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| **Page** | **Attachments:** | **Printed version:** |
|---|---|---|

# Bolted joints
## production standard
## valid for Viper SD-4 RTC and Viper SD-4 NVFR

## VP 07-2014 / AOT

Index



| **Amendments:** | Rev.01: torque for brake tube nuts added, wire ensuring method added |
|---|---|
| | Rev.02: Beringer landing gear and brakes option added |
| | |

| | |
|---|---|
| **Valid from:** 24.SEP 2021<br>**Valid until:** | **Released:**<br>**Reg. Mk. / LU : K.16 / DPL** |
| **Created:** Ing. Ondrej Koločík<br>**Date:** 23.SEP 2021<br>**Endorsed:** Ing. Martin Mihalko<br>**Date:**<br>**Validated:** Ing. Slavomír Dobrovič<br>**Date:** | **Distribution list:** |

## 1.0. General information

Bolts and nuts are the most commonly used fasteners, because they create simple, reliable and easy demountable joints. They are used to join one or more parts or to adjust their relative position in various mechanic constructions.

To create a high quality bolted joints it is necessary to observe a few rules, mostly to use an accurate torque for its tightening and to use the suitable locking mechanism to keep the joints from coming loose.

## 2.0. Tightening of bolted joints

Torque required for firm tightening of bolt and nut is created by hand or by electric or pneumatic torque wrench. This has the definitive influence on the quality of bolted joint.

To create an accurate torque it is necessary to observe a few rules:

1. Proper identification of material and property class of the fastener (bolt and nut). When tightening, it is necessary to put emphasis on the component with lower strength.

    - structural steel

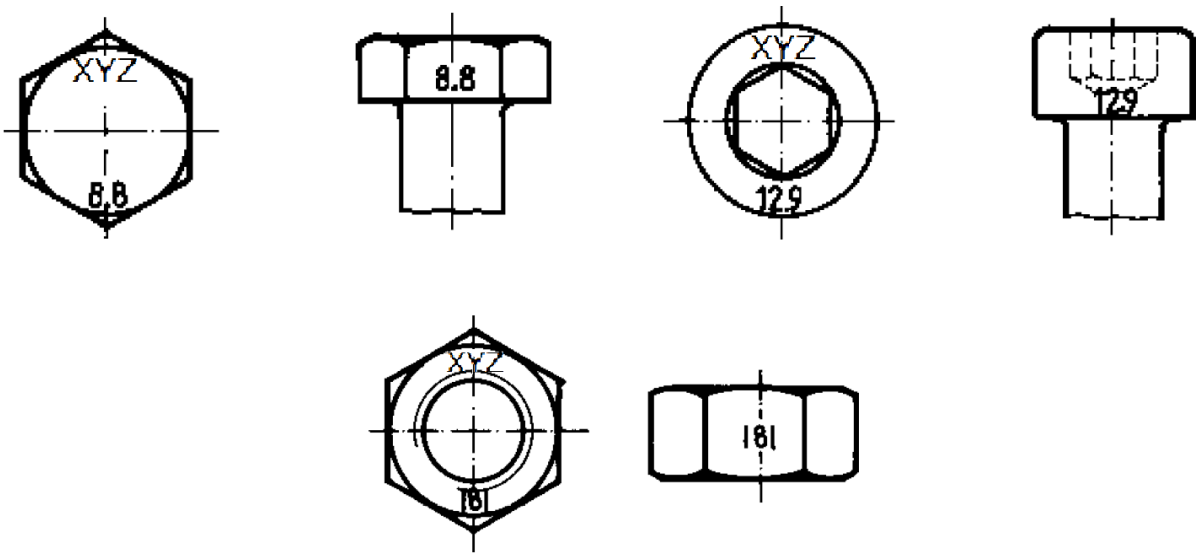
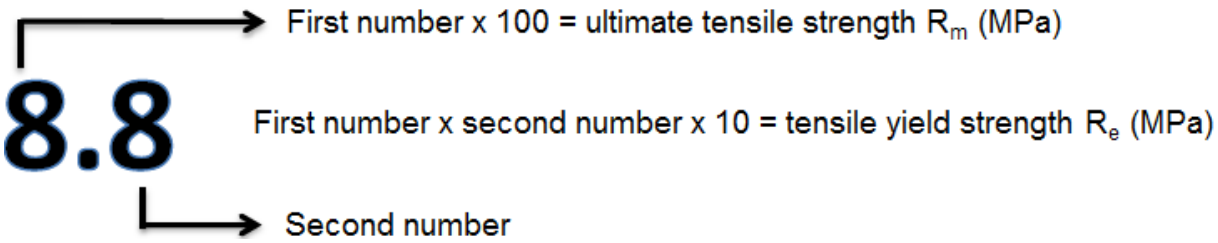



**Fig. 1 - Structural steel bolts and nuts labels**

5.8, 8.8, 10.9, 12.9 – bolt property class
5, 8, 10, 12 – nut property class
XYZ – manufacturer brand




- austenitic stainless steel

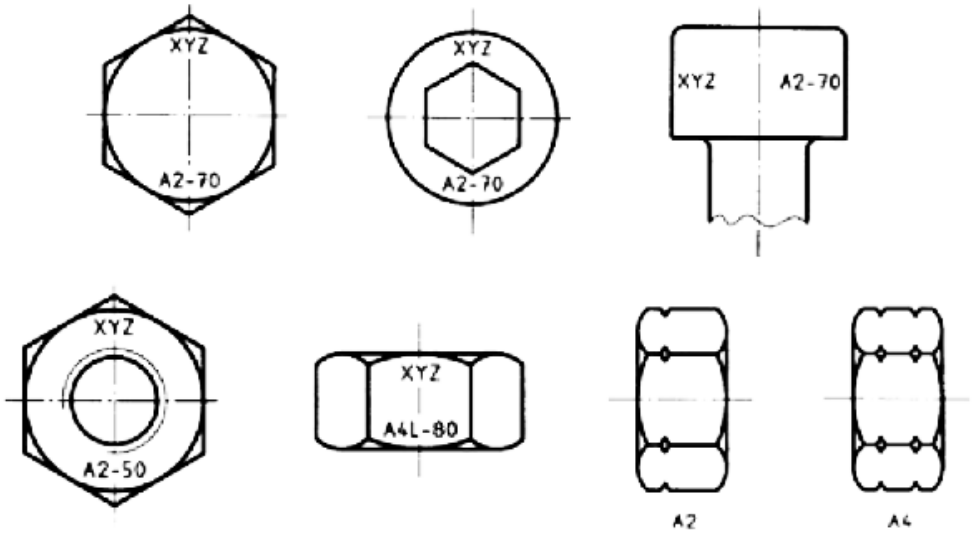



**Fig. 2 – Austenitic stainless steel bolts and nuts labels**

A1, A2, A3, A4, A5 – austenitic stainless steel grade
50, 70, 80 – bolt and nut property class
XYZ – manufacturer brand

2. Set the ratchet or spanner extension to correct position and adjust required torque value (Nm) with mechanism on the handle. Tighten the joint. Acoustic or haptic signal announces the achievement of required torque. After using it is necessary to release the inner spring by adjusting the wrench torque to the lowest value.

**CAUTION: When tightening the bolted joints, use only calibrated manually operated torque wrenches. Never use impulse wrenches.**

3. When components are joined with more bolted joints, tightening procedure depends on the joint layout. Proceed as shown in the Fig.

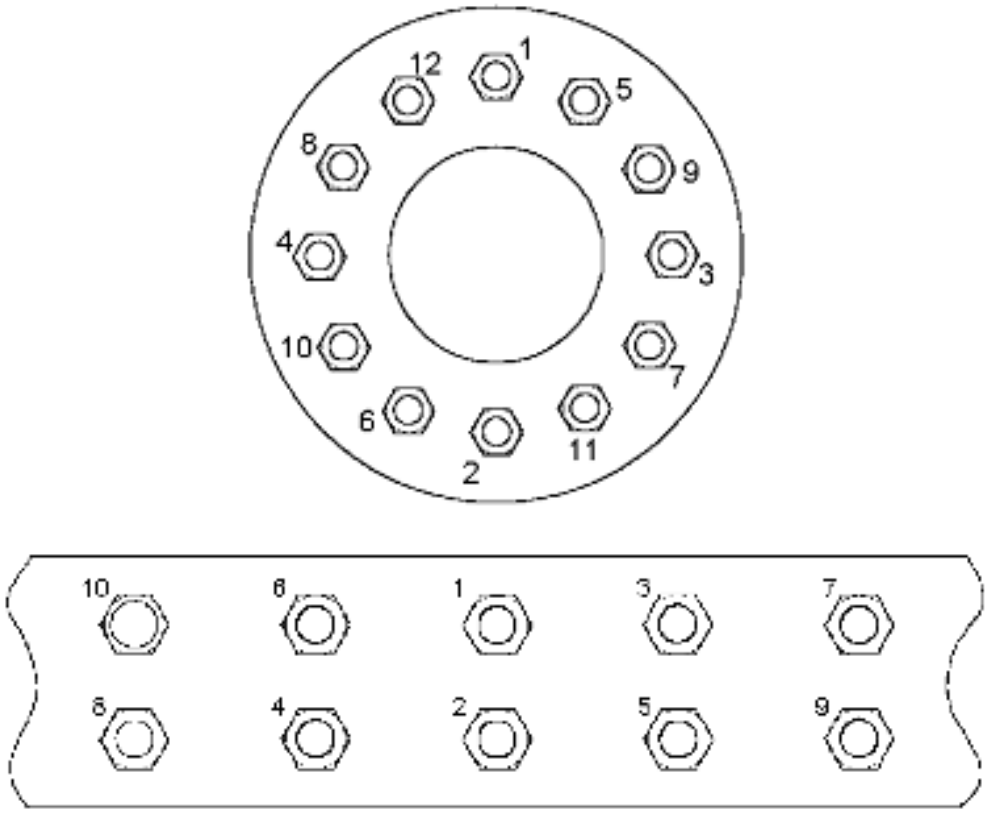



**Fig. 3 - Circular and linear layout of bolted joints**

**CAUTION: When using the washers, avoid falling and locking of the washer in the root of the bolt thread.**

**4.** After potential demounting of any type of self-locking nut never use this nut again. It is necessary to change it by a new one, with the same properties. When demounting the crown nut, it is necessary to change the cotter pin by a new one, with the same properties.

## 3.0. Torque specification

Unless particular value in technological process, manufacturer´s manual or this document is not mentioned, it is necessary to tighten the bolted joints by torque listed in table below.

| ISO metric thread | ISO thread pitch (mm) | Torque (Nm) for structural steel property class | | | | | |
|---|---|---|---|---|---|---|---|
| | | 8.8 / 8 | | 10.9 / 10 | | 12.9 / 12 | |
| | | min | max | min | max | min | max |
| **M3** | 0,5 | 1.1 | 1.6 | 1.4 | 2.2 | 1.7 | 2.6 |
| **M4** | 0,7 | 2.5 | 3.7 | 3.7 | 5.3 | 4.0 | 5.7 |
| **M5** | 0,8 | 5.0 | 7.4 | 7.2 | 106 | 8.0 | 11.6 |
| **M6** | 1 | 8.4 | 12.4 | 12.1 | 17.8 | 13.5 | 19.5 |
| **M8** | 1,25 | 20 | 30 | 29 | 43 | 33 | 47 |
| **M10** | 1,5 | 41 | 60 | 59 | 85 | 65 | 94 |
| **M14** | 2 | 112 | 168 | 161 | 240 | 182 | 265 |
| **M22** | 2,5 | 500 | 705 | 675 | 989 | 750 | 1080 |

| ISO metric thread | ISO thread pitch (mm) | Torque (Nm) for austenitic stainless steel property class | | | | | |
|---|---|---|---|---|---|---|---|
| | | 50 | | 70 | | 80 | |
| | | min | max | min | max | min | max |
| **M3** | 0,5 | 0,85 | 1,25 | 1 | 1,35 | 1,3 | 1,85 |
| **M4** | 0,7 | 0,8 | 1,5 | 1,7 | 3 | 2,3 | 4,1 |
| **M5** | 0,8 | 1,6 | 2,8 | 3,4 | 6,1 | 4,6 | 8 |
| **M6** | 1 | 2,8 | 4,8 | 5,9 | 10,4 | 8 | 13,9 |
| **M8** | 1,25 | 6,8 | 11,9 | 14,5 | 25,5 | 19,3 | 33,9 |
| **M10** | 1,5 | 13,7 | 24 | 30 | 51 | 39,4 | 69 |
| **M14** | 2 | 37,1 | 66 | 79 | 141 | 106 | 188 |
| **M22** | 2,5 | 148 | 272 | 318 | 582 | 424 | 776 |

**1Mkg = 9.81 Nm** (1 Mkg = 10 Nm) **1Nm = 0,102 Mkg** (1 Nm = 0.1 Mkg)

When tightening the joints with nylon insert lock nut it is necessary to use more torque, because overcoming of the resistance between the bolt thread and nylon ring is needed. That's why the torque close to the upper limit of permitted range is required.

**CAUTION: Never exceed the maximum allowed torque to avoid damaging of the thread.**

When tightening the joints with crown nut it is necessary to use the torque close to the lower limit of permitted range. If there is no way to put the cotter pin through the nut and bolt, turn the nut backwards as needed (1/6 of turning max.), so that the middle of the nut cut-out and the cotter pin opening in the bolt mate together.

# 4.0. Locking mechanisms to keep the joints from coming loose

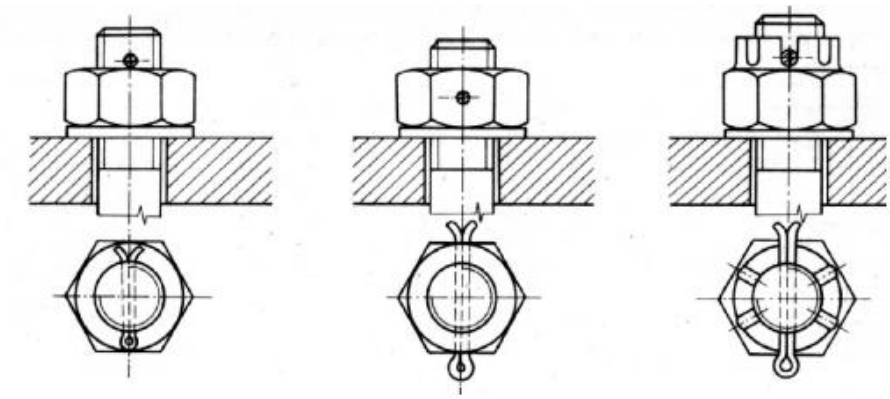
During the dynamic load of unsecured bolted joints this joint can be released when unloaded for a moment. This can be prevented by locking of the nut or bolt. Locking can be mechanical, frictional or by material contact.

Mark the position of all bolted joints with red sealing varnish after the locking.

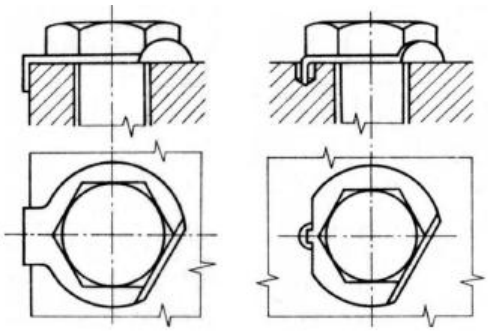

## 4.1. Mechanical locking

Releasing of nut or bolt is mechanically avoided.

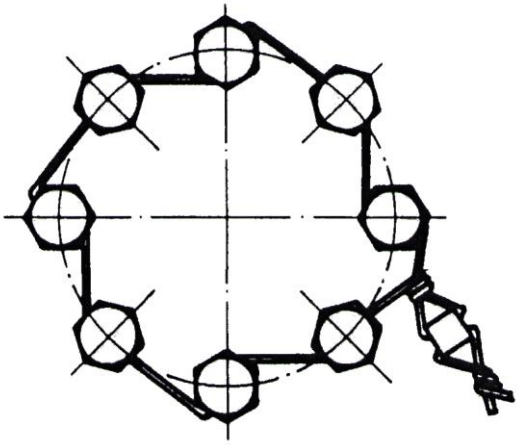
- Cotter pin



- Tab washer



- Wire

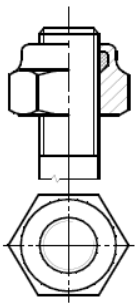


- drag the required wire through the hole in the bolt head, so that the pull of the wire works against the ensuring point or the neighbouring bolt head, always in tightening direction

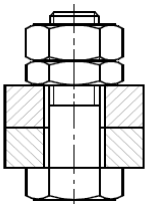
## 4.2. Frictional locking

Releasing of nut or bolt is avoided by friction on the thread or by friction between the nut and components.

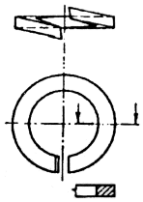
- Self-locking nut



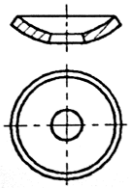
- Jam nut



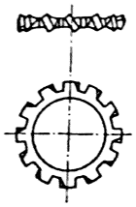
- Spring washer



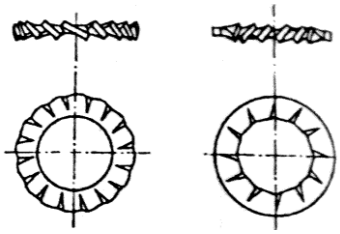
- Belleville washer



- Toothed washer



- Fan disc washer



## 4.3. Locking by material contact

- Cements
- Adhesives


- Welding
- Soldering

## 5.0. Specified bolted joints on Viper SD-4

List of bolted joints with exactly specified values of torque:

| Application of joint | Thread | Torque |
|---|---|---|
| Installation of the Kaspar main landing gear wheel axle | M14, M22 | 40 Nm |
| Installation of the Kaspar front landing gear wheel axle | M8 | 22 Nm |
| Installation of the Kaspar brake tube swivel nuts | M8x1 | 8-10 Nm |
| | | |
| Installation of the Beringer main landing gear wheel axle | M6 | 10 Nm |
| Installation of the Beringer main landing gear wheel axle (lock with the cotter pin) | M25 | 25 Nm |
| Installation of the Beringer front landing gear wheel axle | M8 | 12 Nm |
| Installation of the Beringer brake tube banjo bolts | M10x1 | 17 Nm |
| | | |
| Installation of the aileron steering lever onto the aileron steering tube | M6 | lightly by hand |
| Assembling of the main wing spar | M5 | 6 Nm |
| | | |
| Installation of the main wing spar into the fuselage | M10 | 45 Nm |
| Installation of the rear wing spar into the fuselage | M8 | 20 Nm |
| | | |
| Installation of the rescue system rope (1xfront) onto the fuselage | M10 | 15 Nm |
| Installation of the rescue system rope (2xmain) onto the fuselage | M10 | 15 Nm |
| | | |
| Installation of the auxiliary engine mount assembly (upper attachment points) onto the engine | M10 | 40 Nm |
| Installation of the water inlet elbow | M6 | 10 Nm |
| Installation of the auxiliary engine mount assembly (lower attachment points) and radiator holders onto the engine | M10 | 40 Nm |
| Installation of the oil cooler inlet and outlet elbows | M14, M22 | 22 Nm |
| Installation of the oil tank inlet and outlet elbows | 3/4´´ | 25 Nm |
| Installation of the oil return line connector | M16 | 30 Nm |
| Installation of the fuel pressure gauge | M10 | 10 Nm |
| Installation of the fuel distributor | M10 | 10 Nm |
| Installation of the fuel flow gauge fittings | 1/4´´ | 30 Nm max. |
| Installation of the gascolator inlet and outlet elbows | 1/4´´ | 16 Nm max. |
| Installation of the exhaust tubes onto the engine | M8 | 15 Nm |
| | | |
| Installation of Neuform CR3-65-(IP)-47-101,6 propeller | M6 | 10 Nm |
| Installation of Neuform CR3-65-(IP)-47-101,6 propeller | M8 | 27 Nm |
| Installation of DUC Flash-R H-FSH 3-D-R I propeller | M8 | 25 Nm |

**CAUTION: No self-locking nuts shall be used on any bolt subject to rotation in operation unless a nonfriction locking device is used in addition to self-locking device.**

When locking the crown nut with cotter pin, it is necessary to put the cotter pin through the nut and bolt, to shorten the ends of the pin and to bend them. Bending of the ends of the cotter pin can be provided by two methods, as shown on the Fig. below.

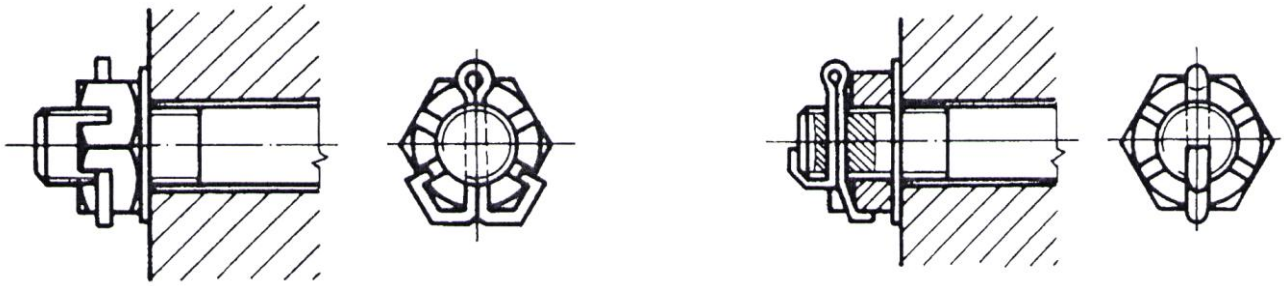


**Fig. 4 – Methods of the crown nut with cotter pin locking**

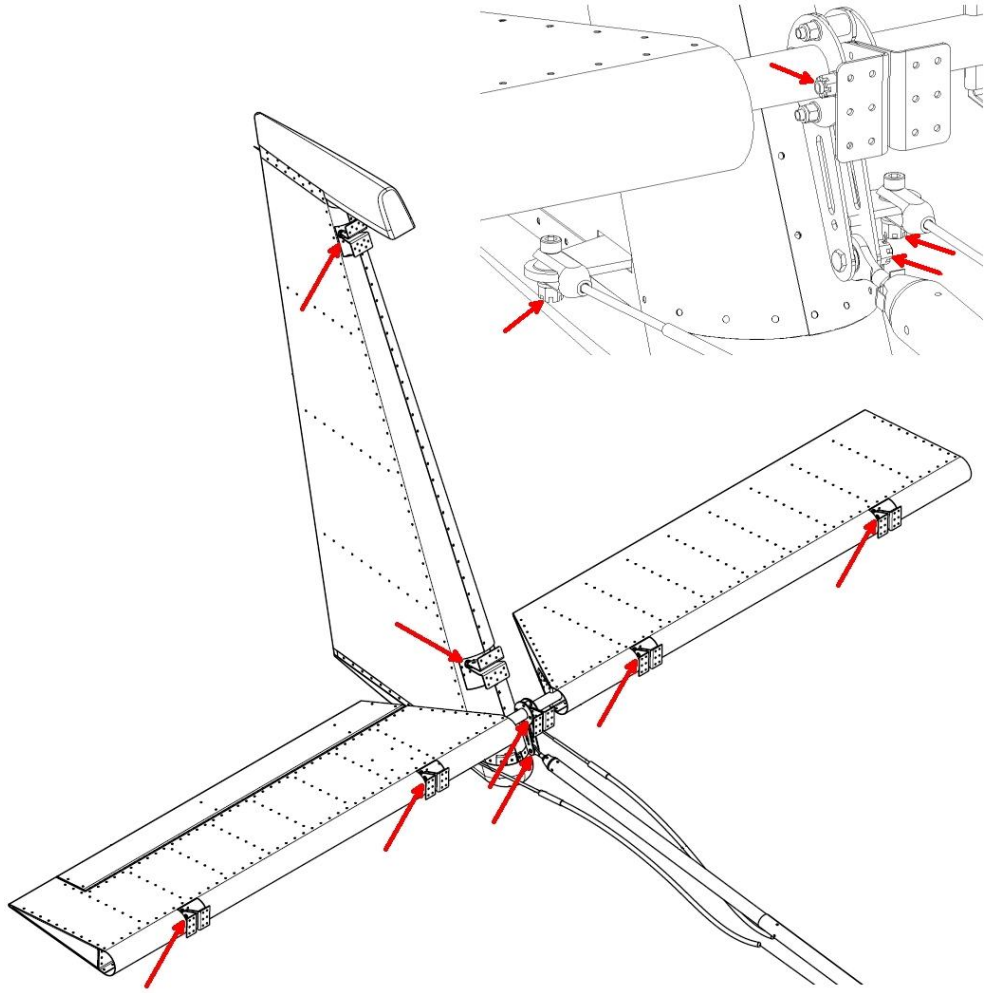


**Fig. 5 – Joints with the crown nut and cotter pin used on the elevator and rudder attachment points and control system**

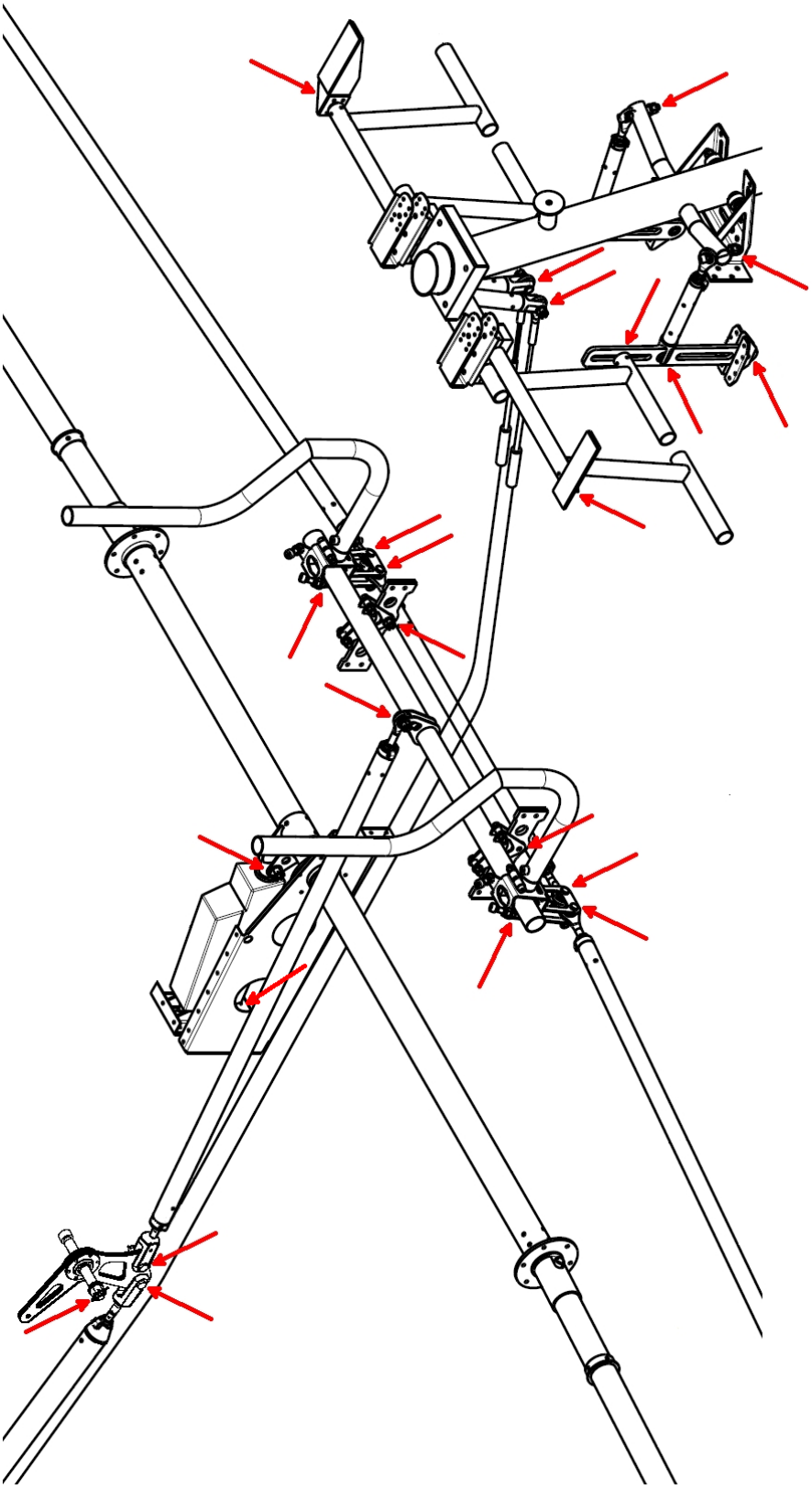


**Fig. 6 - Joints with the crown nut and cotter pin used in the control system in the fuselage**

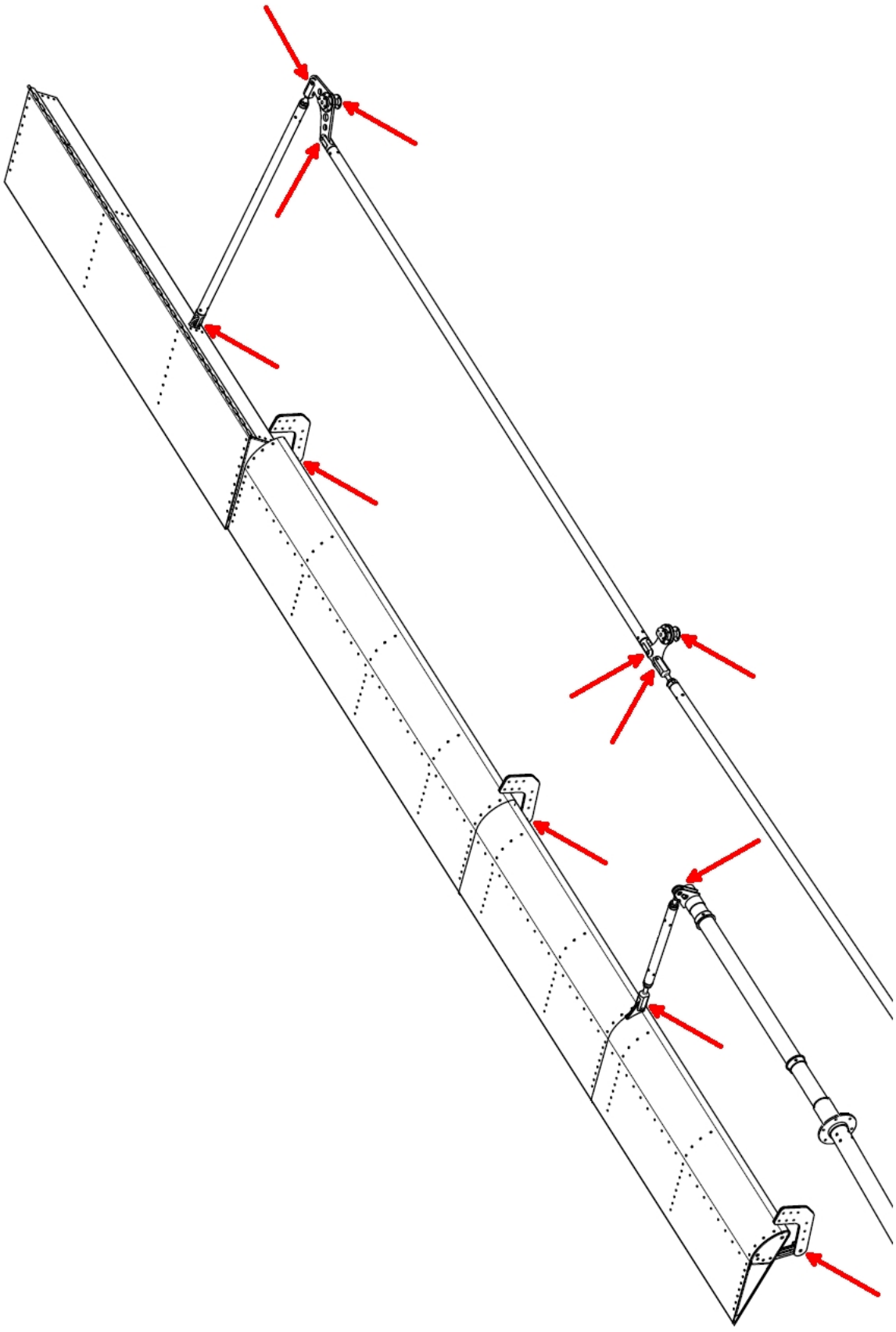


**Fig. 7 - Joints with the crown nut and cotter pin used in the aileron and flap control system in the wing**

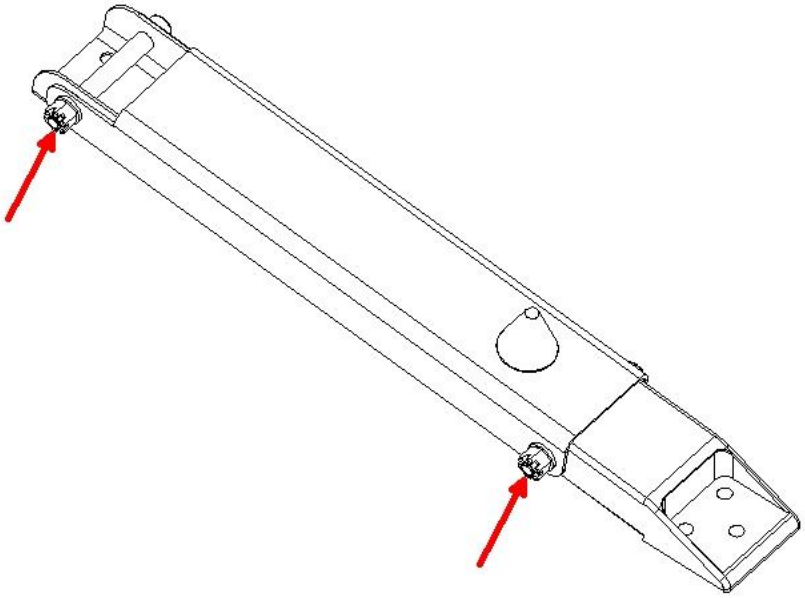


**Fig. 8 - Joints with the crown nut and cotter pin used on the canopy hinge**

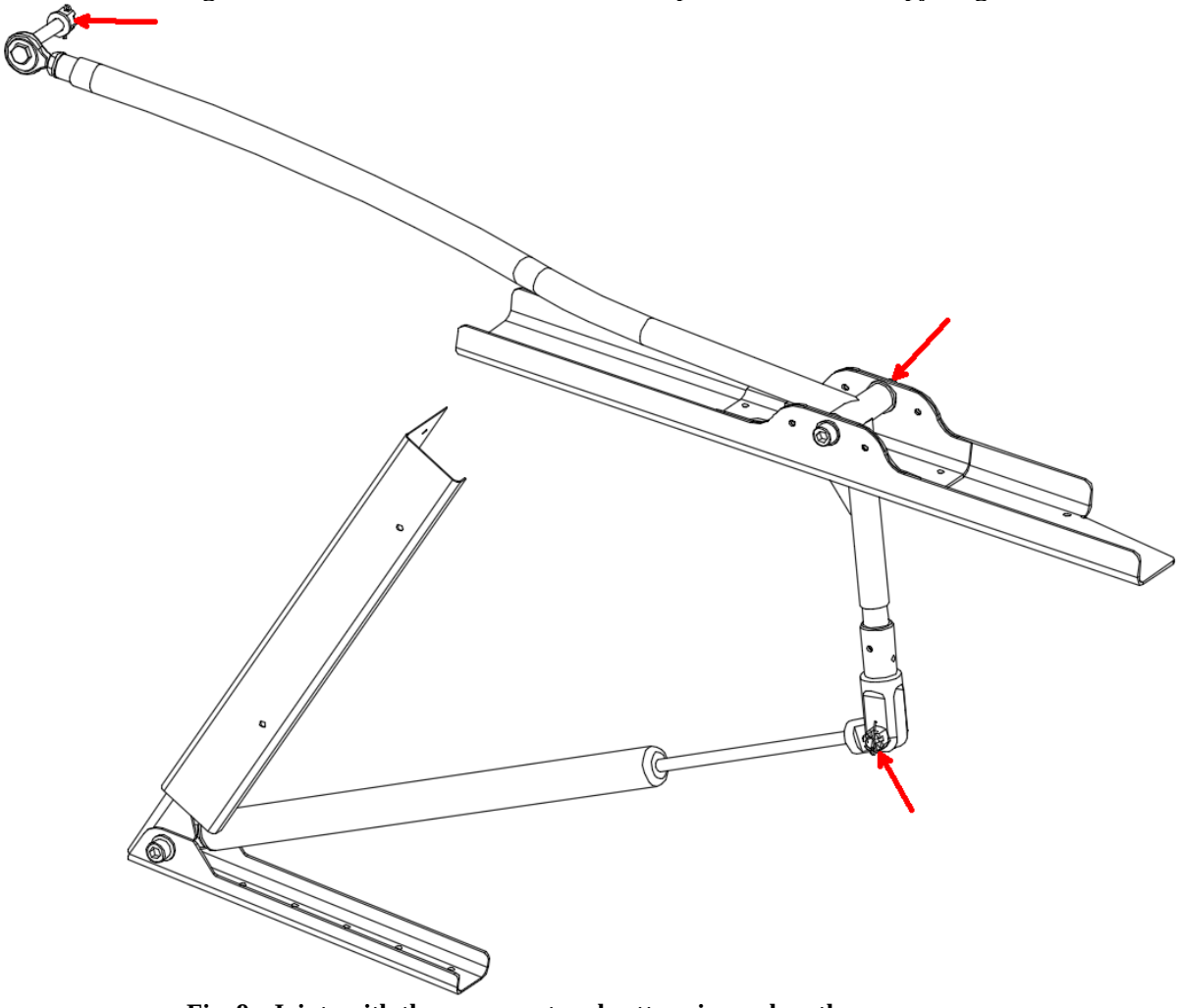


**Fig. 9 - Joints with the crown nut and cotter pin used on the canopy arm**

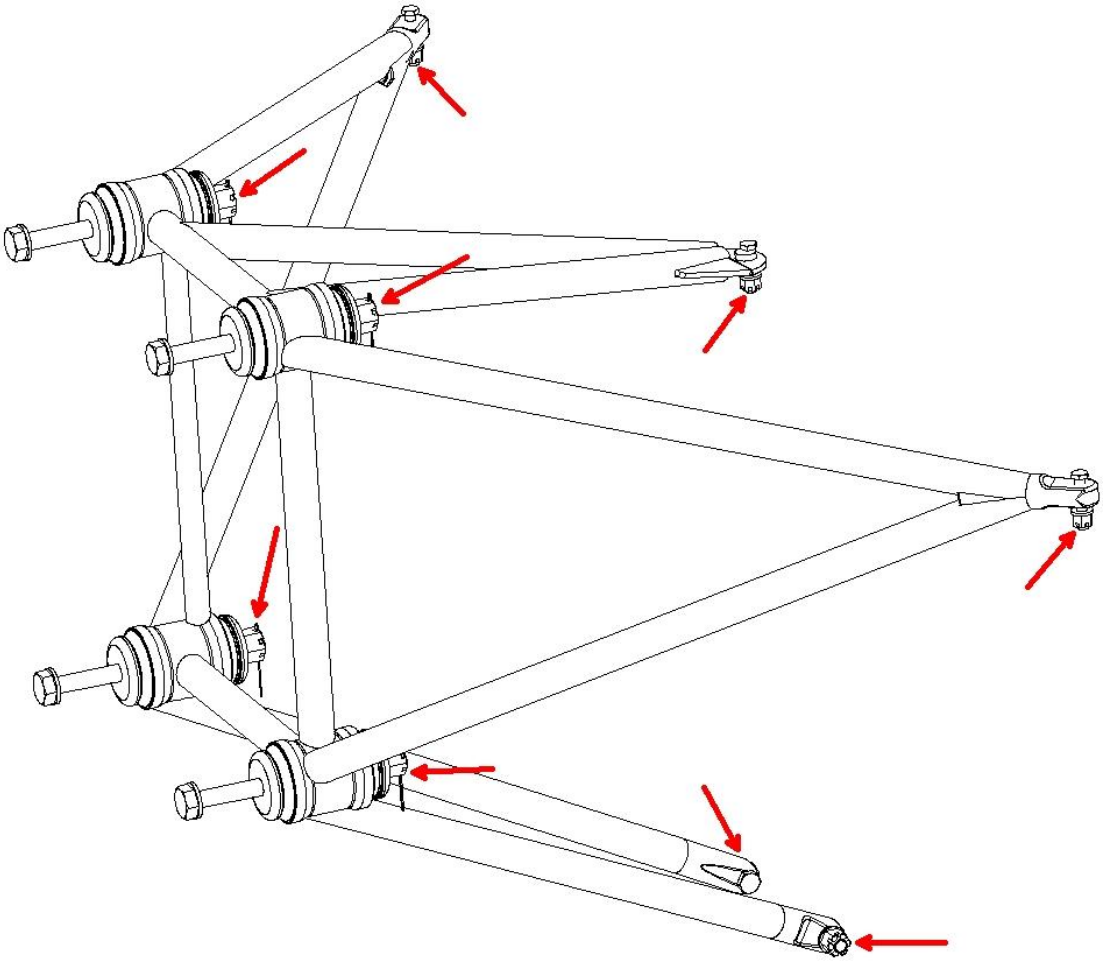


**Fig. 10 - Joints with the crown nut and cotter pin used on the engine mount attachment points**

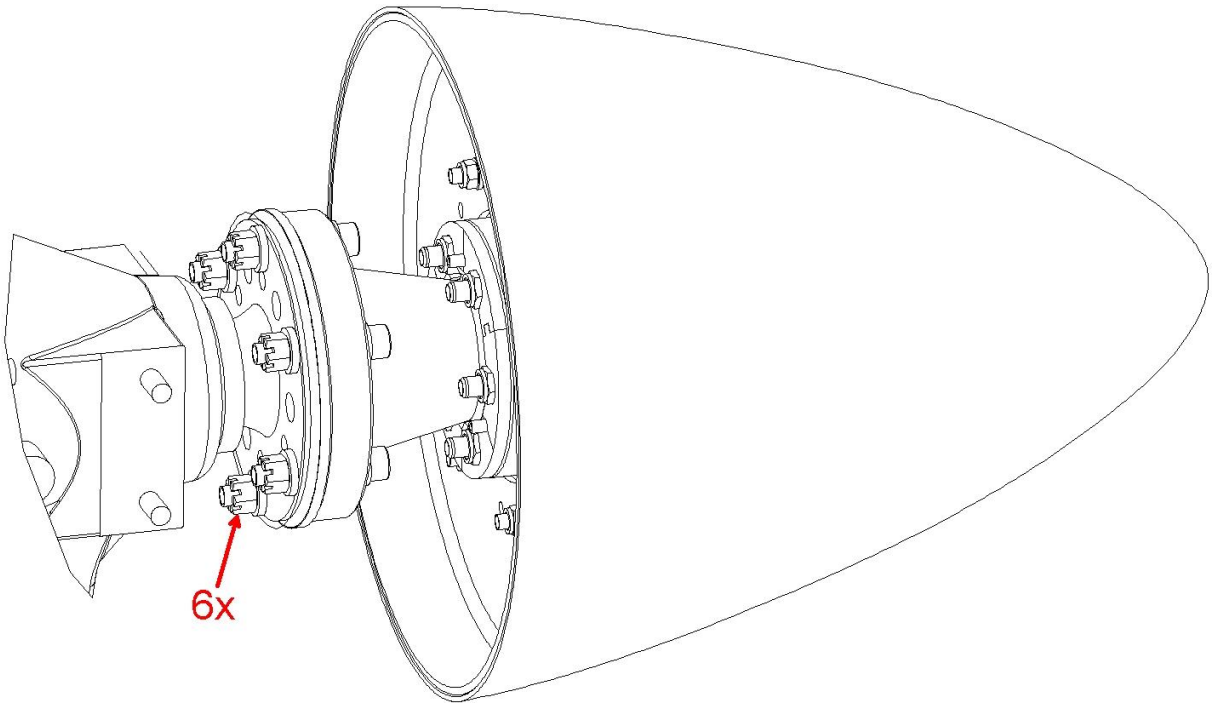



**Fig. 11 - Joints with the crown nut and cotter pin used on the propeller adapter attachment points**