Recent metrology on Scandinavian modules

- XY−metrology
  - All Scandinavian modules since the start up of SQ modules are within specifications (3 before SQ, 5 SQ modules + 4 recent mechanical modules*).* We can control all xy−parameters and we think we can keep high standards in xy.

	JIG1	JIG1	JIG1	JIG2
Parameter	Deviation	Deviation	Deviation	Deviation
mhx [um]	6.36	−12.44	4.63	−5.71
mhy [um]	−23.39	7.43	4.57	−12.19
msx [um]	27.26	1.55	22.36	18
msy [um]	1.59	23.28	13.16	−2.71
sepf [um]	6.77	−0.43	6.87	−0.01
sepb [um]	4.98	5.86	1.18	−3.36
midxf [um]	−0.66	−5.08	−3.85	−1.34
midyf [um]	0.32	−1.45	−1.5	−2.98
a1 [mrad]	−0.03	−0.06	−0.01	0.03
a2 [mrad]	0.03	0.03	−0.01	0.06
a3 [mrad]	0.01	−0.04	0.01	0.1
a4 [mrad]	−0.06	−0.06	−0.04	0.06
stereo [mrad]	0.03	0.07	−0.01	0.06

- Z−metrology
  - The Exel macros from Japan was for the first time introduced on the SQ modules. The macros were not fully understood at the time of last meeting and errors in converting the raw data into the sheets may have occurred. One SQ module was OK in z. Recent modules on Jig#1 are within spec but and we think we can control the z−parameters. There are however work to be done in understanding the z−sheet to be able to correct parameters in the assembly.

Parameter	20220480120018	20220480120018	20220480120013	20220480120017
	JIG1	JIG1	JIG1	JIG2
maxZlower [mm]	−0.075	−0.06	−0.11	−0.31
maxZupper [mm]	0.060	0.11	0.09	0.42
midplaneEq	z=ax+by+c	z=ax+by+c	z=ax+by+c	z=ax+by+c
Left a	0	0	0	0
b	0	0	0	0
c	0.62	0.4	0.4	0.48
Right a	0	0	0	0.01
b	0	0	0	0
c	0.61	0.4	0.4	0.48
midplaneHeight [mm]	0.614	0.4	0.4	0.48
moduleThickness [mm]	1.210	1.19	1.2	1.2
optimalMaxZerrorLower [mm]	0.040	0.03	0.04	0.05
optimalMaxZerrorUpper [mm]	0.044	0.03	0.05	0.04
optimalRmsZerrorLower [mm]	0.017	0.01	0.02	0.02
optimalRmsZerrorUpper [mm]	0.016	0.01	0.02	0.02
moduleConcavity x [mm]	0.001	−0.04	−0.03	−0.03
y	0.025	0.01	0.02	0.01
sensorSkew x [mm]	0.018	−0.24	−0.05	0.63
y	0.114	−0.03	−0.17	0.22
coolingTabThickness [mm]	0.877	0.86	0.91	0.84
farTabThickness [mm]	1.077	0.8	0.73	0.99
halfTabThickness [mm]	0.489	0.41	0.41	0.46
tabSkew y [mm]	−0.100	0.03	0.09	−0.07
adhesiveThicknessTotal [mm]	0.163	0.29	0.31	0.22
adhesiveAsymmetry [mm]	−0.126	0.02	0.01	−0.03
loCoolingFacing a [mrad]	0.276	−0.46	0.25	2.19
b [mrad]	4.264	−6.69	−2.09	−11.08
loCoolingFacingConcavity [mr	0.001	−0.09	0.02	0.08

- Reproducibility
  - The stability in the xy−metrology was not good at the time the SQ− modules where measured. The values given in the summary table for the SQ was the biggest deviation from nominal.
  - We have since the SQ modules gone through the cause for the instability. All the SQ−modules where measure in jig originally designed for low temperature operation. The jig was in plexiglass to limit the thermal conductivity. This jig was not stable enough and has now been replaced by an aluminum jig which shows good reproducibility. (Maxdev better than 1 μm for midfx,midfy)

Summary of 3 sets of measurement on USA−glass module

Parameter	Design	Measure	Deviation	Tolerance	PASS	STDEV measurement
mhx [um]	(6500.0000000)	(6498.6042484)	1.3957516	30.0000000	1	0.402
mhy [um]	(37000.0000000)	(36999.0871033)	0.9128967	30.0000000	1	0.074
msx [um]	38500.0000000	38522.9274345	22.9274345	100.0000000	1	0.457
msy [um]	(37000.0000000)	(37005.5657859)	(5.5657859)	30.0000000	1	0.306
sepf [um]	64090.0000000	64082.4055268	(7.5944732)	10.0000000	1	0.052
sepb [um]	64090.0000000	64090.1052823	0.1052823	10.0000000	1	0.301
midxf [um]	0.0000000	1.0684155	1.0684155	10.0000000	1	0.194
midyf [um]	0.0000000	6.6954418	6.6954418	5.0000000	0	0.205
a1 [mrad]	0.0000000	0.0691252	0.0691252	0.1300000	1	0.013
a2 [mrad]	0.0000000	0.1361492	0.1361492	0.1300000	0	0.004
a3 [mrad]	0.0000000	(0.0103483)	(0.0103483)	0.1300000	1	0.003
a4 [mrad]	0.0000000	(0.1089728)	(0.1089728)	0.1300000	1	0.007