

JEM-X
ENGINEERING MEMORANDUM

TITLE: Dimensional Control of "Alenia" Interface Planarity and Hole Diam. And Position Measurement.		EM NO: IN-EM-JEM-0011 DATE: Nov. 13, 2000 REVISED:
AUTHOR(S): Josef Polny	PHONE: +45 3532 5793	APPROVALS: WBS ENG'R: _____ SYSTEM ENG'R: _____ PROJECT MNG'R: _____

Summary

Jem-X Detector Assembly interfaces with the Integral Satellite Detector Bench via a plane surface on the four legs of Jem-X' DFEE box. The Detector assembly is fastened to the Bench with 8 bolts. The planarity of the interface surface and holes position and diameter tolerances were determined on the three DFEE boxes (FM1, FM2 and SM) in stand-alone configuration. The results show the conformance with the requirements as per ALENIA drawing # 032N403 sheet 3/3 date:11/11/1997 Title JEM-X Envelope & I/F.

Background

In order to secure the problem free integration with satellite the interface tolerances need to be confirmed.

Extend of dimensional control

All three DFEE-boxes were subjected to the following measurements (see also drawing Fig. 1):

1. Determination of the coordinate system
2. Planarity test on the interface surface
3. Determination of the interface holes center position (hole #0 (origo) to #7 see fig. 1)
4. Determination of the diameter of the holes
5. Determination of the overall dimensions in the interface plane (distance from origo to face (line) #8 to #15 see fig. 1)

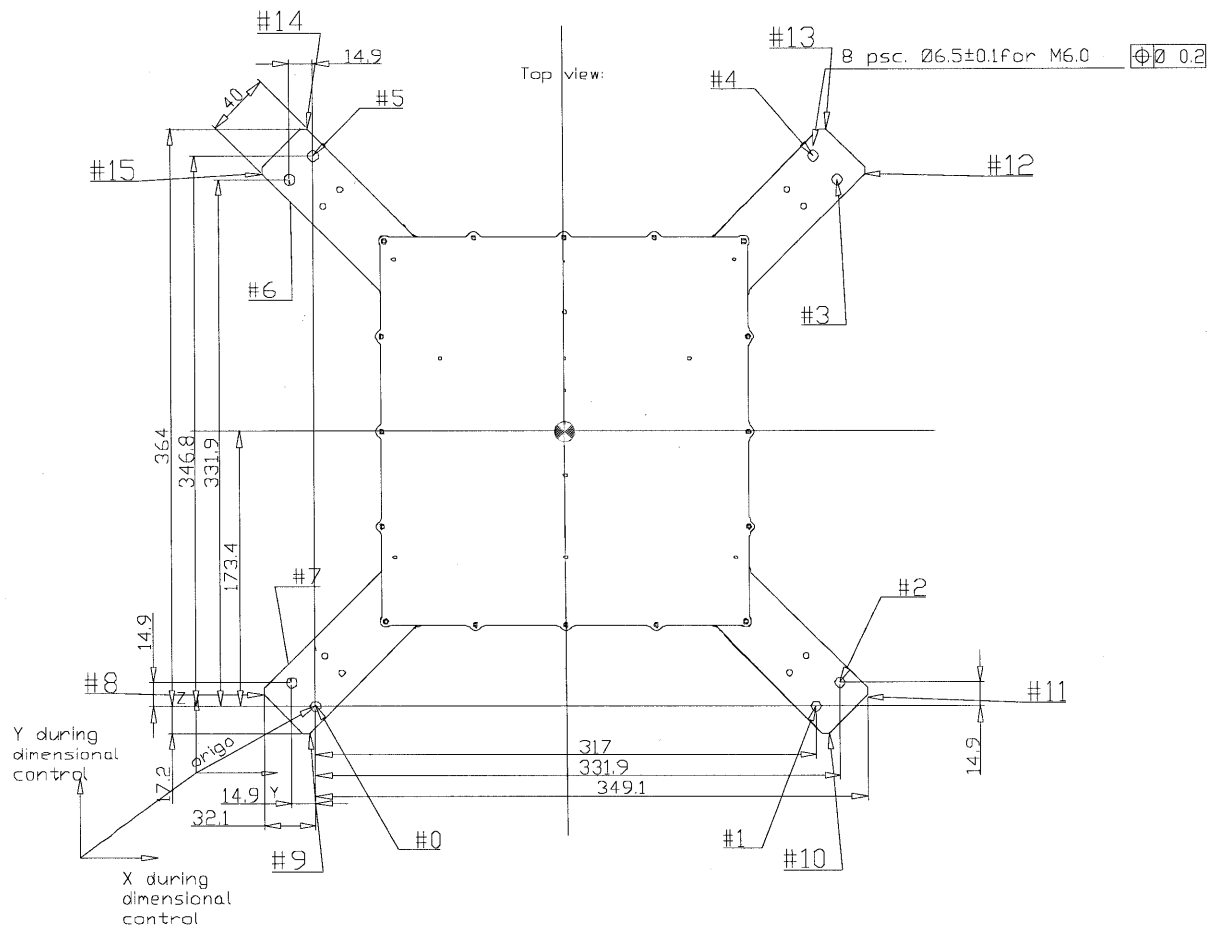


Figure 1. DFEE box during the dimension control of "Alenia" interface. Coordinate system as used during control and measurement entities marked with #number.

Results

1. FM1 DFEE box

11/19/2000

HOLE POSITION & DIM. OF ALUMINUM INTERFER

(4)

Part Program: jem-130100

Type: exe

Directory: D:\XSHEF\PARTPGMS\TEST\

Inspector: BRIAN

Part Serial #:

Rev: 1

2000

Date/Time: 11/13/2000 13:22

CMM: CMM1

TYPE: PLANE

NAME: _PLAN1

	ACTUAL	NOMINAL	+ TOL	- TOL	DEV	OUT-TOL
FM			0.200		0.031	+

TYPE: I.D.

NAME: 0

	ACTUAL	NOMINAL	+ TOL	- TOL	DEV	OUT-TOL
X	0.000	0.000	0.000	0.000	0.000	
Y	0.000	0.000	0.000	0.000	0.000	
DI	6.496	6.500	0.100	0.100	-0.004	-

TYPE: I.D.

NAME: 1

	ACTUAL	NOMINAL	+ TOL	- TOL	DEV	OUT-TOL
X	316.997	317.000	0.050	0.050	-0.003	-
Y	-0.020	0.000	0.050	0.050	-0.020	---
DI	6.500	6.500	0.100	0.100	0.000	+
TP			0.100		0.041	++

TYPE: I.D.

NAME: 2

	ACTUAL	NOMINAL	+ TOL	- TOL	DEV	OUT-TOL
X	331.904	331.900	0.050	0.050	0.004	+
Y	14.873	14.900	0.050	0.050	-0.027	---
DI	6.501	6.500	0.100	0.100	0.001	+
TP			0.100		0.054	+++

TYPE: I.D.

NAME: 3

	ACTUAL	NOMINAL	+ TOL	- TOL	DEV	OUT-TOL
X	331.917	331.900	0.050	0.050	0.017	++
Y	331.925	331.900	0.050	0.050	0.025	++
DI	6.502	6.500	0.100	0.100	0.002	+
TP			0.100		0.061	+++

TYPE: I.D.

NAME: 4

	ACTUAL	NOMINAL	+ TOL	- TOL	DEV	OUT-TOL
X	317.008	317.000	0.050	0.050	0.008	+
Y	346.818	346.800	0.050	0.050	0.018	++
DI	6.500	6.500	0.100	0.100	0.000	-
TP			0.100		0.040	++

TYPE: I.D.

NAME: 5

	ACTUAL	NOMINAL	+ TOL	- TOL	DEV	OUT-TOL
X	0.000	0.000	0.050	0.050	0.000	-
Y	346.843	346.800	0.050	0.050	0.043	++++
DI	6.498	6.500	0.100	0.100	-0.002	-
TP			0.100		0.085	++++

TYPE: I.D.

NAME: 6

	ACTUAL	NOMINAL	+ TOL	- TOL	DEV	OUT-TOL
X	-14.896	-14.900	0.050	0.050	0.004	+
Y	331.949	331.900	0.050	0.050	0.049	++++
DI	6.501	6.500	0.100	0.100	0.001	+
TP			0.100		0.098	++++

TYPE: I.D.

NAME: 7

	ACTUAL	NOMINAL	+ TOL	- TOL	DEV	OUT-TOL
X	-14.902	-14.900	0.050	0.050	-0.002	-
Y	14.892	14.900	0.050	0.050	-0.008	-
DI	6.500	6.500	0.100	0.100	0.000	-

The planarity of the interface surface is determined to be 0.031 mm. The diameter of the holes is 6.5 mm +0.002 and -0.004 mm. The position of the hole center with respect to origo is better or equal to cylinder diameter 0.098 mm.

The envelope dimensions in the interface plane (measurements #8 to #15) were determined with respect to the dimensions given on the MICD. The surfaces, when measured, were covered with Chemglaze Z 306 paint, see results below.

Overall distances, i.e.:

$$\#8 + \#11 = 381.568$$

$$\#9 + \#11 = 381.525$$

$$\#15 + \#12 = 381.409$$

$$\#10 + \#13 = 381.542$$

$$\#8 + \#12 = 381.599$$

$$\#9 + \#13 = 381.547$$

$$\text{Circumscribed circle radius } R = 253.365$$

$$\text{Circumscribed circle radius } R = 253.315$$

$$\text{Circumscribed circle radius } R = 253.384$$

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FNL (2)

TYPE: LINE						
NAME: 8						
X	-32.358	-32.100	0.000	0.000	-0.258	-0.258
TYPE: LINE						
NAME: 9						
Y	-17.287	-17.200	0.000	0.000	-0.087	-0.087
TYPE: LINE						
NAME: 10						
Y	-17.282	-17.200	0.000	0.000	-0.082	-0.082
TYPE: LINE						
NAME: 11						
X	349.210	349.100	0.000	0.000	0.110	0.110
TYPE: LINE						
NAME: 12						
X	349.241	349.100	0.000	0.000	0.141	0.141
TYPE: LINE						
NAME: 13						
Y	364.260	364.000	0.000	0.000	0.260	0.260
TYPE: LINE						
NAME: 14						
Y	364.238	364.000	0.000	0.000	0.238	0.238
TYPE: LINE						
NAME: 15						
X	-32.168	-32.100	0.000	0.000	-0.068	-0.068

On FM1 we additionally checked the position of the center of the Cannon connectors as compared to the nominal values given on the MICD. Deviation between the nominal and measured value is less than 0.1 mm, see below.

FM1 - MEASUREMENT OF ^③
CANNON CONNECTORS X-Y-Z-Pos.

Part Program: jem-130100				Rev: 1	2000	
Type: sxe				Date/Time: 11/13/2011	12:43	
Directory: D:\XSHEF\PARTPGMS\TEST\				CMM: CMM1		
Inspector: BRIAN						
Part Serial #:						

TYPE: POINT						
NAME: J01						
	ACTUAL	NOMINAL	+ TOL	- TOL	DEV	OUT-TOL
X	93.035	93.100	0.100	0.100	-0.065	---
Z	-55.880	-55.900	0.100	0.100	0.020	+
TYPE: POINT						
NAME: J02						
X	213.613	213.700	0.100	0.100	-0.087	----
Z	-55.882	-55.900	0.100	0.100	0.018	+
TYPE: POINT						
NAME: J04						
X	93.027	93.100	0.100	0.100	-0.073	---
Z	-106.389	-106.400	0.100	0.100	0.011	+
TYPE: POINT						
NAME: J03						
X	168.953	169.000	0.100	0.100	-0.047	--
Z	-106.381	-106.400	0.100	0.100	0.019	+
TYPE: POINT						
NAME: J06						
X	222.576	222.600	0.100	0.100	-0.024	-
Z	-106.391	-106.400	0.100	0.100	0.009	+
TYPE: POINT						
NAME: J07						
X	86.767	86.800	0.100	0.100	-0.033	--
Z	-143.367	-143.400	0.100	0.100	0.033	++
TYPE: POINT						
NAME: J05						
X	159.783	159.800	0.100	0.100	-0.017	-
Z	-143.367	-143.400	0.100	0.100	0.033	++
TYPE: POINT						
NAME: J08						
X	234.104	234.200	0.100	0.100	-0.096	----
Z	-143.371	-143.400	0.100	0.100	0.029	++

MEASUREMENT ACCURACY $\pm < 0,002$
ISO 9002.

2. QM/SM DFEE-box

QM - ALENIA INTERFACE
MEASUREMENT.

①

Part Program: jem-130100						
Type: sxe						
Directory: D:\XSHEF\PARTPGMS\TEST\						
Inspector: BRIAN						
Part Serial #:						
Rev: 1 2000						
Date/Time: 11/13/99 13:44						
CMM: CMM1						

TYPE: PLANE						
NAME: _PLAN1						
	ACTUAL	NOMINAL	+ TOL	- TOL	DEV	OUT-TOL
FM			0.200		0.066	++
TYPE: I.D.						
NAME: 0						
	ACTUAL	NOMINAL	+ TOL	- TOL	DEV	OUT-TOL
X	0.000	0.000	0.000	0.000	0.000	
Y	0.000	0.000	0.000	0.000	0.000	
DI	6.521	6.500	0.100	0.100	0.021	+
TYPE: I.D.						
NAME: 1						
X	317.036	317.000	0.050	0.050	0.036	+++
Y	0.001	0.000	0.050	0.050	0.001	+
DI	6.486	6.500	0.100	0.100	-0.014	-
TP			0.100		0.071	+++
TYPE: I.D.						
NAME: 2						
X	331.921	331.900	0.050	0.050	0.021	++
Y	14.949	14.900	0.050	0.050	0.049	++++
DI	6.509	6.500	0.100	0.100	0.009	+
TP			0.100		0.107	0.007
TYPE: I.D.						
NAME: 3						
X	331.897	331.900	0.050	0.050	-0.003	-
Y	331.945	331.900	0.050	0.050	0.045	++++
DI	6.511	6.500	0.100	0.100	0.011	+
TP			0.100		0.091	++++
TYPE: I.D.						
NAME: 4						
X	316.983	317.000	0.050	0.050	-0.017	--
Y	346.839	346.800	0.050	0.050	0.039	++++
DI	6.506	6.500	0.100	0.100	0.006	+
TP			0.100		0.085	++++
TYPE: I.D.						
NAME: 5						
X	-0.001	0.000	0.050	0.050	-0.001	-
Y	346.810	346.800	0.050	0.050	0.010	+
DI	6.514	6.500	0.100	0.100	0.014	+
TP			0.100		0.020	+
TYPE: I.D.						
NAME: 6						
X	-14.905	-14.900	0.050	0.050	-0.005	-
Y	331.907	331.900	0.050	0.050	0.007	+
DI	6.518	6.500	0.100	0.100	0.018	+
TP			0.100		0.017	+
TYPE: I.D.						
NAME: 7						
X	-14.899	-14.900	0.050	0.050	0.001	+
Y	-14.900	-14.900	0.050	0.050	0.000	-

The planarity of the Alenia interface is 0.066 mm. The hole diameter is 6.5 mm +0.021 and -0.014. The hole center position with respect to the origo is inside the cylinder of the diam. 0.107 mm or better.

The envelope dimensions of the QM DFEE box in the interface plane are shown below. The overall distances are:

$$\#8 + \#11 = 381.252 \text{ mm}$$

$$\#9 + \#14 = 383.219 \text{ mm}$$

$$\#15 + \#12 = 381.18 \text{ mm}$$

$$\#10 + \#13 = 381.185 \text{ mm}$$

$$\#8 + \#12 = 381.15 \text{ mm}$$

$$\#9 + \#13 = 381.231 \text{ mm}$$

$$\text{Radius of the circumscribed circle is: } R = 253.146 \text{ mm}$$

$$\text{Radius of the circumscribed circle is } R = 253.108 \text{ mm}$$

$$\text{Radius of the circumscribed circle is } R = 243.114 \text{ mm}$$

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					QM	(2)
TYPE: LINE						
NAME: 8						
X	-32.075	-32.100	0.000	0.000	0.025	0.025
TYPE: LINE						
NAME: 9						
Y	-17.193	-17.200	0.000	0.000	0.007	0.007
TYPE: LINE						
NAME: 10						
Y	-17.147	-17.200	0.000	0.000	0.053	0.053
TYPE: LINE						
NAME: 11						
X	349.177	349.100	0.000	0.000	0.077	0.077
TYPE: LINE						
NAME: 12						
X	349.075	349.100	0.000	0.000	-0.025	-0.025
TYPE: LINE						
NAME: 13						
Y	364.038	364.000	0.000	0.000	0.038	0.038
TYPE: LINE						
NAME: 14						
Y	364.026	364.000	0.000	0.000	0.026	0.026
TYPE: LINE						
NAME: 15						
X	-32.105	-32.100	0.000	0.000	-0.005	-0.005

3. FM2 DFEE-box

TTL

①

Part Program: jem-130100						
Type: sxe						
Directory: D:\XSHEF\PARTPGMS\TEST\						
Inspector: BRIAN						
Part Serial #:						
Rev: 1						
Date/Time: 11/13/2000 14:05						
CMM: CMM1						
TYPE: PLANE						
NAME: _PLAN1						
	ACTUAL	NOMINAL	+ TOL	- TOL	DEV	OUT-TOL
FM			0.200		0.045	+
TYPE: I.D.						
NAME: 0						
	ACTUAL	NOMINAL	+ TOL	- TOL	DEV	OUT-TOL
X	0.000	0.000	0.000	0.000	0.000	
Y	0.000	0.000	0.000	0.000	0.000	
DI	6.498	6.500	0.100	0.100	-0.002	-
TYPE: I.D.						
NAME: 1						
X	316.995	317.000	0.050	0.050	-0.005	-
Y	0.037	0.000	0.050	0.050	0.037	+++
DI	6.500	6.500	0.100	0.100	0.000	-
TP			0.100		0.075	+++
TYPE: I.D.						
NAME: 2						
X	331.908	331.900	0.050	0.050	0.008	+
Y	14.932	14.900	0.050	0.050	0.032	+++
DI	6.497	6.500	0.100	0.100	-0.003	-
TP			0.100		0.065	+++
TYPE: I.D.						
NAME: 3						
X	331.903	331.900	0.050	0.050	0.003	+
Y	331.997	331.900	0.050	0.050	0.097	0.047
DI	6.499	6.500	0.100	0.100	-0.001	-
TP			0.100		0.194	0.094
TYPE: I.D.						
NAME: 4						
X	316.992	317.000	0.050	0.050	-0.008	-
Y	346.893	346.800	0.050	0.050	0.093	0.043
DI	6.497	6.500	0.100	0.100	-0.003	-
TP			0.100		0.188	0.088
TYPE: I.D.						
NAME: 5						
X	-0.002	0.000	0.050	0.050	-0.002	-
Y	346.847	346.800	0.050	0.050	0.047	++++
DI	6.499	6.500	0.100	0.100	-0.001	-
TP			0.100		0.095	++++
TYPE: I.D.						
NAME: 6						
X	-14.908	-14.900	0.050	0.050	-0.008	-
Y	331.934	331.900	0.050	0.050	0.034	+++
DI	6.497	6.500	0.100	0.100	-0.003	-
TP			0.100		0.071	+++
TYPE: I.D.						
NAME: 7						
X	-14.898	-14.900	0.050	0.050	0.002	+
Y	14.909	14.900	0.050	0.050	0.009	+
DI	6.498	6.500	0.100	0.100	-0.002	-
TP			0.100		0.071	+++

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Planarity of the interface surface is 0.045 mm.

The hole diameter is 6.5 mm +0.000 and -0.003 mm. The center of the holes is positioned with respect to the origo inside the cylinder with the diam. 0.194 mm or better.

						FM2	②
TYPE: LINE							
NAME: 8	-32.052	-32.100	0.000	0.000	0.048	0.048	
X							
TYPE: LINE							
NAME: 9	-17.151	-17.200	0.000	0.000	0.049	0.049	
Y							
TYPE: LINE							
NAME: 10	-17.113	-17.200	0.000	0.000	0.087	0.087	
Y							
TYPE: LINE							
NAME: 11	349.062	349.100	0.000	0.000	-0.038	-0.038	
X							
TYPE: LINE							
NAME: 12	349.052	349.100	0.000	0.000	-0.048	-0.048	
X							
TYPE: LINE							
NAME: 13	364.052	364.000	0.000	0.000	0.052	0.052	
Y							
TYPE: LINE							
NAME: 14	363.989	364.000	0.000	0.000	-0.011	-0.011	
Y							
TYPE: LINE							
NAME: 15	-32.057	-32.100	0.000	0.000	0.043	0.043	
X							

#8 + #11 = 381.114mm

#9 + #14 = 381.14 mm

#15 + #12 = 381.109 mm

#10 + #13 = 381.165 mm

#8 + #12 = 381.104 mm

#9 + #13 = 381.203 mm

Radius of the circumscribed circle R = 253.069 mm

Radius of the circumscribed circle R = 253.076 mm

Radius of the circumscribed circle R = 253.088 mm

Measurement accuracy

Accuracy of the measurements shown above can be documented by the calibration of the 3D coordinate machine the measurements were done on, see below.

KALIBRERINGS CERTIFIKAT

GIDDINGS & LEWIS®

SHEFFIELD MEASUREMENT SYSTEMS

A-V-N Maskin AS

Kunde: HANNIBAL A/S

Certifikat nr: 99005

Model: APOLLO RS 30 DCC

Maskin nr: A-0013

Kalibreret af: Teddy Schultz

Dato: 22.04.99

Nøjagtighed ifølge B 89.

Volumetrisk nøjagtighed: 8.6 μ Ball bar: 550 mm

Gentagelses nøjagtighed: X: 0.95 μ Y: 0.33 μ Z: 1.24 μ

Lineær nøjagtighed: X-akse: 2.0 μ Over: 600 mm
Y-akse: 2.0 μ Over: 600 mm
Z-akse: 2.0 μ Over: 600 mm

Nøjagtighed 3D: X-Y-Z: 3.0 μ Over: 600 mm

Lineær måleenhed: Webber bar. Serie nr : 112795.4 Certifikat nr : 9527240-A

Gennemsnitlig temperatur ved kalibreringen : 22° celsius.

Målemaskinen overholder fabrikantens specifikationer for maskintypen: RS 30

Dato: 24/5 - 99

Underskrift: T. Schultz

A-V-N Maskin AS
Hvidkærvej 41
5250 Odense SV
Telefon 63 17 17 11

Teddy Schultz

Conclusion

The interface of Jem-X is fulfilling the dimensional requirements as per ALENIA drawing # 032N403 sheet 3/3 date:11/11/1997 Title JEM-X Envelope & I/F.

Distribution:

DSRI

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