

LASER INTERFEROMETER
GRAVITATIONAL WAVE OBSERVATORY
- LIGO -
CALIFORNIA INSTITUTE OF TECHNOLOGY
MASSACHUSETTS INSTITUTE OF TECHNOLOGY

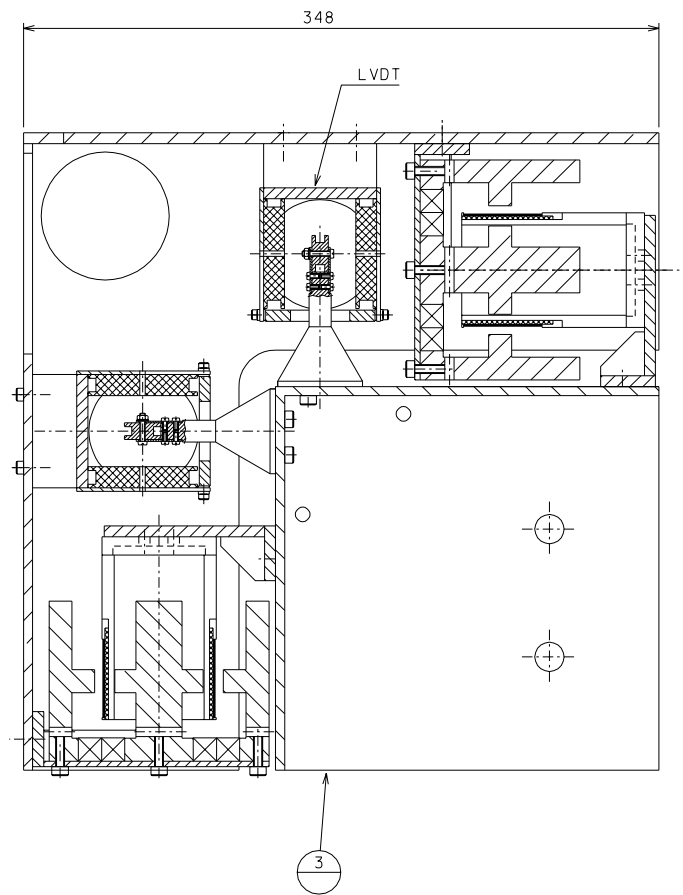
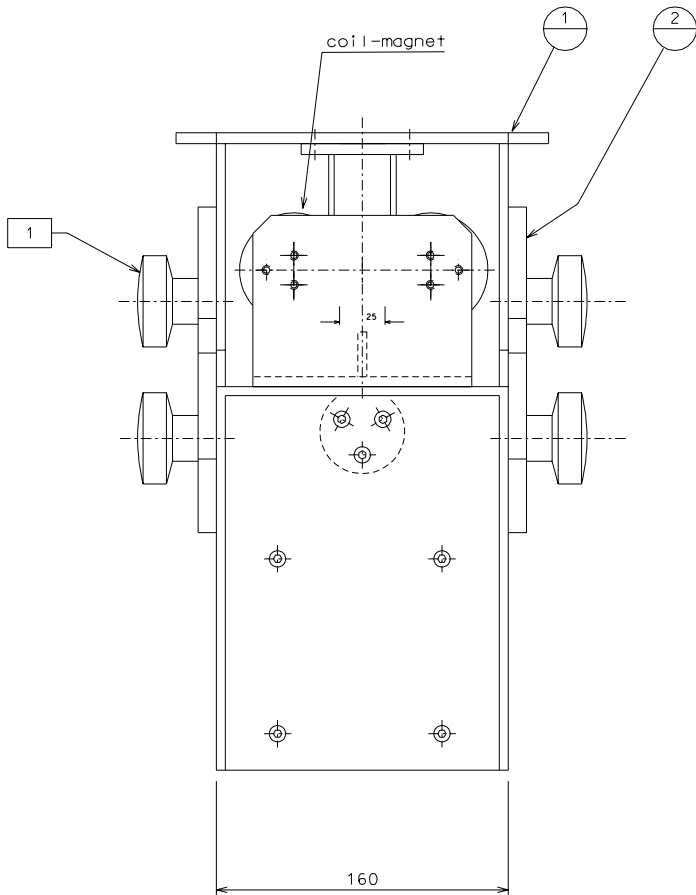
Technical Note	DCC Number LIGO- D020212-00-R	11 th April 2002
Active Internal Stack Damping Production Drawings		
Riccardo DeSalvo, Gianni Gennaro		

Distribution of this draft: TBD
This is an internal working note
of the LIGO Project.

California Institute of Technology
LIGO Laboratory - MS 18-34
Pasadena CA 91125
Phone (626) 395-212
Fax (626) 304-9834
E-mail: info@ligo.caltech.edu

Massachusetts Institute of Technology
LIGO Laboratory - MS 16NW-145
Cambridge, MA 01239
Phone (617) 253-4824
Fax (617) 253-7014
E-mail: info@ligo.mit.edu

www: <http://www.ligo.caltech.edu/>



Note: All screws are plated with silver

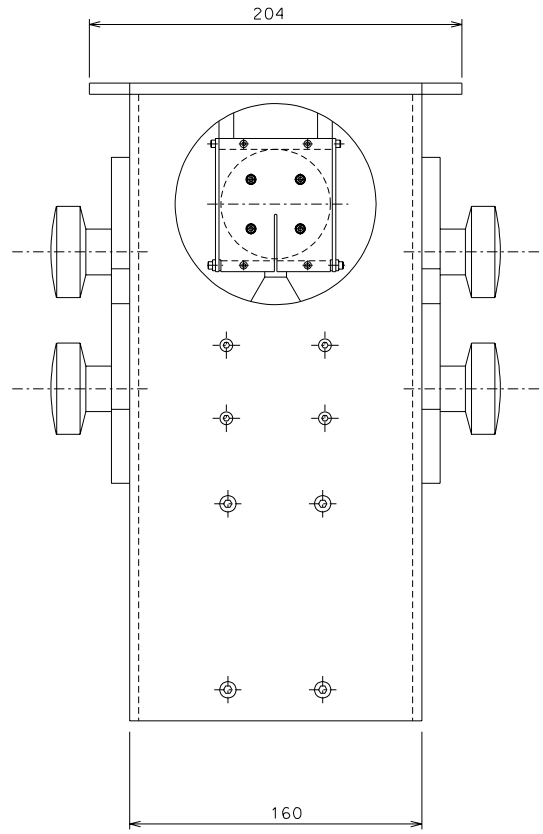
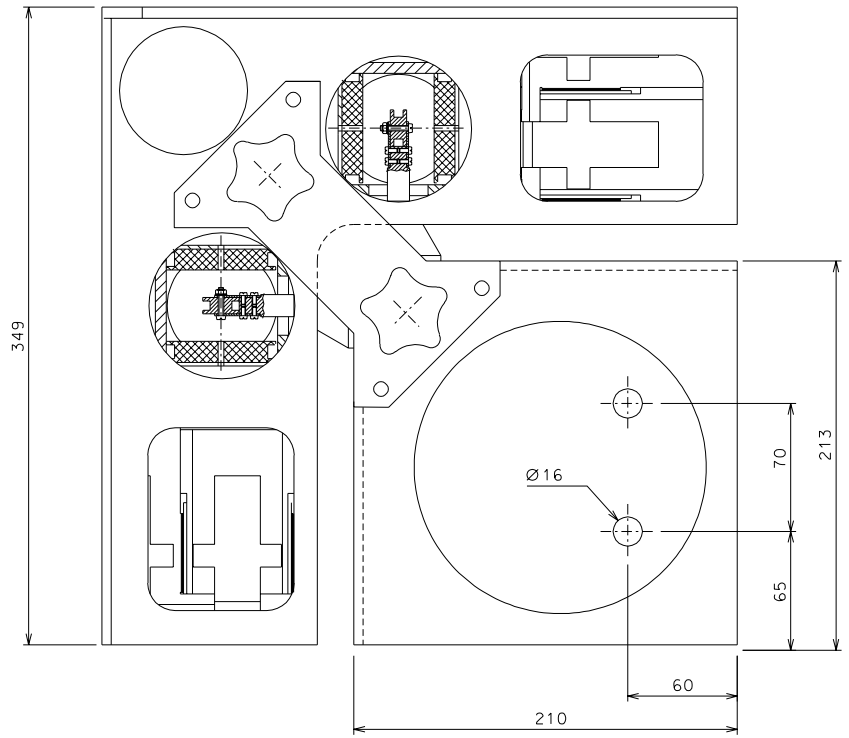
detail	type	n° piec.
3	tommy head screw 5Mx12	10
1	count. head screw 4Mx12	4
1	count. head screw 5Mx12	6
1	tommy head screw 4Mx12	4
1	tommy head screw 5Mx12	6
Screw's table		

1 Elesa VC. 192/50 S-p-M10x20 /N° 4 pieces

ref.	note	date	signature
modifications			

-	003	coil-magnet			
-	002	LVDT			
3	008	little box			
2	010	joint			
1	009	large box			
ref.	draw.	added legend	ref.	draw.	added legend

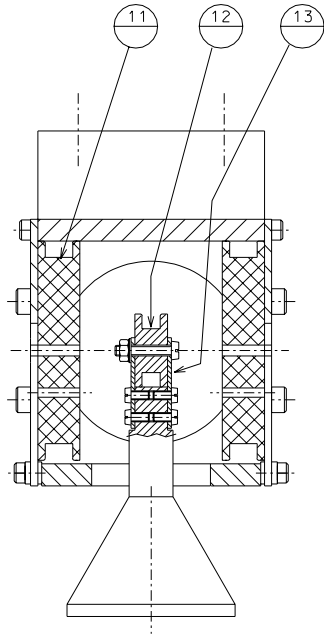
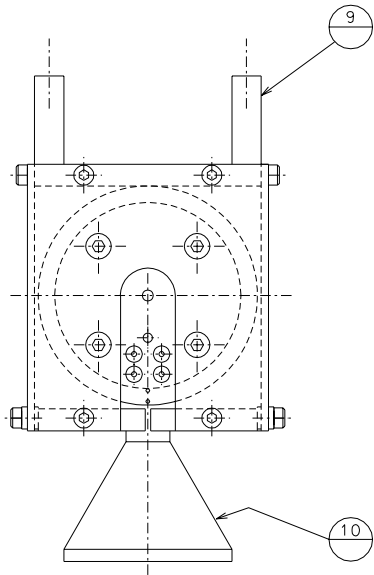
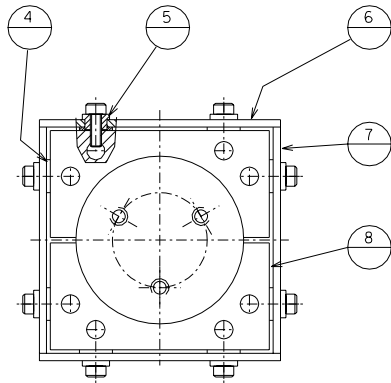
	LIGO PROJECT	designed for R. De Salvo
		ass. num. ligo1_damp.000
LIGO1 DAMPING SECTION		draw. PROMEC 17-02-02
		scale 1:2
		replaces dr. Num. A 2



ref.	draw.	added legend		ref.	draw.	added legend

ref.	note	date	signature
modifications			

	LIGO PROJECT	designed for R. De Salvo
		ass. numb. ligo1.damp.001
LIGO1 DAMPING VIEW	draw. PROMEC 17-02-02	scale 1:2
	replaces dr. numb.	A 2



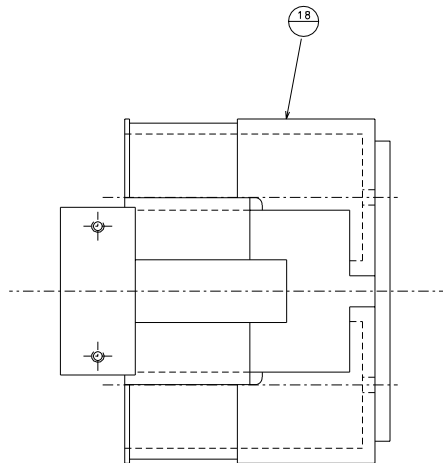
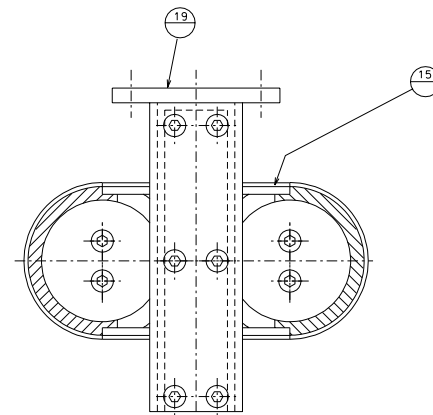
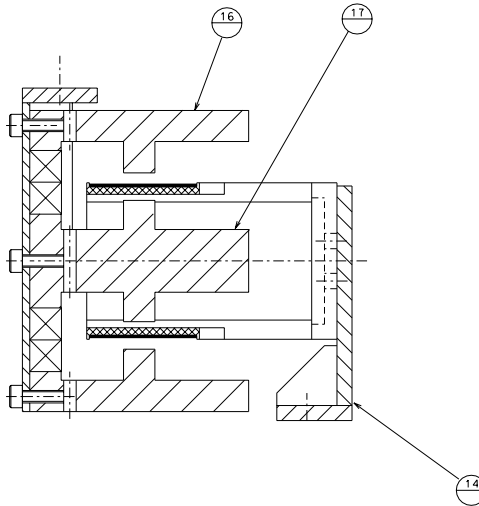
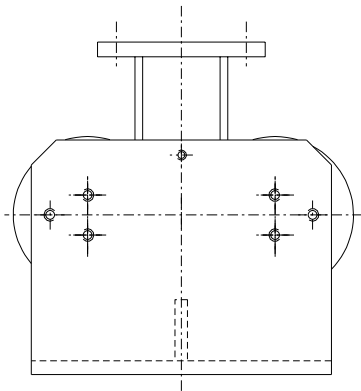
ref.	note	date	signature
modifications			

Note: All screws are plated with silver

ref.	draw.	added legend	ref.	draw.	added legend
12-13	nut 3M	2			
12-13	flat head screw 3Mx16	2			
12-13	flat head screw 2.5Mx5	8			
6-11	tommy head screw 5Mx12	16			
6-7-8-9	tommy head screw 3Mx8	32			
detail	type	n°piec.			
Screw's table					

9	005	bottom plate			
8	004	front plate			
7	005	lateral plate	13	004	join little coil
6	005	lateral plate	12	004	little coil
5	004	insulator ring	11	005	big coil
4	004	insulator ring	10	004	support little coil
ref.	draw.	added legend	ref.	draw.	added legend

	LIGO PROJECT	designed for R. De Salvo
	LIGO1 DAMPING LVDT	ass. numb. ligo1_damp.002
title		draw. PROMEC 17-02-02
		scale 1:1
		replaces dr. Num.
		A 2



Note: All screws are plated with silver

ref.	desc.	qty.
16-17-19	tommy head screw 5Mx12	12
15-18	count. head screw 2.5Mx6	24
14-18	tommy head screw 5Mx12	12
detail	type	n°piec.

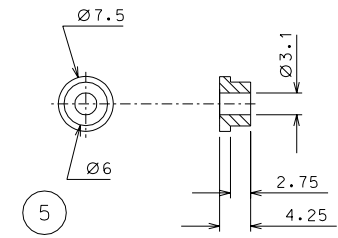
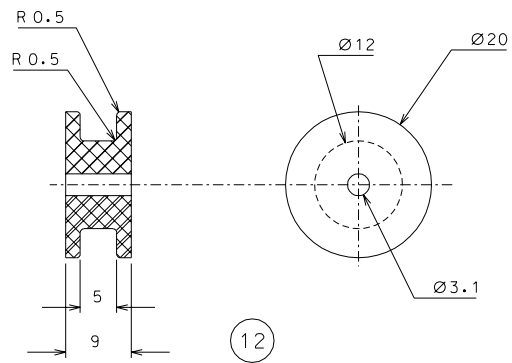
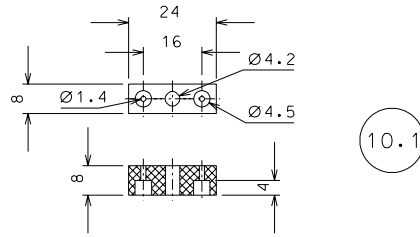
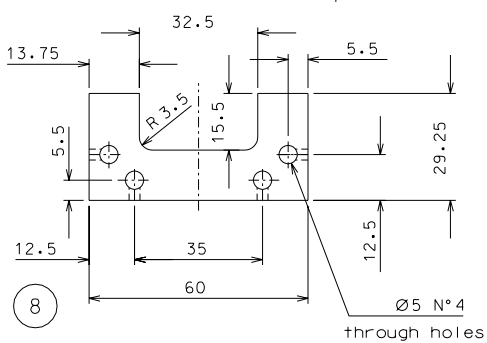
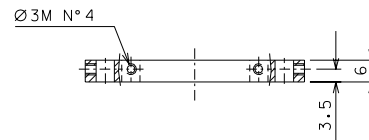
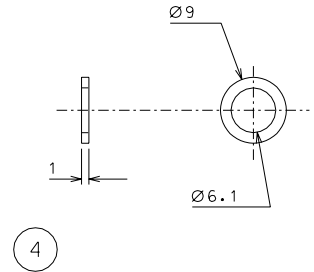
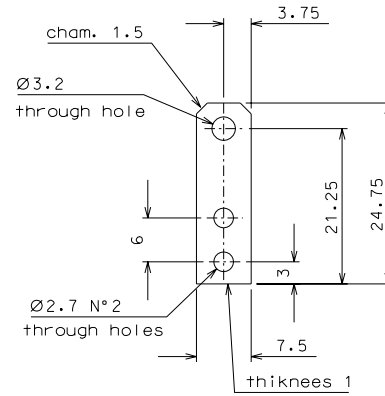
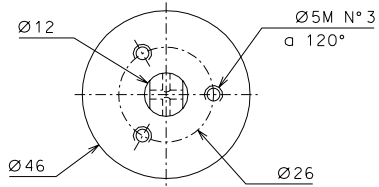
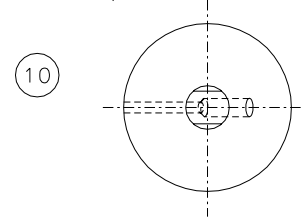
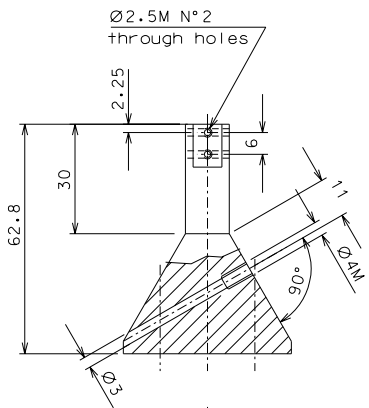
Screw's table

ref.	desc.	code legend	ref.	desc.	code legend
19	007	magnet base			
18	006	coil's spools			
		central flux guide			
17	006	flux guides			
16	006	flux guides			
15	006	coil tray			
14	007	coil spool base			

ref.	note	date	signature

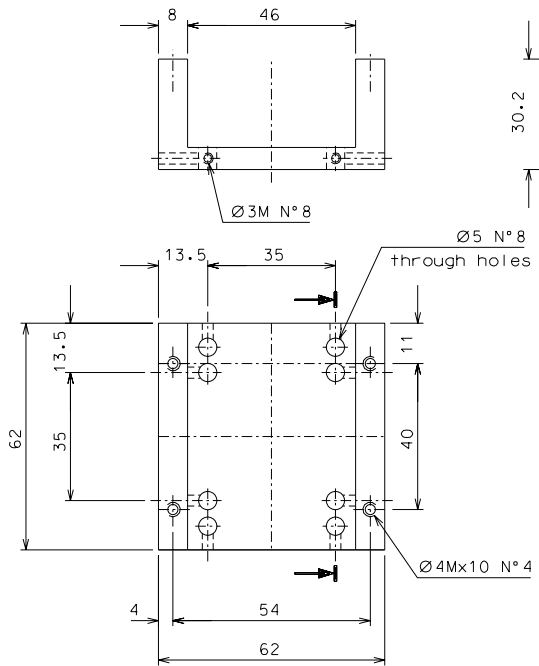
modifications

	LIGO PROJECT LIGO1 DAMPING COIL-MAGNET	designed for R. De Salvo des. num. ligo1_damp.003
		scale 1:1 revision or. Num. A 2

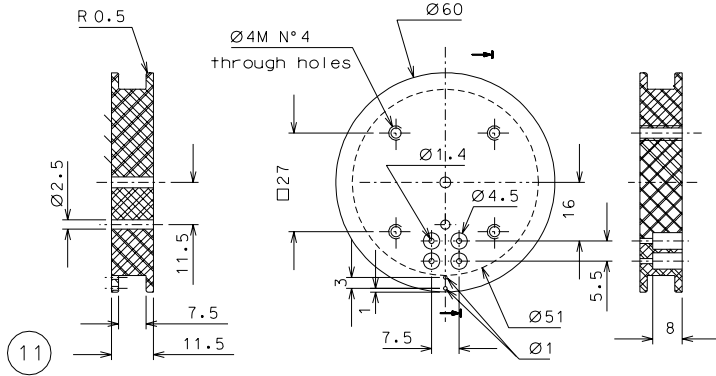


10	2	AL alloy	1:1				
8	4	AL alloy	1:1	13	4	stainless steel	2:1
5	16	peek	2:1	12	2	peek	2:1
4	16	peek	2:1	10.1	2	peek	2:1
ref.	pieces	mat. and treatments	scale	ref.	pieces	mat. and treatments	scale

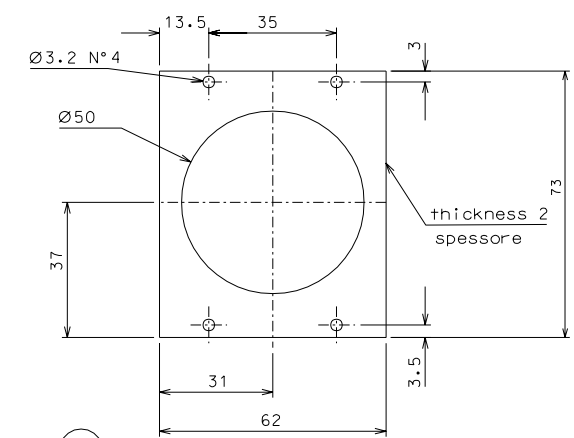
General machining tolerances UNI 5307-63							
Dimensions	< 6	6-30	30-120	120-315	315-1000	1000-4000	> 4000
Linear Toli.	± 0.1	± 0.2	± 0.3	± 0.5	± 0.8	± 1.2	± 3
Angular Toli.	± 1	± 30'	± 20'	± 10' referred to the shortest side			
				LIGO PROJECT designed for R. De Salvo n. ligo1_damp.004			
title LIGO1 DAMPING DETAILS				draw. PROMEC 22-02-02 details from 002 replaces dr. Num. A 2			



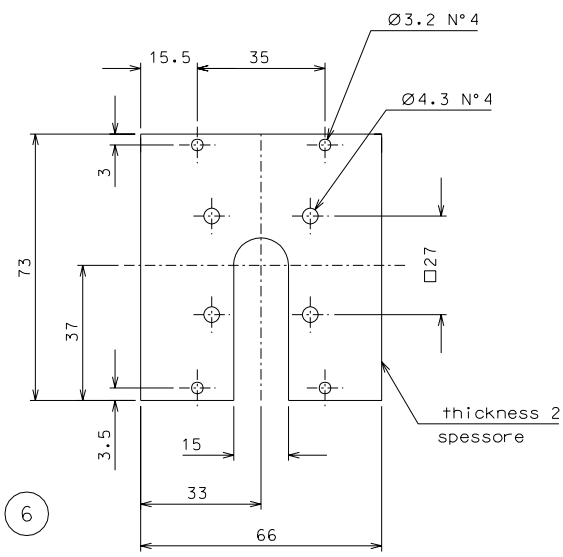
9



11



7

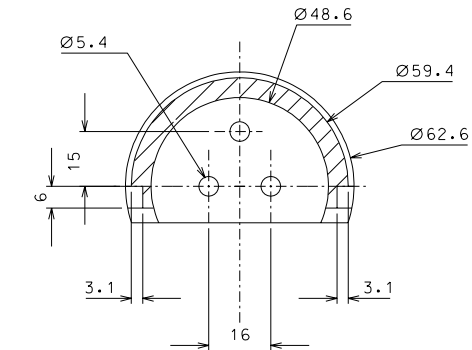
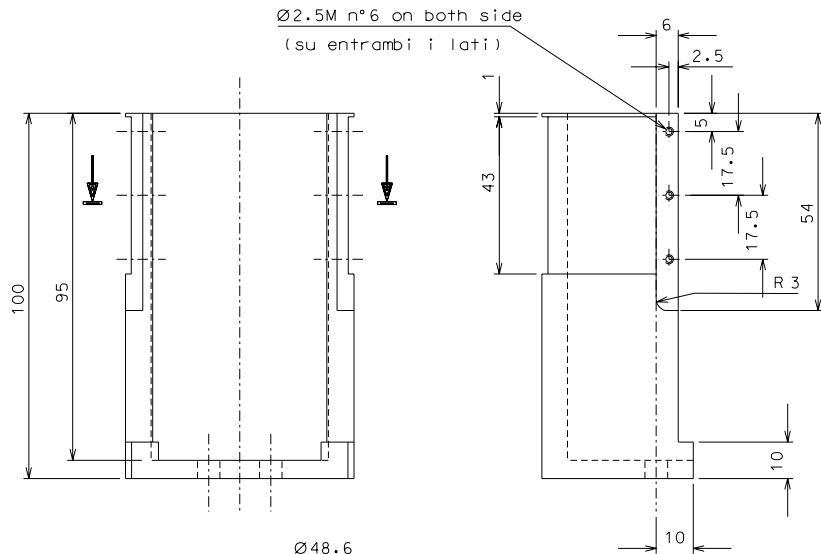


6

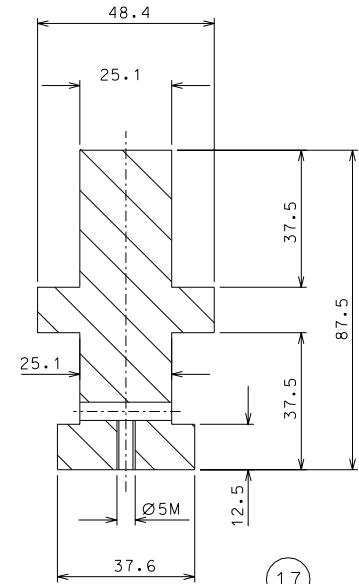
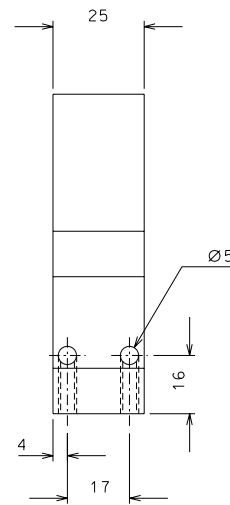
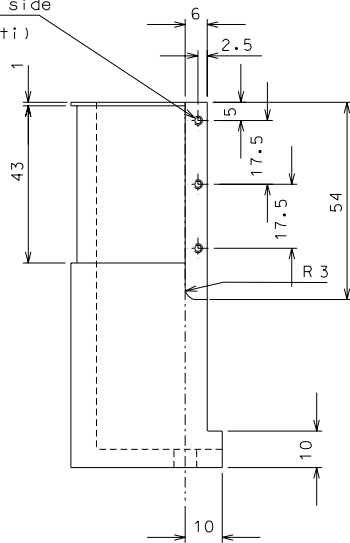
11	4	peek	1:1				
9	2	AL alloy	1:1				
7	4	AL alloy	1:1				
6	4	AL alloy	1:1				
ref.	pieces	mat. and treatments	scale	ref.	pieces	mat. and treatments	scale

General machining tolerances UNI 5307-63							
Dimensions	< 6	> 6-30	> 30-120	> 120-315	> 315-1000	> 1000-2000	> 2000-4000
Linear Toli.	± 0,1	± 0,2	± 0,3	± 0,5	± 0,8	± 1,2	± 3
angular Toli.	± 1'	± 30'	± 20'	± 10' referred to the shortest side			

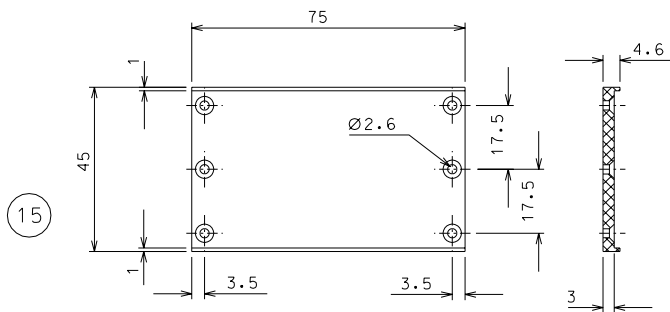
	LIGO PROJECT		designed for R. De Salvo
	title		n. ligo1_damp.005
LIGO1 DAMPING		rev. PROMEC 22-02-02	
DETAILS		details from 002	
replaces dr. Num.		A 2	



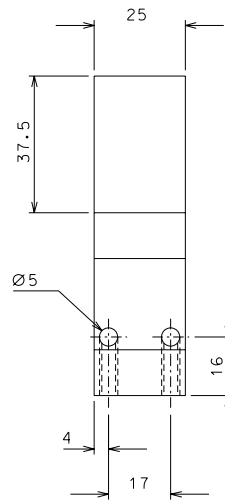
18



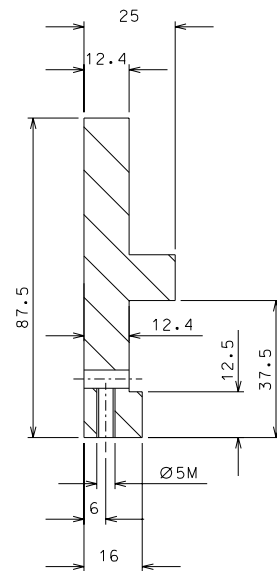
17



15



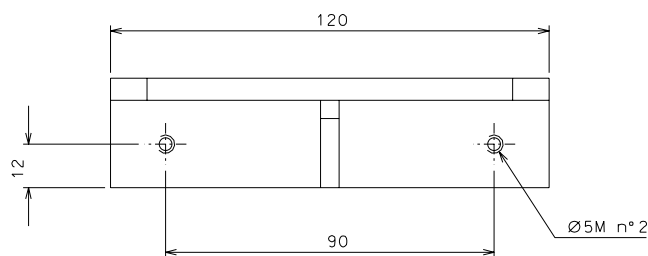
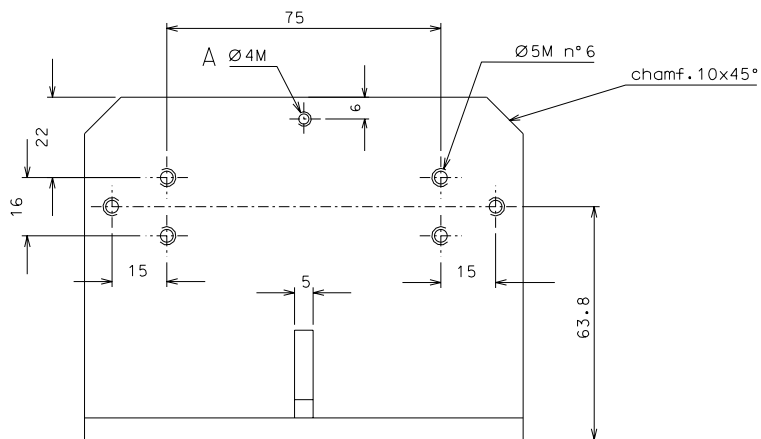
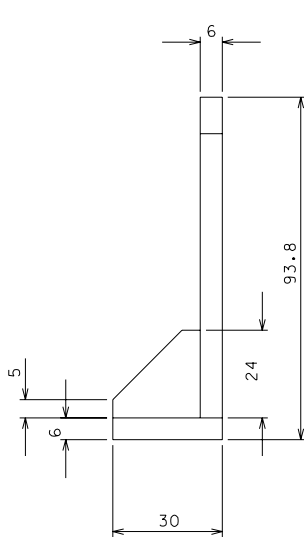
16



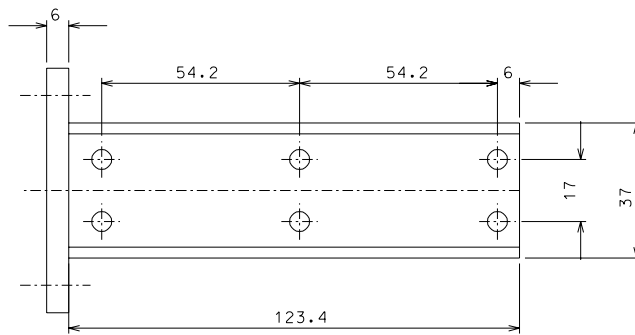
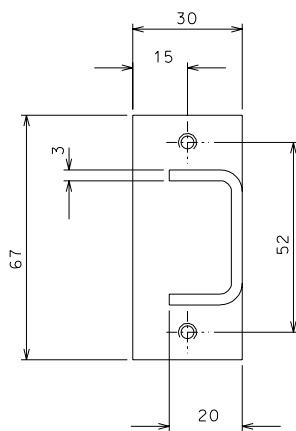
ref.	note	date	signature
	Modified details 15 and 18	14-3-02	
modifications			

18	4	AISI 304	1:1				
17	2	ARMCO steel	1:1				
16	4	"	1:1				
15	4	peek	1:1				
ref.	pieces	mat. and treatments	scale	ref.	pieces	mat. and treatments	scale

General machining tolerances UNI 5307-63								
Dimensions	< 6	> 6-30	> 30-120	> 120-315	> 315-1000	> 1000-2000	> 2000-4000	> 4000
Linear Toli.	± 0.1	± 0.2	± 0.3	± 0.5	± 0.8	± 1.2	± 2	± 3
angular Toli.	± 1'	± 30'	± 20'	± 10' referred to the shortest side				
				LIGO PROJECT				
title LIGO1 DAMPING DETAILS				designed for R. De Salvo n. ligo1_damp.006 draw. PROMEC 3-3-02 details from 003 replaces dr. Num. A 2				



14
welded
(saldato)



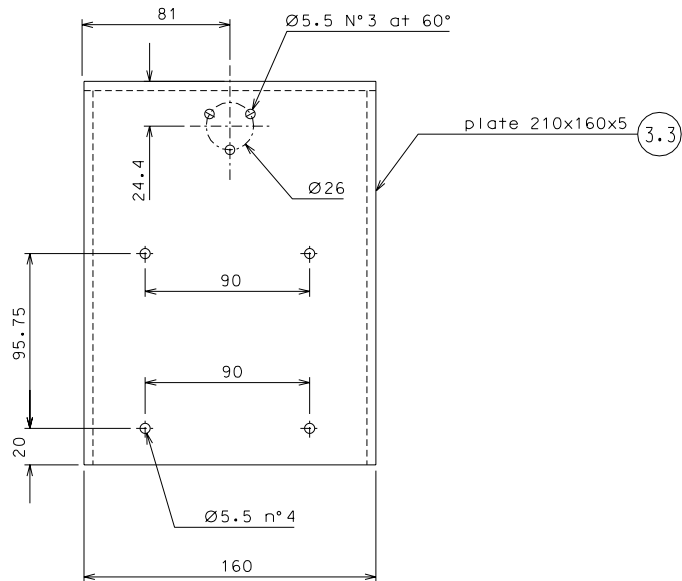
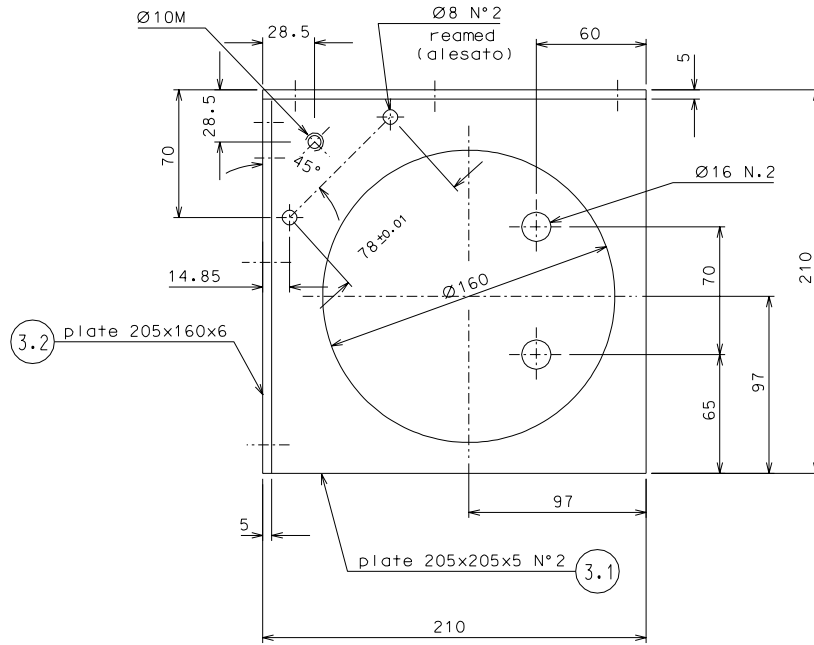
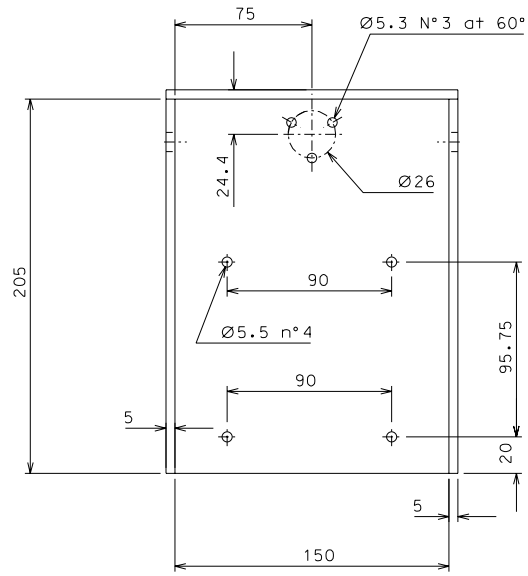
19
welded
(saldato)

A	Added hole		14-3-02	
ref.	note		date	signature
modifications				

19	2	AISI 304	1:1				
14	2	AISI 304	1:1				
ref.	pieces	mat. and treatments	scale	ref.	pieces	mat. and treatments	scale

General machining tolerances UNI 5307-63								
Dimensions	< 6	>6-30	>30-120	>120-315	>315-1000	>1000-2000	>2000-4000	>4000
linear Toli.	± 0.1	± 0.2	± 0.3	± 0.5	± 0.8	± 1.2	± 2	± 3
angular Toli.	± 1'	± 30'	± 20'	± 10'				

	LIGO PROJECT	designed for R. De Salvo
		N. ligo1_damp.007
		draw. PROMEC 3-3-02
		details from 003
title LIGO1 DAMPING DETAILS		replaces dr. Num. A 3



Note: Copy the holes for pins from detail n°3

Nota: Copia i fori per le spine di riferimento dal part. n°2

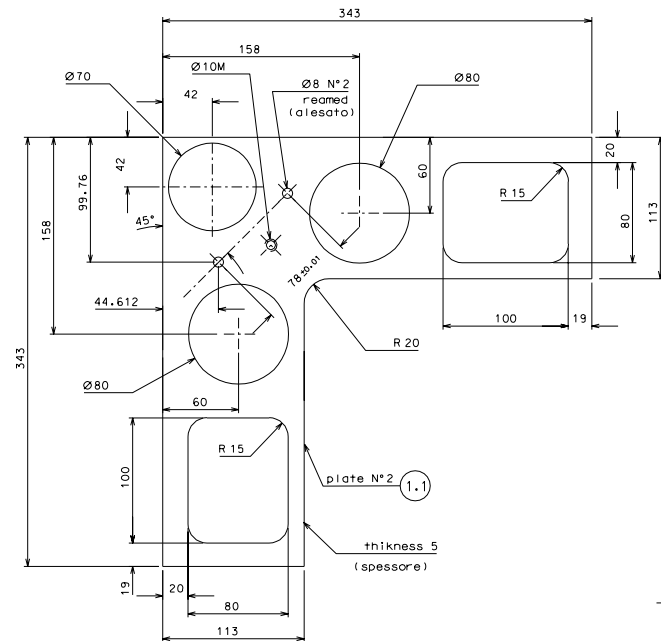
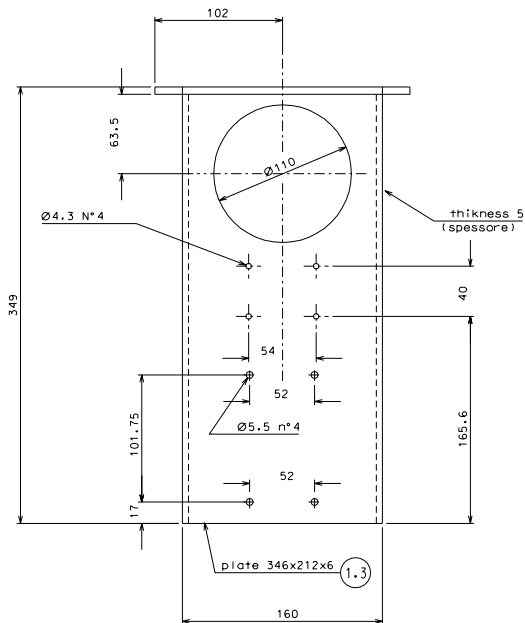
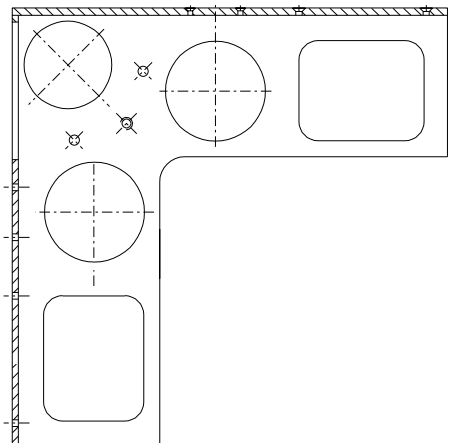
3 welded structure
struttura saldata

ref.	note	date	signature
modifications			

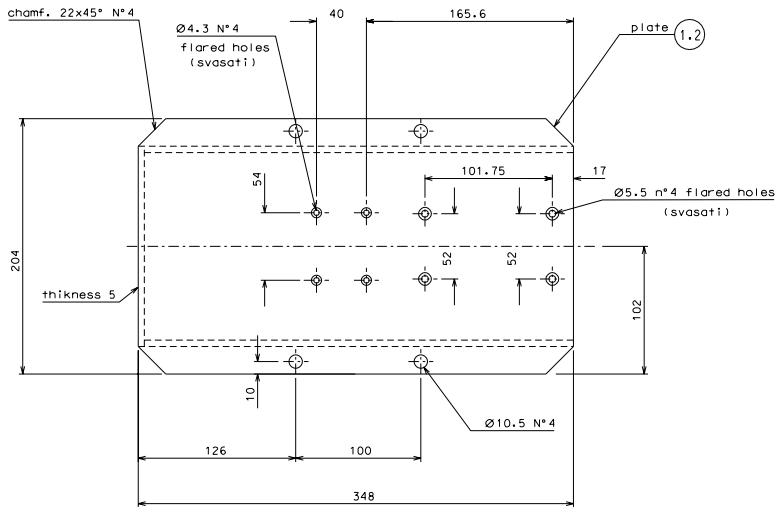
ref.	pieces	mat. and treatments	scale	ref.	pieces	mat. and treatments	scale
3.3	1	AISI 304 L	1:2				
3.2	1	AISI 304 L	1:2				
3.1	1+1	AISI 304 L	1:2				

General machining tolerances UNI 5307-63							
Dimensions	< 6	> 6-30	> 30-120	> 120-315	> 315-1000	> 1000-2000	> 2000-4000
Linear Toli.	± 0.1	± 0.2	± 0.3	± 0.5	± 0.8	± 1.2	± 3
angular Toli.	± 1'	± 30'	± 20'	± 10' referred to the shortest side			

	LIGO PROJECT designed for R. De Salvo N. ligo1_damp.008	
	title LIGO1 DAMPING DETAILS	
replaces dr. Num.		A 2



Note: Copy the holes for pins from detail n°3
 Nota: Copia i fori per le spine di riferimento dal part. n°2

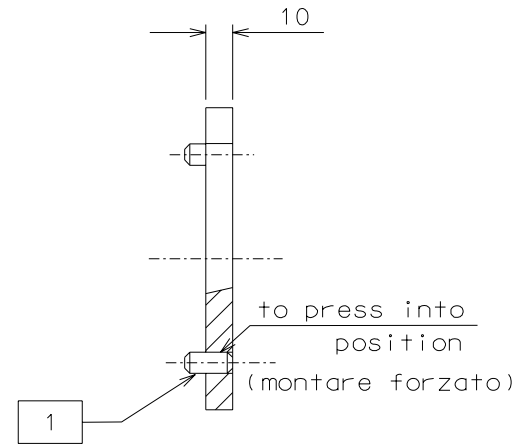
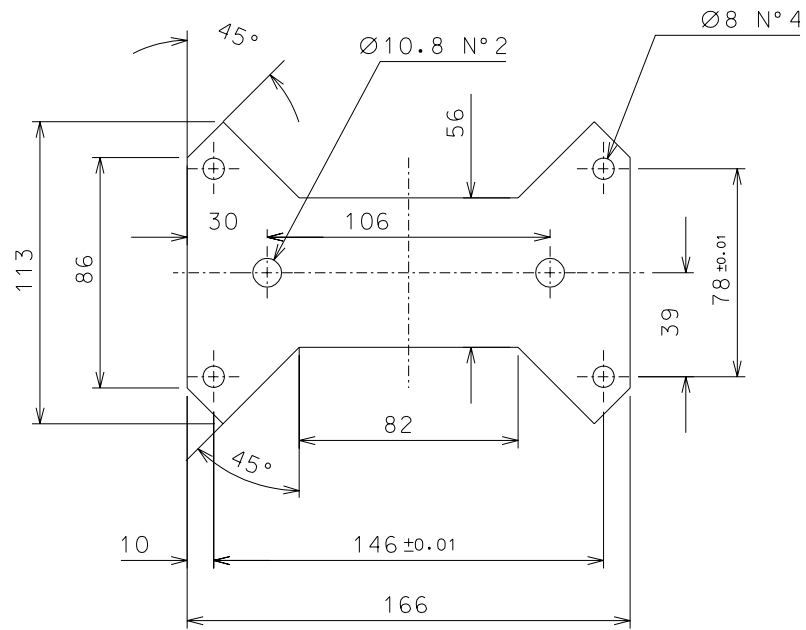


(1) welded structure
 struttura saldata

ref.	piece	mat. and treatments	size	ref.	piece	mat. and treatments	size
1.3	1	AISI 304 L	1x2				
1.2	1	AISI 304 L	1x2				
1.1	2	AISI 304 L	1x2				

General machining tolerances UNI 5007-63							
Dimension	< 4	4-50	50-100	100-315	315-1000	1000-4000	> 4000
linear dim.	±0.1	±0.2	±0.3	±0.5	±1.0	±2.0	±3.0
angular dim.	±1'	±30"	±20"	±10"	related to the shortest side		

designed for R. De Salvo
 n. ligo1_damp-009
 draw. PROMEC 22-02-02
 details from 000
 replaced or. Num. A 1



2

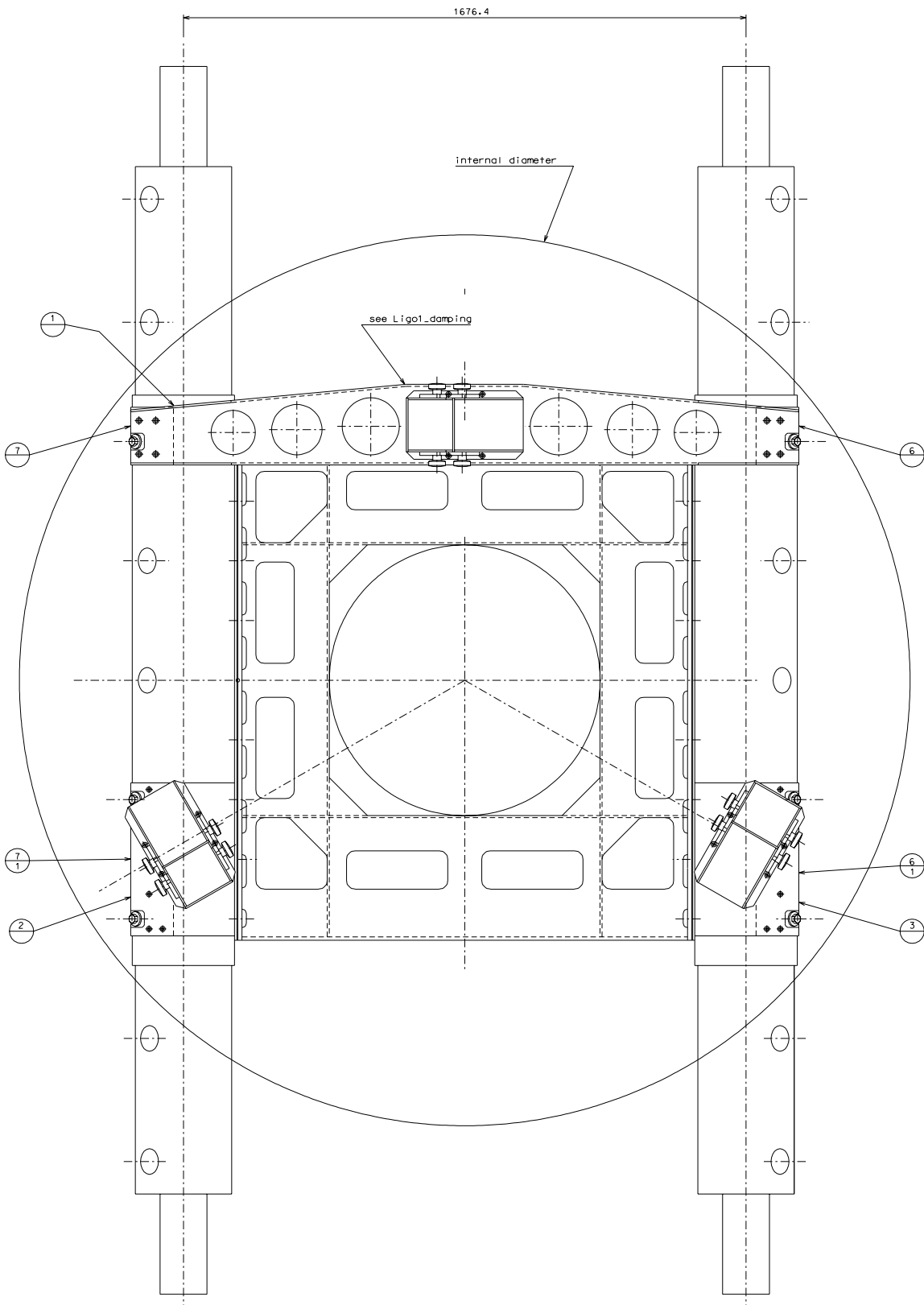
1 pin (perno) UNI-ISO 2340-A-8x18-St /N° 4 pieces

2	2	Al UNI 9006/2	1:2
ref.	pieces	mat. and treatments	scale

ref.	pieces	mat. and treatments	scale

General machining tolerances UNI 5307-63								
Dimensions	< 6	>6-30	>30-120	> 120-315	> 315-1000	>1000-2000	>2000-4000	> 4000
linear TOLL.	± 0.1	± 0.2	± 0.3	± 0.5	± 0.8	± 1.2	± 2	± 3
angular TOLL.	± 1'	± 30'	± 20'	± 10' referred to the shortest side				

	LIGO PROJECT	designed for R. De Salvo
		N. ligo1_damp.010
title LIGO1 DAMPING DETAILS	draw. PROMEC 22-02-02	
	details from 000	
	replaces dr. Numb.	A 3



Note: All screws are plated with silver

ref.	desc.	qty	unit
2-3	counter-head screw 10x20	16	
1	tommy head screw 10x20	12	
Ligo1_damp	tommy head screw 10x16	8	
detail	type	n° piec.	

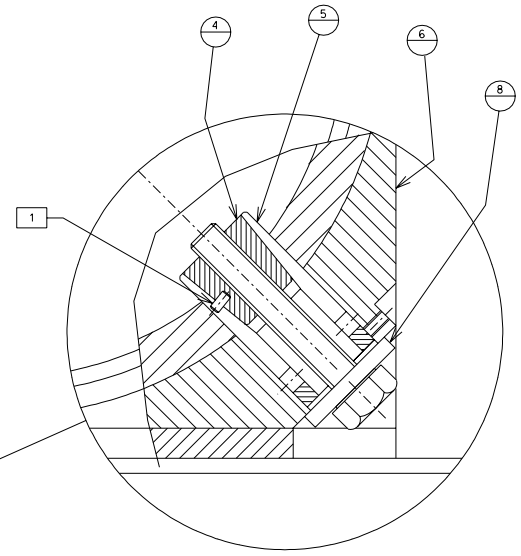
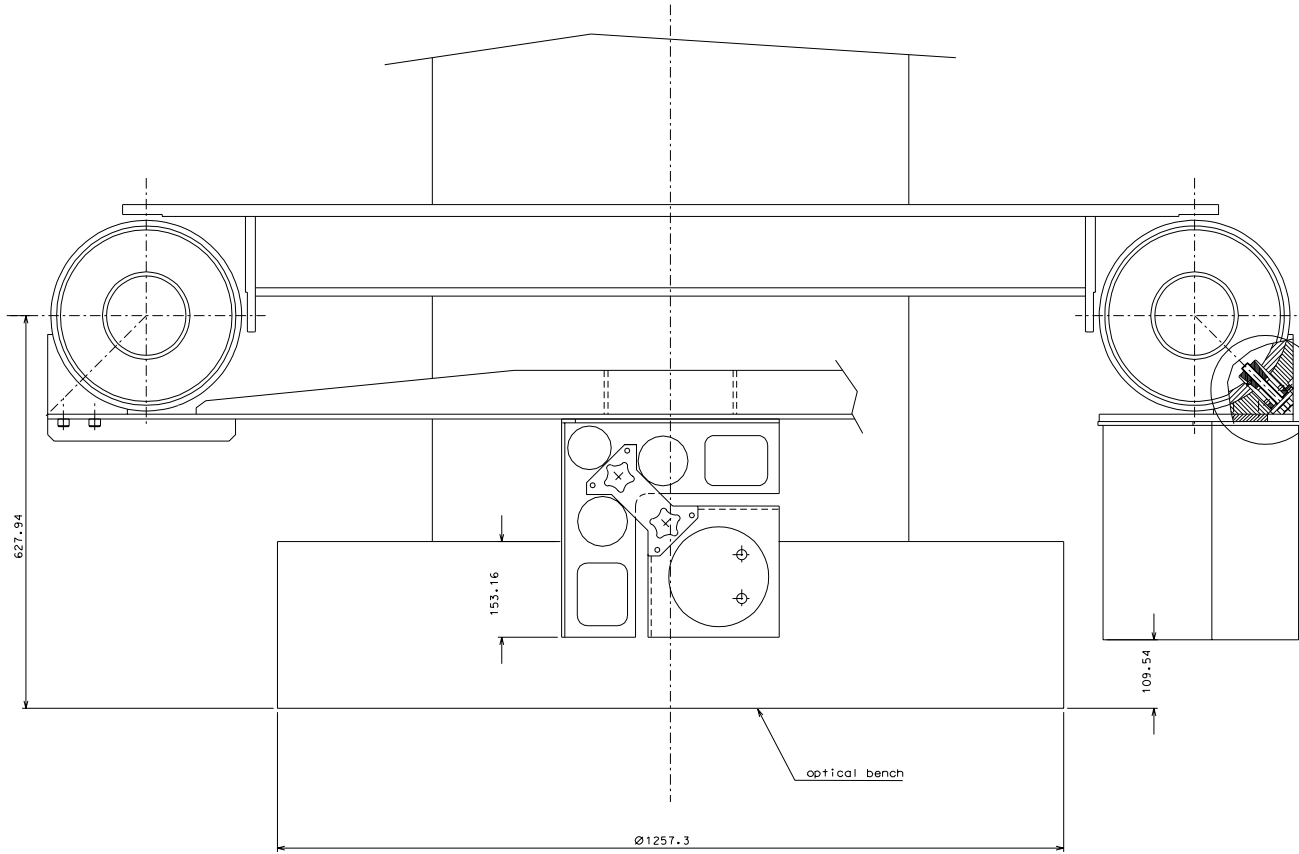
Screw's table

ref.	name	date	signature

modifications

7	003	fastening			
6.1	004	fastening			
6	003	fastening			
3	006	plate support			
2	006	plate support			
1	005	barrel support			
ref.	draw.	code support	ref.	draw.	code support

	designed by R. De Saivo
	draw. num. Opt._damp.000
draw. PRGMEC 17-02-02	scale 1:6
OPTICAL DAMPING SUPPORT TABLE	ref/issue or. num. A 1



SCALE 1:1

Note: All screws are plated with silver

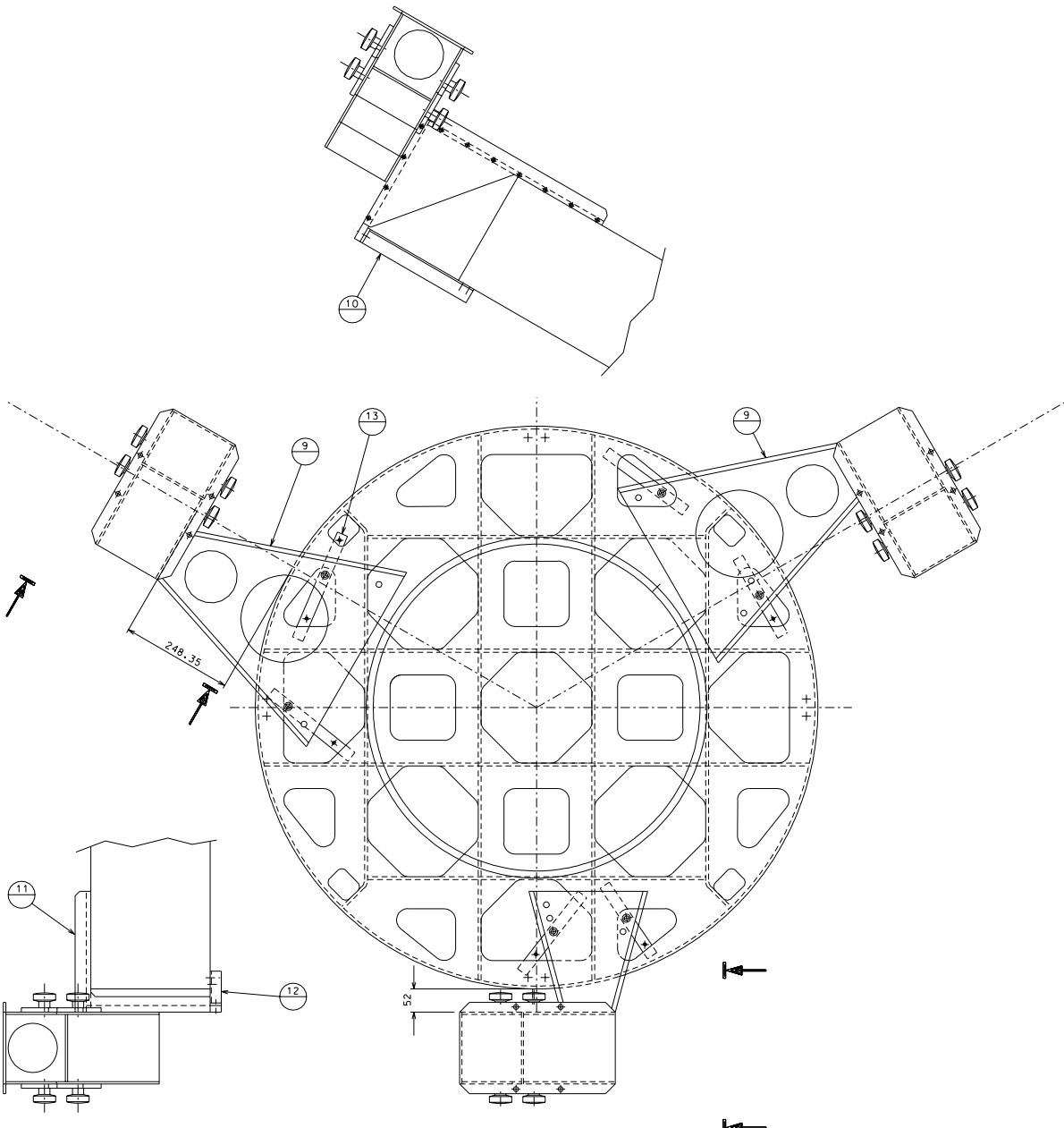
ref.	desc.	qty	unit
6	grub screw 5Mx6 inox	6	
6	hex.head bolt 14Mx80	6	
detail	type	n°piec.	
Screw's table			

1 pin (perno) UNI-ISO-2340-A-4-8-S+

ref.	note	date	signature
modifications			

ref.	desc.	qty	unit	ref.	desc.	qty	unit
8	006 washer						
6	003 fastening						
5	006 expander clamping						
4	006 cone						

	LIGO PROJECT	designed for R. De Salvo
		ass. num. CD1-...damp-001
1114 OPTICAL DAMPING LATERAL VIEW		des. PRIMEC 17-02-02
scale 1:4		ref/issue or. Num. A 1



Note: All screws are plated with silver

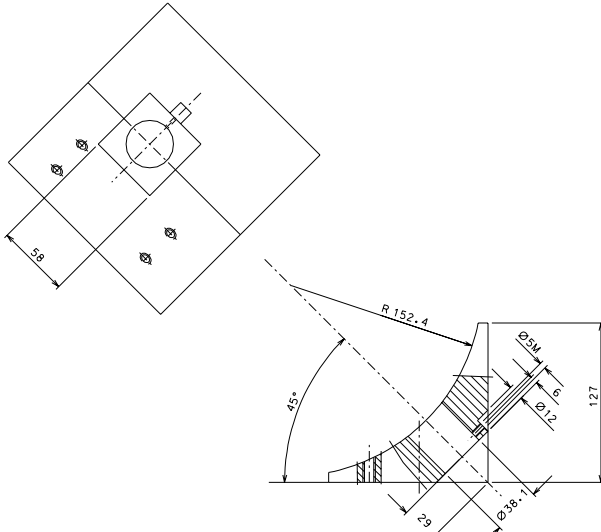
detail	type	n°piec.
11	tommy head screw 5Mx20	16
9	tommy head screw 5Mx20	56
9-10-11-12	tommy head screw 10Mx20	3
9-11	tommy head screw 10Mx45	12

Screw's table

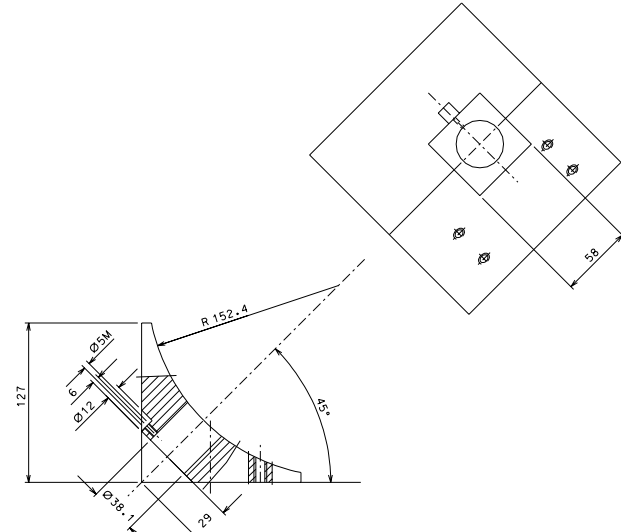
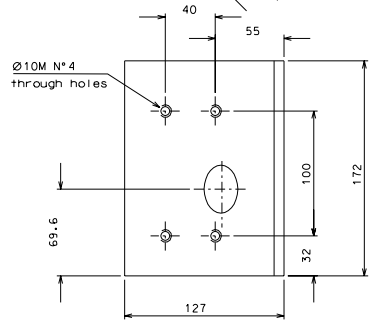
ref.	note	date	signature
modifications			

13	009	fastening			
12	009	ligot refor.			
11	008	ligot support			
10	009	ligot refor.			
9	007	ligot support			
ref.	draw.	added legend	ref.	draw.	added legend

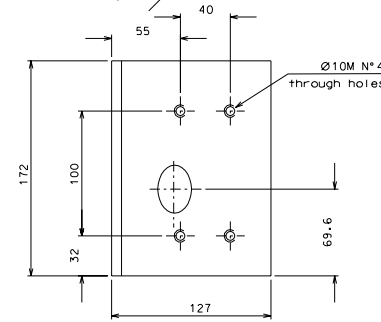
	LIGO PROJECT	designed for R. De Saivo
	OPTICAL DAMPING TOP OPTICAL BENCH	dra. num. Opt. _damp.002
1716	scale 1:5	dra. PRGMEC 17-02-02
		ref/rev. dr. num.



6



7

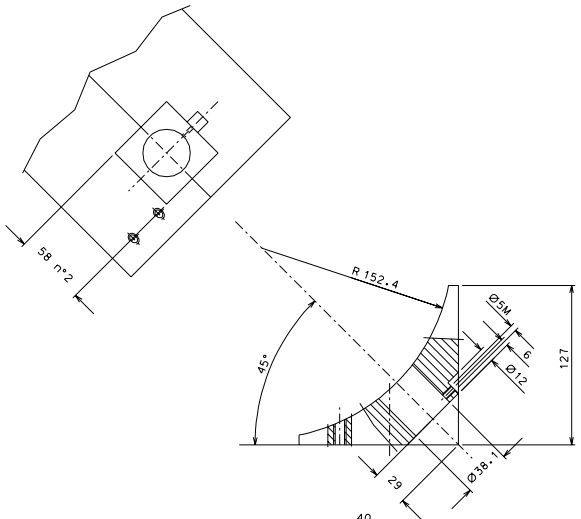


ref.	note	date	signature
modifications			

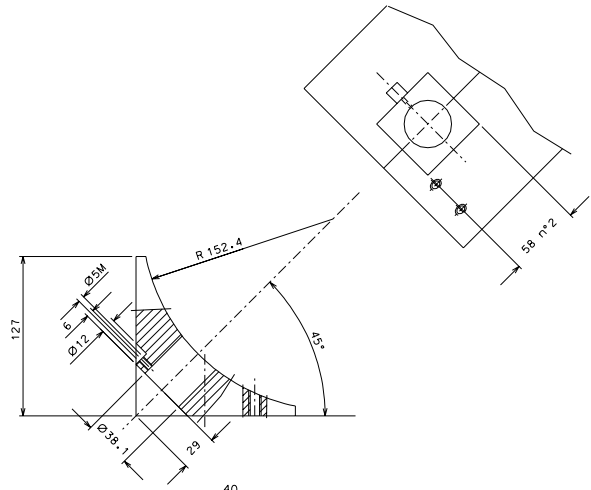
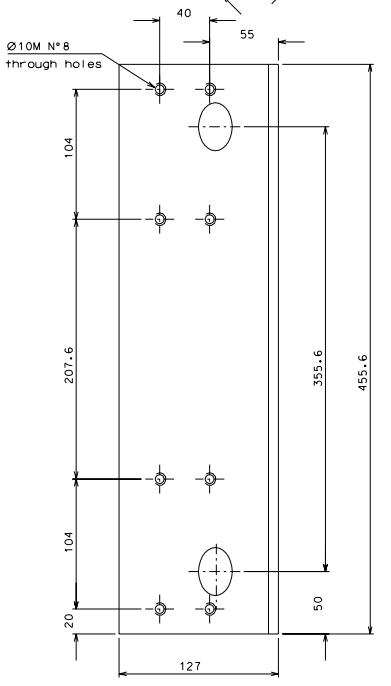
ref.	piece	mat. and treatments	scale	ref.	piece	mat. and treatments	scale
7	1	AISI 304	1:2				
6	1	AISI 304	1:2				

General machining tolerances UNI 5007-63			
Dimension	< 4	4-30	> 30-100
Linear Toli.	± 0.1	± 0.2	± 0.3
Angular Toli.	± 1'	± 30'	± 20'
Surface Toli.	± 0.2	± 0.5	± 1.0
Form Toli.	± 0.1	± 0.2	± 0.3
Surface Toli.	± 0.2	± 0.5	± 1.0
Form Toli.	± 0.1	± 0.2	± 0.3

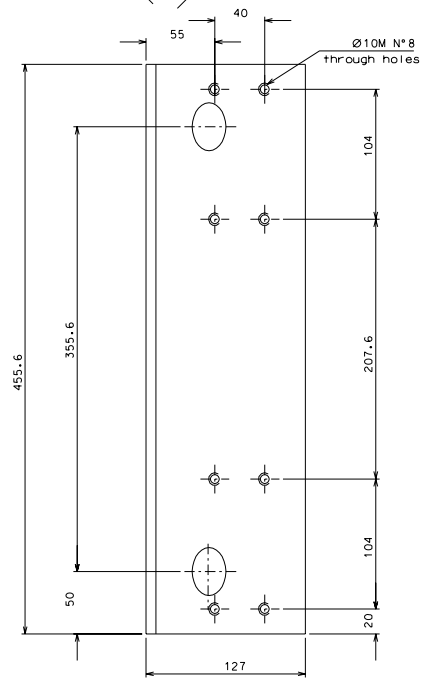
LIGO PROJECT
 designed for R. De Salvo
 w. cp+..._damp.003
 draw. PROMEC 9-3-02
OPTICAL DAMPING
 DETAILS
 details from 000-001
 replacement No. **A 1**



6.1



7.1



ref.	date	signature
modifications		

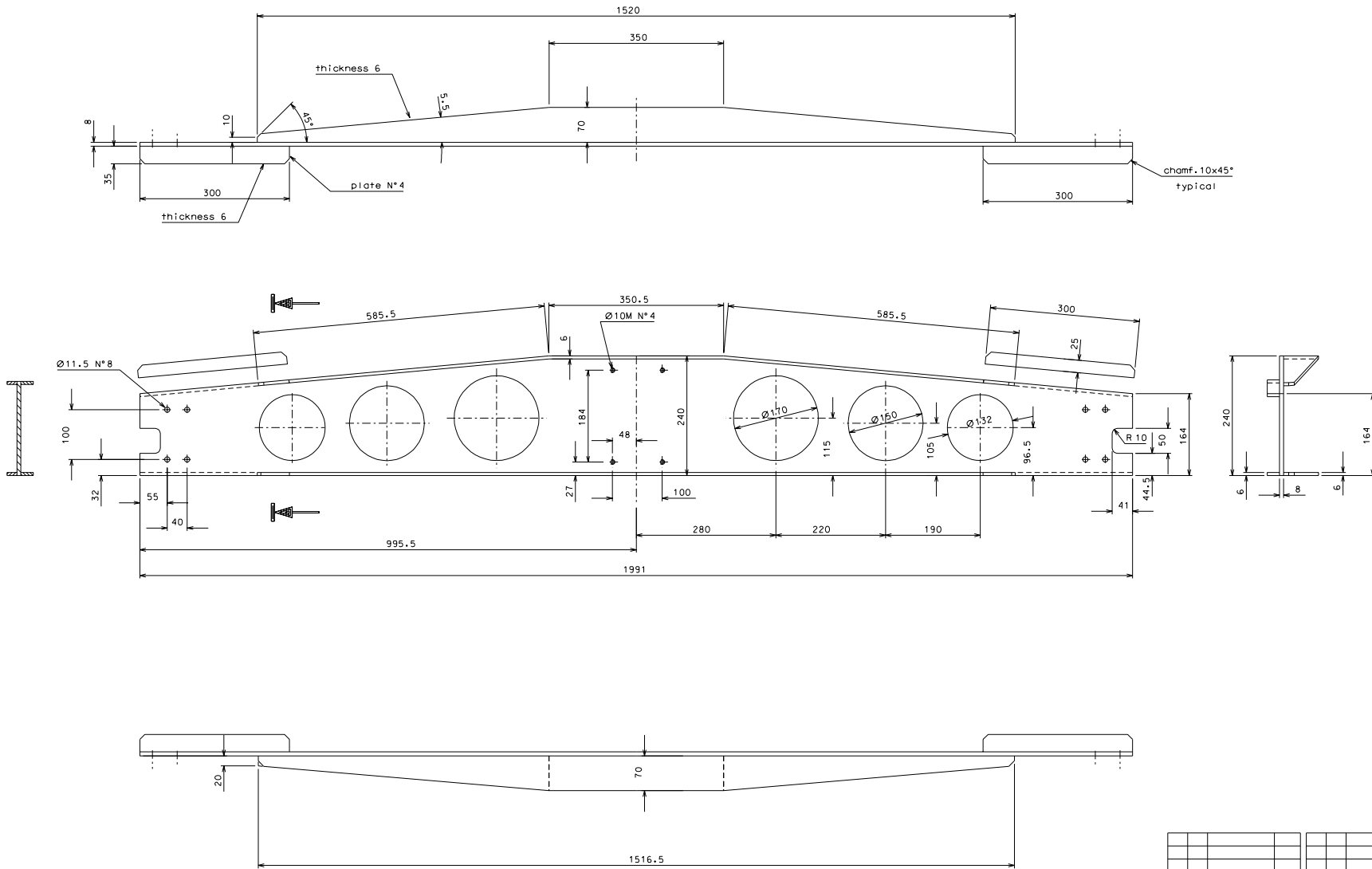
ref.	sheet	rev. and treatments	scale	ref.	sheet	rev. and treatments	scale
7.1	1	AISI 304	1:2				
6.1	1	AISI 304	1:2				

General machining tolerances UNI 5007-63			
Dimension	< 4	4-30	> 30-100
Linear Fall.	± 0.1	± 0.2	± 0.3
Angular Fall.	± 1'	± 30'	± 20'
Surface	± 0.1	± 0.2	± 0.3
Form	± 0.1	± 0.2	± 0.3

designed for R. De Salvo
n. op1+_damp.004
area. PROMEC 9-3-02

LIGO PROJECT
OPTICAL DAMPING
DETAILS


scale from 000-001
revision or. Num. **A 1**



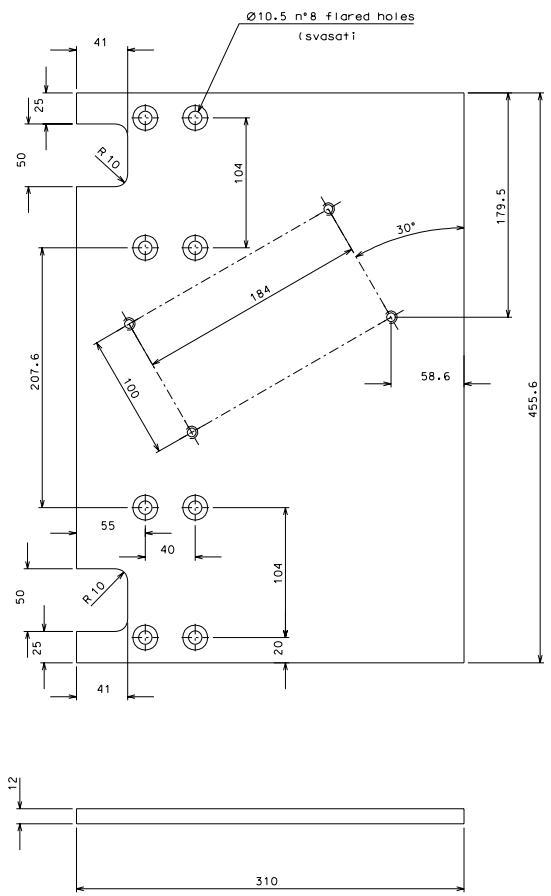
1	1	AISI 304 L	1:4				
ref.	piece	mat. and treatments	scale	ref.	piece	mat. and treatments	scale

General manufacturing tolerances UNI 5007-63

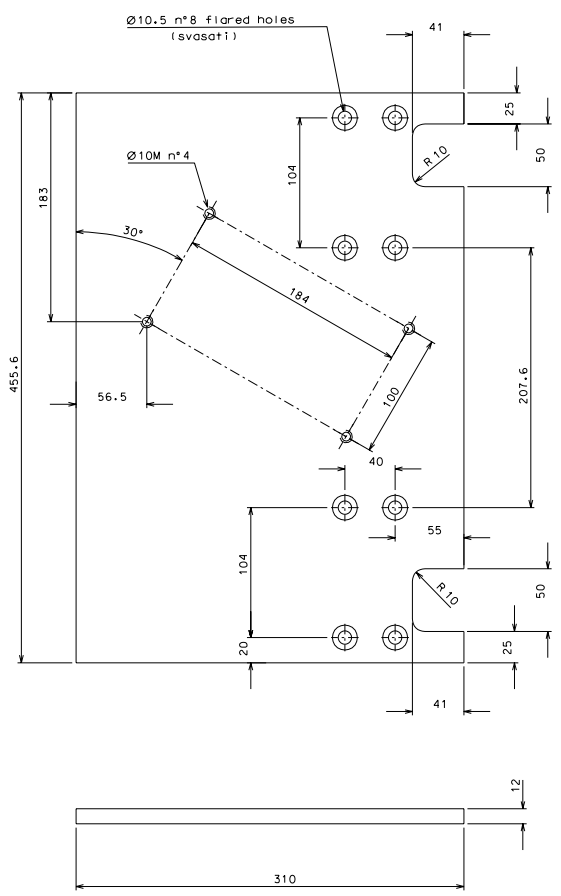
Dimensions	< 4	4-50	50-100	100-150	> 150-1000	> 1000-5000	> 5000
Linear Toli.	± 0.1	± 0.2	± 0.3	± 0.5	± 0.8	± 1.2	± 2
Angular Toli.	± 1'	± 30'	± 20'	± 10'	related to the shortest side		


LIGO PROJECT

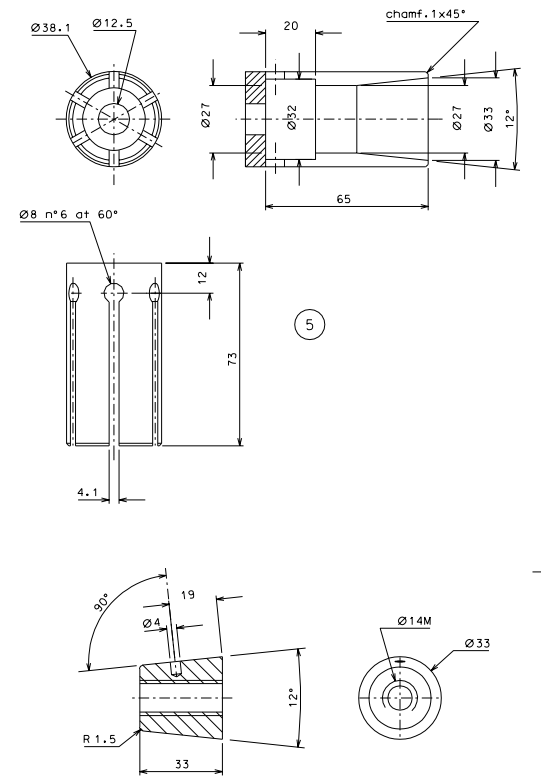
designed for R. De Salvo
 n. op 1 - damp. 005
 draw. PROMEC 17-02-02
 details from 000
 replace or. Num. A 1



2

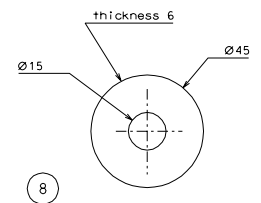


3



5

4 to insert a pin dia. 4x8
(inserire una spina di diam. 4x8)



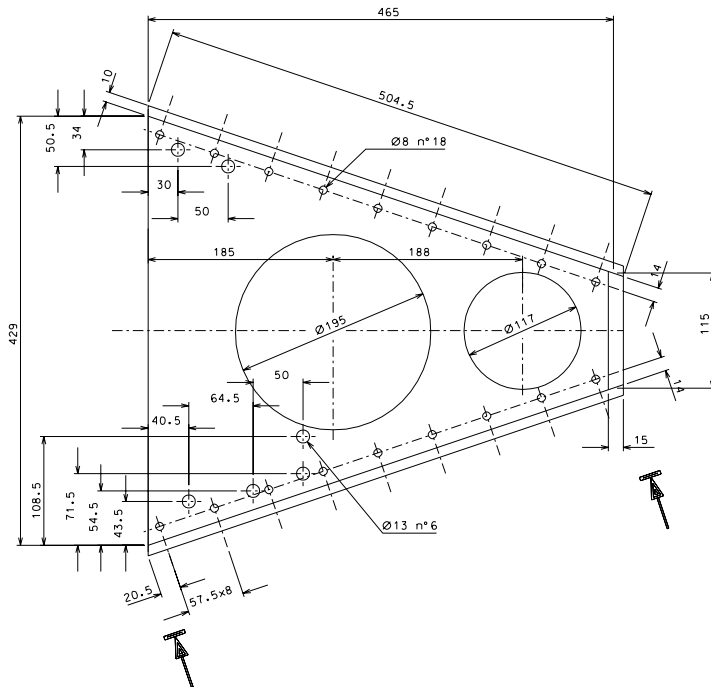
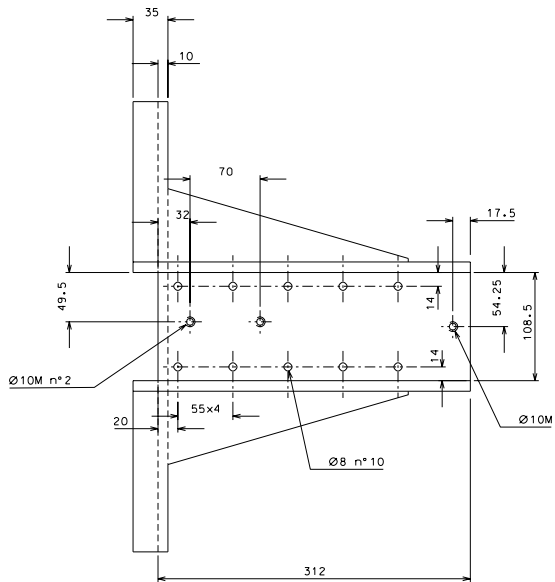
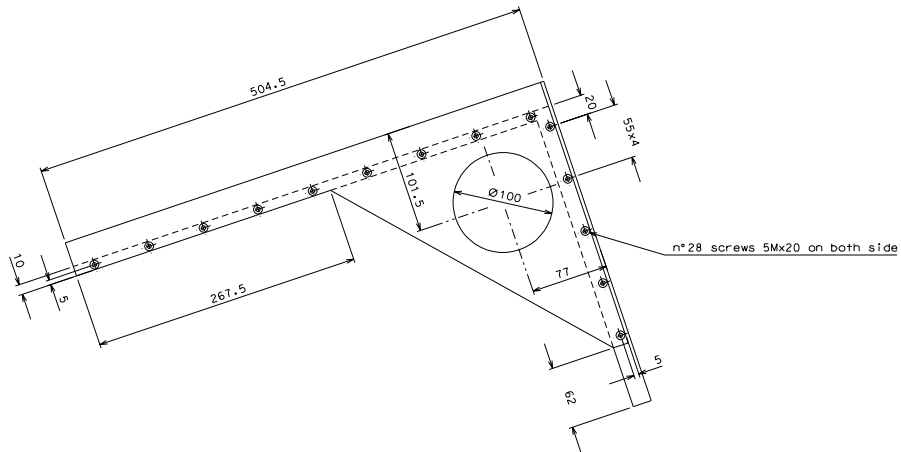
8

ref.	note	date	signature
modifications			

ref.	piece	mat. and treatments	scale	ref.	piece	mat. and treatments	scale
8	6	AISI 304	1:1				
5	6	AISI 304	1:1				
4	6	bronze B14	1:1				
3	1	AISI 304	1:2				
2	1	AISI 304	1:2				

General machining tolerances UNI 5007-63							
Dimension	< 4	>= 4 - < 10	>= 10 - < 30	>= 30 - < 100	>= 100 - < 300	>= 300 - < 1000	>= 1000 - < 3000
linear tol.	± 0.1	± 0.2	± 0.3	± 0.5	± 0.8	± 1.2	± 2
angular tol.	± 1'	± 30"	± 20"	± 10"	related to the smallest size		

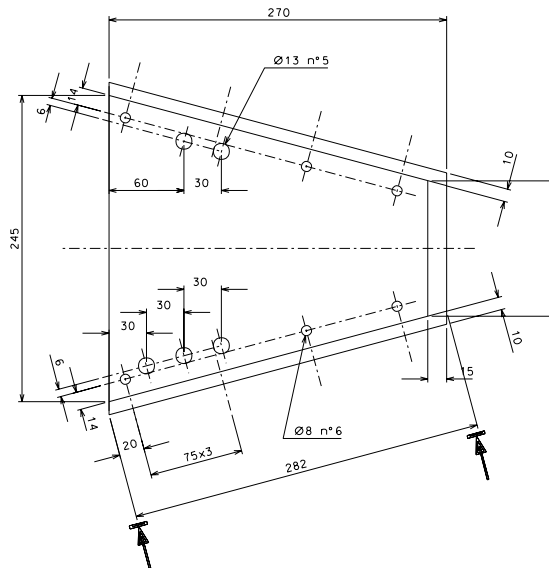
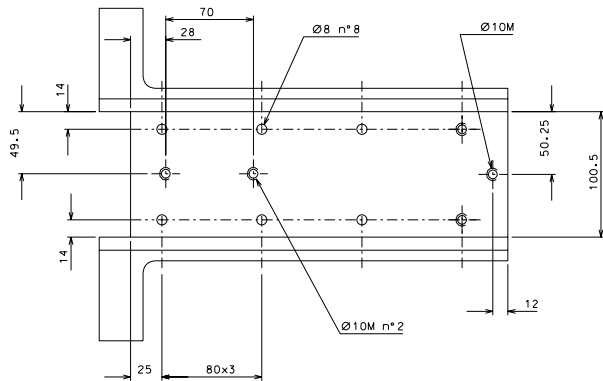
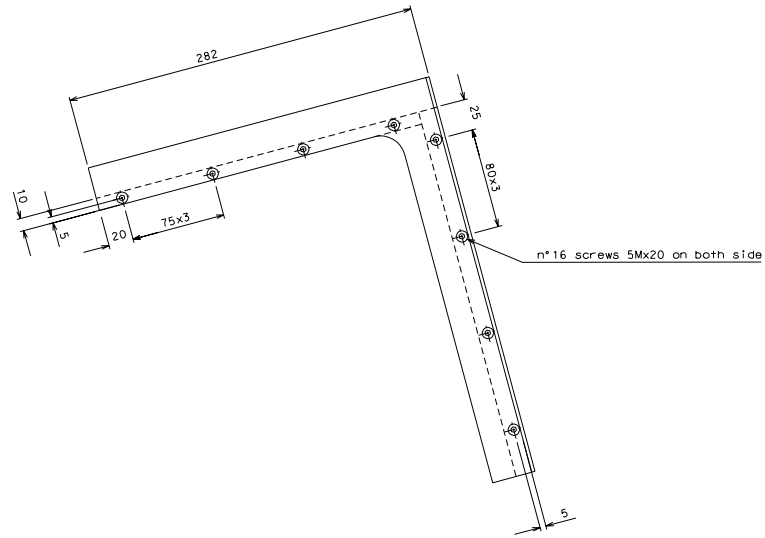
	LIGO PROJECT designed for R. De Salvo n. op1 - damp. 006 draw. PROMEC 9-3-02	details from 000-001 revision or. Num. A 1
	OPTICAL DAMPING DETAILS	



ref.	note	date	signature

9	2	AI	UNI 9006/4	1:2.5			
ref.	sheet	ref. and treatments	scale	ref.	sheet	ref. and treatments	scale

General machining tolerances UNI 5007-63			
Dimensions	< 4	4 - 30	> 30 - 100
Linear Toli.	± 0.1	± 0.2	± 0.3
Angular Toli.	± 1'	± 30'	± 20'
related to the smallest size			
designed for R. De Salvo			
n. cp f. _ damp. 007			
proj. PROMEC 3-3-02			
details from 002			
replaces or. Num. A 1			



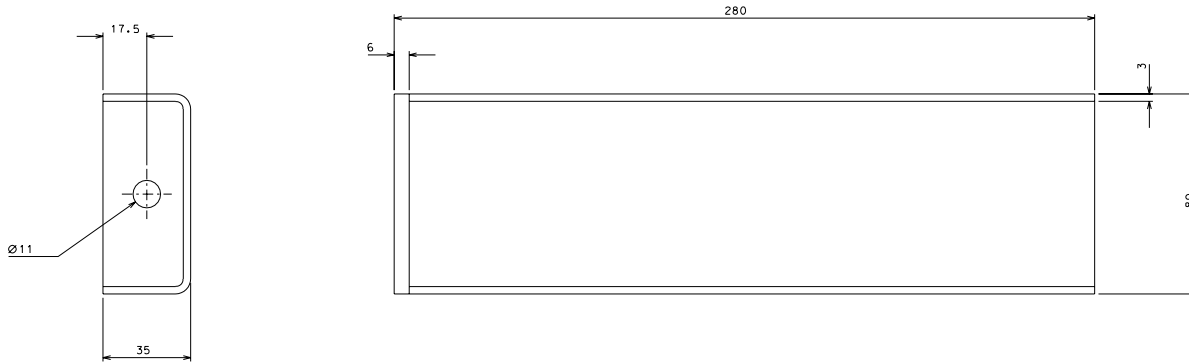
ref.	date	signature

modifications

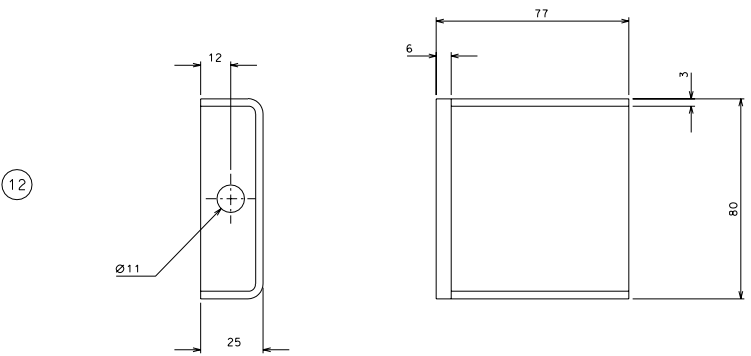
ref.	date	signature

General machining tolerances UNI 5007-63			
Dimensions	< 4	4-30	> 30-100
Linear Toli.	± 0.1	± 0.2	± 0.3
Angular Toli.	± 1'	± 30'	± 20'

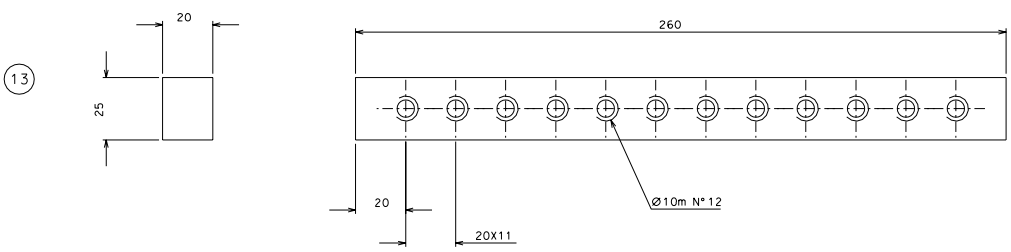
designed for R. De Salvo
w. cp+_-damp.008
draw. PROMEC 3-3-02
details from 002
ref. no. or. Num. A 1



10



12



13

ref.	note	date	signature
modifications			

ref.	piece	mat. and treatments	scale	ref.	piece	mat. and treatments	scale
13	6	Al UNI 9006/4	1:1				
12	1	AISI 304 L	1:1				
10	2	AISI 304 L	1:1				

General machining tolerances UNI 5007-63							
Dimension	< 4	4-30	30-100	> 100-1000	> 1000-5000	> 5000-10000	> 10000
Linear Toli.	± 0.1	± 0.2	± 0.3	± 0.4	± 0.5	± 0.7	± 1
Angular Toli.	± 1'	± 30"	± 20"	± 10"	related to the shortest side		

	LIGO PROJECT w. opt. _damp. 009	designed for R. De Salvo
		area. PROMEC 3-3-02
title OPTICAL DAMPING DETAILS	details from 002	replaced or. Num. A 1