings also varies with temperature and increases at elevated and low temperatures.

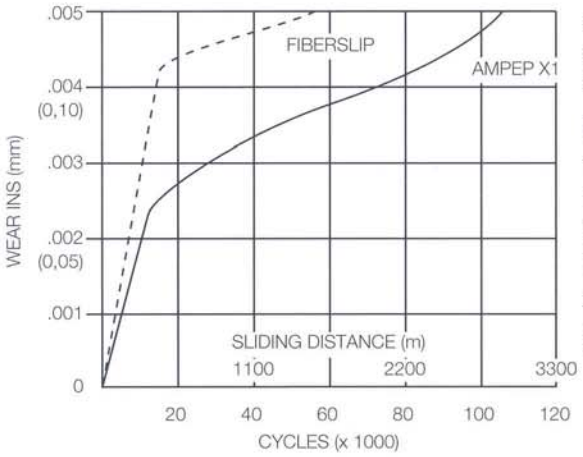


Comparison of the wear rates of standard Fiberslip and AMPEP X1 1¼" bore narrow series spherical bearing at 25000 lbf/in² (172 MPa) .

Fig. 6

Test details:-

Pressure:	As above
Oscillation:	± 25° (100°/cycle)
Frequency:	10 cpm
Loading:	Unidirectional, steady
Temperature:	Approx. 20°C
Av. velocity:	1.32 f.p.m.



Comparison of the wear rates of standard Fiberslip and AMPEP X1 ¾ bore narrow series spherical bearings at 150°C and 26000 lbf/in² (180 MPa).

Fig. 7

Test details:-

Pressure:	As above
Oscillation:	± 25° (100°/cycle)
Frequency:	10 to 13.5cpm
Loading:	Unidirectional, steady
Temperature:	+150°C
Av. velocity:	1 f.p.m.

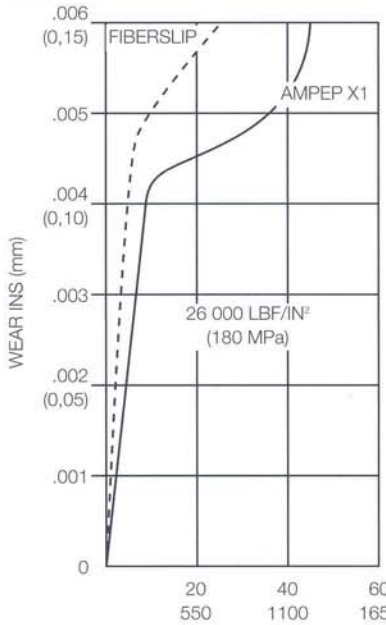


Fig. 8

SN12 SPHERICAL BEARINGS
FIBERSLIP & AMPEP X1
LOAD 18 000 LBF
(UNIDIRECTIONAL & CONSTANT)
OSCILLATION ± 25° (100°/CYCLE)
FREQUENCY 10-13.5 CPM
TEMPERATURE -50°C
AV. VELOCITY 1 FPM

1.0.6 BEARING CHARACTERISTICS

Graphs of wear rates (Figs. 6, 7 and 8) for Fiberslip and AMPEP X1 depict typical results at 223 K (-50°C), 293 K (+20°C) and 423 K (+150°C) and appropriate allowance should be made for such environmental factors when making a suitable choice of bearing. This is discussed in more detail in following paragraphs.

Counterface surface finish is also of particular importance where users are supplying their own shafts in journal bearing or other sliding configurations. Rough surfaces are thought to generate thicker p.t.f.e. lubricating films at the interface which are more readily expressed, and also cause ploughing of the surface with consequentially higher wear rates than smooth surfaces. Experience gained very early in the company's history indicated that the smoother the counterface, the lower is the rate of wear.

This is reflected in the standard of finish embodied in the spherical surfaces of our self aligning bearings which is of the order of 0,05 µm (2 µ inch) CLA. While this standard of finish is considered much better than normally achieved in general engineering practice, a fine ground finish of 0,10-0,15 µm (4-6 µ inch) CLA followed by polishing with a diamond compound proves to be a fairly rapid and effective method of obtaining the required standard on hard surfaces for critical bearing applications. Should this finishing process be considered too costly or inconvenient, then the appropriate size spherical bearing should be selected when the necessary counterface is already embodied

Further advice on the surface finish factor is discussed in the chapter on bearing selection, ref section 1.0.7.

1.0.6/7 COUNTERFACE CHARACTERISTICS AND COMPOSITION

The relatively soft surface of p.t.f.e. permits it to act as a bearing surface with almost any harder counterface material provided there is no interaction leading to degradation of either surface or disruption of the thin p.t.f.e. films in shear. For the practical engineering purposes of obtaining high quality surface finishes and providing abrasion resistance where solid contaminants are encountered, hard surfaces are recommended. Steel is particularly good and may be of the corrosion resistant type, through-hardened to 56 + Rockwell C, i.e. AISI 440 B or C, or nickel or hard chrome plated to give excellent performances. Users are reminded that the absence of oil or grease from dry bearing assemblies requires special attention to corrosion protection of counterfaces and also that electro-plating frequently causes marked reduction in the fatigue strength of shafts and pins thus treated.

Softer steel surfaces can be employed successfully provided surfaces can be maintained in good condition both before and after installation in the bearing assembly.

Aluminium alloys are best hard anodised and subsequently ground and honed or polished. (The anodising treatment can also affect the fatigue properties of the alloy substrates). Hard anodised coatings are frequently porous depending on the chemical composition and the history of alloy manufacture. Alloys should be selected with care as the surface pores in the anodised film can be broken open at high shear stress levels causing roughening of the counterface and increased bearing wear.

Bearing loads approximately half those generally recommended for steels and other coated faces should be considered the maximum for general use with hard anodised aluminium unless specific test evidence indicates otherwise. Ordinary thin chromic or sulphuric acid anodised films are suitable in non-critical applications where anti-fretting is the principal requirement as opposed to extended sliding distances at high stress level.

Titanium counterfaces are best hard chrome or carbide coated as in their uncoated state they have proved to have very poor performance against p.t.f.e. films at high stress levels and their use cannot be recommended. At low stress levels up to 3,45 MPa (500 lbf/in^2) uncoated titanium is capable of yielding satisfactory results but it is strongly advocated that each application should be specifically tested before sealing a design specification. The titanium/p.t.f.e. combination appears to lead to a chemical and/or physical interaction at the rubbing interface which results in heavy discolouration and roughening of the titanium surface and rapid bearing wear.

Other metal compositions such as copper alloys, or hard ceramic, glass or enamel coatings are all potentially good counterfaces in carefully considered environments. Soft surfaces such as paint films, cadmium and zinc plating, are generally unsuitable and should only be considered at static joints or other applications where very little sliding motion is envisaged.

1.0.6/8
CONTAMINANTS

These may be both liquid or solid and their effect on the bearing materials and performance can differ widely.

Dealing first with solid contamination, this is potentially damaging to the performance characteristics and increased wear rate may occur by the scoring of counterfaces. In practice the embedability of the woven p.t.f.e. surface has demonstrated an inherent high tolerance of solid contaminant particles by ingestion into the surface and neutralising their destructive capacity by coating the particles with the p.t.f.e. film. Fine particles appear to be tolerated fairly readily and in some cases have even led to reduced wear rates while very sharp, hard particles measuring 0,25/0,50 mm (.010/.020in) have caused counterface damage and reduced performance. Much depends on the volume, size and physical characteristics of the contaminant in question and work is currently in hand to catalogue the features of the more common solids likely to be encountered and classify them into those considered hazardous or otherwise. Experience to date indicates that AMPEP p.t.f.e. bearings have a much greater tolerance to ingested solids than would be expected of conventional rolling element or greased metal/metal bearings.

Helicopter rotating assemblies are particularly prone to generating dust storms in the rotor areas and no evidence has yet been provided to suggest that special sealing arrangements have proved essential where AMPEP products are being applied.

Liquid contaminants come in two main groups, aqueous and organic, and are potentially capable of affecting both bearing materials and performance. The former most frequently occur as rain or sea water but battery fluids, human body fluids, condensation, wash down, and chemical toilet fluids may also be encountered. Laboratory tests and field experience have shown that the majority have an almost negligible effect, with the exception of the highly dissociated acids and alkalis, viz. nitric or sulphuric acids and particularly caustic soda or potash solutions. All these attack the resin binder and adhesive system in concentrations of 10% or more and must be excluded from the operating environment or from attacking the bearings in any processing operations which the user may wish to carry out following bearing installation but prior to assembly in the airframe, i.e. pre-painting or plating operations.

Organic fluids are encountered both during assembly sequences as chlorinated compounds or ketones used in degreasing and cleaning, and again in service as fuels, lubricants, de-icing and hydraulic fluids. As many AMPEP bearings are employed in power control systems, it is essential that they are compatible with such fluids, as some degree of contamination during assembly, service, and maintenance is unavoidable. Hydrocarbon fuels and mineral oils of similar molecular construction have no deleterious effect and may even improve life. Friction is reduced, as with most fluids including water, but certain oil additives do promote stick-slip and some care is required with bearings fitted to manual control systems and torque sensitive servo mechanisms. Cleaning fluids of the organic type previously mentioned have not been found detrimental and are frequently used during the manufacture of the bearings at Clevedon.

De-icing fluids of the glycol-methanol types and hydraulic fluids of the phosphate ester type tend to cause increased wear but the test results have a fairly wide scatter band. Wear curves illustrating the order of difference between dry and contaminated bearings at high stress levels are depicted in Fig. 9 but no in-service feed-back has been received indicating any user problem to date.

Silicone based hydraulic fluids appear to have negligible effect.

Greases are not recommended in conjunction with AMPEP bearings as the oil segregates at the p.t.f.e. bearing face leaving a soap film mixed with p.t.f.e. debris which is highly viscous, causing stick-slip and erratic friction characteristics. Greases containing molybdenum disulphide or graphite are, if anything, worse than those without.

The chemically inert character of p.t.f.e. renders it resistant to attack by all fluids except those specially developed for etching p.t.f.e. to improve adhesion. The increase in wear rates observed with some de-icing and hydraulic fluids can only be accounted for by assuming their continuing disruption of the p.t.f.e. shear film at the sliding interface which more rapidly depletes the reservoir of p.t.f.e. available for film regeneration than when such fluids are absent.

1.0.6 BEARING CHARACTERISTICS

Fig. 9
FLUID CONTAMINANT WEAR TESTS

LOAD 18,000 LBF
PRESSURE 26,000 LBF/IN²
MOVEMENT ± 25°
FREQUENCY 10 CPM
ROOM TEMPERATURE

GLYCOL ALCOHOL DEICING FLUID

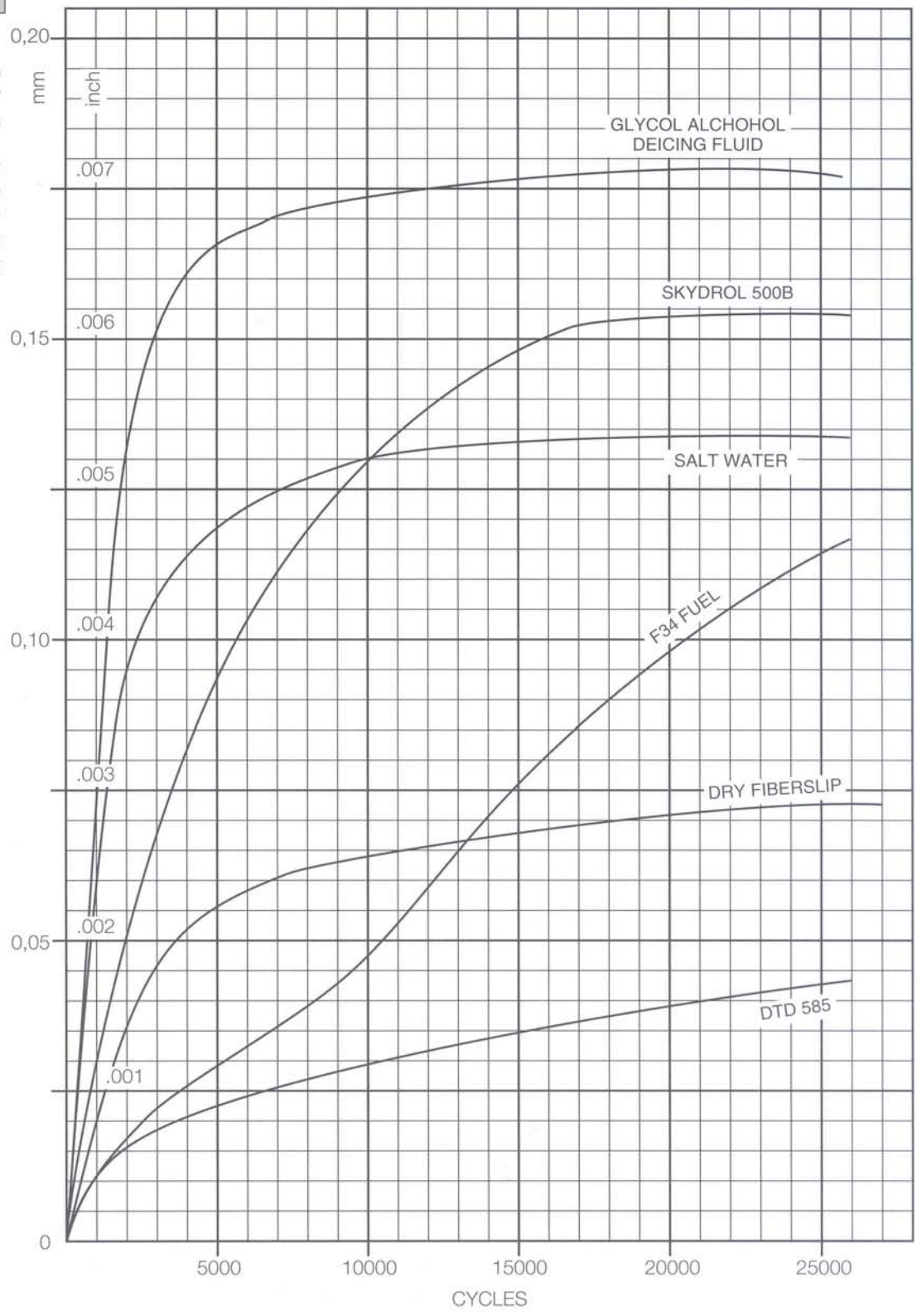
SKYDROL 500B

F34 FUEL

DRY FIBERSLIP

DTD 585

SALT WATER



1.0.6 BEARING CHARACTERISTICS

1.0.6/9 VACUUM (SPACE ENVIRONMENT)

Tests and in service use by various customers using 'Fiberslip' lined bearing which have been specially cleaned and cured for space applications have shown negligible weight losses and no effect on the coefficient of friction at atmospheric pressures as low as 10^{-7} torr. When specifying 'Fiberslip' lined bearings in space applications it is important to ask for this special preparation.

1.0.6/10 CREEP RESISTANCE

Bulk p.t.f.e. resins are well known for their inclination to creep or cold flow at relatively low compressive stress levels. The unique woven construction of AMPEP bearing materials embodying high tensile cold drawn p.t.f.e. filaments interlinked with E type glass yarns in a very thin composite layer overcomes this problem and prolonged periods of compression at pressures up to 172 MPa (25000 lbf/in^2) at room temperature have demonstrated that permanent set values of less than 0,01 mm (0,0004in) are the maximum to be anticipated. Higher temperature creep properties have not been explored although sufficient evidence exists to indicate that maximum permissible stress levels must be reduced as temperatures increase.
P.t.f.e. also has a time lag in recovering from high elastic deformations so that complete recovery may not take place for several hours after the deforming force has been removed. This hysterisis effect is not normally noticeable as it is generally very small in respect of the total elastic deformations observed but may have some significance in very critical applications where backlash at high rates of extreme load reversal are unacceptable. Investigation into this characteristic is proceeding in certain specific military aircraft requirements and will eventually enable us to advise on the best materials for these applications.

1.0.6/11 IRRADIATED ENVIRONMENTS

Irradiation tests for the Joint European Torus indicated only moderate adverse effect on wear properties after exposure to an accumulated dose of 10^8 rads.

1.0.6/12 ELECTRICAL & THERMAL PROPERTIES

Both p.t.f.e. and glass resin impregnated laminates are excellent thermal and electrical insulators. Resistance to heat dissipation should be borne in mind in the higher velocity applications. Electrical conductivity between adjoining structures may need to be provided by ''jumpers" when lightning strikes are being considered.

1.0.6/13 STORAGE & SHELF LIFE

Whereas conventional grease packed aerospace rolling element bearings require regreasing every two years in storage, the AMPEP products remain unchanged over long periods provided storage conditions are maintained at a reasonable standard.
All catalogue items are individually sealed in polythene bags and provided these remain unopened and stores are controlled between 15-25°C and 50-70% R. H . then users are assured of at least 15 years life without detriment.
Packs which have been opened for inspection purposes should be re-heat sealed with identity slips enclosed. Care should be taken not to contaminate bearings removed for inspection with grease, oil, water, etc. and all traces of handling are best removed by solvent degreasing to standard aerospace engineering specifications before re-packing.
If AMPEP bearings are stored in close proximity with lubricated rolling element types, it is suggested that a notice is clearly displayed on the bins warning stores personnel that the greasing of p.t.f.e. self lubricating bearings is both unnecessary and positively detrimental.

1.0.6/14 HANDLING

Users are reminded that these bearings are high quality precision products and should be treated accordingly. This applies especially to the low torque series spherical bearings which are particularly sensitive to mishandling and contamination. Bearings should be kept sealed in their packs at all times until the instant of installation and maintained in a clean environment afterwards.

1.0.7 BEARING SELECTION GUIDE

Where an unrestricted freedom of choice is presented to the aerospace designer familiar with AMPEP products, the selection of a suitable bearing with adequate performance capability is a relatively simple matter. However, for those designers who are meeting this product for the first time and also those with the usual restrictions of space, weight, cost effectiveness etc, it is hoped that this chapter of the manual will provide some measure of guidance in making the correct choice, and also a method of checking the anticipated life of bearings in the more critical applications.

1.0.7/1 BEARING TYPES

The standard catalogue of parts falls into two basic categories, those bearings with a capacity for misalignment i.e. spherical and rod end assemblies, and those with very little misalignment capacity, namely journal bearings. For applications where misalignment is greater than 1° a spherical bearing is essential.

The choice of a rod end or spherical bearing is largely determined by the particular application but designers are reminded that the standard rod end is relatively simple to assemble and replace in service whereas spherical bearings frequently require special skills and tooling for fitting. (See Section 1.0.8).

Journal bearings are lighter than the equivalent spherical bearing of similar projected bearing area but generally yield lower performances than the equivalent spherical bearing due to various reasons, some of which are listed below.

(a) The accumulation of tolerances in housings, bore and outside diameter, plus shaft tolerance, results in a much greater range of running fit than in the equivalent spherical bearing assembly and thus the chances of backlash being present in a proportion of original assemblies is inevitable in practical terms.

(b) As most aerospace bearings are used in highly stressed applications, pin bending within journal bearings is a commonplace occurrence. This produces high edge loadings with consequential high local wear and loss of p.t.f.e. debris at the bearing edges. In contrast, spherical bearings have their high stress/high wear areas concentrated at the centreline of the races where the p.t.f.e. debris tends to be retained and recirculated for further use.

(c) Shafts or pins specified and provided in the normal course of events are seldom to a standard of surface finish comparable with the ball surface of a spherical bearing produced at AMPEP and consequently the performance of the journal bearing is reduced as a result.

(d) Damage to journal bearing p.t.f.e. surfaces can be easily caused by inserting shafts without sufficient care. This can occur where bearings are inserted at location points during assembly of a structure and are subsequently used for the insertion of jigging pins further down the assembly line. Where this is a possibility, dummy or substitute bearings should be specified during the assembly process and the AMPEP bearing substituted at the final phase.
This can also occur with spherical bearings on assembly lines and the same safeguards are recommended.

Although AMPEP journal bearings are not primarily intended to accept misaligned loads, the resilient nature of the woven surface will permit a misalignment of approximately ½° provided the length does not exceed half the bore diameter. Journal bearings with lengths greater than one and a half times the bore diameter are not recommended as pin bending offsets the gain in surface area; increased load carrying capacity should be sought via increased bearing diameter at this point.

Journal bearings have the advantage of being available with either steel or light alloy shells, thus by selecting the appropriate range electrochemical corrosion problems in the equipment or structure are minimised and assembly processes facilitated.

Both flanged type journal bearings and spherical bearings have an axial load carrying capability although this is not a primary function. Spherical bearing axial capacities are of the order of 10% of their radial capacities and cater for the axial components of misaligned radial loads. Flanges on journal bearings can be used for reacting loads but their normal function is to prevent fretting contact between moving parts of fork end fittings. Should a bearing be required primarily for axial thrust loads, design advice should be sought from AMPEP's Engineering and Technical Department where specific designs of plain or spherical thrust assemblies can be proposed.

Rod ends should never be used in axially loaded modes without prior discussion with AMPEP Engineering and Technical Department due to vulnerability in the threaded portions.

An important group of rod ends and spherical bearings is the low torque type. They are used extensively in manual controls on helicopters and light aircraft and in applications where forces are low and light torque is desirable. The standard low torque/controlled clearance bearings shown in this manual are the chamfered outer race type, these are normally bonded into their housings. It is possible, however, to supply the grooved outer race type but great care is needed during the staking process. It is recommended that this is best left to AMPEP to supply the grooved bearings and stake them into the housings.

SELF-LUBRICATING BEARINGS - TECHNICAL INFORMATION

1.0.7 BEARING SELECTION GUIDE

Summarising the choice of bearing type with reference to the foregoing discussion the following generalisations emerge:

SPHERICAL BEARINGS

Advantages
Maximum predictable capacity and life for a given bearing area.
Accepts up to 6-10° misalignment.
Preload and stiffness predictable and consistent with each assembly.
Least prone to damage on assembly.

Disadvantages
Heavier than journal bearing of equivalent area and larger in diameter causing housings to be larger.
Additional skills and special tooling required for assembly and replacement.
Outer races in corrosion resistent steel necessitate use of wet assembly or sacrificial sleeves if used in light alloy structures.

ROD ENDS

Advantages
Convenience of installation and replacement.

Disadvantages
Rod eye end limits capacity of the installed spherical bearing.
Limited number of applications where it can be used.
Restricted use in bending due to stresses in threaded lengths.

JOURNAL BEARINGS

Advantages
Light weight and compact housing requirement.
Ease of fitting.
Choice of compatible shell materials.

Disadvantages
½° Maximum incidental misalignment capacity.
Somewhat lower life than equivalent spherical bearing.
Some free play in a proportion of assemblies.
Possibility of assembly damage greater than with spherical bearings.

Although some of the disadvantages in the various types of bearing can be mitigated with procedures later described in this manual, the recommendation must be for spherical bearings in the most critical areas where performance and stiffness are the primary features and for journal bearings in the less critical areas unless a misaligning feature is required.

Rod ends are a convenient way in which a spherical bearing can be readily adapted but applications tend to be confined to the ends of rods or tubes.

Applications having a primary axial thrust requirement should be dealt with on an individual consultative basis with AMPEP Engineering and Technical Department.

1.0.7/2 BEARING SIZING

Earlier discussion under bearing characteristics has pointed out that wear or backlash in a bearing assembly is normally used to determine the end of useful life and a value of 0,125 mm (.005in) total play distributed on both sides of bearings in a reverse loading application is, in our opinion, a general concensus of the users normal criterion for replacement.

Assuming that no constraints of weight or size are imposed on the designer then the required bearing area can be calculated by applying the recommended maximum and mean operating static and dynamic stress levels given in the tables in Section 1.0.5 selecting an appropriate bearing from the parts listed in the standard series specifications.

1.0.7/3 BEARING LIFE

To check that the bearing selected will fulfil the purpose intended, the order of wear and/or backlash can be calculated assuming that prior experience of these bearings in similar applications is not available within the design organisation. This checking procedure is complicated by a number of factors apart from pressure and sliding distance, and a service is available from AMPEP Engineering and Technical Department whereby your application data can be processed and the appropriate bearing duly recommended.

1.0.7 BEARING SELECTION GUIDE

To ascertain the order of wear occurring for a prescribed life and dynamic load spectrum, the primary objective is to establish the sliding distances required at the pressures predicted in each case listed in the spectrum. Each of these pressure/distance values are then converted to an equivalent sliding distance at a pressure of 172 MPa (25000 lbf/sq. in.) and the amount of wear obtained from a graph of wear versus sliding distance appearing with the worked examples later in this section. This wear value is for a unidirectionally applied load and needs to be doubled if the application is of a reversing load nature. Thus a graphical wear value of 0,125 mm (.005in) will be probably considered satisfactory for a unidirectionally loaded application but will be limited to 0,075 mm (.003in) if the load is reversing and equal about zero.

If the wear value proves unacceptably large then a larger bearing with a lower stress level must be selected until a preliminary satisfactory wear value is obtained. It may be of assistance to remember that the life of a bearing is in approximate ratio to the inverse square of the pressure, i.e. doubling of the bearing area or halving the stress level for a given load increases the life by a factor of 4.
This preliminary selection will establish a bearing potentially capable of yielding a given life under the specified loads at ambient temperatures for a wear not greater than 0,125 mm (.005in).
This life must then be further examined in respect of other factors mentioned earlier in Section 1.0.6 namely extreme temperatures, sliding velocity, surface finish, contaminants etc. These conditions are known to affect life and are acknowledged by applying the following factors.

1.0.7/4 EXTREME TEMPERATURE FACTORS

When operating between temperatures of 223/253 K (-50°C/-20°C) and 353/423 K (+80°C/+150°C),the predicted life should be reduced by a factor of two. If the proportion of the life at these extremes does not exceed 10% of the total life then this factor can be ignored. If it occurs over a greater proportion than 10% then the appropriate allowance should be made.
At a temperature between 423/523 K (+150°C/ +250°C) a life reduction factor of 4 should be applied.

1.0.7/5 SLIDING VELOCITY

The majority of applications involve oscillatory motion and the sliding velocity is normally expressed as an arithmetic mean. Wear remains fairly constant up to 0,03 m/s (6 fpm) but above this rubbing speed it tends to increase as a result of localised heating of the friction surfaces. Thus, between 0,03 - 0,06 m/s (6-12 fpm) the predicted life should be reduced by a factor of 2, from 0,066 - 0,12 m/s (13-24 fpm) by a factor of 3 and 0,127 - 0,254 m/s (25-50 fpm) by a factor of 4.

1.0.7/6 COUNTERFACE SURFACE FINISH

Bearing life is dependant upon the roughness of the counterface surface finish. Ampep standard spherical bearing counterfaces are finished to better than 0,05µm (2 micro inch) RA.

1.0.7/7 CONTAMINANTS

As previously discussed in Section 1.0.6 certain fluid contaminants in service such as mineral oils, silicone oils and kerosene fuels are not detrimental and if continuously applied, may be positively beneficial in reducing friction and removing heat from the sliding interface.

Very fine solid dust contamination has not proved to have a detrimental effect on bearing life but much will depend on the degree of environmental hostility, particle size and abrasiveness of the contaminants involved. In high risk applications consideration should be given to fitting spherical bearings with high preloads to exclude large particles or, in the last resort, some form of external sealing.

Liquid water, aqueous fluids, alcohol/glycol de-icing fluids and the more sophisticated phosphate ester hydraulic fluids have been observed to cause varying degrees of increased wear in p.t.f.e. bearings and predicted lives should be reduced by a factor of 4 where frequent or massive contamination is considered unavoidable.

Water vapour between relative humidities of 5-95% has been demonstrated by test as having no significant effect on wear rate. However the inherent hygroscopic nature of fibre reinforced laminates promotes very small changes in volume of the bearing layer. These are normally almost undetectable by normal measuring techniques but can, on occasion, manifest themselves as changes on no-load rotational characteristics of spherical bearings where the ball is an interference fit in the outer race in order to eliminate any undesirable free play in these assemblies as supplied. Frictional torque underload remains virtually unchanged in the above circumstances as the dimensional changes due to humidity variations are extremely small compared with the elastic deflection of the liner system when loaded.

1.0.7 BEARING SELECTION GUIDE

1.0.7/8 ANGULAR & DIRECTIONAL MOVEMENT

Oscillatory motions of small amplitude and relatively high frequency occurring with vibrations and "fidgeting" motions can be largely discounted in the assessment of total linear sliding distances for life predictions, provided the angular movement does not exceed ½° per cycle. Experience has shown that at these very small angles the bearing material is really at its best and wear is virtually absent although some loss in preload will be observed. All angular motions in excess of ½° must be integrated into the total sliding distance.

In journal bearings used in axial sliding applications or planar sliding motions the rate of wear is known to be increased by a factor of approximately 2.5 and the predicted life should be reduced appropriately. This increased wear rate is due to the almost instantaneous loss of p.t.f.e. shear film and debris at every cycle by transference from the loaded zone by the moving counterface.

1.0.7/9 CHOICE OF BEARING MATERIAL

The prediction of life measured from the graph of wear versus sliding distance at the end of this section is based upon data obtained from thirty years test and service experience with AMPEP'S standard Fiberslip materials. Predicted bearing lives can be improved by factors of 2- 3 if AMPEP X1 is employed within a temperature band of 0 to 80°C. Outside this zone very little improvement over the standard Fiberslip is exhibited.

At bearing pressures up to ± 5000 lbf/in^2 (35 MPa) AMPEP XL provides increasingly extended lives of 5 to 10 times those obtained from Fiberslip and AMPEP X1 . Refer to previous section 1.0.5/3.

A standard range of AMPEP XL bearings does not exist at present. However all standard spherical bearings can be supplied in XL form also many special bearings exist. Please note, bushes are not available in XL form. Contact the Technical Sales Department for further information.

1.0.7/10 GENERAL NOTES

Designers applying the life prediction data and the attendant factors are reminded that this is intended as a guide in selecting a bearing considered appropriate for a particular application. These predictions are based on a variety of rig-tests from many sources and also thirty years of service experience. The results should indicate the order of life expectancy for any particular bearing application if the operating data spectrum used is reasonably accurate. Examples of the use of the method of bearing selection follow these recommendations but should the exercise prove too time-consuming or if doubt exists concerning any critical application then AMPEP Engineering and Technical Department will give the necessary advice on request.

The preceding discussions apply in general to airframe structures, flying control systems, hinges and actuators. From the correction factors applied, one can see that the airframe dry structural joint operating at moderate pressures, with very small movements at ambient temperatures, is an ideal application, whereas the high pressure, axially sliding, extreme temperature, glycol immersed journal application is much more difficult to assess with accuracy. Any life predictions which are only marginally acceptable in critical applications should be tested before sealing designs if the restrictions on design preclude a more suitable choice. The fact that these life predictions may show a selected bearing to be adequate is not necessarily a guarantee that the anticipated performance will be achieved in every circumstance as applications and conditions vary so widely within the total aerospace industry and its equipment suppliers.

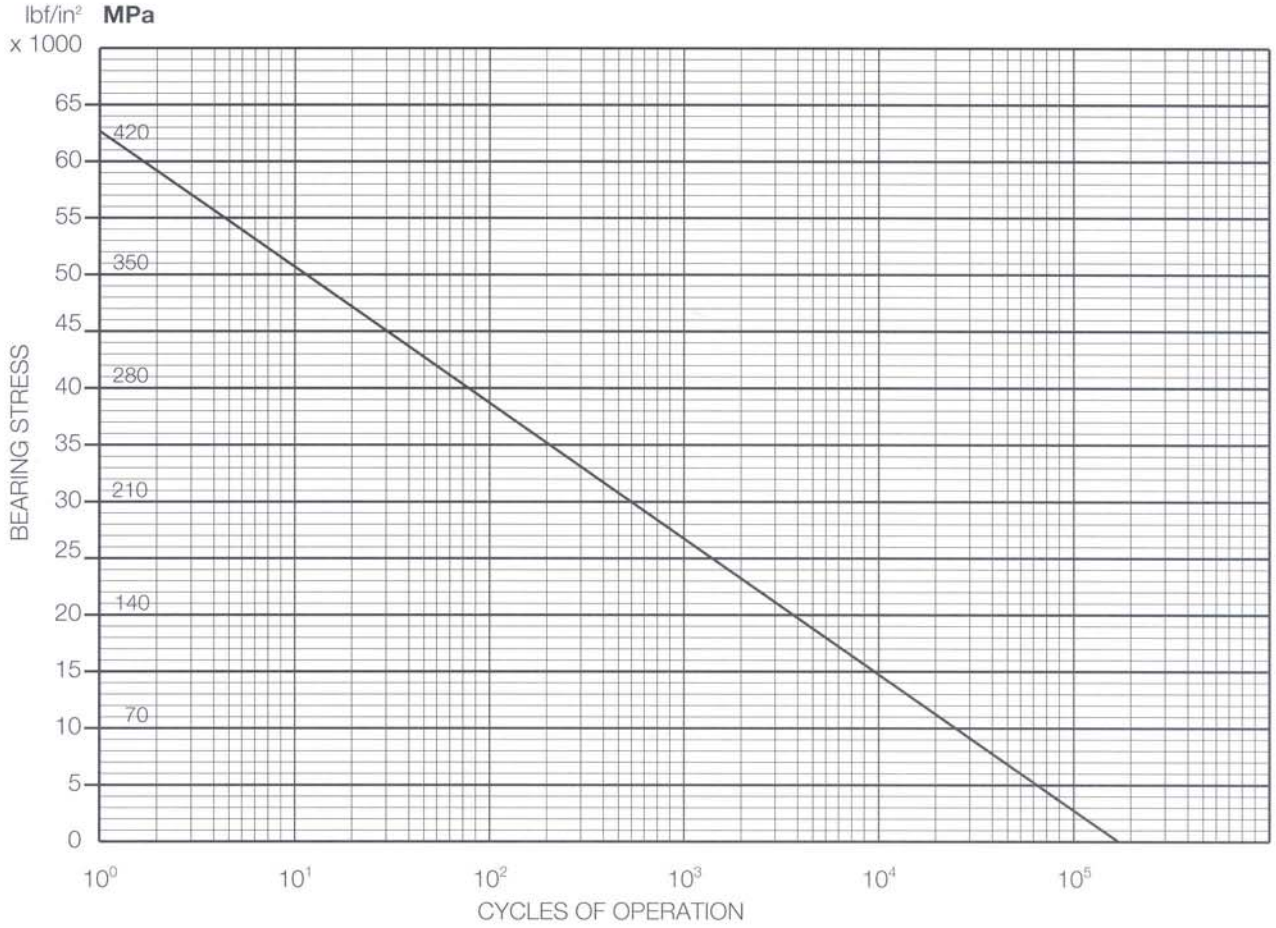
1.0.7/11 SPECIAL NOTES

Actuator attachment point bearings in landing gears, lift dumpers, spoilers, and air brakes require a special mention due to the relatively high incidence of bearing damage known to occur in this equipment. Bearing failures exhibit a specific interlaminar defect which is completely different in character from the usual wear scar observed in normal sliding. The defect always occurs in the extension mode of the actuator and no satisfactory explanation has yet been found although the peak transitory loads at full extension of the actuator plus loads developing as a result of locking or over-centre toggle actions may play a vital role.

If lined bearings are employed, users are advised to limit bearing pressures to levels indicated in the following graph.

1.0.7/12
PREDICTED LIFE LIMITATIONS FOR LANDING GEAR, SPOILER, LIFT DUMPER, AND AIR BRAKE ACTUATOR AND LOCK MECHANISMS.

Fig. 10



To determine the number of cycles in a specific application, perform the following operations.

(a) Calculate the *maximum output load* of the jack *in extension*, i.e. maximum jack inside area x maximum hydraulic pressure.
(b) Convert this output load to bearing stress by dividing it by the bearing projected area .
(c) Selecting the calculated value of stress on the Y axis of the graph Fig. 10, read off the number of cycles of operation on the X axis, and check if this meets the requirement.
(d) If the predicted number of cycles is too few, operate the reverse sequence to determine a new bearing of the correct size.
(e) Cross check that the chosen bearing complies with the other static and dynamic operating recommendations and wear life.

(f) This factor should take precedence over other life factors in these particular applications if early failures are to be avoided.

These types of applications are often more suited to the use of a metal to metal bearing. Refer to Sect. 3.

1.0.7/13
AXIAL SLIDING IN OLEO LEGS

In axially sliding oleo leg applications in landing gears, whilst the maximum landing loads and also sliding movements appear to be the most important, they are considered to constitute only a small percentage of wear life of the bearing. The major portion of the life is expended in taxiing and dispersal and it is this aspect of the sliding distance in conjunction with stress level which is of greater importance. The actual landing loads are of primary importance in ensuring that the bearing is capable of accepting the maximum operating dynamic loading. Approximately 25 metres or 80 feet of sliding *per taxi and dispersal* at the appropriate bearing pressure is a good guide for assessment in these cases. The life values obtained can be further influenced by the effective contact areas in the bearings and whether the bearings are dry or oil immersed. Nose wheel bearings should also be considered in relation to the additional steering motions which they will accumulate.

1.0.7 BEARING SELECTION GUIDE

1.0.7/14 MAXIMUM LOADING AND SAFETY FACTOR

Having selected a bearing with suitable life, the maximum and emergency loading conditions should be checked against the recommendations in section 1.0.5/1. Attention is drawn to the limited safety factors of the aluminium backed journal bearings where the strength of the materials reduces the static limit pressures to 206 MPa (30000 lbf/in²) compared to 430 MPa (62500 lbf/in²) for the corrosion resistant steel backing material .

1.0.7/15 OVERHAUL PERIOD

In the event that designers are limited in their choice of bearings by weight, envelope restrictions, price etc. then the maintenance instructions will need to contain directives for the inspection of particular bearings at the appropriate overhaul periods with replacement as considered necessary. Advice on the condition of worn bearings is given in Section 1.0.8/14 of this manual.

1.0.7/16 EXAMPLES OF PREDICTING BEARING LIFE

The following are actual examples of life predictions for in-service aircraft. As previously mentioned, the inverse square pressure/ distance ratio is an approximation and the linear relationship between wear and log distance only holds good when all distances are expressed at stress levels of 172 MPa (25000 lbf/in²). At lower stress levels and greater distances the predictions become increasingly inaccurate due to marked deviations from linear relationship between wear and log distance. However, the method of prediction used here is generally on the pessimistic side and in-service performances are expected to give acceptable results.

A special spherical bearing in the actuator of a fixed wing aircraft is required to yield 4000 actual flying hours under the conditions given below. The application is Class 1 and the backlash is not to exceed 0,10 mm (.004in) to preclude flutter. Environmental temperature factors are:
2133 hours at 390 K (117°C)
1867 hours at 293 K (20°C)
Duty cycles of in-flight loads and movements for 900 hours endurance are as follows:

Case No.	Total Cycles	Frequency Hz	Loads lbf.	Movements
1	4320	2.0	23,300 ± 500	± 1.43°
2	4320	0.2	23,300 ± 2500	± 7.15°
3	6480	2.0	15,300 ± 500	± 1.43°
4	4320	0.2	15,300 ± 5200	± 14.3°
5	2160	2.0	- 4600 ± 500	± 1.43°
6	4320	0.2	- 4600 ± 2500	± 7.15°
7	1800	0.1	9,500 ± 17400	± 46.5°

The maximum bearing dimensions envisaged dictate an outer race width of 0.783in with a ball diameter of 1.375in, giving an effective bearing area of 0.976 square ins., and a sliding distance per degree of ball rotation of .0010 feet.

Wear V Log Distance at 172 MPa (25000 lbf/in²) for Standard FIBERSLIP Materials

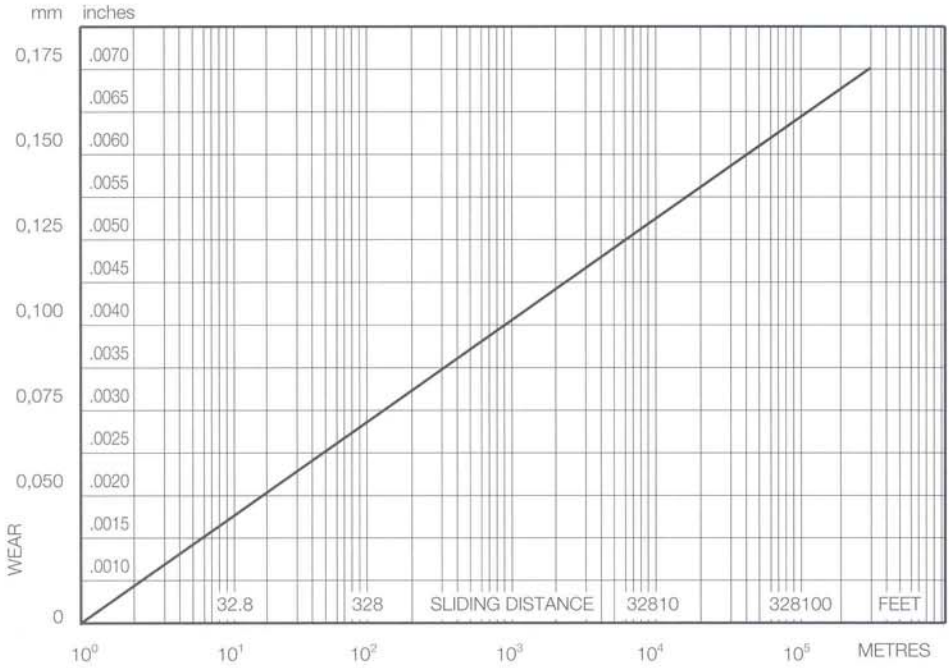


Fig. 11

1.0.7 BEARING SELECTION GUIDE

STEP 1. Determine maximum load in each case and convert to bearing stress P_1 by dividing by the area for the most arduous service condition.

Case	Max. Load lbf	Max. stress lbf/in² = P_1
1	+ 23800	+ 24385
2	+ 25800	+ 26434
3	+ 15800	+ 1 6188
4	+ 20500	+ 21004
5	- 5100	- 5225
6	- 7100	- 7275
*7	+ 26900 - 7900	+ 27561 - 8094

*Case 7 requires special consideration due to the magnitude of the reversing load case at ± 46.5°.

STEP 2. Calculate total sliding distance D_1 in each case i.e. Degrees swept per cycle x distance per degree x total cycles.

Case No.	Cycles	Sweep/Cycle°	Dist/o	Total dist. in 900 hours in feet = D_1
1	4320	± 1.43° = 5.72°	0.001	24.7
2	4320	± 7.15° = 28.6°	"	123.5
3	6480	± 1.43° = 5.72°	"	37.1
4	4320	± 14.3° = 5.72°	"	247.1
5	2160	± 1.43° = 5.72°	"	12.4
6	4320	± 7.15° = 28.6°	"	123.6
7	1800	± 46.5° = 186°	"	334.8

STEP 3. Convert all stress/distance values to equivalent sliding distances at a stress of 25000 lbf/in by applying the inverse square ratio formula.

$$\frac{D_2}{D_1} = \left[\frac{P_1}{P_2}\right]^2$$

or $$D_2 = D_1 \left[\frac{P_1}{P_2}\right]^2$$

Where D_1 is sliding distance at pressure P_1
and D_2 is sliding distance at pressure P_2
Where P_2 = 25000 lbf/in²

e.g.

Case 1 $24.7 \times \left[\frac{24,385}{25,000}\right]^2$ = 23.5 feet

2 $123.5 \times \left[\frac{26,434}{25,000}\right]^2$ = 138.1 feet

3 $37.1 \times \left[\frac{16,188}{25,000}\right]^2$ = 15.6 feet

4 $247.1 \times \left[\frac{21,004}{25,000}\right]^2$ = 174.4 feet

5 $12.4 \times \left[\frac{5,225}{25,000}\right]^2$ = 0.5 feet

6 $123.6 \times \left[\frac{7,275}{25,000}\right]^2$ = 10.5 feet

7 $334.8 \times \left[\frac{27,561}{25,000}\right]^2$ = 406.9 feet

$334.8 \times \left[\frac{8,094}{25,000}\right]^2$ = 35.1 feet

---

STEP 4. Summate all equivalent distances of same sign at 25000 lbf/in² and round off to nearest integer.
+ Cases 1,2,3,4,7 = 759 feet or 231 metres.
- Cases 5,6,& 7 = 46.1 feet or 14 metres.

STEP 5. Read off distances from horizontal axis of graph Fig. 11 and determine predicted wear from vertical axis.

+ Case wear = .0033in - Case wear = .0017in

Total predicted wear in reverse loading conditions specified *at room temperature* is .0050in for 900 endurance hours.

STEP 6. Temperatures environmental factor 2133 hours of every 4000 hours life, i.e. 53% are operational at 117°C which invokes a life reduction factor of 2.

53% of 900 hours = 477 hours - which at a life reduction factor of two becomes approximately 239 hours. The .005in wear predicted will probably occur in 239 + (900-477) hours, i.e 662 hours.

STEP 7. Ensure that maximum and emergency loads yield bearing stress levels compatible with general recommendations and that no other conditions exist which require application of other life factors.

Conclusions: Application is critical and the life should be at least doubled by using AMPEP X1 material in place of Fiberslip. Consideration should also be given to installing a special high pre-load version bearing to further reduce backlash and minimise the onset of a possible flutter condition. These recommendations should succeed in prolonging bearing life to at least 1000 hours between overhaul and replacement but the possibility of achieving the full airframe life is remote.

EXAMPLE 2

A civil aircraft lift dumper actuator containing catalogue part number SN 14 G bearings in both earth and output ends is required to complete 55000 operational flights during 41,250 unfactored flying hours. The maximum stall load of jack in extension is 9150 lbf and a locking mechanism in tension is capable of exerting a force of 20900 lbs. 123750 operations are required. What life can be expected with a free play not exceeding .005in? Angular movements are 0 ⇌ 50° per cycle with maximum loads of 8280 lbf and 4590 lbf during extension and retraction movements respectively.

STEP 1. Determine bearing stress levels for each static and dynamic case.
Areas of bearings are given in the standard series specifications.

Projected area A of SN 14 G = 0.850 in²

Load W lbf.	P_1 Stress =	$\frac{W}{A}$	lbf/in²
Max. static operating—20900	$\frac{20900}{0.850}$	=	24588
Max. stall load + 9150	$\frac{9150}{0.85}$	=	10765
Operating ext. load + 8280	$\frac{8280}{0.85}$	=	9741
Operating retract load + 4590	$\frac{4950}{0.85}$	=	5400

STEP 2. Calculate the sliding distance in each case where applicable.
Distance per degree of movement is given in the standard series specifications.

Extension mode

Ang. movement /cycle	Cycles	Dist/deg. in feet	Total swept distance D_1
50°	123.75 x 10³	0.001	50 x 123.75 x 10³ x .001 = 6188 feet

Retraction mode

Same as extension = 6188 feet

STEP 3. Convert both case of distance at appropriate stress level to equivalent distances at stress level of 172 M Pa (25000 lbf/in²) and summate.

$\frac{D_2}{D_1} = \left[\frac{P_1}{P_2}\right]^2$ as in EXAMPLE 1

Extension $D_2 = 6188 \times \left[\frac{9741}{25000}\right]^2 = 939$ feet

Retraction $D_2 = 6188 \times \left[\frac{5400}{25000}\right]^2 = 289$ feet

∴ Total equivalent distance at 25000lbf/in² = 1228 feet
= 374 metres

STEP 4. Read off predicted wear from graph of wear v log distance Fig. 11 .
=.0035in (approx)
As this is a unidirectionally loaded sliding application this predicted result appears to satisfy the requirements.

STEP 5. This application is included in the group of landing gear, spoiler airbrake, and lift dumper actuators where an additional criterion needs to be met. The discussion earlier in this section refers.

Maximum bearing stress at ext. stall = 10765 lbf/in^2 ref. STEP 1.
Read off from graph Fig.10 the number of cycles recommended at this stress level.
= 23000 operations (approx.)

$$\text{Life} = \frac{23000}{123750} \times 41250 = 7666 \text{ flying hours.}$$

STEP 6. Check the static limit and ultimate requirements can be met and that no other environmental factors are invoked.

Conclusions: Although the predicted wear values are compatible with the complete airframe life the limitations of STEP 5 should be considered the overriding factor and airline operators should be prepared to change bearings at the 10000/12000 hour overhaul periods.

EXAMPLE 3.
A helicopter main rotor assembly is operated by links with p.t.f.e. spherical bearings in each end, and a life of 2500 hours is required. Mean operating loads are 926 ± 926 lbf per revolution at 320 rpm and an angular movement of ± 6° per cycle. A proof load of 4400 lbf is required with an ultimate of 6600 lbf. An AMPEP XL metric bearing was proposed and a backlash of 0,1 mm (.004in) could be tolerated but was considered undesirable. Loads are unidirectional O — →+ ve.

STEP 1. Determine stress level for XL spherical bearing similar to 22 GSW with a ball diameter of 39,4 mm (1.374in).

Projected area A = 0.866in^2
Maximum load = 1852 lbf

Calculate stress at most arduous condition

$$P_1 \text{ Stress} = W/A = \frac{1852}{0.866} = 2139 \text{ lbf/in}^2$$

STEP 2.
Determine sliding distance for 2500 hours service ± 6° = 24° per cycle.

$$D_1 = \frac{\pi 1.374}{12} \times \frac{24}{360} \times 320 \times 60 \times 2500 \text{ feet}$$
$$= \pi 1.374 \times 2 \times 320 \times 417 \text{ feet}$$
$$= 1152000 \text{ feet}$$
$$= 351130 \text{ metres}$$

NOTE: Because the load drops to zero during half the wear cycle, this can be taken as 175565 metres of travel at the loaded surface. An inspection of the XL graph in Section 0.2.1 shows that at a stress level of between ± 6,9 - 27,6 MPa (1000-4000 lbf/in^2) a maximum backlash of 0,05 mm (.002in) is expected after 152 km of sliding distance travelled at the bearing surface. The wear per surface would be 0,025 (.001in) and distance travelled per surface is 76 km. By extrapolation of the backlash curve it can be seen that a 2500 hour life for 0,05 mm (.002in) wear is theoretically possible.

STEP 3. Check velocity factor.

$$\text{Average surface speed} = \frac{\pi 1.374}{12} \times \frac{24}{360} \times 320 \text{ f.p.m.}$$
$$= \frac{\pi 1.374 \times 16}{9} \text{ f.p.m.}$$
$$= 7.67 \text{ f.p.m.}$$

Referring to sliding velocity factors earlier in this section a life reduction factor of 2 is recommended at speeds between 6-12 f.p.m. Thus a more realistic life may be 1200 hours (500000 ft).

STEP 4. Check ultimate and static requirements are satisfactory.

i.e. $\frac{\text{Proof Load}}{\text{Area}} = \frac{4400}{0.866} = 5080$ lbf/in²

Ult. stress = 5080 x 1.5 = 7621 lbf/in².

EXAMPLE 4.

A main undercarriage oleo leg lower sliding bearing operating in DTD 585 mineral oil is required to achieve 4800 unfactored landings and take-offs sliding against a chrome plated steel leg with a surface finish of 8 micro inch CLA.

Loads are unidirectional and wear is not critical provided the integral wiper seals remain operationally effective. Aircraft life required 4000 hours. The bearing is a special journal assembly with a bearing area of 7.17 sq. ins.

Max. static stress	11640 lbf/in²
Ult. static stress	17460 " "
Mean operating stress	3880 " "
Taxi ing stress	1000 " "
Stroke	1.16 feet

Average distance in sliding on taxi and dispersal 84 feet per take-off and landing. Total sliding distance during landing and take-off 10440 feet.

STEP 1. Taking the major cases of sliding wear.

Case (a) 10440 feet at a mean stress of 3880 lbf/in

Case (b) 4800 taxi and dispersals at 84 feet of sliding
= 403200 feet.

Stress level 1000 lbf/in².

STEP 2. Convert to equivalent distances at 25,000 lbf/in as in previous examples.

Case (a) $D_2 = 10440 \left[\frac{3880}{25000}\right]^2 = 251$ feet

Case (b) $D_2 = 40300 \left[\frac{1000}{25000}\right]^2 = 645$ feet

Total equivalent distance = 896 feet or 273 metres.

STEP 3. Consider life factors:
(a) Axial sliding condition reduces life by a factor of approximately 2.5.
(b) Surface finish of 8 micro inch CLA reduces life by factor of 2.

273 metres of sliding is equivalent to .0033in wear from the wear v log distance graph Fig. 11 at 25,000 lbf/in2 and this distance could be achieved without exceeding a predicted .0040in wear value. For .0040in wear the predicted sliding distance would be circa 900 metres and thus one can assume a life of approximately:

$\frac{4000 \times 900}{2.5 \times 2 \times 273} = 2637$ hours

when taking these particular factors into account.

High sliding velocities are also experienced in the initial moment of landing but this condition is partially offset by the presence of the mineral oil hydraulic fluid.

STEP 4. Check that ultimate and static loads are in line with recommendations.
Conclusions: The stress levels in this application are calculated as though a perfect fit of shaft and bearing would be obtained. This is not justified as a substantial running clearance is needed at room temperature to prevent seizure at -40°C due to the differentials of thermal expansion between the steel sliding member and the aluminium bearing and supporting housing. In addition, no allowances have been made for unequal stress distribution due to oleo leg bending and therefore it would not be prudent to anticipate more than a quarter of the aircraft life, with a likely change of bearing every 1200 landings and take-offs using the standard Fiberslip material.

1.0.7 BEARING SELECTION GUIDE

1.0.7/17
BEARING DEFLECTION UNDER LOAD

The amount of deflection under load is of particular importance to the flying control actuator designer with increasingly restrictive specifications for stiffness. Despite the relatively soft nature of p.t.f.e., the very thin sections employed in the liner compared with the thickness of the metal race elements in spherical assemblies causes much less problem than is at first imagined and installation techniques for improving stiffness can be adapted which promote much better results than could be maintained with greased metal to metal bearings which always require clearance fits in the unloaded condition.

Static radial load tests on spherical bearings over the ¼" to 1" bore range have provided a series of load/deflection curves, which, on analysis, produced a linear relationship between bearing stress per unit of outside diameter and deflection, once the "soft centre'' zone at ± 4000 lbf/in² has been exceeded. Graph Fig.12 displays the elastic and permanent set values which can be expected.

A constant of 1.67×10^{-7} inches per lbf/in² bearing stress per inch of bearing outside diameter can be applied for calculation of bearing deflection under load as in the following example:

An actuator containing standard SN 12 G bearings in each end attachment point is required to transmit a maximum load of 25,013 lbf in extension and 17,388 lbf in retraction. What deflection will be exhibited by the bearings and will this exceed the maximum design requirement of .025"?

The effective bearing area of an SN 12 G is 0.6900 sq. inches and the outside diameter is 1.437".

STEP 1: Calculate the bearing stress in extension and retraction $P_{EXt.}$ and $P_{Ret.}$

$$P_{EXt.} = \frac{25013}{.6900} = 36{,}250 \text{ lbf/in}^2$$

$$P_{Ret.} = \frac{17388}{.6900} = 25{,}200 \text{ lbf/in}^2$$

STEP 2: To eliminate the ''soft centre'' characteristic from the linear portion of the load deflection curve between ± 4,000 lbf/in², reduce the stress levels calculated in STEP 1 by this amount:

$P_{EXt.}$ becomes 36250 — 4000 = 32250 lbf/in²

$P_{Ret.}$ becomes 25200 — 4000 = 21200 lbf/in²

STEP 3: Calculate the linear deflections as previously discussed, i.e. corrected stress x deflection constant x bearing outside diameter.

Linear deflection in extension $= 32250 \times 1.67 \times 10^{-7} \times 1.437$
$= 3.225 \times 1.67 \times 10^{-3} \times 1.437$
$= .0077$ inches

Similarly for linear deflection in retraction mode
$= 21200 \times 1.67 \times 10^{-7} \times 1.437$
$= 2.120 \times 1.67 \times 10^{-3} \times 1.437$
$= .0051$ inches

STEP 4: Summate the linear deflections per bearing and add the ''soft centre" deflection of .0035 inches between ± 4000 lbf/in² thus:

.0077 + .0051 + .0035 = 0.0163 ins per brg.

For two bearings, one at each end, the total deflection at maximum load would be approximately 0.033in.

Conclusion: The predicted deflection is too high and although it could be reduced by fitting special pre-loaded type bearings, this would still exceed the requirement.

An SW14G with a projected area of 0.9213in² and an outside diameter of 1.625in would probably produce the desired improvement.

Calculating the latter deflection gives a predicted elastic deflection for the two bearings of .0276in which with a nominal 0.002in interference fit would yield the required maximum acceptable value of approximately 0.024in.

1.0.7/18
ELASTIC AND PERMANENT DEFORMATION CONSTANTS FOR AMPEP SPHERICAL BEARINGS

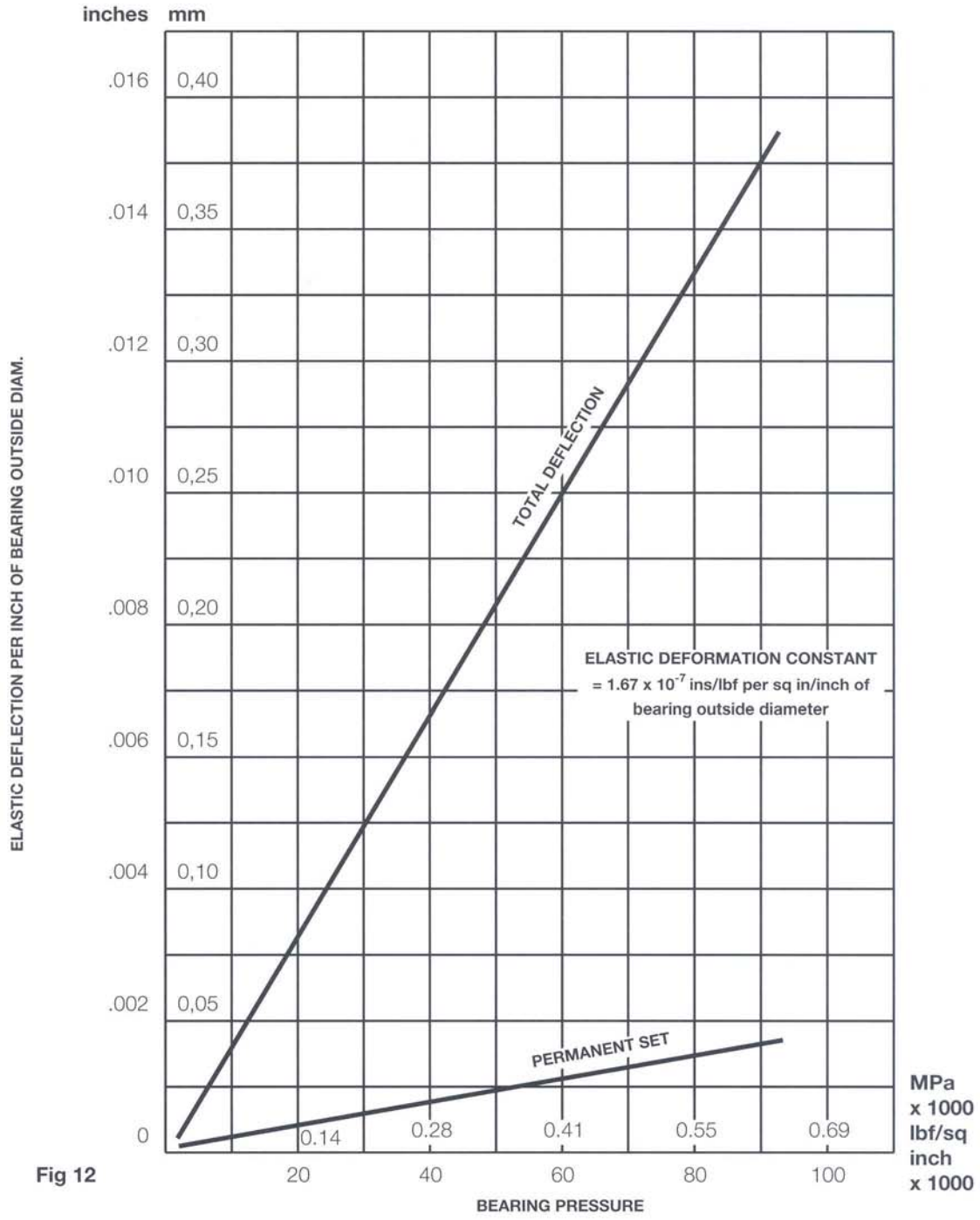


Fig 12

The permanent set associated with these maximum loads can also be predicted with reference to Figure 12.

Before concluding this section on bearing selection it is necessary once more to emphasise that the advice proffered in this section is for guidance only and is not a substitute for sound engineering and design practice. This selection advice cannot be allowed to dominate the design function where previous experience or in-service feed-back indicates that such a choice would later be demonstrated to be in error. Marginal applications should be evaluated by test wherever possible. AMPEP Engineering and Technical personnel are always available to advise on bearing selection from a broad spectrum of applications in which they have been involved over the past three decades.

This information applies to the bearing only. Lack of housing stiffness and clearance between pins and bores, and bearing outside diameter to housing bore, must be added.

1.0.8 BEARING INSTALLATION & RETENTION

1.0.8/1 GENERAL NOTES

This subject is fairly complex and a considerable choice of method is open to users. Some of the methods and techniques discussed will be readily accepted in certain instances as the particular application may well limit any flexibility of choice. However, in other applications particular designers may favour specific methods due to previous or current knowledge of the techniques and their ease of assimilation by the work force on their production and assembly lines.

Whichever method is selected it cannot be overemphasised that this type of bearing is a high quality, precision product and in many instances the resulting performance will depend on the skill and care with which the installation is carried out. Experience at AMPEP to date has demonstrated without doubt that many more design problems and queries arise from methods of installation and retention than are ever received in respect of performance, and this being the case, this particular section is regarded as being of greater importance than the preceding section on bearing selection.

Installation methods cannot be discussed in isolation as the question of housing and shaft sizes is of considerable importance both in respect of the method selected and with regard to the free play or backlash incurred as a direct result of the selected fits. The recurrent theme of limiting or controlling free play and stiffness in this type of bearing cannot be overemphasised as this is one of its main attractions to aerospace design teams and continuing reference will be made to this aspect during this section.

1.0.8/2 ROD END BEARINGS

With this type of bearing the spherical self-aligning assembly is already retained within the eye end of the rod by applying a 360° staking operation to the Grumman groove configuration and deforming the metal lips outwards to engage the chamfers in the eye end. This is a standard technique and is described in detail under spherical bearing retention. The range of fit of the bearing into the rod end eye is from 0,005 mm interference to 0,030 mm clearance (+.0002in to -.0012in) and a wet assembly process using Loctite minimises subsequent fretting or corrosion at the fitted interfaces.

The user normally specifies the method of securing the threaded length within his rod, tube or other structural member. This usually complies with well established and accepted aerospace practices and needs no further comment here.

The fit of the pin or shaft into the spherical bearing bore follows the identical practice recommended in the ensuing section on the self-aligning types.

1.0.8/3 SPHERICAL BEARINGS - NORMAL AND LOW TORQUE - GROOVED OUTER RACE SERIES

These are divided into two main types, normal/low torque series and low torque/controlled backlash series, for which differing methods are recommended. Further sub-divisions are made in respect of retaining methods for plain and grooved bearings and installation techniques suggested for the types of fit into housings.

These bearings are primarily fitted into housings to give 0,005 mm interference to 0,030 mm clearance (+0.0002in to -0.0012in) using wet assembly with Loctite or some other preferred jointing compound, as described previously. The retention is completed by 360° staking the Grumman groove lip over the housing chamfer. The staking process is described in detail below and the recommended housing and pin dimensions are given in Section 1.1.2. Considerable care must be taken to ensure that Loctite does not get into the bearing. Housing and chamfer dimensions are of considerable importance and can greatly influence the scatter of torque values obtained after staking. Ovality and parallelism of housing bores should be controlled within 50% of the bore tolerances quoted to maintain control of the process. Even so, a considerable torque scatter band is possible until an acceptable level of operator skill is eventually acquired. Methods of adjusting the installed torques of bearings are included in this section which will undoubtedly prove useful during the initial learning phases.

A hydraulic press is required to carry out the lip deformation, and staking tool sets can be supplied to customers who require to carry out this operation. The approximate staking load is 4 kN per mm (10 tons per inch) of staking groove diameter but is subject to various factors, of which the rigidity and strength of the housing are of considerable importance.

Staking Process

Tooling
2 off staking heads
1 off staking anvil
2 off location pins
] Staking tool set
1 off bearing insertion tool

Installation Procedure

(a) Submit both bearing and housing to Inspection Authority to verify torque and essential dimensions.

(b) Clean both bearing and housing by flash vapour degreasing or wiping surfaces with an approved fluid and *clean* cloth or tissue. The use of trays of solvent for rinsing is not advisable as these rapidly become contaminated from external sources and lead to contamination of bearings and housings.

(c) Carefully apply a jointing compound or thin line of Loctite to the bearing outside diameter taking care to prevent its spread to areas outside the joint faces.

(d) Manually push fit the bearing into the housing or use a light mandrel press if necessary, and check that the bearing torque has not been markedly changed. If the bearing appears difficult to insert and/or the torque appears to be greatly changed, then an investigation into the causes should be undertaken before the actual staking takes place.

N.B. Under no circumstances should the bearing be forced into the housing by pressing on the end face of the ball.

(e) Position the bearing in its housing on the location pin as shown in diagram A following, and ensure that housing and bearing faces are seated squarely on the anvil faces. Lower staking tool very carefully to just engage groove in the bearing and check that the housing does not foul the tooling in any place before proceeding with the next operation .

(f) Apply the selected staking load to the groove and visually check that a suitable degree of deformation has been obtained. If any jointing compound has exuded this should be carefully removed. It is frequently noticed that some drop in bearing torque can occur at this stage of the staking operation which will subsequently recover during the second stage.

(g) Replace the lower anvil with the second staking head as shown in diagram B. Place the bearing and housing on the location pin such that the lip already deformed is located face downward to engage the lower tool and stake the upper groove with the same load as the first groove.

(h) Remove assembly from press, carefully remove any surplus jointing compound and check rotational torque. If this is too low, increase the staking load by 5 KN (1/2 ton) increments and repeat operation (g) until the correct torque level is obtained.

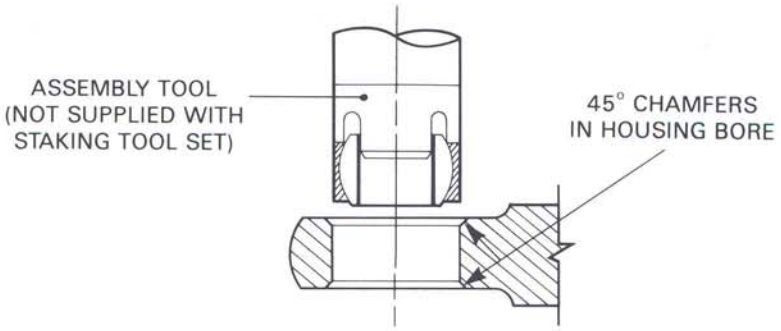
(i) Repeat the complete sequence of operations on the new press setting with a fresh assembly and check if the results compare favourably. Minor adjustments may be required as the production double strike operation at a fixed staking load, frequently produces a different torque value than the multiple strike setting procedure.

(j) It is important to ascertain that the installed bearing has the required stiffness and that the retention process has been properly executed.

To ensure adequate stiffness, it is recommended that the torque of the spherical bearing after staking is higher than before staking, up to double the recommended maximum of the bearing in its free state. Free play in an axial direction can be readily detected by manual checks and subsequently eliminated.

It is most important that the internal conformity of the rubbing surfaces is maintained during these staking operations which cause local deformations of the bearing outer race. The strength of the housing is an essential factor in that it must be able to contain the local bearing deformations to enable the torque adjustments to be carried out successfully.

1.0.8 BEARING INSTALLATION & RETENTION



BEARING INSERTION

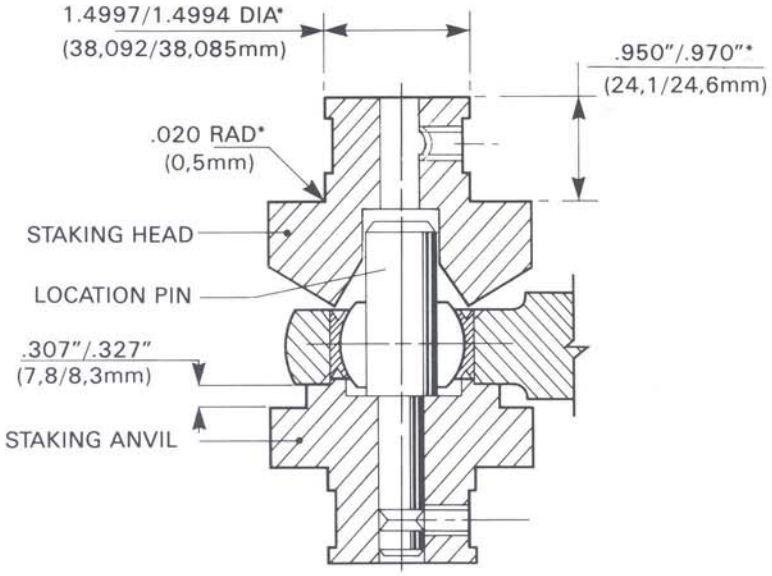
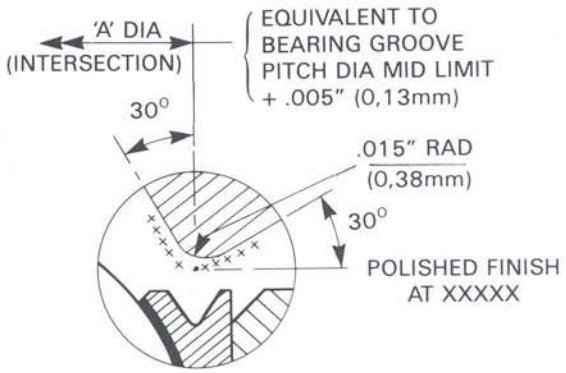


DIAGRAM A - TOOLING ARRANGEMENT
FIRST STAGE STAKE



ENLARGED VIEW OF
STAKING HEAD FEATURE

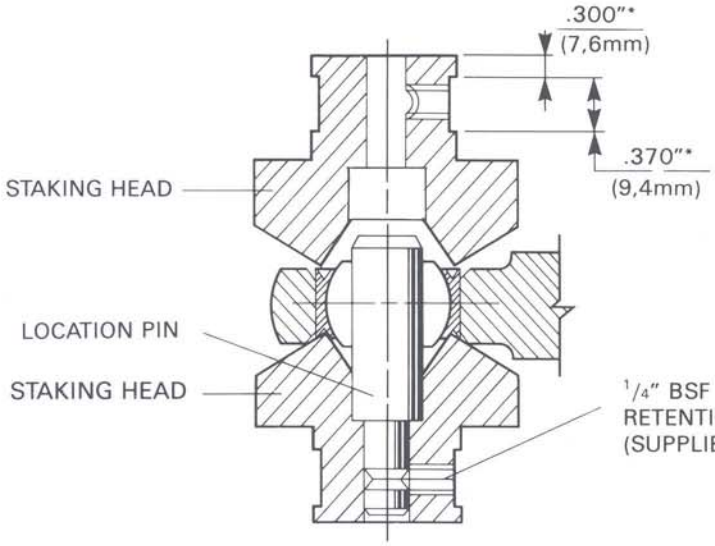
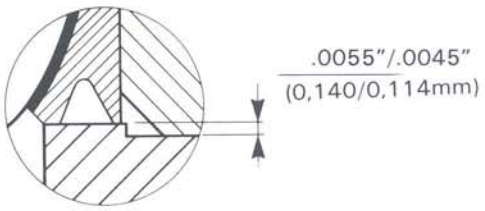


DIAGRAM B - TOOLING ARRANGEMENT
FINAL STAGE STAKE



ENLARGED VIEW OF
STAKING ANVIL FEATURE

NOTES

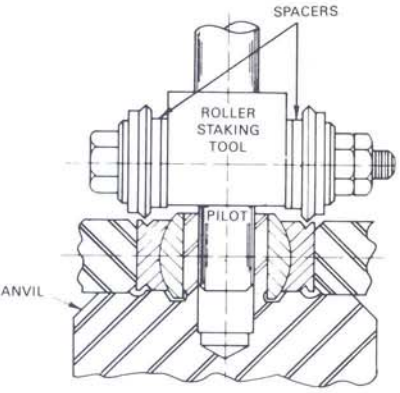
1. Dimensions shown above are Standard Features on AMPEP Staking Tool Sets.

2. Dimensions indicated * apply to both Staking Heads and Anvils and enables the use of a Common Die Set Tool Fitting Arrangement for Staking Tool Sets for the AMPEP Range of Catalogued Spherical Bearings.

3. Standard Staking Tool Set Numbers for Spherical Bearings are given in Sections 1.1.2 and 3.1.2 of this manual.

4. Further detail dimensions of Staking Tools are available on request, customers are advised to check tooling provides sufficient clearance with their housing.

1.0.8 BEARING INSTALLATION & RETENTION



1. PRESS BEARING INTO HOUSING AND LOCATE ON CENTRE.

2. WHILE SUPPORTING BEARING ON ANVIL, USE ROLLER STAKING TOOL TO STAKE OUTER RACE OVER HOUSING. REPEAT ON OPPOSITE SIDE.

DIAGRAM C

Fig. 13 gives approximate staking loads in respect of diameter for steel housings but loads can vary considerably depending on the housing material and rigidity. Light alloy housings call for greater care than higher strength steel and if critical dimensions are not observed it is possible to react staking loads through the housing material instead of the bearing lip and distort the former instead of increasing the installed bearing torque.

To check the retaining strength of the swaged lip the installed bearing can be axially proof-loaded to the levels indicated in Fig. 13 in the case of steel housings. Loads must be applied through the outer race of the bearing and *not* through the ball.

(k) Despite taking every reasonable precaution to control subassembly dimensions and the staking process, some installed bearings will inevitably be in excess of the required torque limit after installation. If these assemblies are heated between 120-150°C for periods between 20 minutes and 2 hours in an air circulating oven and allowed to cool and stabilise for 24 hours, a noticeable reduction in torque is frequently observed with all grades of Fiberslip.

This method of rectification will not harm the bearings and will impart an additional planish to the p.t.f.e. bearing surface, but care should be taken to ensure that the mechanical properties of the housings will also be unaffected by such treatment.

Roller Staking Process

An alternative method of lip swaging is depicted in Diagram C using a rotating rolling head in a vertical drill head. Precise details of roller pitch, contact angles and other critical features of the tooling are not known but the method is thought to lack the control which can be exercised with the 360° staking procedure previously described.

MINIMUM STAKING AND PUSHOUT LOADS

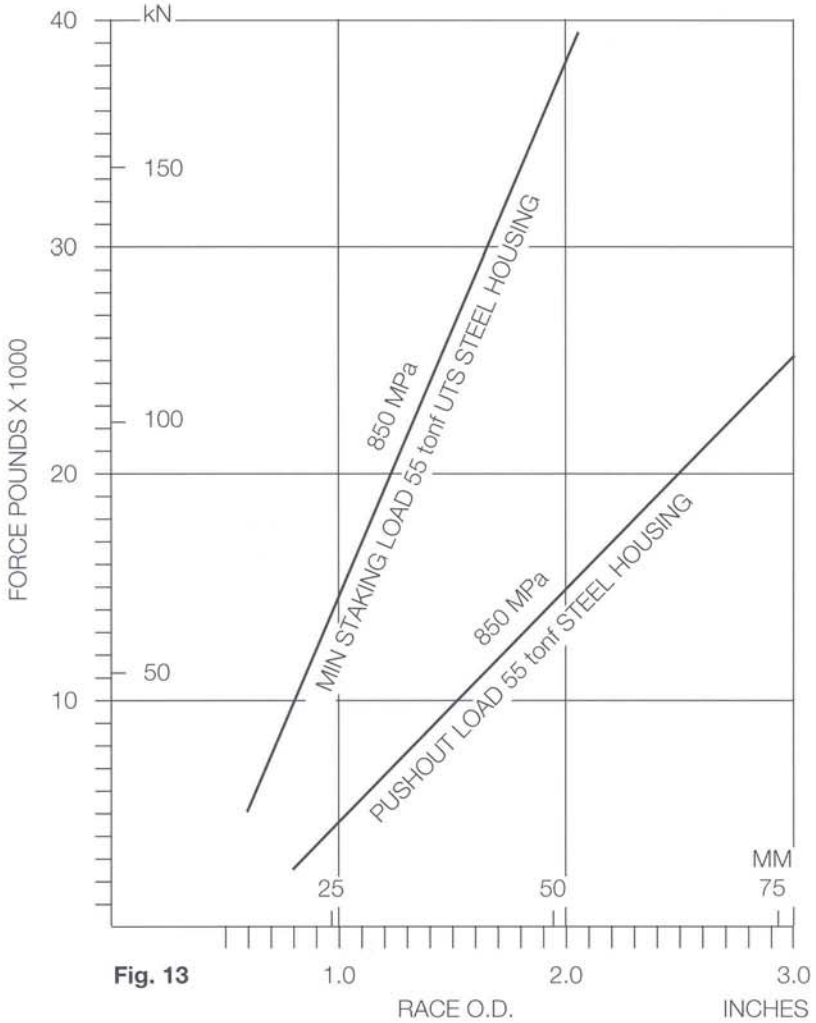


Fig. 13

1.0.8 BEARING INSTALLATION & RETENTION

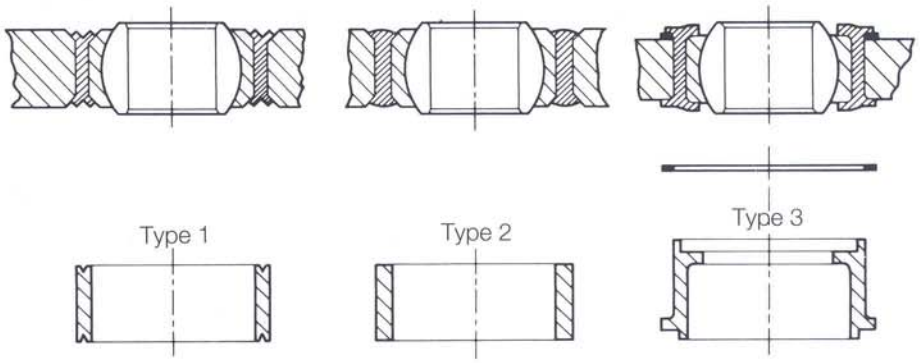
1.0.8/4 SPHERICAL BEARINGS - NORMAL AND LOW TORQUE - CHAMFERED OUTER RACE SERIES

For those designers who do not wish to assemble steel bearings directly into light alloy housings, even with jointing compounds, because of possible electro-chemical corrosion problems, the sacrificial sleeve technique may provide a solution. This technique may also be preferred on the grounds that it facilitates bearing removal from some of the more complex structures with less likelihood of damage to the area surrounding the housing.

The sacrificial sleeve concept is fairly widely practised and various configurations are shown below. Of these, the Grumman grooved type sleeve is preferred as in Type 1 due to the fact that tooling and installation techniques are extensions of those recommended for the installation of spherical bearings which are known to be effective and controllable. Type 2 is simpler but needs rolling simultaneously into chamfers on the bearing and housing and control is liable to be forfeited more readily than Type 1.

Type 3 is more expensive to produce and the practical problems of sizing bores to receive bearings are inhibiting. Furthermore, the acute angles to which the retaining lips need rolling over tends to produce cracking, making this sleeve the least desirable of those illustrated.

1.0.8/5 TYPES OF SACRIFICIAL SLEEVES



Sleeve materials can be produced in anodised aluminium or cadmium plated austenitic stainless steel. The method recommended using Type 1 sleeves is to specify dimensions and tooling related to those recommended for staking bearings in this manual, but design the outer diameter of the sacrificial sleeve to be an interference fit in the housing. The sleeve is then installed by shrink or press fitting with a suitable jointing compound followed by through-boring to our recommended size to fit the appropriate bearing. If a steel sleeve is used the bearing may then be inserted using the wet assembly process with jointing compound. If an aluminium sleeve is employed, some form of local anodising process should be used in conjunction with the jointing medium. In some cases wet epoxy primer has been demonstrated to provide adequate protection against electrolytic action.

Following the insertion of the bearing, the outer and inner lips of the V groove in the sleeve are staked over the housing and bearing respectively in that order. Although it may be feasible to stake both lips simultaneously with a single tool, some loss of control will almost certainly occur and separate tools for inner and outer lips are considered advisable.

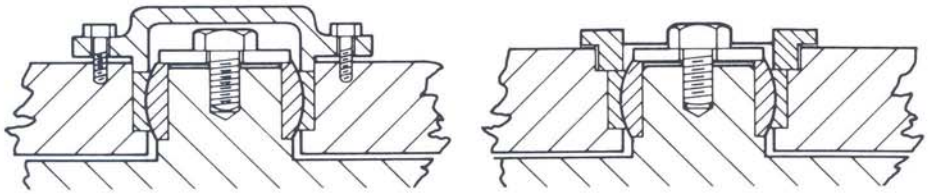
The general recommendations for cleanliness and care with regard to the possible ingress of jointing media into the bearings applies as previously discussed.

Alternatives for plain series sphericals

Where the spherical bearing is required to accept primary axial loads, the use of Grumman groove type mounting is not recommended as so much depends on the process and quality control functions to guarantee the effectiveness of the retaining lip on each individual bearing in its respective housing.

In these axial load cases it is advisable to fit the plain bearings into counterbored housings, as illustrated below, and secure the bearing by keeper plates or screwed end caps. The same housing and shaft sizes for normal light transition fits are employed as given in Section 1.1.2.

1.0.8/6 ALTERNATIVE CHAMFERED OUTER RACE SPHERICAL INSTALLATIONS



1.0.8 BEARING INSTALLATION & RETENTION

1.0.8/7 PRELOADED SPHERICAL BEARINGS

Where bearing stiffness is of particular importance, especially in power control circuits and structural joints consideration should be given to the use of preloaded spherical bearings. Originally interference fitted bearings were employed, but, due to the variation in interference fit resulting from the tolerances of housing bore and bearing outside diameter, considerable torque variations between assembled bearings were encountered.

AMPEP preloaded spherical bearings are specially constructed to provide increased stiffness and whilst there must be a corresponding torque increase, this is predetermined and maintained within reasonable limits. Generally the reduction in diameteral deflection of a preloaded bearing is of the order of 0,05 mm (.002in).
Naturally the mating housing and shaft tolerances must be maintained at a low level as must be the clearance between shaft and bearing bore and spherical bearing outside diameter and housing bore. Otherwise the advantages of a preloaded bearing will be lost. Since interference is not required, the assembly problems with these products are much less than with the interference fitted bearings. It is possible to retain preloaded spherical bearings using the staking method. For further details of these products refer to the AMPEP Engineering and Technical Department.

1.0.8/8 CLEARANCE FITTED SPHERICAL BEARINGS

This technique is usually employed where torque control and backlash are of primary importance. These conditions tend to prevail in low torque bearings for manual control systems and in certain special applications where bearings are supplied with high preloads and controlled stiffness values which must be preserved even after installation in their housings.
Retention is effected solely by an adhesive system which should be selected and tested to suit the user's requirement. Clearances of 0,05/0,10 mm (0.002in/0.004in) have been employed with Loctite grades and also an epoxy system ECCOBOND 104. No problems have been reported using steel housings but the elevated curing temperatures have been known to cause torque fluctuations with light alloy housings owing to the differences in thermal contraction of the dissimilar metals after the adhesive system has hardened. The latter problem is stated to have been overcome by use of a lower temperature curing adhesive system, namely Loctite 270 to DTD 900/6003.

1.0.8/9 ELECTRON BEAM WELD RETENTION OF SPHERICAL BEARINGS

A further method wherein the retention of the bearing is effected by electron beam welding a plain spherical into a steel sacrificial sleeve 360° ring staked into either steel or light alloy housings. The sacrificial sleeve is interference fitted as previously described and through-bored to give a clearance fit with a minimum design clearance of 0,005 mm (0.0002in). No jointing compound is used for fitting the bearing to avoid weld spatter, but the possibility of subsequent corrosion or fretting is obviated by ensuring that the vacuum created in the bearing/sleeve interspace for welding is maintained by the gas tight welded joint. Successful samples of this type have been produced.
This is a useful technique for the retention of low torque/controlled clearance bearings.

1.0.8/10 INSTALLATION AND RETENTION OF JOURNAL BEARINGS

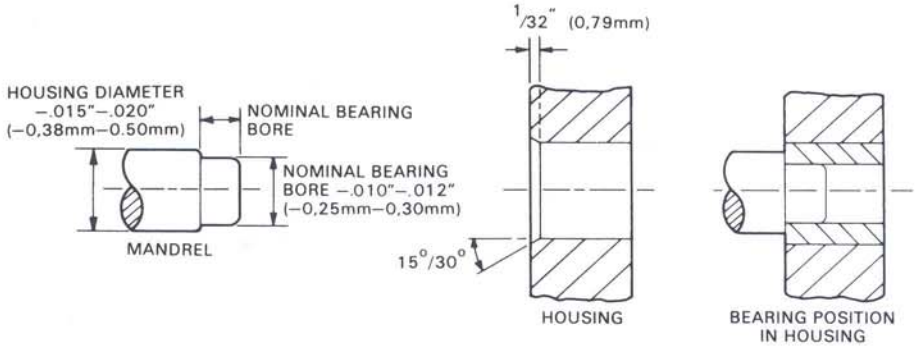
Journal bearings are normally interference fitted into their housings and the technique is illustrated below using a mandrel press with which production personnel are well acquainted. The table in Section 1.3.2 gives the recommended housing and shaft sizes for clearance and transition fits of shafts selected for particular applications.

Where the accumulation of tolerances results in an unacceptably high range of shaft clearance, the range can be reduced by adhesive bonding the bearings into clearance fit housings.

The table in Section 1.3.2 also includes these recommended housing sizes and two ranges of appropriate shafts to give clearance and transition fits but with reduced band widths.

1.0.8 BEARING INSTALLATION & RETENTION

1.0.8/11 JOURNAL BEARING INSTALLATION



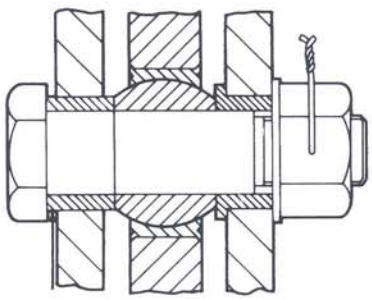
1.0.8/12 PIN AND SHAFT INSTALLATION

For spherical bearings, the recommended pin sizes are given in Section 1.1.2. These sizes give light transition fits with not more than 0,005 mm (.0002in) interference. For those designers wishing to reduce free play still further, it is known that interference fits of pin can be employed but care must be taken to ensure that "pick-up" does not occur between the ball bore and the pin on assembly. One major airframe constructor is reputed to be employing this procedure and avoiding problems by applying a proprietary grade of phosphate and MoS_2 coating to the pin prior to assembly. Potential users of this process must take care to ensure that force fitting end loads on the pins are reacted within the spherical inner race or ball of the bearing and never transmitted from the ball to the outer race and housing.

For journal bearings the shafts or pins can usually be assembled quite readily by hand but it is important to provide a polished radius or rounded lead-in chamfers to shafts to prevent damage to the bearings. The normally accepted 45° chamfers so widely used in engineering are not suitable for use with the Fiberslip type of bearing and need modifying to a much improved standard.

To locate spherical bearings centrally on their pins, most users employ some form of end clamping device on the end faces of the balls.

With journal bearings, the end float is taken on the thrust faces of flanged bearings mounted in fork ends or central lugs of the mechanisms.



1.0.8 BEARING INSTALLATION & RETENTION

1.0.8/13 BEARING REMOVAL

Journal bearings can be removed from housings by pressing out with the same mandrel design as recommended for their installation. The removal of spherical bearings retained by staking will be facilitated if one retaining lip is carefully machined away before attempting pressing out. Again, users are warned not to press on the end face of the balls as it is possible. in the case of high resistance to extraction, that the housing can be permanently deformed.

Housings must be thoroughly cleaned of hardened jointing compound and should be reverified dimensionally before the new bearing is installed.

1.0.8/14 DETECTING WORN BEARINGS

Civil and military operators overhaul and maintenance crews not familiar with this type of bearing may find the following comments of interest where the main aircraft contractors' instructions lack detail in respect of the AMPEP product.

During the initial wear phases a certain amount of brown dust or darker brown flakes may be seen around the exterior of the bearing. This is quite in order and should not give rise to concern provided no excess play can be detected at the hinge or joint.

However, should this debris be in the form of fine curling tendrils, this generally indicates a fairly high wear rate and a more rigorous and critical inspection is called for.

Similarly, in certain applications previously discussed in this manual, backlash can be generated due to a structural collapse of the bearing material. This manifests itself by a progressive extrusion of the bearing liner, usually on the loaded side of an actuator end bearing in the extension mode. The liner is dark brown in colour and provided the backlash is acceptable slight extrusion up to 0,50 mm (0.020in) over an arc of 90° is worthy of note but not necessarily further action. Should this extruded portion be greater than 1,5 mm (.060in) then the bearing assembly should be disassembled to permit closer inspection of the bearing surface and careful removal of any p.t.f.e. debris on the bearing surface and pin followed by a further backlash check before deciding whether replacement is necessary.

Advanced cases of the structural collapse problem are denoted by fairly extensive extrusion together with chips of lining material breaking away from the edge. In such cases the bearings should be changed immediately, irrespective of detectable backlash.

Methods of checking backlash from the main aircraft contractors' viewpoint vary from application to application and some sophisticated methods have been proposed in critical cases. However, when getting down to the grass roots maintenance, one suspects that the time honoured method of "giving the assembly a hefty push-pull and see what moves" will probably be the criterion on which most decisions will be made in the field. While this method is admittedly crude, if used in conjunction with the observations previously discussed, it will most probably be proved adequate in the majority of cases in the long term.

1.0.8/15 REPLACEMENT OF BEARINGS

Most bearings can probably be replaced by maintenance staff, using the main contractors' instructions in conjunction with the advice given in this manual. The replacement of ring-staked spherical bearings is obviously much more difficult in view of the specialist tooling and expertise required. Should further advice or practical demonstrations of technique be required, this will be freely given on application to AMPEP Technical Department.

IMPORTANT
Maintenance crews are warned not to attempt modifications to this type of bearing, either metal details or liners, in view of the finely balanced technical excellence of the product. Any such attempt could easily result in a serious mishap. In a crisis situation, AMPEP can make available every service to assist users with their problems.

SELF-LUBRICATING BEARINGS

SECTION 1.1

SPHERICAL BEARINGS

INDEX

ampep

AMPEP DATA SHEET

1.1.0/INDEX b

ISSUE - 9305

SPHERICAL BEARINGS - SELF LUBRICATING NARROW - GROOVED OUTER RACE NORMAL TORQUE

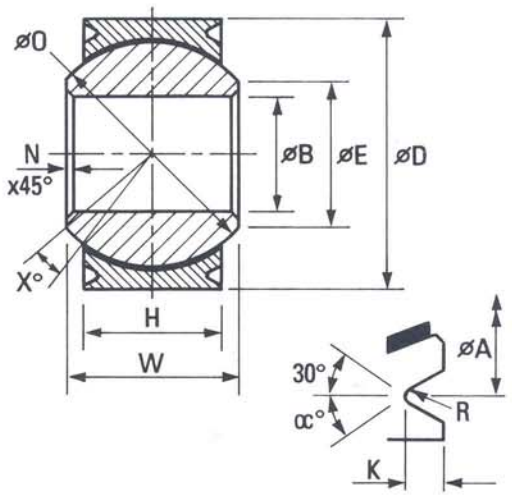
11BNG --
INCH SERIES

MATERIALS

***Liner* - AMPEP X1**
Liner System Qualified to MIL-B-81820

Outer Race
Corrosion resistant steel to AMS 5643 (H1100 Condition)

Ball
Corrosion resistant steel to AISI440C through hardened to 55/62 HRC



N = .005/.015

STANDARDS REFERENCES

MS 14101 / ASN A2121

Refer to Following Section 5.0 for Part No. Cross Reference.

GROOVE FEATURES			
Bearing size code	K	R	α
	Groove Depth	Rad	Angle
	+.000 −.010	Min / Max	–
	in		Degrees
03 & 04	.025	.005 .010	20° Min
051	.035	.005 .010	20° Min
05 to 07	.035	.010 .017	30°
08 to 16	.055	.010 .017	30°
20 to 32	.060	.010 .020	30°

DIMENSIONS, TOLERANCES, LOADS

Part Number		B	W	D	H	A	X°	O	E	No load breakout torque	Radial Proj Area	Axial Proj Area	Static Radial Limit Load	Static Axial Limit Load	Distance Travelled per Degree	Approx Mass
		Bore Dia	Ball Width	Race O/Dia	Race Width	Groove Pitch Dia		Ball Dia	Ball Face							
11 BNG - -		+.0000 -.0005	+.000 -.002	+.0000 -.0005	+.000 -.010	+.000 -.008	Min	Ref	Min	Min/Max						
Code	Size	in						in		lbf.in	in^2		lbf		ft	lb
03	3/16	.1900	.281	.5625	.223	.500	10	.437	.293	0.25 5.0	.071	.016	4 970	560	.00031	.02
04	1/4	.2500	.343	.6562	.255	.594	10°	.500	.364	0.25 5.0	.098	.025	6 860	875	.00036	.02
05	5/16	.3125	.375	.7500	.286	.650	10°	.593	.419	0.25 5.0	.135	.033	9 450	1 155	.00043	.03
051	5/16	.3125	.375	.7500	.286	.660	10°	.593	.419	0.25 5.0	.135	.033	9 450	1 155	.00043	.03
06	3/8	.3750	.406	.8125	.317	.712	9°	.625	.475	0.25 5.0	.162	.046	11 340	1 610	.00045	.04
07	7/16	.4375	.437	.9062	.348	.806	8°	.687	.530	0.50 8.0	.199	.060	13 930	2 100	.00050	.05
08	1/2	.5000	.500	1.0000	.395	.876	8°	.781	.600	0.50 8.0	.272	.090	19 040	3 150	.00057	.07
09	9/16	.5625	.562	1.0937	.442	.970	8°	.875	.670	0.50 8.0	.346	.116	24 220	4 060	.00063	.09
10	5/8	.6250	.625	1.1875	.505	1.063	8°	1.000	.739	1.0 8.0	.459	.158	32 130	5 530	.00072	.12
12	3/4	.7500	.750	1.4375	.598	1.313	8°	1.250	.920	1.0 8.0	.690	.230	48 300	8 050	.00091	.21
14	7/8	.8750	.875	1.5625	.708	1.438	8°	1.375	.980	1.0 8.0	.850	.263	59 500	9 205	.00100	.27
16	1	1.0000	1.000	1.7500	.802	1.626	9°	1.562	1.118	1.0 8.0	1.112	.356	77 840	12 460	.00113	.39
20	1 1/4	1.2500	1.093	2.0000	.947	1.876	6°	1.812	1.445	2.0 20.0	1.553	.533	108 710	18 655	.00132	.53
24	1 1/2	1.5000	1.312	2.4375	1.135	2.313	6°	2.250	1.827	2.0 20.0	2.351	.800	164 570	28 000	.00163	.96
28	1 3/4	1.7500	1.531	2.8125	1.322	2.689	6°	2.625	2.14	10.0 35.0	3.234	1.125	226 380	39 375	.00191	1.48
32	2	2.0000	1.750	3.1875	1.510	3.064	6°	3.000	2.44	10.0 35.0	4.260	1.483	298 200	51 905	.00218	2.10

△1 △1

NOTES

△1 Static loads are based on 2/3 of 0.1% Proof Stress of Outer Race material. If 0.2% Proof Stress is used load ratings will be greater by approx 10%. Radial and Axial limit loads are based on stress levels of 70 000 lbf/in² and 35 000 lbf/in² respectively

△2 For Zinc Nickel Plated Outer Race version dimensions shown also apply after Plating

BEARING INSTALLATION

Refer to following section 1.1.2 for recommended Housing and Shaft dimensions and Staking Tools

PART NUMBERS AND SERIES VERSIONS

Series Part Number Codification

Basic Series Part Number — 11 B N G 06 .
Spherical — B
Specification Ident — N
Narrow — G
Grooved Outer Race — 06
Ball bore dia code in multiples of 1/16 inch — .

△2 **Series Versions - Suffix Identification**

Zinc Nickel Plated Outer Race — J
Low Volatiles (Space Prep) — V
.005 o/size Outer Race dia — Y1
.010 o/size Outer Race dia — Y2

SPECIAL TYPES

Bearings based on the above specification with non–standard features may be supplied on request

ampep

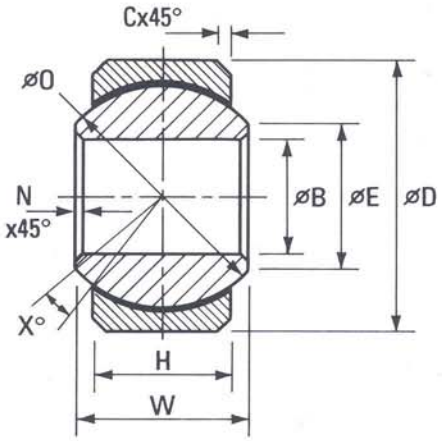
11BNZ -- INCH SERIES

SPHERICAL BEARINGS - SELF LUBRICATING NARROW - CHAMFERED OUTER RACE NORMAL TORQUE

STANDARDS REFERENCES

MS 14104 / ASN A2124

Refer to Following Section 5.0 for Part No. Cross Reference.



MATERIALS

***Liner* - AMPEP X1**
Liner System Qualified to MIL-B-81820

Outer Race
Corrosion resistant steel to AMS 5643 (H1100 Condition)

Ball
Corrosion resistant steel to AISI440C through hardened to 55/62 HRC

DIMENSIONS, TOLERANCES, LOADS

N = .005/.015

Part Number 11 BNZ - -		B Bore Dia + .0000 - .0005	W Ball Width + .000 - .002	D Race O/Dia + .0000 - .0005	H Race Width + .000 - .010	C Race Chamf + .000 - .010	X° Min	O Ball Dia Ref	E Ball Face Min	No load breakout torque Min/Max	Radial Proj Area	Axial Proj Area	Static Radial Limit Load	Static Axial Limit Load	Distance Travelled per Degree	Approx Mass
Code	Size	in						in		lbf.in	in²		lbf		ft	lb
03	3/16	.1900	.281	.5625	.223	.020	10	.437	.293	0.25 5.0	.071	.016	4 970	560	.00031	.02
04	1/4	.2500	.343	.6562	.255	.020	10°	.500	.364	0.25 5.0	.098	.025	6 860	875	.00036	.02
05	5/16	.3125	.375	.7500	.286	.020	10°	.593	.419	0.25 5.0	.135	.033	9 450	1 155	.00043	.03
06	3/8	.3750	.406	.8125	.317	.030	9°	.625	.475	0.25 5.0	.162	.046	11 340	1 610	.00045	.04
07	7/16	.4375	.437	.9062	.348	.030	8°	.687	.530	0.50 8.0	.199	.060	13 930	2 100	.00050	.05
08	1/2	.5000	.500	1.0000	.395	.030	8°	.781	.600	0.50 8.0	.272	.090	19 040	3 150	.00057	.07
09	9/16	.5625	.562	1.0937	.442	.030	8°	.875	.670	0.50 8.0	.346	.116	24 220	4 060	.00063	.09
10	5/8	.6250	.625	1.1875	.505	.030	8°	1.000	.739	1.0 8.0	.459	.158	32 130	5 530	.00072	.12
12	3/4	.7500	.750	1.4375	.598	.040	8°	1.250	.920	1.0 8.0	.690	.230	48 300	8 050	.00091	.21
14	7/8	.8750	.875	1.5625	.708	.040	8°	1.375	.980	1.0 8.0	.850	.263	59 500	9 205	.00100	.27
16	1	1.0000	1.000	1.7500	.802	.040	9°	1.562	1.118	1.0 8.0	1.112	.356	77 840	12 460	.00113	.39
20	1 1/4	1.2500	1.093	2.0000	.947	.040	6°	1.812	1.445	2.0 20.0	1.553	.533	108 710	18 655	.00132	.53
24	1 1/2	1.5000	1.312	2.4375	1.135	.040	6°	2.250	1.827	2.0 20.0	2.351	.800	164 570	28 000	.00163	.96
28	1 3/4	1.7500	1.531	2.8125	1.322	.040	6°	2.625	2.14	10.0 35.0	3.234	1.125	226 380	39 375	.00191	1.48
32	2	2.0000	1.750	3.1875	1.510	.040	6°	3.000	2.44	10.0 35.0	4.260	1.483	298 200	51 905	.00218	2.10

△1 △1

PART NUMBERS AND SERIES VERSIONS

Series Part Number Codification

Basic Series Part Number — 11 B N Z 06 .
Spherical — 11
Specification Ident — B
Narrow — N
Chamfered Outer Race — Z
Ball bore dia code in multiples of 1/16 inch — 06

△2 **Series Versions - Suffix Identification**

Zinc Nickel Plated Outer Race — J
Low Volatiles (Space Prep) — V
.005 o/size Outer Race dia — Y1
.010 o/size Outer Race dia — Y2

SPECIAL TYPES

Bearings based on the above specification with non–standard features may be supplied on request

NOTES

△1 Static loads are based on 2/3 of 0.1% Proof Stress of Outer Race material. If 0.2% Proof Stress is used load ratings will be greater by approx 10%. Radial and Axial limit loads are based on stress levels of 70 000 lbf/in² and 35 000 lbf/in² respectively

△2 For Zinc Nickel Plated Outer Race version dimensions shown also apply after Plating

BEARING INSTALLATION

Refer to following section 1.1.2 for recommended Housing and Shaft dimensions

SPHERICAL BEARINGS - SELF LUBRICATING WIDE - GROOVED OUTER RACE NORMAL TORQUE

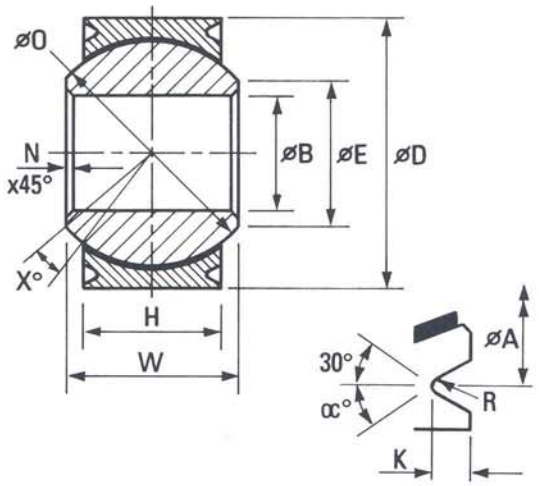
11BWG --
INCH SERIES

MATERIALS

***Liner* - AMPEP X1**
Liner System Qualified to MIL-B-81820

Outer Race
Corrosion resistant steel to AMS 5643 (H1100 Condition)

Ball
Corrosion resistant steel to AISI440C through hardened to 55/62 HRC



N = .005/.015

STANDARDS REFERENCES

MS 14103 / ASN A2123

Refer to Following Section 5.0 for Part No. Cross Reference.

GROOVE FEATURES			
Bearing size code	K	R	α
	Groove Depth	Rad	Angle
	+.000 −.010	Min / Max	–
	in		Degrees
03 & 04	.025	.005 .012	20° Min
05	.025	.005 .012	30°
06 to 10	.035	.010 .017	30°
12 to 16	.055	.010 .017	30°
20 to 32	.060	.010 .020	30°

DIMENSIONS, TOLERANCES, LOADS

Part Number 11 BWG - -		B Bore Dia +.0000 -.0005	W Ball Width +.000 -.002	D Race O/Dia +.0000 -.0005	H Race Width +.000 -.010	A Groove Pitch Dia +.000 -.008	X° Min	O Ball Dia Ref	E Ball Face Min	No load breakout torque Min/Max	Radial Proj Area	Axial Proj Area	Static Radial Limit Load	Static Axial Limit Load	Distance Travelled per Degree	Approx Mass
Code	Size	in						in		lbf.in	in^2		lbf		ft	lb
03	3/16	.1900	.437	.6250	.332	.563	15°	.531	.300	0.25 5.0	.145	.056	10 150	1 960	.00038	.031
04	1/4	.2500	.437	.6250	.332	.563	15°	.531	.300	0.25 5.0	.145	.056	10 150	1 960	.00038	.031
05	5/16	.3125	.437	.6875	.322	.625	14°	.593	.360	0.25 5.0	.156	.050	10 920	1 750	.00043	.035
06	3/8	.3750	.500	.8125	.411	.712	8°	.687	.466	0.25 5.0	.243	.093	17 010	3 255	.00050	.060
07	7/16	.4375	.562	.9375	.447	.837	10°	.781	.537	0.50 8.0	.304	.113	21 280	3 955	.00056	.080
071	7/16	.4375	.562	.9062	.447	.806	10°	.781	.537	.050 8.0	.304	.113	21 280	3 955	.00056	.080
08	1/2	.5000	.625	1.0000	.510	.900	9°	.875	.607	0.50 8.0	.406	.166	28 420	5 810	.00063	.100
09	9/16	.5625	.687	1.1250	.541	1.025	10°	1.000	.721	0.50 8.0	.495	.186	34 650	6 510	.00072	.135
10	5/8	.6250	.750	1.1875	.572	1.087	12°	1.062	.747	1.0 8.0	.558	.210	39 060	7 350	.00077	.160
12	3/4	.7500	.875	1.3750	.635	1.251	13°	1.250	.845	1.0 8.0	.681	.200	47 670	7 000	.00091	.240
14	7/8	.8750	.875	1.6250	.760	1.501	6°	1.375	.995	1.0 8.0	.921	.320	64 470	11 200	.00100	.350
16	1	1.0000	1.375	2.1250	1.010	2.001	12°	1.937	1.269	2.0 12.0	1.782	.616	124 740	21 560	.00140	.970
20	1 1/4	1.2500	1.500	2.3750	1.135	2.251	12°	2.156	1.548	2.0 20.0	2.253	.805	157 710	28 175	.00156	1.100
24	1 1/2	1.5000	1.687	2.6875	1.228	2.563	12°	2.437	1.758	2.0 20.0	2.772	.953	194 040	33 355	.00177	1.450
28	1 3/4	1.7500	1.812	3.0000	1.322	2.876	12°	2.750	2.06	10.0 35.0	3.388	1.116	237 160	39 060	.00199	1.85
32	2	2.0000	1.937	3.2500	1.385	3.126	12°	3.000	2.20	10.0 35.0	3.885	1.233	271 950	43 155	.00218	2.15

△ 1 △ 1

NOTES

△ Static loads are based on 2/3 of 0.1% Proof Stress of Outer Race material. If 0.2% Proof Stress is used load ratings will be greater by approx 10%. Radial and Axial limit loads are based on stress levels of 70 000 lbf/in² and 35 000 lbf/in² respectively

△ For Zinc Nickel Plated Outer Race version dimensions shown also apply after Plating

BEARING INSTALLATION

Refer to following section 1.1.2 for recommended Housing and Shaft dimensions and Staking Tools

PART NUMBERS AND SERIES VERSIONS

Series Part Number Codification

Basic Series Part Number — 11 B W G 06 .
Spherical
Specification Ident
Wide
Grooved Outer Race
Ball bore dia code in multiples of 1/16 inch

△ **Series Versions - Suffix Identification**

Zinc Nickel Plated Outer Race — J
Low Volatiles (Space Prep) — V
.005 o/size Outer Race dia — Y1
.010 o/size Outer Race dia — Y2

SPECIAL TYPES

Bearings based on the above specification with non–standard features may be supplied on request

ampep

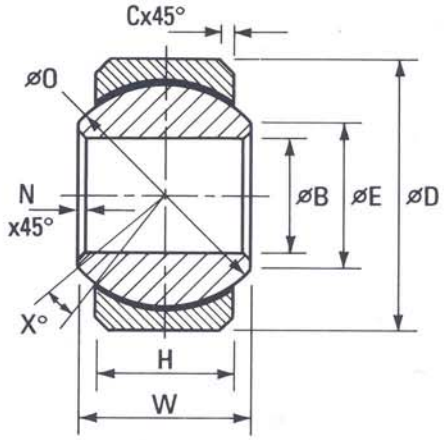
11BWZ --
INCH SERIES

SPHERICAL BEARINGS - SELF LUBRICATING WIDE - CHAMFERED OUTER RACE NORMAL TORQUE

STANDARDS REFERENCES

MS 14102 / ASN A2122

Refer to Following Section 5.0 for Part No. Cross Reference.



MATERIALS

***Liner* - AMPEP X1**
Liner System Qualified to MIL-B-81820

Outer Race
Corrosion resistant steel to AMS 5643 (H1100 Condition)

Ball
Corrosion resistant steel to AISI440C through hardened to 55/62 HRC

DIMENSIONS, TOLERANCES, LOADS

N = .005/.015

Part Number 11 BWZ - -		B Bore Dia + .0000 - .0005	W Ball Width + .000 - .002	D Race O/Dia + .0000 - .0005	H Race Width + .000 - .010	C Race Chamf + .000 - .010	X°	O Ball Dia Ref	E Ball Face Min	No load breakout torque Min/Max	Radial Proj Area	Axial Proj Area	Static Radial Limit Load	Static Axial Limit Load	Distance Travelled per Degree	Approx Mass
Code	Size	in						in		lbf.in	in²		lbf		ft	lb
03	3/16	.1900	.437	.6250	.332	.020	15°	.531	.300	0.25 5.0	.145	.056	10 150	1 960	.00038	.031
04	1/4	.2500	.437	.6250	.332	.020	15°	.531	.300	0.25 5.0	.145	.056	10 150	1 960	.00038	.031
05	5/16	.3125	.437	.6875	.322	.020	14°	.593	.360	0.25 5.0	.156	.050	10 920	1 750	.00043	.035
06	3/8	.3750	.500	.8125	.411	.030	8°	.687	.466	0.25 5.0	.243	.093	17 010	3 255	.00050	.060
07	7/16	.4375	.562	.9375	.447	.030	10°	.781	.537	0.50 8.0	.304	.113	21 280	3 955	.00056	.080
08	1/2	.5000	.625	1.0000	.510	.030	9°	.875	.607	0.50 8.0	.406	.166	28 420	5 810	.00063	.100
09	9/16	.5625	.687	1.1250	.541	.030	10°	1.000	.721	0.50 8.0	.495	.186	34 650	6 510	.00072	.135
10	5/8	.6250	.750	1.1875	.572	.030	12°	1.062	.747	1.0 8.0	.558	.210	39 060	7 350	.00077	.160
12	3/4	.7500	.875	1.3750	.635	.040	13°	1.250	.845	1.0 8.0	.681	.200	47 670	7 000	.00091	.240
14	7/8	.8750	.875	1.6250	.760	.040	6°	1.375	.995	1.0 8.0	.921	.320	64 470	11 200	.00100	.350
16	1	1.0000	1.375	2.1250	1.010	.040	12°	1.937	1.269	2.0 12.0	1.782	.616	124 740	21 560	.00140	.970
20	1 1/4	1.2500	1.500	2.3750	1.135	.050	12°	2.156	1.548	2.0 20.0	2.253	.805	157 710	28 175	.00156	1.100
24	1 1/2	1.5000	1.687	2.6875	1.228	.050	12°	2.437	1.758	2.0 20.0	2.772	.953	194 040	33 355	.00177	1.450
28	1 3/4	1.7500	1.812	3.0000	1.322	.050	12°	2.750	2.06	10.0 35.0	3.388	1.116	237 160	39 060	.00199	1.85
32	2	2.0000	1.937	3.2500	1.385	.050	12°	3.000	2.20	10.0 35.0	3.885	1.233	271 950	43 155	.00218	2.15

△1 △1

PART NUMBERS AND SERIES VERSIONS

Series Part Number Codification

Basic Series Part Number — 11 B W Z 06 .
Spherical — 11
Specification Ident — B
Wide — W
Chamfered Outer Race — Z
Ball bore dia code in multiples of 1/16 inch — 06

△2 **Series Versions - Suffix Identification**

Zinc Nickel Plated Outer Race — J
Low Volatiles (Space Prep) — V
.005 o/size Outer Race dia — Y1
.010 o/size Outer Race dia — Y2

SPECIAL TYPES

Bearings based on the above specification with non–standard features may be supplied on request

NOTES

△1 Static loads are based on 2/3 of 0.1% Proof Stress of Outer Race material. If 0.2% Proof Stress is used load ratings will be greater by approx 10%. Radial and Axial limit loads are based on stress levels of 70 000 lbf/in² and 35 000 lbf/in² respectively

△2 For Zinc Nickel Plated Outer Race version dimensions shown also apply after Plating

BEARING INSTALLATION

Refer to following section 1.1.2 for recommended Housing and Shaft dimensions

SPHERICAL BEARINGS - SELF LUBRICATING HIGH MISALIGNMENT - GROOVED OUTER RACE NORMAL TORQUE

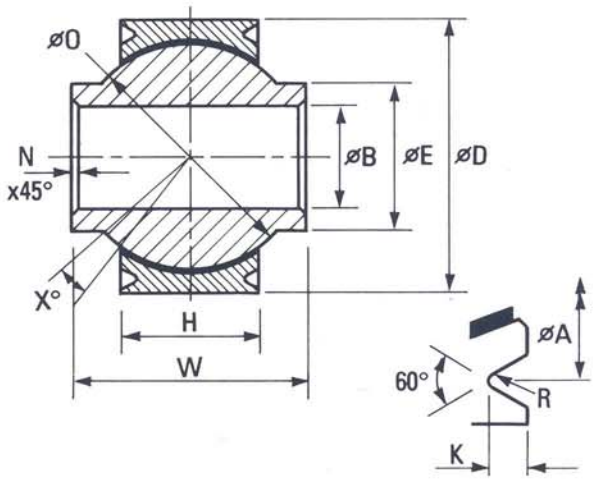
11BHG --
INCH SERIES

MATERIALS

***Liner* - AMPEP X1**
Liner system qualified to MIL-B-81820

Outer Race
Corrosion resistant steel to AMS 5643 (H1100 Condition)

Ball
Corrosion resistant steel to AISI440C through hardened to 55/62 HRC



N = .005/.015

STANDARDS REFERENCES

Refer to Following Section 5.0 for Part No. Cross Reference.

GROOVE FEATURES		
Bearing size code	K	R
	Groove Depth	Rad
	+.000 −.015	+.000 -.010
	in	
03 & 04	.030	.015
05 to 08	.040	.020
10 to 24	.060	.020
031 & 051	.030	.015

DIMENSIONS, TOLERANCES, LOADS

Part Number 11 BHG --		B Bore Dia +.0000 -.0005	W Ball Width +.000 -.002	D Race O/Dia +.0000 -.0005	H Race Width +.000 -.010	A Groove Pitch Dia +.000 -.010	X° Min	O Ball Dia Ref	E Ball Face Min	No load breakout torque Min/Max	Radial Proj Area	Axial Proj Area	Static Radial Limit Load	Static Axial Limit Load	Distance Travelled per Degree	Approx Mass
Code	Size	in						in		lbf.in	in^2		lbf		ft	lb
03	3/16	.1900	.500	.5625	.215	.502	15°	.437	.312	0.25 5.0	.071	.009	4 970	315	.00031	.02
031	3/16	.1900	.560	.6250	.332	.560	15°	.531	.280	0.25 5.0	.150	.051	10 500	1 785	.00038	.03
04	1/4	.2500	.593	.7400	.260	.675	24°	.593	.350	0.25 5.0	.116	.020	8 120	700	.00043	.04
05	5/16	.3125	.813	.9060	.350	.811	22°	.781	.480	0.25 5.0	.233	.053	16 310	1 855	.00056	.07
051	5/16	.3125	.625	.6875	.245	.637	20°	.593	.420	0.25 5.0	.113	.015	7 910	525	.00043	.025
06	3/8	.3750	.813	.9060	.350	.811	22°	.781	.480	0.25 5.0	.233	.053	16 310	1 855	.00056	.07
07	7/16	.4375	.875	1.0000	.350	.905	22°	.875	.570	0.50 8.0	.250	.056	17 500	1 960	.00063	.10
08	1/2	.5000	.937	1.1250	.406	1.030	20°	1.000	.680	0.50 8.0	.333	.083	23 310	2 905	.00072	.16
10	5/8	.6250	1.200	1.3750	.572	1.255	20°	1.250	.810	1.0 8.0	.616	.180	43 120	6 600	.00091	.25
12	3/4	.7500	1.280	1.5625	.625	1.442	19°	1.375	.920	1.0 8.0	.758	.220	53 060	7 700	.00100	.32
14	7/8	.8750	1.400	1.7500	.630	1.630	19°	1.531	1.080	1.0 8.0	.833	.220	58 310	7 700	.00111	.43
16	1	1.0000	1.875	2.1250	.840	2.005	21°	1.875	1.220	2.0 12.0	1.416	.440	99 120	15 400	.00136	.81
20	1 1/4	1.2500	1.875	2.5000	1.010	2.380	21°	2.250	1.500	2.0 20.0	2.066	.660	144 620	23 100	.00163	1.11
24	1 1/2	1.5000	2.250	3.0000	1.180	2.880	21°	2.672	1.802	2.0 20.0	3.019	.798	211 330	27 930	.00194	2.22

△1 △1

NOTES

△1 Static loads are based on 2/3 of 0.1% Proof Stress of Outer Race material. If 0.2% Proof Stress is used load ratings will be greater by approx 10%. Radial and Axial limit loads are based on stress levels of 70 000 lbf/in² and 35 000 lbf/in² respectively

△2 For Cadmium Plated Outer Race version dimensions shown also apply after Plating

BEARING INSTALLATION

Refer to following section 1.1.2 for recommended Housing and Shaft dimensions and Staking Tools

PART NUMBERS AND SERIES VERSIONS

Series Part Number Codification

Basic Series Part Number — 11 B H G 03 .
Spherical
Specification Ident
High Misalignment
Grooved Outer Race
Ball bore dia code in multiples of 1/16 inch

△2 **Series Versions - Suffix Identification**

Cadmium Plated Outer Race — C
Low Volatiles (Space Prep) — V
.005 o/size Outer Race dia — Y1
.010 o/size Outer Race dia — Y2

SPECIAL TYPES

Bearings based on the above specification with non–standard features may be supplied on request

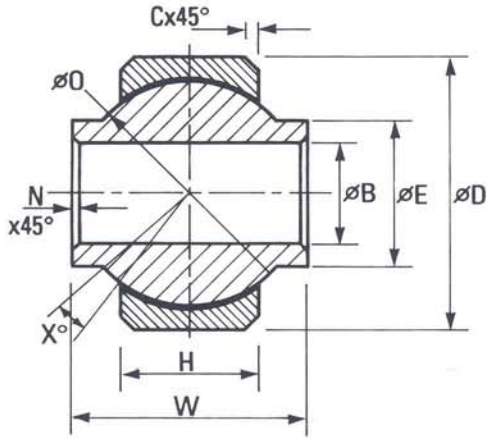
ampep

11BHZ-- INCH SERIES

SPHERICAL BEARINGS - SELF LUBRICATING HIGH MISALIGNMENT - CHAMFERED OUTER RACE NORMAL TORQUE

STANDARDS REFERENCES

Refer to Following Section 5.0 for Part No. Cross Reference.



MATERIALS

***Liner* - AMPEP X1**
Liner system qualified to MIL-B-81820

Outer Race
Corrosion resistant steel to AMS 5643 (H1100 Condition)

Ball
Corrosion resistant steel to AISI440C through hardened to 55/62 HRC

DIMENSIONS, TOLERANCES, LOADS

N = .005/.015
C = .025/.035

Part Number 11BHZ--		B Bore Dia + .0000 - .0005	W Ball Width + .000 - .002	D Race O/Dia + .0000 - .0005	H Race Width + .000 - .010	X°	O Ball Dia Ref	E Ball Face Ref	No load breakout torque Min/Max	Radial Proj Area	Axial Proj Area	Static Radial Limit Load	Static Axial Limit Load	Distance Travelled per Degree	Approx Mass
Code	Size	in					in		lbf.in	in²		lbf		ft	lb
03	3/16	.1900	.500	.5625	.215	15°	.437	.312	0.25 5.0	.071	.009	4 970	315	.00031	.02
031	3/16	.1900	.560	.6250	.332	15°	.531	.280	0.25 5.0	.150	.051	10 500	1 785	.00038	.03
04	1/4	.2500	.593	.7400	.260	24°	.593	.350	0.25 5.0	.116	.020	8 120	700	.00043	.04
05	5/16	.3125	.813	.9060	.350	22°	.781	.480	0.25 5.0	.233	.053	16 310	1 855	.00056	.07
051	5/16	.3125	.625	.6875	.245	20°	.593	.420	0.25 5.0	.113	.015	7 910	525	.00043	.025
06	3/8	.3750	.813	.9060	.350	22°	.781	.480	0.25 5.0	.233	.053	16 310	1 855	.00056	.07
07	7/16	.4375	.875	1.0000	.350	22°	.875	.570	0.50 8.0	.250	.056	17 500	1 960	.00063	.10
08	1/2	.5000	.937	1.1250	.406	20°	1.000	.680	0.50 8.0	.333	.083	23 310	2 905	.00072	.16
10	5/8	.6250	1.200	1.3750	.572	20°	1.250	.810	1.0 8.0	.616	.180	43 120	6 600	.00091	.25
12	3/4	.7500	1.280	1.5625	.625	19°	1.375	.920	1.0 8.0	.758	.220	53 060	7 700	.00100	.32
14	7/8	.8750	1.400	1.7500	.630	19°	1.531	1.080	1.0 8.0	.833	.220	58 310	7 700	.00111	.43
16	1	1.0000	1.875	2.1250	.840	21°	1.875	1.220	2.0 12.0	1.416	.440	99 120	15 400	.00136	.81
20	1 1/4	1.2500	1.875	2.5000	1.010	21°	2.250	1.500	2.0 20.0	2.066	.660	144 620	23 100	.00163	1.11
24	1 1/2	1.5000	2.250	3.0000	1.180	21°	2.672	1.802	2.0 20.0	3.019	.798	211 330	27 930	.00194	2.22
												⚠1	⚠1		

PART NUMBERS AND SERIES VERSIONS

Series Part Number Codification

Basic Series Part Number — 11 B H Z 03 .
Spherical — 11
Specification Ident — B
High Misalignment — H
Chamfered Outer Race — Z
Ball bore dia code in multiples of 1/16 inch — 03

⚠2 **Series Versions - Suffix Identification**

Cadmium Plated Outer Race — C
Low Volatiles (Space Prep) — V
.005 o/size Outer Race dia — Y1
.010 o/size Outer Race dia — Y2

SPECIAL TYPES

Bearings based on the above specification with non–standard features may be supplied on request

NOTES

⚠1 Static loads are based on 2/3 of 0.1% Proof Stress of Outer Race material. If 0.2% Proof Stress is used load ratings will be greater by approx 10%. Radial and Axial limit loads are based on stress levels of 70000 lbf/in² and 35000 lbf/in² respectively

⚠2 For Cadmium Plated Outer Race version dimensions shown also apply after Plating

⚠3 Dimensionally identical to SH--Z series

BEARING INSTALLATION

Refer to following section 1.1.2 for recommended Housing and Shaft dimensions

SPHERICAL BEARINGS - SELF LUBRICATING NARROW - GROOVED OUTER RACE NORMAL TORQUE

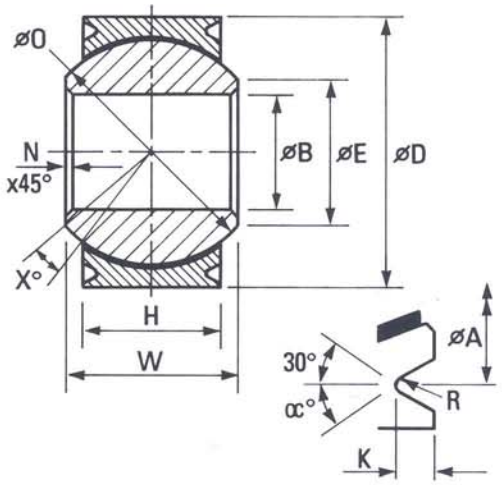
11HNG --
INCH SERIES

MATERIALS

Liner /Counterface
AMPEP XL System exceeds MIL-B-81820 Performance requirements.

Outer Race
Corrosion resistant steel to AMS 5643 (H1100 Condition)

Ball
Corrosion resistant steel to AISI440C through hardened to 55/62 HRC



N = .005/.015

STANDARDS REFERENCES

MS 14101 / ASN A2121

Refer to Following Section 5.0 for Part No. Cross Reference.

GROOVE FEATURES			
Bearing size code	K	R	∝
	Groove Depth	Rad	Angle
	+.000 −.010	Min / Max	–
	in		Degrees
03 & 04	.025	.005 .010	20° Min
051	.035	.005 .010	20° Min
05 to 07	.035	.010 .017	30°
08 to 16	.055	.010 .017	30°
20 to 32	.060	.010 .020	30°

DIMENSIONS, TOLERANCES, LOADS

Part Number 11 HNG - -		B Bore Dia +.0000 -.0005	W Ball Width +.000 -.002	D Race O/Dia +.0000 -.0005	H Race Width +.000 -.010	A Groove Pitch Dia +.000 -.008	X° Min	O Ball Dia Ref	E Ball Face Min	No load breakout torque Min/Max	Radial Proj Area	Axial Proj Area	Static Radial Limit Load	Static Axial Limit Load	Distance Travelled per Degree	Approx Mass
Code	Size	in						in		lbf.in	in^2		lbf		ft	lb
03	3/16	.1900	.281	.5625	.223	.500	10	.437	.293	0.25 5.0	.071	.016	4 970	560	.00031	.02
04	1/4	.2500	.343	.6562	.255	.594	10°	.500	.364	0.25 5.0	.098	.025	6 860	875	.00036	.02
05	5/16	.3125	.375	.7500	.286	.650	10°	.593	.419	0.25 5.0	.135	.033	9 450	1 155	.00043	.03
051	5/16	.3125	.375	.7500	.286	.660	10°	.593	.419	0.25 5.0	.135	.033	9 450	1 155	.00043	.03
06	3/8	.3750	.406	.8125	.317	.712	9°	.625	.475	0.25 5.0	.162	.046	11 340	1 610	.00045	.04
07	7/16	.4375	.437	.9062	.348	.806	8°	.687	.530	0.50 8.0	.199	.060	13 930	2 100	.00050	.05
08	1/2	.5000	.500	1.0000	.395	.876	8°	.781	.600	0.50 8.0	.272	.090	19 040	3 150	.00057	.07
09	9/16	.5625	.562	1.0937	.442	.970	8°	.875	.670	0.50 8.0	.346	.116	24 220	4 060	.00063	.09
10	5/8	.6250	.625	1.1875	.505	1.063	8°	1.000	.739	1.0 8.0	.459	.158	32 130	5 530	.00072	.12
12	3/4	.7500	.750	1.4375	.598	1.313	8°	1.250	.920	1.0 8.0	.690	.230	48 300	8 050	.00091	.21
14	7/8	.8750	.875	1.5625	.708	1.438	8°	1.375	.980	1.0 8.0	.850	.263	59 500	9 205	.00100	.27
16	1	1.0000	1.000	1.7500	.802	1.626	9°	1.562	1.118	1.0 8.0	1.112	.356	77 840	12 460	.00113	.39
20	1 1/4	1.2500	1.093	2.0000	.947	1.876	6°	1.812	1.445	2.0 20.0	1.553	.533	108 710	18 655	.00132	.53
24	1 1/2	1.5000	1.312	2.4375	1.135	2.313	6°	2.250	1.827	2.0 20.0	2.351	.800	164 570	28 000	.00163	.96
28	1 3/4	1.7500	1.531	2.8125	1.322	2.689	6°	2.625	2.14	10.0 35.0	3.234	1.125	226 380	39 375	.00191	1.48
32	2	2.0000	1.750	3.1875	1.510	3.064	6°	3.000	2.44	10.0 35.0	4.260	1.483	298 200	51 905	.00218	2.10

△1 △1

NOTES

△1 Static loads are based on 2/3 of 0.1% Proof Stress of Outer Race material. If 0.2% Proof Stress is used load ratings will be greater by approx 10%. Radial and Axial limit loads are based on stress levels of 70 000 lbf/in² and 35 000 lbf/in² respectively

△2 For Zinc Nickel Plated Outer Race version dimensions shown also apply after Plating

BEARING INSTALLATION

Refer to following section 1.1.2 for recommended Housing and Shaft dimensions and Staking Tools

PART NUMBERS AND SERIES VERSIONS

Series Part Number Codification

Basic Series Part Number — 11 H N G 06 .
Spherical — H
Specification Ident — N
Narrow — G
Grooved Outer Race — 06
Ball bore dia code in multiples of 1/16 inch — .

△2 **Series Versions - Suffix Identification**

Zinc Nickel Plated Outer Race — J
Low Volatiles (Space Prep) — V
.005 o/size Outer Race dia — Y1
.010 o/size Outer Race dia — Y2

SPECIAL TYPES

Bearings based on the above specification with non–standard features may be supplied on request

ampep

AMPEP DATA SHEET
1.1.1/10a
ISSUE - 9504

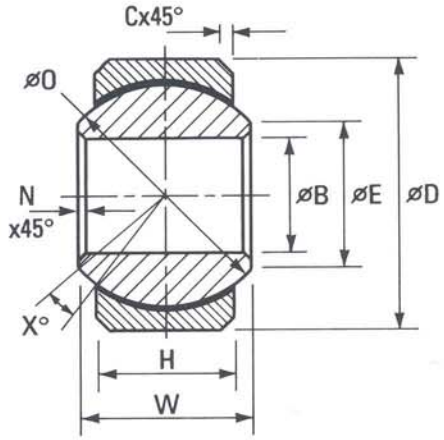
11HNZ --
INCH SERIES

SPHERICAL BEARINGS - SELF LUBRICATING NARROW - CHAMFERED OUTER RACE NORMAL TORQUE

STANDARDS REFERENCES

MS 14104 / ASN A2124

Refer to Following Section 5.0 for Part No. Cross Reference.



MATERIALS

Liner /Counterface
AMPEP XL System exceeds MIL-B-81820 Performance requirements.

Outer Race
Corrosion resistant steel to AMS 5643 (H1100 Condition)

Ball
Corrosion resistant steel to AISI440C through hardened to 55/62 HRC

DIMENSIONS, TOLERANCES, LOADS

N = .005/.015

Part Number 11 HNZ --		B Bore Dia + .0000 - .0005	W Ball Width + .000 - .002	D Race O/Dia + .0000 - .0005	H Race Width + .000 - .010	C Race Chamf + .000 - .010	X° Min	O Ball Dia Ref	E Ball Face Min	No load breakout torque Min/Max	Radial Proj Area	Axial Proj Area	Static Radial Limit Load	Static Axial Limit Load	Distance Travelled per Degree	Approx Mass
Code	Size	in						in		lbf.in	in²		lbf		ft	lb
03	3/16	.1900	.281	.5625	.223	.020	10	.437	.293	0.25 5.0	.071	.016	4 970	560	.00031	.02
04	1/4	.2500	.343	.6562	.255	.020	10°	.500	.364	0.25 5.0	.098	.025	6 860	875	.00036	.02
05	5/16	.3125	.375	.7500	.286	.020	10°	.593	.419	0.25 5.0	.135	.033	9 450	1 155	.00043	.03
06	3/8	.3750	.406	.8125	.317	.030	9°	.625	.475	0.25 5.0	.162	.046	11 340	1 610	.00045	.04
07	7/16	.4375	.437	.9062	.348	.030	8°	.687	.530	0.50 8.0	.199	.060	13 930	2 100	.00050	.05
08	1/2	.5000	.500	1.0000	.395	.030	8°	.781	.600	0.50 8.0	.272	.090	19 040	3 150	.00057	.07
09	9/16	.5625	.562	1.0937	.442	.030	8°	.875	.670	0.50 8.0	.346	.116	24 220	4 060	.00063	.09
10	5/8	.6250	.625	1.1875	.505	.030	8°	1.000	.739	1.0 8.0	.459	.158	32 130	5 530	.00072	.12
12	3/4	.7500	.750	1.4375	.598	.040	8°	1.250	.920	1.0 8.0	.690	.230	48 300	8 050	.00091	.21
14	7/8	.8750	.875	1.5625	.708	.040	8°	1.375	.980	1.0 8.0	.850	.263	59 500	9 205	.00100	.27
16	1	1.0000	1.000	1.7500	.802	.040	9°	1.562	1.118	1.0 8.0	1.112	.356	77 840	12 460	.00113	.39
20	1 1/4	1.2500	1.093	2.0000	.947	.040	6°	1.812	1.445	2.0 20.0	1.553	.533	108 710	18 655	.00132	.53
24	1 1/2	1.5000	1.312	2.4375	1.135	.040	6°	2.250	1.827	2.0 20.0	2.351	.800	164 570	28 000	.00163	.96
28	1 3/4	1.7500	1.531	2.8125	1.322	.040	6°	2.625	2.14	10.0 35.0	3.234	1.125	226 380	39 375	.00191	1.48
32	2	2.0000	1.750	3.1875	1.510	.040	6°	3.000	2.44	10.0 35.0	4.260	1.483	298 200	51 905	.00218	2.10

△1 △1

PART NUMBERS AND SERIES VERSIONS

Series Part Number Codification

Basic Series Part Number — 11 H N Z 06 .
Spherical — 11
Specification Ident — H
Narrow — N
Chamfered Outer Race — Z
Ball bore dia code in multiples of 1/16 inch — 06

△2 **Series Versions - Suffix Identification**

Zinc Nickel Plated Outer Race — J
Low Volatiles (Space Prep) — V
.005 o/size Outer Race dia — Y1
.010 o/size Outer Race dia — Y2

SPECIAL TYPES

Bearings based on the above specification with non–standard features may be supplied on request

△ NOTES

△1 Static loads are based on 2/3 of 0.1% Proof Stress of Outer Race material. If 0.2% Proof Stress is used load ratings will be greater by approx 10%. Radial and Axial limit loads are based on stress levels of 70 000 lbf/in² and 35 000 lbf/in² respectively

△2 For Zinc Nickel Plated Outer Race version dimensions shown also apply after Plating

BEARING INSTALLATION

Refer to following section 1.1.2 for recommended Housing and Shaft dimensions

ampep

SPHERICAL BEARINGS - SELF LUBRICATING WIDE - GROOVED OUTER RACE NORMAL TORQUE

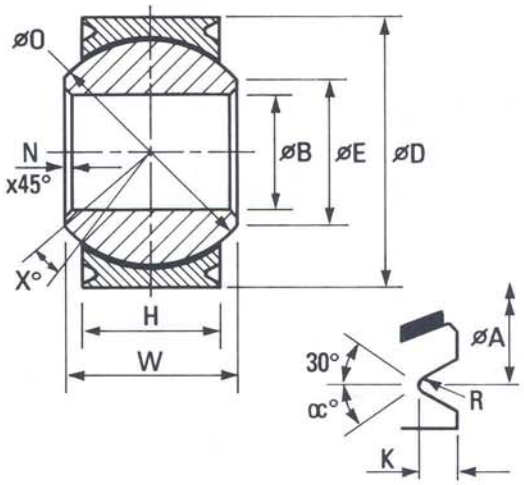
11HWG --
INCH SERIES

MATERIALS

Liner/Counterface
AMPEP XL system exceeds MIL-B-81820 Performance requirements.

Outer Race
Corrosion resistant steel to AMS 5643 (H1100 Condition)

Ball
Corrosion resistant steel to AISI440C through hardened to 55/62 HRC



N = .005/.015

STANDARDS REFERENCES

MS 14103 / ASN A2123

Refer to Following Section 5.0 for Part No. Cross Reference.

GROOVE FEATURES			
Bearing size code	K	R	αc
	Groove Depth	Rad	Angle
	+ .000 −.010	Min / Max	–
	in		Degrees
03 & 04	.025	.005 .012	20° Min
05	.025	.005 .012	30°
06 to 10	.035	.010 .017	30°
12 to 16	.055	.010 .017	30°
20 to 32	.060	.010 .020	30°

DIMENSIONS, TOLERANCES, LOADS

Part Number 11 HWG--		B	W	D	H	A	X°	O	E	No load breakout torque	Radial Proj Area	Axial Proj Area	Static Radial Limit Load	Static Axial Limit Load	Distance Travelled per Degree	Approx Mass
		Bore Dia	Ball Width	Race O/Dia	Race Width	Groove Pitch Dia		Ball Dia	Ball Face							
		+ .0000 - .0005	+ .000 - .002	+ .0000 - .0005	+ .000 - .010	+ .000 - .008	Min	Ref	Min	Min/Max						
Code	Size	in						in		lbf.in	in^2		lbf		ft	lb
03	3/16	.1900	.437	.6250	.332	.563	15°	.531	.300	0.25 5.0	.145	.056	10 150	1 960	.00038	.031
04	1/4	.2500	.437	.6250	.332	.563	15°	.531	.300	0.25 5.0	.145	.056	10 150	1 960	.00038	.031
05	5/16	.3125	.437	.6875	.322	.625	14°	.593	.360	0.25 5.0	.156	.050	10 920	1 750	.00043	.035
06	3/8	.3750	.500	.8125	.411	.712	8°	.687	.466	0.25 5.0	.243	.093	17 010	3 255	.00050	.060
07	7/16	.4375	.562	.9375	.447	.837	10°	.781	.537	0.50 8.0	.304	.113	21 280	3 955	.00056	.080
071	7/16	.4375	.562	.9062	.447	.806	10°	.781	.537	.050 8.0	.304	.113	21 280	3 955	.00056	.080
08	1/2	.5000	.625	1.0000	.510	.900	9°	.875	.607	0.50 8.0	.406	.166	28 420	5 810	.00063	.100
09	9/16	.5625	.687	1.1250	.541	1.025	10°	1.000	.721	0.50 8.0	.495	.186	34 650	6 510	.00072	.135
10	5/8	.6250	.750	1.1875	.572	1.087	12°	1.062	.747	1.0 8.0	.558	.210	39 060	7 350	.00077	.160
12	3/4	.7500	.875	1.3750	.635	1.251	13°	1.250	.845	1.0 8.0	.681	.200	47 670	7 000	.00091	.240
14	7/8	.8750	.875	1.6250	.760	1.501	6°	1.375	.995	1.0 8.0	.921	.320	64 470	11 200	.00100	.350
16	1	1.0000	1.375	2.1250	1.010	2.001	12°	1.937	1.269	2.0 12.0	1.782	.616	124 740	21 560	.00140	.970
20	1 1/4	1.2500	1.500	2.3750	1.135	2.251	12°	2.156	1.548	2.0 20.0	2.253	.805	157 710	28 175	.00156	1.100
24	1 1/2	1.5000	1.687	2.6875	1.228	2.563	12°	2.437	1.758	2.0 20.0	2.772	.953	194 040	33 355	.00177	1.450
28	1 3/4	1.7500	1.812	3.0000	1.322	2.876	12°	2.750	2.06	10.0 35.0	3.388	1.116	237 160	39 060	.00199	1.85
32	2	2.0000	1.937	3.2500	1.385	3.126	12°	3.000	2.20	10.0 35.0	3.885	1.233	271 950	43 155	.00218	2.15

△ 1 △ 1

NOTES

△ 1 Static loads are based on 2/3 of 0.1% Proof Stress of Outer Race material. If 0.2% Proof Stress is used load ratings will be greater by approx 10%. Radial and Axial limit loads are based on stress levels of 70 000 lbf/in² and 35 000 lbf/in² respectively

△ 2 For Zinc Nickel Plated Outer Race version dimensions shown also apply after Plating

BEARING INSTALLATION

Refer to following section 1.1.2 for recommended Housing and Shaft dimensions and Staking Tools

PART NUMBERS AND SERIES VERSIONS

Series Part Number Codification

Basic Series Part Number — 11 H W G 06 .
Spherical
Specification Ident
Wide
Grooved Outer Race
Ball bore dia code in multiples of 1/16 inch

△ 2 **Series Versions - Suffix Identification**

Zinc Nickel Plated Outer Race — J
Low Volatiles (Space Prep) — V
.005 o/size Outer Race dia — Y1
.010 o/size Outer Race dia — Y2

SPECIAL TYPES

Bearings based on the above specification with non–standard features may be supplied on request

ampep

AMPEP DATA SHEET
1.1.1/11a
ISSUE - 9504

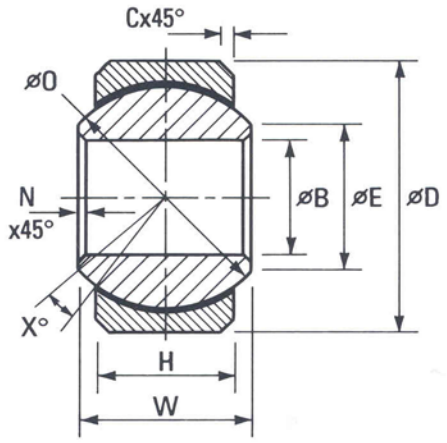
11HWZ --
INCH SERIES

SPHERICAL BEARINGS - SELF LUBRICATING WIDE - CHAMFERED OUTER RACE NORMAL TORQUE

STANDARDS REFERENCES

MS 14102 / ASN A2122

Refer to Following Section 5.0 for Part No. Cross Reference.



MATERIALS

Liner/Counterface
AMPEP XL system exceeds MIL-B-81820 Performance requirements.

Outer Race
Corrosion resistant steel to AMS 5643 (H1100 Condition)

Ball
Corrosion resistant steel to AISI440C through hardened to 55/62 HRC

DIMENSIONS, TOLERANCES, LOADS

N = .005/.015

Part Number 11 HWZ - -		B Bore Dia + .0000 - .0005	W Ball Width + .000 - .002	D Race O/Dia + .0000 - .0005	H Race Width + .000 - .010	C Race Chamf + .000 - .010	X°	O Ball Dia Ref	E Ball Face Min	No load breakout torque Min/Max	Radial Proj Area	Axial Proj Area	Static Radial Limit Load	Static Axial Limit Load	Distance Travelled per Degree	Approx Mass
Code	Size	in						in		lbf.in	in²		lbf		ft	lb
03	3/16	.1900	.437	.6250	.332	.020	15°	.531	.300	0.25 5.0	.145	.056	10 150	1 960	.00038	.031
04	1/4	.2500	.437	.6250	.332	.020	15°	.531	.300	0.25 5.0	.145	.056	10 150	1 960	.00038	.031
05	5/16	.3125	.437	.6875	.322	.020	14°	.593	.360	0.25 5.0	.156	.050	10 920	1 750	.00043	.035
06	3/8	.3750	.500	.8125	.411	.030	8°	.687	.466	0.25 5.0	.243	.093	17 010	3 255	.00050	.060
07	7/16	.4375	.562	.9375	.447	.030	10°	.781	.537	0.50 8.0	.304	.113	21 280	3 955	.00056	.080
08	1/2	.5000	.625	1.0000	.510	.030	9°	.875	.607	0.50 8.0	.406	.166	28 420	5 810	.00063	.100
09	9/16	.5625	.687	1.1250	.541	.030	10°	1.000	.721	0.50 8.0	.495	.186	34 650	6 510	.00072	.135
10	5/8	.6250	.750	1.1875	.572	.030	12°	1.062	.747	1.0 8.0	.558	.210	39 060	7 350	.00077	.160
12	3/4	.7500	.875	1.3750	.635	.040	13°	1.250	.845	1.0 8.0	.681	.200	47 670	7 000	.00091	.240
14	7/8	.8750	.875	1.6250	.760	.040	6°	1.375	.995	1.0 8.0	.921	.320	64 470	11 200	.00100	.350
16	1	1.0000	1.375	2.1250	1.010	.040	12°	1.937	1.269	2.0 12.0	1.782	.616	124 740	21 560	.00140	.970
20	1 1/4	1.2500	1.500	2.3750	1.135	.050	12°	2.156	1.548	2.0 20.0	2.253	.805	157 710	28 175	.00156	1.100
24	1 1/2	1.5000	1.687	2.6875	1.228	.050	12°	2.437	1.758	2.0 20.0	2.772	.953	194 040	33 355	.00177	1.450
28	1 3/4	1.7500	1.812	3.0000	1.322	.050	12°	2.750	2.06	10.0 35.0	3.388	1.116	237 160	39 060	.00199	1.85
32	2	2.0000	1.937	3.2500	1.385	.050	12°	3.000	2.20	10.0 35.0	3.885	1.233	271 950	43 155	.00218	2.15

⚠1 ⚠1

PART NUMBERS AND SERIES VERSIONS

Series Part Number Codification

Basic Series Part Number — 11 H W Z 06 .
Spherical
Specification Ident
Wide
Chamfered Outer Race
Ball bore dia code in multiples of 1/16 inch

⚠2 **Series Versions - Suffix Identification**

Zinc Nickel Plated Outer Race — J
Low Volatiles (Space Prep) — V
.005 o/size Outer Race dia — Y1
.010 o/size Outer Race dia — Y2

SPECIAL TYPES

Bearings based on the above specification with non–standard features may be supplied on request

NOTES

⚠1 Static loads are based on 2/3 of 0.1% Proof Stress of Outer Race material. If 0.2% Proof Stress is used load ratings will be greater by approx 10%. Radial and Axial limit loads are based on stress levels of 70 000 lbf/in² and 35 000 lbf/in² respectively

⚠2 For Zinc Nickel Plated Outer Race version dimensions shown also apply after Plating

BEARING INSTALLATION

Refer to following section 1.1.2 for recommended Housing and Shaft dimensions

SPHERICAL BEARINGS - SELF LUBRICATING HIGH MISALIGNMENT - GROOVED OUTER RACE NORMAL TORQUE

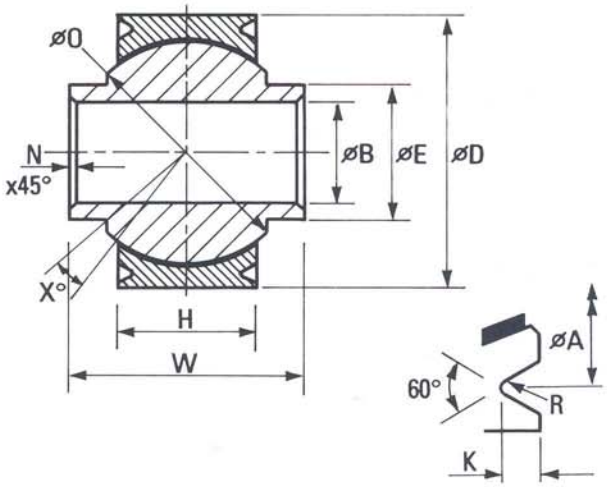
11HHG --
INCH SERIES

MATERIALS

Liner /Counterface
AMPEP XL system exceeds MIL-B-81820 Performance requirements

Outer Race
Corrosion resistant steel to AMS 5643 (H1100 Condition)

Ball
Corrosion resistant steel to AISI440C through hardened to 55/62 HRC



N = .005/.015

STANDARDS REFERENCES

Refer to Following Section 5.0 for Part No. Cross Reference.

GROOVE FEATURES		
Bearing size code	K	R
	Groove Depth	Rad
	+ .000 −.015	+ .000 - .010
	in	
03 & 04	.030	.015
05 to 08	.040	.020
10 to 24	.060	.020
031 & 051	.030	.015

DIMENSIONS, TOLERANCES, LOADS

Part Number 11 HHG - -		B	W	D	H	A		O	E	No load breakout torque	Radial Proj Area	Axial Proj Area	Static Radial Limit Load	Static Axial Limit Load	Distance Travelled per Degree	Approx Mass
		Bore Dia	Ball Width	Race O/Dia	Race Width	Groove Pitch Dia	X° Min	Ball Dia	Ball Face							
		+ .0000 - .0005	+ .000 - .002	+ .0000 - .0005	+ .000 - .010	+ .000 - .010		Ref	Min	Min/Max						
Code	Size	in						in		lbf.in	in²		lbf		ft	lb
03	3/16	.1900	.500	.5625	.215	.502	15°	.437	.312	0.25 5.0	.071	.009	4 970	315	.00031	.02
031	3/16	.1900	.560	.6250	.332	.560	15°	.531	.280	0.25 5.0	.150	.051	10 500	1 785	.00038	.03
04	1/4	.2500	.593	.7400	.260	.675	24°	.593	.350	0.25 5.0	.116	.020	8 120	700	.00043	.04
05	5/16	.3125	.813	.9060	.350	.811	22°	.781	.480	0.25 5.0	.233	.053	16 310	1 855	.00056	.07
051	5/16	.3125	.625	.6875	.245	.637	20°	.593	.420	0.25 5.0	.113	.015	7 910	525	.00043	.025
06	3/8	.3750	.813	.9060	.350	.811	22°	.781	.480	0.25 5.0	.233	.053	16 310	1 855	.00056	.07
07	7/16	.4375	.875	1.0000	.350	.905	22°	.875	.570	0.50 8.0	.250	.056	17 500	1 960	.00063	.10
08	1/2	.5000	.937	1.1250	.406	1.030	20°	1.000	.680	0.50 8.0	.333	.083	23 310	2 905	.00072	.16
10	5/8	.6250	1.200	1.3750	.572	1.255	20°	1.250	.810	1.0 8.0	.616	.180	43 120	6 600	.00091	.25
12	3/4	.7500	1.280	1.5625	.625	1.442	19°	1.375	.920	1.0 8.0	.758	.220	53 060	7 700	.00100	.32
14	7/8	.8750	1.400	1.7500	.630	1.630	19°	1.531	1.080	1.0 8.0	.833	.220	58 310	7 700	.00111	.43
16	1	1.0000	1.875	2.1250	.840	2.005	21°	1.875	1.220	2.0 12.0	1.416	.440	99 120	15 400	.00136	.81
20	1 1/4	1.2500	1.875	2.5000	1.010	2.380	21°	2.250	1.500	2.0 20.0	2.066	.660	144 620	23 100	.00163	1.11
24	1 1/2	1.5000	2.250	3.0000	1.180	2.880	21°	2.672	1.802	2.0 20.0	3.019	.798	211 330	27 930	.00194	2.22

△ NOTES

△1 Static loads are based on 2/3 of 0.1% Proof Stress of Outer Race material. If 0.2% Proof Stress is used load ratings will be greater by approx 10%. Radial and Axial limit loads are based on stress levels of 70 000 lbf/in² and 35 000 lbf/in² respectively

△2 For Cadmium Plated Outer Race version dimensions shown also apply after Plating

BEARING INSTALLATION

Refer to following section 1.1.2 for recommended Housing and Shaft dimensions and Staking Tools

PART NUMBERS AND SERIES VERSIONS

Series Part Number Codification

Basic Series Part Number — 11 H H G 03 .
Spherical
Specification Ident
High Misalignment
Grooved Outer Race
Ball bore dia code in multiples of 1/16 inch

△2 **Series Versions - Suffix Identification**

Cadmium Plated Outer Race — C
Low Volatiles (Space Prep) — V
.005 o/size Outer Race dia — Y1
.010 o/size Outer Race dia — Y2

SPECIAL TYPES

Bearings based on the above specification with non–standard features may be supplied on request

ampep

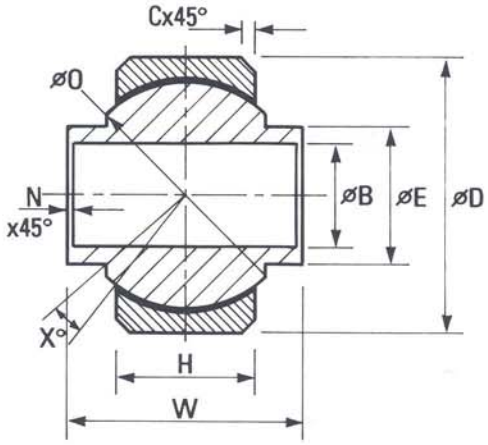
AMPEP DATA SHEET
1.1.1/12a
ISSUE - 9504

11HHZ-- INCH SERIES

SPHERICAL BEARINGS - SELF LUBRICATING HIGH MISALIGNMENT - CHAMFERED OUTER RACE NORMAL TORQUE

STANDARDS REFERENCES

Refer to Following Section 5.0 for Part No. Cross Reference.



MATERIALS

Liner /Counterface
AMPEP XL system exceeds MIL-B-81820 Performance requirements

Outer Race
Corrosion resistant steel to AMS 5643 (H1100 Condition)

Ball
Corrosion resistant steel to AISI440C through hardened to 55/62 HRC

DIMENSIONS, TOLERANCES, LOADS

N = .005/.015
C = .025/.035

Part Number 11HHZ--		B Bore Dia +.0000 -.0005	W Ball Width +.000 -.002	D Race O/Dia +.0000 -.0005	H Race Width +.000 -.010	X°	O Ball Dia Ref	E Ball Face Ref	No load breakout torque Min/Max	Radial Proj Area	Axial Proj Area	Static Radial Limit Load	Static Axial Limit Load	Distance Travelled per Degree	Approx Mass
Code	Size	in					in		lbf.in	in²		lbf		ft	lb
03	3/16	.1900	.500	.5625	.215	15°	.437	.312	0.25 5.0	.071	.009	4 970	315	.00031	.02
031	3/16	.1900	.560	.6250	.332	15°	.531	.280	0.25 5.0	.150	.051	10 500	1 785	.00038	.03
04	1/4	.2500	.593	.7400	.260	24°	.593	.350	0.25 5.0	.116	.020	8 120	700	.00043	.04
05	5/16	.3125	.813	.9060	.350	22°	.781	.480	0.25 5.0	.233	.053	16 310	1 855	.00056	.07
051	5/16	.3125	.625	.6875	.245	20°	.593	.420	0.25 5.0	.113	.015	7 910	525	.00043	.025
06	3/8	.3750	.813	.9060	.350	22°	.781	.480	0.25 5.0	.233	.053	16 310	1 855	.00056	.07
07	7/16	.4375	.875	1.0000	.350	22°	.875	.570	0.50 8.0	.250	.056	17 500	1 960	.00063	.10
08	1/2	.5000	.937	1.1250	.406	20°	1.000	.680	0.50 8.0	.333	.083	23 310	2 905	.00072	.16
10	5/8	.6250	1.200	1.3750	.572	20°	1.250	.810	1.0 8.0	.616	.180	43 120	6 600	.00091	.25
12	3/4	.7500	1.280	1.5625	.625	19°	1.375	.920	1.0 8.0	.758	.220	53 060	7 700	.00100	.32
14	7/8	.8750	1.400	1.7500	.630	19°	1.531	1.080	1.0 8.0	.833	.220	58 310	7 700	.00111	.43
16	1	1.0000	1.875	2.1250	.840	21°	1.875	1.220	2.0 12.0	1.416	.440	99 120	15 400	.00136	.81
20	1 1/4	1.2500	1.875	2.5000	1.010	21°	2.250	1.500	2.0 20.0	2.066	.660	144 620	23 100	.00163	1.11
24	1 1/2	1.5000	2.250	3.0000	1.180	21°	2.672	1.802	2.0 20.0	3.019	.798	211 330	27 930	.00194	2.22
												⚠1	⚠1		

PART NUMBERS AND SERIES VERSIONS

Series Part Number Codification

Basic Series Part Number — 11 H H Z 03 .
Spherical — 11
Specification Ident — H
High Misalignment — H
Chamfered Outer Race — Z
Ball bore dia code in multiples of 1/16 inch — 03

⚠2 **Series Versions - Suffix Identification**

Cadmium Plated Outer Race — C
Low Volatiles (Space Prep) — V
.005 o/size Outer Race dia — Y1
.010 o/size Outer Race dia — Y2

SPECIAL TYPES

Bearings based on the above specification with non–standard features may be supplied on request

NOTES

⚠1 Static loads are based on 2/3 of 0.1% Proof Stress of Outer Race material. If 0.2% Proof Stress is used load ratings will be greater by approx 10%. Radial and Axial limit loads are based on stress levels of 70000 lbf/in² and 35000 lbf/in² respectively

⚠2 For Cadmium Plated Outer Race version dimensions shown also apply after Plating

BEARING INSTALLATION

Refer to following section 1.1.2 for recommended Housing and Shaft dimensions

SPHERICAL BEARINGS - SELF LUBRICATING
LIGHT - GROOVED OUTER RACE
NORMAL TORQUE

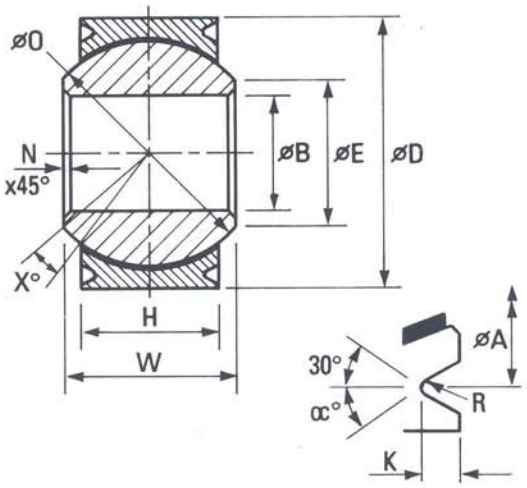
11C -- EG
11F -- EG
METRIC SERIES

MATERIALS

***Liner* - AMPEP X1**
Liner system qualified to MIL-B-81820

Outer Race
Corrosion resistant steel to
AMS 5643 (H1100 Condition)

Ball
For 11C-- Series
Corrosion resistant steel AISI440C
through hardened to 55/62 HRC
For 11F-- Series
Corrosion resistant steel AISI440C
through hardened to 55/62 HRC
and Spherical Surface Hard Chrome
Plated to Def. Stan. 03 - 14



STANDARDS REFERENCES

EN 2584R
EN 2584R--P
EN 2585R } 05 SIZE ONLY
EN 2585R--P }

Refer to Following Section 5.0 for Part No. Cross Reference.

GROOVE FEATURES			
Bearing size code	K	α	R
	Groove Depth	Angle	Rad
	+0.00 −0.20	—	+0.10 −0.00
	mm	—	mm
05 & 08	0.7	20° min	0.2
12 to 17	0.9	30°	0.3
25 to 50	1.4	30°	0.3
55	1.5	30°	0.3

DIMENSIONS, TOLERANCES, LOADS

Part Number 11C -- EG 11F -- EG	B	W	D	H	A	X°	O	E	N	No load breakout torque	Radial Proj Area	Axial Proj Area	Static Radial Limit Load	Static Axial Limit Load	Distance Travelled per Degree	Approx Mass
	Ball Bore	Ball Width	Race O/Dia	Race Width	Groove Pitch Dia		Ball Dia	Ball Face	Ball Chamf							
	–	+0.00 −0.05	+0.000 −0.012	+0.10 −0.10	−0.00 +0.10		Ref	Ref	–	–						
Code	mm						mm			Nm	mm^2		KN		$x10^{-3}$ Metre	g
05	5.000 4.990	11	16	8.5	14.2	15°	13.5	7.7	0.1 0.4	0.08 0.50	98.28	36.18	45.21	8.32	0.11781	16
08	8.000 7.990	10	18	7.0	16.2	15°	14.3	10.2	0.1 0.4	0.08 0.50	82.65	18.74	38.02	4.31	0.12650	12
12	12.000 11.989	13	25	10.0	22.4	10°	19.8	15.0	0.1 0.4	0.12 0.80	173.84	50.86	79.96	11.70	0.17270	32
15	15.000 14.989	15	29	12.0	26.4	8°	25.40	20.5	0.1 0.4	0.12 0.80	273.81	78.42	125.95	18.04	0.22160	50
17	17.000 16.989	16	31	13.5	28.4	7°	27.00	21.7	0.1 0.4	0.12 0.80	331.56	105.50	152.52	24.27	0.23560	59
25	25.000 24.988	25	45	20	41.8	8°	38.80	29.6	0.1 0.4	0.25 1.00	710.04	237.26	305.32	51.00	0.33850	185
30	30.000 29.988	28	51	24	47.8	6°	45.20	35.5	0.1 0.4	0.40 2.00	1007.96	361.80	433.42	77.79	0.39440	300
35	35.000 34.988	31	57	26	53.8	7°	52.00	41.7	0.1 0.4	0.40 2.00	1263.6	428.96	543.35	92.23	0.45370	340
40	40.000 39.988	34	64	29	60.8	6°	58.00	47.0	0.1 0.4	0.60 2.70	1583.4	546.77	680.86	117.56	0.50610	460
45	45.000 44.988	37	72	32	68.8	5°	64.00	52.2	0.1 0.4	0.60 2.70	1939.2	678.72	833.85	145.93	0.55850	630
50	50.000 49.988	41	80	34	76.8	7°	72.00	59.2	0.1 0.4	0.60 2.70	2325.6	769.51	1000.0	165.44	0.62830	870
55	55.000 54.988	52	96	40	92.8	10°	82.00	63.4	0.1 0.4	0.60 3.50	3140.6	1096.78	1350.46	235.81	0.71550	1580

(1) (1)

NOTES

(1) Static loads are based on 2/3 of 0.1% Proof Stress of Outer Race material. If 0.2% Proof Stress is used load ratings will be greater by approx 10%. Radial and Axial Static limit loads are based on stress levels of 460 MPa and 230 MPa respectively for Bore sizes up to but not including 25mm. For Bore sizes of 25mm and over, stress levels are based on 430MPa and 215MPa respectively

(2) For Cadmium Plated Outer Race version dimensions shown also apply after Plating

BEARING INSTALLATION

Refer to following section 1.1.2 for recommended Housing and Shaft dimensions and Staking Tools

PART NUMBERS AND SERIES VERSIONS

Series Part Number Codification

Basic Series Part Number — 11 C 05 E G .
Spherical — F
Specification Ident (Ref. Material Data)
'C' for Non-Plated Ball, 'F' for Chrome Plated Ball
Ball Bore Dia Code in mm
Light
Grooved Outer Race

(2) **Series Versions - Suffix Identification**

Cadmium Plated Outer Race — C
Low Volatiles (Space Prep) — V
0.1 mm o/size Outer Race dia — Y1
0.2 mm o/size Outer Race dia — Y2

SPECIAL TYPES

Bearings are based on the above specifications with non-standard features may be supplied on request

ampep

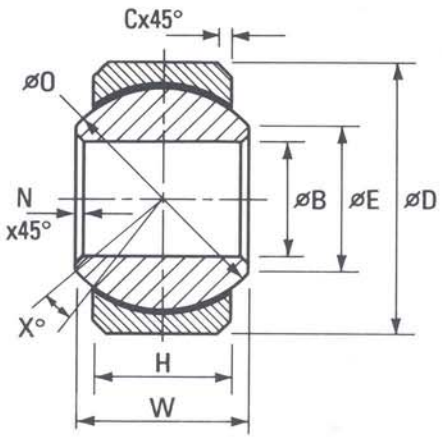
11C -- EZ
11F -- EZ
METRIC SERIES

SPHERICAL BEARINGS - SELF LUBRICATING
LIGHT - CHAMFERED OUTER RACE
NORMAL TORQUE

STANDARDS REFERENCES

EN 2584S
EN 2584S--P
EN 2585S } 05 SIZE ONLY
EN 2585S--P }

Refer to Following Section 5.0 for Part No. Cross Reference.



MATERIALS

***Liner* - AMPEP X1**
Liner system qualified to MIL-B-81820

Outer Race
Corrosion resistant steel to AMS 5643 (H1100 Condition)

Ball
For 11C-- Series
Corrosion resistant steel AISI440C through hardened to 55/62 HRC
For 11F-- Series
Corrosion resistant steel AISI440C through hardened to 55/62 HRC and Spherical Surface Hard Chrome Plated to Def. Stan. 03 - 14

DIMENSIONS, TOLERANCES, LOADS

Part Number 11C -- EZ 11F -- EZ	B	W	D	H	C	X°	O	E	N	No load breakout torque	Radial Proj Area	Axial Proj Area	Static Radial Limit Load	Static Axial Limit Load	Distance Travelled per Degree	Approx Mass
	Ball Bore	Ball Width	Race O/Dia	Race Width	Race Chamf		Ball Dia	Ball Face	Ball Chamf							
	–	+ 0.00 - 0.05	+ 0.000 - 0.012	+ 0.10 - 0.10	–		Ref	Ref	–	–						
Code	mm						mm			Nm	mm^2		KN		-3 x10 Metre	g
05	5.000 4.990	11	16	8.5	0.5 0.8	15°	13.5	7.7	0.1 0.4	0.08 0.50	98.28	36.18	45.21	8.32	0.11781	16
08	8.000 7.990	10	18	7.0	0.5 0.8	15°	14.3	10.2	0.1 0.4	0.08 0.50	82.65	18.74	38.02	4.31	0.12650	12
12	12.000 11.989	13	25	10.0	0.5 0.8	10°	19.8	15.0	0.1 0.4	0.12 0.80	173.84	50.86	79.96	11.70	0.17270	32
15	15.000 14.989	15	29	12.0	0.5 0.8	8°	25.40	20.5	0.1 0.4	0.12 0.80	273.81	78.42	125.95	18.04	0.22160	50
17	17.000 16.989	16	31	13.5	0.5 0.8	7°	27.00	21.7	0.1 0.4	0.12 0.80	331.56	105.50	152.52	24.27	0.23560	59
25	25.000 24.988	25	45	20	0.6 1.0	8°	38.80	29.6	0.1 0.4	0.25 1.00	710.04	237.26	305.32	51.00	0.33850	185
30	30.000 29.988	28	51	24	0.6 1.0	6°	45.20	35.5	0.1 0.4	0.40 2.00	1007.96	361.80	433.42	77.79	0.39440	300
35	35.000 34.988	31	57	26	0.8 1.2	7°	52.00	41.7	0.1 0.4	0.40 2.00	1263.6	428.96	543.35	92.23	0.45370	340
40	40.000 39.988	34	64	29	0.8 1.2	6°	58.00	47.0	0.1 0.4	0.60 2.70	1583.4	546.77	680.86	117.56	0.50610	460
45	45.000 44.988	37	72	32	0.8 1.2	5°	64.00	52.2	0.1 0.4	0.60 2.70	1939.2	678.72	833.85	145.93	0.55850	630
50	50.000 49.988	41	80	34	0.8 1.2	7°	72.00	59.2	0.1 0.4	0.60 2.70	2325.6	769.51	1000.0	165.44	0.62830	870
55	55.000 54.988	52	96	40	0.8 1.2	10°	82.00	63.4	0.1 0.4	0.60 3.50	3140.6	1096.78	1350.46	235.81	0.71550	1580

△1 △1

PART NUMBERS AND SERIES VERSIONS

Series Part Number Codification

Basic Series Part Number — 11 C 05 E Z .
Spherical — F
Specification Ident (Ref. Material Data)
'C' for Non-Plated Ball, 'F' for Chrome Plated Ball
Ball Bore Dia Code in mm
Light
Chamfered Outer Race

△2 **Series Versions - Suffix Identification**

Cadmium Plated Outer Race — C
Low Volatiles (Space Prep) — V
0.1 mm o/size Outer Race dia — Y1
0.2 mm o/size Outer Race dia — Y2

SPECIAL TYPES

Bearings are based on the above specifications with non-standard features may be supplied on request

NOTES

△1 Static loads are based on 2/3 of 0.1% Proof Stress of Outer Race material. If 0.2% Proof Stress is used load ratings will be greater by approx 10%. Radial and Axial Static limit loads are based on stress levels of 460 MPa and 230 MPa respectively for Bore sizes up to but not including 25mm. For Bore sizes of 25mm and over, stress levels are based on 430MPa and 215MPa respectively

△2 For Cadmium Plated Outer Race version dimensions shown also apply after Plating

BEARING INSTALLATION

Refer to following section 1.1.2 for recommended Housing and Shaft dimensions and Staking Tools

SPHERICAL BEARINGS - SELF LUBRICATING NARROW - GROOVED OUTER RACE NORMAL TORQUE

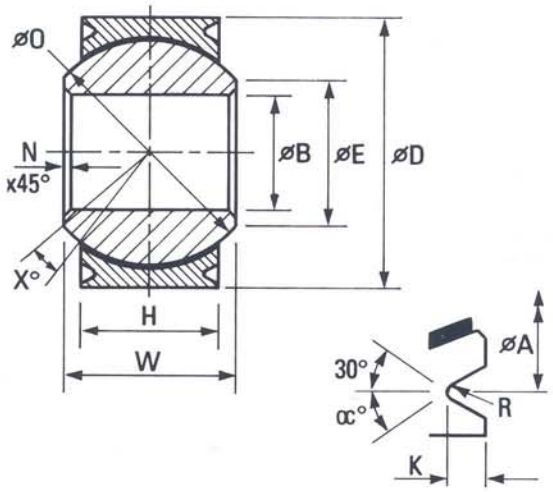
11C -- NG
11F -- NG
METRIC SERIES

MATERIALS

***Liner* - AMPEP X1**
Liner system qualified to MIL-B-81820

Outer Race
Corrosion resistant steel to AMS 5643 (H1100 Condition)

Bail
For 11C-- Series
Corrosion resistant steel AISI440C through hardened to 55/62 HRC
For 11F-- Series
Corrosion resistant steel AISI440C through hardened to 55/62 HRC and Spherical Surface Hard Chrome Plated to Def. Stan. 03 - 14



STANDARDS REFERENCES

EN 2584R
EN 2584R--P
EN 3048R
EN 3048R--P
} 06 & 10 SIZES ONLY

Refer to Following Section 5.0 for Part No. Cross Reference.

GROOVE FEATURES			
Bearing size code	K	α	R
	Groove Depth	Angle	Rad
	+ 0.00 −0.20	—	+ 0.10 - 0.00
	mm	—	mm
06	0.7	20° min	0.2
10	0.9	30°	0.3
12 to 20	0.7	30°	0.2
25 & 30	0.9	30°	0.3
35 to 50	1.4	30°	0.3

DIMENSIONS, TOLERANCES, LOADS

Part Number 11C -- NG 11F -- NG	B	W	D	H	A	X°	O	E	N	No load breakout torque	Radial Proj Area	Axial Proj Area	Static Radial Limit Load	Static Axial Limit Load	Distance Travelled per Degree	Approx Mass
	Ball Bore	Ball Width	Race O/Dia	Race Width	Groove Pitch Dia		Ball Dia	Ball Face	Ball Chamf							
	–	+ 0.00 - 0.05	+ 0.000 - 0.012	+ 0.10 - 0.10	- 0.00 + 0.10		Ref	Ref	–	–						
Code	mm						mm			Nm	mm^2		KN		-3 x10 Metre	g
06	6.000 5.990	9	16	6.5	14.2	14°	12.73	9.0	0.10 0.40	0.08 0.50	67.21	15.34	30.92	3.53	0.11108	9
10	10.000 9.990	10.5	21	8	18.4	11°	15.87	11.9	0.10 0.40	0.12 0.80	107.60	28.11	49.50	6.47	0.13849	20
12	12.000 11.989	10	22	7	20.2	11°	17.45	14.3	0.10 0.40	0.12 0.80	100.86	15.90	46.40	3.66	0.15227	17
15	15.000 14.989	12	26	9	24.2	9°	22.21	18.7	0.10 0.40	0.12 0.80	172.80	34.77	79.50	8.00	0.19381	32
17	17.000 16.989	14	30	10	28.2	10°	25.41	21.2	0.10 0.40	0.12 0.80	223.10	46.00	102.63	10.58	0.22174	49
20	20.000 19.988	16	35	12	33.2	9°	29.73	24.9	0.10 0.40	0.12 0.80	320.49	74.03	147.43	17.03	0.25944	65
25	25.000 24.988	20	42	16	39.4	7°	36.05	30.0	0.10 0.40	0.25 1.00	515.52	133.49	221.67	28.70	0.31459	115
30	30.000 29.988	22	47	18	44.4	6°	40.75	34.3	0.10 0.40	0.40 2.00	664.23	177.85	285.62	38.23	0.35560	160
35	35.000 34.988	25	55	20	51.8	7°	47.59	40.5	0.10 0.40	0.40 2.00	870.90	226.29	374.49	48.65	0.41529	229
40	40.000 39.988	28	62	22	58.8	7°	53.01	45.0	0.10 0.40	0.60 3.50	1076.10	282.52	462.72	60.74	0.46259	315
45	45.000 44.988	32	68	25	64.8	7°	60.46	51.3	0.10 0.40	0.60 3.50	1408.72	379.72	605.75	81.64	0.52761	460
50	50.000 49.988	35	75	28	71.8	7°	67.91	58.2	0.10 0.40	0.60 3.50	1786.03	490.96	769.99	105.55	0.59262	560

△ ① ① ①

NOTES

① Static loads are based on 2/3 of 0.1% Proof Stress of Outer Race material. If 0.2% Proof Stress is used load ratings will be greater by approx 10%. Radial and Axial Static limit loads are based on stress levels of 460 MPa and 230 MPa respectively for Bore sizes up to but not including 25mm. For Bore sizes of 25mm and over, stress levels are based on 430MPa and 215MPa respectively

② For Cadmium Plated Outer Race version dimensions shown also apply after Plating

BEARING INSTALLATION

Refer to following section 1.1.2 for recommended Housing and Shaft dimensions and Staking Tools

PART NUMBERS AND SERIES VERSIONS

Series Part Number Codification

Basic Series Part Number — 11 C 06 N G .
Spherical — F
Specification Ident (Ref. Material Data)
'C' for Non-Plated Ball, 'F' for Chrome Plated Ball
Ball Bore Dia Code in mm
Narrow
Grooved Outer Race

② **Series Versions - Suffix Identification**

Cadmium Plated Outer Race	C
Low Volatiles (Space Prep)	V
0.1 mm o/size Outer Race dia	Y1
0.2 mm o/size Outer Race dia	Y2

SPECIAL TYPES

Bearings are based on the above specifications with non-standard features may be supplied on request

ampep

AMPEP DATA SHEET
1.1.1/17a
ISSUE - 9504

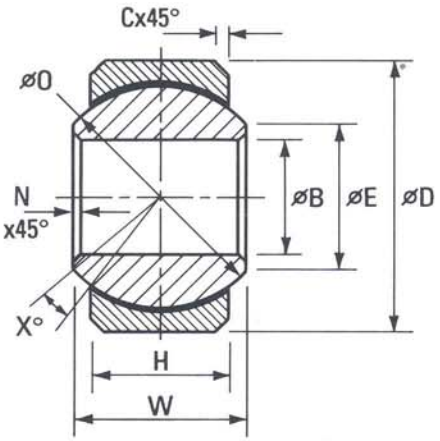
11C -- NZ
11F -- NZ
METRIC SERIES

SPHERICAL BEARINGS - SELF LUBRICATING NARROW - CHAMFERED OUTER RACE NORMAL TORQUE

STANDARDS REFERENCES

EN 2584S
EN 2584S--P
EN 3048S
EN 3048S--P
} 06 & 10 SIZES ONLY

Refer to Following Section 5.0 for Part No. Cross Reference.



MATERIALS

***Liner* - AMPEP X1**
Liner system qualified to MIL-B-81820

Outer Race
Corrosion resistant steel to AMS 5643 (H1100 Condition)

Ball
For 11C-- Series
Corrosion resistant steel AISI440C through hardened to 55/62 HRC
For 11F-- Series
Corrosion resistant steel AISI440C through hardened to 55/62 HRC and Spherical Surface Hard Chrome Plated to Def. Stan. 03 - 14

DIMENSIONS, TOLERANCES, LOADS

Part Number 11C -- NZ 11F -- NZ	B	W	D	H	C	X°	O	E	N	No load breakout torque	Radial Proj Area	Axial Proj Area	Static Radial Limit Load	Static Axial Limit Load	Distance Travelled per Degree	Approx Mass
	Ball Bore	Ball Width	Race O/Dia	Race Width	Race Chamf		Ball Dia	Ball Face	Ball Chamf							
	–	+ 0.00 - 0.05	+ 0.000 - 0.012	+ 0.10 - 0.10	–		Ref	Ref	–	–						
Code	mm						mm			Nm	mm^2		KN		-3 x10 Metre	g
06	6.000 5.990	9	16	6.5	0.50 0.80	14°	12.73	9.0	0.10 0.40	0.08 0.50	67.21	15.34	30.92	3.53	0.11108	9
10	10.000 9.990	10.5	21	8	0.50 0.80	11°	15.87	11.9	0.10 0.40	0.12 0.80	107.60	28.11	49.50	6.47	0.13849	20
12	12.000 11.989	10	22	7	0.50 0.80	11°	17.45	14.3	0.10 0.40	0.12 0.80	100.86	15.90	46.40	3.66	0.15227	17
15	15.000 14.989	12	26	9	0.50 0.80	9°	22.21	18.7	0.10 0.40	0.12 0.80	172.80	34.77	79.50	8.00	0.19381	32
17	17.000 16.989	14	30	10	0.50 0.80	10°	25.41	21.2	0.10 0.40	0.12 0.80	223.10	46.00	102.63	10.58	0.22174	49
20	20.000 19.988	16	35	12	0.60 1.00	9°	29.73	24.9	0.10 0.40	0.12 0.80	320.49	74.03	147.43	17.03	0.25944	65
25	25.000 24.988	20	42	16	0.60 1.00	7°	36.05	30.0	0.10 0.40	0.25 1.00	515.52	133.49	221.67	28.70	0.31459	115
30	30.000 29.988	22	47	18	0.60 1.00	6°	40.75	34.3	0.10 0.40	0.40 2.00	664.23	177.85	285.62	38.23	0.35560	160
35	35.000 34.988	25	55	20	0.80 1.20	7°	47.59	40.5	0.10 0.40	0.40 2.00	870.90	226.29	374.49	48.65	0.41529	229
40	40.000 39.988	28	62	22	0.80 1.20	7°	53.01	45.0	0.10 0.40	0.60 3.50	1076.10	282.52	462.72	60.74	0.46259	315
45	45.000 44.988	32	68	25	0.80 1.20	7°	60.46	51.3	0.10 0.40	0.60 3.50	1408.72	379.72	605.75	81.64	0.52761	460
50	50.000 49.988	35	75	28	0.80 1.20	7°	67.91	58.2	0.10 0.40	0.60 3.50	1786.03	490.96	769.99	105.55	0.59262	560

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PART NUMBERS AND SERIES VERSIONS

Series Part Number Codification

Basic Series Part Number — 11 C 06 N Z .
Spherical — F
Specification Ident (Ref. Material Data)
'C' for Non-Plated Ball, 'F' for Chrome Plated Ball
Ball Bore Dia Code in mm
Narrow
Chamfered Outer Race

△2 **Series Versions - Suffix Identification**

Cadmium Plated Outer Race — C
Low Volatiles (Space Prep) — V
0.1 mm o/size Outer Race dia — Y1
0.2 mm o/size Outer Race dia — Y2

SPECIAL TYPES

Bearings are based on the above specifications with non-standard features may be supplied on request

NOTES

△1 Static loads are based on 2/3 of 0.1% Proof Stress of Outer Race material. If 0.2% Proof Stress is used load ratings will be greater by approx 10%. Radial and Axial Static limit loads are based on stress levels of 460 MPa and 230 MPa respectively for Bore sizes up to but not including 25mm. For Bore sizes of 25mm and over, stress levels are based on 430MPa and 215MPa respectively

△2 For Cadmium Plated Outer Race version dimensions shown also apply after Plating

BEARING INSTALLATION

Refer to following section 1.1.2 for recommended Housing and Shaft dimensions and Staking Tools

SPHERICAL BEARINGS - SELF LUBRICATING
WIDE - GROOVED OUTER RACE
NORMAL TORQUE

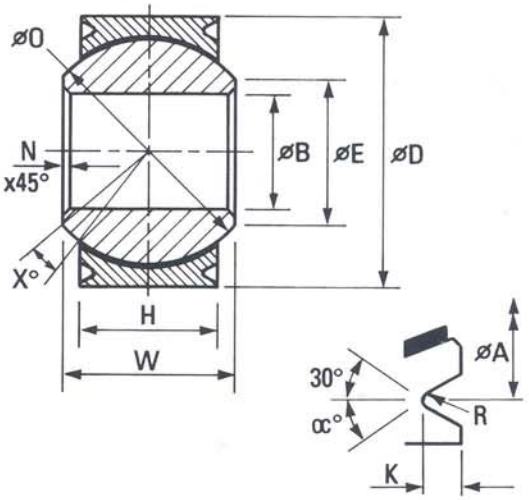
11C -- WG
11F -- WG
METRIC SERIES

MATERIALS

***Liner* - AMPEP X1**
Liner system qualified to MIL-B-81820

Outer Race
Corrosion resistant steel to
AMS 5643 (H1100 Condition)

Ball
For 11C-- Series
Corrosion resistant steel AISI440C
through hardened to 55/62 HRC
For 11F-- Series
Corrosion resistant steel AISI440C
through hardened to 55/62 HRC
and Spherical Surface Hard Chrome
Plated to Def. Stan. 03 - 14



STANDARDS REFERENCES

EN 2584R
EN 2584R--P
EN 2585R
EN 2585R--P
} 05 & 22 SIZES ONLY

Refer to Following Section 5.0 for Part No. Cross Reference.

GROOVE FEATURES			
Bearing size code	K	∝	R
	Groove Depth	Angle	Rad
	+ 0.00 −0.20	—	+ 0.10 - 0.00
	mm	—	mm
05 & 06	0.7	20° min	0.2
08	0.7	30°	0.2
10 to 17	0.9	30°	0.3
20 to 50	1.4	30°	0.3

DIMENSIONS, TOLERANCES, LOADS

Part Number 11C --WG 11F -- WG	B	W	D	H	A	X°	O	E	N	No load breakout torque	Radial Proj Area	Axial Proj Area	Static Radial Limit Load	Static Axial Limit Load	Distance Travelled per Degree	Approx Mass
	Ball Bore	Ball Width	Race O/Dia	Race Width	Groove Pitch Dia		Ball Dia	Ball Face	Ball Chamf							
	–	+ 0.00 - 0.05	+ 0.000 - 0.012	+ 0.10 - 0.10	+ 0.10 - 0.00		Ref	Ref	–	–						
Code	mm						mm			Nm	mm^2		KN		$x10^{-3}$ Metre	g
05	5.000 4.990	7	14	5.5	12.2	9°	11.09	8.6	0.10 0.40	0.08 0.50	47.51	8.39	21.85	1.93	0.09677	7
06	6.000 5.990	11	16	8.5	14.2	15°	13.43	7.7	0.10 0.40	0.08 0.50	97.77	36.16	44.97	8.32	0.11719	16
08	8.000 7.990	11	18	8.0	16.2	14°	15.07	10.3	0.10 0.40	0.08 0.50	102.17	28.80	47.00	6.62	0.13150	17
10	10.000 9.990	12.5	21	10.0	18.4	10°	17.47	12.2	0.10 0.40	0.12 0.80	153.39	52.96	70.56	12.18	0.15245	27
12	12.000 11.989	16	26	13.0	23.4	10°	22.28	15.5	0.10 0.40	0.12 0.80	262.46	99.74	120.73	22.94	0.19442	49
15	15.000 14.989	17	29	13.5	26.4	9°	25.42	18.9	0.10 0.40	0.12 0.80	312.16	106.71	143.59	24.54	0.22183	62
17	17.000 16.989	18	30	14.5	27.4	9°	27.31	20.1	0.10 0.40	0.12 0.80	362.68	126.20	166.83	29.03	0.23832	69
20	20.000 19.988	20	35	16.0	31.8	8°	31.78	24.7	0.10 0.40	0.12 0.80	469.71	156.63	216.06	36.03	0.27733	104
22	22.000 21.988	22	40	18.0	36.8	8°	34.90	27.1	0.10 0.40	0.25 1.00	585.62	206.72	269.83	47.54	0.30455	126
25	25.000 24.988	32	54	26	50.8	9°	47.63	35.3	0.10 0.40	0.25 1.00	1157.40	434.33	497.68	93.38	0.41564	445
30	30.000 29.988	34	60	28	56.8	8°	53.18	40.9	0.10 0.40	0.40 2.00	1398.63	509.79	601.41	109.60	0.46408	480
35	35.000 34.988	36	65	29	61.8	8°	58.01	45.5	0.10 0.40	0.40 2.00	1583.67	546.95	680.98	117.59	0.50623	565
40	40.000 39.988	38	68	31	64.8	8°	60.44	47.0	0.10 0.40	0.60 2.70	1770.89	635.31	761.48	136.59	0.52743	600
45	45.000 44.988	41	76	33	72.8	8°	67.88	54.1	0.10 0.40	0.60 2.70	2124.64	723.18	913.60	155.48	0.59236	800
50	50.000 49.988	44	82	35	78.8	8°	74.65	60.3	0.10 0.40	0.60 2.70	2485.84	819.43	1068.91	176.18	0.65144	970

△1 △1

NOTES

△1 Static loads are based on 2/3 of 0.1% Proof Stress of Outer Race material. If 0.2% Proof Stress is used load ratings will be greater by approx 10%. Radial and Axial Static limit loads are based on stress levels of 460 MPa and 230 MPa respectively for Bore sizes up to but not including 25mm. For Bore sizes of 25mm and over, stress levels are based on 430MPa and 215MPa respectively

△2 For Cadmium Plated Outer Race version dimensions shown also apply after Plating

BEARING INSTALLATION

Refer to following section 1.1.2 for recommended Housing and Shaft dimensions and Staking Tools

PART NUMBERS AND SERIES VERSIONS

Series Part Number Codification

Basic Series Part Number — 11 C 06 W G .
Spherical — F
Specification Ident (Ref. Material Data)
'C' for Non-Plated Ball, 'F' for Chrome Plated Ball
Ball Bore Dia Code in mm
Wide
Grooved Outer Race

△2 **Series Versions - Suffix Identification**

Cadmium Plated Outer Race — C
Low Volatiles (Space Prep) — V
0.1 mm o/size Outer Race dia — Y1
0.2 mm o/size Outer Race dia — Y2

SPECIAL TYPES

Bearings are based on the above specifications with non-standard features may be supplied on request

ampep

AMPEP DATA SHEET
1.1.1/18a
ISSUE - 9504

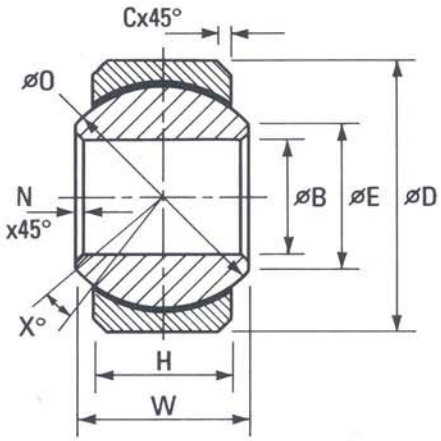
11C -- WZ
11F -- WZ
METRIC SERIES

SPHERICAL BEARINGS - SELF LUBRICATING
WIDE - CHAMFERED OUTER RACE
NORMAL TORQUE

STANDARDS REFERENCES

EN 2584S
EN 2584S--P
EN 2585S
EN 2585S--P
} 05 & 22 SIZES ONLY

Refer to Following Section 5.0 for Part No. Cross Reference.



MATERIALS

***Liner* - AMPEP X1**
Liner system qualified to MIL-B-81820

Outer Race
Corrosion resistant steel to AMS 5643 (H1100 Condition)

Ball
For 11C-- Series
Corrosion resistant steel AISI440C through hardened to 55/62 HRC
For 11F-- Series
Corrosion resistant steel AISI440C through hardened to 55/62 HRC and Spherical Surface Hard Chrome Plated to Def. Stan. 03 - 14

DIMENSIONS, TOLERANCES, LOADS

Part Number 11C --WZ 11F -- WZ	B	W	D	H	C	X°	O	E	N	No load breakout torque	Radial Proj Area	Axial Proj Area	Static Radial Limit Load	Static Axial Limit Load	Distance Travelled per Degree	Approx Mass
	Ball Bore	Ball Width	Race O/Dia	Race Width	Race Chamf		Ball Dia	Ball Face	Ball Chamf							
	–	+ 0.00 - 0.05	+ 0.000 - 0.012	+ 0.10 - 0.10	–		Ref	Ref	–	–						
Code	mm						mm			Nm	mm^2		KN		-3 x10 Metre	g
05	5.000 4.990	7	14	5.5	0.50 0.80	9°	11.09	8.6	0.10 0.40	0.08 0.50	47.51	8.39	21.85	1.93	0.09677	7
06	6.000 5.990	11	16	8.5	0.50 0.80	15°	13.43	7.7	0.10 0.40	0.08 0.50	97.77	36.16	44.97	8.32	0.11719	16
08	8.000 7.990	11	18	8.0	0.50 0.80	14°	15.07	10.3	0.10 0.40	0.08 0.50	102.17	28.80	47.00	6.62	0.13150	17
10	10.000 9.990	12.5	21	10.0	0.50 0.80	10°	17.47	12.2	0.10 0.40	0.12 0.80	153.39	52.96	70.56	12.18	0.15245	27
12	12.000 11.989	16	26	13.0	0.50 0.80	10°	22.28	15.5	0.10 0.40	0.12 0.80	262.46	99.74	120.73	22.94	0.19442	49
15	15.000 14.989	17	29	13.5	0.50 0.80	9°	25.42	18.9	0.10 0.40	0.12 0.80	312.16	106.71	143.59	24.54	0.22183	62
17	17.000 16.989	18	30	14.5	0.50 0.80	9°	27.31	20.1	0.10 0.40	0.12 0.80	362.68	126.20	166.83	29.03	0.23832	69
20	20.000 19.988	20	35	16.0	0.50 0.80	8°	31.78	24.7	0.10 0.40	0.12 0.80	469.71	156.63	216.06	36.03	0.27733	104
22	22.000 21.988	22	40	18.0	0.60 1.00	8°	34.90	27.1	0.10 0.40	0.25 1.00	585.62	206.72	269.83	47.54	0.30455	126
25	25.000 24.988	32	54	26	0.60 1.00	9°	47.63	35.3	0.10 0.40	0.25 1.00	1157.40	434.33	497.68	93.38	0.41564	445
30	30.000 29.988	34	60	28	0.80 1.20	8°	53.18	40.9	0.10 0.40	0.40 2.00	1398.63	509.79	601.41	109.60	0.46408	480
35	35.000 34.988	36	65	29	0.80 1.20	8°	58.01	45.5	0.10 0.40	0.40 2.00	1583.67	546.95	680.98	117.59	0.50623	565
40	40.000 39.988	38	68	31	0.80 1.20	8°	60.44	47.0	0.10 0.40	0.60 2.70	1770.89	635.31	761.48	136.59	0.52743	600
45	45.000 44.988	41	76	33	0.80 1.20	8°	67.88	54.1	0.10 0.40	0.60 2.70	2124.64	723.18	913.60	155.48	0.59236	800
50	50.000 49.988	44	82	35	0.80 1.20	8°	74.65	60.3	0.10 0.40	0.60 2.70	2485.84	819.43	1068.91	176.18	0.65144	970

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PART NUMBERS AND SERIES VERSIONS

Series Part Number Codification

Basic Series Part Number	11	C	06	W	Z	.
Spherical		F				

Specification Ident (Ref. Material Data)
'C' for Non-Plated Ball, 'F' for Chrome Plated Ball
Ball Bore Dia Code in mm
Wide
Chamfered Outer Race

△2 **Series Versions - Suffix Identification**

Cadmium Plated Outer Race	C
Low Volatiles (Space Prep)	V
0.1 mm o/size Outer Race dia	Y1
0.2 mm o/size Outer Race dia	Y2

SPECIAL TYPES

Bearings are based on the above specifications with non-standard features may be supplied on request

△ ### NOTES

△1 Static loads are based on 2/3 of 0.1% Proof Stress of Outer Race material. If 0.2% Proof Stress is used load ratings will be greater by approx 10%. Radial and Axial Static limit loads are based on stress levels of 460 MPa and 230 MPa respectively for Bore sizes up to but not including 25mm. For Bore sizes of 25mm and over, stress levels are based on 430MPa and 215MPa respectively

△2 For Cadmium Plated Outer Race version dimensions shown also apply after Plating

BEARING INSTALLATION

Refer to following section 1.1.2 for recommended Housing and Shaft dimensions and Staking Tools

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SPHERICAL BEARINGS - SELF LUBRICATING SHAFT & HOUSING DIMENSIONS & STAKING TOOLS

SN---, SW---
11AN---, 11AW---
INCH SERIES

SERIES: SN -- G, SN -- GX, SN -- Z, SN -- ZX, 11ANG --, 11ANZ --

Nominal Bore		Recommended Shaft Dia.		Recommended Housing Dia.		Recommended Housing Width		Recommended 45° Housing Chamfer For use when Staking		Staking Tool set number
Code	Size	Max	Min	Max	Min	Max	Min	Max	Min	
		in		in		in		in		
03	3/16	.1897	.1892	.5628	.5623	.228	.218	.025	.020	TSA 03N
04	1/4	.2497	.2492	.6565	.6560	.260	.250	.025	.020	TSA 04N
05	5/16	.3122	.3117	.7503	.7498	.291	.281	.025	.020	TSA 05N
06	3/8	.3747	.3742	.8128	.8123	.322	.312	.025	.020	TSA 06N
07	7/16	.4372	.4367	.9065	.9060	.353	.343	.025	.020	TSA 07N
08	1/2	.4997	.4992	.1.0003	.9998	.400	.390	.045	.040	TSA 08N
09	9/16	.5622	.5617	1.0940	1.0935	.447	.437	.045	.040	TSA 09N
10	5/8	.6247	.6242	1.1878	1.1873	.510	.500	.045	.040	TSA 10N
12	3/4	.7497	.7492	1.4378	1.4373	.603	.593	.045	.040	TSA 12N
14	7/8	.8747	.8742	1.5628	1.5623	.713	.703	.045	.040	TSA 14N
16	1	.9997	.9992	1.7503	1.7498	.807	.797	.045	.040	TSA 16N
20	1 1/4	1.2497	.1.2492	2.0003	1.9998	.952	.942	.045	.040	TSA 20N
24	1 1/2	1.4997	1.4992	2.4378	2.4373	1.140	1.130	.045	.040	TSA 24N
28	1 3/4	1.7497	1.7492	2.8128	2.8123	1.327	1.317	.045	.040	TSA 28N
32	2	1.9997	1.9992	3.1878	3.1873	1.515	1.505	.045	.040	TSA 32N

SERIES: SW -- G, SW -- GX, SW -- Z, SW -- ZX, 11AWG --, 11AWZ --

Nominal Bore		Recommended Shaft Dia.		Recommended Housing Dia.		Recommended Housing Width		Recommended 45° Housing Chamfer For use when Staking		Staking Tool set number
Code	Size	Max	Min	Max	Min	Max	Min	Max	Min	
		in		in		in		in		
03	3/16	.1897	.1892	.6253	.6248	.337	.327	.025	.020	TSA 03W
04	1/4	.2497	.2492	.6253	.6248	.337	.327	.025	.020	TSA 04W
05	5/16	.3122	.3117	.6878	.6873	.327	.317	.025	.020	TSA 05W
06	3/8	.3747	.3742	.8128	.8123	.416	.406	.025	.020	TSA 06W
07	7/16	.4372	.4367	.9378	.9373	.452	.442	.025	.020	TSA 07W
08	1/2	.4997	.4992	1.0003	.9998	.515	.505	.025	.020	TSA 08W
09	9/16	.5622	.5617	1.1253	1.1248	.546	.536	.025	.020	TSA 09W
10	5/8	.6247	.6242	1.1878	1.1873	.577	.567	.025	.020	TSA 10W
12	3/4	.7497	.7492	1.3753	1.3748	.640	.630	.045	.040	TSA 12W
14	7/8	.8747	.8742	1.6253	1.6248	.765	.755	.045	.040	TSA 14W
16	1	.9997	.9992	2.1253	2.1248	1.015	1.005	.045	.040	TSA 16W
20	1 1/4	1.2497	.1.2492	2.3753	2.3748	1.140	1.130	.045	.040	TSA 20W
24	1 1/2	1.4997	1.4992	2.6878	2.6873	1.233	1.223	.045	.040	TSA 24W
28	1 3/4	1.7497	1.7492	3.0003	2.9998	1.327	1.317	.045	.040	TSA 28W
32	2	1.9997	1.9992	3.2503	3.2498	1.390	1.380	.045	.040	TSA 32W

SH---
11BH--,11HH--
INCH SERIES

SPHERICAL BEARINGS - SELF LUBRICATING SHAFT & HOUSING DIMENSIONS & STAKING TOOLS

SERIES: SH -- G, SH -- Z

Nominal Bore		Recommended Shaft Dia.		Recommended Housing Dia.		Recommended Housing Width		Recommended 45° Housing Chamfer For use when Staking		Staking Tool set number
Code	Size	Max	Min	Max	Min	Max	Min	Max	Min	
		in		in		in		in		
03	3/16	.1897	.1892	.6253	.6248	.337	.327	.025	.020	TSA 03H
04	1/4	.2497	.2492	.7403	.7398	.265	.255	.025	.020	TSA 04H
05	5/16	.3122	.3117	.9063	.9058	.355	.345	.025	.020	TSA 05H
06	3/8	.3747	.3742	.9063	.9058	.355	.345	.025	.020	TSA 06H
07	7/16	.4372	.4367	.1.0003	.9998	.355	.345	.025	.020	TSA 07H
08	1/2	.4997	.4992	1.1253	1.1248	.411	.401	.025	.020	TSA 08H
10	5/8	.6247	.6242	1.3753	1.3748	.577	.567	.045	.040	TSA 10H
12	3/4	.7497	.7492	1.5628	1.5623	.630	.620	.045	.040	TSA 12H
14	7/8	.8747	.8742	1.7503	1.7498	.635	.625	.045	.040	TSA 14H
16	1	.9997	.9992	2.1253	2.1248	.845	.835	.045	.040	TSA 16H
20	1 1/4	1.2497	.1.2492	2.5003	2.4998	1.015	1.005	.045	.040	TSA 20H

SERIES: 11BHG --, 11BHZ --, 11HHG --, 11HHZ --

Nominal Bore		Recommended Shaft Dia.		Recommended Housing Dia.		Recommended Housing Width		Recommended 45° Housing Chamfer For use when Staking		Staking Tool set number
Code	Size	Max	Min	Max	Min	Max	Min	Max	Min	
		in		in		in		in		
03	3/16	.1897	.1892	.5628	.5623	.220	.210	.025	.020	TSA 03H/1
031	3/16	.1897	.1892	.6253	.6248	.337	.327	.025	.020	TSA 03H/2
04	1/4	.2497	.2492	.7403	.7398	.265	.255	.025	.020	TSA 04H
05	5/16	.3122	.3117	.9063	.9058	.355	.345	.025	.020	TSA 05H
051	5/16	.3122	.3117	.6878	.6873	.250	.240	.025	.020	TSA 05H/1
06	3/8	.3747	.3742	.9063	.9058	.355	.345	.025	.020	TSA 06H
07	7/16	.4372	.4367	.1.0003	.9998	.355	.345	.025	.020	TSA 07H
08	1/2	.4997	.4992	1.1253	1.1248	.411	.401	.025	.020	TSA 08H
10	5/8	.6247	.6242	1.3753	1.3748	.577	.567	.045	.040	TSA 10H
12	3/4	.7497	.7492	1.5628	1.5623	.630	.620	.045	.040	TSA 12H
14	7/8	.8747	.8742	1.7503	1.7498	.635	.625	.045	.040	TSA 14H
16	1	.9997	.9992	2.1253	2.1248	.845	.835	.045	.040	TSA 16H
20	1 1/4	1.2497	1.2492	2.5003	2.4998	1.015	1.005	.045	.040	TSA 20H
24	1 1/2	1.4997	1.4992	3.0003	2.9998	1.185	1.175	.045	.040	TSA 24H

SPHERICAL BEARINGS - SELF LUBRICATING SHAFT & HOUSING DIMENSIONS & STAKING TOOLS

11BN--, 11BW--
11HN--, 11HW--
INCH SERIES

SERIES: 11BNG --, 11BNZ --, 11HNG --, 11HNZ --

Nominal Bore		Recommended Shaft Dia.		Recommended Housing Dia.		Recommended Housing Width		Recommended 45° Housing Chamfer For use when Staking		Staking Tool set number
Code	Size	Max	Min	Max	Min	Max	Min	Max	Min	
		in		in		in		in		
03	3/16	.1897	.1892	.5628	.5623	.228	.218	.025	.020	TSA 03N/1
04	1/4	.2497	.2492	.6565	.6560	.260	.250	.025	.020	TSA 04N/1
05	5/16	.3122	.3117	.7503	.7498	.291	.281	.025	.020	TSA 05N
051	5/16	.3122	.3117	.7503	.7498	.291	.281	.025	.020	TSA 051N
06	3/8	.3747	.3742	.8128	.8123	.322	.312	.025	.020	TSA 06N
07	7/16	.4372	.4367	.9065	.9060	.353	.343	.025	.020	TSA 07N
08	1/2	.4997	.4992	.1.0003	.9998	.400	.390	.045	.040	TSA 08N
09	9/16	.5622	.5617	1.0940	1.0935	.447	.437	.045	.040	TSA 09N
10	5/8	.6247	.6242	1.1878	1.1873	.510	.500	.045	.040	TSA 10N
12	3/4	.7497	.7492	1.4378	1.4373	.603	.593	.045	.040	TSA 12N
14	7/8	.8747	.8742	1.5628	1.5623	.713	.703	.045	.040	TSA 14N
16	1	.9997	.9992	1.7503	1.7498	.807	.797	.045	.040	TSA 16N
20	1 1/4	1.2497	.1.2492	2.0003	1.9998	.952	.942	.045	.040	TSA 20N
24	1 1/2	1.4997	1.4992	2.4378	2.4373	1.140	1.130	.045	.040	TSA 24N
28	1 3/4	1.7497	1.7492	2.8128	2.8123	1.327	1.317	.045	.040	TSA 28N
32	2	1.9997	1.9992	3.1878	3.1873	1.515	1.505	.045	.040	TSA 32N

SERIES: 11BWG --, 11BWZ --, 11HWG --, 11HWZ --,

Nominal Bore		Recommended Shaft Dia.		Recommended Housing Dia.		Recommended Housing Width		Recommended 45° Housing Chamfer For use when Staking		Staking Tool set number
Code	Size	Max	Min	Max	Min	Max	Min	Max	Min	
		in		in		in		in		
03	3/16	.1897	.1892	.6253	.6248	.337	.327	.025	.020	TSA 03W/1
04	1/4	.2497	.2492	.6253	.6248	.337	.327	.025	.020	TSA 04W/1
05	5/16	.3122	.3117	.6878	.6873	.327	.317	.025	.020	TSA 05W
06	3/8	.3747	.3742	.8128	.8123	.416	.406	.025	.020	TSA 06W
07	7/16	.4372	.4367	.9378	.9373	.452	.442	.025	.020	TSA 07W
071	7/16	.4372	.4367	.9065	.9060	.452	.442	.025	.020	TSA 071W
08	1/2	.4997	.4992	1.0003	.9998	.515	.505	.025	.020	TSA 08W
09	9/16	.5622	.5617	1.1253	1.1248	.546	.536	.025	.020	TSA 09W
10	5/8	.6247	.6242	1.1878	1.1873	.577	.567	.025	.020	TSA 10W
12	3/4	.7497	.7492	1.3753	1.3748	.640	.630	.045	.040	TSA 12W
14	7/8	.8747	.8742	1.6253	1.6248	.765	.755	.045	.040	TSA 14W
16	1	.9997	.9992	2.1253	2.1248	1.015	1.005	.045	.040	TSA 16W
20	1 1/4	1.2497	.1.2492	2.3753	2.3748	1.140	1.130	.045	.040	TSA 20W
24	1 1/2	1.4997	1.4992	2.6878	2.6873	1.233	1.223	.045	.040	TSA 24W
28	1 3/4	1.7497	1.7492	3.0003	2.9998	1.327	1.317	.045	.040	TSA 28W
32	2	1.9997	1.9992	3.2503	3.2498	1.390	1.380	.045	.040	TSA 32W

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AMPEP DATA SHEET

1.1.2/2b

ISSUE - 9305

SPHERICAL BEARINGS - SELF LUBRICATING SHAFT & HOUSING DIMENSIONS & STAKING TOOLS

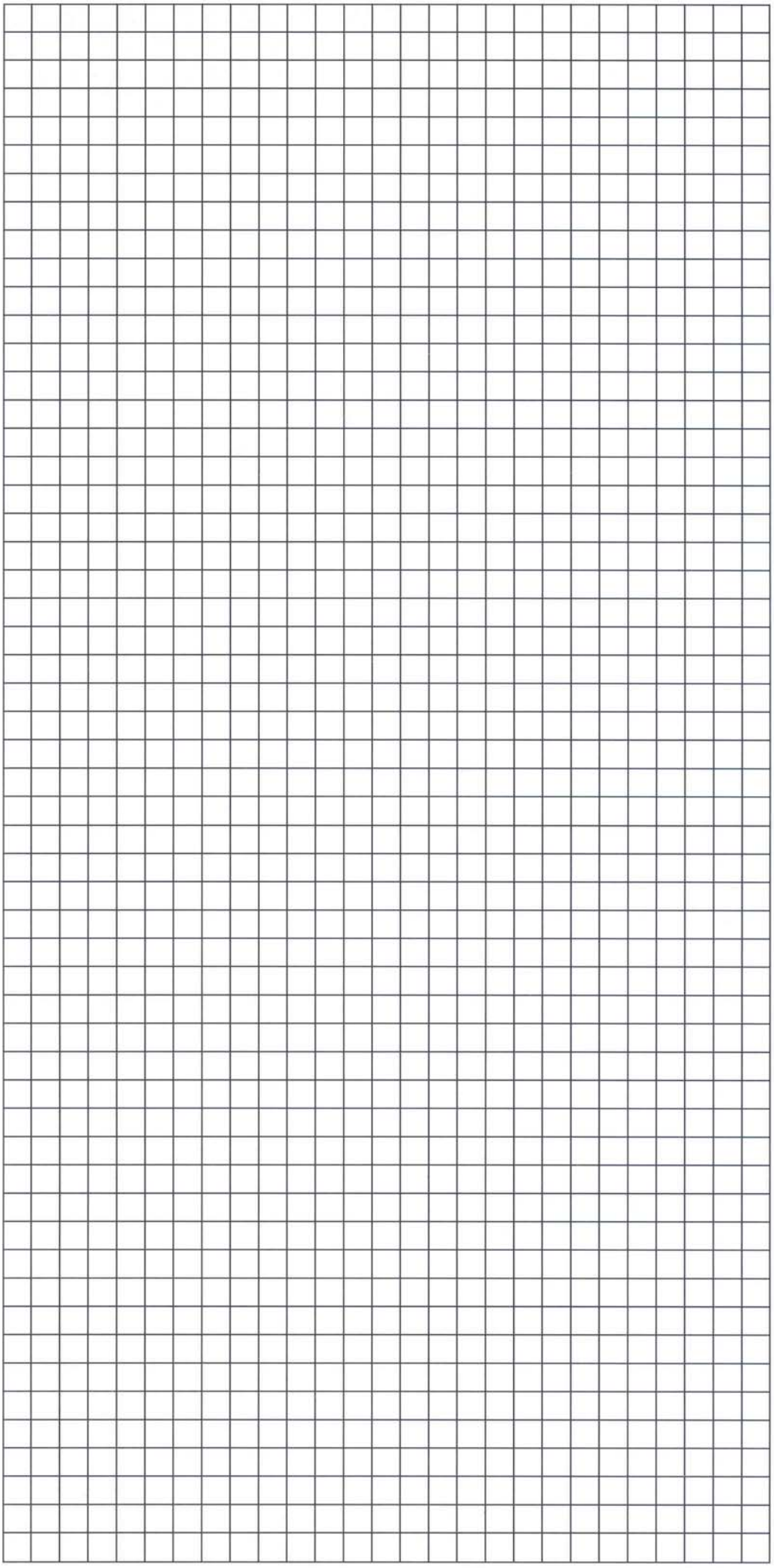
--- SN
--- SW
METRIC SERIES

SERIES: -- GSN, -- ZSN

Nominal Bore	Recommended Shaft Dia.		Recommended Housing Dia.		Recommended Housing Width		Recommended 45° Housing Chamfer For use when Staking		Staking Tool set number
Code	Max	Min	Max	Min	Max	Min	Max	Min	
	mm		mm		mm		mm		
06	5.992	5.980	16.008	15.995	6.70	6.50	0.45	0.35	TSM 06N
10	9.992	9.980	21.008	20.995	8.20	8.00	0.65	0.55	TSM 10N
12	11.992	11.980	22.008	21.995	7.20	7.00	0.45	0.35	TSM 12N
15	14.992	14.980	26.008	25.995	9.20	9.00	0.45	0.35	TSM 15N
17	16.992	16.980	30.008	29.995	10.20	10.00	0.45	0.35	TSM 17N
20	19.992	19.980	35.008	34.995	12.20	12.00	0.45	0.35	TSM 20N
25	24.992	24.980	42.008	41.995	16.20	16.00	0.65	0.55	TSM 25N
30	29.992	29.980	47.008	46.995	18.20	18.00	0.65	0.55	TSM 30N
35	34.992	34.980	55.008	54.995	20.20	20.00	1.15	1.05	TSM 35N
40	39.992	39.980	62.008	61.995	22.20	22.00	1.15	1.05	TSM 40N
45	44.992	44.980	68.008	67.995	25.20	25.00	1.15	1.05	TSM 45N
50	49.992	49.980	75.008	74.995	28.20	28.00	1.15	1.05	TSM 50N

SERIES: -- GSW, -- ZSW

Nominal Bore	Recommended Shaft Dia.		Recommended Housing Dia.		Recommended Housing Width		Recommended 45° Housing Chamfer For use when Staking		Staking Tool set number
Code	Max	Min	Max	Min	Max	Min	Max	Min	
	mm		mm		mm		mm		
05	4.992	4.980	14.008	13.995	5.70	5.50	0.45	0.35	TSM 05W
06	5.992	5.980	16.008	15.995	8.70	8.50	0.45	0.35	TSM 06W
08	7.992	7.980	18.008	17.995	8.20	8.00	0.45	0.35	TSM 08W
10	9.992	9.980	21.008	20.995	10.20	10.00	0.65	0.55	TSM 10W
12	11.992	11.980	26.008	25.995	13.20	13.00	0.65	0.55	TSM 12W
15	14.992	14.980	29.008	28.995	13.70	13.50	0.65	0.55	TSM 15W
17	16.992	16.980	30.008	29.995	14.70	14.50	0.65	0.55	TSM 17W
20	19.992	19.980	35.008	34.995	16.20	16.00	1.15	1.05	TSM 20W
22	21.992	21.980	40.008	39.995	18.20	18.00	1.15	1.05	TSM 22W
25	24.992	24.980	54.008	53.995	26.20	26.00	1.15	1.05	TSM 25W
30	29.992	29.980	60.008	59.995	28.20	28.00	1.15	1.05	TSM 30W
35	34.992	34.980	65.008	64.995	29.20	29.00	1.15	1.05	TSM 35W
40	39.992	39.980	68.008	67.995	31.20	31.00	1.15	1.05	TSM 40W
45	44.992	44.980	76.008	75.995	33.20	33.00	1.15	1.05	TSM 45W
50	49.992	49.980	82.008	81.995	35.20	35.00	1.15	1.05	TSM 50W



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AMPEP DATA SHEET

1.1.2/3b

ISSUE - 9305

SPHERICAL BEARINGS - SELF LUBRICATING SHAFT & HOUSING DIMENSIONS & STAKING TOOLS

11C-- E & N-
11F-- E & N-
METRIC SERIES

SERIES: 11C-- EG, 11C-- EZ, 11F-- EG, 11F-- EZ

Nominal Bore	Recommended Shaft Dia.		Recommended Housing Dia.		Recommended Housing Width		Recommended 45° Housing Chamfer For use when Staking		Staking Tool set number
Code	Max	Min	Max	Min	Max	Min	Max	Min	
	mm		mm		mm		mm		
05	4.992	4.980	16.008	15.995	8.70	8.50	0.45	0.35	TSM 05E
08	7.992	7.980	18.008	17.995	7.20	7.00	0.45	0.35	TSM 08E
12	11.992	11.980	25.008	24.995	10.20	10.00	0.65	0.55	TSM 12E
15	14.992	14.980	29.008	28.995	12.20	12.00	0.65	0.55	TSM 15E
17	17.992	17.980	31.008	30.995	13.70	13.50	0.65	0.55	TSM 17E
25	24.992	24.980	45.008	44.995	20.20	20.00	1.15	1.05	TSM 25E
30	29.992	29.980	51.008	50.995	24.20	24.00	1.15	1.05	TSM 30E
35	34.992	34.980	57.008	56.995	26.20	26.00	1.15	1.05	TSM 35E
40	39.992	39.980	64.008	63.995	29.20	29.00	1.15	1.05	TSM 40E
45	44.992	44.980	72.008	71.995	32.20	32.00	1.15	1.05	TSM 45E
50	49.992	49.980	80.008	79.995	34.20	34.00	1.15	1.05	TSM 50E
55	54.992	54.980	96.008	95.995	40.20	40.00	1.15	1.05	TSM 55E

SERIES: 11C-- NG, 11C-- NZ, 11F-- NG, 11F-- NZ

Nominal Bore	Recommended Shaft Dia.		Recommended Housing Dia.		Recommended Housing Width		Recommended 45° Housing Chamfer For use when Staking		Staking Tool set number
Code	Max	Min	Max	Min	Max	Min	Max	Min	
	mm		mm		mm		mm		
05	5.992	5.980	16.008	15.995	6.70	6.50	0.45	0.35	TSM 06N
10	9.992	9.980	21.008	20.995	8.20	8.00	0.65	0.55	TSM 10N
12	11.992	11.980	22.008	21.995	7.20	7.00	0.45	0.35	TSM 12N
15	14.992	14.980	26.008	25.995	9.20	9.00	0.45	0.35	TSM 15N
17	16.992	16.980	30.008	29.995	10.20	10.00	0.45	0.35	TSM 17N
20	19.992	19.980	35.008	34.995	12.20	12.00	0.45	0.35	TSM 20N
25	24.992	24.980	42.008	41.995	16.20	16.00	0.65	0.55	TSM 25N
30	29.992	29.980	47.008	46.995	18.20	18.00	0.65	0.55	TSM 30N
35	34.992	34.980	55.008	54.995	20.20	20.00	1.15	1.05	TSM 35N
40	39.992	39.980	62.008	61.995	22.20	22.00	1.15	1.05	TSM 40N
45	44.992	44.980	68.008	67.995	25.20	25.00	1.15	1.05	TSM 45N
50	49.992	49.980	75.008	74.995	28.20	28.00	1.15	1.05	TSM 50N

11C-- W-
11F-- W-
METRIC SERIES

SPHERICAL BEARINGS - SELF LUBRICATING SHAFT & HOUSING DIMENSIONS & STAKING TOOLS

SERIES: 11C-- WG, 11C-- WZ, 11F-- WG, 11F-- WZ

Nominal Bore	Recommended Shaft Dia.		Recommended Housing Dia.		Recommended Housing Width		Recommended 45° Housing Chamfer For use when Staking		Staking Tool set number
Code	Max	Min	Max	Min	Max	Min	Max	Min	
	mm		mm		mm		mm		
05	4.992	4.980	14.008	13.995	5.70	5.50	0.45	0.35	TSM 05W
06	5.992	5.980	16.008	15.995	8.70	8.50	0.45	0.35	TSM 06W
08	7.992	7.980	18.008	17.995	8.20	8.00	0.45	0.35	TSM 08W
10	9.992	9.980	21.008	20.995	10.20	10.00	0.65	0.55	TSM 10W
12	11.992	11.980	26.008	25.995	13.20	13.00	0.65	0.55	TSM 12W
15	14.992	14.980	29.008	28.995	13.70	13.50	0.65	0.55	TSM 15W
17	16.992	16.980	30.008	29.995	14.70	14.50	0.65	0.55	TSM 17W
20	19.992	19.980	35.008	34.995	16.20	16.00	1.15	1.05	TSM 20W
22	21.992	21.980	40.008	39.995	18.20	18.00	1.15	1.05	TSM 22W
25	24.992	24.980	54.008	53.995	26.20	26.00	1.15	1.05	TSM 25W
30	29.992	29.980	60.008	59.995	28.20	28.00	1.15	1.05	TSM 30W
35	34.992	34.980	65.008	64.995	29.20	29.00	1.15	1.05	TSM 35W
40	39.992	39.980	68.008	67.995	31.20	31.00	1.15	1.05	TSM 40W
45	44.992	44.980	76.008	75.995	33.20	33.00	1.15	1.05	TSM 45W
50	49.992	49.980	82.008	81.995	35.20	35.00	1.15	1.05	TSM 50W

STANDARD SERIES SPECIFICATIONS					DATA SHEET
INCH SERIES	**AMPEP X1 Liner**	MALE	RH PLAIN	R -- MR	**1.2.1/1a**
			LH PLAIN	R -- ML	
			RH KEYWAYED	R -- MRK	
			LH KEYWAYED	R -- MLK	
		FEMALE	RH PLAIN	R -- FR	**1.2.1/1b**
			LH PLAIN	R -- FL	
			RH KEYWAYED	R -- FRK	
			LH KEYWAYED	R -- FLK	
	AMPEP X1 Liner	MALE	RH PLAIN	12 BMR --	**1.2.1/2a**
			LH PLAIN	12 BML --	
			RH KEYWAYED	12 BMR -- K	
			LH KEYWAYED	12 BML -- K	
		FEMALE	RH PLAIN	12 BFR --	**1.2.1/3a**
			LH PLAIN	12 BFL --	
			RH KEYWAYED	12 BFR -- K	**1.2.1/3b**
			LH KEYWAYED	12 BFL -- K	
			RH WIDE	12 BFR -- W	
			LH WIDE	12 BFL -- W	
		MALE	RH PLAIN	12 BNMR --	**1.2.1/4a**
			LH PLAIN	12 BNML --	
			RH KEYWAYED	12 BNMR -- K	
			LH KEYWAYED	12 BNML -- K	
		FEMALE	RH PLAIN	12 BNFR --	**1.2.1/5a**
			LH PLAIN	12 BNFL --	
			RH KEYWAYED	12 BNFR -- K	**1.2.1/5b**
			LH KEYWAYED	12 BNFL -- K	
			RH WIDE	12 BNFR -- W	
			LH WIDE	12 BNFL -- W	
METRIC SERIES	**AMPEP X1 Liner**	***Wide Range of Metric Size Rod Ends Manufactured. Details of Specific Parts Available - Supplied on Request.***			
	AMPEP X1 Liner				

ampep

AMPEP DATA SHEET

1.2.0/INDEX b

ISSUE - 9305

ROD END BEARINGS - SELF LUBRICATING WIDE - MALE

12 BMR--
12 BML--
INCH SERIES

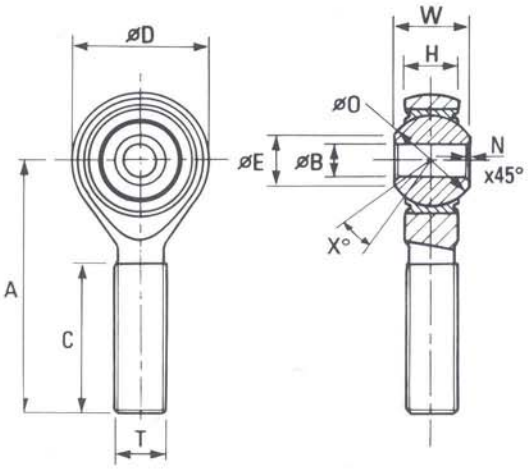
MATERIALS

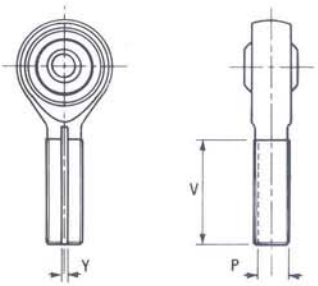
***Liner* - AMPEP X1**
Liner system qualified to MIL-B-81820

Outer Race
Corrosion resistant steel
AMS 5643 (H1100 condition)

Ball
Corrosion resistant steel to AISI440C
through hardened to 55/62 HRC

Rod End Body
Alloy steel to MIL-S-5000 (4340) 39/42 HRC
Cadmium Plated to QQ-P-416 Type II Class 2





N = .005/.015

STANDARDS REFERENCES

MIL. M81935/1
ASN-A2125

Refer to Following Section 5.0 for Part No. Cross Reference.

DIMENSIONS, TOLERANCES

Part Number 12BMR-- 12BML--	B	W	D	H	A	T	C	X	O	E
	Ball Bore Dia	Ball Width	Head Dia	Head Width	Length	Thread	Full Thread Length	–	Ball Dia	Ball Face
	+ .0000 - .0005	+ .000 - .002	+ .010 - .010	+ .005 - .005	+ .010 - .010	UNJF-3A	+ .031 - .031	Min	Ref	Ref
03	.1900	.437	.806	.337	1.562	5/16 -24	.968	15°	.531	.300
04	.2500	.437	.806	.337	1.562	5/16 -24	.968	15°	.531	.300
05	.3125	.437	.900	.327	1.875	5/16 -24	1.187	14°	.593	.360
06	.3750	.500	1.025	.416	1.938	3/8 -24	1.187	8°	.687	.466
07	.4375	.562	1.150	.452	2.125	7/16 -20	1.281	10°	.781	.537
08	.5000	.625	1.337	.515	2.438	1/2 -20	1.468	9°	.875	.607
10	.6250	.750	1.525	.577	2.625	5/8 -18	1.562	12°	1.062	.747
12	.7500	.875	1.775	.640	2.875	3/4 -16	1.687	13°	1.250	.845
14	.8750	.875	2.025	.765	3.375	7/8 -14	2.000	6°	1.375	.995
16	1.0000	1.375	2.775	1.015	4.125	1 1/4 -12	2.343	12°	1.875	1.269

TORQUES, LOADS

No Load Breakout Torque	Radial Proj Area	Ultimate Static Load	Distance Travelled per Degree	Max Mass
lbf.in	**in²**	**lbf**	**ft**	**lb**
.5 6	.145	2360	.00038	.072
.5 6	.145	4860	.00038	.072
.5 6	.156	7180	.00043	.087
1 15	.243	8550	.00050	.136
1 15	.304	12000	.00056	.183
1 15	.406	19500	.00063	.278
1 15	.558	21900	.00077	.424
1 15	.681	29300	.00091	.639
1 24	.921	34500	.0010	.963
1 24	1.782	80300	.0014	2.546

KEYWAYED VERSION

Part Number 12BMR--K 12BML--K	P	Y	V
	A/Slot Thickness	Slot Width	Slot Length
	+ .000 - .005	+ .005 - .000	+ .000 - .020
03	.268	.062	.980
04	.268	.062	.980
05	.268	.062	1.270
06	.319	.093	1.235
07	.383	.093	1.402
08	.445	.093	1.589
10	.541	.125	1.683
12	.663	.125	1.808
14	.777	.156	2.121
16	.900	.156	2.464

PART NUMBERS AND SERIES VERSIONS

Series Part Number Codification

Basic Series Part Number — 12 B M R 03 .
Rod End — 12
Specification Ident — B
Male — M
Thread (Right Hand - R, Left Hand - L) — R / L
Ball bore dia code in multiples of 1/16 inch — 03

Series Versions - Suffix Identification

Keywayed — K

SPECIAL TYPES

Bearings based on the above specification with non-standard features may be supplied on request

ampep

ROD END BEARINGS - SELF LUBRICATING WIDE - FEMALE

12 BFR--
12 BFL--
INCH SERIES

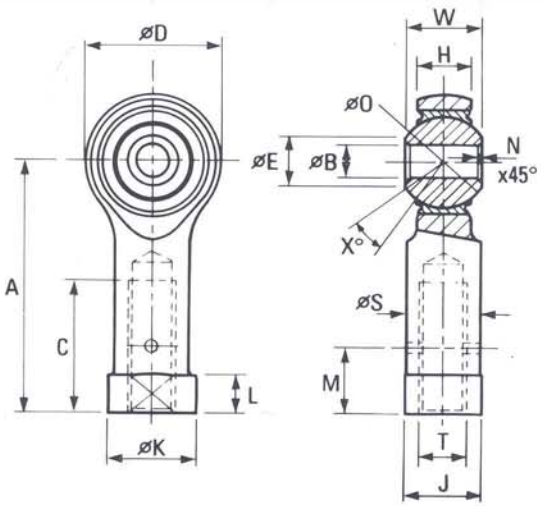
MATERIALS

***Liner* - AMPEP X1**
Liner system qualified to MIL-B-81820

Outer Race
Corrosion resistant steel
AMS 5643 (H1100 condition)

Ball
Corrosion resistant steel to AISI440C
through hardened to 55/62 HRC

Rod End Body
Alloy steel to MIL-S-5000 (4340) 39/42 HRC
Cadmium Plated to QQ-P-416 Type II Class 2



N = .005/.015

STANDARDS REFERENCES

MIL. M81935/2
ASN-A2126

Refer to Following Section 5.0 for Part No. Cross Reference.

DIMENSIONS, TOLERANCES

Part Number 12BFR-- 12BFL--	B	W	D	H	A	J	K	M	L	T	C	S	X	O	E
	Ball Bore Dia	Ball Width	Head Dia	Head Width	Length	A/Flats	Flat Dia	Hole Centre	—	Thread	Full Thread Depth	Shank Dia	—	Ball Dia	Ball Face
	+ .0000 - .0005	+ .000 - .002	+ .010 - .010	+ .005 - .005	+ .010 - .010	+ .002 - .010	Ref	Ref	+ .010 - .062	UNJF-3B	Min	+ .010 - .010	Min	Ref	Ref
03	.1900	.437	.806	.337	1.375	.437	.500	.375	.188	5/16 -24	.750	.422	15°	.531	.300
04	.2500	.437	.806	.337	1.469	.437	.500	.375	.188	5/16 -24	.750	.422	15°	.531	.300
05	.3125	.437	.900	.327	1.625	.500	.580	.437	.250	3/8 -24	.875	.485	14°	.593	.360
06	.3750	.500	1.025	.416	1.812	.562	.660	.437	.250	3/8 -24	1.000	.547	8°	.687	.466
07	.4375	.562	1.150	.452	2.000	.625	.720	.500	.250	7/16 -20	1.125	.610	10°	.781	.537
08	.5000	.625	1.337	.515	2.250	.750	.880	.562	.250	1/2 -20	1.250	.735	9°	.875	.607
10	.6250	.750	1.525	.577	2.500	.875	1.020	.687	.375	5/8 -18	1.375	.860	12°	1.062	.747
12	.7500	.875	1.775	.640	2.875	1.000	1.160	.812	.375	3/4 -16	1.625	.985	13°	1.250	.845
14	.8750	.875	2.025	.765	3.375	1.125	1.300	.937	.500	7/8 -14	1.875	1.110	6°	1.375	.995
16	1.0000	1.375	2.775	1.015	4.125	1.750	2.020	1.312	.563	1 1/4 -12	2.125	1.688	12°	1.875	1.269

TORQUES, LOADS

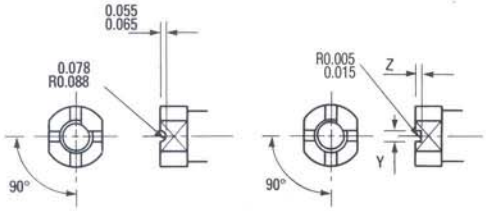
Part No.	No Load Breakout Torque	Radial Proj Area	Ultimate Static Load	Distance Travelled per Degree	Max Mass
	lbf.in	in²	lbf	ft	lb
03	.5 6	.145	2360	.00038	.080
04	.5 6	.145	4860	.00038	.084
05	.5 6	.156	7180	.00043	.102
06	1 15	.243	8550	.00050	.161
07	1 15	.304	12000	.00056	.212
08	1 15	.406	19500	.00063	.325
10	1 15	.558	21900	.00077	.481
12	1 15	.681	29300	.00091	.673
14	1 24	.921	34500	.00100	.959
16	1 24	1.782	80300	.00140	2.717

NOTE

SEE OVERLEAF FOR DETAILS OF KEYWAYED VERSION PART NUMBERS, SERIES VERSIONS AND SPECIAL TYPES

12BFR--
12BFL--
INCH SERIES

ROD END BEARINGS - SELF LUBRICATING WIDE - FEMALE



2 SLOTS -03K to -06K
4 SLOTS -07K & -08K

4 SLOTS -10K to -16K
4 SLOTS -03W to -16W

KEYWAYED VERSION

Part Number 12BFR--K 12BFL--K	Z	Y
	Slot Depth	Slot Width
	+ .005 - .000	+ .005 - .000
03	—	—
04	—	—
05	—	—
06	—	—
07	—	—
08	—	—
10	.077	.125
12	.077	.125
14	.086	.156
16	.116	.187

KEYWAYED VERSION

Part Number 12BFR--W 12BFL--W	Z	Y
	Slot Depth	Slot Width
	+ .005 - .000	+ .005 - .000
03	.110	.062
04	.110	.062
05	.110	.093
06	.110	.093
07	.110	.093
08	.110	.093
10	.110	.125
12	.110	.125
14	.110	.156
16	.116	.187

PART NUMBERS AND SERIES VERSIONS

Series Part Number Codification

Basic Series Part Number	12	B	F	R	03	.
Rod End						
Specification Ident						
Female						
Thread (Right Hand - R, Left Hand - L)				L		
Ball bore dia code in multiples of 1/16 inch						

Series Versions - Suffix Identification

Keywayed	K
	W

SPECIAL TYPES

Bearings based on the above specification with non-standard features may be supplied on request

NOTE

See overleaf for Materials, Dimensions and Tolerances. Torques and Loads for basic Rod End Design

ROD END BEARINGS - SELF LUBRICATING NARROW - MALE

12 BNMR--
12 BNML--
INCH SERIES

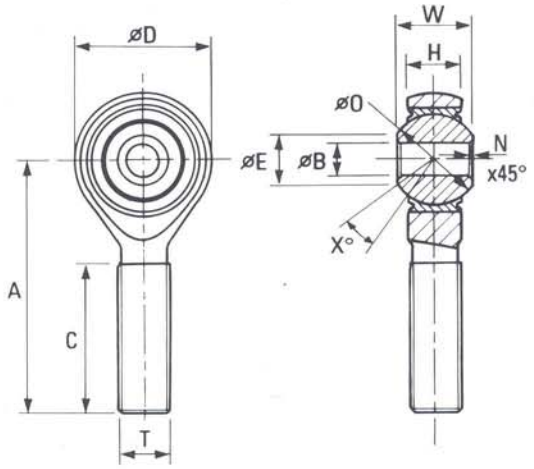
MATERIALS

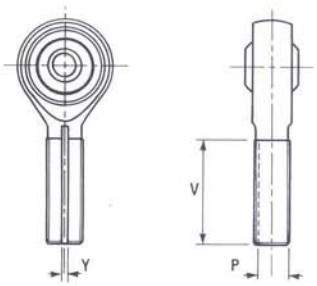
***Liner* - AMPEP X1**
Liner system qualified to MIL-B-81820

Outer Race
Corrosion resistant steel
AMS 5643 (H1100 condition)

Ball
Corrosion resistant steel to AISI440C
through hardened to 55/62 HRC

Rod End Body
Alloy steel to MIL-S-5000 (4340) 39/42 HRC
Cadmium Plated to QQ-P-416 Type II Class 2





N = .005/.015

STANDARDS REFERENCES

M81935/4

Refer to Following Section 5.0 for Part No. Cross Reference.

DIMENSIONS, TOLERANCES

Part Number 12BNMR-- 12BNML--	B	W	D	H	A	T	C	X	O	E
	Ball Bore Dia	Ball Width	Head Dia	Head Width	Length	Thread	Full Thread Length	–	Ball Dia	Ball Face
	+ .0000 - .0005	+ .000 - .002	+ .010 - .010	+ .005 - .005	+ .010 - .010	UNJF-3A	+ .031 - .031	Min	Ref	Ref
03	.1900	.281	.680	.228	1.315	.250 - 28	0.775	10°	.437	.293
04	.2500	.343	.827	.260	1.443	.250 - 28	0.775	10°	.500	.364
05	.3125	.375	.984	.291	1.948	.3125 - 24	1.187	10°	.593	.419
06	.3750	.406	1.131	.322	2.030	.375 - 24	1.187	9°	.625	.475
07	.4375	.437	1.294	.353	2.250	.4375 - 20	1.281	8°	.687	.530
08	.5000	.500	1.459	.400	2.544	.500 - 20	1.468	8°	.781	.600
10	.6250	.625	1.763	.510	2.832	.625 - 18	1.562	8°	1.000	.739
12	.7500	.750	2.140	.603	3.193	.750 - 16	1.687	8°	1.250	.920
14	.8750	.875	2.372	.713	3.677	.875 - 14	2.000	8°	1.375	.980
16	1.0000	1.000	2.681	.807	3.968	1.000 - 12	2.100	9°	1.562	1.118

TORQUES, LOADS

No Load Breakout Torque	Radial Proj Area	Ultimate Static Load	Distance Travelled per Degree	Approx Mass
lbf.in	**in²**	**lbf**	**ft**	**lb**
.5 6	.071	3000	.00031	.038
.5 6	.098	5300	.00036	.045
1 15	.135	8600	.00043	.081
1 15	.162	13000	.00045	.120
1 15	.199	17800	.00050	.172
1 15	.272	24200	.00057	.254
1 15	.459	38500	.00072	.455
1 15	.690	56600	.00091	.774
1 24	.850	77400	.0010	1.141
1 24	1.112	101400	.00113	1.646

KEYWAYED VERSION

Part Number 12BNMR--K 12BNML--K	P	Y	V
	Keyway Thickness	Keyway Width	Keyway Length
	+ .000 - .005	+ .005 - .000	+ .000 - .020
03	.207	.062	.896
04	.207	.062	.896
05	.268	.062	1.308
06	.319	.093	1.308
07	.383	.093	1.402
08	.445	.093	1.589
10	.541	.125	1.683
12	.663	.125	1.808
14	.777	.156	2.121
16	.900	.156	2.221

PART NUMBERS AND SERIES VERSIONS

Series Part Number Codification

Basic Series Part Number — 12 B N M R 03 .
Rod End — B
Specification Ident — N
Narrow — M
Male — R
Thread (Right Hand - R, Left Hand - L) — 03
Ball bore dia code in multiples of 1/16 inch

Series Versions - Suffix Identification

Keywayed — K

SPECIAL TYPES

Bearings based on the above specification with non-standard features may be supplied on request

ampep

AMPEP DATA SHEET
1.2.1/4a
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ROD END BEARINGS - SELF LUBRICATING NARROW - FEMALE

12 BNFR--
12 BNFL--
INCH SERIES

MATERIALS

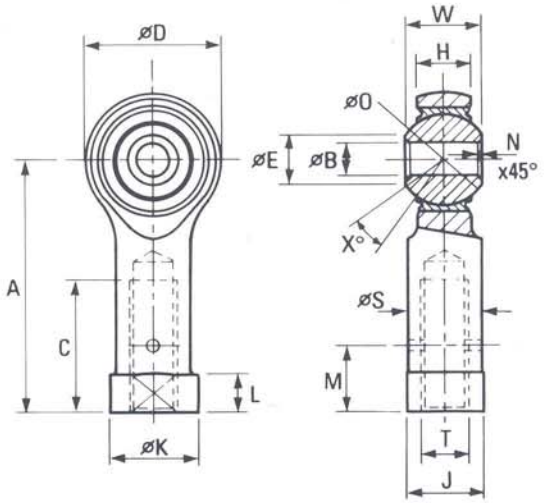
***Liner* - AMPEP X1**
Liner system qualified to MIL-B-81820

Outer Race
Corrosion resistant steel
AMS 5643 (H1100 condition)

Ball
Corrosion resistant steel to AISI440C
through hardened to 55/62 HRC

Rod End Body
Alloy steel to MIL-S-5000 (4340) 39/42 HRC
Cadmium Plated to QQ-P-416 Type II Class 2

N = .005/.015



STANDARDS REFERENCES

M81935/5

Refer to Following Section 5.0 for Part No. Cross Reference.

DIMENSIONS, TOLERANCES

Part Number 12BNFR-- 12BNFL--	B	W	D	H	A	J	K	M	L	T	C	S	X	O	E
	Ball Bore Dia	Ball Width	Head Dia	Head Width	Length	A/Flats	Flat Dia	Hole Centre	—	Thread	Thread Length	Shank Dia	—	Ball Dia	Ball Face
	+ .0000 - .0005	+ .000 - .002	+ .010 - .010	+ .005 - .005	+ .010 - .010	+ .002 - .010	Ref	Ref	+ .010 - .062	UNJF-3B	Min	+ .010 - .010	Min	Ref	Ref
03	.1900	.281	.680	.228	1.210	.375	.430	.312	.188	.250 - 28	.625	.329	10°	.437	.293
04	.2500	.343	.827	.260	1.338	.375	.430	.312	.188	.250 - 28	.625	.329	10°	.500	.364
05	.3125	.375	.984	.291	1.566	.437	.500	.375	.188	.3125 - 24	.750	.413	10°	.593	.419
06	.3750	.406	1.131	.322	1.908	.625	.720	.437	.250	.375 - 24	1.000	.501	9°	.625	.475
07	.4375	.437	1.294	.353	2.125	.625	.720	.500	.250	.4375 - 20	1.125	.584	8°	.687	.530
08	.5000	.500	1.459	.400	2.356	.875	1.020	.562	.375	.500 - 20	1.250	.672	8°	.781	.600
10	.6250	.625	1.763	.510	2.707	.875	1.020	.687	.375	.625 - 18	1.375	.845	8°	1.000	.793
12	.7500	.750	2.140	.603	3.193	1.125	1.300	.812	.500	.750 - 16	1.625	1.017	8°	1.250	.920
14	.8750	.875	2.372	.713	3.677	1.250	1.375	.937	.500	.875 - 14	1.875	1.187	8°	1.375	.980
16	1.0000	1.000	2.681	.807	4.101	1.375	1.590	1.062	.500	1.000 - 12	2.125	1.356	9°	1.562	1.118

TORQUES, LOADS

Part No.	No Load Breakout Torque Max	Radial Proj Area	Ultimate Static Load	Distance Travelled per Degree	Max Mass
	lbf.in	in²	lbf	ft	lb
03	.5 6	.071	3000	.00031	.044
04	.5 6	.098	5500	.00036	.052
05	1 15	.135	8900	.00043	.087
06	1 15	.162	13400	.00045	.137
07	1.' 15	.199	18200	.00050	.193
08	1 15	.272	24600	.00057	.279
10	1 15	.459	39500	.00072	.504
12	1 15	.690	57200	.00091	.860
14	1 24	.850	77800	.0010	1.266
16	1 24	1.112	101000	.00113	1.814

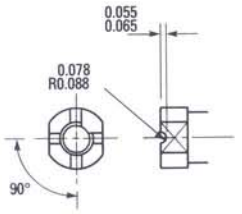
NOTE

SEE OVERLEAF FOR DETAILS OF KEYWAYED VERSION
PART NUMBERS, SERIES VERSIONS AND SPECIAL TYPES

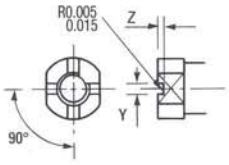
ampep

12BNFR--
12BNFL--
INCH SERIES

ROD END BEARINGS - SELF LUBRICATING
NARROW - FEMALE



2 SLOTS -03K to -06K
4 SLOTS -07K & -08K



4 SLOTS -10K to -16K
4 SLOTS -03W to -16W

KEYWAYED VERSION

Part Number 12BNFR--K 12BNFL--K	Z Slot Depth + .005 - .000	Y Slot Width + .005 - .000
03	—	—
04	—	—
05	—	—
06	—	—
07	—	—
08	—	—
10	.077	.125
12	.077	.125
14	.086	.156
16	.094	.156

KEYWAYED VERSION

Part Number 12BNFR--W 12BNFL--W	Z Slot Depth + .005 - .000	Y Slot Width + .005 - .000
03	.110	.062
04	.110	.062
05	.110	.093
06	.110	.093
07	.110	.093
08	.110	.093
10	.110	.125
12	.110	.125
14	.110	.156
16	.110	.156

PART NUMBERS AND SERIES VERSIONS

Series Part Number Codification

Basic Series Part Number	12	B	N	F	R	03	.
Rod End							
Specification Ident							
Narrow							
Female							
Thread (Right Hand - R, Left Hand - L)					L		
Ball bore dia code in multiples of 1/16 inch							

Series Versions - Suffix Identification

Keywayed	K
	W

SPECIAL TYPES

Bearings based on the above specification with non-standard features may be supplied on request

NOTE

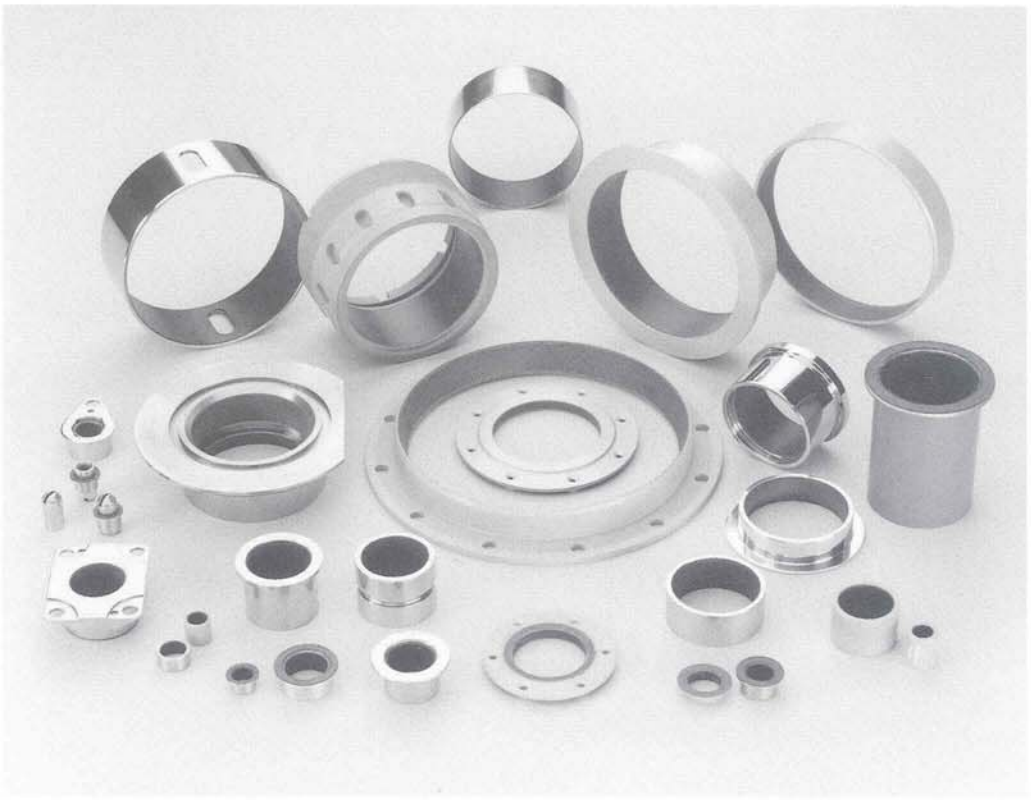
See overleaf for Materials, Dimensions and Tolerances. Torques and Loads for basic Rod End Design

SELF-LUBRICATING BEARINGS

SECTION 1.3

JOURNAL BEARINGS

INDEX



ampep

AMPEP DATA SHEET

1.3.0/INDEX b

ISSUE - 9305

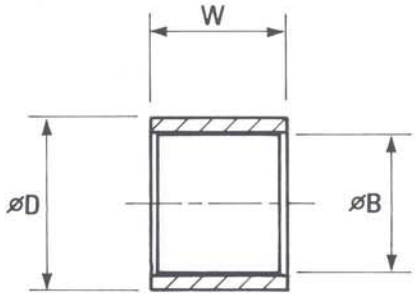
JOURNAL BEARINGS - SELF LUBRICATING PLAIN - AL. ALLOY & STEEL BACKED

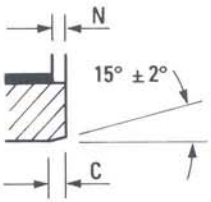
KA----P
KS----P
INCH SERIES

MATERIALS

***Liner* - FIBERSLIP®**
B.40 to AFS 2125 & DTD900/4903 for sizes 04 to12
B.30 to AFS 2125 & DTD900/4902 for sizes 14 to 32

Shell
For KA----P Series:
Aluminium Alloy to Specification DTD5014 or similar, Anodised to Def Stan 03-24.
For KS----P Series:
Corrosion Resistant Steel to British Specification S.80





STANDARDS REFERENCES

AGS 3808 & 9
BAS 7661 & 2
NSA 8145 & 6
NSA 8194 & D

Refer to Following Section 5.0 for Part No. Cross Reference.

N= .010 For Sizes 04 to 12 incl.
.020 For Sizes 14 to 32 incl.
C= .020/.030

DIMENSIONS AND TOLERANCES

All Dimensions in Inches

Nominal Bore		B	D	W													Distance Travelled Per Degree	Per Inch Width Al. Alloy	Per Inch Width Steel
		Bore Dia	O/Dia	-0.005 Overall Width -0.015															
Code	Size	–	–	3/16	1/4	5/16	3/8	7/16	1/2	5/8	3/4	7/8	1	1 1/4	1 1/2	2	ft	lb (Max)	
04	1/4	.2512 .2503	.3755 .3760	03	04												.00018	.007	.012
05	5/16	.3139 .3130	.4381 .4386	03	04	05											.00022	.008	.020
06	3/8	.3765 .3756	.5006 .5011	03	04	05	06	07									.00026	.009	.024
08	1/2	.5016 .5006	.6883 .6888	03	04	05	06	07	08								.00036	.019	.050
10	5/8	.6267 .6257	.8134 .8139		04	05	06	07	08	10							.00045	.023	.060
12	3/4	.7520 .7508	.9384 .9389		04	05	06	07	08	10	12	14					.00054	.027	.070
14	7/8	.8771 .8759	1.0635 1.0640			05	06	07	08	10	12	14					.00063	.030	.075
16	1	1.0022 1.0010	1.1885 1.1890			05	06	07	08	10	12	14	16				.00072	.034	.084
18	1 1/8	1.1275 1.1263	1.3137 1.3143				06	07	08	10	12	14	16				.00081	.038	.093
20	1 1/4	1.2528 1.2512	1.5013 1.5019						08	10	12	14	16	20			.00090	.058	.146
22	1 3/8	1.3779 1.3763	1.6263 1.6269						08	10	12	14	16	20			.00100	.063	.160
24	1 1/2	1.5029 1.5013	1.7513 1.7519						08	10	12	14	16	20	24		.00109	.068	.173
28	1 3/4	1.7533 1.7517	2.0016 2.0023								12	14	16	20	24		.00127	.078	.200
32	2	2.0035 2.0017	2.2516 2.2523								12	14	16	20	24	32	.00145	.089	.225

MASS

LOADS

For KA----P Series:
Static Limit Load = 30000xBx(W-0.06) lbf

For KS----P Series:
Static Limit Load = 62500xBx(W-0.06) lbf

BEARING INSTALLATION

Refer to the following section 1.3.2. for recommended Housing and Shaft dimensions.

NOTES

△1 Oversize 'D' dia versions identified by groove .060 rad x .020/.030 deep.
Y1 has one groove in each end face.
Y2 has two grooves in each end face.

△2 For KS----P Series:
Cadmium Plated version - dimensions shown also apply after plating.

PART NUMBERS AND SERIES VERSIONS

Series Part Number Codification

Basic Series Part Number	K	A	04	03	P	.
Journal Bearing		S				
Backing Matl. (A-AL.Alloy, S-Steel)						
Bore dia code in multiples of 1/16 inch						
Width code in multiples of 1/16 inch						
Pre-finish code						

△1 Series Versions - Suffix Identification

.005 o/size dia 'D'	Y1
.010 o/size dia 'D'	Y2
Low Volatiles (Space prep)	V

△2 For KS----P Series:

Cadmium Plated Metal Surfaces	C

SPECIAL TYPES

Bearings based on the above specifications with non-standard features may be supplied on request.

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KAF----P
KSF----P
INCH SERIES

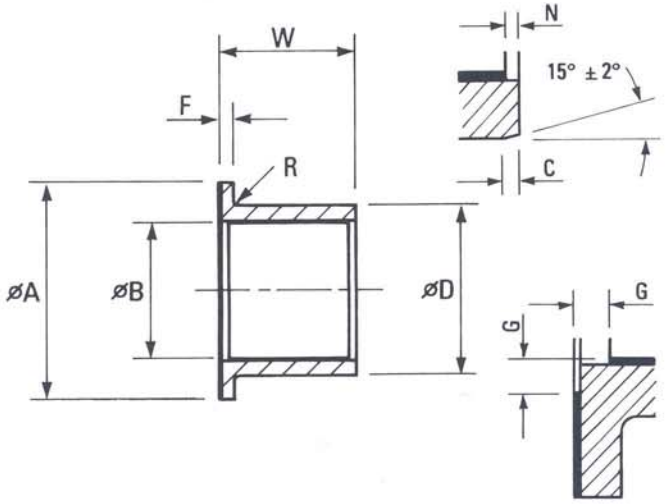
JOURNAL BEARINGS - SELF LUBRICATING FLANGED - AL. ALLOY & STEEL BACKED

STANDARDS REFERENCES

AGS 3810 & 1
BAS 7663 & 4
NSA 8147 & 8
NSA 8195 & D

Refer to Following Section 5.0 for Part No. Cross Reference.

N= .010 For Sizes 04 to 12 incl.
.020 For Sizes 14 to 32 incl.
G= .020 For Sizes 04 to 12 incl.
.040 For Sizes 14 to 32 incl.
R= .020/.030
C= .020/.030



MATERIALS

***Liner* - FIBERSLIP®**
B.40 to AFS 2125 & DTD900/4903 for sizes 04 to12
B.30 to AFS 2125 & DTD900/4902 for sizes 14 to 32

Shell
For KAF----P Series:
Aluminium Alloy to Specification DTD5014 or similar, Anodised to Def Stan 03-24.
For KSF----P Series:
Corrosion Resistant Steel to British Specification S.80

DIMENSIONS AND TOLERANCES

All Dimensions in Inches

Nominal Bore		B	D	F	A	W												Distance Travelled Per Degree	Per Inch Width Al. Alloy	Per Inch Width Steel
		Bore Dia	O/Dia	Flange Thickness	Flange Dia	-0.005 Overall Width -0.015														
Code	Size	–	–	+0.000 -0.005	+0.000 -0.010	1/4	5/16	3/8	7/16	1/2	5/8	3/4	7/8	1	1 1/4	1 1/2	2	ft	lb (Max)	
04	1/4	.2512 .2503	.3755 .3760	0.062	.500	04	05											.00018	.0077	.0132
05	5/16	.3139 .3130	.4381 .4386	0.062	.562	04	05	06	07									.00022	.0088	.0220
06	3/8	.3765 .3756	.5006 .5011	0.062	.625	04	05	06	07									.00026	.0099	.0264
08	1/2	.5016 .5006	.6883 .6888	0.062	.875	04	05	06	07	08								.00036	.0209	.0550
10	5/8	.6267 .6257	.8134 .8139	0.062	1.000	04	05	06	07	08	10							.00045	.0263	.0660
12	3/4	.7520 .7508	.9384 .9389	0.062	1.125	04	05	06	07	08	10	12	14					.00054	.0297	.0770
14	7/8	.8771 .8759	1.0635 1.0640	0.062	1.250		05	06	07	08	10	12	14					.00063	.0330	.0825
16	1	1.0022 1.0010	1.1885 1.1890	0.062	1.375		05	06	07	08	10	12	14	16				.00072	.0374	.0924
18	1 1/8	1.1275 1.1263	1.3137 1.3143	0.094	1.625			06	07	08	10	12	14	16				.00081	.0418	.1023
20	1 1/4	1.2528 1.2512	1.5013 1.5019	0.094	1.750					08	10	12	14	16	20			.00090	.0638	.1606
22	1 3/8	1.3779 1.3763	1.6263 1.6269	0.094	1.875					08	10	12	14	16	20			.00100	.0693	.1760
24	1 1/2	1.5029 1.5013	1.7513 1.7519	0.094	2.000					08	10	12	14	16	20	24		.00109	.0748	.1903
28	1 3/4	1.7533 1.7517	2.0016 2.0023	0.094	2.250							12	14	16	20	24		.00127	.0858	.2200
32	2	2.0035 2.0017	2.2516 2.2523	0.094	2.500							12	14	16	20	24	32	.00145	.0979	.2475

SPECIAL TYPES

Bearings based on the above specifications with non-standard features may be supplied on request.

LOADS

For KAF----P Series:
Static Limit Load = 30000×B×(W-0.06) lbf

For KSF----P Series:
Static Limit Load = 62500×B×(W-0.06) lbf

BEARING INSTALLATION

Refer to the following section 1.3.2. for recommended Housing and Shaft dimensions.

NOTES

△ Oversize 'D' dia versions identified by groove .060 rad x .020/.030 deep.
Y1 has one groove in each end face.
Y2 has two grooves in each end face.

△2 For KSF----P Series:
Cadmium Plated version - dimensions shown also apply after plating.

PART NUMBERS AND SERIES VERSIONS

Series Part Number Codification

Basic Series Part Number	K	A	F	04	04	P	.
Journal Bearing		S					
Backing Matl. (A-AL.Alloy, S-Steel)							
Flanged							
Bore dia code in multiples of 1/16 inch							
Width code in multiples of 1/16 inch							
Pre-finish code							

△1 **Series Versions - Suffix Identification**

.005 o/size dia 'D'	Y1
.010 o/size dia 'D'	Y2
Low Volatiles (Space prep)	V

△2 For KSF----P Series:
Cadmium Plated Metal Surfaces — C

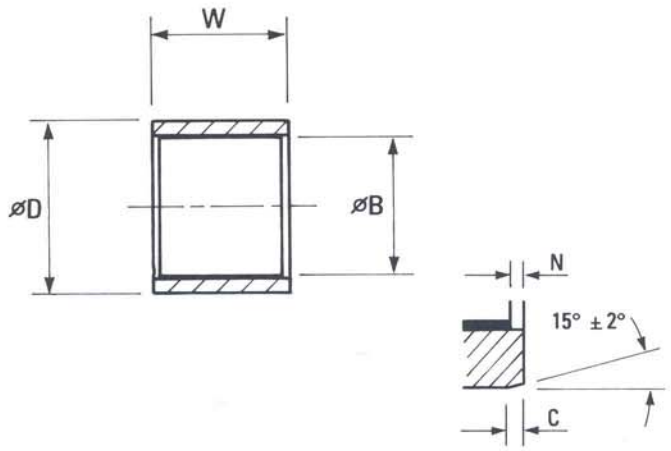
JOURNAL BEARINGS - SELF LUBRICATING PLAIN - AL. ALLOY & STEEL BACKED

13AAZ----
13ASZ----
INCH SERIES

MATERIALS

***Liner* - AMPEP X1**
Liner System qualified to MIL - B - 81820

Shell
For 13AAZ---- Series:
Aluminium Alloy to Specification DTD5014 or similar, Anodised to Def Stan 03-24.
For 13ASZ---- Series:
Corrosion Resistant Steel to British Specification S.80



STANDARDS REFERENCES

NSA 8145 & 6

Refer to Following Section 5.0 for Part No. Cross Reference.

N= .010 For Sizes 04 to 12 incl.
.020 For Sizes 14 to 32 incl.
C= .020/.030

DIMENSIONS AND TOLERANCES

All Dimensions in Inches

Nominal Bore		B	D	W													Distance Travelled Per Degree	Per Inch Width Al. Alloy	Per Inch Width Steel
		Bore Dia	O/Dia	-0.005 Overall Width -0.015															
Code	Size	–	–	3/16	1/4	5/16	3/8	7/16	1/2	5/8	3/4	7/8	1	1 1/4	1 1/2	2	ft	lb (Max)	
04	1/4	.2512 .2503	.3755 .3760	03	04												.00018	.007	.012
05	5/16	.3139 .3130	.4381 .4386	03	04	05											.00022	.008	.020
06	3/8	.3765 .3756	.5006 .5011	03	04	05	06	07									.00026	.009	.024
08	1/2	.5016 .5006	.6883 .6888	03	04	05	06	07	08								.00036	.019	.050
10	5/8	.6267 .6257	.8134 .8139		04	05	06	07	08	10							.00045	.023	.060
12	3/4	.7520 .7508	.9384 .9389		04	05	06	07	08	10	12	14					.00054	.027	.070
14	7/8	.8771 .8759	1.0635 1.0640			05	06	07	08	10	12	14					.00063	.030	.075
16	1	1.0022 1.0010	1.1885 1.1890			05	06	07	08	10	12	14	16				.00072	.034	.084
18	1 1/8	1.1275 1.1263	1.3137 1.3143				06	07	08	10	12	14	16				.00081	.038	.093
20	1 1/4	1.2528 1.2512	1.5013 1.5019						08	10	12	14	16	20			.00090	.058	.146
22	1 3/8	1.3779 1.3763	1.6263 1.6269						08	10	12	14	16	20			.00100	.063	.160
24	1 1/2	1.5029 1.5013	1.7513 1.7519						08	10	12	14	16	20	24		.00109	.068	.173
28	1 3/4	1.7533 1.7517	2.0016 2.0023								12	14	16	20	24		.00127	.078	.200
32	2	2.0035 2.0017	2.2516 2.2523								12	14	16	20	24	32	.00145	.089	.225

MASS

LOADS

For 13AAZ---- Series:
Static Limit Load = 30000×B×(W-0.06) lbf

For 13ASZ---- Series:
Static Limit Load = 62500×B×(W-0.06) lbf

BEARING INSTALLATION

Refer to the following section 1.3.2. for recommended Housing and Shaft dimensions.

NOTES

△

⚠1 Oversize 'D' dia versions identified by groove .060 rad x .020/.030 deep.
Y1 has one groove in each end face.
Y2 has two grooves in each end face.

⚠2 For 13ASZ---- Series:
Cadmium Plated version - dimensions shown also apply after plating.

PART NUMBERS AND SERIES VERSIONS

Series Part Number Codification

Basic Series Part Number — 13 A A Z 04 03 .
Journal Bearing — A
Specification ident — S
Backing Matl. (A-AL.Alloy, S-Steel) — Z
Plain — 04
Bore dia code in multiples of 1/16 inch — 03
Width code in multiples of 1/16 inch — .

⚠1 **Series Versions - Suffix Identification**

.005 o/size dia 'D' — Y1
.010 o/size dia 'D' — Y2
Low Volatiles (Space prep) — V

⚠2 For 13ASZ-- Series:
Cadmium Plated Metal Surfaces — C

SPECIAL TYPES

Bearings based on the above specifications with non-standard features may be supplied on request.

ampep

AMPEP DATA SHEET
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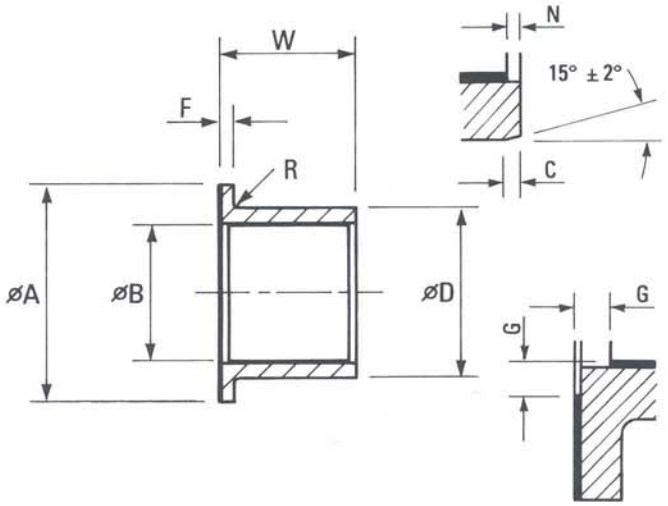
13AAF----
13ASF----
INCH SERIES

JOURNAL BEARINGS - SELF LUBRICATING FLANGED - AL. ALLOY & STEEL BACKED

STANDARDS REFERENCES

NSA 8147 & 8

Refer to Following Section 5.0 for Part No. Cross Reference.



N= .010 For Sizes 04 to 12 incl.
.020 For Sizes 14 to 32 incl.
G= .020 For Sizes 04 to 12 incl.
.040 For Sizes 14 to 32 incl.
R= .020/.030
C= .020/.030

MATERIALS

***Liner* - AMPEP X1**
Liner System Qualified to MIL-B-81820

Shell
For 13AAF---- Series:
Aluminium Alloy to Specification DTD5014 or similar, Anodised to Def Stan 03-24.
For 13ASF---- Series:
Corrosion Resistant Steel to British Specification S.80

DIMENSIONS AND TOLERANCES

All Dimensions in Inches

Nominal Bore		B	D	F	A	W												Distance Travelled Per Degree
		Bore Dia	O/Dia	Flange Thickness	Flange Dia	-0.005 Overall Width -0.015												
Code	Size	–	–	+0.000 -0.005	+0.000 -0.010	1/4	5/16	3/8	7/16	1/2	5/8	3/4	7/8	1	1 1/4	1 1/2	2	ft
04	1/4	.2512 .2503	.3755 .3760	0.062	.500	04	05											.00018
05	5/16	.3139 .3130	.4381 .4386	0.062	.562	04	05	06	07									.00022
06	3/8	.3765 .3756	.5006 .5011	0.062	.625	04	05	06	07									.00026
08	1/2	.5016 .5006	.6883 .6888	0.062	.875	04	05	06	07	08								.00036
10	5/8	.6267 .6257	.8134 .8139	0.062	1.000	04	05	06	07	08	10							.00045
12	3/4	.7520 .7508	.9384 .9389	0.062	1.125	04	05	06	07	08	10	12	14					.00054
14	7/8	.8771 .8759	1.0635 1.0640	0.062	1.250		05	06	07	08	10	12	14					.00063
16	1	1.0022 1.0010	1.1885 1.1890	0.062	1.375		05	06	07	08	10	12	14	16				.00072
18	1 1/8	1.1275 1.1263	1.3137 1.3143	0.094	1.625			06	07	08	10	12	14	16				.00081
20	1 1/4	1.2528 1.2512	1.5013 1.5019	0.094	1.750					08	10	12	14	16	20			.00090
22	1 3/8	1.3779 1.3763	1.6263 1.6269	0.094	1.875					08	10	12	14	16	20			.00100
24	1 1/2	1.5029 1.5013	1.7513 1.7519	0.094	2.000					08	10	12	14	16	20	24		.00109
28	1 3/4	1.7533 1.7517	2.0016 2.0023	0.094	2.250							12	14	16	20	24		.00127
32	2	2.0035 2.0017	2.2516 2.2523	0.094	2.500							12	14	16	20	24	32	.00145

MASS

Per Inch Width Al. Alloy	Per Inch Width Steel
lb (Max)	
.0077	.0132
.0088	.0220
.0099	.0264
.0209	.0550
.0263	.0660
.0297	.0770
.0330	.0825
.0374	.0924
.0418	.1023
.0638	.1606
.0693	.1760
.0748	.1903
.0858	.2200
.0979	.2475

SPECIAL TYPES

Bearings based on the above specifications with non-standard features may be supplied on request.

LOADS

For 13AAF---- Series:
Static Limit Load = 30000xBx(W-0.06) lbf

For 13ASF---- Series:
Static Limit Load = 62500xBx(W-0.06) lbf

BEARING INSTALLATION

Refer to the following section 1.3.2. for recommended Housing and Shaft dimensions.

NOTES

△ NOTES

1 Oversize 'D' dia versions identified by groove .060 rad x .020/.030 deep.
Y1 has one groove in each end face.
Y2 has two grooves in each end face.

2 For 13ASF---- Series:
Cadmium Plated version - dimensions shown also apply after plating.

PART NUMBERS AND SERIES VERSIONS

Series Part Number Codification

Basic Series Part Number — 13 A A F 04 04 .
Journal Bearing — A
Specification ident — S
Backing Matl. (A-AL.Alloy, S-Steel)
Flanged — F
Bore dia code in multiples of 1/16 inch — 04
Width code in multiples of 1/16 inch — 04

1 **Series Versions - Suffix Identification**

.005 o/size dia 'D' — Y1
.010 o/size dia 'D' — Y2
Low Volatiles (Space prep) — V

2 For 13ASF---- Series:
Cadmium Plated Metal Surfaces — C

ampep

JOURNAL BEARINGS - SELF LUBRICATING PLAIN - AL. ALLOY BACKED

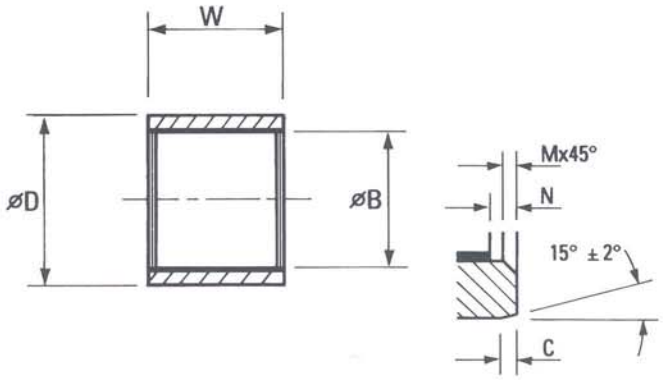
13BAZ----
INCH SERIES

MATERIALS

***Liner* - AMPEP X1**
Liner System qualified to MIL - B - 81820

Shell
Aluminium Alloy ASTM B221 and B241 or QQ-A-225/6 (2024T8511), Anodised per MIL-A-8625

C= .020/.030
N= .025 Max
M= .005/.015



STANDARDS REFERENCES

MIL M81934/1
ASN-A2127

Refer to Following Section 5.0 for Part No. Cross Reference.

DIMENSIONS AND TOLERANCES

All Dimensions in Inches

Nominal Bore		B	D	W																												Distance Travelled Per Degree	Per Inch Width
		Bore Dia	O/Dia	+0.000 Overall Width -0.010																													
Code	Size	+0.0000 -0.0010	+0.0005 -0.0005	1/4	9/32	5/16	11/32	3/8	7/16	1/2	9/16	5/8	11/16	3/4	7/8	1	1 1/8	1 1/4	1 3/8	1 1/2	1 5/8	1 3/4	1 7/8	2	2 1/8	2 1/4	2 3/8	2 1/2	2 3/4	3	ft	lb
04	1/4	0.2515	0.3760	08	09	10	11	12	14																						.00018	0.006
05	5/16	0.3140	0.4386	08	09	10	11	12	14	16	18																				.00022	0.007
06	3/8	0.3765	0.5012	08	09	10	11	12	14	16	18	20	22																		.00026	0.008
07	7/16	0.4390	0.5638	08	09	10	11	12	14	16	18	20	22	24	28																.00032	0.009
08	1/2	0.5015	0.6265	08	09	10	11	12	14	16	18	20	22	24	28																.00036	0.011
09	9/16	0.5640	0.6892	08	09	10	11	12	14	16	18	20	22	24	28	32	36														.00041	0.012
10	5/8	0.6265	0.8142	08	09	10	11	12	14	16	18	20	22	24	28	32	36	40	44												.00045	0.021
11	11/16	0.6890	0.8767	08	09	10	11	12	14	16	18	20	22	24	28	32	36	40	44	48	52										.00050	0.022
12	3/4	0.7515	0.9393	08	09	10	11	12	14	16	18	20	22	24	28	32	36	40	44	48	52										.00054	0.024
14	7/8	0.8765	1.0645	08	09	10	11	12	14	16	18	20	22	24	28	32	36	40	44	48	52										.00063	0.028
16	1	1.0015	1.1898	08	09	10	11	12	14	16	18	20	22	24	28	32	36	40	44	48	52	56	60								.00072	0.031
18	1 1/8	1.1265	1.3148			10	11	12	14	16	18	20	22	24	28	32	36	40	44	48	52	56	60								.00081	0.035
20	1 1/4	1.2515	1.4398					12	14	16	18	20	22	24	28	32	36	40	44	48	52	56	60	64	68						.00090	0.038
22	1 3/8	1.3765	1.5648					12	14	16	18	20	22	24	28	32	36	40	44	48	52	56	60	64	68						.00100	0.041
24	1 1/2	1.5015	1.7523					12	14	16	18	20	22	24	28	32	36	40	44	48	52	56	60	64	68	72	76	80	88		.00109	0.062
26	1 5/8	1.6265	1.8773							16	18	20	22	24	28	32	36	40	44	48	52	56	60	64	68	72	76	80	88	96	.00120	0.067
28	1 3/4	1.7515	2.0023							16	18	20	22	24	28	32	36	40	44	48	52	56	60	64	68	72	76	80	88	96	.00127	0.071
32	2	2.0015	2.2523							16	18	20	22	24	28	32	36	40	44	48	52	56	60	64	68	72	76	80	88	96	.00145	0.081

MASS

LOADS

Static Limit Load = 50000×B×(W-0.13) lbf

BEARING INSTALLATION

Refer to the following section 1.3.2. for recommended Housing and Shaft dimensions.

NOTES

△ Oversize 'D' dia version code in multiples of 0.005 inch, eg. Y4 is 0.020 inch oversize.

PART NUMBERS AND SERIES VERSIONS

Series Part Number Codification

Basic Series Part Number — 13 B A Z 04 10 .
Journal Bearing — B
Specification ident — A
Aluminium Alloy — Z
Plain — 04
Bore dia code in multiples of 1/16 inch — 04
Width code in multiples of 1/32 inch — 10

△1 **Series Versions - Suffix Identification**

.005 o/size dia 'D' — Y1
.010 o/size dia 'D' — Y2
Low Volatiles (Space prep) — V

SPECIAL TYPES

Bearings based on the above specifications with non-standard features may be supplied on request.

ampep

13BSZ----
INCH SERIES

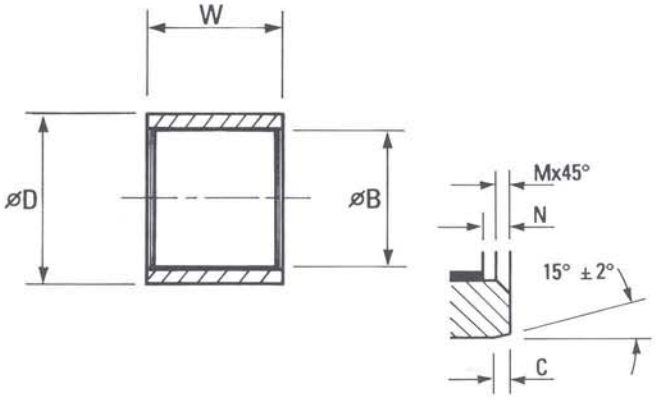
JOURNAL BEARINGS - SELF LUBRICATING PLAIN - STEEL BACKED

STANDARDS REFERENCES

MIL M81934/1
ASN - A2127

Refer to Following Section 5.0 for Part No. Cross Reference.

C= .020/.030
N= .025 Max
M= .005/.015



MATERIALS

***Liner* - AMPEP X1**
Liner System Qualified to MIL-B-81820

Shell
Corrosion Resistant Steel
AMS 5643 condition H 1150
Passivated per QQ-P-35.

DIMENSIONS AND TOLERANCES

All Dimensions in Inches

Nominal Bore		B	D	W																											Distance Travelled Per Degree	Per Inch Width
		Bore Dia	O/Dia	-0.000 Overall Width -0.010																												
Code	Size	+0.0000 -0.0010	+0.0000 -0.0005	1/4	9/32	5/16	11/32	3/8	7/16	1/2	9/16	5/8	11/16	3/4	7/8	1	1 1/8	1 1/4	1 3/8	1 1/2	1 5/8	1 3/4	1 7/8	2	2 1/8	2 1/4	2 3/8	2 1/2	2 3/4	3	ft	lb
04	1/4	0.2515	0.3760	08	09	10	11	12	14																						.00018	0.016
05	5/16	0.3140	0.4386	08	09	10	11	12	14	16	18																				.00022	0.019
06	3/8	0.3765	0.5012	08	09	10	11	12	14	16	18	20	22																		.00026	0.022
07	7/16	0.4390	0.5638	08	09	10	11	12	14	16	18	20	22	24	28																.00032	0.025
08	1/2	0.5015	0.6265	08	09	10	11	12	14	16	18	20	22	24	28																.00036	0.028
09	9/16	0.5640	0.6892	08	09	10	11	12	14	16	18	20	22	24	28	32	36														.00041	0.031
10	5/8	0.6265	0.8142	08	09	10	11	12	14	16	18	20	22	24	28	32	36	40	44												.00045	0.056
11	11/16	0.6890	0.8767	08	09	10	11	12	14	16	18	20	22	24	28	32	36	40	44	48	52										.00050	0.060
12	3/4	0.7515	0.9393	08	09	10	11	12	14	16	18	20	22	24	28	32	36	40	44	48	52										.00054	0.065
14	7/8	0.8765	1.0645	08	09	10	11	12	14	16	18	20	22	24	28	32	36	40	44	48	52										.00063	0.075
16	1	1.0015	1.1898	08	09	10	11	12	14	16	18	20	22	24	28	32	36	40	44	48	52	56	60								.00072	0.084
18	1 1/8	1.1265	1.3148			10	11	12	14	16	18	20	22	24	28	32	36	40	44	48	52	56	60								.00081	0.094
20	1 1/4	1.2515	1.4398					12	14	16	18	20	22	24	28	32	36	40	44	48	52	56	60	64	68						.00090	0.103
22	1 3/8	1.3765	1.5648					12	14	16	18	20	22	24	28	32	36	40	44	48	52	56	60	64	68						.00100	0.113
24	1 1/2	1.5015	1.7523					12	14	16	18	20	22	24	28	32	36	40	44	48	52	56	60	64	68	72	76	80	88		.00109	0.171
26	1 5/8	1.6265	1.8773							16	18	20	22	24	28	32	36	40	44	48	52	56	60	64	68	72	76	80	88	96	.00120	0.183
28	1 3/4	1.7515	2.0023							16	18	20	22	24	28	32	36	40	44	48	52	56	60	64	68	72	76	80	88	96	.00127	0.196
32	2	2.0015	2.2523							16	18	20	22	24	28	32	36	40	44	48	52	56	60	64	68	72	76	80	88	96	.00145	0.222

MASS

SPECIAL TYPES

Bearings based on the above specifications with non-standard features may be supplied on request.

LOADS

Static Limit Load = 78500×B×(W-0.13) lbf

BEARING INSTALLATION

Refer to the following section 1.3.2. for recommended Housing and Shaft dimensions.

NOTES

△1 Oversize 'D' dia version code in multiples of 0.005 inch, eg. Y4 is 0.020 inch oversize

△2 Cadmium Plated version - dimensions shown also apply after plating.

PART NUMBERS AND SERIES VERSIONS

Series Part Number Codification

Basic Series Part Number	13	B	S	Z	04	10	.
Journal Bearing							
Specification ident							
Steel							
Plain							
Bore dia code in multiples of 1/16 inch							
Width code in multiples of 1/32 inch							

△1 Series Versions - Suffix Identification

.005 o/size dia 'D'	Y1
.010 o/size dia 'D'	Y2
Low Volatiles (Space prep)	V

△2 Cadmium Plated Metal Surfaces — C

JOURNAL BEARINGS - SELF LUBRICATING FLANGED - AL. ALLOY BACKED

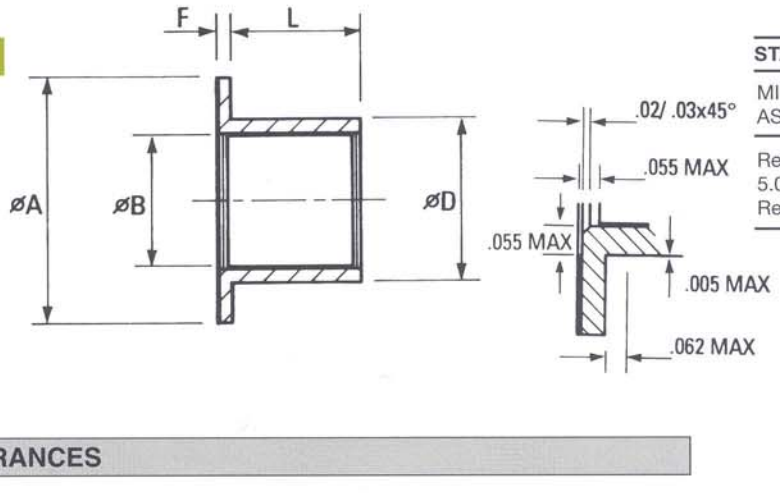
13BAF----
INCH SERIES

MATERIALS

***Liner* - AMPEP X1**
Liner System qualified to MIL - B - 81820

Shell
Aluminium Alloy ASTM B221 and B241 or QQ-A-225/6 (2024T8511), Anodised per MIL-A-8625

C= .020/.030
N= .025 Max
M= .005/.015



STANDARDS REFERENCES

MIL M81934/2
ASN-A2128

Refer to Following Section 5.0 for Part No. Cross Reference.

DIMENSIONS AND TOLERANCES

All Dimensions in Inches

Nominal Bore		B	D	F	A	L																										
		Bore Dia	O/Dia	Flange Thickness	Flange Dia	Length to Back Face of Flange +0.000 -0.010																										
Code	Size	+0.0000 -0.0010	+0.0005 -0.0005	+0.000 -0.005	+0.000 -0.020	1/4	9/32	5/16	11/32	3/8	7/16	1/2	9/16	5/8	11/16	3/4	7/8	1	1 1/8	1 1/4	1 3/8	1 1/2	1 5/8	1 3/4	1 7/8	2	2 1/8	2 1/4	2 3/8	2 1/2	2 3/4	3
04	1/4	0.2515	0.3760	0.0625	0.750	08	09	10	11	12	14																					
05	5/16	0.3140	0.4386	0.0625	0.812	08	09	10	11	12	14	16	18																			
06	3/8	0.3765	0.5012	0.0625	0.875	08	09	10	11	12	14	16	18	20	22																	
07	7/16	0.4390	0.5638	0.0625	0.937	08	09	10	11	12	14	16	18	20	22	24	28															
08	1/2	0.5015	0.6265	0.0625	1.000	08	09	10	11	12	14	16	18	20	22	24	28															
09	9/16	0.5640	0.6892	0.0625	1.125	08	09	10	11	12	14	16	18	20	22	24	28	32	36													
10	5/8	0.6265	0.8142	0.0625	1.250	08	09	10	11	12	14	16	18	20	22	24	28	32	36	40	44											
11	11/16	0.6890	0.8767	0.0625	1.375	08	09	10	11	12	14	16	18	20	22	24	28	32	36	40	44	48	52									
12	3/4	0.7515	0.9393	0.0625	1.500	08	09	10	11	12	14	16	18	20	22	24	28	32	36	40	44	48	52									
14	7/8	0.8765	1.0645	0.0625	1.625	08	09	10	11	12	14	16	18	20	22	24	28	32	36	40	44	48	52									
16	1	1.0015	1.1898	0.0625	1.750	08	09	10	11	12	14	16	18	20	22	24	28	32	36	40	44	48	52	56	60							
18	1 1/8	1.1265	1.3148	0.0937	1.875			10	11	12	14	16	18	20	22	24	28	32	36	40	44	48	52	56	60							
20	1 1/4	1.2515	1.4398	0.0937	2.000					12	14	16	18	20	22	24	28	32	36	40	44	48	52	56	60	64	68					
22	1 3/8	1.3765	1.5648	0.0937	2.125					12	14	16	18	20	22	24	28	32	36	40	44	48	52	56	60	64	68					
24	1 1/2	1.5015	1.7523	0.0937	2.250					12	14	16	18	20	22	24	28	32	36	40	44	48	52	56	60	64	68	72	76	80	88	
26	1 5/8	1.6265	1.8773	0.0937	2.375							16	18	20	22	24	28	32	36	40	44	48	52	56	60	64	68	72	76	80	88	96
28	1 3/4	1.7515	2.0023	0.0937	2.500							16	18	20	22	24	28	32	36	40	44	48	52	56	60	64	68	72	76	80	88	96
32	2	2.0015	2.2523	0.0937	2.750							16	18	20	22	24	28	32	36	40	44	48	52	56	60	64	68	72	76	80	88	96

LOADS

Static Limit Load = 50000×B×(L-0.13) lbf

BEARING INSTALLATION

Refer to the following section 1.3.2. for recommended Housing and Shaft dimensions.

NOTES

△ Oversize 'D' dia versions code in multiples of 0.005 inch eg. Y4 is 0.020 inch oversize. See overleaf for details of mass and distance travelled per degree.

PART NUMBERS AND SERIES VERSIONS

Series Part Number Codification

Basic Series Part Number — 13 B A F 04 08 .
Journal Bearing — 13
Specification Ident — B
Aluminium Alloy — A
Flanged — F
Bore dia code in multiples of 1/16 inch — 04
Length code in multiples of 1/32 inch — 08

△ Series Versions - Suffix Identification

.005 o/size dia 'D' — Y1
.010 o/size dia 'D' — Y2
Low Volatiles (Space prep) — V

SPECIAL TYPES

Bearings based on the above specifications with non-standard features may be supplied on request.

ampep

13BAF----
INCH SERIES

JOURNAL BEARINGS - SELF LUBRICATING FLANGED - AL. ALLOY BACKED

MASS

Nominal Bore		Mass per Inch of Length L	Mass of Flange		Distance Travelled Per Degree
Code	Size	lb	lb		ft
04	1/4	0.006	0.003		.00018
05	5/16	0.008	0.003		.00022
06	3/8	0.009	0.003		.00026
07	7/16	0.010	0.003		.00032
08	1/2	0.011	0.004		.00036
09	9/16	0.013	0.004		.00041
10	5/8	0.022	0.005		.00045
11	11/16	0.023	0.007		.00050
12	3/4	0.025	0.009		.00054
14	7/8	0.029	0.009		.00063
16	1	0.033	0.010		.00072
18	1 1/8	0.037	0.014		.00081
20	1 1/4	0.040	0.018		.00090
22	1 3/8	0.044	0.019		.00100
24	1 1/2	0.065	0.019		.00109
26	1 5/8	0.070	0.020		.00120
28	1 3/4	0.075	0.023		.00127
32	2	0.085	0.026		.00145

JOURNAL BEARINGS - SELF LUBRICATING FLANGED - STEEL BACKED

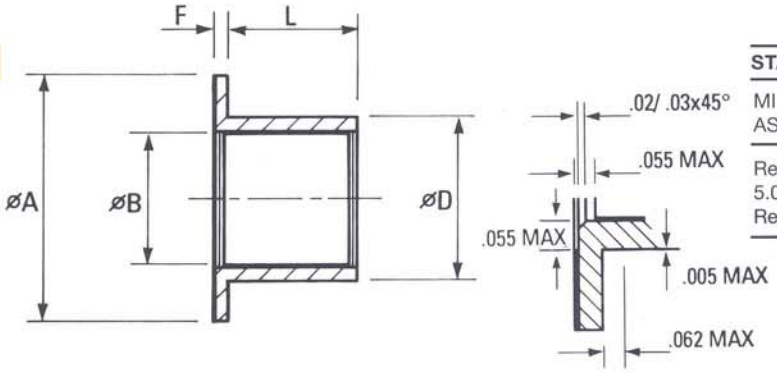
13BSF----
INCH SERIES

MATERIALS

***Liner* - AMPEP X1**
Liner System qualified to
MIL - B - 81820

Shell
Corrosion Resistant Steel
AMS 5643 Condition H 1150,
Passivated per QQ-P-35.

C= .020/.030
N= .025 Max
M= .005/.015



STANDARDS REFERENCES

MIL M81934/2
ASN-A2128

Refer to Following Section 5.0 for Part No. Cross Reference.

DIMENSIONS AND TOLERANCES

All Dimensions in Inches

Nominal Bore		B	D	F	A	L
		Bore Dia	O/Dia	Flange Thickness	Flange Dia	Length to Back Face of Flange +0.000 -0.010
Code	Size	+0.0000 -0.0010	+0.0000 -0.0005	+0.000 -0.005	+0.000 -0.020	1/4 9/32 5/16 11/32 3/8 7/16 1/2 9/16 5/8 11/16 3/4 7/8 1 1 1/8 1 1/4 1 3/8 1 1/2 1 5/8 1 3/4 1 7/8 2 2 1/8 2 1/4 2 3/8 2 1/2 2 3/4 3
04	1/4	0.2515	0.3760	0.0625	0.750	08 09 10 11 12 14
05	5/16	0.3140	0.4386	0.0625	0.812	08 09 10 11 12 14 16 18
06	3/8	0.3765	0.5012	0.0625	0.875	08 09 10 11 12 14 16 18 20 22
07	7/16	0.4390	0.5638	0.0625	0.937	08 09 10 11 12 14 16 18 20 22 24 28
08	1/2	0.5015	0.6265	0.0625	1.000	08 09 10 11 12 14 16 18 20 22 24 28
09	9/16	0.5640	0.6892	0.0625	1.125	08 09 10 11 12 14 16 18 20 22 24 28 32 36
10	5/8	0.6265	0.8142	0.0625	1.250	08 09 10 11 12 14 16 18 20 22 24 28 32 36 40 44
11	11/16	0.6890	0.8767	0.0625	1.375	08 09 10 11 12 14 16 18 20 22 24 28 32 36 40 44 48 52
12	3/4	0.7515	0.9393	0.0625	1.500	08 09 10 11 12 14 16 18 20 22 24 28 32 36 40 44 48 52
14	7/8	0.8765	1.0645	0.0625	1.625	08 09 10 11 12 14 16 18 20 22 24 28 32 36 40 44 48 52
16	1	1.0015	1.1898	0.0625	1.750	08 09 10 11 12 14 16 18 20 22 24 28 32 36 40 44 48 52 56 60
18	1 1/8	1.1265	1.3148	0.0937	1.875	10 11 12 14 16 18 20 22 24 28 32 36 40 44 48 52 56 60
20	1 1/4	1.2515	1.4398	0.0937	2.000	12 14 16 18 20 22 24 28 32 36 40 44 48 52 56 60 64 68
22	1 3/8	1.3765	1.5648	0.0937	2.125	12 14 16 18 20 22 24 28 32 36 40 44 48 52 56 60 64 68
24	1 1/2	1.5015	1.7523	0.0937	2.250	12 14 16 18 20 22 24 28 32 36 40 44 48 52 56 60 64 68 72 76 80 88
26	1 5/8	1.6265	1.8773	0.0937	2.375	16 18 20 22 24 28 32 36 40 44 48 52 56 60 64 68 72 76 80 88 96
28	1 3/4	1.7515	2.0023	0.0937	2.500	16 18 20 22 24 28 32 36 40 44 48 52 56 60 64 68 72 76 80 88 96
32	2	2.0015	2.2523	0.0937	2.750	16 18 20 22 24 28 32 36 40 44 48 52 56 60 64 68 72 76 80 88 96

LOADS

Static Limit Load = 78500×B×(W-0.13) lbf

BEARING INSTALLATION

Refer to the following section 1.3.2. for recommended Housing and Shaft dimensions.

NOTES

△ Oversize 'D' dia versions code in multiples of .005 inch, eg. Y4 is 0.020 inch oversize. See overleaf for details of mass and distance travelled per degree.

△2 Cadmium plated version dimensions shown also apply after plating.

PART NUMBERS AND SERIES VERSIONS

Series Part Number Codification

Basic Series Part Number — 13 B S F 04 08 .
Journal Bearing — B
Specification Ident — S
Steel
Flanged — F
Bore dia code in multiples of 1/16 inch — 04
Length code in multiples of 1/32 inch — 08

Series Versions - Suffix Identification

△1 .005 o/size dia 'D' — Y1
.010 o/size dia 'D' — Y2
△2 Cadmium Plated metal surfaces — C
Low Volatiles (Space prep) — V

SPECIAL TYPES

Bearings based on the above specifications with non-standard features may be supplied on request.

ampep

13BSF----
INCH SERIES

JOURNAL BEARINGS - SELF LUBRICATING FLANGED - STEEL BACKED

MASS

Nominal Bore		Mass per Inch of Length L	Mass of Flange		Distance Travelled Per Degree
Code	Size	lb	lb		ft
04	1/4	0.017	0.007		.00018
05	5/16	0.022	0.007		.00022
06	3/8	0.025	0.007		.00026
07	7/16	0.028	0.008		.00032
08	1/2	0.031	0.010		.00036
09	9/16	0.036	0.011		.00041
10	5/8	0.061	0.014		.00045
11	11/16	0.064	0.020		.00050
12	3/4	0.070	0.023		.00054
14	7/8	0.080	0.025		.00063
16	1	0.091	0.027		.00072
18	1 1/8	0.101	0.041		.00081
20	1 1/4	0.111	0.050		.00090
22	1 3/8	0.122	0.053		.00100
24	1 1/2	0.179	0.054		.00109
26	1 5/8	0.193	0.056		.00120
28	1 3/4	0.207	0.064		.00127
32	2	0.234	0.072		.00145

JOURNAL BEARINGS - SELF LUBRICATING PLAIN - AL. ALLOY & STEEL BACKED

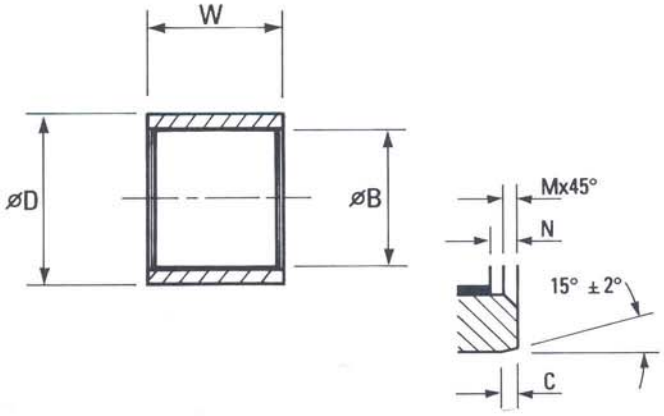
13C----AZ
13C----SZ
METRIC SERIES

MATERIALS

***Liner* - AMPEP X1**
Liner system qualified to
MIL -B-81820

Shell
For 13C----AZ Series:
Aluminium Alloy DTD 5014
condition 'TF'
Anodised per DEF STAN 03 - 24

For 13C----SZ Series:
Corrosion resistant Steel
AMS 5643 Condition H1150



STANDARDS REFERENCES

EN 2285
EN 2287

Refer to Following Section 5.0 for Part No. Cross Reference.

N= 0.8 MAX
C= 0.50/0.75
M= 0.2 MAX

DIMENSIONS AND TOLERANCES

All Dimensions in Millimetres

Nominal Bore	B	D	W															
	Bore Dia	O/Dia	Overall Length -0.1 -0.4															
Code Size	–	–	06	08	10	12	15	16	18	20	22	25	28	30	32	35	40	45	50
06	6.004 6.022	10.024 10.015	06																
08	8.005 8.027	12.029 12.018	06	08															
10	10.005 10.027	14.029 14.018	06	08	10														
12	12.006 12.033	16.029 16.018	06	08	10	12													
15	15.006 15.033	19.035 19.022		08	10	12	15												
16	16.006 16.033	20.035 20.022		08	10	12	15	16											
18	18.006 18.033	22.035 22.022			10	12	15		18										
20	20.007 20.040	25.035 25.022			10	12	15			20									
22	22.007 22.040	26.035 26.022				12	15			20	22								
25	25.007 25.040	30.035 30.022				12	15			20	22	25							
28	28.007 28.040	34.042 34.026					15			20	22	25	28						
30	30.007 30.040	36.042 36.026					15			20	22	25		30					
32	32.009 32.048	38.042 38.026					15			20	22	25		30	32				
35	35.009 35.048	42.042 42.026								20	22	25		30		35			
40	40.009 40.048	48.042 48.026								20		25		30		35	40		
45	45.009 45.048	52.051 52.032										25		30		35	40	45	
50	50.009 50.048	58.051 58.032										25		30		35	40	45	50

MASS

Per mm Length Al. Alloy	Per mm Length Steel
g (Approx.)	
0.15	0.39
0.18	0.48
0.22	0.58
0.26	0.68
0.31	0.82
0.32	0.87
0.37	0.97
0.51	1.36
0.44	1.16
0.63	1.66
0.85	2.25
0.91	2.40
0.96	2.54
1.23	3.26
1.61	4.25
1.55	4.11
1.98	5.22

LOADS

For 13C----AZ Series:
Static Limit Load = 206 x B x (W-1.5) Newtons

For 13C----SZ Series:
Static Limit Load = 430 x B x (W-1.5) Newtons

BEARING INSTALLATION

Refer to the following section 1.3.2. for recommended Housing and Shaft dimensions.

NOTES

△

△1 Oversize 'D' dia versions identified by groove 1.50 rad x 0.50/0.75 deep.
Y1 has one groove in each end face.
Y2 has two grooves in each end face.

For 13C----SZ Series:
△2 Cadmium Plated version - dimensions shown also apply after plating.

PART NUMBERS AND SERIES VERSIONS

Series Part Number Codification

Basic Series Part Number — 13 C 08 08 A Z .
Journal Bearing — 13
Specification Ident — C
Bore Dia Code in mm — 08
Length Code in mm — 08
Backing Material (A-Alloy, S-Steel) — A = Alloy, S = Steel
Plain — Z

△1 **Series Versions - Suffix Identification**

0.1 mm o/size dia 'D' — Y1
0.2 mm o/size dia 'D' — Y2
Low Volatiles (Space prep) — V

△2 For 13C----SZ Series:
Cadmium Plated Metal Surfaces — C

SPECIAL TYPES

Bearings based on the above specifications with non-standard features may be supplied on request.

ampep

AMPEP DATA SHEET
1.3.1/6a
ISSUE - 9504

13C----AF
13C----SF
METRIC SERIES

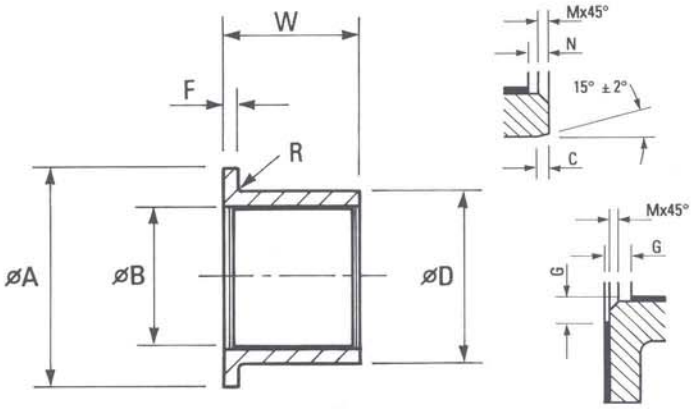
JOURNAL BEARINGS - SELF LUBRICATING FLANGED - AL. ALLOY & STEEL BACKED

STANDARDS REFERENCES

EN 2286
EN 2288

Refer to Following Section 5.0 for Part No. Cross Reference.

G= 0.5 for sizes 06 to 18 incl.
1.0 for sizes 20 to 50 incl.
R= 0.1/0.4 for sizes 06 to 10 incl.
0.5/0.8 for sizes 12 to 50 incl.
C= 0.50/0.75
M= 0.2 MAX



MATERIALS

***Liner* - AMPEP X1**
Liner System qualified to MIL - B - 81820

Shell
For 13C----AF Series:
Aluminium Alloy DTD 5014 condition 'TF'
Anodised per DEF STAN 03-24
For 13C----SF Series:
Corrosion Resistant Steel AMS 5643 condition H1150
Where specified Cadmium plated per DEF STAN 03-19

DIMENSIONS AND TOLERANCES

All Dimensions in Millimetres

Nominal Bore	B	D	F	A	W															
	Bore Dia	O/Dia	Flange Thickness	Flange Dia	Overall Length -0.1 -0.4															
Code Size	–	–	+0.00 -0.15	+0.00 -0.25	06	08	10	12	15	16	18	20	22	25	28	30	32	35	40	45	50
06	6.004 6.022	10.024 10.015	1.5	12.0	06																
08	8.005 8.027	12.029 12.018	1.5	14.0	06	08															
10	10.005 10.027	14.029 14.018	1.5	16.0	06	08	10														
12	12.006 12.033	16.029 16.018	1.5	22.0	06	08	10	12													
15	15.006 15.033	19.035 19.022	1.5	25.0		08	10	12	15												
16	16.006 16.033	20.035 20.022	1.5	26.0		08	10	12	15	16											
18	18.006 18.033	22.035 22.022	1.5	28.0			10	12	15		18										
20	20.007 20.040	25.035 25.022	1.5	30.0			10	12	15			20									
22	22.007 22.040	26.035 26.022	1.5	32.0				12	15			20	22								
25	25.007 25.040	30.035 30.022	1.5	35.0				12	15			20	22	25							
28	28.007 28.040	34.042 34.026	2.5	40.0					15			20	22	25	28						
30	30.007 30.040	36.042 36.026	2.5	42.0					15			20	22	25		30					
32	32.009 32.048	38.042 38.026	2.5	44.0					15			20	22	25		30	32				
35	35.009 35.048	42.042 42.026	2.5	47.0								20	22	25		30		35			
40	40.009 40.048	48.042 48.026	2.5	52.0								20		25		30		35	40		
45	45.009 45.048	52.051 52.032	2.5	57.0										25		30		35	40	45	
50	50.009 50.048	58.051 58.032	2.5	62.0										25		30		35	40	45	50

MASS

Per mm Length Al. Alloy	Per mm Length Steel
g (Approx)	
0.18	0.46
0.21	0.55
0.24	0.65
0.35	0.91
0.39	1.03
0.40	1.08
0.44	1.16
0.57	1.53
0.51	1.34
0.69	1.82
0.97	2.56
1.03	2.77
1.08	2.85
1.32	3.50
1.69	4.45
1.64	4.34
2.05	5.41

SPECIAL TYPES

Bearings based on the above specifications with non-standard features may be supplied on request.

LOADS

For 13C----AF Series:
Static Limit Load
= 206 x B x (W-F-1.5) Newtons
Static Axial Limit Load
= 180 x $\pi/4$ x $[(A-0.75)^2 - (B+2.75)^2]$Newtons

For 13C----SF Series:
Static Limit Load
= 430 x B x (W-F-1.5) Newtons
Static Axial Limit Load
= 340 x $\pi/4$ x $[(A-0.75)^2 - (B+2.75)^2]$Newtons

NOTES

△

△1 Oversize 'D' dia versions identified by groove 1.50 rad x 0.50/0.75 deep.
Y1 has one groove in end face & in Flange dia.
Y2 has two grooves in end face & in Flange dia.

△2 For 13C----SF Series:
Cadmium Plated version - dimensions shown also apply after plating.

PART NUMBERS AND SERIES VERSIONS

Series Part Number Codification

Basic Series Part Number	13	C	08	08	A	F	.
Journal Bearing							
Specification Ident					S		
Bore Dia Code in mm							
Length Code in mm							
Backing Material (A-Alloy, S-Steel)							
Flanged							

△1 **Series Versions - Suffix Identification**

0.1 mm o/size dia 'D'	Y1
0.2 mm o/size dia 'D'	Y2
Low Volatiles (Space prep)	V

△2 For 13C----SF Series:
Cadmium Plated Metal Surfaces — C

BEARING INSTALLATION

Refer to the following section 1.3.2. for recommended Housing and Shaft dimensions.

ampep

AMPEP DATA SHEET
1.3.1/6b
ISSUE - 9504

JOURNAL BEARINGS - SELF LUBRICATING PLAIN - AL. ALLOY & STEEL BACKED

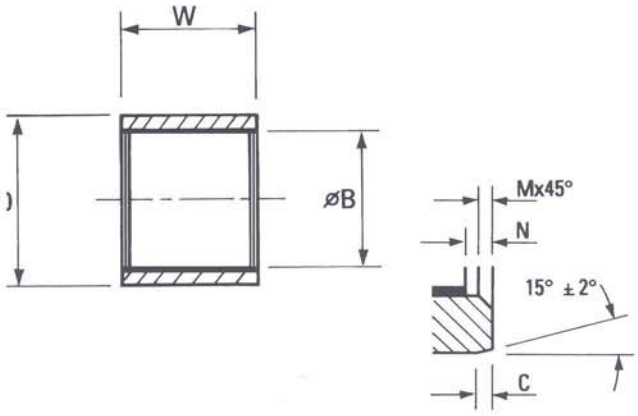
13D----AZ
13D----SZ
METRIC SERIES

MATERIALS

***Liner* - AMPEP X1**
Liner system qualified to MIL -B-81820

Shell
For 13D----AZ Series:
Aluminium Alloy ASTM B221 and B241 or QQ-A-225/6 (2024T8511), Anodised per MIL-A-8625

For 13D----SZ Series:
Corrosion Resistant Steel AMS 5643 Condition H1150 Passivated per QQ-P-35 when specified:Cadmium plated per QQ-P-416 Type II Class 2



STANDARDS REFERENCES

Refer to Following Section 5.0 for Part No. Cross Reference.

N= 0.15/0.60
C= 0.50/0.80
M= 0.13/0.45

DIMENSIONS AND TOLERANCES

All Dimensions in Millimetres

Nominal Bore	B	D	W															Distance travelled per Degree
	Bore Dia	O/Dia	Overall Length -0.1 -0.4															
Code Size	–	–	06	08	10	12	15	18	20	22	25	28	30	35	40	45	50	x 10^{-3}m
06	6.004 6.022	10.024 10.015	06	08														0.0523
08	8.005 8.027	12.029 12.018	06	08	10	12												0.0698
10	10.005 10.027	14.029 14.018	06	08	10	12	15											0.0872
12	12.006 12.033	16.029 16.018	06	08	10	12	15											0.1047
15	15.006 15.033	19.035 19.022		08	10	12	15	18	20									0.1308
16	16.006 16.033	20.035 20.022		08	10	12	15	18	20	22	25							0.1396
18	18.006 18.033	22.035 22.022			10	12	15	18	20	22	25							0.1570
20	20.007 20.040	25.035 25.022			10	12	15	18	20	22	25	28	30					0.1745
22	22.007 22.040	26.035 26.022			10	12	15	18	20	22	25	28	30					0.1919
25	25.007 25.040	30.035 30.022			10	12	15	18	20	22	25	28	30	35				0.2181
28	28.007 28.040	34.042 34.026					15	18	20	22	25	28	30	35	40			0.2443
30	30.007 30.040	36.042 36.026					15	18	20	22	25	28	30	35	40			0.2617
32	32.009 32.048	38.042 38.026					15	18	20	22	25	28	30	35	40			0.2792
35	35.009 35.048	42.042 42.026						18	20	22	25	28	30	35	40	45	50	0.3054
40	40.009 40.048	48.042 48.026							20	22	25	28	30	35	40	45	50	0.3490
45	45.009 45.048	52.051 52.032									25	28	30	35	40	45	50	0.3926
50	50.009 50.048	58.051 58.032									25	28	30	35	40	45	50	0.4360

MASS

Per mm Length Al. Alloy	Per mm Length Steel
g (Max)	
0.18	0.44
0.22	0.55
0.26	0.66
0.31	0.77
0.37	0.92
0.40	0.98
0.44	1.09
0.56	1.41
0.46	1.14
0.68	1.72
0.94	2.40
0.99	2.55
1.05	2.70
1.54	2.95
1.78	4.69
1.72	4.51
2.18	5.75

LOADS

For 13D----AZ Series:
Static Limit Load = 208 x B x (W-1.5) Newtons

For 13D----SZ Series:
Static Limit Load = 430 x B x (W-1.5) Newtons

BEARING INSTALLATION

Refer to the following section 1.3.2. for recommended Housing and Shaft dimensions.

NOTES

△1 Oversize 'D' dia versions identified by groove 1.50 rad x 0.50/0.75 deep.
Y1 has one groove in each end faces
Y2 has two grooves in each end faces.

△2 For 13D----SZ Series:
Cadmium Plated version - dimensions shown also apply after plating.

PART NUMBERS AND SERIES VERSIONS

Series Part Number Codification

Basic Series Part Number	13	D	08	08	A	Z	.
Journal Bearing							
Specification Ident					S		
Bore Dia Code in mm							
Length Code in mm							
Backing Material (A-Alloy, S-Steel)							
Plain							

△1 **Series Versions - Suffix Identification**

0.1 mm o/size dia 'D'	Y1
0.2 mm o/size dia 'D'	Y2
Low Volatiles (Space prep)	V

△2 For 13D----SZ Series:
Cadmium Plated Metal Surfaces — C

SPECIAL TYPES

Bearings based on the above specifications with non-standard features may be supplied on request.

ampep

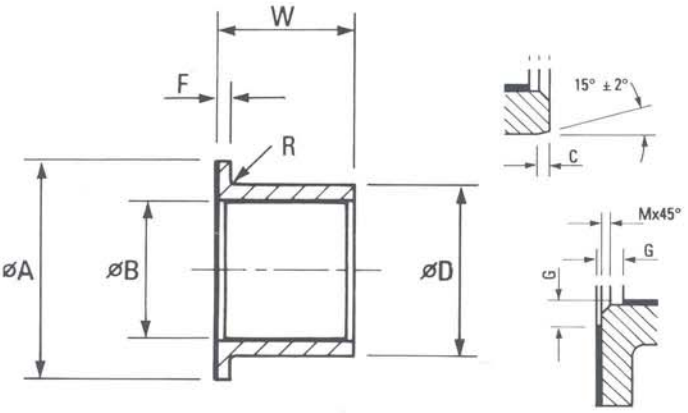
13D----AF
13D----SF
METRIC SERIES

JOURNAL BEARINGS - SELF LUBRICATING FLANGED - AL. ALLOY & STEEL BACKED

STANDARDS REFERENCES

Refer to Following Section 5.0 for Part No. Cross Reference.

G= 0.5/1.0
N= 0.15/0.60
C= 0.50/0.80
R= 0.50/0.80
M= 0.13/0.45



MATERIALS

***Liner* - AMPEP X1**
Liner system qualified to MIL -B-81820

Shell
For 13D----AF Series:
Aluminium Alloy QQ-A-200/3 (2024T851) or QQ-A-225/6 (2024T8511), Anodised per MIL-A-8625

For 13D----SF Series:
Corrosion Resistant Steel AMS 5643 Condition H1150 Passivated per QQ-P-35 when specified:Cadmium plated per QQ-P-416 Type II Class 2

DIMENSIONS AND TOLERANCES

All Dimensions in Millimetres

Nominal Bore	B	D	F	A	W															Distance travelled per Degree
	Bore Dia	O/Dia	Flange Thickness	Flange Dia	Overall Length -0.1 -0.4															
Code Size	–	–	+0.00 -0.15	+0.00 -0.25	06	08	10	12	15	18	20	22	25	28	30	35	40	45	50	x 10^{-3}m
06	6.004 6.022	10.024 10.015	1.5	14.0	06	08														0.0523
08	8.005 8.027	12.029 12.018	1.5	16.0	06	08	10	12												0.0698
10	10.005 10.027	14.029 14.018	1.5	18.0	06	08	10	12	15											0.0872
12	12.006 12.033	16.029 16.018	1.5	22.0	06	08	10	12	15											0.1047
15	15.006 15.033	19.035 19.022	1.5	25.0		08	10	12	15	18	20									0.1308
16	16.006 16.033	20.035 20.022	1.5	26.0		08	10	12	15	18	20	22	25							0.1396
18	18.006 18.033	22.035 22.022	1.5	28.0			10	12	15	18	20	22	25							0.1570
20	20.007 20.040	25.035 25.022	1.5	31.0			10	12	15	18	20	22	25	28	30					0.1745
22	22.007 22.040	26.035 26.022	1.5	32.0			10	12	15	18	20	22	25	28	30					0.1919
25	25.007 25.040	30.035 30.022	1.5	36.0			10	12	15	18	20	22	25	28	30	35				0.2181
28	28.007 28.040	34.042 34.026	2.5	40.0					15	18	20	22	25	28	30	35	40			0.2443
30	30.007 30.040	36.042 36.026	2.5	42.0					15	18	20	22	25	28	30	35	40			0.2617
32	32.009 32.048	38.042 38.026	2.5	44.0					15	18	20	22	25	28	30	35	40			0.2792
35	35.009 35.048	42.042 42.026	2.5	48.0						18	20	22	25	28	30	35	40	45	50	0.3054
40	40.009 40.048	48.042 48.026	2.5	55.0							20	22	25	28	30	35	40	45	50	0.3490
45	45.009 45.048	52.051 52.032	2.5	59.0									25	28	30	35	40	45	50	0.3926
50	50.009 50.048	58.051 58.032	2.5	65.0									25	28	30	35	40	45	50	0.4360

MASS

Per mm Length Al. Alloy	Per mm Length Steel
g (Max)	
0.18	0.44
0.22	0.55
0.26	0.66
0.31	0.77
0.37	0.92
0.40	0.98
0.44	1.09
0.56	1.41
0.46	1.14
0.68	1.72
0.94	2.40
0.99	2.55
1.05	2.70
1.54	2.95
1.78	4.69
1.72	4.51
2.18	5.75

SPECIAL TYPES

Bearings based on the above specifications with non-standard features may be supplied on request.

LOADS

For 13D----AF Series:
Static Limit Load
= 250 x B x (W-F-1.5) Newtons

For 13D----SF Series:
Static Limit Load
= 450 x B x (W-F-1.5) Newtons

NOTES

△

1. Oversize 'D' dia versions identified by groove 1.50 rad x 0.50/0.75 deep.
Y1 has one groove in end face & in Flange dia.
Y2 has two grooves in end face & in Flange dia.

2. For 13D----SF Series:
Cadmium Plated version - dimensions shown also apply after plating.

PART NUMBERS AND SERIES VERSIONS

Series Part Number Codification

Basic Series Part Number	13	D	08	08	A	F	.
Journal Bearing					S		

Specification Ident
Bore Dia Code in mm
Length Code in mm
Backing Material (A-Alloy, S-Steel)
Flanged

1. **Series Versions - Suffix Identification**

0.1 mm o/size dia 'D'	Y1
0.2 mm o/size dia 'D'	Y2
Low Volatiles (Space prep)	V

2. For 13D----SF Series:
Cadmium Plated Metal Surfaces — C

BEARING INSTALLATION

Refer to the following section 1.3.2. for recommended Housing and Shaft dimensions.

ampep

AMPEP DATA SHEET
1.3.1/7b
ISSUE - 9504

JOURNAL BEARINGS - SELF LUBRICATING PLAIN - AL. ALLOY & STEEL BACKED

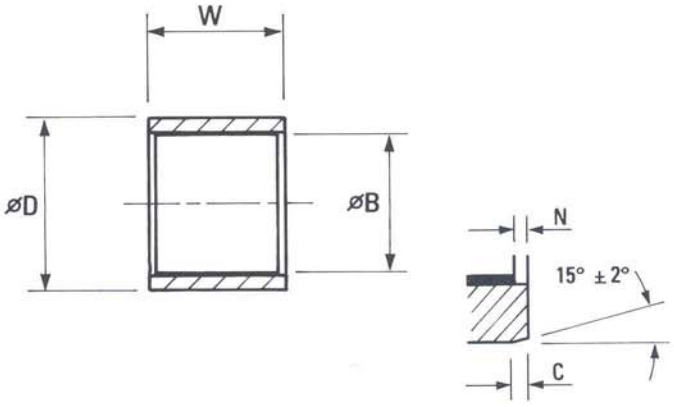
----AK
----SK
METRIC SERIES

MATERIALS

***Liner* - FIBERSLIP®**
B.40 to AFS 2125 & DTD 900/4903
for sizes 06 to 18
B.30 to AFS 2125 & DTD 900/4902
for sizes 20 to 50

Shell
For ----AK Series:
Aluminium Alloy to Specification DTD5014 or similar,
Anodised to Def Stan 03-24

For ----SK Series:
Corrosion Resistant Steel to British Specification S.80



STANDARDS REFERENCES

PAN 4834 & 5
EN 2285
EN 2287

Refer to Following Section 5.0 for Part No. Cross Reference.

N= 0.25 for sizes 06 to 18 incl
0.50 for sizes 20 to 50 incl
C= 0.5 / 0.75

DIMENSIONS AND TOLERANCES

All Dimensions in Millimetres

Nominal Bore	B	D	W															Distance travelled per Degree
	Bore Dia	O/Dia	Overall Width -0.1 -0.4															
Code Size	–	–	06	08	10	12	15	18	20	22	25	28	30	35	40	45	50	x 10^{-3}m
06	6.004 6.022	10.024 10.015	06															0.0523
08	8.005 8.027	12.029 12.018	06	08														0.0698
10	10.005 10.027	14.029 14.018	06	08	10													0.0872
12	12.006 12.033	16.029 16.018	06	08	10	12												0.1047
15	15.006 15.033	19.035 19.022		08	10	12	15											0.1308
16	16.006 18.033	20.035 20.022		08	10	12	15											0.1396
18	18.006 18.033	22.035 22.022			10	12	15	18										0.1570
20	20.007 20.040	25.035 25.022			10	12	15	18	20									0.1745
22	22.007 22.040	26.035 26.022				12	15		20									0.1919
25	25.007 25.040	30.035 30.022				12	15	18	20	22	25							0.2181
28	28.007 28.040	34.042 34.026					15		20		25							0.2443
30	30.007 30.040	36.042 36.026					15	18	20	22	25	28	30					0.2617
32	32.009 32.048	38.042 38.026					15		20		25		30					0.2792
35	35.009 35.048	42.042 42.026						18	20	22	25	28	30	35				0.3054
40	40.009 40.048	48.042 48.026							20		25		30	35	40			0.3490
45	45.009 45.048	52.051 52.032									25		30	35	40	45		0.3926
50	50.009 50.048	58.051 58.032									25		30	35	40	45	50	0.4360

MASS

Per mm Width Al. Alloy	Per mm Width Steel
g (Max)	
0.16	0.40
0.20	0.50
0.24	0.60
0.28	0.70
0.34	0.84
0.36	0.89
0.40	0.99
0.51	1.28
0.42	1.04
0.62	1.56
0.85	2.18
0.90	2.32
0.95	2.45
1.40	2.68
1.62	4.26
1.56	4.10
2.00	5.23

LOADS

For ----AK Series:
Static Limit Load = 206 x B x (W-1.5) Newtons

For ----SK Series:
Static Limit Load = 430 x B x (W-1.5) Newtons

BEARING INSTALLATION

Refer to the following section 1.3.2. for recommended Housing and Shaft dimensions.

NOTES

△

△1 Oversize 'D' dia versions identified by groove 1.50 rad x 0.50/0.75 deep.
Y1 has one groove in each end face
Y2 has two grooves in each end face.

△2 For ----SK Series:
Cadmium Plated to Def Stan 03-19 version - dimensions shown also apply after plating.

PART NUMBERS AND SERIES VERSIONS

Series Part Number Codification

Basic Series Part Number — 06 06 A K .
Bore Dia Code in mm — 06 06
Width Code in mm — 06
Backing Material (A-AL. Alloy, S-Steel) — A S
Journal Bearing — K

△1 **Series Versions - Suffix Identification**

0.1 mm o/size dia 'D' — Y1
0.2 mm o/size dia 'D' — Y2
Low Volatiles (Space prep) — V

△2 For ----SK Series:
Cadmium Plated Metal Surfaces — C

SPECIAL TYPES

Bearings based on the above specifications with non-standard features may be supplied on request.

ampep

AMPEP DATA SHEET
1.3.1/8a
ISSUE - 9305

----FAK
----FSK
METRIC SERIES

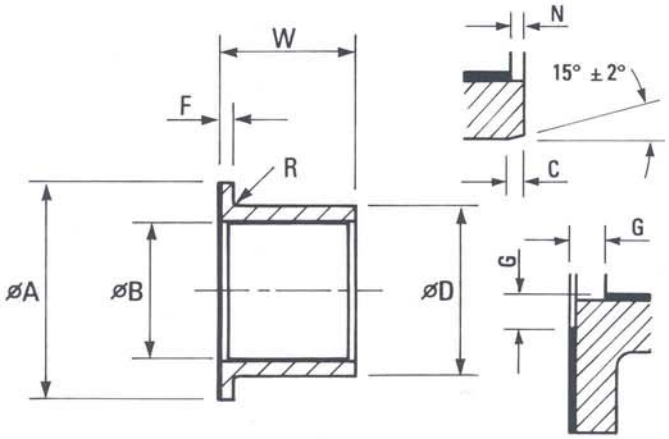
JOURNAL BEARINGS - SELF LUBRICATING FLANGED - AL. ALLOY & STEEL BACKED

STANDARDS REFERENCES

PAN 4832 & 3
EN 2286
EN 2288

Refer to Following Section 5.0 for Part No. Cross Reference.

G = 0.50 for sizes 06 to 18 incl
1.00 for sizes 20 to 50 incl
N = 0.25 for sizes 06 to 18 incl
0.50 for sizes 20 to 50 incl
R = 0.10/0.40 for sizes 06 to 10 incl
0.50/0.75 for sizes 12 to 50 incl
C= 0.50 / 0.75



MATERIALS

***Liner* - FIBERSLIP®**
B.40 to AFS 2125 & DTD 900/4903 for sizes 06 to 18 Incl
B.30 to AFS 2125 & DTD 900/4902 for sizes 20 to 50 Incl

Shell
For ----FAK Series:
Aluminium Alloy to Specification DTD5014 or similar, Anodised to Def Stan 03-24

For ----FSK Series:
Corrosion Resistant Steel to British Specification S.80

DIMENSIONS AND TOLERANCES

All Dimensions in Millimetres

Nominal Bore	B	D	F	A	W															Distance travelled per Degree
	Bore Dia	O/Dia	Flange Thickness	Flange Dia	Overall Width -0.1 -0.4															
Code Size	–	–	+0.000 -0.125	+0.000 -0.250	06	08	10	12	15	18	20	22	25	28	30	35	40	45	50	x 10^{-3}m
06	6.004 6.022	10.024 10.015	1.5	12	06															0.0523
08	8.005 8.027	12.029 12.018	1.5	14	06	08														0.0698
10	10.005 10.027	14.029 14.018	1.5	16	06	08	10													0.0872
12	12.006 12.033	16.029 16.018	1.5	22	06	08	10	12												0.1047
15	15.006 15.033	19.035 19.022	1.5	25		08	10	12	15											0.1308
16	16.006 16.033	20.035 20.022	1.5	26		08	10	12	15											0.1396
18	18.006 18.033	22.035 22.022	1.5	28			10	12	15	18										0.1570
20	20.007 20.040	25.035 25.022	1.5	30			10	12	15	18	20									0.1745
22	22.007 22.040	26.035 26.022	1.5	32				12	15		20									0.1919
25	25.007 25.040	30.035 30.022	1.5	35				12	15	18	20	22	25							0.2181
28	28.007 28.040	34.042 34.026	2.5	40					15		20		25							0.2443
30	30.007 30.040	36.042 36.026	2.5	42					15	18	20	22	25	28	30					0.2617
32	32.009 32.048	38.042 38.026	2.5	44					15		20		25		30					0.2792
35	35.009 35.048	42.042 42.026	2.5	47						18	20	22	25	28	30	35				0.3054
40	40.009 40.048	48.042 48.026	2.5	52							20		25		30	35	40			0.3490
45	45.009 45.048	52.051 52.032	2.5	57									25		30	35	40	45		0.3926
50	50.009 50.048	58.051 58.032	2.5	62									25		30	35	40	45	50	0.4360

MASS

Per mm Width Al. Alloy	Per mm Width Steel
g (Max)	
0.18	0.44
0.22	0.55
0.26	0.66
0.31	0.77
0.37	0.92
0.40	0.98
0.44	1.09
0.56	1.41
0.46	1.14
0.68	1.72
0.94	2.40
0.99	2.55
1.05	2.70
1.54	2.95
1.78	4.69
1.72	4.51
2.18	5.75

SPECIAL TYPES

Bearings based on the above specifications with non-standard features may be supplied on request.

LOADS

For ----FAK Series:
Static Limit Load
= 206 x B x (W-F-1.6) Newtons

For ----FSK Series:
Static Limit Load
= 430 x B x (W-F-1.5) Newtons

NOTES

△

1 Oversize 'D' dia versions identified by groove 1.50 rad x 0.50/0.75 deep.
Y1 has one groove in end face & in Flange dia.
Y2 has two grooves in end face & in Flange dia.

2 For ----FSK Series:
Cadmium Plated Version - dimensions shown also apply after plating.

PART NUMBERS AND SERIES VERSIONS

Series Part Number Codification

Basic Series Part Number — 06 06 F A K .
Bore Dia Code in mm — 06 06
Width Code in mm — 06
Flanged — F
Backing Material (A-AL. Alloy, S-Steel) — A S
Journal Bearing — K

1 **Series Versions - Suffix Identification**

0.1 mm o/size dia 'D' — Y1
0.2 mm o/size dia 'D' — Y2
Low Volatiles (Space prep) — V

2 For ----FSK Series:
Cadmium Plated Metal Surfaces — C

BEARING INSTALLATION

Refer to the following section 1.3.2. for recommended Housing and Shaft dimensions.

ampep

JOURNAL BEARINGS - SELF LUBRICATING SHAFT & HOUSING DIMENSIONS

K----
13A----
INCH SERIES

SERIES: KA----P, KS----P, KAF----P, KSF----P, 13AAZ----, 13ASZ----, 13AAF----, 13ASF----

Nominal Bore		Housing Dia.		Shaft Dia.				Housing Dia.		Shaft Dia.			
Code	Size	Interference Fit		Transition Running Fit		Clearance Running Fit		Adhesive Bonded		Transition Running Fit		Clearance Running Fit	
		Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min
04	1/4	.3754	.3750	.2500	.2496	.2495	.2491	.3800	.3780	.2511	.2507	.2503	.2499
05	5/16	.4380	.4375	.3125	.3121	.3120	.3116	.4426	.4406	.3138	.3134	.3130	.3126
06	3/8	.5005	.5000	.3750	.3746	.3745	.3741	.5051	.5031	.3764	.3760	.3756	.3752
08	1/2	.6882	.6875	.5000	.4996	.4994	.4990	.6928	.6908	.5014	.5010	.5006	.5002
10	5/8	.8133	.8125	.6250	.6246	.6244	.6240	.8179	.8159	.6265	.6261	.6257	.6253
12	3/4	.9383	.9375	.7500	.7495	.7492	.7487	.9429	.9409	.7516	.7511	.7508	.7503
14	7/8	1.0633	1.0625	.8750	.8745	.8742	.8737	1.0680	1.0660	.8767	.8762	.8759	.8754
16	1	1.1883	1.1875	1.0000	.9995	.9992	.9987	1.1930	1.1910	1.0018	1.0013	1.0010	1.0005
18	1 1/8	1.3135	1.3125	1.1250	1.1245	1.1242	1.1237	1.3183	1.3163	1.1271	1.1266	1.1263	1.1258
20	1 1/4	1.5010	1.5000	1.2500	1.2494	1.2490	1.2484	1.5059	1.5039	1.2520	1.2514	1.2512	1.2506
22	1 3/8	1.6260	1.6250	1.3750	1.3744	1.3740	1.3734	1.6309	1.6289	1.3771	1.3765	1.3763	1.3757
24	1 1/2	1.7510	1.7500	1.5000	1.4994	1.4990	1.4984	1.7539	1.7519	1.5021	1.5015	1.5013	1.5007
28	1 3/4	2.0012	2.0000	1.7500	1.7494	1.7490	1.7484	2.0063	2.0043	1.7525	1.7519	1.7517	1.7511
32	2	2.2512	2.2500	2.0000	1.9993	1.9988	1.9981	2.2563	2.2543	2.0025	2.0018	2.0017	2.0010

JOURNAL BEARINGS - SELF LUBRICATING PLAIN & FLANGED - STEEL & AL. ALLOY BACKED SHAFT & HOUSING DIMENSIONS

13B---- INCH SERIES

SERIES: 13BAZ----, 13BAF----

Nominal Bore		Housing Dia.		Shaft Dia.			
Code	Size	Interference Fit		Transition Running Fit		Clearance Running Fit	
		Max	Min	Max	Min	Max	Min
04	1/4	.3754	.3750	.2495	.2490	.2489	.2484
05	5/16	.4380	.4375	.3120	.3115	.3114	.3109
06	3/8	.5005	.5000	.3745	.3740	.3739	.3734
07	7/16	.5631	.5624	.4365	.4360	.4358	.4353
08	1/2	.6258	.6251	.4990	.4985	.4983	.4978
09	9/16	.6885	.6878	.5615	.5610	.5608	.5603
10	5/8	.8135	.8127	.6240	.6235	.6233	.6228
11	11/16	.8760	.8752	.6865	.6860	.6858	.6853
12	3/4	.9386	.9378	.7490	.7485	.7482	.7478
14	7/8	1.0638	1.0630	.8740	.8735	.8732	.8727
16	1	1.1891	1.1883	.9990	.9985	.9982	.9978
18	1 1/8	1.3141	1.3131	1.1240	1.1235	1.1232	1.1227
20	1 1/4	1.4390	1.4380	1.2490	1.2484	1.2480	1.2474
22	1 3/8	1.5640	1.5630	1.3740	1.3734	1.3730	1.3724
24	1 1/2	1.7515	1.7505	1.4990	1.4984	1.4980	1.4974
26	1 5/8	1.8765	1.8755	1.6240	1.6234	1.6230	1.6224
28	1 3/4	2.0014	2.0002	1.7480	1.7484	1.7480	1.7474
32	2	2.2514	2.2502	1.9990	1.9983	1.9978	1.9971

Housing Dia.		Shaft Dia.			
Adhesive Bonded		Transition Running Fit		Clearance Running Fit	
Max	Min	Max	Min	Max	Min
.3800	.3780	.2513	.2508	.2505	.2500
.4426	.4406	.3138	.3133	.3130	.3125
.5051	.5031	.3763	.3758	.3755	.3750
.5677	.5657	.4388	.4383	.4380	.4375
.6305	.6285	.5013	.5008	.5005	.5000
.6932	.6912	.5638	.5633	.5630	.5625
.8181	.8161	.6263	.6258	.6255	.6250
.8806	.8786	.6888	.6883	.6880	.6875
.9432	.9412	.7513	.7508	.7505	.7500
1.0684	1.0664	.8763	.8758	.8755	.8750
1.1938	1.1918	1.0013	1.0008	1.0005	1.0000
1.3189	1.3169	1.1263	1.1258	1.1255	1.1250
1.4440	1.4420	1.2513	1.2507	1.2505	1.2499
1.5699	1.5679	1.3763	1.3757	1.3755	1.3749
1.7544	1.7524	1.5013	1.5007	1.5005	1.4999
1.8818	1.8798	1.6263	1.6257	1.6255	1.6249
2.0065	2.0045	1.7513	1.7506	1.7505	1.7499
2.2565	2.2545	2.0013	2.0006	2.0005	1.9998

13B----
INCH SERIES

JOURNAL BEARINGS - SELF LUBRICATING PLAIN & FLANGED - STEEL & AL. ALLOY BACKED SHAFT & HOUSING DIMENSIONS

SERIES: 13BSZ----, 13BSF----

Nominal Bore		Housing Dia.		Shaft Dia.				Housing Dia.		Shaft Dia.			
Code	Size	Interference Fit		Transition Running Fit		Clearance Running Fit		Adhesive Bonded		Transition Running Fit		Clearance Running Fit	
		Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min
04	1/4	.3754	.3750	.2500	.2495	.2494	.2489	.3800	.3780	.2513	.2508	.2505	.2500
05	5/16	.4380	.4375	.3125	.3120	.3119	.3114	.4426	.4406	.3138	.3133	.3130	.3125
06	3/8	.5005	.5000	.3750	.3745	.3744	.3739	.5051	.5031	.3763	.3758	.3755	.3750
07	7/16	.5631	.5624	.4370	.4365	.4363	.4358	.5677	.5657	.4388	.4383	.4380	.4375
08	1/2	.6258	.6251	.4995	.4990	.4988	.4983	.6305	.6285	.5013	.5008	.5005	.5000
09	9/16	.6885	.6878	.5620	.5615	.5613	.5608	.6932	.6912	.5638	.5633	.5630	.5625
10	5/8	.8135	.8127	.6245	.6240	.6238	.6233	.8181	.8161	.6263	.6258	.6255	.6250
11	11/16	.8760	.8752	.6870	.6865	.6863	.6858	.8806	.8786	.6888	.6883	.6880	.6875
12	3/4	.9386	.9378	.7495	.7490	.7487	.7482	.9432	.9412	.7513	.7508	.7505	.7500
14	7/8	1.0638	1.0630	.8745	.8740	.8737	.8732	1.0684	1.0664	.8763	.8758	.8755	.8750
16	1	1.1891	1.1883	.9995	.9990	.9987	.9982	1.1938	1.1918	1.0013	1.0008	1.0005	1.0000
18	1 1/8	1.3141	1.3131	1.1245	1.1240	1.1237	1.1232	1.3189	1.3169	1.1265	1.1258	1.1255	1.1250
20	1 1/4	1.4390	1.4380	1.2495	1.2489	1.2485	1.2479	1.4440	1.4420	1.2513	1.2507	1.2505	1.2499
22	1 3/8	1.5640	1.56630	1.3745	1.3739	1.3735	1.3729	1.5699	1.5679	1.3763	1.3757	1.3755	1.3749
24	1 1/2	1.7515	1.7505	1.4995	1.4989	1.4985	1.4979	1.7544	1.7524	1.5013	1.5007	1.5005	1.4999
26	1 5/8	1.8765	1.8755	1.6245	1.6239	1.6235	1.6229	1.8818	1.8798	1.6263	1.6257	1.6255	1.6249
28	1 3/4	2.0014	2.0002	1.7495	1.7489	1.7485	1.7479	2.0065	2.0045	1.7513	1.7506	1.7505	1.7499
32	2	2.2514	2.2502	1.9995	1.9988	1.9983	1.9976	2.2565	2.2545	2.0013	2.0006	2.0005	1.9998

JOURNAL BEARINGS - SELF LUBRICATING SHAFT & HOUSING DIMENSIONS

----K, 13C---- 13D---- METRIC SERIES

SERIES: ----AK, ----SK, ----FAK, ----FSK
13C----AZ, 13C----SZ, 13C----AF, 13C----SF
13D----AZ, 13D----SZ, 13D----AF, 13D----SF

Nominal Bore		Housing Dia.		Shaft Dia.				Housing Dia.		Shaft Dia.			
Code	Size	Interference Fit		Transition Running Fit		Clearance Running Fit		Adhesive Bonded		Transition Running Fit		Clearance Running Fit	
		Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min
06		10.015	10.000	6.007	5.999	5.990	5.982	10.124	10.074	6.024	6.016	6.004	5.996
08		12.018	12.000	8.007	7.998	7.987	7.978	12.129	12.079	8.025	8.016	8.005	7.996
10		14.018	14.000	10.007	9.998	9.987	9.978	14.129	14.079	10.025	10.016	10.005	9.996
12		16.018	16.000	12.008	11.997	11.984	11.973	16.129	16.079	12.026	12.015	12.006	11.995
15		19.021	19.000	15.008	14.997	14.984	14.973	19.135	19.085	15.026	15.015	15.006	14.995
16		20.021	20.000	16.008	15.997	15.984	15.973	20.135	20.085	16.026	16.015	16.006	15.995
18		22.021	22.000	18.008	17.997	17.984	17.973	22.135	22.085	18.026	18.015	18.006	17.995
20		25.021	25.000	20.009	19.996	19.980	19.967	25.135	25.085	20.027	20.014	20.007	19.994
22		26.021	26.000	22.009	21.996	21.980	21.967	26.135	26.085	22.027	22.014	22.007	21.994
25		30.021	30.000	25.009	24.996	24.980	24.967	30.135	30.085	25.027	25.014	25.007	24.994
28		34.025	34.000	28.009	27.996	27.980	27.967	34.142	34.092	28.027	28.014	28.007	27.994
30		36.025	36.000	30.009	29.996	29.980	29.967	36.142	36.092	30.027	30.014	30.007	29.994
32		38.025	38.000	32.011	31.995	31.975	31.959	38.142	38.092	32.029	32.013	32.009	31.993
35		42.025	42.000	35.011	34.995	34.975	34.959	42.142	42.092	35.029	35.013	35.009	34.993
40		48.025	48.000	40.011	39.995	39.975	39.959	48.142	48.092	40.029	40.013	40.009	39.993
45		52.030	52.000	45.011	44.995	44.975	44.959	52.151	52.101	45.029	45.013	45.009	44.993
50		58.030	58.000	50.011	49.995	49.975	49.959	58.151	58.101	50.029	50.013	50.009	49.993

ampep

AMPEP DATA SHEET

1.3.2/3b

ISSUE - 9305

CROSS REFERENCE

INDEX

ampep

AMPEP DATA SHEET

5.0.0/INDEX b

ISSUE - 9305

AGS / AMPEP PART No. CROSS-REFERENCE

AGS INCH STANDARDS

AGS 3808	
AGS Number	AMPEP part No.
3808-04--	KA04--P
3808-05--	KA05--P
3808-06--	KA06--P
3808-08--	KA08--P
3808-10--	KA10--P
3808-12--	KA12--P
3808-14--	KA14--P
3808-16--	KA16--P
3808-18--	KA18--P
3808-20--	KA20--P
3808-22--	KA22--P
3808-24--	KA24--P
3808-28--	KA28--P
3808-32--	KA32--P

AGS 3809	
AGS Number	AMPEP part No.
3809-04--	KS04--P
3809-05--	KS05--P
3809-06--	KS06--P
3809-08--	KS08--P
3809-10--	KS10--P
3809-12--	KS12--P
3809-14--	KS14--P
3809-16--	KS16--P
3809-18--	KS18--P
3809-20--	KS20--P
3809-22--	KS22--P
3809-24--	KS24--P
3809-28--	KS28--P
3809-32--	KS32--P

AGS 3810	
AGS Number	AMPEP part No.
3810-04--	KAF04--P
3810-05--	KAF05--P
3810-06--	KAF06--P
3810-08--	KAF08--P
3810-10--	KAF10--P
3810-12--	KAF12--P
3810-14--	KAF14--P
3810-16--	KAF16--P
3810-18--	KAF18--P
3810-20--	KAF20--P
3810-22--	KAF22--P
3810-24--	KAF24--P
3810-28--	KAF28--P
3810-32--	KAF32--P

AGS 3811	
AGS Number	AMPEP part No.
3811-04--	KSF04--P
3811-05--	KSF05--P
3811-06--	KSF06--P
3811-08--	KSF08--P
3811-10--	KSF10--P
3811-12--	KSF12--P
3811-14--	KSF14--P
3811-16--	KSF16--P
3811-18--	KSF18--P
3811-20--	KSF20--P
3811-22--	KSF22--P
3811-24--	KSF24--P
3811-28--	KSF28--P
3811-32--	KSF32--P

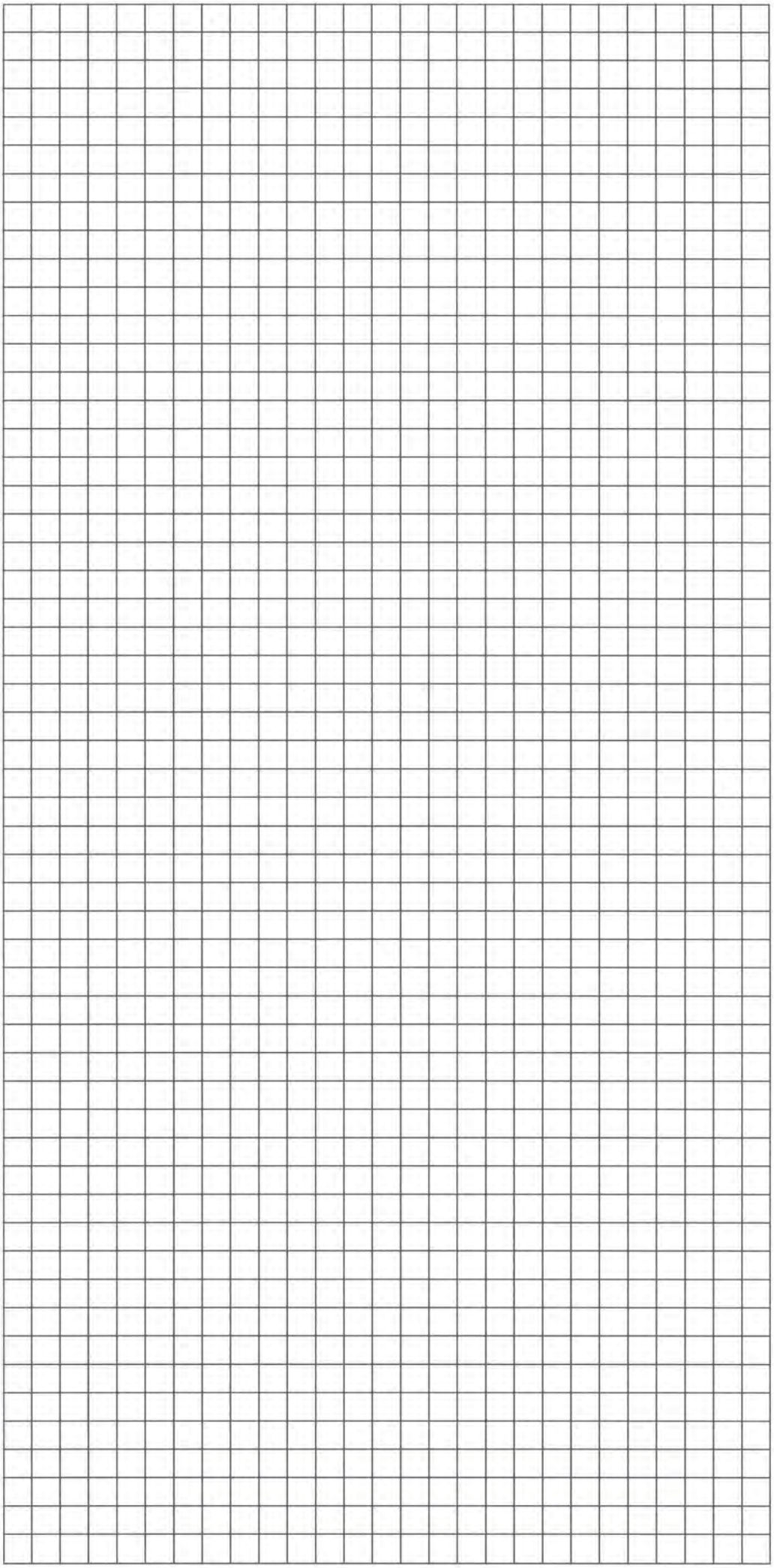
NOTE: LAST TWO NUMBERS IN AGS AND AMPEP CODES ARE WIDTH IN MULTIPLES OF $^{1}/_{16}$ INCH

AGS 3812	
AGS Number	AMPEP part No.
3812-03	SW03G
3812-04	SW04G
3812-05	SW05G
3812-06	SW06G
3812-07	SW07G
3812-08	SW08G
3812-09	SW09G
3812-10	SW10G
3812-12	SW12G
3812-14	SW14G
3812-16	SW16G

AGS 3813	
AGS Number	AMPEP part No.
3813-03	SN03G
3813-04	SN04G
3813-05	SN05G
3813-06	SN06G
3813-07	SN07G
3813-08	SN08G
3813-09	SN09G
3813-10	SN10G
3813-12	SN12G
3813-14	SN14G
3813-16	SN16G

AGS 3814	
AGS Number	AMPEP part No.
3814-03	SW03Z
3814-04	SW04Z
3814-05	SW05Z
3814-06	SW06Z
3814-07	SW07Z
3814-08	SW08Z
3814-09	SW09Z
3814-10	SW10Z
3814-12	SW12Z
3814-14	SW14Z
3814-16	SW16Z
3814-20	SW20Z
3814-24	SW24Z
3814-28	SW28Z
3814-32	SW32Z

AGS 3815	
AGS Number	AMPEP part No.
3815-03	SN03Z
3815-04	SN04Z
3815-05	SN05Z
3815-06	SN06Z
3815-07	SN07Z
3815-08	SN08Z
3815-09	SN09Z
3815-10	SN10Z
3815-12	SN12Z
3815-14	SN14Z
3815-16	SN16Z
3815-20	SN20Z
3815-24	SN24Z
3815-28	SN28Z
3815-32	SN32Z



ampep

AMPEP DATA SHEET

5.0.1/1b

ISSUE - 9305

ASN / AMPEP PART No. CROSS-REFERENCE

ASN INCH STANDARDS

ASN-A2121	
ASN Number	AMPEP part No.
ASN-A2121-03	11BNG03
ASN-A2121-04	11BNG04
ASN-A2121-05	11BNG051
ASN-A2121-06	11BNG06
ASN-A2121-07	11BNG07
ASN-A2121-08	11BNG08
ASN-A2121-09	11BNG09
ASN-A2121-10	11BNG10
ASN-A2121-12	11BNG12
ASN-A2121-14	11BNG14
ASN-A2121-16	11BNG16

ASN-A2122	
ASN Number	AMPEP part No.
ASN-A2122-03	11BWZ03
ASN-A2122-04	11BWZ04
ASN-A2122-05	11BWZ05
ASN-A2122-06	11BWZ06
ASN-A2122-07	11BWZ07
ASN-A2122-08	11BWZ08
ASN-A2122-09	11BWZ09
ASN-A2122-10	11BWZ10
ASN-A2122-12	11BWZ12
ASN-A2122-14	11BWZ14
ASN-A2122-16	11BWZ16

ASN-A2123	
ASN Number	AMPEP part No.
ASN-A2123-03	11BWG03
ASN-A2123-04	11BWG04
ASN-A2123-05	11BWG05
ASN-A2123-06	11BWG06
ASN-A2123-07	11BWG07
ASN-A2123-08	11BWG08
ASN-A2123-09	11BWG09
ASN-A2123-10	11BWG10
ASN-A2123-12	11BWG12
ASN-A2123-14	11BWG14
ASN-A2123-16	11BWG16

ASN-A2124	
ASN Number	AMPEP part No.
ASN-A2124-03	11BNZ03
ASN-A2124-04	11BNZ04
ASN-A2124-05	11BNZ05
ASN-A2124-06	11BNZ06
ASN-A2124-07	11BNZ07
ASN-A2124-08	11BNZ08
ASN-A2124-09	11BNZ09
ASN-A2124-10	11BNZ10
ASN-A2124-12	11BNZ12
ASN-A2124-14	11BNZ14
ASN-A2124-16	11BNZ16

ASN-A2125--	
ASN Number	AMPEP part No.
ASN-A2125-03	12BMR03
ASN-A2125-04	12BMR04
ASN-A2125-05	12BMR05
ASN-A2125-06	12BMR06
ASN-A2125-07	12BMR07
ASN-A2125-08	12BMR08
ASN-A2125-10	12BMR10
ASN-A2125-12	12BMR12
ASN-A2125-14	12BMR14
ASN-A2125-16	12BMR16

ASN-A2125--K	
ASN Number	AMPEP part No.
ASN-A2125-03K	12BMR03K
ASN-A2125-04K	12BMR04K
ASN-A2125-05K	12BMR05K
ASN-A2125-06K	12BMR06K
ASN-A2125-07K	12BMR07K
ASN-A2125-08K	12BMR08K
ASN-A2125-10K	12BMR10K
ASN-A2125-12K	12BMR12K
ASN-A2125-14K	12BMR14K
ASN-A2125-16K	12BMR16K

ASN-A2125--L	
ASN Number	AMPEP part No.
ASN-A2125-03L	12BML03
ASN-A2125-04L	12BML04
ASN-A2125-05L	12BML05
ASN-A2125-06L	12BML06
ASN-A2125-07L	12BML07
ASN-A2125-08L	12BML08
ASN-A2125-10L	12BML10
ASN-A2125-12L	12BML12
ASN-A2125-14L	12BML14
ASN-A2125-16L	12BML16

ASN-A2125--KL	
ASN Number	AMPEP part No.
ASN-A2125-03KL	12BML03K
ASN-A2125-04KL	12BML04K
ASN-A2125-05KL	12BML05K
ASN-A2125-06KL	12BML06K
ASN-A2125-07KL	12BML07K
ASN-A2125-08KL	12BML08K
ASN-A2125-10KL	12BML10K
ASN-A2125-12KL	12BML12K
ASN-A2125-14KL	12BML14K
ASN-A2125-16KL	12BML16K

ASN-A2126--	
ASN Number	AMPEP part No.
ASN-A2126-03	12BFR03
ASN-A2126-04	12BFR04
ASN-A2126-05	12BFR05
ASN-A2126-06	12BFR06
ASN-A2126-07	12BFR07
ASN-A2126-08	12BFR08
ASN-A2126-10	12BFR10
ASN-A2126-12	12BFR12
ASN-A2126-14	12BFR14
ASN-A2126-16	12BFR16

ASN-A2126--K	
ASN Number	AMPEP part No.
ASN-A2126-03K	12BFR03K
ASN-A2126-04K	12BFR04K
ASN-A2126-05K	12BFR05K
ASN-A2126-06K	12BFR06K
ASN-A2126-07K	12BFR07K
ASN-A2126-08K	12BFR08K
ASN-A2126-10K	12BFR10K
ASN-A2126-12K	12BFR12K
ASN-A2126-14K	12BFR14K
ASN-A2126-16K	12BFR16K

ASN-A2126--L	
ASN Number	AMPEP part No.
ASN-A2126-03L	12BFL03
ASN-A2126-04L	12BFL04
ASN-A2126-05L	12BFL05
ASN-A2126-06L	12BFL06
ASN-A2126-07L	12BFL07
ASN-A2126-08L	12BFL08
ASN-A2126-10L	12BFL10
ASN-A2126-12L	12BFL12
ASN-A2126-14L	12BFL14
ASN-A2126-16L	12BFL16

ASN-A2126--KL	
ASN Number	AMPEP part No.
ASN-A2126-03KL	12BFL03K
ASN-A2126-04KL	12BFL04K
ASN-A2126-05KL	12BFL05K
ASN-A2126-06KL	12BFL06K
ASN-A2126-07KL	12BFL07K
ASN-A2126-08KL	12BFL08K
ASN-A2126-10KL	12BFL10K
ASN-A2126-12KL	12BFL12K
ASN-A2126-14KL	12BFL14K
ASN-A2126-16KL	12BFL16K

ASN
INCH
STANDARDS

ASN / AMPEP PART No. CROSS-REFERENCE

ASN-A2127-A-	
ASN Number	AMPEP part No.
A2127-04A--	13BAZ04--
A2127-05A--	13BAZ05--
A2127-06A--	13BAZ06--
A2127-07A--	13BAZ07--
A2127-08A--	13BAZ08--
A2127-09A--	13BAZ09--
A2127-10A--	13BAZ10--
A2127-11A--	13BAZ11--
A2127-12A--	13BAZ12--
A2127-14A--	13BAZ14--
A2127-16A--	13BAZ16--
A2127-18A--	13BAZ18--
A2127-20A--	13BAZ20--
A2127-22A--	13BAZ22--
A2127-24A--	13BAZ24--
A2127-26A--	13BAZ26--
A2127-28A--	13BAZ28--
A2127-32A--	13BAZ32--

ASN-A2127-C-	
ASN Number	AMPEP part No.
A2127-04C--	13BSZ04--
A2127-05C--	13BSZ05--
A2127-06C--	13BSZ06--
A2127-07C--	13BSZ07--
A2127-08C--	13BSZ08--
A2127-09C--	13BSZ09--
A2127-10C--	13BSZ10--
A2127-11C--	13BSZ11--
A2127-12C--	13BSZ12--
A2127-14C--	13BSZ14--
A2127-16C--	13BSZ16--
A2127-18C--	13BSZ18--
A2127-20C--	13BSZ20--
A2127-22C--	13BSZ22--
A2127-24C--	13BSZ24--
A2127-26C--	13BSZ26--
A2127-28C--	13BSZ28--
A2127-32C--	13BSZ32--

ASN-A2128-A-	
ASN Number	AMPEP part No.
A2128-04A--	13BAF04--
A2128-05A--	13BAF05--
A2128-06A--	13BAF06--
A2128-07A--	13BAF07--
A2128-08A--	13BAF08--
A2128-09A--	13BAF09--
A2128-10A--	13BAF10--
A2128-11A--	13BAF11--
A2128-12A--	13BAF12--
A2128-14A--	13BAF14--
A2128-16A--	13BAF16--
A2128-18A--	13BAF18--
A2128-20A--	13BAF20--
A2128-22A--	13BAF22--
A2128-24A--	13BAF24--
A2128-26A--	13BAZ26--
A2128-28A--	13BAF28--
A2128-32A--	13BAF32--

ASN-A2128-C-	
ASN Number	AMPEP part No.
A2128-04C--	13BSF04--
A2128-05C--	13BSF05--
A2128-06C--	13BSF06--
A2128-07C--	13BSF07--
A2128-08C--	13BSF08--
A2128-09C--	13BSF09--
A2128-10C--	13BSF10--
A2128-11C--	13BSF11--
A2128-12C--	13BSF12--
A2128-14C--	13BSF14--
A2128-16C--	13BSF16--
A2128-18C--	13BSF18--
A2128-20C--	13BSF20--
A2128-22C--	13BSF22--
A2128-24C--	13BSF24--
A2128-26C--	13BSF26--
A2128-28C--	13BSF28--
A2128-32C--	13BSF32--

BAS / AMPEP PART No. CROSS-REFERENCE

BAS INCH STANDARDS

BAS 7651--	
BAS Number	AMPEP part No.
7651-03	11BNZ03
7651-04	11BNZ04
7651-05	11BNZ05
7651-06	11BNZ06
7651-07	11BNZ07
7651-08	11BNZ08
7651-09	11BNZ09
7651-10	11BNZ10
7651-12	11BNZ12
7651-14	11BNZ14
7651-16	11BNZ16
7651-20	11BNZ20
7651-24	11BNZ24
7651-28	11-10053P
7651-32	11BNZ32

BAS 7651--LF	
BAS Number	AMPEP part No.
7651-03LF	SN03ZT
7651-04LF	SN04ZT
7651-05LF	SN05ZT
7651-06LF	SN06ZT
7651-08LF	SN08ZT
7651-10LF	SN10ZT
7651-12LF	SN12ZT
7651-14LF	SN14ZT
7651-16LF	SN16ZT

BAS 7652--	
BAS Number	AMPEP part No.
7652-03	SW03Z
7652-04	SW04Z
7652-05	SW05Z
7652-06	SW06Z
7652-07	SW07Z
7652-08	SW08Z
7652-09	SW09Z
7652-10	SW10Z
7652-12	SW12Z
7652-14	SW14Z
7652-16	SW16Z
7652-20	SW20Z
7652-24	SW24Z
7652-28	SW28Z
7652-32	SW32Z

BAS 7653--	
BAS Number	AMPEP part No.
7653-03	SN03G
7653-04	SN04G
7653-05	SN05G
7653-06	SN06G
7653-07	SN07G
7653-08	SN08G
7653-09	SN09G
7653-10	SN10G
7653-12	SN12G
7653-14	SN14G
7653-16	SN16G

BAS 7654--	
BAS Number	AMPEP part No.
7654-03	SW03G
7654-04	SW04G
7654-05	SW05G
7654-06	SW06G
7654-07	SW07G
7654-08	SW08G
7654-09	SW09G
7654-10	SW10G
7654-12	SW12G
7654-14	SW14G
7654-16	SW16G

BAS 7661	
BAS Number	AMPEP part No.
7661-04--	KS04--P
7661-05--	KS05--P
7661-06--	KS06--P
7661-08--	KS08--P
7661-10--	KS10--P
7661-12--	KS12--P
7661-14--	KS14--P
7661-16--	KS16--P
7661-18--	KS18--P
7661-20--	KS20--P
7661-22--	KS22--P
7661-24--	KS24--P
7661-28--	KS28--P
7661-32--	KS32--P

BAS 7662	
BAS Number	AMPEP part No.
7662-04--	KA04--P
7662-05--	KA05--P
7662-06--	KA06--P
7662-08--	KA08--P
7662-10--	KA10--P
7662-12--	KA12--P
7662-14--	KA14--P
7662-16--	KA16--P
7662-18--	KA18--P
7662-20--	KA20--P
7662-22--	KA22--P
7662-24--	KA24--P
7662-28--	KA28--P
7662-32--	KA32--P

BAS 7663	
BAS Number	AMPEP part No.
7663-04--	KSF04--P
7663-05--	KSF05--P
7663-06--	KSF06--P
7663-08--	KSF08--P
7663-10--	KSF10--P
7663-12--	KSF12--P
7663-14--	KSF14--P
7663-16--	KSF16--P
7663-18--	KSF18--P
7663-20--	KSF20--P
7663-22--	KSF22--P
7663-24--	KSF24--P
7663-28--	KSF28--P
7663-32--	KSF32--P

BAS 7664	
BAS Number	AMPEP part No.
7664-04--	KAF04--P
7664-05--	KAF05--P
7664-06--	KAF06--P
7664-08--	KAF08--P
7664-10--	KAF10--P
7664-12--	KAF12--P
7664-14--	KAF14--P
7664-16--	KAF16--P
7664-18--	KAF18--P
7664-20--	KAF20--P
7664-22--	KAF22--P
7664-24--	KAF24--P
7664-28--	KAF28--P
7664-32--	KAF32--P

NOTE: LAST TWO NUMBERS IN BAS CODES ARE WIDTH IN MULTIPLES OF $^1/_{32}$INCH

LAST TWO NUMBERS IN AMPEP CODES ARE WIDTH IN MULTIPLES OF $^1/_{16}$ INCH

E.G. BAS 7661-0408 = AMPEP KS0404P

ampep

BAS INCH STANDARDS

BAS / AMPEP PART No. CROSS-REFERENCE

BAS 7668--	
BAS Number	AMPEP part No.
7668-SH03Z	SH03Z
7668-SH04Z	SH04Z
7668-SH05Z	SH05Z
7668-SH06Z	SH06Z
7668-SH07Z	SH07Z
7668-SH08Z	SH08Z
7668-SH10Z	SH10Z
7668-SH12Z	SH12Z
7668-SH14Z	SH14Z
7668-SH16Z	SH16Z
7668-SH20Z	SH20Z

BAS 7671--RF	
BAS Number	AMPEP part No.
7671-03RF	R03MR
7671-04RF	R04MR
7671-05RF	R05MR
7671-06RF	R06MR
7671-07RF	R07MR
7671-08RF	R08MR
7671-10RF	R10MR
7671-12RF	R12MR
7671-14RF	R14MR
7671-16RF	R16MR

BAS 7671--R K	
BAS Number	AMPEP part No.
7671-03R K	R03MRK
7671-04R K	R04MRK
7671-05R K	R05MRK
7671-06R K	R06MRK
7671-07R K	R07MRK
7671-08R K	R08MRK
7671-10R K	R10MRK
7671-12R K	R12MRK
7671-14R K	R14MRK
7671-16R K	R16MRK

BAS 7671--LF	
BAS Number	AMPEP part No.
7671-03LF	R03ML
7671-04LF	R04ML
7671-05LF	R05ML
7671-06LF	R06ML
7671-07LF	R07ML
7671-08LF	R08ML
7671-10LF	R10ML
7671-12LF	R12ML
7671-14LF	R14ML
7671-16LF	R16ML

BAS 7671--L K	
BAS Number	AMPEP part No.
7671-03L K	R03MLK
7671-04L K	R04MLK
7671-05L K	R05MLK
7671-06L K	R06MLK
7671-07L K	R07MLK
7671-08L K	R08MLK
7671-10L K	R10MLK
7671-12L K	R12MLK
7671-14L K	R14MLK
7671-16L K	R16MLK

BAS 7672--R	
BAS Number	AMPEP part No.
7672-03R	R03FR
7672-04R	R04FR
7672-05R	R05FR
7672-06R	R06FR
7672-07R	R07FR
7672-08R	R08FR
7672-10R	R10FR
7672-12R	R12FR
7672-14R	R14FR
7672-16R	R16FR

BAS 7672--R K	
BAS Number	AMPEP part No.
7672-03R K	R03FRK
7672-04R K	R04FRK
7672-05R K	R05FRK
7672-06R K	R06FRK
7672-07R K	R07FRK
7672-08R K	R08FRK
7672-10R K	R10FRK
7672-12R K	R12FRK
7672-14R K	R14FRK
7672-16R K	R16FRK

BAS 7672--L	
BAS Number	AMPEP part No.
7672-03L	R03FL
7672-04L	R04FL
7672-05L	R05FL
7672-06L	R06FL
7672-07L	R07FL
7672-08L	R08FL
7672-10L	R10FL
7672-12L	R12FL
7672-14L	R14FL
7672-16L	R16FL

BAS 7672--LK	
BAS Number	AMPEP part No.
7672-03LK	R03FLK
7672-04LK	R04FLK
7672-05LK	R05FLK
7672-06LK	R06FLK
7672-07LK	R07FLK
7672-08LK	R08FLK
7672-10LK	R10FLK
7672-12LK	R12FLK
7672-14LK	R14FLK
7672-16LK	R16FLK

EN / AMPEP PART No. CROSS-REFERENCE

EN METRIC STANDARDS

EN 2285	
EN Number	AMPEP part No.
2285-06--	06--AK
2285-08--	08--AK
2285-10--	10--AK
2285-12--	12--AK
2285-15--	15--AK
2285-16--	16--AK
2285-18--	18--AK
2285-20--	20--AK
2285-22--	22--AK
2285-25--	25--AK
2285-28--	28--AK
2285-30--	30--AK
2285-32--	32--AK
2285-35--	35--AK
2285-40--	40--AK
2285-45--	45--AK
2285-50--	50--AK

EN 2286	
EN Number	AMPEP part No.
2286-06--	06--FAK
2286-08--	08--FAK
2286-10--	10--FAK
2286-12--	12--FAK
2286-15--	15--FAK
2286-16--	16--FAK
2286-18--	18--FAK
2286-20--	20--FAK
2286-22--	22--FAK
2286-25--	25--FAK
2286-28--	28--FAK
2286-30--	30--FAK
2286-32--	32--FAK
2286-35--	35--FAK
2286-40--	40--FAK
2286-45--	45--FAK
2286-50--	50--FAK

EN 2287	
EN Number	AMPEP part No.
2287-06--	06--SK
2287-08--	08-SK
2287-10--	10--SK
2287-12--	12--SK
2287-15--	15--SK
2287-16--	16--SK
2287-18--	18--SK
2287-20--	20--SK
2287-22--	22--SK
2287-25--	25--SK
2287-28--	28--SK
2287-30--	30--SK
2287-32--	32--SK
2287-35--	35--SK
2287-40--	40--SK
2287-45--	45--SK
2287-50--	50--SK

EN 2288	
EN Number	AMPEP part No.
2288-06--	06--FSK
2288-08--	08-FSK
2288-10--	10--FSK
2288-12--	12--FSK
2288-15--	15--FSK
2288-16--	16--FSK
2288-18--	18--FSK
2288-20--	20--FSK
2288-22--	22--FSK
2288-25--	25--FSK
2288-28--	28--FSK
2288-30--	30--FSK
2288-32--	32--FSK
2288-35--	35--FSK
2288-40--	40--FSK
2288-45--	45--FSK
2288-50--	50--FSK

NOTE: Second pair of numbers -- are width code in millimetres EG: EN2285-0608 = 0608AK

EN 2584R	
EN Number	AMPEP part No.
2584R05	11C05WG
2584R06	11C06NG
2584R08	11C08EG
2584R10	11C10NG
2584R12	11C12EG
2584R15	11C15EG
2584R17	11C17EG
2584R22	11C22WG
2584R25	11C25EG
2584R30	11C30EG
2584R35	11C35EG
2584R40	11C40EG
2584R45	11C45EG
2584R50	11C50EG

EN 2584R--P	
EN Number	AMPEP part No.
2584R05P	11F05WG
2584R06P	11F06NG
2584R08P	11F08EG
2584R10P	11F10NG
2584R12P	11F12EG
2584R15P	11F15EG
2584R17P	11F17EG
2584R22P	11F22WG
2584R25P	11F25EG
2584R30P	11F30EG
2584R35P	11F35EG
2584R40P	11F40EG
2584R45P	11F45EG
2584R50P	11F50EG

EN 2584S	
EN Number	AMPEP part No.
2584S05	11C05WZ
2584S06	11C06NZ
2584S08	11C08EZ
2584S10	11C10NZ
2584S12	11C12EZ
2584S15	11C15EZ
2584S17	11C17EZ
2584S22	11C22WZ
2584S25	11C25EZ
2584S30	11C30EZ
2584S35	11C35EZ
2584S40	11C40EZ
2584S45	11C45EZ
2584S50	11C50EZ

EN 2584S--P	
EN Number	AMPEP part No.
2584S05P	11F05WZ
2584S06P	11F06NZ
2584S08P	11F08EZ
2584S10P	11F10NZ
2584S12P	11F12EZ
2584S15P	11F15EZ
2584S17P	11F17EZ
2584S22P	11F22WZ
2584S25P	11F25EZ
2584S30P	11F30EZ
2584S35P	11F35EZ
2584S40P	11F40EZ
2584S45P	11F45EZ
2584S50P	11F50EZ

EN 2022R	
EN Number	AMPEP part No.
2022R12	12GSN
2022R15	15GSN
2022R17	17GSN
2022R20	20GSN
2022R25	25GSN
2022R30	30GSN
2022R35	35GSN
2022R40	40GSN
2022R45	45GSN
2022R50	50GSN

EN 2022S	
EN Number	AMPEP part No.
2022S12	12ZSN
2022S15	15ZSN
2022S17	17ZSN
2022S20	20ZSN
2022S25	25ZSN
2022S30	30ZSN
2022S35	35ZSN
2022S40	40ZSN
2022S45	45ZSN
2022S50	50ZSN

EN METRIC STANDARDS

EN / AMPEP PART No. CROSS-REFERENCE

EN 2585R	
EN Number	AMPEP part No.
2585R05	11C05EG
2585R06	11C06WG
2585R08	11C08WG
2585R10	11C10WG
2585R12	11C12WG
2585R15	11C15WG
2585R17	11C17WG
2585R20	11C20WG
2585R25	11C25WG
2585R30	11C30WG
2585R35	11C35WG
2585R40	11C40WG
2585R45	11C45WG
2585R50	11C50WG
2585R55	11C55EG

EN 2585R--P	
EN Number	AMPEP part No.
2585R05P	11F05EG
2585R06P	11F06WG
2585R08P	11F08WG
2585R10P	11F10WG
2585R12P	11F12WG
2585R15P	11F15WG
2585R17P	11F17WG
2585R20P	11F20WG
2585R25P	11F25WG
2585R30P	11F30WG
2585R35P	11F35WG
2585R40P	11F40WG
2585R45P	11F45WG
2585R50P	11F50WG
2585R55P	11F55EG

EN 2585S	
EN Number	AMPEP part No.
2585S05	11C05EZ
2585S06	11C06WZ
2585S08	11C08WZ
2585S10	11C10WZ
2585S12	11C12WZ
2585S15	11C15WZ
2585S17	11C17WZ
2585S20	11C20WZ
2585S25	11C25WZ
2585S30	11C30WZ
2585S35	11C35WZ
2585S40	11C40WZ
2585S45	11C45WZ
2585S50	11C50WZ
2585S55	11C55EZ

EN 2585S--P	
EN Number	AMPEP part No.
2585S05P	11F05EZ
2585S06P	11F06WZ
2585S08P	11F08WZ
2585S10P	11F10WZ
2585S12P	11F12WZ
2585S15P	11F15WZ
2585S17P	11F17WZ
2585S20P	11F20WZ
2585S25P	11F25WZ
2585S30P	11F30WZ
2585S35P	11F35WZ
2585S40P	11F40WZ
2585S45P	11F45WZ
2585S50P	11F50WZ
2585S55P	11F55EZ

EN 3048R	
EN Number	AMPEP part No.
3048R12	11C12NG
3048R15	11C15NG
3048R17	11C17NG
3048R20	11C20NG
3048R25	11C25NG
3048R30	11C30NG
3048R35	11C35NG
3048R40	11C40NG
3048R45	11C45NG
3048R50	11C50NG

EN 3048R--P	
EN Number	AMPEP part No.
3048R12P	11F12NG
3048R15P	11F15NG
3048R17P	11F17NG
3048R20P	11F20NG
3048R25P	11F25NG
3048R30P	11F30NG
3048R35P	11F35NG
3048R40P	11F40NG
3048R45P	11F45NG
3048R50P	11F50NG

EN 3048S	
EN Number	AMPEP part No.
3048S12	11C12NZ
3048S15	11C15NZ
3048S17	11C17NZ
3048S20	11C20NZ
3048S25	11C25NZ
3048S30	11C30NZ
3048S35	11C35NZ
3048S40	11C40NZ
3048S45	11C45NZ
3048S50	11C50NZ

EN 3048S--P	
EN Number	AMPEP part No.
3048S12P	11F12NZ
3048S15P	11F15NZ
3048S17P	11F17NZ
3048S20P	11F20NZ
3048S25P	11F25NZ
3048S30P	11F30NZ
3048S35P	11F35NZ
3048S40P	11F40NZ
3048S45P	11F45NZ
3048S50P	11F50NZ

EN 2023R--E	
EN Number	AMPEP part No.
2023R05E	05GSW
2023R06E	06GSN
2023R10E	10GSN
2023R12E	11/6513P
2023R22E	22GSW
2023R25E	11/6094P
2023R30E	11/6095P

EN 2023R--L	
EN Number	AMPEP part No.
2023R06L	06GSW
2023R08L	08GSW
2023R10L	10GSW
2023R12L	12GSW
2023R15L	15GSW
2023R17L	17GSW
2023R20L	20GSW
2023R25L	25GSW
2023R30L	30GSW
2023R35L	35GSW
2023R40L	40GSW
2023R45L	45GSW
2023R50L	50GSW

EN 2023S--E	
EN Number	AMPEP part No.
2023S05E	05ZSW
2023S06E	06ZSN
2023S10E	10ZSN
2023S12E	11/6514P
2023S22E	22ZSW
2023S25E	11/6515P
2023S30E	11/6516P

EN 2023S--L	
EN Number	AMPEP part No.
2023S06L	06ZSW
2023S08L	08ZSW
2023S10L	10ZSW
2023S12L	12ZSW
2023S15L	15ZSW
2023S17L	17ZSW
2023S20L	20ZSW
2023S25L	25ZSW
2023S30L	30ZSW
2023S35L	35ZSW
2023S40L	40ZSW
2023S45L	45ZSW
2023S50L	50ZSW

ampep

MIL / AMPEP PART No. CROSS-REFERENCE

M & MS (MIL) INCH STANDARDS

MS 14101	
MIL Number	AMPEP part No.
MS14101-3	11BNG03
MS14101-4	11BNG04
MS14101-5	11BNG05
MS14101-5A	11BNG051
MS14101-6	11BNG06
MS14101-7	11BNG07
MS14101-8	11BNG08
MS14101-9	11BNG09
MS14101-10	11BNG10
MS14101-12	11BNG12
MS14101-14	11BNG14
MS14101-16	11BNG16

MS 14102	
MIL Number	AMPEP part No.
MS14102-3	11BWZ03
MS14102-4	11BWZ04
MS14102-5	11BWZ05
MS14102-6	11BWZ06
MS14102-7	11BWZ07
MS14102-8	11BWZ08
MS14102-9	11BWZ09
MS14102-10	11BWZ10
MS14102-12	11BWZ12
MS14102-14	11BWZ14
MS14102-16	11BWZ16

MS 14103	
MIL Number	AMPEP part No.
MS14103-3	11BWG03
MS14103-4	11BWG04
MS14103-5	11BWG05
MS14103-6	11BWG06
MS14103-7	11BWG07
MS14103-7A	11BWG071
MS14103-8	11BWG08
MS14103-9	11BWG09
MS14103-10	11BWG10
MS14103-12	11BWG12
MS14103-14	11BWG14
MS14103-16	11BWG16

MS 14104	
MIL Number	AMPEP part No.
MS14104-3	11BNZ03
MS14104-4	11BNZ04
MS14104-5	11BNZ05
MS14104-6	11BNZ06
MS14104-7	11BNZ07
MS14104-8	11BNZ08
MS14104-9	11BNZ09
MS14104-10	11BNZ10
MS14104-12	11BNZ12
MS14104-14	11BNZ14
MS14104-16	11BNZ16

MS 14101--P	
MIL Number	AMPEP part No.
MS14101-3P	11BNG03J
MS14101-4P	11BNG04J
MS14101-5P	11BNG05J
MS14101-5AP	11BNG051J
MS14101-6P	11BNG06J
MS14101-7P	11BNG07J
MS14101-8P	11BNG08J
MS14101-9P	11BNG09J
MS14101-10P	11BNG10J
MS14101-12P	11BNG12J
MS14101-14P	11BNG14J
MS14101-16P	11BNG16J

MS 14102--P	
MIL Number	AMPEP part No.
MS14102-3P	11BWZ03J
MS14102-4P	11BWZ04J
MS14102-5P	11BWZ05J
MS14102-6P	11BWZ06J
MS14102-7P	11BWZ07J
MS14102-8P	11BWZ08J
MS14102-9P	11BWZ09J
MS14102-10P	11BWZ10J
MS14102-12P	11BWZ12J
MS14102-14P	11BWZ14J
MS14102-16P	11BWZ16J

MS 14103--P	
MIL Number	AMPEP part No.
MS14103-3P	11BWG03J
MS14103-4P	11BWG04J
MS14103-5P	11BWG05J
MS14103-6P	11BWG06J
MS14103-7P	11BWG07J
MS14103-7AP	11BWG071J
MS14103-8P	11BWG08J
MS14103-9P	11BWG09J
MS14103-10P	11BWG10J
MS14103-12P	11BWG12J
MS14103-14P	11BWG14J
MS14103-16P	11BWG16J

MS 14104--P	
MIL Number	AMPEP part No.
MS14104-3P	11BNZ03J
MS14104-4P	11BNZ04J
MS14104-5P	11BNZ05J
MS14104-6P	11BNZ06J
MS14104-7P	11BNZ07J
MS14104-8P	11BNZ08J
MS14104-9P	11BNZ09J
MS14104-10P	11BNZ10J
MS14104-12P	11BNZ12J
MS14104-14P	11BNZ14J
MS14104-16P	11BNZ16J

MS 21154B--	
MIL Number	AMPEP part No.
MS21154B03	31CNG03D
MS21154B04	31CNG04D
MS21154B05	31CNG05D
MS21154B06	31CNG06D
MS21154B07	31CNG07D
MS21154B08	31CNG08D
MS21154B09	31CNG09D
MS21154B10	31CNG10D
MS21154B12	31CNG12D
MS21154B14	31CNG14D
MS21154B16	31CNG16D

MS 21155B--	
MIL Number	AMPEP part No.
MS21155B03	31CNZ03D
MS21155B04	31CNZ04D
MS21155B05	31CNZ05D
MS21155B06	31CNZ06D
MS21155B07	31CNZ07D
MS21155B08	31CNZ08D
MS21155B09	31CNZ09D
MS21155B10	31CNZ10D
MS21155B12	31CNZ12D
MS21155B14	31CNZ14D
MS21155B16	31CNZ16D

M & MS (MIL) INCH STANDARDS

MIL / AMPEP PART No. CROSS-REFERENCE

MS 21230 *	
MIL Number	AMPEP part No.
MS21230-3	11AWG03
MS21230-4	11AWG04
MS21230-5	11AWG05
MS21230-6	11AWG06
MS21230-7	11AWG07
MS21230-8	11AWG08
MS21230-9	11AWG09
MS21230-10	11AWG10
MS21230-12	11AWG12
MS21230-14	11AWG14
MS21230-16	11AWG16

MS 21231 *	
MIL Number	AMPEP part No.
MS21231-3	11AWZ03
MS21231-4	11AWZ04
MS21231-5	11AWZ05
MS21231-6	11AWZ06
MS21231-7	11AWZ07
MS21231-8	11AWZ08
MS21231-9	11AWZ09
MS21231-10	11AWZ10
MS21231-12	11AWZ12
MS21231-14	11AWZ14
MS21231-16	11AWZ16

MS 21232 *	
MIL Number	AMPEP part No.
—	—
MS21232-4	11ANG04
MS21232-5	11ANG05
MS21232-6	11ANG06
MS21232-7	11ANG07
MS21232-8	11ANG08
MS21232-9	11ANG09
MS21232-10	11ANG10
MS21232-12	11ANG12
MS21232-14	11ANG14
MS21232-16	11ANG16

MS 21233 *	
MIL Number	AMPEP part No.
MS21233-3	11ANZ03
MS21233-4	11ANZ04
MS21233-5	11ANZ05
MS21233-6	11ANZ06
MS21233-7	11ANZ07
MS21233-8	11ANZ08
MS21233-9	11ANZ09
MS21233-10	11ANZ10
MS21233-12	11ANZ12
MS21233-14	11ANZ14
MS21233-16	11ANZ16

These MS parts refer toMIL-B-8942 specification. AMPEP parts quoted are not approved to this specification, but are dimensionally equivalent and have liner systems qualified to MIL-B-81820.

M81934/1--A---	
MIL Number	AMPEP part No.
M81934/1-04A--	13BAZ04--
M81934/1-05A--	13BAZ05--
M81934/1-06A--	13BAZ06--
M81934/1-07A--	13BAZ07--
M81934/1-08A--	13BAZ08--
M81934/1-09A--	13BAZ09--
M81934/1-10A--	13BAZ10--
M81934/1-11A--	13BAZ11--
M81934/1-12A--	13BAZ12--
M81934/1-14A--	13BAZ14--
M81934/1-16A--	13BAZ16--
M81934/1-18A--	13BAZ18--
M81934/1-20A--	13BAZ20--
M81934/1-22A--	13BAZ22--
M81934/1-24A--	13BAZ24--
M81934/1-26A--	13BAZ26--
M81934/1-28A--	13BAZ28--
M81934/1-32A--	13BAZ32--

M81934/1--C---	
MIL Number	AMPEP part No.
M81934/1-04C--	13BSZ04--
M81934/1-05C--	13BSZ05--
M81934/1-06C--	13BSZ06--
M81934/1-07C--	13BSZ07--
M81934/1-08C--	13BSZ08--
M81934/1-09C--	13BSZ09--
M81934/1-10C--	13BSZ10--
M81934/1-11C--	13BSZ11--
M81934/1-12C--	13BSZ12--
M81934/1-14C--	13BSZ14--
M81934/1-16C--	13BSZ16--
M81934/1-18C--	13BSZ18--
M81934/1-20C--	13BSZ20--
M81934/1-22C--	13BSZ22--
M81934/1-24C--	13BSZ24--
M81934/1-26C--	13BSZ26--
M81934/1-28C--	13BSZ28--
M81934/1-32C--	13BSZ32--

M81934/2--A---	
MIL Number	AMPEP part No.
M81934/2-04A--	13BAF04--
M81934/2-05A--	13BAF05--
M81934/2-06A--	13BAF06--
M81934/2-07A--	13BAF07--
M81934/2-08A--	13BAF08--
M81934/2-09A--	13BAF09--
M81934/2-10A--	13BAF10--
M81934/2-11A--	13BAF11--
M81934/2-12A--	13BAF12--
M81934/2-14A--	13BAF14--
M81934/2-16A--	13BAF16--
M81934/2-18A--	13BAF18--
M81934/2-20A--	13BAF20--
M81934/2-22A--	13BAF22--
M81934/2-24A--	13BAF24--
M81934/2-26A--	13BAF26--
M81934/2-28A--	13BAF28--
M81934/2-32A--	13BAF32--

M81934/2--C---	
MIL Number	AMPEP part No.
M81934/2-04C--	13BSF04--
M81934/2-05C--	13BSF05--
M81934/2-06C--	13BSF06--
M81934/2-07C--	13BSF07--
M81934/2-08C--	13BSF08--
M81934/2-09C--	13BSF09--
M81934/2-10C--	13BSF10--
M81934/2-11C--	13BSF11--
M81934/2-12C--	13BSF12--
M81934/2-14C--	13BSF14--
M81934/2-16C--	13BSF16--
M81934/2-18C--	13BSF18--
M81934/2-20C--	13BSF20--
M81934/2-22C--	13BSF22--
M81934/2-24C--	13BSF24--
M81934/2-26C--	13BSF26--
M81934/2-28C--	13BSF28--
M81934/2-32C--	13BSF32--

NOTE: LAST THREE NUMBERS IN MIL CODES ARE LENGTH IN MULTIPLES OF 1/32 INCH
LAST TWO NUMBERS IN AMPEP CODES ARE LENGTH IN MULTIPLES OF 1/32 INCH
EG. M81934/1-04A012 = 13BAZ0412

MIL / AMPEP PART No. CROSS-REFERENCE

M & MS (MIL) INCH STANDARDS

M81935/1--	
MIL Number	AMPEP part No.
M81935/1-03	12BMR03
M81935/1-04	12BMR04
M81935/1-05	12BMR05
M81935/1-06	12BMR06
M81935/1-07	12BMR07
M81935/1-08	12BMR08
M81935/1-10	12BMR10
M81935/1-12	12BMR12
M81935/1-14	12BMR14
M81935/1-16	12BMR16

M81935/1--K	
MIL Number	AMPEP part No.
M81935/1-03K	12BMR03K
M81935/1-04K	12BMR04K
M81935/1-05K	12BMR05K
M81935/1-06K	12BMR06K
M81935/1-07K	12BMR07K
M81935/1-08K	12BMR08K
M81935/1-10K	12BMR10K
M81935/1-12K	12BMR12K
M81935/1-14K	12BMR14K
M81935/1-16K	12BMR16K

M81935/1--L	
MIL Number	AMPEP part No.
M81935/1-03L	12BML03
M81935/1-04L	12BML04
M81935/1-05L	12BML05
M81935/1-06L	12BML06
M81935/1-07L	12BML07
M81935/1-08L	12BML08
M81935/1-10L	12BML10
M81935/1-12L	12BML12
M81935/1-14L	12BML14
M81935/1-16L	12BML16

M81935/1--KL	
MIL Number	AMPEP part No.
M81935/1-03KL	12BML03K
M81935/1-04KL	12BML04K
M81935/1-05KL	12BML05K
M81935/1-06KL	12BML06K
M81935/1-07KL	12BML07K
M81935/1-08KL	12BML08K
M81935/1-10KL	12BML10K
M81935/1-12KL	12BML12K
M81935/1-14KL	12BML14K
M81935/1-16KL	12BML16K

M81935/4--	
MIL Number	AMPEP part No.
M81935/4-03	12BNMR03
M81935/4-04	12BNMR04
M81935/4-05	12BNMR05
M81935/4-06	12BNMR06
M81935/4-07	12BNMR07
M81935/4-08	12BNMR08
M81935/4-10	12BNMR10
M81935/4-12	12BNMR12
M81935/4-14	12BNMR14
M81935/4-16	12BNMR16

M81935/4--K	
MIL Number	AMPEP part No.
M81935/4-03K	12BNMR03K
M81935/4-04K	12BNMR04K
M81935/4-05K	12BNMR05K
M81935/4-06K	12BNMR06K
M81935/4-07K	12BNMR07K
M81935/4-08K	12BNMR08K
M81935/4-10K	12BNMR10K
M81935/4-12K	12BNMR12K
M81935/4-14K	12BNMR14K
M81935/4-16K	12BNMR16K

M81935/4--L	
MIL Number	AMPEP part No.
M81935/4-03L	12BNML03
M81935/4-04L	12BNML04
M81935/4-05L	12BNML05
M81935/4-06L	12BNML06
M81935/4-07L	12BNML07
M81935/4-08L	12BNML08
M81935/4-10L	12BNML10
M81935/4-12L	12BNML12
M81935/4-14L	12BNML14
M81935/4-16L	12BNML16

M81935/4--KL	
MIL Number	AMPEP part No.
M81935/4-03KL	12BNML03K
M81935/4-04KL	12BNML04K
M81935/4-05KL	12BNML05K
M81935/4-06KL	12BNML06K
M81935/4-07KL	12BNML07K
M81935/4-08KL	12BNML08K
M81935/4-10KL	12BNML10K
M81935/4-12KL	12BNML12K
M81935/4-14KL	12BNML14K
M81935/4-16KL	12BNML16K

M81935/2--	
MIL Number	AMPEP part No.
M81935/2-03	12BFR03
M81935/2-04	12BFR04
M81935/2-05	12BFR05
M81935/2-06	12BFR06
M81935/2-07	12BFR07
M81935/2-08	12BFR08
M81935/2-10	12BFR10
M81935/2-12	12BFR12
M81935/2-14	12BFR14
M81935/2-16	12BFR16

M81935/2--K	
MIL Number	AMPEP part No.
M81935/2-03K	12BFR03K
M81935/2-04K	12BFR04K
M81935/2-05K	12BFR05K
M81935/2-06K	12BFR06K
M81935/2-07K	12BFR07K
M81935/2-08K	12BFR08K
M81935/2-10K	12BFR10K
M81935/2-12K	12BFR12K
M81935/2-14K	12BFR14K
M81935/2-16K	12BFR16K

M81935/2--L	
MIL Number	AMPEP part No.
M81935/2-03L	12BFL03
M81935/2-04L	12BFL04
M81935/2-05L	12BFL05
M81935/2-06L	12BFL06
M81935/2-07L	12BFL07
M81935/2-08L	12BFL08
M81935/2-10L	12BFL10
M81935/2-12L	12BFL12
M81935/2-14L	12BFL14
M81935/2-16L	12BFL16

M81935/2--KL	
MIL Number	AMPEP part No.
M81935/2-03KL	12BFL03K
M81935/2-04KL	12BFL04K
M81935/2-05KL	12BFL05K
M81935/2-06KL	12BFL06K
M81935/2-07KL	12BFL07K
M81935/2-08KL	12BFL08K
M81935/2-10KL	12BFL10K
M81935/2-12KL	12BFL12K
M81935/2-14KL	12BFL14K
M81935/2-16KL	12BFL16K

M81935/2--W	
MIL Number	AMPEP part No.
M81935/2-03W	12BFR03W
M81935/2-04W	12BFR04W
M81935/2-05W	12BFR05W
M81935/2-06W	12BFR06W
M81935/2-07W	12BFR07W
M81935/2-08W	12BFR08W
M81935/2-10W	12BFR10W
M81935/2-12W	12BFR12W
M81935/2-14W	12BFR14W
M81935/2-16W	12BFR16W

M81935/2--WL	
MIL Number	AMPEP part No.
M81935/2-03WL	12BFL03W
M81935/2-04WL	12BFL04W
M81935/2-05WL	12BFL05W
M81935/2-06WL	12BFL06W
M81935/2-07WL	12BFL07W
M81935/2-08WL	12BFL08W
M81935/2-10WL	12BFL10W
M81935/2-12WL	12BFL12W
M81935/2-14WL	12BFL14W
M81935/2-16WL	12BFL16W

M & MS
(MIL)
INCH STANDARDS

MIL / AMPEP PART No. CROSS-REFERENCE

M81935/5--	
MIL Number	AMPEP part No.
M81935/5-03	12BNFR03
M81935/5-04	12BNFR04
M81935/5-05	12BNFR05
M81935/5-06	12BNFR06
M81935/5-07	12BNFR07
M81935/5-08	12BNFR08
M81935/5-10	12BNFR10
M81935/5-12	12BNFR12
M81935/5-14	12BNFR14
M81935/5-16	12BNFR16

M81935/5--K	
MIL Number	AMPEP part No.
M81935/5-03K	12BNFR03K
M81935/5-04K	12BNFR04K
M81935/5-05K	12BNFR05K
M81935/5-06K	12BNFR06K
M81935/5-07K	12BNFR07K
M81935/5-08K	12BNFR08K
M81935/5-10K	12BNFR10K
M81935/5-12K	12BNFR12K
M81935/5-14K	12BNFR14K
M81935/5-16K	12BNFR16K

M81935/5--L	
MIL Number	AMPEP part No.
M81935/5-03L	12BNFL03
M81935/5-04L	12BNFL04
M81935/5-05L	12BNFL05
M81935/5-06L	12BNFL06
M81935/5-07L	12BNFL07
M81935/5-08L	12BNFL08
M81935/5-10L	12BNFL10
M81935/5-12L	12BNFL12
M81935/5-14L	12BNFL14
M81935/5-16L	12BNFL16

M81935/5--KL	
MIL Number	AMPEP part No.
M81935/5-03KL	12BNFL03K
M81935/5-04KL	12BNFL04K
M81935/5-05KL	12BNFL05K
M81935/5-06KL	12BNFL06K
M81935/5-07KL	12BNFL07K
M81935/5-08KL	12BNFL08K
M81935/5-10KL	12BNFL10K
M81935/5-12KL	12BNFL12K
M81935/5-14KL	12BNFL14K
M81935/5-16KL	12BNFL16K

M81935/5--W	
MIL Number	AMPEP part No.
M81935/5-03W	12BNFR03W
M81935/5-04W	12BNFR04W
M81935/5-05W	12BNFR05W
M81935/5-06W	12BNFR06W
M81935/5-07W	12BNFR07W
M81935/5-08W	12BNFR08W
M81935/5-10W	12BNFR10W
M81935/5-12W	12BNFR12W
M81935/5-14W	12BNFR14W
M81935/5-16W	12BNFR16W

M81935/5--WL	
MIL Number	AMPEP part No.
M81935/5-03WL	12BNFL03W
M81935/5-04WL	12BNFL04W
M81935/5-05WL	12BNFL05W
M81935/5-06WL	12BNFL06W
M81935/5-07WL	12BNFL07W
M81935/5-08WL	12BNFL08W
M81935/5-10WL	12BNFL10W
M81935/5-12WL	12BNFL12W
M81935/5-14WL	12BNFL14W
M8193/5-16WL	12BNFL16W

M81936/1--R	
MIL Number	AMPEP part No.
M81936/1-04R	31BNG04R
M81936/1-05R	31BNG05R
M81936/1-06R	31BNG06R
M81936/1-07R	31BNG07R
M81936/1-08R	31BNG08R
M81936/1-09R	31BNG09R
M81936/1-10R	31BNG10R
M81936/1-12R	31BNG12R
M81936/1-13R	31BNG13R
M81936/1-14R	31BNG14R
M81936/1-16R	31BNG16R
M81936/1-18R	31BNG18R
M81936/1-20R	31BNG20R
M81936/1-22R	31BNG22R
M81936/1-24R	31BNG24R

M81936/1--	
MIL Number	AMPEP part No.
M81936/1-04	31BNG04D
M81936/1-05	31BNG05D
M81936/1-06	31BNG06D
M81936/1-07	31BNG07D
M81936/1-08	31BNG08D
M81936/1-09	31BNG09D
M81936/1-10	31BNG10D
M81936/1-12	31BNG12D
M81936/1-13	31BNG13D
M81936/1-14	31BNG14D
M81936/1-16	31BNG16D
M81936/1-18	31BNG18D
M81936/1-20	31BNG20D
M81936/1-22	31BNG22D
M81936/1-24	31BNG24D

M81936/2--R	
MIL Number	AMPEP part No.
M81936/2-04R	31BNZ04R
M81936/2-05R	31BNZ05R
M81936/2-06R	31BNZ06R
M81936/2-07R	31BNZ07R
M81936/2-08R	31BNZ08R
M81936/2-09R	31BNZ09R
M81936/2-10R	31BNZ10R
M81936/2-12R	31BNZ12R
M81936/2-13R	31BNZ13R
M81936/2-14R	31BNZ14R
M81936/2-16R	31BNZ16R
M81936/2-18R	31BNZ18R
M81936/2-20R	31BNZ20R
M81936/2-22R	31BNZ22R
M81936/2-24R	31BNZ24R

M81936/2--	
MIL Number	AMPEP part No.
M81936/2-04	31BNZ04D
M81936/2-05	31BNZ05D
M81936/2-06	31BNZ06D
M81936/2-07	31BNZ07D
M81936/2-08	31BNZ08D
M81936/2-09	31BNZ09D
M81936/2-10	31BNZ10D
M81936/2-12	31BNZ12D
M81936/2-13	31BNZ13D
M81936/2-14	31BNZ14D
M81936/2-16	31BNZ16D
M81936/2-18	31BNZ18D
M81936/2-20	31BNZ20D
M819362-22	31BNZ22D
M81936/2-24	31BNZ24D

NSA / AMPEP PART No. CROSS-REFERENCE

NSA INCH STANDARDS

NSA 8130--	
NSA Number	AMPEP part No.
8130-03	31ANZ03
8130-04	31ANZ04
8130-05	31ANZ05
8130-06	31ANZ06
8130-07	31ANZ07
8130-08	31ANZ08
8130-09	31ANZ09
8130-10	31ANZ10
8130-12	31ANZ12
8130-14	31ANZ14
8130-16	31ANZ16
8130-20	31ANZ20
8130-24	31ANZ24
8130-28	31ANZ28
8130-32	31ANZ32

NSA 8131--	
NSA Number	AMPEP part No.
8131-03	31AWZ03
8131-04	31AWZ04
8131-05	31AWZ05
8131-06	31AWZ06
8131-07	31AWZ07
8131-08	31AWZ08
8131-09	31AWZ09
8131-10	31AWZ10
8131-12	31AWZ12
8131-14	31AWZ14
8131-16	31AWZ16
8131-20	31AWZ20
8131-24	31AWZ24
8131-28	31AWZ28
8131-32	31AWZ32

NSA 8132--	
NSA Number	AMPEP part No.
8132-03	31ANG03
8132-04	31ANG04
8132-05	31ANG05
8132-06	31ANG06
8132-07	31ANG07
8132-08	31ANG08
8132-09	31ANG09
8132-10	31ANG10
8132-12	31ANG12
8132-14	31ANG14
8132-16	31ANG16
8132-20	31ANG20
8132-24	31ANG24
8132-28	31ANG28
8132-32	31ANG32

NSA 8133--	
NSA Number	AMPEP part No.
8133-03	31AWG03
8133-04	31AWG04
8133-05	31AWG05
8133-06	31AWG06
8133-07	31AWG07
8133-08	31AWG08
8133-09	31AWG09
8133-10	31AWG10
8133-12	31AWG12
8133-14	31AWG14
8133-16	31AWG16
8133-20	31AWG20
8133-24	31AWG24
8133-28	31AWG28
8133-32	31AWG32

NSA 8130--X	
NSA Number	AMPEP part No.
8130-03X	31ANZ03X
8130-04X	31ANZ04X
8130-05X	31ANZ05X
8130-06X	31ANZ06X
8130-07X	31ANZ07X
8130-08X	31ANZ08X
8130-09X	31ANZ09X
8130-10X	31ANZ10X
8130-12X	31ANZ12X
8130-14X	31ANZ14X
8130-16X	31ANZ16X
8130-20X	31ANZ20X
8130-24X	31ANZ24X
8130-28X	31ANZ28X
8130-32X	31ANZ32X

NSA 8131--X	
NSA Number	AMPEP part No.
8131-03X	31AWZ03X
8131-04X	31AWZ04X
8131-05X	31AWZ05X
8131-06X	31AWZ06X
8131-07X	31AWZ07X
8131-08X	31AWZ08X
8131-09X	31AWZ09X
8131-10X	31AWZ10X
8131-12X	31AWZ12X
8131-14X	31AWZ14X
8131-16X	31AWZ16X
8131-20X	31AWZ20X
8131-24X	31AWZ24X
8131-28X	31AWZ28X
8131-32X	31AWZ32X

NSA 8132--X	
NSA Number	AMPEP part No.
8132-03X	31ANG03X
8132-04X	31ANG04X
8132-05X	31ANG05X
8132-06X	31ANG06X
8132-07X	31ANG07X
8132-08X	31ANG08X
8132-09X	31ANG09X
8132-10X	31ANG10X
8132-12X	31ANG12X
8132-14X	31ANG14X
8132-16X	31ANG16X
8132-20X	31ANG20X
8132-24X	31ANG24X
8132-28X	31ANG28X
8132-32X	31ANG32X

NSA 8133--X	
NSA Number	AMPEP part No.
8133-03X	31AWG03X
8133-04X	31AWG04X
8133-05X	31AWG05X
8133-06X	31AWG06X
8133-07X	31AWG07X
8133-08X	31AWG08X
8133-09X	31AWG09X
8133-10X	31AWG10X
8133-12X	31AWG12X
8133-14X	31AWG14X
8133-16X	31AWG16X
8133-20X	31AWG20X
8133-24X	31AWG24X
8133-28X	31AWG28X
8133-32X	31AWG32X

NSA 8134--		
NSA Number	AMPEP part No.	AMPEP part No.
8134-03	SN03Z	11ANZ03
8134-04	SN04Z	11ANZ04
8134-05	SN05Z	11ANZ05
8134-06	SN06Z	11ANZ06
8134-07	SN07Z	11ANZ07
8134-08	SN08Z	11ANZ08
8134-09	SN09Z	11ANZ09
8134-10	SN10Z	11ANZ10
8134-12	SN12Z	11ANZ12
8134-14	SN14Z	11ANZ14
8134-16	SN16Z	11ANZ16
8134-20	SN20Z	11ANZ20
8134-28	1492P	—

NSA 8134--X	
NSA Number	AMPEP part No.
8134-03X	SN03ZX
8134-04X	SN04ZX
8134-05X	SN05ZX
8134-06X	SN06ZX
8134-07X	SN07ZX
8134-08X	SN08ZX
8134-09X	SN09ZX
8134-10X	SN10ZX
8134-12X	SN12ZX
8134-14X	SN14ZX
8134-16X	SN16ZX
8134-20X	SN20ZX
8134-28X	—

NSA INCH STANDARDS

MIL / AMPEP PART No. CROSS-REFERENCE

NSA 8135--		
NSA Number	AMPEP part No.	AMPEP part No.
8135-03	SW03Z	11AWZ03
8135-04	SW04Z	11AWZ04
8135-05	SW05Z	11AWZ05
8135-06	SW06Z	11AWZ06
8135-07	SW07Z	11AWZ07
8135-08	SW08Z	11AWZ08
8135-09	SW09Z	11AWZ09
8135-10	SW10Z	11AWZ10
8135-12	SW12Z	11AWZ12
8135-14	SW14Z	11AWZ14
8135-16	SW16Z	11AWZ16
8135-20	SW20Z	11AWZ20
8135-24	SW24Z	11AWZ24
8135-28	SW28Z	11AWZ28
8135-32	SW32Z	11AWZ32

NSA 8135--X	
NSA Number	AMPEP part No.
8135-03X	SW03ZX
8135-04X	SW04ZX
8135-05X	SW05ZX
8135-06X	SW06ZX
8135-07X	SW07ZX
8135-08X	SW08ZX
8135-09X	SW09ZX
8135-10X	SW10ZX
8135-12X	SW12ZX
8135-14X	SW14ZX
8135-16X	SW16ZX
8135-20X	SW20ZX
8135-24X	SW24X
8135-28X	SW28X
8135-32X	SW32X

NSA 8136--		
NSA Number	AMPEP part No.	AMPEP part No.
8136-03	SN03G	11ANG03
8136-04	SN04G	11ANG04
8136-05	SN05G	11ANG05
8136-06	SN06G	11ANG06
8136-07	SN07G	11ANG07
8136-08	SN08G	11ANG08
8136-09	SN09G	11ANG09
8136-10	SN10G	11ANG10
8136-12	SN12G	11ANG12
8136-14	SN14G	11ANG14
8136-16	SN16G	11ANG16

NSA 8136--X	
NSA Number	AMPEP part No.
8136-03X	SN03GX
8136-04X	SN04GX
8136-05X	SN05GX
8136-06X	SN06GX
8136-07X	SN07GX
8136-08X	SN08GX
8136-09X	SN09GX
8136-10X	SN10GX
8136-12X	SN12GX
8136-14X	SN14GX
8136-16X	SN16GX

NSA 8137--		
NSA Number	AMPEP part No.	AMPEP part No.
8137-03	SW03G	11AWG03
8137-04	SW04G	11AWG04
8137-05	SW05G	11AWG05
8137-06	SW06G	11AWG06
8137-07	SW07G	11AWG07
8137-08	SW08G	11AWG08
8137-09	SW09G	11AWG09
8137-10	SW10G	11AWG10
8137-12	SW12G	11AWG12
8137-14	SW14G	11AWG14
8137-16	SW16G	11AWG16

NSA 8137--X	
NSA Number	AMPEP part No.
8137-03X	SW03GX
8137-04X	SW04GX
8137-05X	SW05GX
8137-06X	SW06GX
8137-07X	SW07GX
8137-08X	SW08GX
8137-09X	SW09GX
8137-10X	SW10GX
8137-12X	SW12GX
8137-14X	SW14GX
8137-16X	SW16GX

NSA 8138--	
NSA Number	AMPEP part No.
8138-03	31AHZ03C
8138-04	31AHZ04C
8138-05	31AHZ05C
8138-06	31AHZ06C
8138-07	31AHZ07C
8138-08	31AHZ08C
8138-10	31AHZ10C
8138-12	31AHZ12C
8138-14	31AHZ14C
8138-16	31AHZ16C

NSA / AMPEP PART No. CROSS-REFERENCE

NSA INCH STANDARDS

NSA 8143--RF	
NSA Number	AMPEP part No.
8143-03RF	R03MR
8143-04RF	R04MR
8143-05RF	R05MR
8143-06RF	R06MR
8143-07RF	R07MR
8143-08RF	R08MR
8143-10RF	R10MR
8143-12RF	R12MR
8143-14RF	R14MR
8143-16RF	R16MR

NSA 8143--RK	
NSA Number	AMPEP part No.
8143-03RK	R03MRK
8143-04RK	R04MRK
8143-05RK	R05MRK
8143-06RK	R06MRK
8143-07RK	R07MRK
8143-08RK	R08MRK
8143-10RK	R10MRK
8143-12RK	R12MRK
8143-14RK	R14MRK
8143-16RK	R16MRK

NSA 8143--LF	
NSA Number	AMPEP part No.
8143-03LF	R03ML
8143-04LF	R04ML
8143-05LF	R05ML
8143-06LF	R06ML
8143-07LF	R07ML
8143-08LF	R08ML
8143-10LF	R10ML
8143-12LF	R12ML
8143-14LF	R14ML
8143-16LF	R16ML

NSA 8143--LK	
NSA Number	AMPEP part No.
8143-03LK	R03MLK
8143-04LK	R04MLK
8143-05LK	R05MLK
8143-06LK	R06MLK
8143-07LK	R07MLK
8143-08LK	R08MLK
8143-10LK	R10MLK
8143-12LK	R12MLK
8143-14LK	R14MLK
8143-16LK	R16MLK

NSA 8145		
NSA Number	AMPEP part No.	AMPEP part No.
8145-04--	KS04--P	13ASZ04--
8145-05--	KS05--P	13ASZ05--
8145-06--	KS06--P	13ASZ06--
8145-08--	KS08--P	13ASZ08--
8145-10--	KS10--P	13ASZ10--
8145-12--	KS12--P	13ASZ12--
8145-14--	KS14--P	13ASZ14--
8145-16--	KS16--P	13ASZ16--
8145-18--	KS18--P	13ASZ18--
8145-20--	KS20--P	13ASZ20--
8145-22--	KS22--P	13ASZ22--
8145-24--	KS24--P	13ASZ24--
8145-28--	KS28--P	13ASZ28--
8145-32--	KS32--P	13ASZ32--

For oversize o/dia versions codes applicable are
NSA8194--R1-- = KS----PY1 = 13ASZ----Y1
NSA8194--R2-- = KS----PY2 = 13ASZ----Y2

NSA 8146		
NSA Number	AMPEP part No.	AMPEP part No.
8146-04--	KA04--P	13AAZ04--
8146-05--	KA05--P	13AAZ05--
8146-06--	KA06--P	13AAZ06--
8146-08--	KA08--P	13AAZ08--
8146-10--	KA10--P	13AAZ10--
8146-12--	KA12--P	13AAZ12--
8146-14--	KA14--P	13AAZ14--
8146-16--	KA16--P	13AAZ16--
8146-18--	KA18--P	13AAZ18--
8146-20--	KA20--P	13AAZ20--
8146-22--	KA22--P	13AAZ22--
8146-24--	KA24--P	13AAZ24--
8146-28--	KA28--P	13AAZ28--
8146-32--	KA32--P	13AAZ32--

For oversize o/dia versions codes applicable are
NSA8194D--R1-- = KA----PY1 = 13AAZ----Y1
NSA8194D--R2-- = KA----PY2 = 13AAZ----Y2

NSA 8147		
NSA Number	AMPEP part No.	AMPEP part No.
8147-04--	KSF04--P	13ASF04--
8147-05--	KSF05--P	13ASF05--
8147-06--	KSF06--P	13ASF06--
8147-08--	KSF08--P	13ASF08--
8147-10--	KSF10--P	13ASF10--
8147-12--	KSF12--P	13ASF12--
8147-14--	KSF14--P	13ASF14--
8147-16--	KSF16--P	13ASF16--
8147-18--	KSF18--P	13ASF18--
8147-20--	KSF20--P	13ASF20--
8147-22--	KSF22--P	13ASF22--
8147-24--	KSF24--P	13ASF24--
8147-28--	KSF28--P	13ASF28--
8147-32--	KSF32--P	13ASF32--

For oversize o/dia versions codes applicable are
NSA8195--R1-- = KSF----PY1 = 13ASF----Y1
NSA8195--R2-- = KSF----PY2 = 13ASF----Y2

NSA 8148		
NSA Number	AMPEP part No.	AMPEP part No.
8148-04--	KAF04--P	13AAF04--
8148-05--	KAF05--P	13AAF05--
8148-06--	KAF06--P	13AAF06--
8148-08--	KAF08--P	13AAF08--
8148-10--	KAF10--P	13AAF10--
8148-12--	KAF12--P	13AAF12--
8148-14--	KAF14--P	13AAF14--
8148-16--	KAF16--P	13AAF16--
8148-18--	KAF18--P	13AAF18--
8148-20--	KAF20--P	13AAF20--
8148-22--	KAF22--P	13AAF22--
8148-24--	KAF24--P	13AAF24--
8148-28--	KAF28--P	13AAF28--
8148-32--	KAF32--P	13AAF32--

For oversize o/dia versions codes applicable are
NSA8195D--R1-- = KS----PY1 = 13AAF----Y1
NSA8195D--R2-- = KS----PY2 = 13AAF----Y2

NOTE: LAST TWO NUMBERS IN NSA CODES ARE WIDTH IN MULTIPLES OF 1/32 INCH
LAST TWO NUMBERS IN AMPEP CODES ARE WIDTH IN MULTIPLES OF 1/16 INCH
EG. NSA8145-0408 = KS 0404P = 13ASZ0404

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NSA INCH STANDARDS

NSA / AMPEP PART No. CROSS-REFERENCE

NSA 8149--R	
NSA Number	AMPEP part No.
8149-03R	R03FR
8149-04R	R04FR
8149-05R	R05FR
8149-06R	R06FR
8149-07R	R07FR
8149-08R	R08FR
8149-10R	R10FR
8149-12R	R12FR
8149-14R	R14FR
8149-16R	R16FR

NSA 8149--RK	
NSA Number	AMPEP part No.
8149-03RK	R03FRK
8149-04RK	R04FRK
8149-05RK	R05FRK
8149-06RK	R06FRK
8149-07RK	R07FRK
8149-08RK	R08FRK
8149-10RK	R10FRK
8149-12RK	R12FRK
8149-14RK	R14FRK
8149-16RK	R16FRK

NSA 8149--L	
NSA Number	AMPEP part No.
8149-03L	R03FL
8149-04L	R04FL
8149-05L	R05FL
8149-06L	R06FL
8149-07L	R07FL
8149-08L	R08FL
8149-10L	R10FL
8149-12L	R12FL
8149-14L	R14FL
8149-16L	R16FL

NSA 8149--LK	
NSA Number	AMPEP part No.
8149-03LK	R03FLK
8149-04LK	R04FLK
8149-05LK	R05FLK
8149-06LK	R06FLK
8149-07LK	R07FLK
8149-08LK	R08FLK
8149-10LK	R10FLK
8149-12LK	R12FLK
8149-14LK	R14FLK
8149-16LK	R16FLK

PAN / AMPEP PART No. CROSS-REFERENCE

PAN METRIC STANDARDS

PAN 4830--N	
PAN Number	AMPEP part No.
4830-06N	06GSN
4830-10N	10GSN
4830-12N	12GSN
4830-15N	15GSN
4830-17N	17GSN
4830-20N	20GSN
4830-25N	25GSN
4830-30N	30GSN
4830-35N	35GSN
4830-40N	40GSN
4830-45N	45GSN
4830-50N	50GSN

PAN 4830--W	
PAN Number	AMPEP part No.
4830-05W	05GSW
4830-06W	06GSW
4830-08W	08GSW
4830-10W	10GSW
4830-12W	12GSW
4830-15W	15GSW
4830-17W	17GSW
4830-20W	20GSW
4830-22W	22GSW
4830-25W	25GSW
4830-30W	30GSW
4830-35W	35GSW
4830-40W	40GSW
4830-45W	45GSW
4830-50W	50GSW

PAN 4831--N	
PAN Number	AMPEP part No.
4831-06N	06ZSN
4831-10N	10ZSN
4831-12N	12ZSN
4831-15N	15ZSN
4831-17N	17ZSN
4831-20N	20ZSN
4831-25N	25ZSN
4831-30N	30ZSN
4831-35N	35ZSN
4831-40N	40ZSN
4831-45N	45ZSN
4831-50N	50ZSN

PAN 4831--W	
PAN Number	AMPEP part No.
4831-05W	05ZSW
4831-06W	06ZSW
4831-08W	08ZSW
4831-10W	10ZSW
4831-12W	12ZSW
4831-15W	15ZSW
4831-17W	17ZSW
4831-20W	20ZSW
4831-22W	22ZSW
4831-25W	25ZSW
4831-30W	30ZSW
4831-35W	35ZSW
4831-40W	40ZSW
4831-45W	45ZSW
4831-50W	50ZSW

PAN 4832	
PAN Number	AMPEP part No.
4832-06--	06--FSK
4832-08--	08-FSK
4832-10--	10--FSK
4832-12--	12--FSK
4832-15--	15--FSK
4832-16--	16--FSK
4832-18--	18--FSK
4832-20--	20--FSK
4832-22--	22--FSK
4832-25--	25--FSK
4832-28--	28--FSK
4832-30--	30--FSK
4832-32--	32--FSK
4832-35--	35--FSK
4832-40--	40--FSK
4832-45--	45--FSK
4832-50--	50--FSK

PAN 4833	
PAN Number	AMPEP part No.
4833-06--	06--FAK
4833-08--	08-FAK
4833-10--	10--FAK
4833-12--	12--FAK
4833-15--	15--FAK
4833-16--	16--FAK
4833-18--	18--FAK
4833-20--	20--FAK
4833-22--	22--FAK
4833-25--	25--FAK
4833-28--	28--FAK
4833-30--	30--FAK
4833-32--	32--FAK
4833-35--	35--FAK
4833-40--	40--FAK
4833-45--	45--FAK
4833-50--	50--FAK

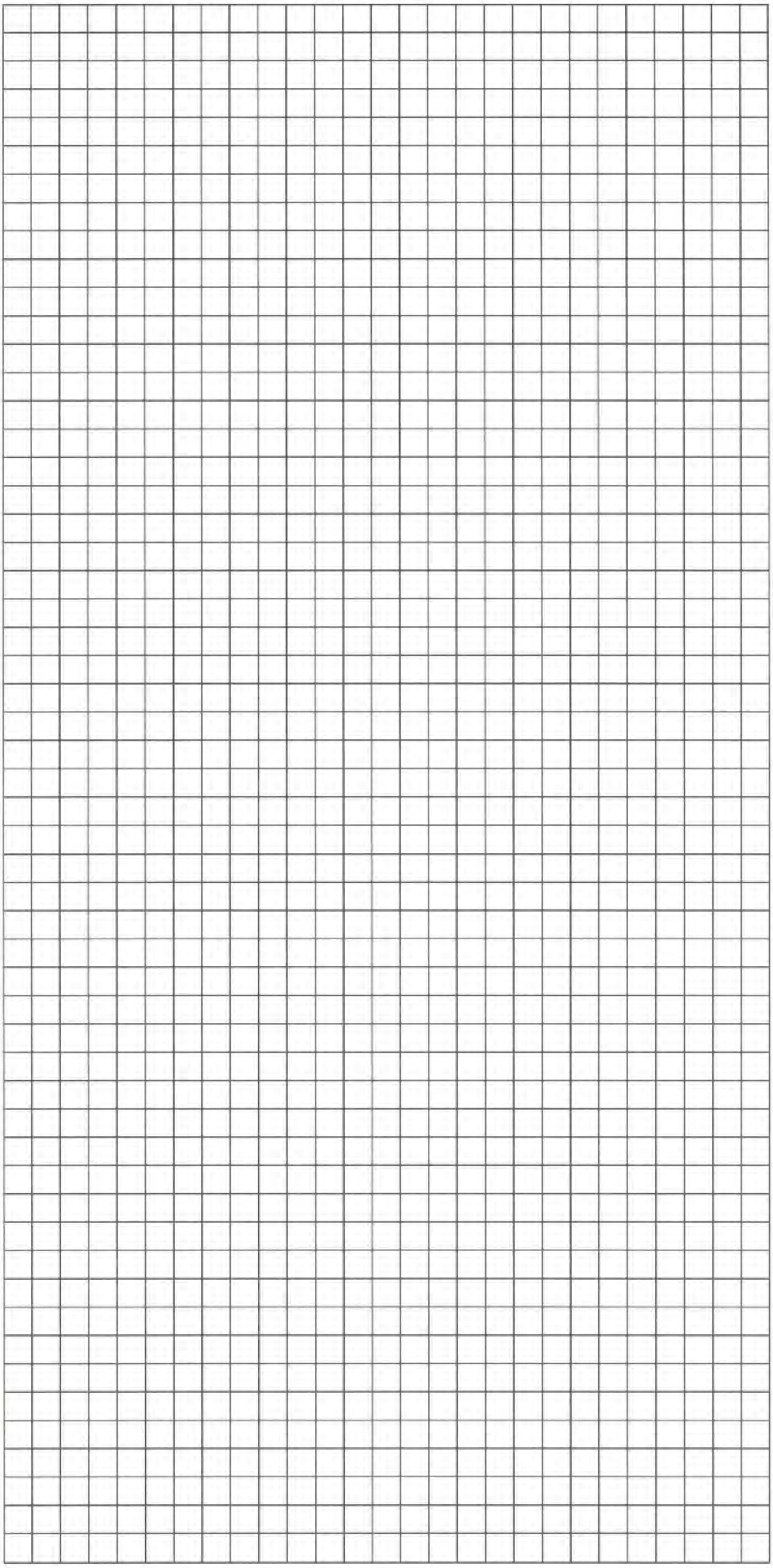
PAN 4834	
PAN Number	AMPEP part No.
4834-06--	06--SK
4834-08--	08-SK
4834-10--	10--SK
4834-12--	12--SK
4834-15--	15--SK
4834-16--	16--SK
4834-18--	18--SK
4834-20--	20--SK
4834-22--	22--SK
4834-25--	25--SK
4834-28--	28--SK
4834-30--	30--SK
4834-32--	32--SK
4834-35--	35--SK
4834-40--	40--SK
4834-45--	45--SK
4834-50--	50--SK

PAN 4835	
PAN Number	AMPEP part No.
4835-06--	06--AK
4835-08--	08-AK
4835-10--	10--AK
4835-12--	12--AK
4835-15--	15--AK
4835-16--	16--AK
4835-18--	18--AK
4835-20--	20--AK
4835-22--	22--AK
4835-25--	25--AK
4835-28--	28--AK
4835-30--	30--AK
4835-32--	32--AK
4835-35--	35--AK
4835-40--	40--AK
4835-45--	45--AK
4835-50--	50--AK

NOTE: Second pair of numbers -- are width code in millimetres EG: PAN4832-0608 = 0608FSK

PAN 4843--N	
PAN Number	AMPEP part No.
4843-06N	06ZSNT
4843-10N	10ZSNT

PAN 4843--W	
PAN Number	AMPEP part No.
4843-06W	06ZSWT
4843-08W	08ZSWT
4843-10W	10ZSWT



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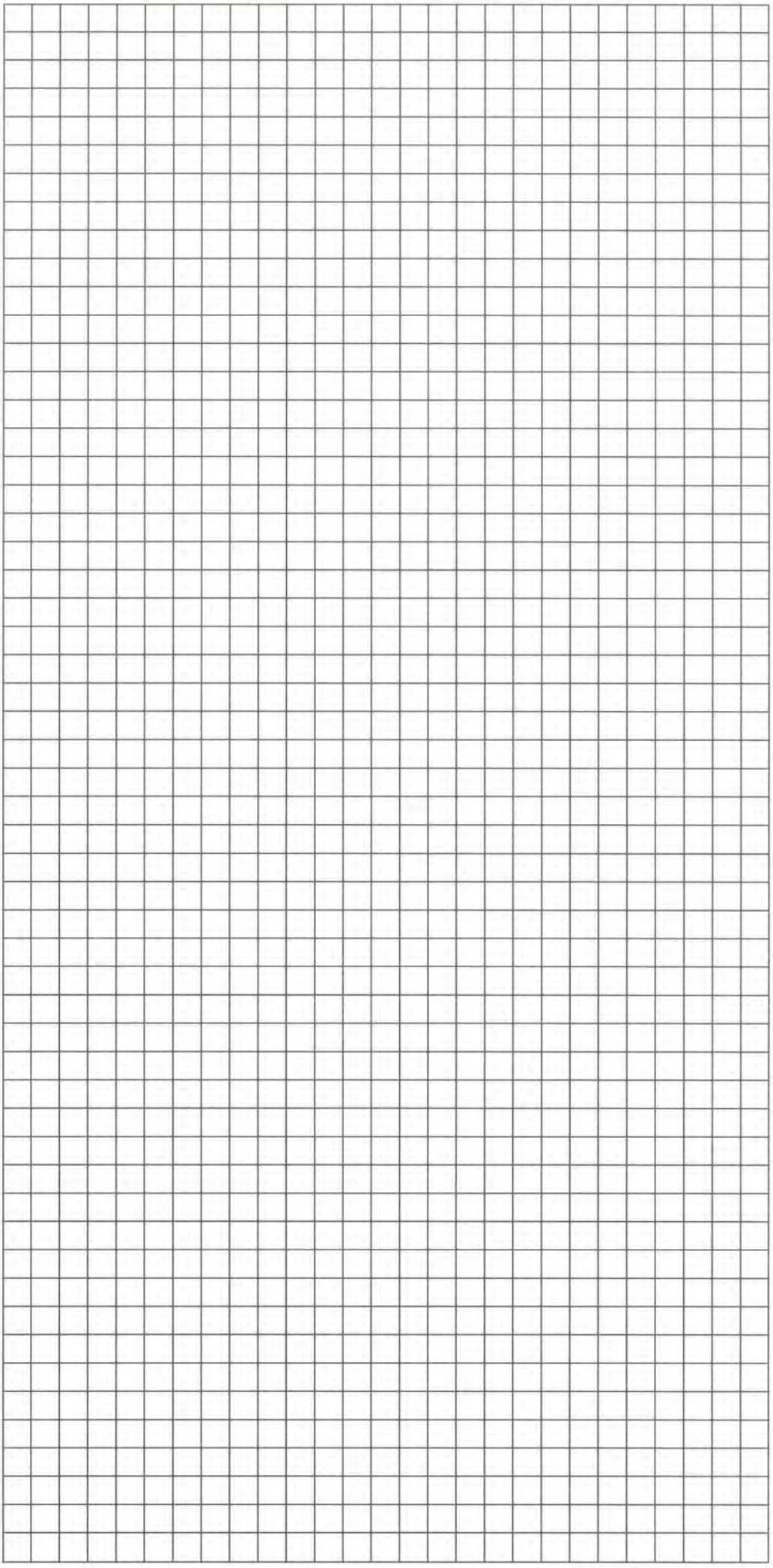


UNITS, MULTIPLES & CONVERSIONS

UNITS

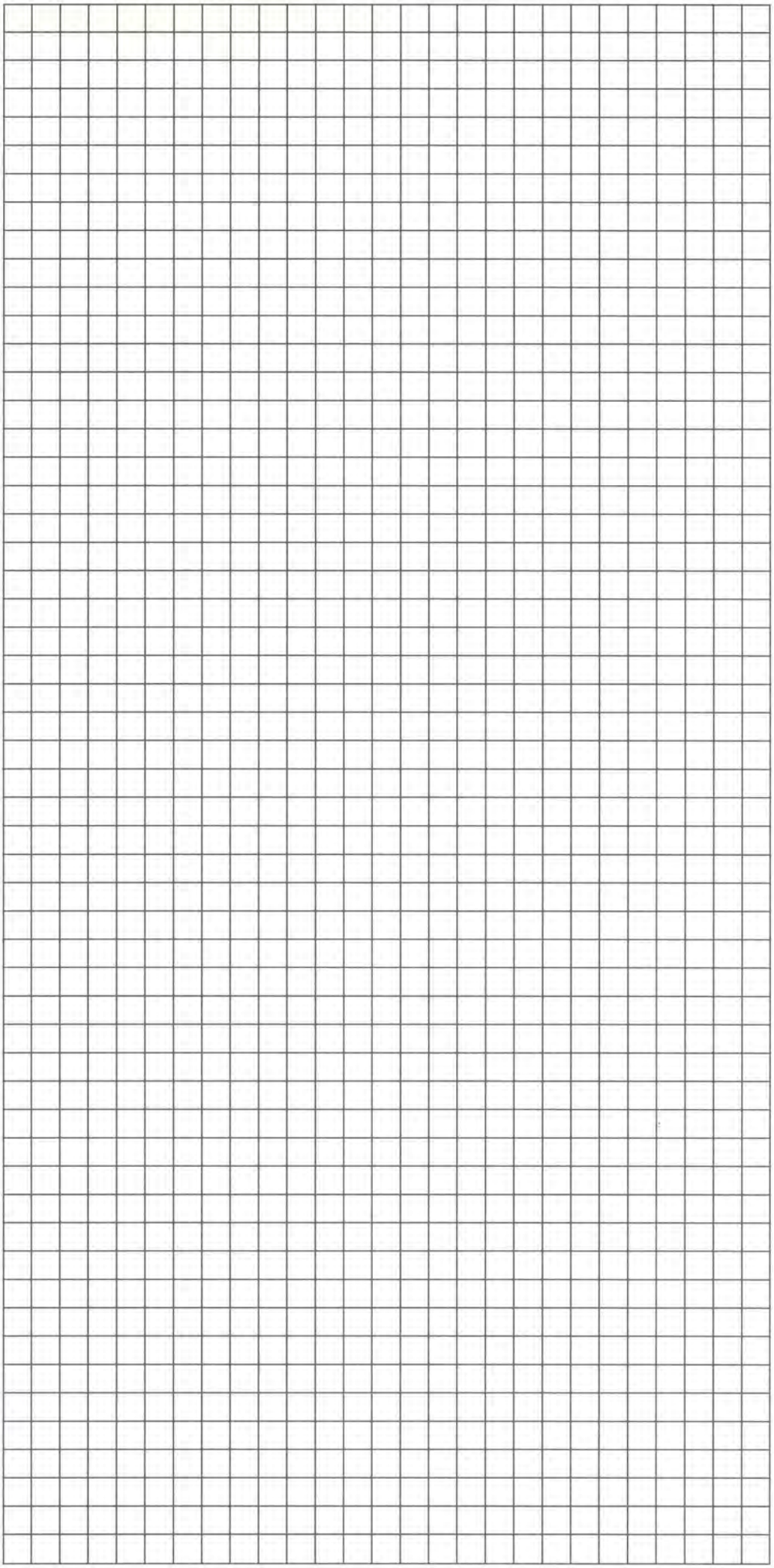
LENGTH	Metre m	Inch in
MASS	Kilogramme Kg	Pounds lb
TEMPERATURE	Celsius C	Fahrenheit F
TIME	Second s	Minute min
FREQUENCY	Hertz Hz	
FORCE	Newton N	Pounds lbf
PRESSURE	Pascal Pa	Pounds/inch^2

MULTIPLES

10^9	giga	G
10^6	mega	M
10^3	kilo	K
10^{-3}	milli	m
10^{-6}	micro	μ

CONVERSIONS

1in	= 25,4 mm
1ft	= 304,8 mm
1in^2	= 645,16 mm^2
1in^3	= 16387,0 mm^3
1ft/min	= 0,0051 m/s
1lb	= 0,453592 Kg
1lbf	= 4,448 N
1lbf/in^2	= 6,896 KPa (10,000 lbf/in^2 = 70 MPa)
1lbf.in	= 0,113 Nm
1 Radian	= 57.3 degrees
1°C	= $^5/_9$ (°F-32)



TERMS AND CONDITIONS OF SALE

Note:- (i) AMPEP PLC is reffered to below as "the Company ".
(ii) the headings are for the purpose of convenience and not interpretation.

1. Variations of Terms and Conditions
No officer or servant or agent of the Company has authority to vary these conditions or to contract on any other conditions except with the express written consent of the Company.
The Company reserves the right to vary its published conditions without prior notification.

2. Acceptance
Any order placed with the Company requires the confirmation of the Company before a contract becomes binding and shall be deemed to be subject to the conditions herein printed which are the only conditions on which the Company is willing to contract. Any conditions introduced by the customer (in so far as they differ from these conditions) shall be ignored and the order shall be deemed to have been placed without them unless written agreement has been given by the Company modifying these conditions. The return of the customer's standard order acknowledgement form does not constitute a written agreement to the modification of these conditions by the Company.

3. Guarantee
Any goods supplied by the Company which are found within one year of being put into service or within fifteen months of despatch from the Company's works (whichever is the earlier) to be defective in workmanship or material will be replaced or rectified free of charge provided that no alteration has been made to such goods after leaving the Company's works and provided that such defect is not due in whole or in part to lack of care, overload, natural wear, incorrect choice of bearings, faulty mounting or any other circumstances whatsoever beyond the Company's control.
No Guarantee can be given in respect of the performance of the Company's products in a specific application.

4. Terms of Payment
Ledger accounts approved by the Company: Net cash monthly. Other accounts: Cash with order unless otherwise stated on invoice. The Company reserves the right to withhold deliveries if:-
(a) Payment has not been made on the due date, or
(b) the customer shall fail to comply with any request made by the Company at any time for payment prior to delivery irrespective of whether the order has been accepted on net cash monthly terms or otherwise.

5. Prices
It is an express condition that the Company may at any time in its discretion amend the price for all or any part of the goods that are to be supplied under the contract to the current price for such goods at the time when the same are delivered. In the event that the quantity ordered is less than that originally quoted for, the Company reserves the right to amend the price.

6. Quotations
Quotations, whether verbal or in writing, are made subject to thier acceptance within one calendar month of the date of issue, and are subject to the Company's published Terms and Conditions.

7. Minimum Order Charge
The Company will apply a minimum charge per order, details of which are available upon application.

8. Delivery
The Company, whilst making every effort to effect prompt delivery, will not be liable for loss or damage or consequential loss or damage of any description occasioned by delay in delivery howsoever caused, and any delivery dates quoted are given subject to this condition.

9. Service
Any service or advice which may be given by the Company, its servants or agents to users of its products is rendered in all good faith but the Company shall not be liable for any loss or damage arising therefrom, unless it has been expressly requested to give such service or such written advice and it has done so in writing in response to such request.

10. Specifications and Drawings
Every effort is made to ensure that descriptions, drawings and other information in correspondence, catalogues, etc., are accurate but no warranty is given in respect thereof and the Company shall not be liable for any error therin unless it had expressly requested to advice in writing on the accuracy of the descriptions drawings, information, etc., and the Company has given such written advice.
The Company also reserves the right to modify the design of its own products without notice. Goods are manufactured to the Company's own specifications, and to its own quality standards unless specifically agreed otherwise at the time of Quotation and indicated as such on the Company's Order Acknowledgement.

11. Quantities
Although every effort will be made to supply the exact order quantity of standard bearings, the Company reserves the right to vary and charge for the delivered quantity by plus or minus 5%. Orders for goods specially manufactured for the customer will only be accepted subject to the Company's right to deliver and charge for up to 10% more or less than the quantity ordered. The Company will not accept any restriction of its right to manufacture, sell or offer to any other customers, goods which may be manufactured specially for a specific customer or customers.

12. Customer's Material
Reasonable care will be exercised in safeguarding any property issued to the Company in respect of any order or request for quotation or examination. However, the Company cannot accept responsibility for such property.
Customers supplying materials must ensure that they make an adequate allowance to cover scrap. The Company reserves the right to dispose of all scrap and surplus materials, without liability, unless agreed otherwise at the time of receipt of the materials.

13. Special Inspection
A charge may be made to cover cost of release of goods against special inspection requirements.

14. Tooling
As the design of tooling required for the manufacture of proprietary bearings is confidential, it must remain the property, and in the control of the Company.
A charge covering part cost of tools may be made in connection with the supply of parts not specified as standard parts in the Company's published literature.

15. Sub Contract
The Company reserves the right to sub-contract all or any part of all orders, and quotations are made on this basis.

16. Carriage
The Company will normally pay the carriage on all orders exceeding £200 in value to destinations within the United Kingdom provided delivery is made by our selected method. When the customer requests delivery by means other than that normally used by the Company, the cost, if any, may be charged to the customer. Unless specifically agreed otherwise and noted as such in the Quotation and order.
Acknowledgement, goods supplied to destinations outside the United Kingdom are priced as ex works.

17. Returned Goods
No returns will be accepted by the Company other than by express agreement in writing. Unauthorised returns received by the Company will be sent back to the returning company carriage forward. Claims for loss or damage to goods in transit must be made by the customer direct to the Carrier in strict compliance with the procedures and time laid down by the Carrier, and the Company informed of all such claims immediately. No such claim will be considered by the Company unless there has been strict compliance as aforesaid.

18. Force Majeure
The Company shall be excused from liability if performance of the contract is prevented or hindered by any cause whatsoever beyond the Company's control and in particular but without prejudice to the generality of the foregoing by Act of God, War, Government Control, restrictions or prohibitions or any other Government act or omission whether local or national, fire, flood, subsidence, sabotage, accident, strike or lockout, and shall not be liable for any loss or damage resulting from any such circumstances.

19. Cancellation
In the event of cancellation of an order, the Company reserves the right (in addition to any other right which it may have) to make charges as necessary to recover the cost of work already carried out and for any special tooling manufactured against the order.

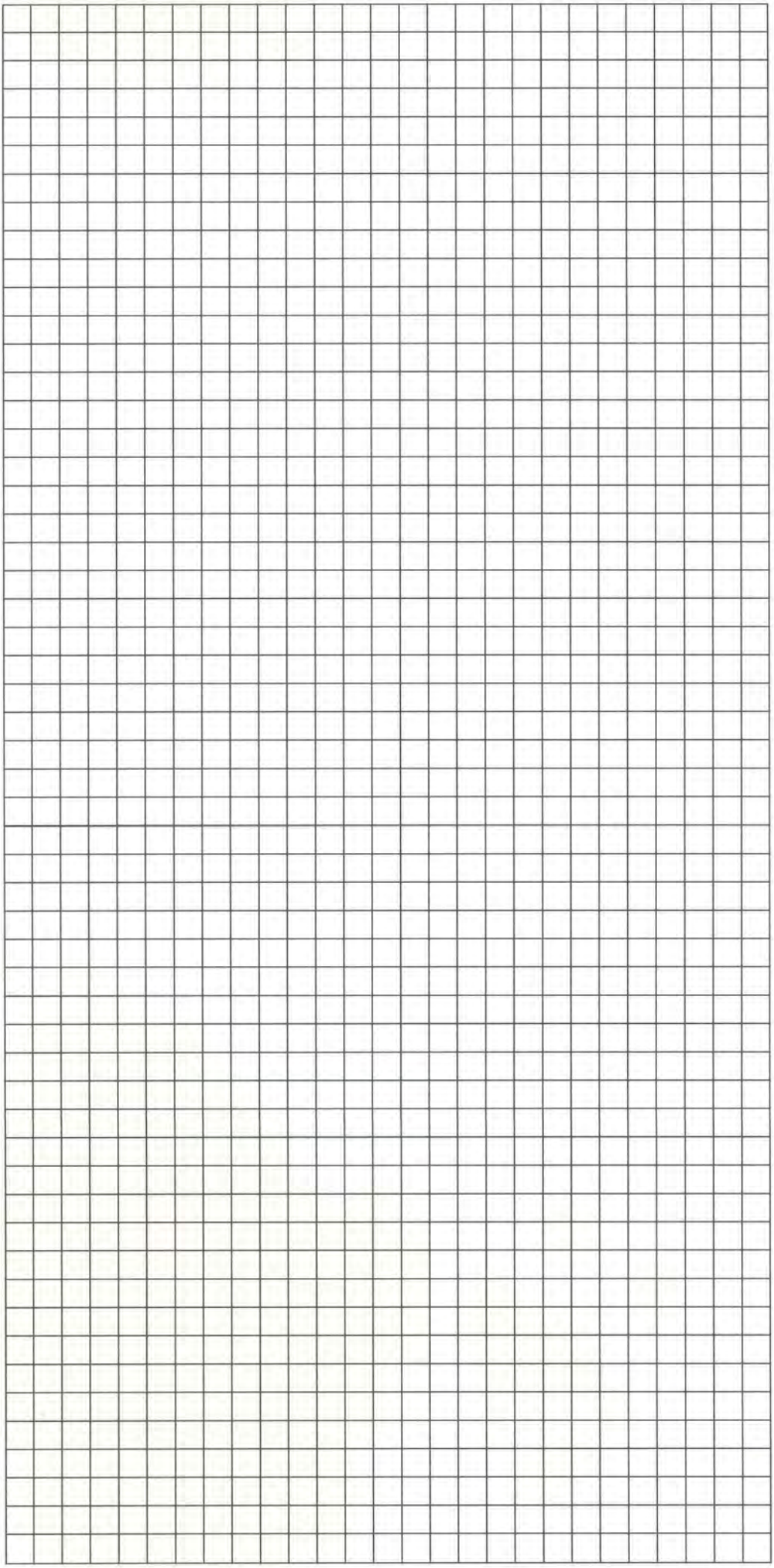
20. Re-Sale
Except with the prior consent of the Company, the customer may not re-sell the goods or any part thereof except in or as part of his manufacture or as spare parts therefor.

21. Exhibitions
Except with the Company's prior approval in writing, goods sold by the Company may not be exhibited or advertised in any show, display, or exhibition other than on the customer's own premises and may not be entered for any event.

22. Health & Safety
To the best of the Company's knowledge and belief, none of the Company's products are hazardous or contain hazardous materials, however, most of said products incorporate polytetrafluoroethylene (p.t.f.e.) and therefore the usual precautions associated with this material should be observed.

23. Property
The property in any goods sold by the Company shall not pass to the customer until such time as the Company is in actual receipt of the full amount of the price thereof.

24. Legal Interpretation
All contracts governed by these conditions shall be subject to English Law and any question of interpretation or dispute shall be settled by the English Courts or, at the option of the Company, by arbitration in London, England, by an Arbitrator appointed by the Company in accordance with the provisions of the Arbitration Act 1950 or any statutory re-enactment or modification thereof.



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