

Attachment 2. Eurocopter Standard Practices Guidance

DCA12MA020 Maintenance Factual Report

JOINING
Assembling by bolts and nuts

** Please see
page 3*

1 ASSEMBLING BY BOLTS AND NUTS-GENERAL

- The torques indicated apply to normal tightening of the nut.
- In the very special cases where the bolt is tightened, the maximum torques are still applicable, provided that they are not related to :
 - . close tolerance bolts.
 - . screws with non-hexagonal head ; these screws shall be tightened and checked, without measuring the torque, by means of a normal screwdriver.
- Buckling of several layers of sheet metal shall be taken into account. A first tightening action shall be exerted and then a second tightening to the torque indicated shall be made.

1.1 Tightening procedure (Fig. 1 - DETAIL A)

Unless otherwise specified in each assembly Manual, once the bolts are installed and approximately tightened, the nuts shall be tightened in the numerical order of the sketches.

1.2 Torque loading

1.2.1 Torque check procedure

NOTE 1 : The purpose of the torque check procedure is to check that the torque load on the assembly is not less than the specified minimum torque value.

Torque check as follows :

- Identify the position of the nut relative to the assembly.
- Loosen without separating the assembly components.
- Tighten, until the mark on the nut is aligned with the mark on the assembly, checking that the minimum torque value is reached.

NOTE 2 :

- If the minimum torque value is reached before the marks are aligned, continue tightening until the marks are aligned.
- If the minimum torque value is reached after the marks have been aligned, refer to the recommendations given in the maintenance manuals. If no specific recommendations are given and if the loss of tightening torque is greater than 15% of the minimum torque value, dismantle the coupling and check all parts (fretting). If the loss of tightening torque less than the 15% of the minimum torque value, reapply torque.

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CAUTION : NEVER CHECK A TIGHTENING TORQUE DURING THE LOOSENING PHASE.

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This procedure may lead to maintenance and the replacement of components if the criteria in the maintenance manuals (MET, MMA, MRR) are not complied with.

1.2.2 Readjustment of the torque loading

Readjustment is a maintenance procedure which is performed without checking the torque loading. Proceed as follows :

- Loosen by approximately one quarter of a turn.
- Re-tighten to the value specified in the Maintenance Manual (MET, MMA, MRR).

1.3 Checking torque wrenches and adapters

Torque wrenches and adapters shall be checked every 3 months on appropriate testers.

Tolerance : Calibration shall be true to $\pm 15 \%$, otherwise the wrench must be recalibrated.

NOTE : If calibration of the wrench is checked before each time it is used, the calibration interval is increased to 6 months.

1.3.1 Using adapters

When nuts can be tightened only through an adapter, it is necessary to take some precautions to preclude errors in the application and reading of torque loading.

The adapter shall be normally positioned so that the center of the tightening hexagon or fork is located along the axis of the torque wrench.

- Exceptionally, adapters with offset axis may be used, but the offset angle shall not exceed 15° .
- The adapter shall never be positioned perpendicular to the torque wrench.
- When an adapter is used, the tightening torque to be applied to the nut is not the same as that read on the torque wrench ; it is necessary to determine a correspondence chart between the torque applied and the torque read for each combination of wrench and adapter.

1.4 Criteria for re-using nuts and bolts

1.4.1 Re-using screws, nuts and threaded pins

Each time an externally threaded part is removed it shall be carefully examined. All parts presenting any of the defects defined below, to the thread or calibrated shank is to be rejected and replaced :

- Necking, bending, twisting
- Stripping, scoring
- Wear beyond tolerance limits
- Protective finish damaged
- Pitting.

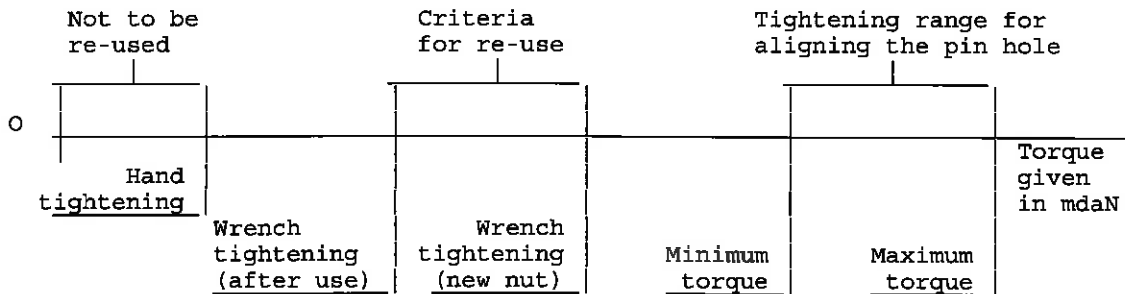
NOTE : Bolts and pins used in close tolerance applications (e.g. H7-p6) in important structural areas should not be re-used more than twice.

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1.4.2 Criteria for re-using dual locking nuts (Inner nylon lock castellated nuts)

Prior to re-using the nuts :

- Make sure nylon lock is not excessively damaged.
- Fit the nut by hand :
 - . if nut can easily be tightened, it is to be discarded
 - . if nut is hard and cannot be tightened by hand, it may be re-used. (In a workshop, the minimum locking torque value can be read using a torque wrench).



1.4.3 Requirements relative to fitting of self-locking nuts, new or already used

1.4.3.1 Particular precautions to be taken before fitting nuts

It is prohibited :

- to clean nuts with phenolic product (Nylstop type nuts)
- to tap a self-locking nut before fitting or re-fitting, whatever the type.

1.4.3.2 Checking procedure for fitting and re-fitting nuts of diameter not exceeding 9.5 mm

CAUTION : RE-FITTING OF SELF-LOCKING NUTS IS :

- PROHIBITED FOR INTERNALLY LINED SELF-LOCKING NUTS
- AUTHORIZED FOR ELLIPTICALLY DEFORMED SELF-LOCKING NUTS, PROVIDING THAT A VISUAL EXAMINATION AND A TORQUE LOADING CHECK ARE PERFORMED.

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Irrespective of the type of self-locking nut used (metal, fiberglass or nylon), it will be tested by screwing on by hand. If the self-locking part engages on screw threads, the nut shall mandatorily be rejected.

1.4.3.3 Checking procedure for fitting and re-fitting nuts of diameter from 10 to 20 mm

Irrespective of the type of self-locking nut used, the minimum torque shall be measured by screwing the nut after its self-locking part has been entirely engaged on screw threads ; however its bearing face shall not be in contact with the component to be secured.

Nut diameter (mm)	Minimum locking torque (m.daN)
10	0.12
12	0.18
14	0.25
16	0.37
18	0.50
20	0.77

1.5 Standard torque loading

1.5.1 General

Only standard torque loading is given in this paragraph. Special torque loading for maintenance is specified when necessary in the Maintenance or Repair Manuals (MET, MMA, MRR).

NOTE : For special torque loading :

- The value of the correcting factor specific to the type of assembly (dry assembly, or assembly with a lubricant or interfay product) is already included in the specified torque load value.
- Therefore, the applicable torque load values are those indicated, plus any locking torque load required for the nut. (See § 1.5.1.1).

1.5.1.1 Locking torque

When the nut is of the self-locking type, its actual locking torque load must be measured to make sure the correct tightening torque load will be applied.

In the documentation, the requirement to measure and add the locking torque load to the tightening torque load is identified by the symbol shown in Figure 1, DETAIL C.

When this symbol is not available, no locking torque load is to be added.

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Locking torque measuring procedure :

- Screw the nut fully onto the screw.
- Continue to screw the nut with a dial-type torque wrench until the dial reads the required torque load.
- The applicable value is the constant load value after the initial application phase and before the mating surface of the nut makes contact with the part to be secured.

The locking torque load is measured to :

- Take this torque load into account when applying the useful torque load.
- Check the nut locking feature before each installation. The nut must be replaced if the locking torque load is outside the required range. When this check is not specified in the documentation, refer to the criteria for re-use of self-locking nuts. (See § 1.4)

1.5.1.2 Torque loading of castellated nuts

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Torque as follows :

- Torque to the minimum torque value.
- Continue tightening beyond the minimum torque value to reach the pin hole, without exceeding the maximum torque value.

NOTE : Never exceed the maximum torque value to align a nut slot with a pin hole.

1.5.2 Applicable torque loading

NOTE : These torques are not applicable to screws with non-hexagonal head.

- The following torques apply to "dry" installation of standard steel and titanium bolts and nuts with ISO threads when no instruction is given on the drawings. They are based on the yield strength of the bolt material and are applicable to all categories and grades of standard nuts. The values are given in "metre-decanewtons" (m.daN).
- Therefore, the applicable torque load values are those indicated, plus any locking torque load required for the nut. (See § 1.5.1.1).

Table 1-Torque values applied in "dry" condition (in metre-decanewtons (m.daN))

These torque values apply to ISO M and ISO MJ hardware.

Threads		With hexagonal nut Cadmium-plated steel bolt				With self-locking nut Cadmium-plated steel bolt			
Diame- ter	Pitch	35 NC6		30 NCD 16		35 NC 6		30 NCD 16	
		TS :		TS :		TS :		TS :	
		880-1080Mpa		1080-1220Mpa		880-1080Mpa		1080-1220Mpa	
		min.	max.	min.	max.	min.	max.	min.	max.
4	0.7	0.2	0.25	0.25	0.3	0.25	0.3	0.3	0.35
5	0.8	0.3	0.4	0.4	0.5	0.4	0.5	0.5	0.6
6	1	0.6	0.75	0.75	0.9	0.75	0.9	0.9	1.1
7	1	1	1.25	1.25	1.50	1.25	1.50	1.50	1.75
8	1 and 1.25	1.5	1.9	1.9	2.3	1.9	2.3	2.3	2.7
10	1.25 and 1.50	3.4	4.1	4.1	4.8	4.1	4.8	4.8	5.5
12	1.25 and 1.50	6.3	7.5	7.3	8.5	7.3	8.5	8.3	9.5
14	1.50	10	12	11.5	13.5	11.5	13.5	13	15
16	1.50	16	19	18	21	18	21	20	23

NOTE : For Nylstop and slotted nuts, the torque loading value is determined by the Design Office and noted on work cards.

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NOTE : "Dry" condition means without lubricant (or sealing compound) on the threads or bearing surfaces.
The use of such products requires the application of a compensating coefficient to the "dry" values : see para. 1.7.

Table 2 : Torque values applied in "dry" condition for ISO bolts and nuts (inch) in metre-decanewtons (m.daN).

NOTE : Application requirements are the same for BNAE standard metric bolts.

THREADS		STANDARD NUTS				SELF-LOCKING NUTS			
Diameter	Qty of threads per inch	S T E E L B O L T				S T E E L B O L T			
		35 NC 6		30 NCD 16		35 NC 6		30 NCD 16	
		TS : 88 hbar YS 0.002 73 hbar		TS : 108 hbar YS 0.002 88 hbar		TS : 88 hbar YS 0.002 73 hbar		TS : 108 hbar YS 0.002 88 hbar	
		mini.	maxi.	mini.	maxi.	mini.	maxi.	mini.	maxi.
.190 (No.10)	32	0.30	0.40	0.40	0.50	0.40	0.50	0.50	0.60
.2500 (1/4)	28	0.70	0.90	0.90	1.10	0.90	1.10	1.10	1.30
.3125 (5/16)	24	1.60	2.00	2.00	2.50	1.80	2.20	2.20	2.70
.3750 (3/8)	24	2.70	3.50	3.30	4.00	3.00	3.80	4.00	5.00
.4375 (7/16)	20	4.50	5.50	5.50	7.00	5.20	6.30	6.70	8.00
.5000 (1/2)	20	7.30	8.50	8.50	10.00	8.00	9.50	9.50	11.50
.5625 (9/16)	18	10.50	12.50	11.50	13.50	11.50	13.50	14.00	16.00
.6250 (5/8)	18	14.00	16.00	17.00	20.00	16.00	19.00	19.00	22.00
.7500 (3/4)	16	24.00	28.00	28.00	32.00	27.00	31.00	32.00	37.00

Table 3 : Dry torque loading (mdaN) for titanium alloy bolts and nuts

NOTE : T-A6V titanium alloy bolts are supplied lubricated with molybdenum disulfide (Air 4223). No other lubricating material shall be applied on assembly.

THREADS		Annealed T-A6V Bolt - Protective treatment : Sulfuric anodizing + MoS2 lubrication TS = 880-1130 MPa			
		STANDARD NUT Cadmium-plated alloy steel (unlubricated)		SELF-LOCKING NUT Cadmium-plated alloy steel + MoS2 lubrication	
Diameter	Pitch	min.	max.	min.	max.
4	0.7	0.13	0.16	0.18	0.21
5	0.8	0.27	0.32	0.37	0.42
6	1	0.46	0.55	0.66	0.75
7	1	0.75	0.9	1	1.15
8 (ISO M)	1.25	1.1	1.3	1.5	1.7
8 (ISO MJ)	1	1.1	1.3	1.5	1.7
10 (ISO M)	1.50	2.2	2.6	2.9	3.3
10 (ISO MJ)	1.25	2.2	2.6	2.9	3.3
12 (ISO M)	1.50	4	4.8	5	5.8
12 (ISO MJ)	1.25	4	4.8	5	5.8
14	1.50	6.5	7.5	8	9
16	1.50	9.5	11.5	11.5	13.5

Torque load on INCONEL 718 screws : The torque loading value is determined by the Design Office and noted on the drawing.

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1.5.3 Torque loading values for slotted nuts

Thick nuts P/N 22451BCL

Thin nuts P/N 22453BCL

- The following torque values, applicable to "dry" installation of 35 NC 6 steel screws and nuts, are specified in metre-decanewtons (m.daN).

THREAD Dia & pitch	Thin nut Ref. 22453BCL		Thick nut Ref. 22451BCL	
	Min.torque	Max.torque	Min.torque	Max.torque
5 x 0.80	0.15	0.30	0.20	0.40
6 x 1.00	0.35	0.55	0.45	0.75
7 x 1.00	0.45	0.95	0.50	1.20
8 x 1.25	0.55	1.35	0.80	1.80
10 x 1.50	1.10	2.80	1.90	4.00
12 x 1.50	1.90	4.60	3.60	7.30
14 x 1.50	3.80	7.60	5.90	11.80

1.5.4 Torque loading values for double-locked slotted nuts

Thick nuts P/N 52347 BCL

Thin nuts P/N 52346 BCL

 - The following torque values, applicable to "dry" installation of 35 NC 6 steel screws and nuts, are specified in metre-decanewtons (m.daN).

THREAD Dia. & pitch	Thin nuts Ref. 52346 ... BCL		Thick nuts Ref. 52347 ... BCL	
	Min.torque	Max.torque	Min.torque	Max.torque
5 x 0.8	0.20	0.35	0.30	0.50
6 x 1	0.45	0.65	0.60	0.90
7 x 1	0.60	1.10	0.80	1.50
8 x 1.25	0.80	1.60	1.30	2.30
10 x 1.5	1.60	3.30	2.70	4.80
12 x 1.5	2.80	5.50	4.80	8.50
14 x 1.5	5.20	9.00	7.60	13.50

1.5.5 Selected Alloy Grades for Bolts

35 NC 6 : T.S. 88 hbar minimum YS 73 hbar minimum

30 NCD 16 : T.S. 108 hbar minimum YS 88 hbar minimum

T.A4M : T.S. 93 hbar minimum YS 83 hbar minimum

T.A6V : T.S. 88 hbar minimum YS 82 hbar minimum

Torque values are effective for all steel grades with the same mechanical properties. If properties are different, torque values shall be proportional to yield strength.

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1.5.6 Identification of hardware material, see work card 20.02.05.103

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1.6 Torque loading values for hardware in metal or NOMEX sandwich construction panels

Unless otherwise indicated on the work card, for all assembling in flat sandwich structure panel plain holes, the torque loading value shall be 50 % of the standard value given in paragraph 1.5.2.

1.7 Requirements for applying products to threaded assembling components
(Table 4 below)

- Bolts, nuts and washers : cadmium-plated.
- Threads : machined or rolled.
- Threads and bearing surfaces : clean.
- Torque loading : applied to the nut.
- When a grease or a product is used, the new torque loading value is obtained by multiplying the "dry" torque loading value by the correction factor for the product used.
e. g. : grease (correction factor : 0.55)
Minimum standard dry torque loading value : 4.10
Torque loading value to be applied : $4.10 \times 0.55 = 2.25 \text{ m.daN}$.

IMPORTANT NOTES : - THESE CORRECTION FACTORS ARE NOT TO BE APPLIED TO SELF-LOCKING NUTS.

- TALLOW IS PROHIBITED FOR INSTALLING HARDWARE

When sealing product has been applied, the torque value is to be checked within the 4 hours following application of the product (PR 1436 or 1321). In all cases, the curing time of the product has to be taken into account, in order to preclude errors in the application of the torque loading

NOTE : - As Mastinox and Loctite products are not lubricants, they do not have correcting factors: Use the dry torque load values. R
- As T-A6V screws are originally lubricated with Moss2, no lubricating products must be used, unless otherwise specified on the drawing. R
- Correcting factors do not apply to nylon or fiber lock nuts, which must be fitted dry. R

CAUTION : DO NOT USE A PRODUCT THAT IS NOT LISTED IN THE FOLLOWING TABLE. R

Greases and products - Correction factors

AIR STANDARD	NATO CODE	TYPE OR USE OF PRODUCT	Trade-Mark	MANUFACTURER'S REFERENCE	FACTOR	
3565A	S.743	Pure mineral petrolatum for electrical bonding	NYCO	Vaseline NYCO 65	0.75	R R
4205B	G.359	Mineral base grease	SHELL	Aeroshell grease 5	0.50	R R
4206B	G.355	Graphited mineral base grease	NYCO	NYCO grease GNO6	0.40	R R R R
4207A	G.361	Wide temperature range grease. Ester type extreme pressure.			0.55	R R R R
4210B	G.354	Low freezing point grease. Ester type "extreme pressure"	SHELL	Aeroshell grease 7A	0.50	

Greases and products - Correction factors (Cont'd)

AIR STANDARD	NATO CODE	TYPE OR USE OF PRODUCT	Trade-Mark	MANUFACTURER'S REFERENCE	FACTOR	
4215B	G.382	General purpose mineral grease	SHELL	Aeroshell Grease 6B	0.50	R R R R
4222 (superse- des 4217)	G.395	Synthetic hydrocarbon greases	SHELL	Aeroshell Grease 22	0.50	R R
4247A	S.720	Graphited mineral base petrolatum			0.50	R R

OTHER PRODUCTS

Sealant	None	Polysulfide sealing compound	LE JOINT FRANCAIS	PR 1829 B2 PR 1773 B2 PR 1771 B2	1.60	
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1.8 Torque marking on nuts and bolts (Fig. 1 - DETAIL B) R

- Torque MARKING by a RED LINE is now optional for special and standard torque loadings.
- Marking shall henceforth be done only if specified by the Aérospatiale Design Office or Production Department.
- This marking is now applicable to all nuts and bolts regardless of the type of locking method used (split pin, lockwire, internal locking, elliptical deformation) and regardless of the torque loading (standard or special).

1.8.1 Marking of internally lined or elliptically deformed self-locking nuts R

NOTE : The method described below is applicable to all initially marked nuts which are removed for servicing operations (Removal - Repair - Installation of assemblies or subassemblies secured by nuts).

1) On assembly :

- Apply specified torque loading.

2) After assembly and tightening to the specified torque :**a) Hexagonal nut :**

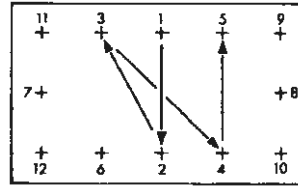
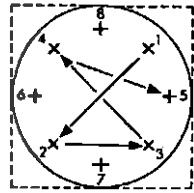
- Mark the nut position with a red paint line (approx. 2 mm wide) on tip of bolt, nut, washer and a fixed component.

b) Anchor nut :

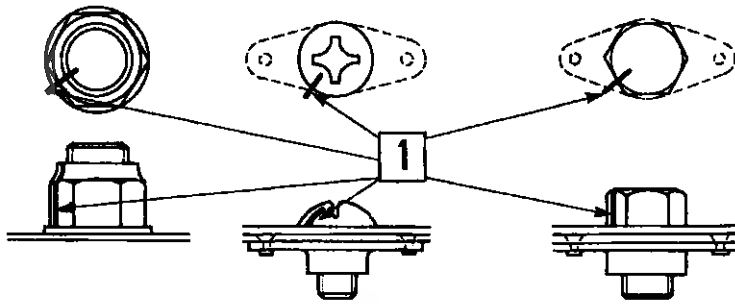
- Mark the bolt position with a red paint line (approx. 2 mm wide) on bolt head, washer (if any) and a fixed component.

CAUTION : EXCEPT AFTER STAKING, THE BOLT, ONCE TIGHTENED, SHALL EXTEND FROM THE NUT BY AT LEAST ONE THREAD (DISREGARDING THE END CHAMFER OF THE BOLT), UNLESS OTHERWISE SPECIFIED BY THE DESIGN OFFICE.
IN THE CASE OF A SELF-LOCKING NUT, THE BOLT SHALL PROTRUDE BY ONE THREAD BEYOND THE LOCKING LINER.

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