

HELICOPTER PROCEDURE SPECIFICATION

CONTROL PROCEDURE FOR DYNAMIC ROLLING ELEMENT BEARINGS

PUBLICATION NOTICE

WHPS 703 has been amended as indicated by marginal lines, and is raised to Issue 3.

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1. INTRODUCTION

1.1 Control of the integrity of Dynamic Rolling Element Bearings is essential to protect the safety of the aircraft.

1.2 This procedural specification defines the special requirements which are necessary to ensure the integrity of Dynamic Rolling Element Bearings. It is applicable to all stages in the production of such bearings from design through manufacture to delivery and subsequently during repair and overhaul.

1.3 This specification replaces:

WHPS 307	Material Quality and Inspection Requirements of Metric Ball and Roller Bearings used in Type Approved Equipment for Lynx and Subsequent Aircraft.
WHPS 493	Procurement of Ball and Roller Bearings.
Q500	Paragraph 9.1.13 Bearing Suppliers' and Supplement A Paragraph 9.3.
SQA 60	Vendor Check Requirements for Bearings Manufacturers/Agents.
WGS1.62	Quality Assurance of Ball, Roller and Needle Bearings.

2. PURPOSE

To provide a single specification which supports the detail drawing and provides the overall requirements for Westland Helicopters Ltd. (WHL) Dynamic Rolling Element Bearings.

To maintain the quality requirements as detailed in the replaced specifications but enables the manufacturers to use their own WHL agreed processes and procedures.

3. SCOPE

The procedure is applicable to all stages (Design, Manufacture, Repair and Overhaul) in which WHL (including Sub-Contractors), its bearing manufacturers and any repair agencies are involved.

4. APPLICABILITY

4.1 This specification covers

- a) Category A1 and A2 bearings for which WHL are the Design Authority.
- b) Category B bearings which are procured against a WHL vendor control drawing or the manufacturer's part number.
- c) Freewheel Rollers

Paragraph 7 defines the various categories and Table 1 provides a cross-reference to categories as previously defined in WHPS 307, WHPS 493 and WGS1.62.

5. REFERENCE DOCUMENTS

5.1 This specification makes reference to the following documents:

MDS P30-1053 Westland Special Bearings

WHPS 000	The Control and Use of Westland Helicopter Process, Procedure and Material Specifications.
WHPS 057	Interference Fits for Component Assembly.
WHPS 158	The Protection of Metallic and Non-Metallic Items.
WHPS 307	Material Quality and Inspection Requirements of Metric Ball and Roller Bearings used in Type Approved Equipment for Lynx and Subsequent Aircraft.
WHPS 378	Cleaning and Inspection of Bearings at Overhaul.
WHPS 493	Procurement of Ball and Roller Bearings.
QRS01	Quality Requirements for Suppliers.
SQA60	Vendor Check Requirements for Bearing Manufacturers/Agents.
WGS1.62	Quality Assurance of Ball, Roller and Needle Bearings.

5.2 In addition to the requirements of this specification users shall ensure compliance with any paragraph in WHPS 000, which is applicable to them

6. QUALITY REQUIREMENTS FOR SUPPLIERS

6.1 All bearing manufacturers and suppliers shall be:

- a) Approved by Westland Helicopters Ltd.
- b) Listed in the Vendor Approvals Database.

7. BEARING CATEGORISATION

7.1 Bearings shall be categorised in accordance with the following criteria:

7.2 Category A1

These are bearings which are subject to heavy duty and are critical from a flight safety aspect.

7.3 Category A2

These are bearings which are critical from a reliability aspect or whose failure may cause significant secondary effects.

7.4 Category B

Bearings not covered by the above categories, which are procured against a WHL vendor control drawing or the manufacturer's part number..

TABLE 1

CROSS REFERENCE OF OLD AND NEW CATEGORIES

SPECIFICATION	WHPS 703	WHPS 493	WHPS 307
CATEGORY	A1	1 (Para. 5.2)	AA
	A2	1 (Para. 5.1)	A
	B	2	B & C

8. PROCEDURE

8.1 Applicable procedures are detailed in the following appendices:

Drawing Requirements	-	Appendix A
Qualification Tests and Re-approval	-	Appendix B
Procurement	-	Appendix C
Manufacture	-	Appendix D
Receipt Inspection	-	Appendix E
Approval of Manufacturers and Products	-	Appendix F
Installation	-	Appendix G
Repair and Overhaul	-	Appendix H

APPENDIX A

DRAWING REQUIREMENTS

This appendix has been compiled as a guide to the interpretation of Westland drawings, with regard to the requirements for Category A1 and A2 Dynamic Rolling Element Bearings. Definitive instructions on the preparation of drawings are defined in MDS P30-1053, Westland Special Bearings.

A.1 REFERENCE TO WHPS 703

All new and **where practical** re-issued bearing drawings shall make reference to WHPS 703 as the controlling document.

However, there are and will be instances where specific drawing notes are at variance to this specification. In these instances the drawing is mandatory.

A.2 APPROVED SUPPLIER

A.2.1 CATEGORY A1 AND A2 BEARINGS

The name of the approved bearing manufacturer shall be stated on all new and re-issued drawings.

A.2.2 CATEGORY B BEARINGS

The name of the approved bearing manufacturer shall be detailed either on all new and re-issued vendor control drawings or included in the WHL Engineering standard for the bearing.

Notes...

1. For the purpose of this procedural specification, a new or re-issued drawing is a drawing published after the date of issue of this specification.
2. **Non-metallic bearing cages are not acceptable for any Category of bearing.**
3. **Riveted cages shall only be used by agreement with WHL Design. The details of such an agreement shall include the rivet material and the procedure for manufacture and cage assembly.**

APPENDIX B

QUALIFICATION TESTS AND RE-APPROVAL

B.1 INITIAL QUALIFICATION

B.1.1 CATEGORY A1 and A2 BEARINGS

B.1.1.1 The suitability of Category A1 and A2 bearings for the purposes for which they are intended shall be demonstrated by test. These tests shall be performed by WHL unless otherwise agreed. The test environment shall replicate that likely to be seen in service. Typically, this will require testing in a representative installation e.g. in a gearbox as part of the gearbox qualification. The cleanliness and filtration standard of the oil shall be representative. The test shall be carried out at factored loads (or factored displacements, if appropriate). The condition of the bearings shall be assessed at the end of the factored load test and a life declared for the bearing in that installation.

B.1.1.2 The entry into service TBO for the bearing in a specific installation shall be based on the condition of the bearing after test, the length of the test and the magnitude of the load factor or on other endurance testing.

B.1.1.3 In addition, for Category A1 bearings, which require some form of condition monitoring, the ability of the condition monitoring method to detect deterioration in the bearing in a timely manner shall be demonstrated by test.

B.1.1.4 In the event of significant modification or change in manufacturer similar repeat testing as detailed in B.1.1.1 to B.1.1.3 will be required.

B.1.2 CATEGORY B BEARINGS

B.1.2.1 The suitability of Category B bearings shall be demonstrated by test, unless the performance of the bearing can be determined from prior use, in similar applications where the performance of the bearing has been monitored. WHL shall establish if any tests are required.

B.1.2.2 It is acceptable for the testing of Category B bearings to be conducted in stand alone bearing test rigs.

B.2 RE-APPROVAL

B.2.1 In the event that the manufacturing standard of a bearing is changed, the entire bearing has to be replaced by a different bearing, or the loading on the bearing is increased, an assessment shall be made of the impact of the change on the performance of the bearing in each application to which the change is applicable. The Chief Mechanical Engineer shall decide on the appropriate response, which can range from no action to a new test.

B.2.2 Where testing is required, Category A1 bearings shall be re-qualified in a fully representative environment. For Category A2 bearings, if this is not cost effective, back to back testing may be conducted using stand alone rigs.

APPENDIX C

PROCUREMENT

This appendix is written to reflect the procedures and terminology to be used by WHL Purchasing Departments. The requirements equally apply to Suppliers purchasing bearings on behalf of WHL.

C.1 PURCHASE ORDERS

C.1.1 Bearings shall only be procured from the supplier stated on the drawing or within the WHL Engineering standard.

C.1.2 The purchase order shall include reference to this specification.

C.1.3 Bearing manufacturers shall be approved to WHPS 703, however, until the drawing is reissued specifying WHPS 703 Quality Plans are not required and existing manufacturing/inspection procedures are acceptable.

C.2 QUALITY PLAN APPROVALS FOR CATEGORY A1 AND A2 BEARINGS

C.2.1 For Category A1 and A2 bearings the manufacturer shall submit a Quality Plan for approval by Product Assurance Department (Critical Parts) (PAD(CP)) and WHL Materials Laboratory. Manufacture shall not commence until this Quality Plan has been approved. The Quality Plan shall describe how the manufacturer intends to satisfy the requirements of this specification.

C.2.2 Any significant changes to the method of manufacture (i.e. heat treatment including carburising or nitriding, NDT, material, method of machining, sequence of operations) shall be submitted to WHL for review. The proposed changes shall not be implemented until written approval has been received from WHL.

C.3 CATEGORY B BEARINGS

C.3.1 For Category B bearings the manufacturer shall inform WHL in advance of any proposed change to the manufacturing standard or materials of the bearing. This will enable WHL to take any appropriate action.

APPENDIX D

MANUFACTURE

D.1 MANUFACTURING CONTROLS FOR CATEGORY A1 AND A2 BEARINGS

D.1.1 For Category A1 and A2 bearings, a process layout for each component part shall be prepared by the manufacturer which fully defines the method of manufacture, including any special processes, special inspection techniques or assembly procedures. This process layout may be generic and cover a number of similar component parts. Authority to use generic process layouts shall be granted through a Quality Plan. Process layouts shall be available for audit at the manufacturer's facility.

D.1.2 Quality Plans shall be authorised by the manufacturer's Authorised Approved Signatory prior to being submitted to the relevant Westland Purchasing Authority with a front sheet. (Form WA 3713 See Fig. 1).

D.1.3 Bearing manufacturers who purchase component parts from another source shall ensure that such parts satisfy the applicable requirements of this specification.

D.1.4 Once compiled, the Quality Plan shall be reviewed by the manufacturer and by WHL. The layout shall then be considered as FROZEN.

D.1.5 Manufacture shall not commence until the Quality Plan has been reviewed in accordance with Para. D.1.4.

D.1.6 A copy of the layout shall be used to record the relevant manufacturing/inspection data for each production batch. This shall be retained by the manufacturer as a Quality Record for a minimum of 15 years.

D.1.7 WHL shall be informed of any proposed change to the materials or method of manufacture to ensure any effect on the integrity of the installed bearing can be assessed. Such changes shall be reflected in a revision of the Quality Plan which shall be submitted to PAD (CP) for review..

D.1.8 All Category A1 and A2 bearings shall be individually identified by a unique serial number marked on the bearing allocated by the manufacturer.

D.2 DETAILED REQUIREMENTS (CATEGORY A1 AND A2 BEARINGS)

Note ...

The following details the minimum that shall be included on the process layouts for all component parts of the bearing.

D.2.1 MATERIAL

D.2.1.1 The process layout shall reference the material specification and initial condition, this shall include, when applicable, details of the forgings from which the parts are manufactured.

D.2.1.2 The process layout shall specify an inspection check to ensure that the raw material issued and its condition are correct. Furthermore, this check shall ensure that the identity of the material source has been recorded.

D.2.2 HEAT TREATMENT

D.2.2.1 Hardening and tempering of steels shall be controlled in accordance with the relevant material/process specification.

D.2.2.2 Case hardening shall be controlled by a case depth test piece. The process layout shall specify the case depth required and where necessary a sketch shall be included to identify the areas that require case hardening. The criteria for determining the case depth shall be clearly defined.

D.2.2.3 Times and temperatures for de-embrittlement and low temperature stress relief shall be controlled in accordance with the relevant in house procedures.

D.2.3 NON-DESTRUCTIVE TESTING (NDT)

The following NDT shall be applied to component parts, as applicable.

D.2.3.1 100% Etch inspection for the detection of machining abuse and faulty heat treatment including carburising errors (See Table 1 for Acceptance Standard).

Notes ...

1. After Etch Inspection all parts shall be de-embrittled
2. Etch inspection is not required on component parts with a hardness of 35 HRC (350 Hv) or less.

D.2.3.2 100% Visual Inspection (See Tables 2 and 3 for Acceptance Standard).

D.2.3.3 100% Magnetic Flaw Detection (See Tables 2, 3 and 4 for Acceptance Standard).

D.2.3.4 100% Penetrant Flaw Detection (See Table 4 for Acceptance Standard).

Note...

Alternative methods of Non-Destructive Testing may be used with agreement from the WHL Materials Laboratory. Approval of the Quality Plan by the WHL Materials Laboratory shall signify approval of any alternatives that are to be used.

D.2.4 INNER AND OUTER RINGS

Inner and Outer Rings shall be inspected in accordance with Paras. D.2.3.1, D.2.3.2 and D.2.3.3.

D.2.5 ROLLERS AND BALLS

Rollers and Balls shall be inspected in accordance with Para. D.2.3.1 and D.2.3.2 after grinding but before final grinding/lapping. Rollers only shall be inspected in accordance with Para. D.2.3.3.

D.2.6 CAGES

Cages made from ferromagnetic materials shall be inspected in accordance with Para. D.2.3.1 and Para. D.2.3.3. Cages manufactured by stamping/punching from ferromagnetic sheet shall only be inspected in accordance with Para. D.2.3.3. Cages made from non-magnetic materials shall be inspected in accordance with Para. D.2.3.4.

D.2.7 SURFACE FINISH REQUIREMENTS

D.2.7.1 The Quality Plan shall ensure the surface finish requirements, as detailed in Table 5, are satisfied.

D.2.8 IDENTIFICATION AND TRACEABILITY

D.2.8.1 The process layout shall ensure that all component parts retain their manufacturing history. This shall include material identity, heat treatment, non-destructive tests and any other special processes that are used.

D.2.8.2 The traceability that has been maintained throughout the component part manufacture shall also be maintained throughout the assembly process.

Note ...

The manufacturing history of any detail part shall be traceable through the serial number of the bearing assembly.

D.2.8.3 The method of marking bearings/bearing components shall be in accordance with the drawing, Laser Marking may be agreed by WHL on an individual bearing basis.

D.2.9 OTHER REQUIREMENTS

D.2.9.1 To ensure the integrity of the assembled bearing, the following inspections/tests shall be documented:

- a)* Torque test - resistance to rotation.
- b)* Spinning test - to ensure there is no evidence of binding, undue noise or vibration.
- c) Deburring of component parts has been carried out.
- d) Demagnetising to three Gauss or less.
- e) Cleanliness standard has been met.
- f) Lubrication (If the bearing is grease filled then the presence of grease shall be confirmed by weight or other agreed method).

- **Not mandatory for Tapered Roller Bearings**

D.2.9.2 Dimensional control checks shall be included on the process layout, where applicable, for the following:

- a) Bore and outside diameter including out of roundness and taper.
- b) Width of rings and parallelism of sides.
- c) Groove run-out with a reference side (inner and outer rings).
- d) Radial run-out (eccentricity) inner and outer ring.
- e) Reference side run-out with the bore (inner and outer ring).
- f) Track run-out with face (for thrust bearings).
- g) Size grading and sphericity of balls.
- h) Size grading and circularity of rollers and raceways.
- i) Radial and axial internal clearance.

D.2.9.3 Specific Features

The following features shall be verified on all completed bearings unless it can be demonstrated that these features are 100% controlled during normal manufacture:

- a) Mounting dimensions.
- b) Radial internal clearance.
- c) Rolling qualities by spinning and other tests.
- d) General external condition, including absence of defects such as corrosion, damage, defective cage retention (e.g. defective rivets, welding, clenching, cracks, distortion, burrs etc), missing balls/rollers, deficient or incorrect marking and defective seals of shields.

D.2.9.4 Handling Damage

D.2.9.4.1 Protection against handling damage shall be applied at all stages of manufacture.

D.2.9.4.2 Prior to packaging, all bearings shall be 100% inspected for handling damage.

Handling damage that may affect a bearings performance is not acceptable.

D.2.9.5 A First Article Inspection shall be performed on the first item of each part number produced and a report (FAIR) provided with the first batch delivered. The content of the FAIR shall be as detailed in Para. F3. of Appendix F.

D.3 MANUFACTURING CONTROL FOR CATEGORY B BEARINGS

D.3.1 The manufacturer is responsible for defining the manufacturing route for Category B bearings and documenting the method of manufacture, which shall be available for audit.

D.3.2 If the bearing standard invokes a controlling document for manufacture, inspection and testing, then the full provisions of that document shall be satisfied.

D.3.3 WHL shall be informed in advance of any changes to the method of manufacture, so that appropriate actions can be taken.

D.3.4 Category B bearings shall be identified with the part number, the manufacturer's identity and the manufacturing batch or component serial number.

D.4 PRESENTATION AND PACKING - CATEGORY A1, A2 AND B BEARINGS

D.4.1 All assembled bearings and component parts shall be individually packaged to ensure long term protection for at least 5 years for oil wetted bearings and 3 years for grease packed bearings. As a minimum the packaging shall comprise of the bearing being hermetically sealed in preferably clear polythene followed by a second layer of packaging to protect the sealed first layer.

Note ...

The use of clear polythene will enable the bearings to be inspected for evidence of corrosion or lack of lubricant and in most cases will enable the bearing to be re-lifed without breaking the original packaging.

D.4.2 Each package shall be adequately labelled and as a minimum shall include:

- Part Number.
- Serial Number.
- Manufacturing Batch Number.
- Final Inspection Stamp.
- Date of Packaging.
- Expiry date for installation.

D.4.3 Bearings shall not be supplied with less than 90% shelf life remaining.

Note ...

The shelf life of a bearing should not be confused with the shelf life of the oil or grease. The oil/grease used shall be inside the manufacturer's specified expiry date. Once applied to the bearing and hermetically sealed the bearing's shelf life starts. This is the date that shall be used to calculate the bearing's shelf life expiry date.

APPENDIX D - TABLE 1

ACCEPTANCE STANDARD FOR MACHINING ABUSE AND FAULTY HEAT TREATMENT INCLUDING CARBURISING (ALL SURFACES)

1. No component parts shall show evidence of:
 - a) Machining abuse, re-hardening or temper burns.
 - b) Grinding cracks.
 - c) Carbon spots caused by poor masking during selective carburising (dark areas).
 - d) Excessive case removal during grinding (light areas).

APPENDIX D - TABLES 2 AND 3

ACCEPTANCE STANDARD FOR SURFACE DEFECTS IDENTIFIED BY MAGNETIC FLAW DETECTION, VISUAL INSPECTION OR ETCH INSPECTION. (SEE FOOTNOTES FOR DEFINITIONS)

APPENDIX D - TABLE 2

APPLICABLE TO BALLS AND ROLLERS (ALL SURFACES)

DEFECT	STANDARD
Pits ² and Inclusions ⁹ (Isolated or in Clusters)	Shall not exceed 0.10 mm in length or diameter Density shall not exceed 4 within an area of 6.0 mm dia. Clusters shall not exceed two in number and be at least one ball or roller dia. apart.
Nicks or Indentations ³	If they can be felt with a 1.00 mm radius scribe shall not exceed: 0.20 mm long x 0.10 mm wide for Ball and Roller dia. 12.5 mm or less. 0.30 mm long x 0.10 mm wide for Ball and Roller dia. over 12.5 mm.
Scratches ⁴	Shall not be readily felt with a 1.00 mm radius scribe. If they can be felt with a 0.5 mm radius scribe they shall not exceed 0.12mm in width. Single scratches shall not extend more than halfway around the circumference. Scratches shall not cross each other.
Scuffs ⁵	Shall only be superficial and shall not exceed limitations for, nicks or indentations.
Cracks ¹ and Corrosion ⁷	Shall not be accepted.
Staining ⁸	Shall not be accepted if it cannot be removed by light polishing.
Scale or Oxidation Products ¹⁰	Shall not be accepted.
General	On rollers, the blending at each end of the contact surface shall be defect free.

APPENDIX D - TABLE 3

APPLICABLE TO INNER AND OUTER RINGS (RACEWAY SURFACES ONLY)

DEFECT	STANDARD
Pits ² , and Inclusions ⁹ (Isolated or in Clusters)	Shall not exceed 0.10 mm in length or diameter. Density shall not exceed 4 within an area of 6.0 mm dia. Number shall not exceed 25 ÷ number of whole millimetres in dia. of track and be not less than 25.0 mm apart.
Nicks and Indentations ³	If they can be felt with a 1.00 mm radius scribe, shall not exceed 0.30 mm x 0.15 mm wide. Shall not be accepted with raised edges discernible without magnification.
Scratches ⁴	If they can be felt with a 1.00 mm radius scribe, shall not exceed 0.15 mm in width. Single scratches shall not extend more than 6.50 mm in length. Multiple scratches shall not extend more than halfway across the track. Scratches shall not cross each other.
Scuffs ⁵	Shall only be superficial and shall not exceed limitations for nicks, indentations or scratches.
Grinding, Honing or Polishing Marks ⁶	To be ignored if they cannot be felt with 1.00 mm radius scribe, otherwise they shall not exceed 6.50 mm in length.
Cracks ¹ and Corrosion ⁷	Shall not be accepted in any location.
Irregularities of Boundary Surfaces and Identification Marks	Shall not be accepted with raised edges.
Scale or Oxidation Products ¹⁰	Shall not be accepted.
Staining ⁸	Shall not be accepted if it cannot be removed by light polishing.

Notes ...

1. Cracks – Surface discontinuities exhibiting a fracture in the surface material.
2. Pits - Small irregular cavities in the surface, usually dark bottomed.
3. Nicks and Indentations - Slight depressions or hollows on the surface made by mechanical injury to the surface materials, e.g. blows or pressure from hard objects, contacting the finished surfaces. These are usually bright bottomed.
4. Scratches - Linear abrasions on the surface.
5. Scuffs - Series of small superficial scratches.
6. Grinding, Honing or Polishing Marks - Surface abrasion or discontinuities.
7. Corrosion - When the surface is broken, pitted or discoloured.
8. Stains - Surface discolouration.
9. Inclusions – Particles of foreign matter exhibited in the surface.
10. Surface Scale/oxidation – Scale or other oxidation products which occur on surfaces not machined after heat treatment, which may subsequently become detached.

APPENDIX D - TABLE 4

APPLICABLE TO CAGES

DEFECT	STANDARD
Cracks and Corrosion	Shall not be accepted.
Steel Cages - Machining Abuse	Refer to Table 1.

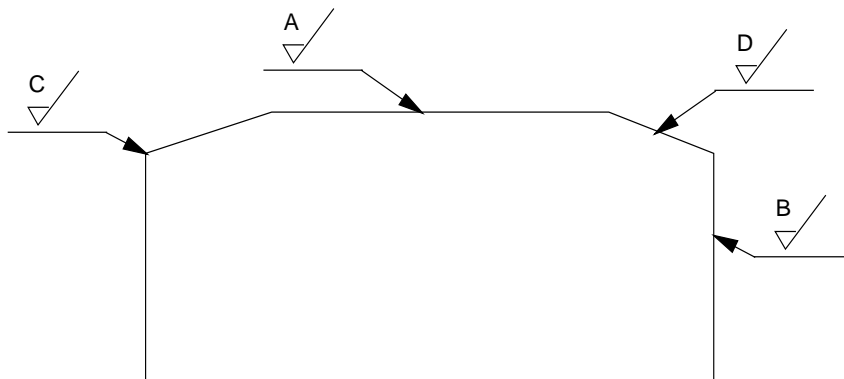
APPENDIX D - TABLE 5

SURFACE FINISH REQUIREMENTS

Surface Roughness

The surface roughness requirements defined below are applicable to all rolling element bearings unless otherwise stated on the drawing. The limits indicated are the maximum allowable. All values are defined as RA to ISO/R468.

DEFINED SURFACE		CAT A1		CAT A2		CAT B	
		Micro Inch	Micro Metres	Micro Inch	Micro Metres	Micro Inch	Micro Metres
LOCATION	ROLLING ELEMENTS						
A	Roller ^O / _D & Balls	2	0.05	2	0.05	2	0.05
B	Roller End Faces	10	0.25	10	0.25	12	0.30
C	Roller Corner Radii	8	0.20	16	0.40	16	0.40
D	Roller End Relief (Rad or Chamfer)	4	0.10	8	0.20	8	0.20



Note ...

Not mandatory for tapered rollers used on existing designs.

TABLE 5 Cont'd.....

DEFINED SURFACE		CAT A1		CAT A2		CAT B	
		Micro Inch	Micro Metres	Micro Inch	Micro Metres	Micro Inch	Micro Metres
Location	Rings: Inner & Outer						
E	O/D Outer Ring	16	0.40	16	0.40	16	0.40
F	Bore – Inner Ring	16	0.40	16	0.40	24	0.60
G	All end faces	24	0.60	24	0.60	24	0.60
H	Split Race Abutment faces	20	0.50	20	0.50	24	0.60
J	Spherical Alignment Sleeves : Inner & Outer	8	0.20	8	0.20	8	0.20
K	Inner & Outer Ring Ride Lands	8	0.20	12	0.30	16	0.40
L	Inner & Outer Non-Ride Lands	63	1.60	63	1.60	63	3.20
M	Seal Lands for Grease Packed Bearings	8	0.20	8	0.20	8	0.20
N	Unspecified Surfaces	125	3.20	125	3.20	125	3.20
P	Inner & Outer Raceways	6	0.15	8	0.20	8	0.20
R	Inside Faces	16	0.40	16	0.40	16	0.40

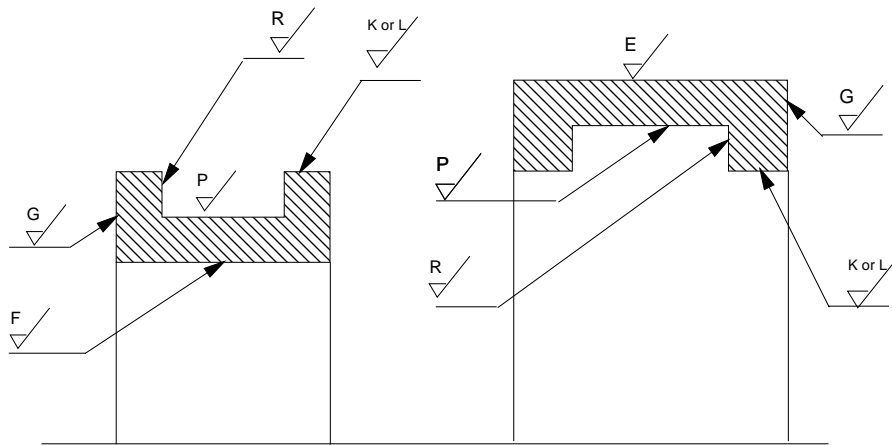


TABLE 5 Cont'd....

DEFINED SURFACE	CAT A1		CAT A2		CAT B	
	Micro Inch	Micro Metres	Micro Inch	Micro Metres	Micro Inch	Micro Metres
Cages						
Cage Pockets: Pressed or Machined	32	0.80	32	0.80	48	1.20
Cage Pockets: Broached (up to 127mm ¹ / _D)	48	1.20	48	1.20	63	1.60
Cage Pockets: Broached (over 127mm ¹ / _D)	48	1.20	48	1.20	63	1.60
Cage Ride Lands	16	0.40	16	0.40	24	0.60
Unspecified Surfaces	125	3.20	125	3.20	125	3.20
General						
Part Marking (must be subsurface)	48	1.60	48	1.60	48	1.60
Undercuts – Including Radii	48	1.60	48	1.60	48	1.60
Reamed Holes	48	1.60	48	1.60	48	1.60
Drilled Holes	250	6.30	250	6.30	250	6.30
Milled Flanges & other Profiles	125	3.20	125	3.20	125	3.20
Screw Threads	BS 4084					
Chamfers & Countersinks	125	3.20	125	3.20	125	3.20

Notes ...

1. All production planning shall include a surface roughness measurement. A percentage of each detail may be applied providing historical evidence of repeatedly achieving the requirements can be shown.
2. All surface roughness measurements shall be carried out on approved and calibrated equipment. Data printouts shall be maintained with production documentation.
3. Surface roughness applies to all components in their finished state, with the exception of the cage where it applies prior to Silver Plating, Phosphating or similar finish.
4. Surface treatments to rolling elements or raceways, such as Thin Dense Chrome shall be considered as the finished state for the component.

APPENDIX E

RECEIPT INSPECTION

E.1 Assembled bearings or component parts shall not be removed from the supplier's packaging.

E.2 Details of the supplied bearings shall be established by the accompanying paperwork and the identification label on each bearing package.

E.3 Receipt inspection shall be controlled by a Quality Inspection Plan or equivalent.

E.4 Any evidence which indicates the packaging has been tampered with shall be cause for rejection.

E.5 Bearing manufacturer's performance shall be monitored in accordance with Supplier Quality Control procedures.

APPENDIX F

APPROVAL OF MANUFACTURERS AND PRODUCTS

F.1 Bearing manufacturers shall be approved by Product Assurance Department (PAD) and WHL Materials Laboratory.

F.2 For Category A1 and A2 bearings Supplier Quality Control (SQC) shall review the First Article Inspection Report (FAIR) prior to release of the bearing. This may include an overview visit.

F.3 The following shall be included in the FAIR:

F.3.1 Assembled Bearings

- a) Visually inspect for packaging and preservation, corrosion and finish, condition of cage and rivets or shield/seals and retainers as appropriate, cleanliness.
- b) Mounting dimensions.
- c) Internal clearance.
- d) Radial runout.
- e) Side runout with outside diameter of outer ring.
- f) Side runout with bore of inner ring.
- g) Width variation on rings.
- h) Torque requirements, where specified.
- i) Lubrication.
- j) Rolling qualities by spinning and other tests.
- k) Hardness values of components.
- l) Confirm surface treatment and plating thickness as required.
- m) Part marking.
- n) Material traceability.

F.3.2 Bearing Component Parts

- a) Circularity of rings. (Roundness/Roll Profile).
- b) Sphericity of balls.
- c) Circularity and cylindricity of rollers. (Roundness/Roll Profile).
- d) Uniformity of ball/roller sizes.
- e) Groove runout with reference side.
- f) Surface condition of tracks, balls/rollers and cage pockets.
- g) Condition of cages.
- h) Hardness of components.
- i) Micro-structural requirements including a hardness traverse for case depth, retained austenite, core hardness etc., as required.

F.3.3 The applicable batch manufacturing record shall be reviewed as part of the FAIR to ensure completion of all operations and satisfactory data recording.

F.4 Bearing manufacturers shall be re-assessed by PAD (CP) and WHL Materials Laboratory every three years.

F.5 Performance monitoring of bearing manufacturers shall be achieved through information established by WHL Mechanical Design, Fault Investigation, Repair and Overhaul, Materials Laboratory, PAD (CP), QAS and SQC. This information may necessitate a change to the audit programme.

F.6 The PAD (CP) re-assessment of the manufacturer shall take the form of a sample first article inspection. PAD (CP) shall take a previously delivered unused bearing back to the manufacturer and witness inspections as detailed in Clauses F.3.1, F.3.2 and F.3.3.

APPENDIX G

INSTALLATION

G.1 BUILD SCHEDULE PROCEDURE

G.1.1 Build schedules shall adequately describe the installation process. They shall include:

- a) A check of the part number and serial number on the bearing.
- b) The need to ensure components of dismantlable bearings are not mixed.
- c) The method of assembly, including the heating/cooling procedure and media ref. WHPS 057.

Note ...

Where bearing components are carburised, then any heating specified for assembly shall not jeopardise the bearing component's final hardness.

- d) The need to record serial numbers. (See Para. G.2).
- e) The tooling to be used.
- f) After installation, bearings are lubricated with oil or grease to the correct specification.
- g) The relevant position of each bearing within a stack is identified.

G.1.2 Build schedules shall ensure all assembly loads are not applied through the rolling elements and are steady and non-impacting.

G.1.3 Every precaution shall be taken to prevent handling damage prior to and during assembly.

G.2 SERIAL NUMBERS

The bearing serial number shall be recorded during initial installation on the job card (or other history build documentation) of the assembly, providing the assembly is itself identifiable. If the first or subsequent assembly levels are not identifiable, a label shall be attached to the assembly annotated with the bearing serial number. This shall be transferred to subsequent assemblies, as necessary, to enable the bearing serial number to be transferred to the build history documentation at a serialised assembly level.

G.3 BEARING INSTALLATION

G.3.1 Bearing installation shall only be performed in a clean, dry environment.

G.3.2 Bearings shall only be installed in accordance with the build procedure. This shall include, when necessary, the correct tooling.

G.3.3 After installation, bearings shall be checked for freedom of rotation.

G.3.4 Where necessary, part installed bearings shall be temporary protected to WHPS 158.

APPENDIX H

REPAIR AND OVERHAUL


H.1 Repair and Overhaul procedures shall adequately describe the method of dismantling and re-installing bearings. The procedure shall ensure the necessary loads are not applied through the rolling elements and are steady and non-impacting. Any special tooling shall be identified.

H.2 Bearing assemblies shall only be dismantled/installed in a clean, dry environment.

H.3 Once dismantled all rolling element bearings which are to be considered for re-use shall be processed in accordance with WHPS 378.

H.4 Installation of bearings during rebuild shall follow the procedures detailed in Appendix G.

FIGURE 1
(Actual size A4)

DYNAMIC ROLLING ELEMENT BEARING QUALITY PLAN APPROVAL SHEET		THIS APPROVAL SHEET SHALL BE PREPARED IN ACCORDANCE WITH WHPS 703 BY THE COMPANY MANUFACTURING THE RELEVANT CATEGORY A1 AND A2 DYNAMIC ROLLING ELEMENT BEARING. IT SHALL BE SUBMITTED ALONG WITH THE QUALITY PLAN FOR APPROVAL	
WESTLAND AGUSTAWESTLAND 	SUPPLIER'S NAME		
SUPPLIER APPROVAL		AGUSTAWESTLAND APPROVAL	
		PRODUCTION ENGINEERING	
		MATERIALS LABORATORY	
		QUALITY	
		WA 3713	