



**Programme:** ELT

**Project/WP:** Instrumentation System Engineering

## **Definition of additional support points for instruments on the ELT Nasmyth platforms**

**Document Number:** ESO-321039

**Document Version:** 5

**Document Type:** Design Report (DER)

**Released On:** 2023-05-05

**Document Classification:** ESO Internal Use [Confidential for Non-ESO Staff]

<b>Owner:</b>	Cavaller Marques, Lluís
<b>Validated by WPM:</b>	González Herrera, Juan Carlos
<b>Approved by PM:</b>	González Herrera, Juan Carlos
	Name



## Authors

Name	Affiliation
Lluís Cavaller	ESO

## Change Record from previous Version

Affected Section(s)	Changes / Reason / Remarks
	See CRE ET-1252
2.1.2	New version of AD2
2.1.2	New version of AD3
4.2	Maximum moments on the support points for light loads included



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# 1. Introduction

AD1 defines requirements for the instruments mounting interfaces on the Nasmyth platforms.

Requirement I-INS/ELT-498 defines the possibility to provide additional support points for instruments on the Nasmyth platforms beyond the main interface flanges defined in AD2, if they are required for any instrument because it is proven to be advantageous for the system. This requirement defines also that the allowed positions, design and performance of these support points shall be agreed with ESO in a case by case basis.

The additional support points for instruments includes the stiff structural support points where high stiffness and load capacity is required and the support points for light loads, where no specific stiffness is required.

## 1.1 Scope

This document defines the allowed positions and performance of the additional support points for instruments that can be provided by ESO on the ELT Nasmyth platforms in addition to the main ones defined in AD2.

## 1.2 Definitions and Conventions

### 1.2.1 Abbreviations and Acronyms

The following abbreviations and acronyms are used in this document:

TBC	To Be Confirmed
TBD	To Be Defined

## 2. Related Documents

### 2.1 Applicable Documents

The following documents, of the exact version shown, form part of this document to the extent specified herein. In the event of conflict between the documents referenced herein



and the content of this document, the content of this document shall be considered as superseding.

### 2.1.1 ESO Documents

AD1 Common ICD between the E-ELT Nasmyth Instruments and the Rest of the E-ELT System;

ESO-253082 Version 4

<https://pdm.eso.org/kronodoc/HQ/ESO-253082/4>

### 2.1.2 ESO Drawings

AD2 Nasmyth Platform Interfaces;

CAD-135139 Revision 2

<https://pdm.eso.org/kronodoc/HQ/ESO-286456/2>

AD3 Additional Support Points for Instruments on the Nasmyth Platform;

CAD-153255 Revision 6

<https://pdm.eso.org/kronodoc/HQ/ESO-321386/6>

### 2.1.3 Standards

AD4 Eurocode 1: Actions on structures;

EN 1991-1-1:2002



## 3. Support points definition

The additional support points for instruments includes the stiff structural support points where high stiffness and load capacity is required and the support points for light loads (e.g. electrical cabinets or access platforms), where no specific stiffness is required.

The stiff additional support points will be implemented by a specific interface flange, while support points for light loads will be implemented by bolting the required elements directly on the Nasmyth platform floor plate.

Allowed positions and flange design for the additional support points are defined in AD3.

### 3.1 Stiff support points

The stiff additional support points will be implemented by an interface flange similar to the one defined for the main interface support points in AD2, providing a centering diameter  $\varnothing 160H7$ , 8 threaded holes M20 and 8 threaded holes M8

The proposed design allows the implementation of the defined support points in the positions defined in the drawing by bolting the interface flanges on the top of the floor of the Nasmyth platform. These interface flanges will be placed 60mm above the main ones (50mm above the Nasmyth platform floor), as defined in AD3. These interface flanges can not be placed at the same level as the main ones, since the main ones are embedded in recesses of the Nasmyth platform floor, while the additional support points will be placed on the top of the floor.

The flanges of the additional support points shall guarantee the electrical grounding of the instruments legs, by direct contact or by including a dedicated grounding point.

Two different types of stiff additional support points are defined:

- Intermediate support points: Flanges supported on the main beams of the Nasmyth platform, following the existing beams pattern.
- Supplementary support points: Flanges supported on intermediate positions on the Nasmyth platform floor plates. The implementation of these flanges requires the installation of a reinforcement beam (IPE 450 typically) below the floor plate in order to provide the required stiffness to the support point.

The implementation of Intermediate support points is strongly preferred to the Supplementary ones, since they do not require the installation of additional reinforcement beams below the floor of the Nasmyth platform.

The additional support points are connected to the main support points by means of the beams of the Nasmyth platform, hence the load applied on the additional support points is transferred to the main support points where the beams are connected. In case of implementing additional support points, the force exerted on any of the main attachment points includes the load directly exerted on it and the force exerted on the additional support points connected to it.

In the case that intermediate support points are to be implemented on one of the platform main beams which has at the same time a reinforcement beam installed for supplementary

support points, the intermediate support points should be placed on the structural node created by the main beam and the reinforcement beam.

A maximum mass of 1000 kg per instrument will be granted for the implementation of additional support points (intermediate and/or supplementary ones). (This corresponds roughly to, e.g. 7 meters of IPE 450 beams and 10 supplementary support point plates, assuming 30kg per support flange). If an instrument requires more mass for additional support points, the excess mass shall have to be absorbed within the instrument's own mass budget.

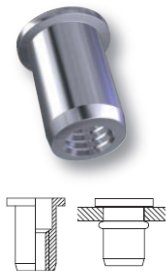
### 3.2 Support points for light loads

The support points for light loads will be implemented by rivet nuts inserted in the Nasmyth platform plate. The floor plate of the Nasmyth platform is a 8mm thick steel plate where holes will be drilled in the required positions in order to install the rivet nuts.

Rivet nuts to be installed will be RIVKLE series 233 01: steel zinc-plated, flat head, plain, cylindrical, open standard rivet nuts.

The rivet nuts can be installed in any position of the Nasmyth platform, excepting the non allowed areas defined in sheet#2 of AD3.

Steel | Flat head | Plain | Open



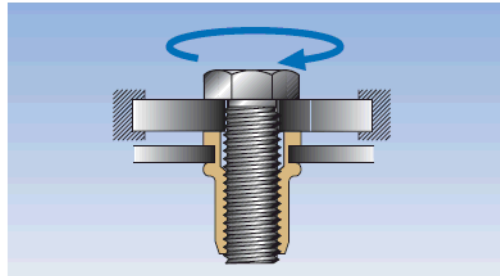
d (mm)	L (mm)	B (mm)	θ (min - max) (mm)	+0,1/0 (mm)	S (mm)	L <sub>2</sub> (mm)	E (mm)		
<b>M3</b>	8,3	7,5	0,5 - 1,0	5,0	S=2,1-e	5,2	1,0	233 01 030 010	
	8,7		1,0 - 1,5		S=3,2-e	4,8		233 01 030 015	
	9,7		1,5 - 3,0		S=4,2-e			233 01 030 030	
	11,2		3,0 - 4,5		S=5,8-e	4,4		233 01 030 045	
	12,9		4,5 - 6,0		S=7,2-e	4,7		233 01 030 060	
<b>M4</b>	9,7	9,0	0,5 - 1,0	6,0	S=2,6-e	5,4	1,0	233 01 040 010	
	10,2		1,0 - 2,0		S=3,6-e			233 01 040 020	
	11,8		2,0 - 4,0		S=5,6-e	5,6		233 01 040 040	
	13,8		4,0 - 6,0		S=7,5-e	5,3		233 01 040 060	
<b>M5</b>	13,75	10,0	0,5 - 3,0	7,0	S=5,0-e	8,0	1,0	233 01 050 030	
	16,7		3,0 - 5,5		S=7,5-e			233 01 050 055	
	19,8		5,5 - 8,0		S=9,7-e	9,1		233 01 050 080	
<b>M6</b>	15,8	13,0	0,5 - 3,0	9,0	S=5,2-e	10,0	1,5	233 01 060 030	
	18,7		3,0 - 5,5		S=7,9-e	9,3		233 01 060 055	
	21,7		5,5 - 8,0		S=10,2-e	10,0		233 01 060 080	
<b>M8</b>	17,8	16,0	0,5 - 3,0	11,0	S=5,7-e	11,0	1,5	233 01 080 030	
	20,8		3,0 - 5,5		S=8,2-e			233 01 080 055	
	23,8		5,5 - 8,0		S=10,6-e	11,7		233 01 080 080	
	26,8		8,0 - 10,5		S=13,5-e	11,8		233 01 080 105	
<b>M10</b>	22,75	19,0	1,0 - 3,5	13,0	S=6,5-e	15,0	2,0	233 01 100 035	
	25,75		3,5 - 6,0		S=9,0-e				233 01 100 060
	27,75		6,0 - 8,5		S=11,5-e				233 01 100 085
	31,8		8,5 - 11,0		S=14,0-e				233 01 100 110
<b>M12</b>	26,7	23,0	1,0 - 4,0	16,0	S=7,7-e	17,1	2,0	233 01 120 040	
	29,7		4,0 - 7,0		S=10,7-e			233 01 120 070	
	34,8		7,0 - 10,0		S=13,7-e	17,5		233 01 120 100	
<b>M14</b>	35,5	24,0	4,5 - 6,0	18,0	S=9,8-e	23,2	2,5	233 01 140 600	

Table 1 – RIVKLE blind rivet nuts.

### RIVKLE® blind rivet nuts and studs, crimping torque

RIVKLE® can be used with all the screw types shown in the table below providing the maximum crimping torque (in Nm) is not exceeded.

Size RIVKLE®	Steel/ stainless steel	Aluminium
M3	1.2	0.7
M4	3	2
M5	6	4
M6	10	6
M8	24	15
M10	48	27
M12	82	45



Note: For steel and stainless steel RIVKLE® from size M 3 up to and including M 10 these torques correspond to grade 8.8 screws.

### Mechanical characteristics of RIVKLE® internal and external threads

#### ■ Axial proof load

Size	RIVKLE® blind rivet nut steel & stainl. steel	RIVKLE® blind rivet nut aluminium	RIVKLE® blind rivet stud steel
M3	4 000	2 500	/
M4	6 800	4 000	/
M5	10 000	5 500	8 100
M6	15 000	8 300	11 500
M8	27 000	13 000	21 000
M10	37 000	20 000	/
M12	54 000	28 000	/

Unit: N

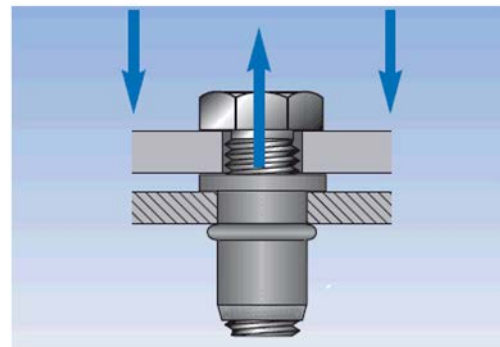


Table 2 – Maximum torque and preload for RIVKLE cylindrical rivet nuts.

## 4. Requirements

### 4.1 Stiff support points

Requirements defined in section 7.3 of document AD1 are fully applicable to the additional support points (intermediate and supplementary) defined in this document, excepting values of load handling capacity and stiffness defined in requirements I-INS/ELT-245 and I-INS/ELT-246 in subsection 7.3.2.

The maximum load handling capacity of any additional support point defined in this document shall be the following, according to the terms defined in requirement I-INS/ELT-245 of AD1:

- Intermediate Support points: 350kN in  $X_{AZ}$ ,  $Y_{AZ}$  directions and 600kN in traction or compression in  $Z_{AZ}$  direction.
- Supplementary Support points: 250kN in  $X_{AZ}$ ,  $Y_{AZ}$  directions and 450kN in traction or compression in  $Z_{AZ}$  direction.



For the estimation of the forces on the flanges a safety factor  $SF=1.5$  shall be considered in all load cases, including survival and accidental load cases, as indicated in the referred requirement.

In order to estimate the force exerted by any of the Nasmyth instruments on any of the main attachment points as defined in requirement I-INS/ELT-245, direct loads on the main point and loads on the intermediate and supplementary support points connected to it shall be considered. Loads on intermediate support points shall be transferred to the two closest main support points placed on the same Nasmyth platform beam. The fraction of the load transferred to each of the two main support points shall be estimated inversely proportional to the distance between the intermediate support point and the main one. Loads on supplementary support points shall be converted first to two equivalent intermediate support loads using the same rule. ESO will support the instruments consortia in assessing this aspect.

The minimum local stiffness of the additional support points (intermediate and supplementary) defined in this document shall be  $150 \times 10^6$  N/m in vertical direction  $k_z$  and  $200 \times 10^6$  N/m in lateral directions  $k_x$  and  $k_y$ , according to the terms defined in requirement I-INS/ELT-246 of document AD1. These values are same ones defined for the auxiliary flanges of zone B in requirement I-INS/ELT-246.

## 4.2 Support points for light loads

The load carried by support points for light loads implemented on the platform floor plate shall be according to the load limits defined in requirements I-INS/ELT-442 and I-INS/ELT-443 in AD1.

The maximum load capacity of each support point is defined by the allowed FL3 forklift load defined in I-INS/ELT-442.

Section 6.3.2.3 of AD4 defines a maximum static vertical load of 63kN per forklift axis for category FL3. The vertical static load on a support point can be assimilated to  $\frac{1}{2}$  of this load, assuming it as the load supported on a single wheel of the forklift, by an area of  $0.2 \times 0.2 \text{m}^2$ : 31.5kN.

Horizontal loads shall be limited to 30% of the vertical loads according to AD4, resulting in a maximum horizontal static load of 9.45kN.

The maximum moments that can be supported on the  $0.2 \times 0.2 \text{m}^2$  area can be estimated assuming half of the vertical load  $31.5/2=15.75$  applied in traction at 80mm of the center of the area and half of the load applied in compression at 80mm of the center of the area, resulting in a maximum moment of 2.52kNm.

Assuming dynamic loads (e.g. earthquake loads) a factor 2 can be assumed according to AD4, resulting in a total load of 63kN vertical, 18.9kN horizontal and 5.04kNm moment in dynamic conditions.

For the estimation of the forces and moments applied on these support points a safety factor  $SF=1.5$  shall also be considered in all load cases, including survival and accidental load cases, as indicated in the referred requirements.

The overall maximum load supported by all the support points for light loads placed in an area limited by the four closest main interface support points shall be limited to the floor load capacity defined in I-INS/ELT-443 ( $10 \text{kN/m}^2$ ) multiplied by the area defined by the four



support points (e.g. 90kN for an area of 9m<sup>2</sup>). The overall load on a defined area shall be estimated assuming the safety factor SF=1.5 previously defined on the load estimate on each support point contained in the area.