

LASER INTERFEROMETER GRAVITATIONAL WAVE OBSERVATORY

- LIGO -

CALIFORNIA INSTITUTE OF TECHNOLOGY
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Drop Test - COC Carrier and Shipping Case		
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Distribution of this draft:

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1 ABSTRACT

The drop test of the shipping case containing the COC carrier and dummy optic was performed at National Technical Systems in Fullerton, CA on 8/30/96. The dummy optic, secured within the COC carrier, was made of aluminum, and exactly the size and shape of a large LIGO optic, but with 27% more mass.

The case was dropped in ten different orientations from a height of 36" onto a concrete floor. The setup consisted of a hinged platform with a stretched bunji cord attached for quick separation from the case at drop-time, a mounted triaxial accelerometer (accel), and electronic monitoring equipment including two oscilloscopes.

The test revealed inadequacy of the shipping case, with the current foam insert design, to shield the carrier from the resulting shock forces. The carrier experienced shock forces of up to approximately 200g. It appears likely that a greater thickness of foam (as well as a larger case) will be deemed necessary. Stress analysis of the COC carrier standoffs will determine whether the standoffs should be thickened and provided with threaded inserts.

2 PROCEDURE RECAP

(See attached NTS Log Sheet, graphs, sketches and photos)

The accel was initially mounted with dental cement to the side of the dummy optic, approximately centered between it's top and bottom, with axes oriented as sketched. After a couple of drops to get the 'feel' and adjust equipment settings, the setup was seen to provide very good control of the drop orientation with no interference from the platform owing to the pre-loaded bunji cord. The drops were executed with good results until the 7th drop, at which time the case and carrier were opened revealing damage to the carrier including completely stripped threads in the mounting screw holes of the hinged standoff, looseness of the other two standoffs at the base, bending of the top plate hold-down screws and locating pins, fracturing of the L-section teflon base pad at the hinged standoff, buckling of the top face of the cover and a sheared mounting screw to the left handle plate. The accel was broken free from the optic and had left an imprint in the side of the cover. After re-mounting the accel to the cover as sketched with the original axes orientations, the test was resumed with the optic in its non-secure condition in the damaged carrier. The accel was broken loose again on the 8th drop, and re-mounted in approximately the same location for the 9th and 10th drops. The final three drops yielded questionable output results (see table below). Through the course of the test, the case incurred mainly cosmetic damage, and was not rendered unusable.

NOTE: The worst case drop (with this test's carrier/case orientation) would presumably be a front side drop, in which the weaker mounted hinged standoff would take the full impact of the optic. This drop was not executed in this test

APPENDIX 1 PEAK ACCELERATION VALUES

Table 1:

Drop #	Orientation	Peak Acceleration (G)		
		X _p	Y _p	Z _p
1	bottom	-72	-2	-2
2	side, hinge	-78/97	193/-80	106/-115
3	left side, handle	-49/15	-15/8	-75/0
4	bottom left edge	80/-70	197/168	67/-118
5	top left edge	-95/29	-67/67	-50/35
6	top side edge (hinge)	21/3	40/-3	4/-1
7	bottom side edge (latch)	-82/15	-71/49	-27/53
8 ^a	top left corner (latch)	-110/80	-70/55	-112/128
9 ^a	bottom left corner (latch)	-175/74	197/-60	164/-119
10 ^b	top	14/-12	8/-9	6/-8

a. Suspect output traces. Plots decay to non-zero steady state values.

b. Outputs not as expected. Y_p & Z_p values should be near zero.

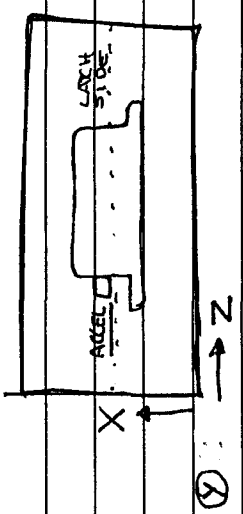
LIGO-DRAFT



GENERAL LOG SHEET

TEST 36" FREE FALL DROP MJO 673-3185
 CUSTOMER CALIFORNIA INSTITUTE OF TECH. DATE 8-30-96
 TEST ITEM CARGO CONTAINER P/N _____ S/N _____
 SPECIFICATION CUSTOMER VERBAL PAR _____

DATE	TIME	LOG ENTRIES	INITIAL
8-30-96	0900	SET UP DROP APPARATUS, ATTACH ACCELEROMETER TO DUMMY MASS, START TEST	
		DROP BOTTOM, COMPLETE	
		2. SIDE (HINGE), COMPLETE	
		3. LEFT SIDE (HANDLE), COMPLETE	
		4. BOTTOM LEFT EDGE, COMPLETE	
		5. TOP LEFT EDGE, COMPLETE	
		6. TOP SIDE EDGE (HINGE), COMPLETE	
		7. BOTTOM SIDE EDGE (LATCH), COMPLETE	
		8. TOP LEFT CORNER (LATCH), COMPLETE	
		9. BOTTOM LEFT CORNER (LATCH), COMPLETE	
		10. TOP, COMPLETE	
8-30-96	1330	TEST COMPLETE	



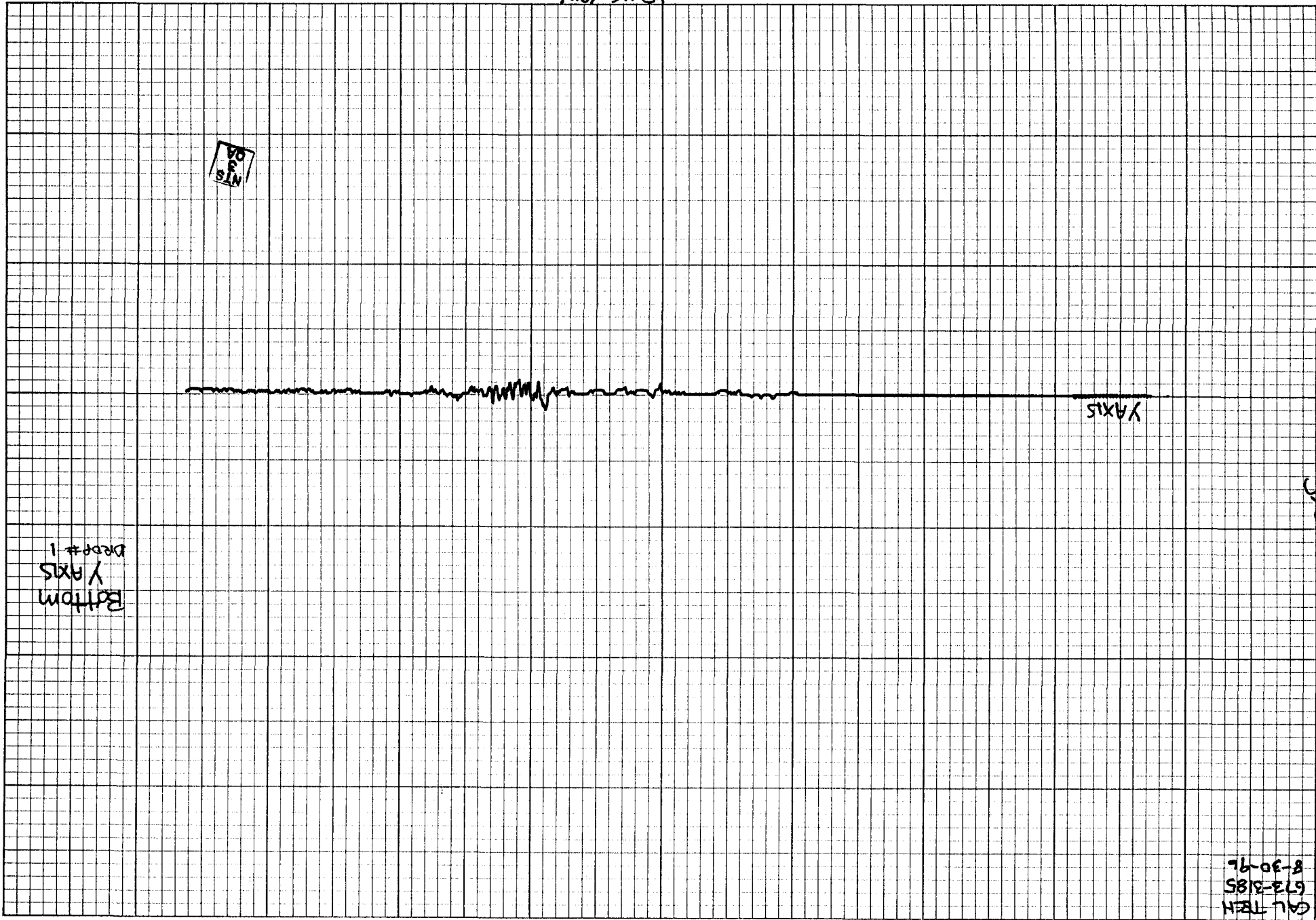
PAGE 1 OF 1 TEST BY T. Anderson DATE 8-30-96
 ENGR. MJS GOVT OAR 3



200g/div

2

CAL-TECH
673-3185
8-30-76



NTS
6
20

Bottom
Y AXIS
Trace # 1

Y AXIS

20g/div

CAL TRH
673-3185
8-30-96

1 ms/div

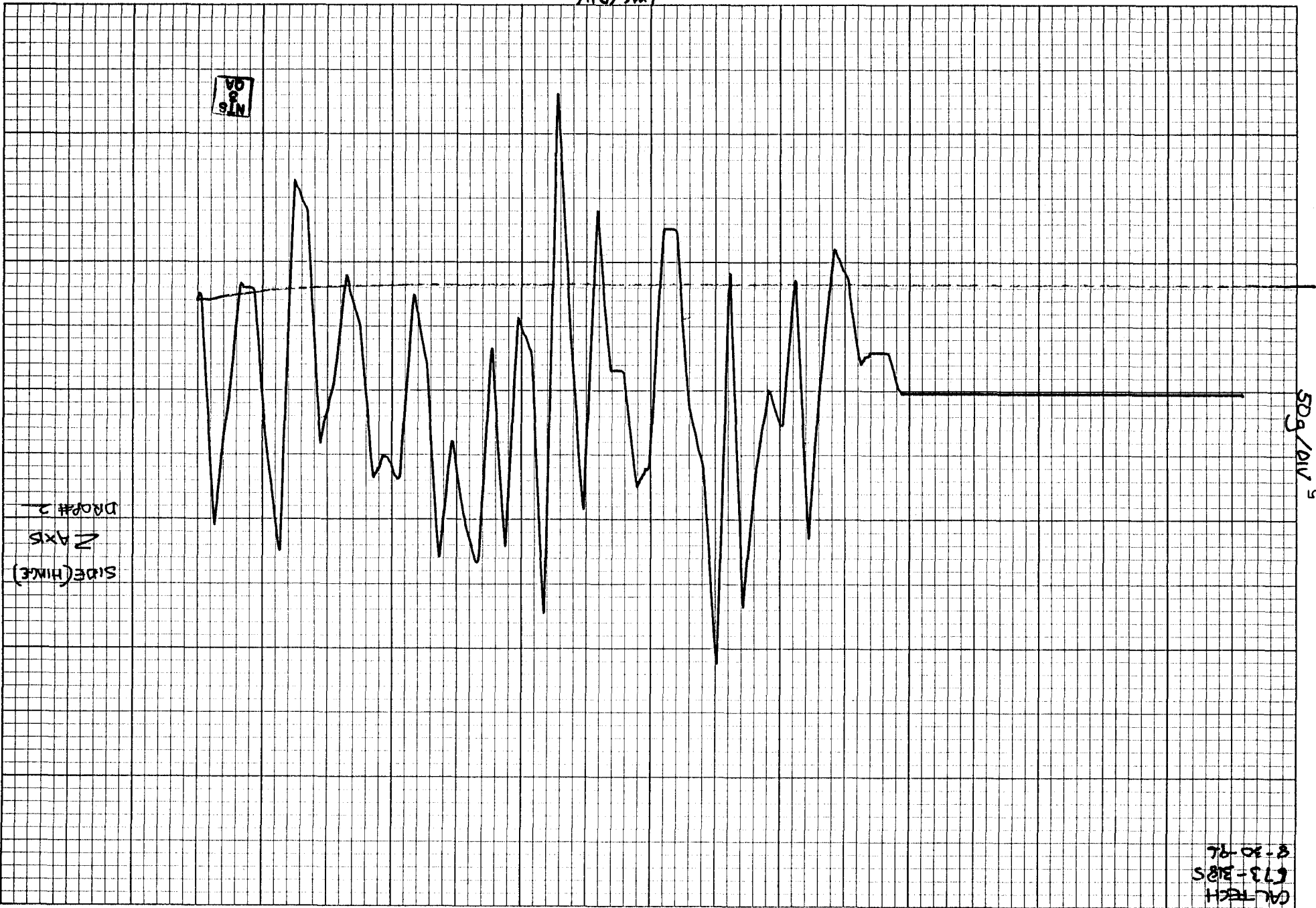
NTS

SIDE (INCH)
Y-axis
DROP # 2

50g/div
4

CALL TECH
673-3185
8-30-86





CAL TECH
673-3185
8-20-94

110/SW1

VO
P
SIN

SIDE (HINCE)
X AXIS
DROPP#2



SDG 9/10/11

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8-30-96