09CQ02

Tinian Harbor, Tinian

Appendix F:

Tide Station Descriptive Report

UNCLASSIFIED

DISTRIBUTION STATEMENT A:

APPROVED FOR PUBLIC RELEASE
DISTRIBUTION UNLIMITED

FLEET SURVEY TEAM

TIDE STATION - DESCRIPTION
INSTALLATION - LEVELING RECORD

Country: Commonwealth of the Northern Mariana Islands, USA
Tinian Island

Specific Location: Tinian Harbor

Vessel: FST Swamp Fox

HIC: Charles A. Baptiste

Date:

Station Number: Tinian Harbor Tide Gauge

09CQ02

ARCHIVE NUMBER

0691-LL-000-3605

NAVOCEANO 3140/68 (07-00)

BENCH MARK LABELING

Bench mark disks should be stamped with steel dies, using a ten-digit IHO Identification Number, the Year of Installation and a Bench mark number BM1, BM2, etc. The IHO Number is constructed as follows:

Q	LATITUDE	LONGITUDE
#	DDMM	DDDMM

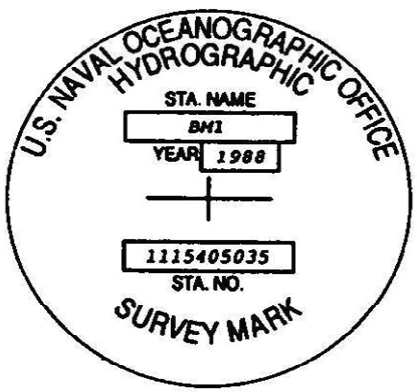
Where Q is the quadrant of the world,

1 for North-East
2 for North-West
3 for South-West
4 for South-East

LATITUDE in degrees-minutes
LONGITUDE in degrees-minutes

The values of minutes of a degree should be rounded to the nearest minute. Marks without disks should have their Identification Numbers etched in concrete while it is still wet.

EXAMPLE
BENCH MARK DISK



NOTE: "1115405035 1988 BM1" WOULD BE STAMPED IN THE FIELD FOR N11°54' E050°35'

"C" CHECK INSTRUCTIONS

Place rods approximately 100m apart with the instrument setups about 10m from each point. Record rod readings to three decimal points for all three wires, if the difference is greater than 0.003m, reobserve. Determine the mean centerwire reading to four decimal places and sum the intervals for each observation. Multiply the sum interval for each foresight times 100 (stadia interval factor) to determine the shot length in meters. Use this distance to find the rod corrections in Table 1 for each foresight. Use the formula below to calculate the value of "C" to four decimals. Values greater than ± 0.004 require instrument adjustment.

$$\text{"C"} = \frac{\text{(sum of BS means - sum of corrected FS means)}}{\text{(sum of FS intervals - sum of BS intervals)}}$$

DISTANCE METERS	CORRECTION TO ROD IN METERS
0 to 27	0.0000
28 to 47	-0.0001
48 to 60	-0.0002
61 to 72	-0.0003
73 to 81	-0.0004
82 to 90	-0.0005
91 to 98	-0.0006
99 to 105	-0.0007

TABLE 1

LEVELING INSTRUCTIONS

1) Make all entries in ball point pen.

2) Record wire readings to three decimal places.

3) Always start a level run with the tide staff as the first backsight.

4) Pace all distances between rod placements before setting up the instrument. Balance all foresight and backsight distances (shots). Keep the total foresight and backsight distances within 10 meters. The maximum shot distance should not exceed 90 meters. The same person should pace all the distances for a level run and know the length of his/her pace before starting.

5) Individual unbalanced shots can be corrected by algebraically adding the collimation and curvature corrections to the observed height difference between turning points.

   a) The collimation correction is determined using the formula:
      Coll. Corr. = "C"(Sum F.S. Intervals - Sum B.S. Intervals)
      For a lengthened foresight where:
      C = "C" Check value (Instrument collimation error)

   b) Curvature corrections ® are computed using the formula:

$$r = -(\Delta s^2/\mathrm{d})$$

Where: Δs = The distance of the shot imbalance in meters

d = 12,756,000m the diameter of the earth.

6) Subtract the total elevation difference for the forward run from the reverse run to determine the error of closure (E.C.). Calculate the allowable error (A.E.) with the following formula:

A.E. = ± 0.012m $\boxed{\sqrt{k}}$ where k is the distance in kilometers of the shortest leg of the transit.

TIDE STATION REPORT

STATION NAME:		STATION #:	
Tinian Harbor		N/A	
STATION LOCATION:	**LATITUDE:**	**LONGITUDE:**	**TIME ZONE:**
Tinian Harbor, Tinian Island, CNMI	14° 58' 02" N	145° 37' 05" E	UTC +10hr
INSTALLED BY:		**TIME:**	**DATE:**
Naval Oceanographic Office / Fleet Survey Team (FST) Charles A. Baptiste, Jessica Burt			04 Jun 2009

GAUGE TYPE/MANUFACTURER:	SERIAL #	RANGE/SCALE:
Mini-Troll / In-Situ	08814	3.5m

BRIEF DESCRIPTION OF GAUGE SHELTER/SECUREMENT:	POSTED NOTICE (Y / N)
The gauge was secured to the 2" x 10" wooden plank tide staff with 2 rubber insulated stainless steel clamps. Zip ties secured the gauge cable approximately every 0.5m to the plank. Three 1m graduated plates were screwed onto the board. The board was then bolted to the concrete pier with 2 anchor bolts.	N

TIDE STAFF, PRECISE LOCATION, METHOD OF SECUREMENT, TYPE OF STAFF DESCRIPTION OF ROD STOP AND ADDITIONAL REMARKS:

The Tide Gauge/Staff was located in the Northwest corner of the Tinian Harbor facility. It was secured directly across from the floating dock at the small craft harbor on a small concrete pier extending out from a concrete wharf.

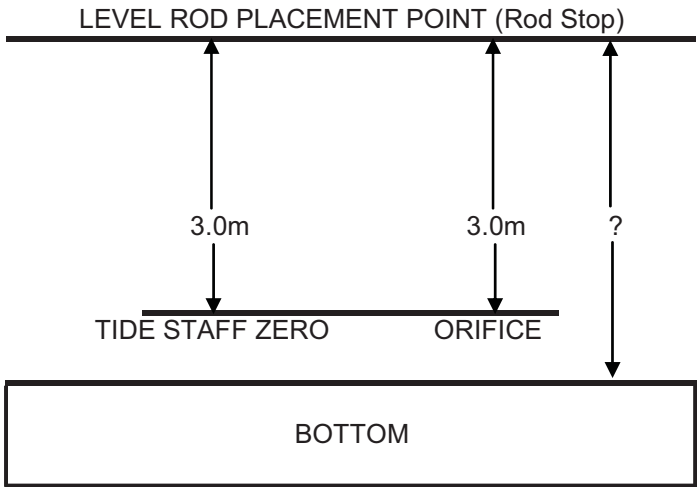
LIMITS OF STAFF GRADUATIONS	POSITION OF RODSTOP
0.0m - 3.0m Staff, 1cm graduations	Screw set into 2" x 10" wooden plank Tide Staff 3.0m above the Orifice of the Tide Gauge
DATE OF LEVELS TO TIDE STAFF	**CONNECTED TO LOCAL DATUM (Y / N)**
Leveled In, 03 Jun 2009 Leveled Out 24, Jun 2009	Y
NO. OF MARKS CONNECTED	**NO. OF MARKS ESTABLISHED**
3	1 Rod Stop on Staff, 2 Bench Marks (BM's 2 & 3)
NO. OF MARKS RECOVERED	**DATES OF OTHER LEVEL RUNS**
Steel Bolt on flagpole brace used for 3rd Bench Mark (BM3)	N/A

REMARKS ON LEVELING

3 BM's were used to tie in the Tide Gauge Orifice

ADDITIONAL INFORMATION

MEASUREMENTS



INSTALLATION SKETCH

DESCRIPTION OF BENCH MARK - BM1

1. B.M. No.: BM1

2. Established by: Fleet Survey Team (FST)

Date: 03 Jun 2009

3. Recovered by: N/A

4. Type of mark: Round Head Stainless Steel Bolt, 15mm (9/16") in diameter epoxy glued into the concrete wharf deck.

5. How stamped: No Stamp, Round Stainless Steel Bolt Head Only. However, there are markings in the concrete surface relating to another mark beside the FST Bench Mark. The etchings are: F. P. A. & P. I. B. and 8 - 6 - 07

6. Location and Detailed Description: BM1 is located in the Northwest corner of the main wharf at the small craft harbor and is set almost flush near the edge of the wharf deck. See graphic.

Photos

DESCRIPTION OF BENCH MARK - BM2

1. B.M. No.: BM2

2. Established by: Fleet Survey Team (FST)

Date: 03 Jun 2009

3. Recovered by: N/A

4. Type of mark: Round Head Stainless Steel Bolt, 15mm (9/16") in diameter epoxy glued into a fence post concrete base.

5. How Stamped: There are no markings on the bolt or concrete, Round Head Stainless Steel Bolt Only.

6. Location and Detailed Description: BM2 is located in the concrete base of the 6th chain link fence post from the gate that enters into the Saipan Express Ferry berth / commercial port. Start counting from the post that holds the gate and move Northwest towards the small craft harbor on the outside of the fence. See graphic.

PICTURES

DESCRIPTION OF BENCH MARK - BM3

1. B.M. No.: BM3

2. Established by: Fleet Survey Team (FST)

Date: 03 Jun 2009

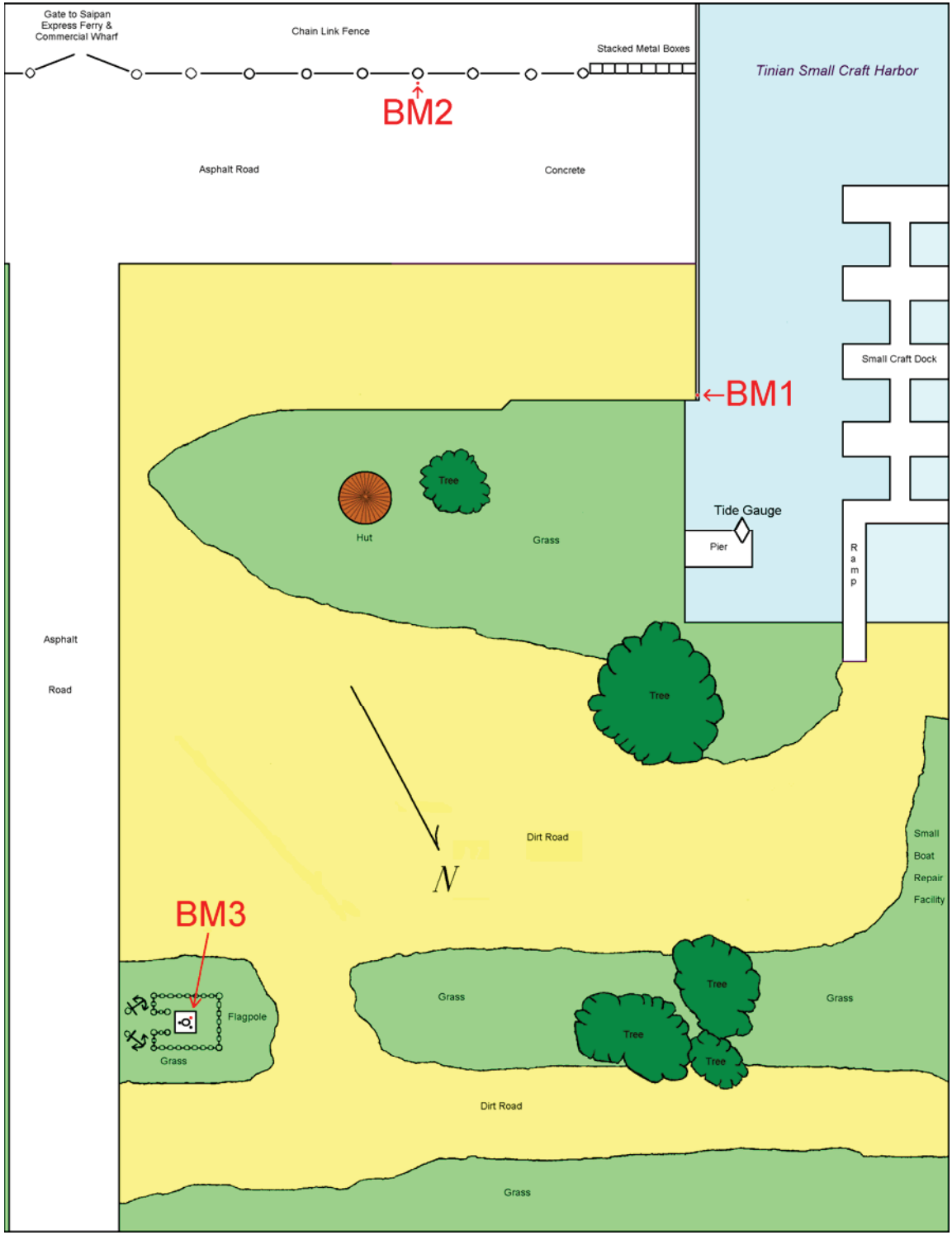
3. Recovered by: N/A

4. Type of Mark: Inverted (threads up) Steel Bolt painted Red securing flagpole brace. There are 3 red Bolts on the red bracket securing the flagpole to the concrete base, BM3 is the Bolt closest to the chain link fence that surrounds the ferry berth / commercial harbor area.

5. How Stamped: The Bolt is not stamped, 'FST BM' with an arrow pointing to the Bolt is written in indelible ink on the aluminum flagpole above BM3.

6. Location and Detailed Description: The flagpole and BM3 are located approximately 55 meters Northeast of BM2 in a small memorial surrounded by a heavy metal chain. There are 2 large anchors in front of the chains and the monument is in a grassy patch with small palm trees between dirt roads. See graphic.

PICTURES



Graphic F-1: Bench mark locations in Tinian Harbor, Tinian.

Level-In, C-Check

Tinian Harbor, Tinian Island, Commonwealth of the Northern Mariana Islands (CNMI)

"C" CHECK						"C" CHECK					
TOPCON 486357		Date:	5/22/09 UTC, 5/23/09 Local			Observer:	J. Burt		Recorder:	J. Burt	
Partly Cloudy		Time:	23:00 UTC, 09:00 Local			Rodman:	C. Baptiste		Int. X 100	Distance in meters	
	BACKSIGHT	MEAN	INTERVAL	SUM OF INT	REMARKS	FORESIGHT	MEAN	INTERVAL	SUM OF INT	DISTANCE	CORR.
	1.570		0.050			2.085		0.450			
A	1.520	1.5200		0.100		1.635	1.6350		0.900	90.000	-0.0005
	1.470		0.050			1.185		0.450			
	1.484		0.051			1.770		0.445			
B	1.433	1.4330		0.102		1.325	1.3233		0.895	89.500	-0.0005
	1.382		0.051			0.875		0.450			
	A =	2.9530	B =	0.202		C =	2.9583	D =	1.795	E =	-0.001

$$"C" = \frac{A-(C+E)}{D-B}$$

"C" = -0.00272023

"C" MUST BE LESS THAN ± 0.004 0.002720234 < 0.004 **PASS**

Level-In

THREE WIRE LEVELING						THREE WIRE LEVELING				
Project:	09CQ02	Location:	Tinian Hbr, Tinian Is.			Observer:	Jessica Burt		Recorder:	Jessica Burt
Date:	03 Jun 2009	Time:	1300L, 0200 UTC			Rodman:	Charles Baptiste		Instr #:	Topcon 486357
From:	Rod Stop	To:	BM3			Weather:	Overcast, Humid and Rainy			
STATION	BACKSIGHT	MEAN	INTERVAL	SUM OF INT		FORESIGHT	MEAN	INTERVAL	SUM OF INT	REMARKS
Rod Stop	1.292		0.064			0.799		0.051		Forward Run
TO	1.228	1.2280		0.128		0.748	0.7480		0.102	Level In
BM1	1.164		0.064			0.697		0.051		
		1.2280		0.128			0.7480		0.102	
BM1	1.195		0.064			1.576		0.060		
TO	1.131	1.1310		0.128		1.516	1.5160		0.120	
BM2	1.067		0.064			1.456		0.060		
		2.3590		0.256			2.2640		0.222	
BM2	1.406		0.108			1.176		0.136		
TO	1.298	1.2980		0.216		1.040	1.0397		0.273	
BM3	1.190		0.108			0.903		0.137		
		3.6570		0.472			3.3037		0.495	
									0.495	F.S. INTERVAL
									0.472	B.S. INTERVAL
B.S. MEAN	3.6570								0.967	100=TRANSIT LENGTH
-F.S. MEAN	3.3037						F DIST. (Meters)		96.700	
Δ ELEVATION	0.3533	= FDE					F DIST (Km)		0.0967	
FOR FORWARD RUN		FDE =	0.3533							
		BDE =	-0.3527			A.E.	0.003732	PASS		
		EC =	0.0007							

Level-In

THREE WIRE LEVELING						THREE WIRE LEVELING				
Project:	09CQ02	**Location:**	Tinian Hbr, Tinian Is.			**Observer:**	Jessica Burt		**Recorder:**	Jessica Burt
Date:	03 Jun 2009	**Time:**				**Rodman:**	Charles Baptiste		**Instr #:**	Topcon 486357
From:	BM3	**To:**	Rod Stop			**Weather:**	Overcast, Humid and Rainy			
STATION	**BACKSIGHT**	**MEAN**	**INTERVAL**	**SUM OF INT**		**FORESIGHT**	**MEAN**	**INTERVAL**	**SUM OF INT**	**REMARKS**
BM3	1.198		0.137			1.427		0.108		**Backward Run**
TO	1.061	1.0610		0.274		1.319	1.3190		0.216	**Level In**
BM2	0.924		0.137			1.211		0.108		
		1.0610		0.274			1.3190		0.216	
BM2	1.559		0.060			1.178		0.064		
TO	1.499	1.4990		0.120		1.114	1.1137		0.129	
BM1	1.439		0.060			1.049		0.065		
		2.5600		0.394			2.4327		0.345	
BM1	0.783		0.052			1.276		0.065		
TO	0.731	0.7310		0.104		1.211	1.2110		0.130	
Rod Stop	0.679		0.052			1.146		0.065		
		3.2910		0.498			3.6437		0.475	
									0.475	**F.S. INTERVAL**
									0.498	**B.S. INTERVAL**
B.S. MEAN	3.2910								0.973	**100=TRANSIT LENGTH**
-F.S. MEAN	3.6437						**B DIST. (Meters)**		97.300	
Δ ELEVATION	-0.3527	**= BDE**					**B DIST (Km)**		0.0973	
FOR BACKWARD RUN										

Level-In

ABSTRACT OF LEVELING

Date: 04 Jun 2009

The symbol B.M. (a) is used here to designate the Staff Stops Elevation above the Orifice, or the graduation of the Staff corresponding to the point at which the level rod was held.

Copy the Direct Elevation for each Bench Mark as given by the Forward and Backward runs of the levels into the form below. List the Bench Marks in Order of their Connection to the Staff on the Forward run.

(Source: Naval Oceanographic Tide Gauge Installation Manual)

LEVELS

DIFFERENCE OF ELEVATION

DESIGNATION OF SECTION	FORWARD RUN	BACKWARD RUN	MEAN
	Meters	Meters	Meters
Elevation of Rodstop above Orifice/Staff Zero (a) =			3.0000
Rod Stop → BM1	0.4800	0.4800	0.4800
BM1 → BM2	-0.3850	-0.3853	-0.3852
BM2 → BM3	0.2583	0.2580	0.2582

B.M. NUMBERS	FORWARD RUN	BACKWARD RUN
	Meters	Meters
Rod Stop	3.0000	3.0000
BM1	3.4800	3.4800
BM2	3.0950	3.0947
BM3	3.3533	3.3527

Indicate sections as "Staff to 1," etc., with the Sign of the Forward run for the Mean.

The Algebraic Sum of the successive Mean Differences gives the Elevations above Zero of the Tide Staff.

(Source: Naval Oceanographic Tide Gauge Installation Manual)

ELEVATIONS ABOVE ZERO OF THE TIDE STAFF

BM1	3.4800	Meters		Meters	
BM2	3.0948	Meters		Meters	
BM3	3.3530	Meters		Meters	

Level-Out, C-Check

Tinian Harbor, Tinian Island, Commonwealth of the Northern Mariana Islands (CNMI)

"C" CHECK						"C" CHECK					
Topcon 486357		Date	18 Jun 2009 UTC			Observer:	Barry Sysak		Recorder:	Jessica Burt	
Hot, Humid, Partly Cloudy		Time:	1300 Local 0300 UTC			Rodman:	Charles Baptiste		Int. X 100	Distance in meters	
	BACKSIGHT	MEAN	INTERVAL	SUM OF INT	REMARKS	FORESIGHT	MEAN	INTERVAL	SUM OF INT	DISTANCE	CORR.
	1.473		0.060			1.718		0.319			
A	1.413	1.4127		0.121		1.399	1.3990		0.638	63.800	-0.0003
	1.352		0.061			1.080		0.319			
	1.560		0.053			1.850		0.326			
B	1.507	1.5077		0.104		1.524	1.5237		0.653	65.300	-0.0003
	1.456		0.051			1.197		0.327			
	A =	2.9203	B =	0.225		C =	2.9227	D =	1.291	E =	-0.0006

$$"C" = \frac{A-(C+E)}{D-B}$$

"C" = -0.00162602

"C" MUST BE LESS THAN ± 0.004 0.001626016 < 0.004 **PASS**

Level-Out

THREE WIRE LEVELING						THREE WIRE LEVELING				
Project:	09CQ02	**Location:**	Tinian Hbr, Tinian Is.			**Observer:**	Barry Sysak	**Recorder:**	Jessica Burt	
Date:	6/18/2009	**Time:**	1200 L 0200 UTC			**Rodman:**	Charles Baptiste	**Instr #:**	Topcon 486357	
From:	Rod Stop	**To:**	BM3			**Weather:**	Hot, Humid, Scattered Clouds			
STATION	**BACKSIGHT**	**MEAN**	**INTERVAL**	**SUM OF INT**		**FORESIGHT**	**MEAN**	**INTERVAL**	**SUM OF INT**	**REMARKS**
Rod Stop	1.294		0.038			0.809		0.032		
TO	1.256	1.2560		0.076		0.777	0.7767		0.065	
BM1	1.218		0.038			0.744		0.033		
		1.2560		0.076			0.7767		0.065	
BM1	1.299		0.057			1.694		0.067		
TO	1.242	1.2420		0.114		1.627	1.6273		0.133	
BM2	1.185		0.057			1.561		0.066		
		2.4980		0.190			2.4040		0.198	
BM2	1.479		0.114			1.240		0.133		
TO	1.365	1.3650		0.228		1.107	1.1070		0.266	
BM3	1.251		0.114			0.974		0.133		
		3.8630		0.418			3.5110		0.464	
									0.464	**F.S. INTERVAL**
									0.418	**B.S. INTERVAL**
B.S. MEAN	3.8630								0.882	**100=TRANSIT LENGTH**
-F.S. MEAN	3.5110						**F DIST. (Meters)**		88.200	
Δ ELEVATION	0.3520	**= FDE**					**F DIST (Km)**		0.0882	
FOR FORWARD RUN		**FDE =**	0.3520							
		BDE =	-0.3523			**A.E.**	0.003564	**PASS**		
		EC =	0.0003							

Level-Out

THREE WIRE LEVELING						THREE WIRE LEVELING				
Project:	09CQ02	**Location:**	Tinian Hbr, Tinian Is.			**Observer:**	Barry Sysak		**Recorder:**	Jessica Burt
Date:	6/18/2009	**Time:**	1200L 0200 UTC			**Rodman:**	Charles Baptiste		**Instr #:**	Topcon 486357
From:	BM3	**To:**	Rod Stop			**Weather:**	Hot, Humid, Scattered Clouds			
STATION	**BACKSIGHT**	**MEAN**	**INTERVAL**	**SUM OF INT**		**FORESIGHT**	**MEAN**	**INTERVAL**	**SUM OF INT**	**REMARKS**
BM3	1.250		0.135			1.485		0.111		
TO	1.115	1.1150		0.270		1.374	1.3737		0.223	
BM2	0.980		0.135			1.262		0.112		
		1.1150		0.270			1.3737		0.223	
BM2	1.651		0.068			1.252		0.055		
TO	1.583	1.5827		0.137		1.197	1.1970		0.110	
BM1	1.514		0.069			1.142		0.055		
		2.6977		0.407			2.5707		0.333	
BM1	0.824		0.036			1.305		0.038		
TO	0.788	0.7880		0.072		1.267	1.2673		0.075	
Rod Stop	0.752		0.036			1.230		0.037		
		3.4857		0.479			3.8380		0.408	
									0.408	**F.S. INTERVAL**
									0.479	**B.S. INTERVAL**
B.S. MEAN	3.4857								0.887	**100=TRANSIT LENGTH**
-F.S. MEAN	3.8380						**B DIST. (Meters)**		88.700	
Δ ELEVATION	-0.3523	**= BDE**					**B DIST (Km)**		0.0887	
FOR BACKWARDS RUN										