Calmar Catenary Software. Trinity House Application.

Calmar is a software tool, as originally supplied, is used for calculating the mooring arrangements for plastic float based navigation buoys dependant on individual station parameters. This document describes how Trinity House has applied this software to their steel buoys.

The software requires a model with attached physical parameters. This can be constructed from up to four parts; float, structure (core), pylon and topmark. These can be sub divided into segments that can each have parameters attached.

After consideration The Trinity Buoy Fig 1 was split to create the Calmar model in Fig 2. The structure was used to model the steel buoy body and the float was disregarded.

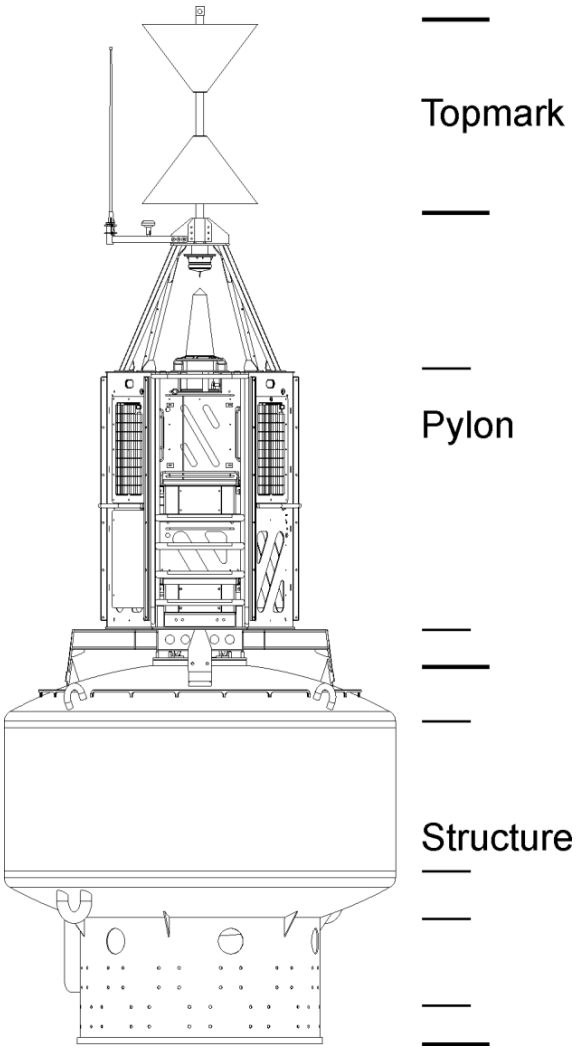


Fig. 1

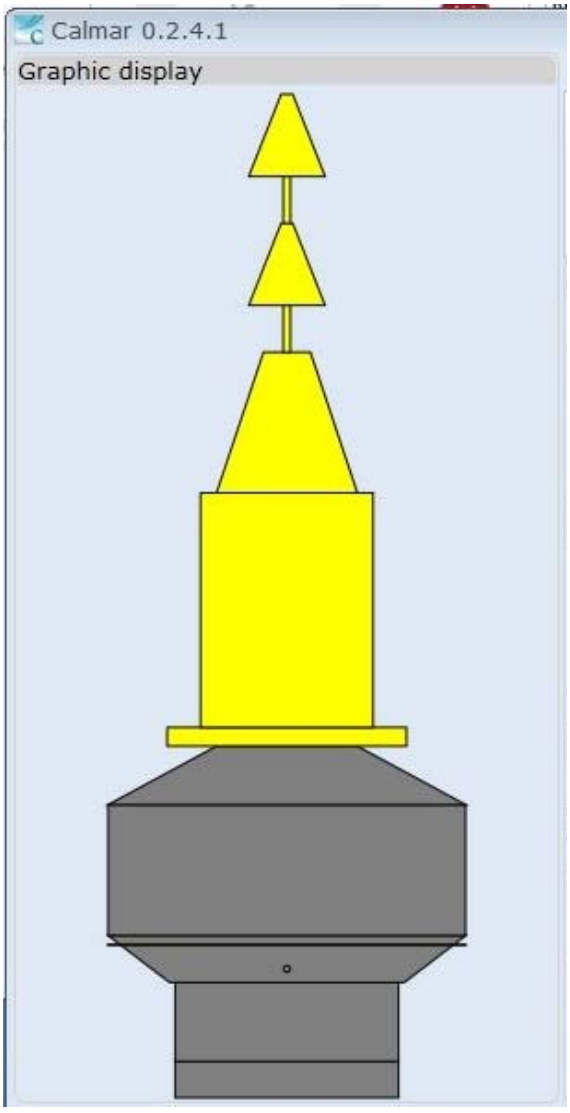
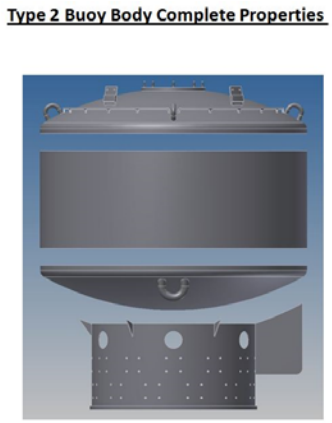


Fig. 2

Structure:

The Trinity House Type two buoy body was divided into sections, as this means that derivatives of this can be created easily in the software using these and other sections as building blocks. Using CAD modelling tools, the properties required by the Calmar software, weight, and 'real' volume of the segments were calculated (Figs. 3 and 4). All brackets, mooring eyes and webbing were included in the section properties. These, along with real dimensions to create the Calmar representations (Fig. 5).



Type 2 Buoy Body Complete Properties

Top Shell Assembly
Weight: 786 Kg
Volume of metalwork: 0.1001 M3
Capacity of Interior: 2.1779 M3
Total Displaced Volume: 2.2780 M3

Mid Shell
Weight: 838 Kg
Volume of metalwork: 0.1064 M3
Capacity of Interior: 8.0280 M3
Total Displaced Volume: 8.1344 M3

Bottom Shell Assembly
Weight: 1167 Kg
Volume of metalwork: 0.1482 M3
Capacity of Interior: 2.1160 M3
Total Displaced Volume: 2.2642 M3

Skirt Assembly
Weight: 563 Kg
Volume of metalwork: 0.0714 M3
Capacity of Interior: Not enclosed
Total Displaced Volume: 0.0714 M3

Hatch and Bolts
Weight: 51 Kg
Volume of metalwork: 0.0075 M3

Total Weight: 3405 Kg
Volume of Metalwork: 0.4336 M3
Volume of Interior: 12.3219 M3
Total Displaced Volume: 12.7555 M3

Fig. 3

Fig. 4

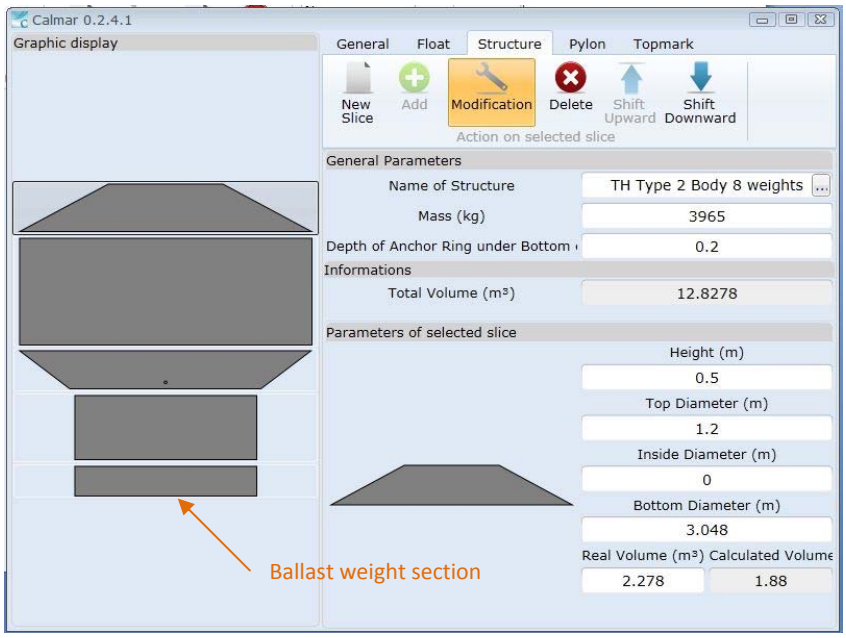


Fig. 5

The anchor ring point is positioned where the mooring eyes sit regardless that a bridle mooring arrangement is used.

In the 'General' Tab, ballast can be applied to the complete buoy. For the above model, the ballast weights were created as a section and applied to the structure.

Float:

This was rendered inactive by entering zero values.

Pylon and Topmark:

Using representative dimensions the components of the pylon were conveniently grouped and the mass totals established and applied to the representative sections as Fig. 6 and 7

As with the structure, the equipment mass is included in the model segments, and not applied separately with the specific tabs in the software.

Type 2 Lightweight Buoy Components Weights - Lightweight Hex Structure

Component Description	Mass (Kg)	Lateral no bell	Lateral with bell	Pillar no bell	Pillar with bell	Racon
SBB050 Cardinal Topmark	20			20	20	20
SBD113 Special Mark Topmark	13	13	13			
Topmark Total		**13**	**13**	**20**	**20**	**20**
Topmark Support - Std Lighted 3 leg	18	18	18	18	18	
Topmark Clamp	0.5	0.5	0.5	0.5	0.5	0.5
VLB-36 Lantern	2	2	2	2	2	2
Topmark Support - Racon 4 leg	24					24
Antenna Outrigger	0.4					0.8
Paknet Antenna	0.4					0.8
Garmin GPS Antenna	0.2					0.4
Topmark Support Total		**20.5**	**20.5**	**20.5**	**20.5**	**28.5**
Superstructure Welded Assembly - Std Lighted	190	190	190	190	190	
BP525 solar panel	4	12	12	12	12	
Handrail - 1 unit	0.7	3.5	3.5	3.5	3.5	
Daymark (Polyurethane) & Clamp Strip - 1 unit	12	72	72			
Electrical Box Complete - Std Lighted with charge controller no batts	24	24	24	24	24	
Battery 1 off	25	75	75	75	75	
Superstructure Welded Assembly - Racon	192					192
Sunware Solar panel	3					15
Racon	23.5					23.5
Charge Controller Chassis Plate Assy.	11					11
Comms Unit Chassis Plate Assy.	9.2					9.2
Main Unit Chassis Plate Assy.	14.7					14.7
Head Unit Chassis Plate Assy.	9.5					9.5
Electrical Box Complete - Racon	190					190
Superstructure Total		**376.5**	**376.5**	**304.5**	**304.5**	**464.9**
Aluminium Cruicform - I Beam - G.A.	82	82	82	82	82	82
Bell Unit	96		96		96	
Electrical Box Complete - Racon	190					190
Electrical Box - Bell Mount Adaptor	15					15
Cruciform Total		**82**	**178**	**82**	**178**	**287**
Complete Assembly		**492**	**588**	**427**	**523**	**800.4**

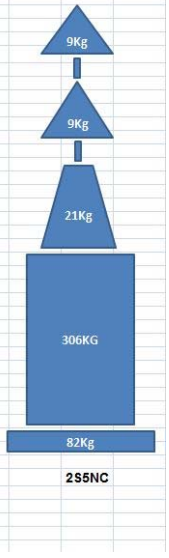


Fig. 6

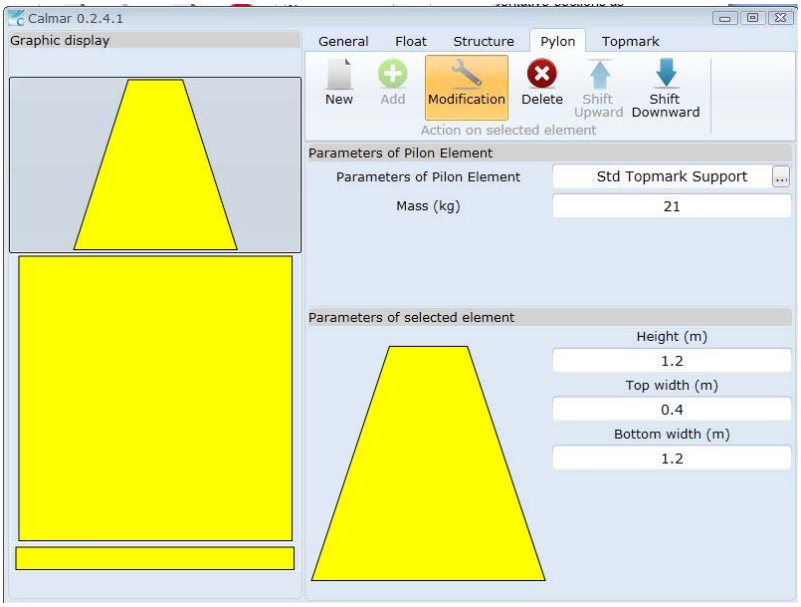
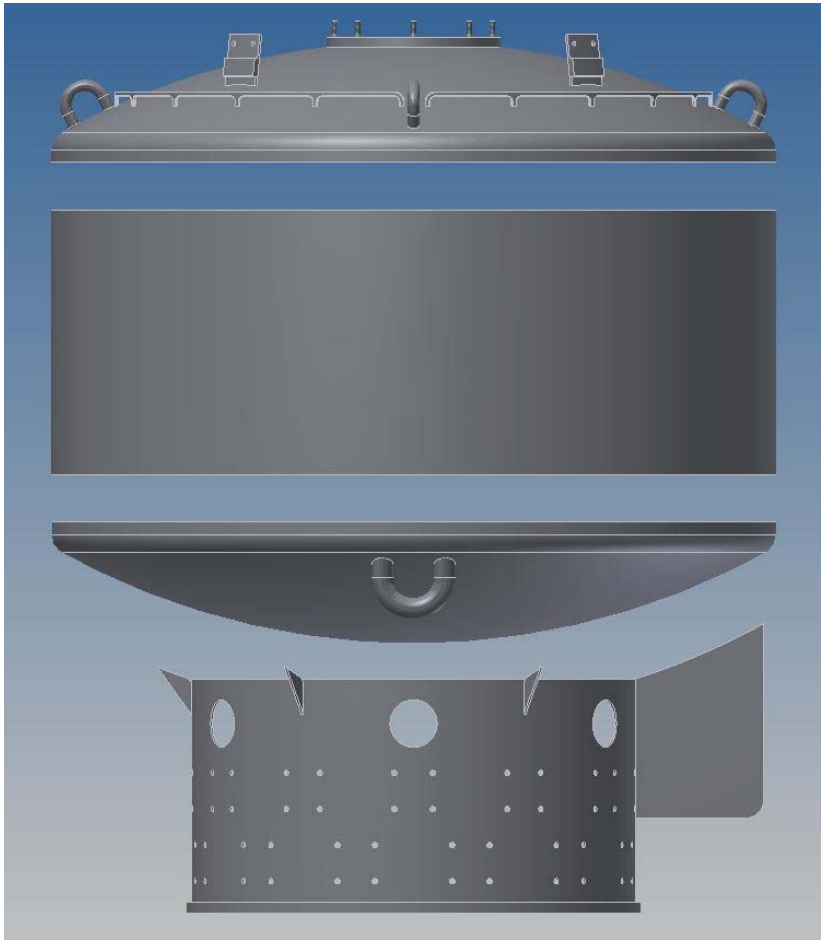


Fig. 7

S. Jacobs 15/10/2013

Type 2 Buoy Body Complete Properties



Top Shell Assembly

Weight:	786 Kg
Volume of metalwork:	0.1001 M3
Capacity of Interior:	2.1779 M3
Total Displaced Volume:	2.2780 M3

Mid Shell

Weight:	838 Kg
Volume of metalwork:	0.1064 M3
Capacity of Interior:	8.0280 M3
Total Displaced Volume:	8.1344 M3

Bottom Shell Assembly

Weight:	1167 Kg
Volume of metalwork:	0.1482 M3
Capacity of Interior:	2.1160 M3
Total Displaced Volume:	2.2642 M3

Skirt Assembly

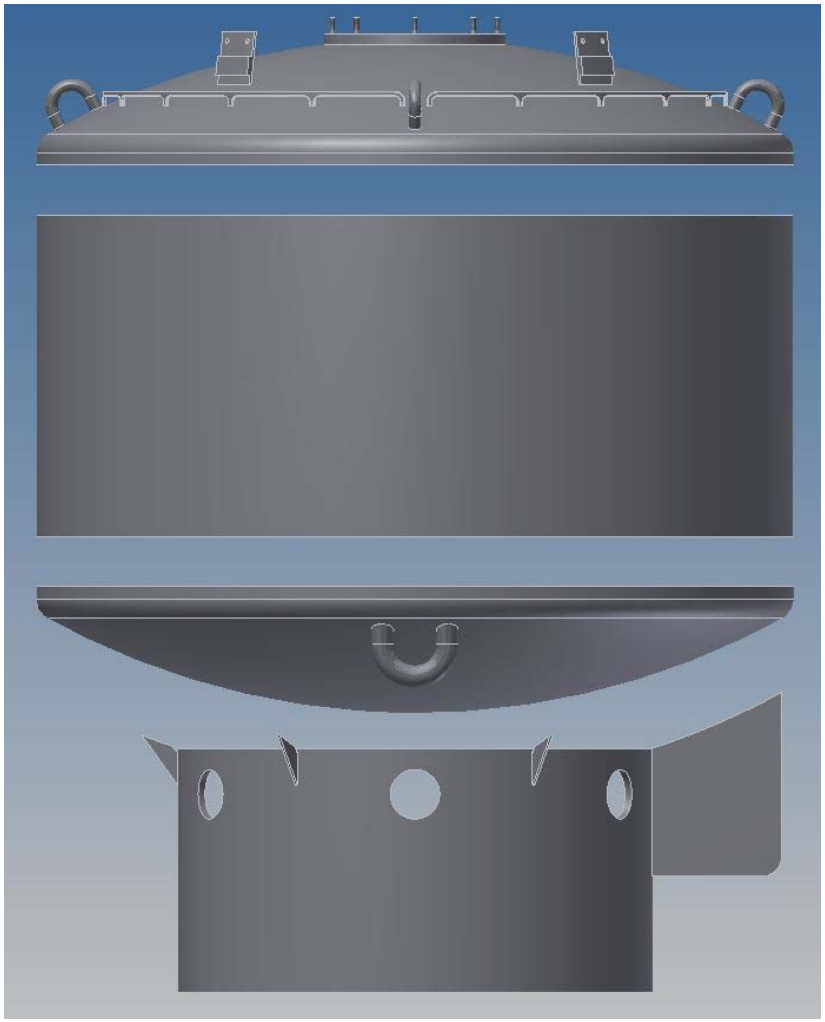
Weight:	563 Kg
Volume of metalwork:	0.0714 M3
Capacity of Interior:	Not enclosed
Total Displaced Volume:	0.0714 M3

Hatch and Bolts

Weight:	51 Kg
Volume of metalwork:	0.0075 M3

Total Weight:	**3405 Kg**
Volume of Metalwork:	**0.4336 M3**
Volume of Interior:	**12.3219 M3**
Total Displaced Volume:	**12.7555 M3**

+2 Buoy Body Complete Properties



Top Shell Assembly

Weight:	786 Kg
Volume of metalwork:	0.1001 M3
Capacity of Interior:	2.1779 M3
Total Displaced Volume:	2.2780 M3

Mid Shell

Weight:	973 Kg
Volume of metalwork:	0.1235 M3
Capacity of Interior:	9.3255 M3
Total Displaced Volume:	9.4490 M3

Bottom Shell Assembly

Weight:	1167 Kg
Volume of metalwork:	0.1482 M3
Capacity of Interior:	2.1160 M3
Total Displaced Volume:	2.2642 M3

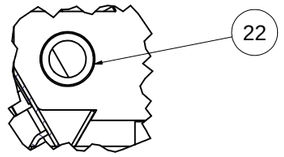
Skirt Assembly

Weight:	1440 Kg
Volume of metalwork:	0.1828 M3
Capacity of Interior:	Not enclosed
Total Displaced Volume:	0.1823 M3

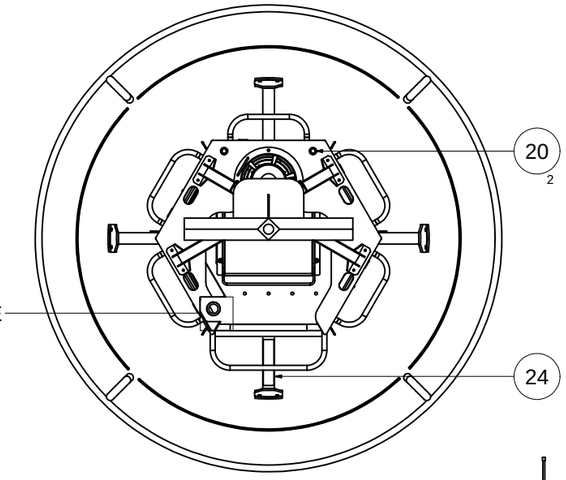
Hatch and Bolts

Weight:	51 Kg
Volume of metalwork:	0.0075 M3

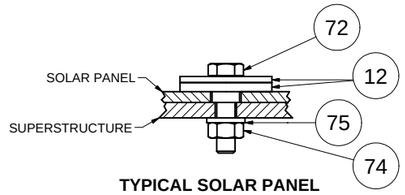
Total Weight:	**4417 Kg**
Volume of Metalwork:	**0.5621 M3**
Volume of Interior:	**13.6194 M3**
Total Displaced Volume:	**14.1815 M3**



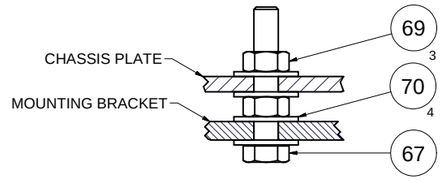
CUT AWAY VIEW E
SHOWING INTERNAL FLOOR DETAIL
SCALE: 1 :5



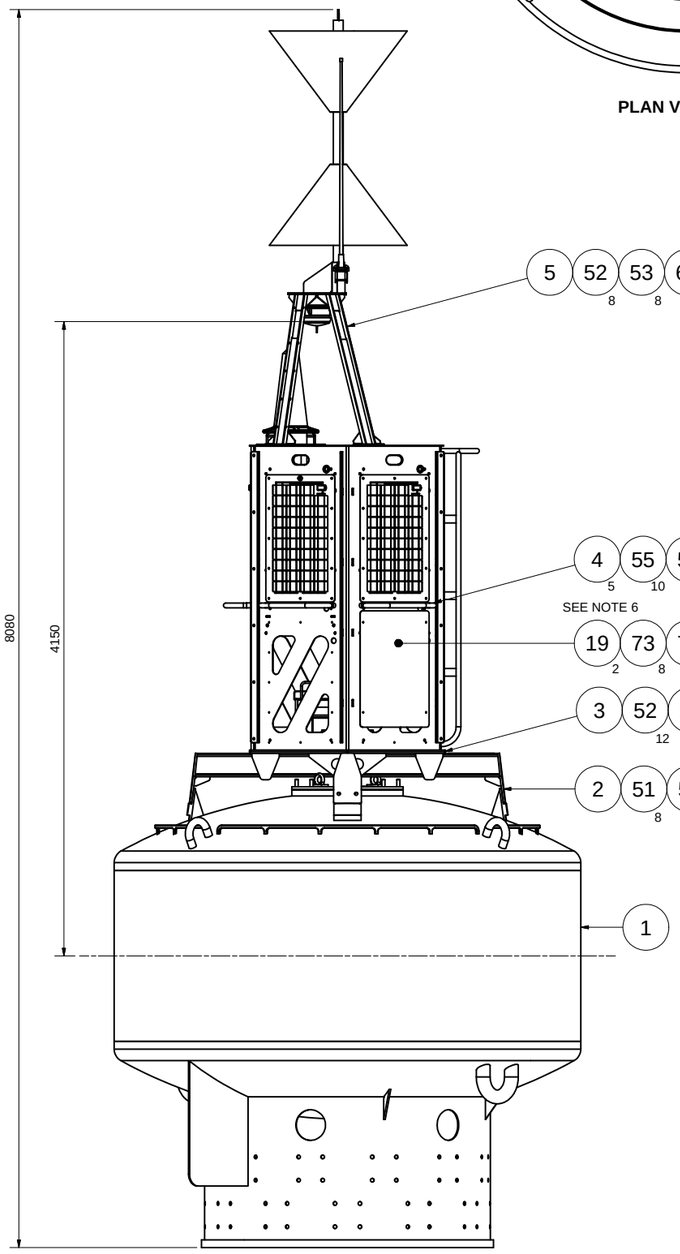
PLAN VIEW ON D



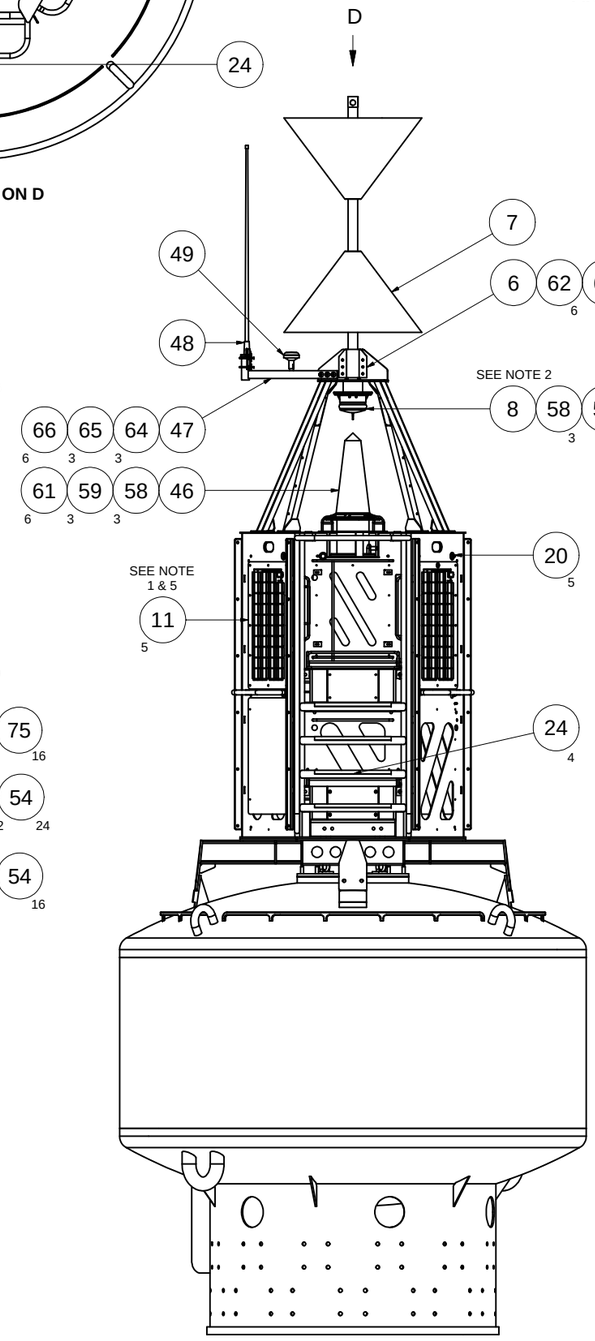
TYPICAL SOLAR PANEL
FIXING DETAIL 12 POS.
SCALE: (1 : 1)



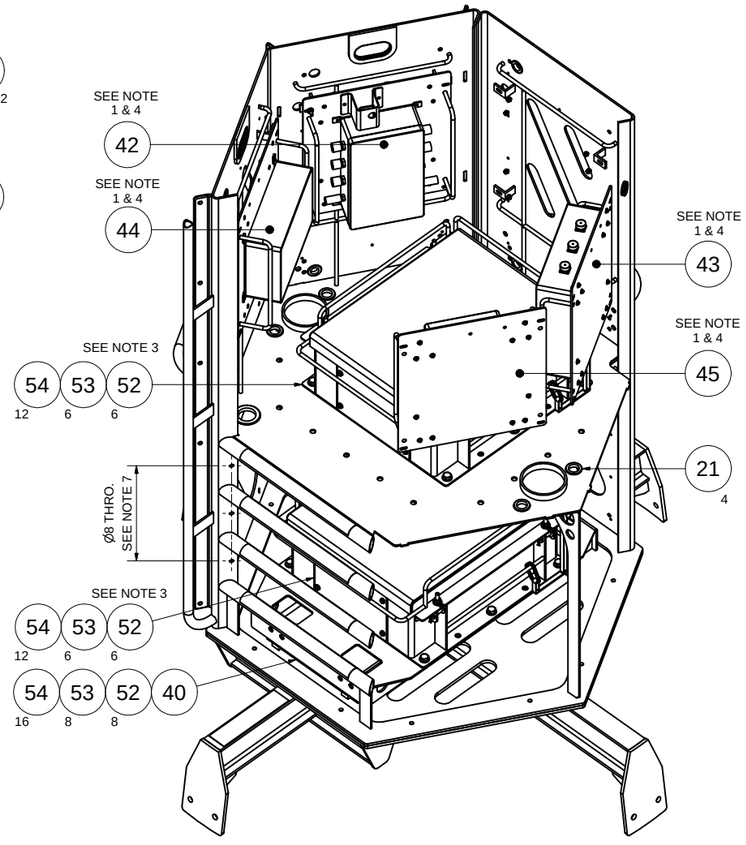
TYPICAL CHASSIS PLATE
FIXING ARRANGEMENT 4 POS.
SCALE: (1 : 1)



SIDE ELEVATION
DEEP SKIRT BUOY BODY SHOWN



FRONT ELEVATION
DEEP SKIRT BUOY BODY SHOWN



INTERNAL VIEW OF SUPERSTRUCTURE
SHOWING RACON MONITORING ELECTRICAL FIT
SUPERSTRUCTURE COMPONENTS REMOVED FOR CLARITY

DO NOT SCALE

THIS DRAWING UNLESS STAMPED IN RED - '***CONTROLLED DRAWING***' WILL NOT BE UPDATED.

UNLESS OTHERWISE SPECIFIED:
GENERAL TOLERENCES
X. = ± 0.5 .X = ± 0.25 .XX = ± 0.125
GEOMETRIC TOLERANCES AS ISO 2768-2

ALL DIMENSIONS IN MILLIMETERS

REMOVE ALL BURRS & SHARP EDGES

ALL WELD SYMBOLS IN ACCORDANCE WITH BS EN 22553

NOTES

1. FIXING ARRANGEMENT AND COMPONENTS SHOWN IN DETAILED VIEW
2. LIGHT CHARACTER DEFINED BY STATION
3. ELECTRICAL BOX ASSEMBLY DETAIL AS DRG. NO. 402/900 SHEET 3
4. CHASSIS PLATE ASSEMBLY DETAIL AS DRG. NO. 402/926
5. SOLAR PANELS TO BE MOUNTED IN DARK PAINTED AREAS.
6. NAME BOARDS TO BE MOUNTED IN 2 POSTIONS ON OPPOSITE FACES AS SHOWN DICTATED BY SOLAR PANEL POSITIONS AS NOTE 5.
7. 3 OFF Ø12 HOLES TO BE DRILLED TO SUIT LOWER ELECTRICAL BOX CABLE RESTRAINT. HOLES TO BE EQUISPACED BETWEEN RUNGS AND 15MM FROM PANEL EDGE.
8. APPLY NOVALUBE LIBERALLY TO ALL BOLT SHANKS AND THREADS.
9. SEE T.H. DRG. NO. 402/900 SHEET 4 FOR PARTS LIST.

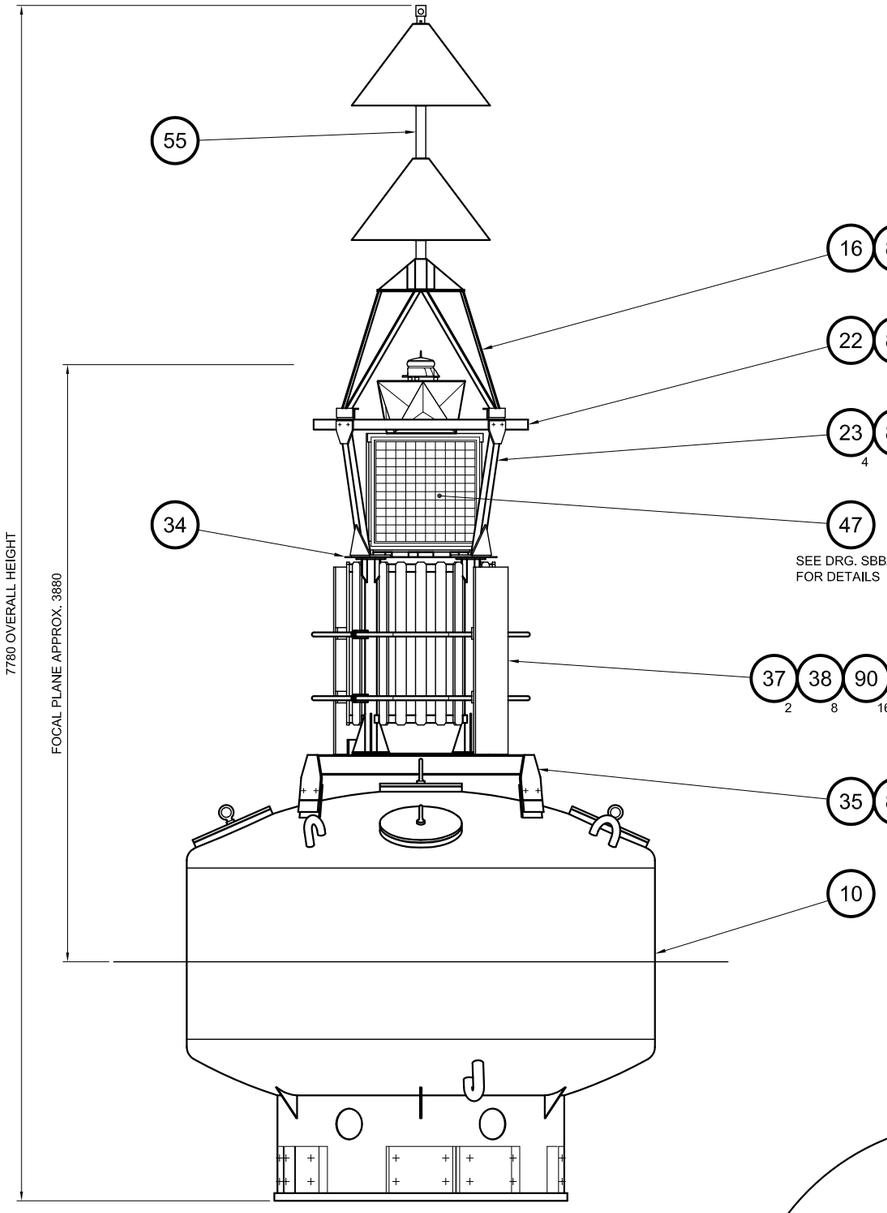
REV	DATE	DETAILS

Trinity House
OPERATIONS DIRECTORATE
HARWICH, ESSEX

TYPE 2 LIGHTWEIGHT BUOY

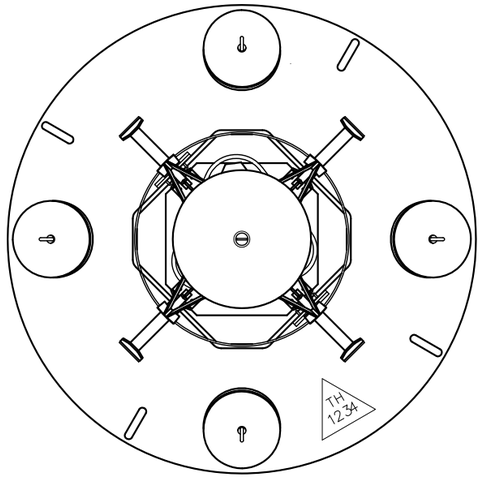
GENERAL ARRANGEMENT
MONITORED RACON
PILLAR (PRE 2011)

DRAWN BY:	DATE:	SCALE:
SPJ	15/06/11	
CHECKED BY: MJY	DRG No: **402/900**	
APPROVED BY: RWL		
	SHEET: 1 OF 4	REVISION:

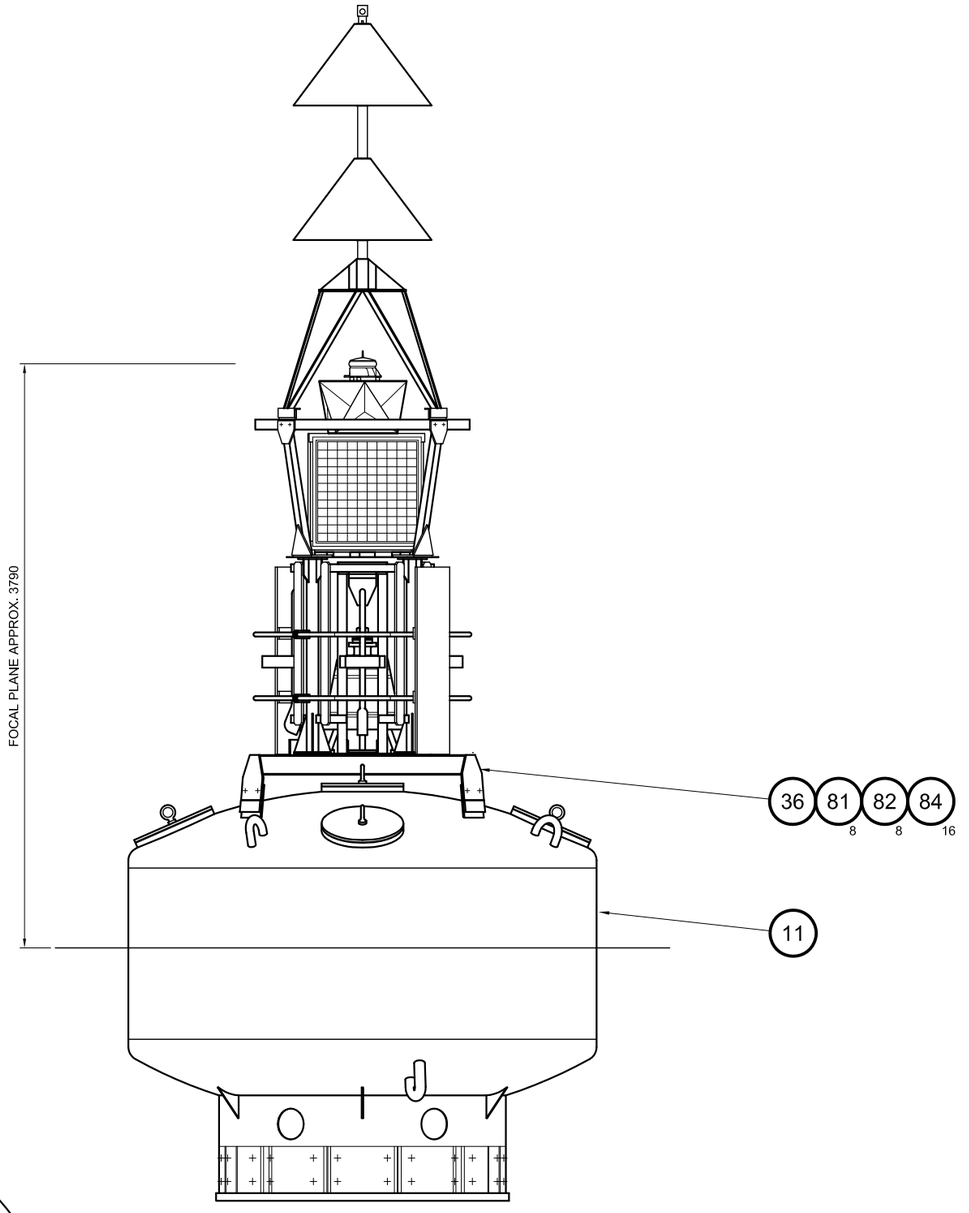


MAX. WEIGHT WITH STANDARD BODY
INCLUDING MOORING BRIDLE 5470Kg.

BUOY ASSEMBLY 5A



TYPICAL PLAN VIEW



MAX. WEIGHT WITH STANDARD BODY
INCLUDING MOORING BRIDLE 6110Kg.

BUOY ASSEMBLY 5B

DO NOT SCALE

THIS DRAWING UNLESS STAMPED IN RED ***"CONTROLLED DRAWING"*** WILL NOT BE UPDATED

GENERAL TOLERANCES EXCEPT WHERE STATED:

WHOLE NUMBERS	±0.50mm
ONE DECIMAL PLACE	±0.25mm

ALL OTHER TOLERANCES ARE TO BE DEFINED.

NOTES

1/ SEE DRG SBB/30 FOR DETAILS OF NAVIGATION LIGHT CHARACTERISTICS.

2/ SOLAR UNIT IS TO BE POSITIONED WITH ACCESS DOOR ON SIDE OF FOOTPLATE MARKED F.

3/ SEE DRG SBB/31 FOR ELECTRICAL CABLE SCHEMATIC.

4/ FOR PARTS LIST SEE SHEET 11.

5/ MINIMUM LETTER SIZE - 92mm x 92mm

REV	DATE	DETAILS	DRN	CHKD	APPVD
E	22/07/13	LANTERNS REDEFINED. CONCESSION 053 SPRING WASHERS REMOVED	SPJ	MJY	RWL
D	24/07/12	NOTE 5 ADDED.	R.R.	C.E.P.	R.W.L.
C	27/07/10	'CLASS' CHG TO 'TYPE' SHEET No & BORDER UPDATED	E.M.	M.J.Y.	R.W.L.
B	28/09/01	NOW SHEET 5 OF 13	I.T.C.	F.G.C.	C.A.M.
A	18/01/01	ITEM 35 (BASE PLATE) MODIFIED	B.J.K.	B.J.D.	A.H.W.

Trinity House

OPERATIONS DIRECTORATE
HARWICH, ESSEX

SOLAR BUOY ARRANGEMENTS

TYPE 2 BUOY PILLAR

DRAWN BY: D.L.C.	DATE: 27/10/97	SCALE: 1:20 (A1)
CHECKED: J.E.S.	DRG. No. SBA/4	
APPROVED: A.H.W.		
30 Sep 2013 10:18	SHEET 5 OF 11	REV. E