BRITISH STANDARD AEROSPACE SERIES

BS EN
2943:1998

Inserts, screw thread, helical coil, self-locking — Technical specification

The European Standard EN 2943:1998 has the status of a British Standard

ICS 49.030.30

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National foreword

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Summary of pages

This document comprises a front cover, an inside front cover, pages i and ii, the EN title page, pages 2 to 14 and a back cover.

This standard has been updated (see copyright date) and may have had amendments incorporated. This will be indicated in the amendment table on the inside front cover.

Amendments issued since publication

Amd. No.	Date	Comments

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Descriptors: Aircraft industry, screw thread, self-locking screw thread, definition, quality assurance, acceptance testing, specification, characteristic

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Aerospace series — Inserts, screw thread, helical coil, self-locking — Technical specification

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CEN

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Comité Européen de Normalisation
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Ref. No. EN 2943:1998 E

Foreword

This European Standard has been prepared by the European Association of Aerospace Manufacturers (AECMA).

After inquiries and votes carried out in accordance with the rules of this Association, this Standard has received the approval of the National Associations and the Official Services of the member countries of AECMA, prior to its presentation to CEN.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by March 1999, and conflicting national standards shall be withdrawn at the latest by March 1999.

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Contents

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1 Scope

This standard specifies the characteristics, qualification and acceptance requirements for self-locking helical coil screw thread inserts in NI-PH2801 or FE-PA3004, with or without surface coating.

It is applicable whenever referenced.

2 Normative references

This European Standard incorporates by dated or undated reference provisions from other publications. These normative references are cited at the appropriate places in the text and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this European Standard only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies.

ISO 2859-1, *Sampling procedures for inspection by attributes — Part 1: Sampling plans indexed by acceptable quality level (AQL) for lot-by-lot inspection.*

ISO 3353, *Aerospace — Rolled threads for bolts — Lead and runout requirements.*

ISO 3534-1977, *Statistics — Vocabulary and symbols.*

ISO 4288, *Rules and procedures for the measurement of surface roughness using stylus instruments.*

ISO 5855-2, *Aerospace — MJ threads — Part 2: Limit dimensions for bolts and nuts.*

EN 2398, *Heat resisting steel FE-PA92-HT — $R_m \geq 900$ MPa — Bars for machined bolts — $D \leq 25$ mm — Aerospace series*[1)].

EN 2404, *Heat resisting nickel base alloy NI-P100-HT — Solution treated and precipitation treated — Bars — Aerospace series*[1)].

EN 2945, *Aerospace series — Inserts, screw thread, helical coil, self-locking — Assembly procedure*[2)].

EN 3042, *Aerospace Series — Quality assurance — EN aerospace products — Qualification procedure.*

EN 3044, *Aerospace series — Installation holes and procedures for inserts, screw thread, helical coil, self-locking — Design standard*[2)].

3 Definitions

For the purposes of this standard, the following definitions apply:

3.1
batch

quantity of finished thread inserts, of the same type and same diameter, produced from a material obtained from the same melt, manufactured in the course of the same production cycle, following the same manufacturing route and having undergone all the relevant heat treatments and surface treatments

3.2 Surface discontinuities

3.2.1
crack

rupture in the material which may extend in any direction and which may be intercrystalline or transcrystalline in character

3.2.2
seam

open surface defect

3.2.3
lap

surface defect caused by folding over metal fins or sharp corners and then compressing them into the surface

3.2.4
inclusions

non-metallic particles originating from the material manufacturing process. These particles may be isolated or arranged in strings

3.3
test temperature

ambient temperature, unless otherwise specified

3.4
simple random sampling

the taking of n items from a population of N items in such a way that all possible combinations of n items have the same probability of being chosen[3)]

3.5
critical defect

a defect that, according to judgement and experience, is likely to result in hazardous or unsafe conditions for individuals using, maintaining, or depending upon the considered product, or that is likely to prevent performance of the function of a major end item[3)]

[1)] Published as AECMA Standard at the date of publication of this standard

[2)] Published as AECMA Prestandard at the date of publication of this standard

[3)] Definition taken from ISO 3534

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3.6
major defect

a defect other than critical, that is likely to result in a failure or to reduce materially the usability of the considered product for its intended purpose[4)]

3.7
minor defect

a defect that is not likely to reduce materially the usability of the considered product for its intended purpose, or that is a departure from established specification having little bearing on the effective use or operation of this product[4)]

3.8
sampling plan

a plan according to which one or more samples are taken in order to obtain information and possibly to reach a decision[4)]

3.9
limiting quality

in a sampling plan, the quality level which corresponds to the specified 10 % probability of acceptance

3.10
acceptable quality level (AQL)

a quality level which in a sampling plan corresponds to a specified but relatively high probability of acceptance

it is the maximum per cent defective (or the maximum number of defects per hundred units) that, for purposes of sampling inspection can be considered satisfactory as a process average[4)]

3.11
finished thread insert

a thread insert ready for use, inclusive of any possible treatments and/or surface coatings, as specified in the product standard or definition document

3.12
definition document

document specifying all the requirements for finished thread inserts

3.13
self-locking torque

the torque to be applied to the associated bolt to maintain its movement of rotation in relation to the thread insert assembly which is under no axial load and the thread insert locking zone being completely engaged with the bolt (minimum protrusion of two pitches, including the end chamfer)

3.14
seating torque

the tightening torque to be applied to the thread insert and bolt assembly to introduce or to increase the axial load in the assembly

3.15
unseating torque

the untightening torque to be applied to the thread insert and bolt assembly to reduce or remove the axial load in the assembly

3.16
breakaway torque

the torque required to start unscrewing the associated bolt with respect to the installed thread insert, with the insert locking zone still fully engaged on the bolt, but after the axial load in the assembly has been removed by unscrewing half a turn followed by a halt in rotational movement

4 Quality assurance

4.1 Qualification

EN 3042

Qualification inspections and tests (requirements, methods, numbers of thread inserts) are specified in Table 1. They shall be carried out on:

— each type and diameter of thread insert;

— 26 thread inserts selected from a single batch by simple random sampling.

The test programme may possibly be reduced, or the qualification be granted without inspection or testing: any such decision shall be based on the results obtained on similar types and diameters of thread inserts provided that the design and manufacturing conditions are identical.

Table 2 indicates the allocation of thread insert specimens for the inspections and tests.

4.2 Acceptance

4.2.1 *Purpose*

The purpose of acceptance inspections and tests is to check, as simply as possible, by a method representative of actual use conditions, with the uncertainty inherent to statistical sampling, that the thread inserts constituting the batch satisfy the requirements of this standard.

4.2.2 *Conditions*

Acceptance inspections and tests (requirements, methods, numbers of thread inserts) are specified in Table 1. They shall be carried out on each batch. Thread inserts from the batch to be tested shall be selected by simple random sampling.

[4)] Definition taken from ISO 3534

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Each thread insert may be submitted to several inspections or tests.

If a more stringent inspection is deemed necessary, all or part of the qualification inspections and tests may be performed during the acceptance inspection and testing. In this case, the number of thread inserts submitted to these inspections and tests is the same as that submitted for qualification inspection and tests.

4.2.3 *Responsibility*

Acceptance inspections and tests shall be carried out by the manufacturer, or under his responsibility.

4.2.4 *Inspection and test report*

A test report showing actual numerical values shall be provided if specified in the purchase order.

5 Requirements

See Table 1.

Table 1 — Technical requirements and test methods

Clause	Characteristic	Requirement	Inspection and test method	Q/A[a]	Sample size
5.1	**Material**	In accordance with the product standard or definition document	Chemical analysis or certificate of compliance issued by the manufacturer of the semi-finished product	Q	
				A	
5.2	**Dimensions, tolerances and tolerances of form and position**	In accordance with the product standard or definition document	Standard gauging	Q	26
				A	Table 3
5.3	**Manufacturing**				
5.3.1	**Surface roughness**	In accordance with the product standard or definition document	ISO 4288 Visual examination	Q	3
				A	Table 3
5.3.2	**Surface coating**	In accordance with the product standard or definition document	See applicable coating standard.	Q	23
				A	Table 3
5.4	**Mechanical properties**	Thread inserts shall be assembled into test equipment according to EN 2945 (see Table 4).			
5.4.1	**Permanent set test** (ambient temperature)	Measured torques of the thread inserts shall not exceed the maximum self-locking torque nor shall be less than the minimum breakaway torque, see Table 5. When screwing and unscrewing the maximum and minimum mandrels, the rotation of the thread insert in its location shall not exceed ± 90°.	Lubricate the maximum mandrel using clean engine oil. Fit the maximum mandrel in the thread insert, until it protrudes at least two pitches beyond the locking zone of the thread insert, measuring the self-locking torque on screwing. Unscrew, removing the maximum mandrel completely from the thread insert. Carry out the same chronological sequence of operations using the minimum mandrel, measuring the breakaway torque. Check that the mandrel dimensions are within the limits given in Annex A and that their threads have not been damaged. The rotation of the mandrels shall be sufficiently slow so that the temperature of the thread insert does not exceed 45 °C during operations.	Q	3
5.4.2	**Reusability test**	When screwing and unscrewing the bolt, the rotation of the thread insert in its location shall not exceed ± 90°.	Test equipment, see Table 4. Assembly, see Annex B. The self-locking torques shall be recorded for each cycle.		

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Table 1 — Technical requirements and test methods

Clause	Characteristic	Requirement	Inspection and test method	Q/A[a]	Sample size
5.4.2.1	**Self-locking torque at ambient temperature** (15 cycles)	Shall be between the minimum breakaway torque and the maximum self-locking torque, see Table 5, for each cycle,	Lubricate the bolt using clean engine oil. Place the bolt in the spacer, fit the bolt in the thread insert, until it protrudes at least two pitches beyond the locking zone of the thread insert. Unscrew, removing the bolt completely from the thread insert. Screw up again until the bolt protrudes at least two pitches beyond the locking zone of the thread insert, measuring the self-locking torque on screwing. Apply the seating torque to Table 5. Remove the load from the thread insert by unscrewing at least one half turn and until the spacer can be moved freely. Repeat the unscrewing operation, measuring the breakaway torque. Check that the bolt dimensions are within the limits given in Annex C and that their threads have not been damaged. The rotation of the bolts shall be sufficiently slow so that the temperature of the thread insert does not exceed 45 °C during operations. Repeat above a total of 15 times.	Q	10
5.4.2.2	**Self-locking torque at ambient temperature after baking**[b] (five cycles)	Shall be between the minimum breakaway torque and the maximum self-locking torque, see Table 5, for each cycle.	As **5.4.2.1**, except cycles requirement, ***but***, after applying the seating torque and before removing the load, heat the assembly in an oven at the maximum test temperature of the thread insert ± 10 °C for 6 h ± 5 min. Take the assembly out of the oven and let it cool down to ambient temperature. Repeat above a total of five times.	Q	10

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Table 1 — Technical requirements and test methods

Clause	Characteristic	Requirement	Inspection and test method	Q/A[a]	Sample size
5.4.2.3	**Self-locking torque at ambient temperature** (three cycles)	Shall be between the minimum breakaway torque and the maximum self-locking torque, see Table 5, for each cycle.	As **5.4.2.**, except cycles requirement. Repeat above a total of three times.	A	Table 3
5.5	**Metallurgical properties**				
5.5.1	**Surface discontinuities** (before coating or colour marking)	The thread inserts shall be of a uniform appearance, clean, free from cracks, seams, laps, inclusions or any other defects which could impair their performance.	Magnification 8 times to 15 times	Q	26
				A	Table 3
5.5.2	**Material identification**	Finished thread inserts shall be subjected to a non-destructive test to verify the type of material.	The test equipment shall be calibrated by samples of known chemical composition of the same type and form and in the same heat treatment condition as the parts to be tested.	Q	26
				A	100 %
5.6	**Product identification**	Identification in accordance with the product standard or definition document	Visual examination	Q	26
				A	Table 3
5.7	**Packaging**	The thread inserts shall be packaged in such a way as to prevent any damage or corrosion occurring in the course of handling, transportation and storage. Each basic package shall only contain thread inserts with the same part number and batch number, the maximum quantity in a basic package shall be 500. The various basic packages forming part of the same consignment may be combined to form a collective package.	Visual examination	A	100 %
5.8	**Labelling**	Each basic package shall bear a label upon which is legibly recorded: — designation as specified by the product standard or definition document; — quantity; — batch number; — manufacturer's name and trade mark.	Visual examination	A	100 %

[a] Q = Qualification, A = Acceptance
[b] Test temperature from product standard or definition document

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Table 2 — Allocation of qualification testing requirements

Type of test	Defined in	Thread insert sample number																								
Non-destructive																										
Dimensions, tolerances, tolerances of form & position	**5.2**	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Surface roughness	**5.3.1**[a]	X	X	X																						
Surface coating	**5.3.2**				X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Surface discontinuities	**5.5.1**[a]	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Material identification	**5.5.2**	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Product identification	**5.6**	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Destructive																										
Permanent set	**5.4.1**				X	X	X																			
Reusability — 15 cycles at ambient temperature	**5.4.2.1**							X	X	X	X	X	X	X	X	X	X									
— Five cycles after baking	**5.4.2.2**																	X	X	X	X	X	X	X	X	X

[a] Tests to be carried out prior to coating or colour marking.

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Table 3 — Sampling plans

Batch size	Sample size	Acceptance number (Ac) and limiting quality (LQ) in accordance with the acceptable quality level (AQL)			
		Reusability (three cycles) AQL 4 %		All other tests AQL 1,5 %	
		Ac	LQ_{10} %	Ac	LQ_{10} %
≤ 25	5	0	↓	↓	↓
26 to 50	8	↓	↓	↓	25
51 to 90	13	1	27	0	↑
91 to 150	20	2	25	1	↑
151 to 280	32	3	20	1	12
281 to 500	50	5	18	2	10
501 to 1 200	80	7	14	3	8,2
1 201 to 3 200	125	10	12	5	7,4
3 201 to 10 000	200	14	10	7	5,9
10 001 to 35 000	315	21	9	10	4,9
≥ 35 001	500	↑	↑	14	4

↑ Use sampling plan above.

↓ Use sampling plan below.

NOTE The data given in this table are based on single sampling plans for a normal inspection, as specified in ISO 2859-1 (Table II-A and Table VI-A).

NOTE Other sampling plans specified in ISO 2859-1 may be used (double or multiple sampling), but these shall be chosen in such a way as to ensure an equivalent quality level.

NOTE As regards those manufacturers who carry out an inspection during the manufacturing process (inspection on a machine and/or inspection between operations), the sampling plan for the final inspection shall be compiled in such a way that the overall inspection plan shall guarantee an equivalent quality level.

Table 4 — Test equipment

Type of test		Type of test block (Table 6)		Associated test bolt	Mandrels	Spacer
		Thread insert made from NI-PH2801	Thread insert made from FE-PA3004			
Permanent set		B			See Annex A	
Reusability	15 cycles	B	A	See Annex C		See Annex D
	Five cycles after baking	B				
	Three cycles	B	A			

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Table 5 — Values of breakaway torque, self-locking torque and seating torque

Diameter code	Thread	Breakaway torque Nm			Self-locking torque Nm		Seating torque Nm
		min.[a]	min.[b]	min.[c]	max.[d]	max.[e]	[f]
040	MJ4 × 0,7	0,15	0,3	0,18	1,6	3,3	2,8
050	MJ5 × 0,8	0,25	0,5	0,3	2	4	5,5
060	MJ6 × 1	0,35	0,7	0,4	3,2	6,4	9,6
070	MJ7 × 1	0,5	1	0,6	4,6	9,2	16
080	MJ8 × 1	0,65	1,3	0,8	6	12	24
100	MJ10 × 1,25	1,2	2,4	1,4	9,5	19	46

[a] For 15 cycle test, five cycle test and permanent set test
[b] For first cycle of three cycle test
[c] For second and third cycle of three cycle test
[d] For 15 cycle test, three cycle test and permanent set test. Torque values higher than the maximum torque by up to 20 % shall be acceptable for the permanent set test.
[e] For five cycle test
[f] For 15 cycle test, five cycle test and three cycle test

Table 6 — Test blocks

Test block	Material	Hardness	Min. thickness	Installation hole
Type A	Aluminium alloy	130 ≤ HB ≤ 150	L^a + 2 pitches	EN 3044
Type B	Stainless steel	HV 30 ≥ 276		

[a] L = nominal length of thread insert

Annex A (normative)
Definition of maximum and minimum mandrels for the permanent set test

See Figure A.1.

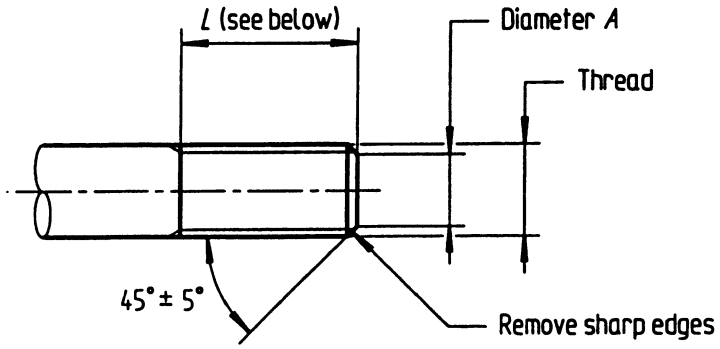

Figure A.1

Material: steel heat treated to HRC ≥ 39

Surface coating: none

Surface roughness: thread flanks 0,8 µm R_a.

Thread: ISO 5855-2, except pitch diameter (see Table A.1). Thread length *L* shall be sufficient to allow fitting of the mandrel with a projection of at least two pitches beyond the locking zone of the thread insert.

Table A.1

Dimensions in millimetres

Diameter code	**Thread**	***A***	**Pitch diameter**				
			nom.		Tol.	Tol.	
		– 0,1 – 0,3	Maximum mandrel	Minimum mandrel[a]		**Half flank angle**	**Pitch**
040	MJ4 × 0,7	2,7	3,53	3,489	0 – 0,01	± 15′	± 0,008
050	MJ5 × 0,8	3,7	4,464	4,42			
060	MJ6 × 1	4,7	5,333	5,279			
070	MJ7 × 1	5,7	6,333	6,279			
080	MJ8 × 1	6,7	7,332	7,279			
100	MJ10 × 1,25	8,7	9,169	9,113			

[a] Values equal to d_2 min. specified in ISO 5855-2 for bolts with a tolerance class of 4h6h

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Annex B (normative)
Assembly for reusability tests

See Figure B.1.

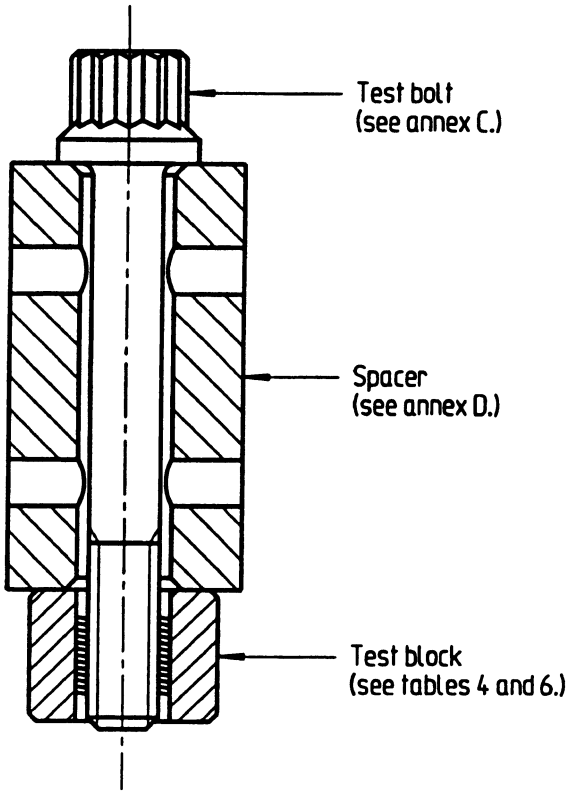

Figure B.1

Annex C (normative)
Definition of test bolt for reusability tests

See Figure C.1.

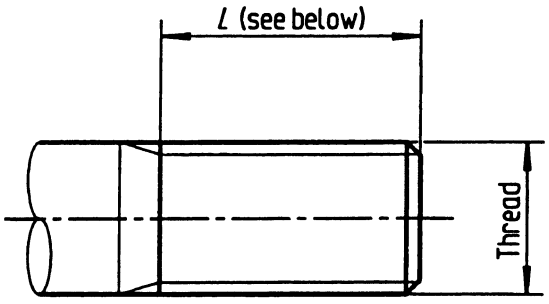

Figure C.1

Material: NI-P100HT to EN 2404 or steel of hardness HV 30 ≥ 334

Surface coating: see Table C.1.

Surface roughness: thread flanks and underhead bearing area 0,8 µm R_a.

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Thread: ISO 5855-2, class 4h6h after coating (where applicable), rolled thread form. Thread length L shall be sufficient to allow fitting of test bolt with a projection of at least two pitches beyond the locking zone of the thread insert.

Thread runout: in accordance with ISO 3353

Head configuration: optional form

Table C.1

Coating	
Thread insert	**Test bolt**
Silver	none
none	Silver

Annex D (normative)
Definition of spacer for reusability tests

See Figure D.1 and Table D.1. Dimensions and tolerances are in millimetres. Values of surface roughness in micrometres.

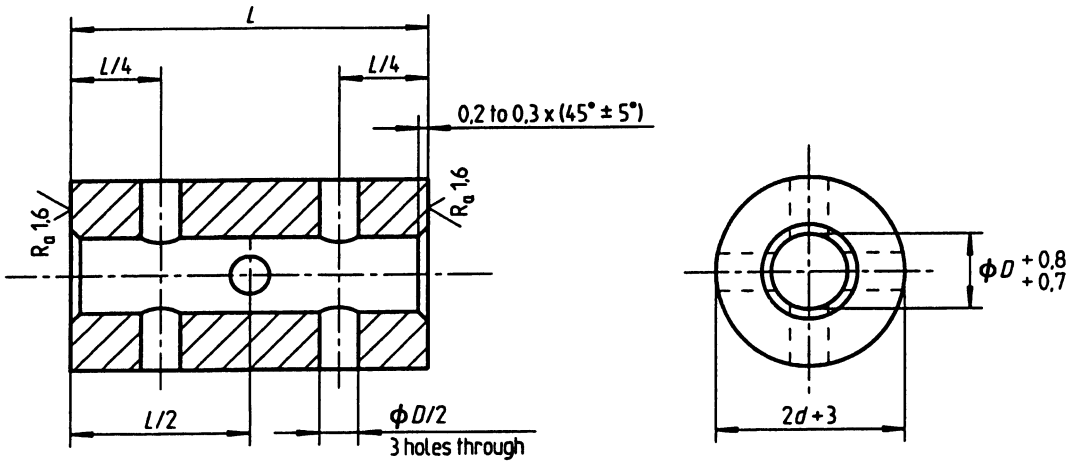

Figure D.1

Material: heat resisting steel FE-PA92HT (A286) to EN 2398

Tolerances: ± 0,5 unless otherwise stated

Table D.1

Diameter code	**Thread** (insert installed)		L^a
	D × pitch	d	
040	MJ4 × 0,7	4	30
050	MJ5 × 0,8	5	
060	MJ6 × 1	6	32
070	MJ7 × 1	7	
080	MJ8 × 1	8	
100	MJ10 × 1,25	10	

[a] For ease of provisioning for bolts (length), spacers may be used with length L equal to D min. For these spacers, the radial drillings are not carried out.

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