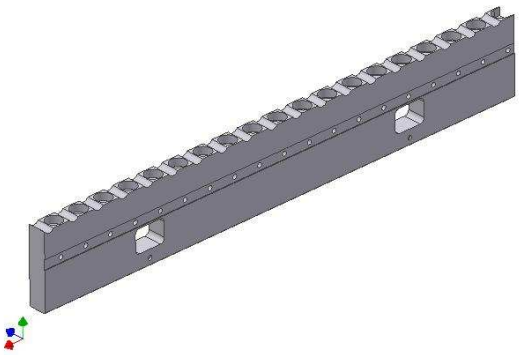
Choice of materials

After have taken vision of the supplied documentation, about the job to realize, we began the study with the choice of the appropriate materials to use.

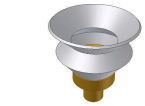
The choice of materials have also been conditioned by the Clean Room (class 10.000) requirements in wich the assembly of the detectors will be done.

For the Plate, aluminum ALCOA Alca Plus has been choosen because it has a good dimensional stability also after machining; the ALCOA slabs are obtained from fusion and then they go through a thermal process in furnace in order to get the stresses relief, after the slabs are grinded on the two surfaces to obtain an exceptional flatness, its lightness offers a remarkable advantage in the realization of equipments.

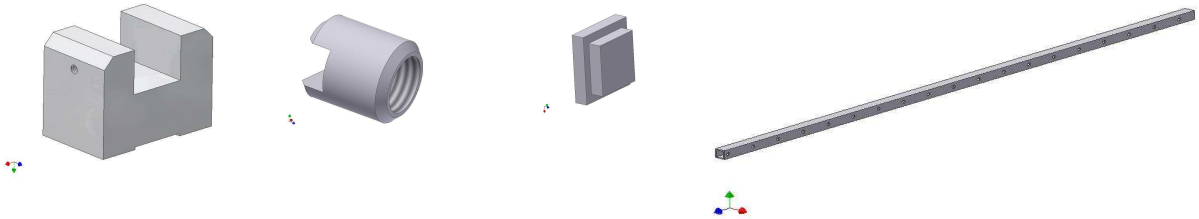


Stainless-steel rods (to avoid rust) of AISI-304 diameter 12h6 x 30mm, grinded and calibrated are used to position the tubes.

After a market survey on industrial vacuum systems we choose our suckers from Vuototecnica catalog, those are bellow shaped in silicones rubber, because they better attach on the aluminum tubes, the force applied is 6N.



The remaining parts are in aluminum Anticorodal (Al Si 1 Mg Mn) in agreement to lightness and mechanical strength needed.



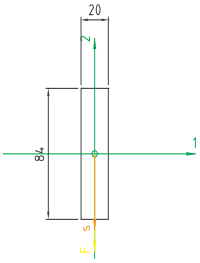
The choice of adhesive was driven from the kind of metals to join together aluminum/stainless-steel and the request to have a very low shrinkage 1-2% and was on ARALDITE 2014 (epoxy bicomponent); also duration on time mechanical strength and viscosity were correct.

Dimensioning of the Precision Comb

On the base of the given dimensions of the Plate driven from the dimensions of the Suckers that we have to put inside the plate ,we have to fix what is the best position of the feet to obtain the minimal sagitta of the comb .

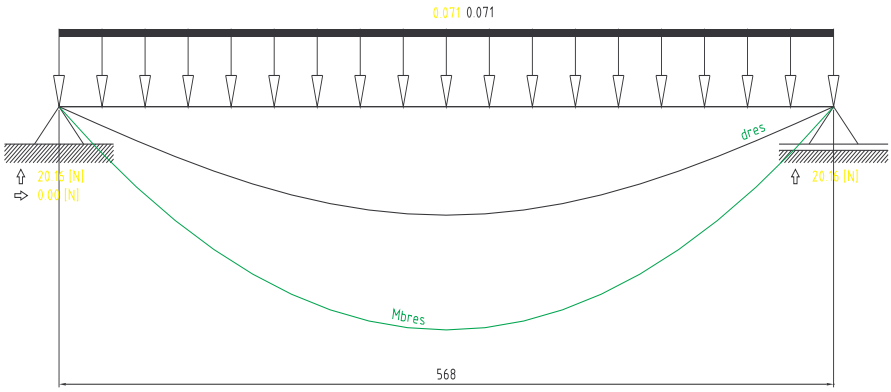
We consider the plate like a supported beam ; first of all we calculate the Inertia momentum and the the sagitta putting the feet at the extremities of the plate , this calculation will be done with the software Autocad 2000 Power Pack and will be checked with hand calculation based on the Vademecuum L.Baldassini, and the handbook Cremonese .

Own weight= 26 N Alcoa Plate = 0.046 N/mm
Steel Rods Φ12x30 = 0.3 N x 19 = 5.7 N = 0.010 N/mm AISI 304
MDT tubes weight (19 tubes) on comb = 8.2 N = 0.015 N/mm



Alcoa Plate	
I_1 [mm^4]	987800
I_2 [mm^4]	56000
S_c [mm]	42
S_t [mm]	42
A [mm^2]	1680

Moment of Inertia I1	[mm^4]	987800
Moment of Inertia I2	[mm^4]	56000
Moment of Inertia Ieff	[mm^4]	987800
Max. Border Dist.	[mm]	42
Safety Factor		1314.2400
Stretch Limits	[N/mm^2]	160
E-Modulus	[N/mm^2]	70000
Material		AlMgSi0.5F22
Max.Deflection d1	[mm]	0
Max.Bending Moment Mb1	[Nm]	0.8583 E-30
Max.Deflection d2	[mm]	1.391629 E-3
Max.Bending Moment Mb2	[Nm]	2.8633
Max.Stress Res.	[N/mm^2]	0.1217
Max.Deflection dres	[mm]	1.391629 E-3
Max.Bending Moment Mbres	[Nm]	2.8633
Scale for Defl. Line		50000:1
Scale for bending mom. line		50:1

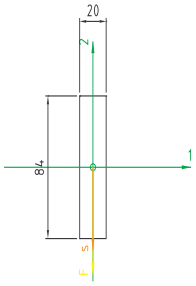


the result is around 1.4x10^-3 mm.

Now we try to improve the sagitta putting the feet in the Bessel Points that we can get from the Scienze of Construction book Vol.1 - O.Belluzzi

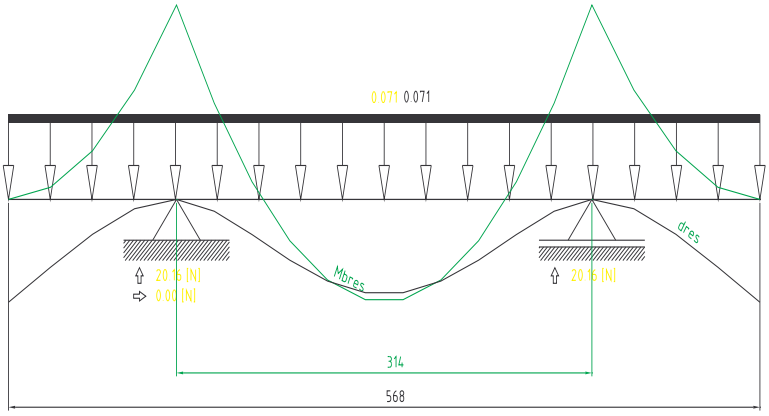
page 337 exercise 214 – case “g” ; the calculated distance between feet is 314 mm , and the sagitta is :

Own weight= 26 N Alcoa Plate = 0.046 N/mm
Steel Rods Φ12x30 = 0.3 N x 19 = 5.7 N = 0.010 N/mm AISI 304
MDT tubes weight (19 tubes) on comb = 8.2 N = 0.015 N/mm



Alcoa Plate		
I_1	[mm^4]	987800
I_2	[mm^4]	56000
S_c	[mm]	42
S_t	[mm]	42
A	[mm^2]	1680

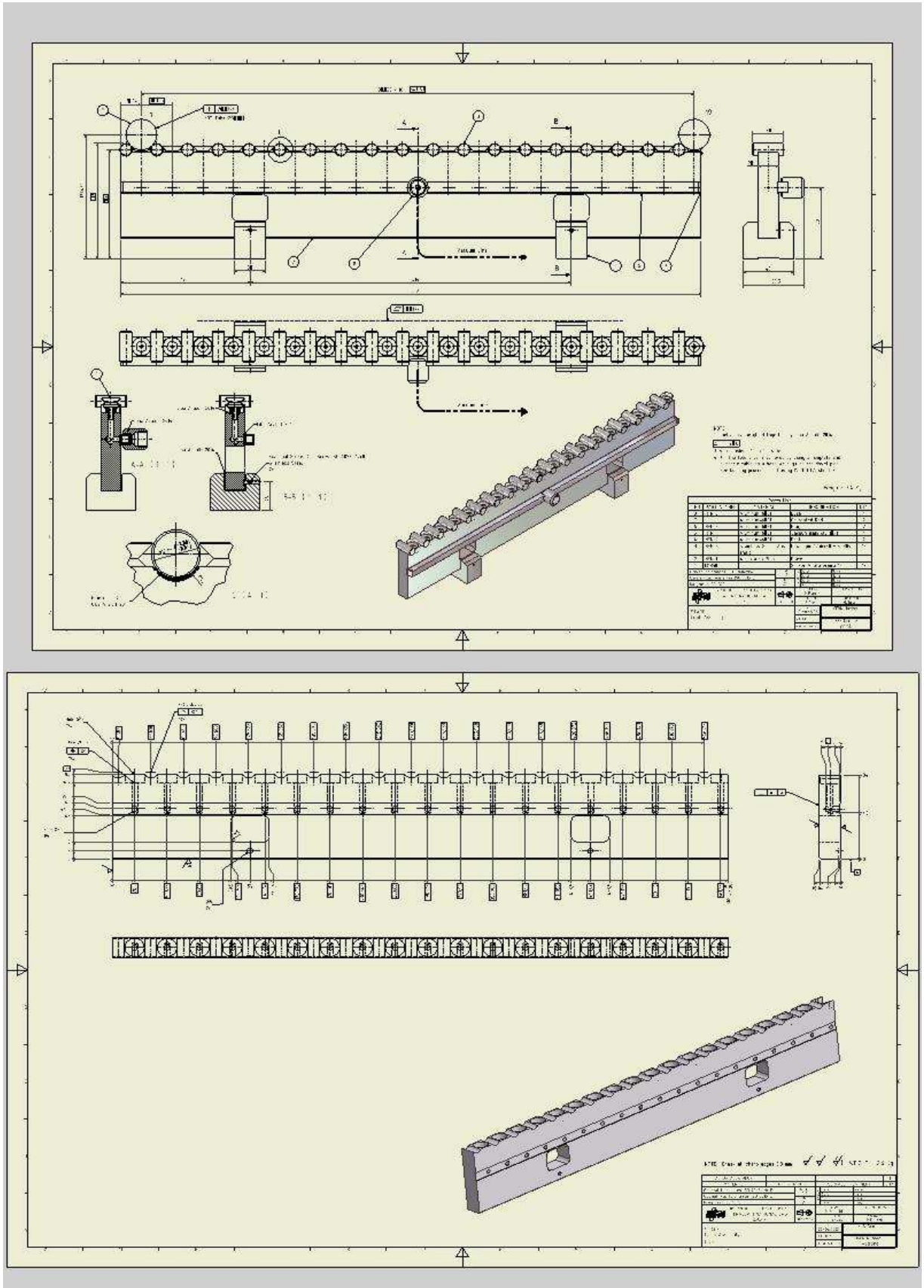
Moment of Inertia I1	[mm^4]	987800
Moment of Inertia I2	[mm^4]	56000
Moment of Inertia Ieff	[mm^4]	987800
Max. Border Dist.	[mm]	42
Safety Factor		6572.0963
Stretch Limits	[N/mm^2]	160
E-Modulus	[N/mm^2]	70000
Material		AlMgSi0.5F22
Max.Deflection d1	[mm]	0.032706 E-18
Max.Bending Moment Mb1	[Nm]	0.0351 E-15
Max.Deflection d2	[mm]	0.030281 E-3
Max.Bending Moment Mb2	[Nm]	0.5726
Max.Stress Res.	[N/mm^2]	24.345 E-3
Max.Deflection dres	[mm]	0.030281 E-3
Max.Bending Moment Mbres	[Nm]	0.5726
Scale for Defl. Line		2000000:1
Scale for bending mom. line		200:1

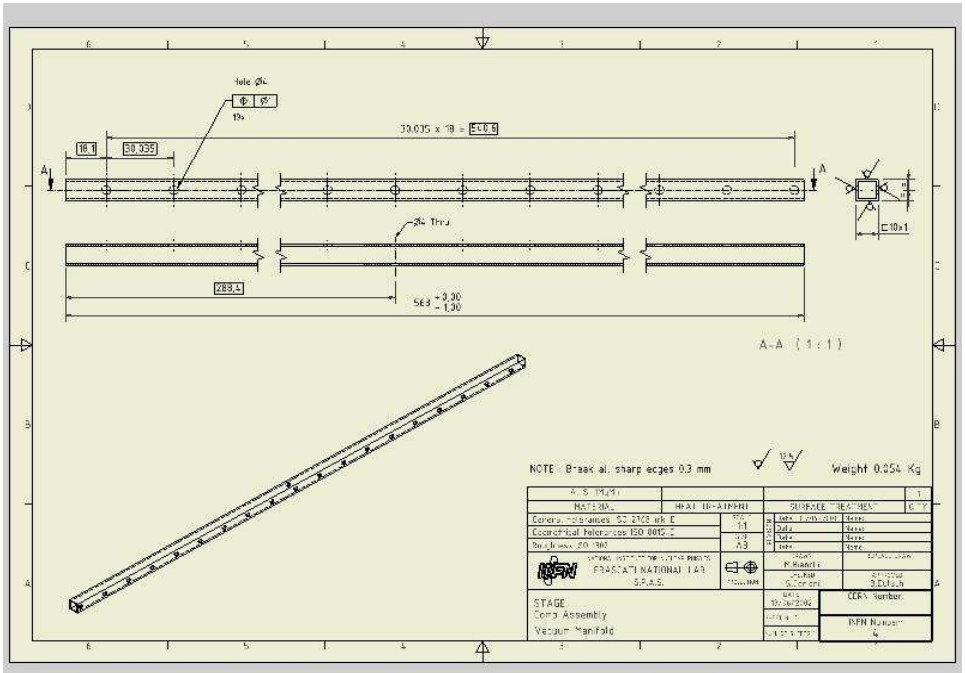


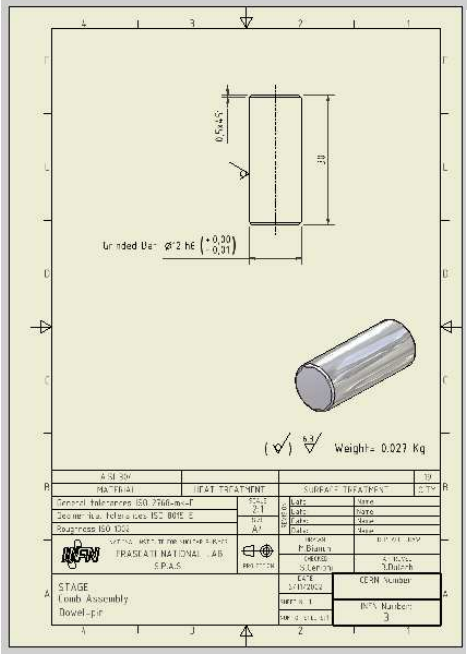
We see that there is a nice improvemt of the sagitta 0.03x10^-3 mm the gain factor is : 1.4x10^-3 / 0.03x10^-3 = **46** so we plan to realize the Precision Comb in this situation.

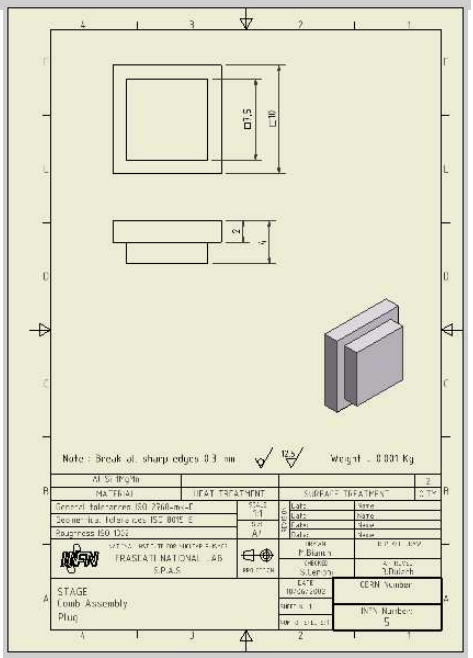
Drawings of the Precision Comb

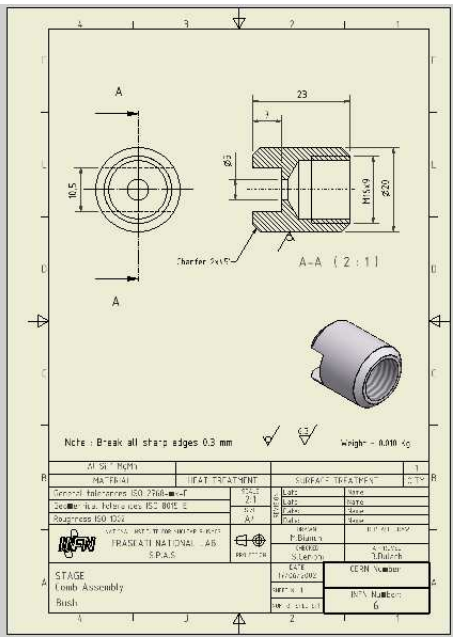
We realize the assembly and the detail drawings using Autodesk Inventor 5 , a 3D parametric CAD softare .

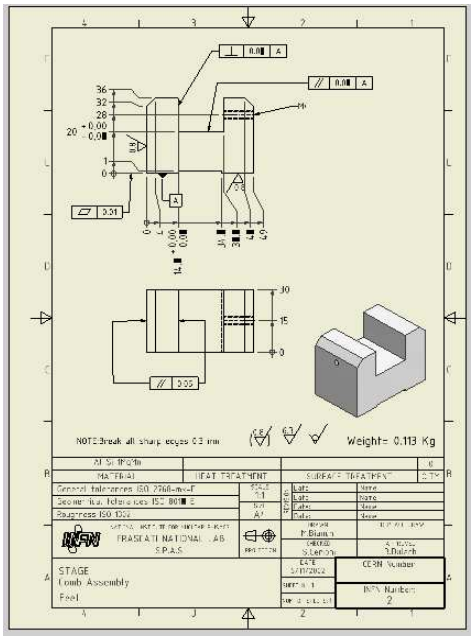



Note Ø4
15x
33.035 x 19 = 540.5
18.1
30.035
A
A
Ø4 Thru
288.4
563 +0.30 -1.90
C10x1
A-A (1 : 1)
NOTE : Break al. sharp ecges 0.3 mm
Weight 0.054 Kg
MATERIAL
HEAT TREATMENT
SURFACE TREATMENT
General tolerances ISO 2768 mK E
Geometrical tolerances ISO 8015 E
Roughness ISO 1302
1:1
A3
FRASCATI NATIONAL LAB
S.P.A.S.
STAGE
Comb Assembly
Vacuum Manifold
CERN Number
INFN Number
4


0.5x45°
Grinded Usit Ø12 h6 (+0.00 -0.01)
Weight= 0.027 Kg
MATERIAL
HEAT TREATMENT
SURFACE TREATMENT
General tolerances ISO 2768-mK-F
Geometrical Tolerances ISO 8015 E
Roughness ISO 1302
2:1
A4
FRASCATI NATIONAL LAB
S.P.A.S.
STAGE
Comb Assembly
Dowel-pin
CERN Number
INFN Number
3

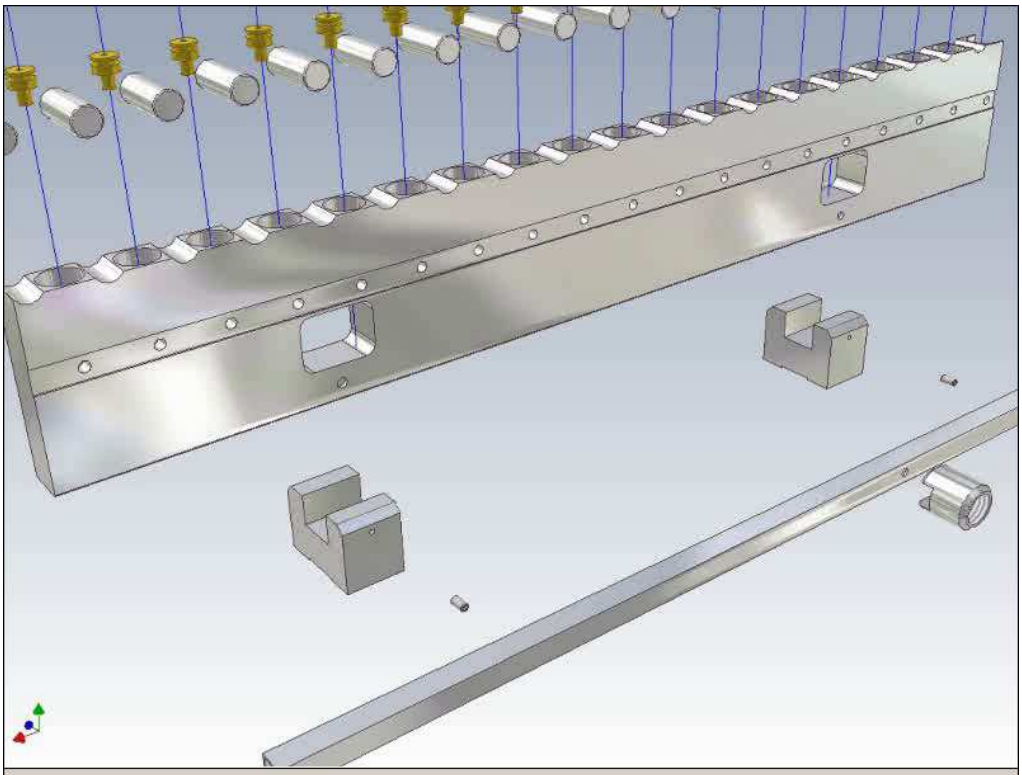

Ø1.5
L10
Note : Break al. sharp edges 0.3 mm
Weight = 0.001 Kg
MATERIAL
HEAT TREATMENT
SURFACE TREATMENT
General tolerances ISO 2768-mK-F
Geometrical Tolerances ISO 8015 E
Roughness ISO 1302
1:1
A4
FRASCATI NATIONAL LAB
S.P.A.S.
STAGE
Comb Assembly
Plug
CERN Number
INFN Number
5


A
23
10.5
Ø3
M15x1
Ø20
Charfer 2x45°
A-A (2 : 1)
A
Note : Break all sharp edges 0.3 mm
Weight = 0.010 Kg
MATERIAL
HEAT TREATMENT
SURFACE TREATMENT
General tolerances ISO 2768-mK-F
Geometrical Tolerances ISO 8015 E
Roughness ISO 1302
2:1
A4
FRASCATI NATIONAL LAB
S.P.A.S.
STAGE
Comb Assembly
Bush
CERN Number
INFN Number
6

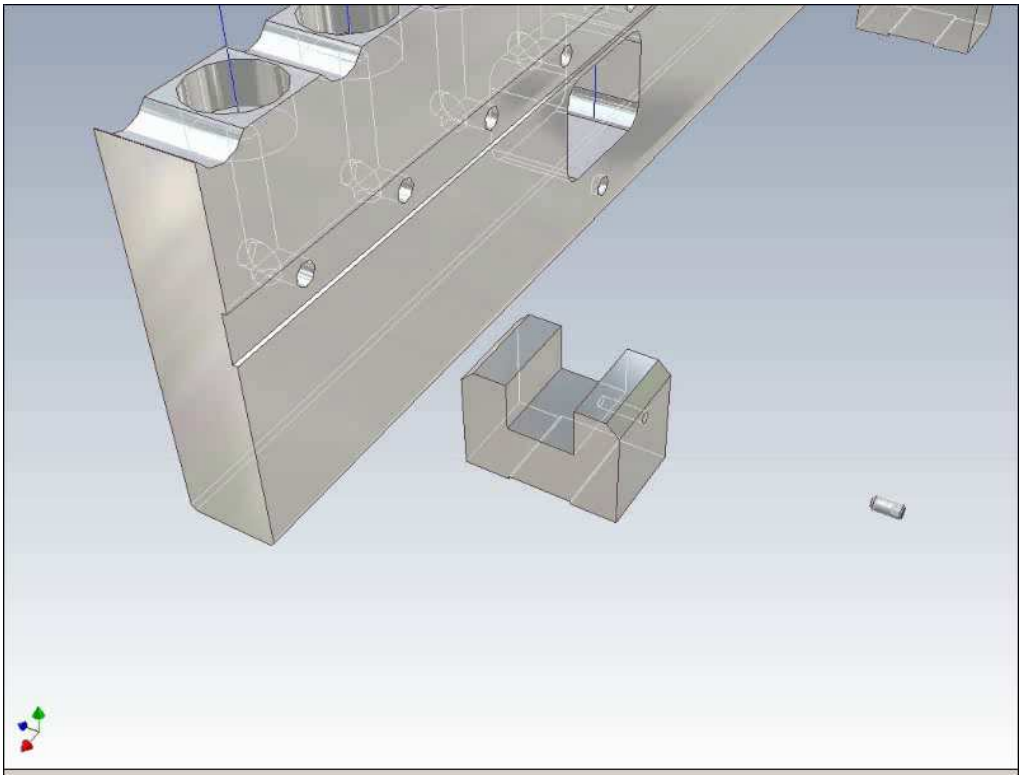

0.01 A
0.01 A
36
32
28
20 +0.00 -0.01
0.01 A
0.01
10
15
0
0.005
NOTE:Break all sharp ecges 0.3 mm
Weight= 0.113 Kg
MATERIAL
HEAT TREATMENT
SURFACE TREATMENT
General tolerances ISO 2768-mK-F
Geometrical Tolerances ISO 8015 E
Roughness ISO 1302
1:1
A3
FRASCATI NATIONAL LAB
S.P.A.S.
STAGE
Comb Assembly
Feet
CERN Number
INFN Number
2

Comb construcion

Here two short animation of the construcion procedure in .mpeg



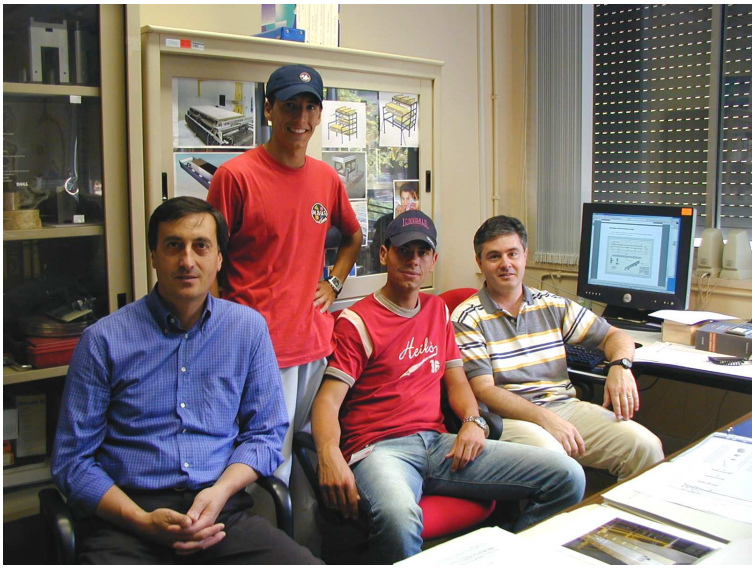
comb800



detail-h-800

Some photos

S.P.A.S Office



S.P.A.S Office

S.P.A.S Office

Clean Room

Clean Room

Workshop

Workshop

Metrology lab.