經濟部暨所屬機關因公出國人員報告書
(出國類別：洽公)

LNG 船船艙計量系統校驗監測工作報告書

服務機關： 台灣中油永安液化天然氣廠

姓名職稱： 溫秀祥 輸氣技術員

派赴國家： 馬來西亞

出國期間： 97 年 11 月 25 日至 11 月 28 日

報告日期： 97 年 12 月 29 日

摘　要

中油公司每年自國外進口大量液化天然氣（LNG），以供應國內市場所需，目前永安廠是國內最大液化天然氣（LNG）卸收單位，LNG 卸收數量係以船上之計量設備爲依據，此套計量設備之準確性影響交易雙方之權益甚巨，所以對船上計量設備進行測量及校驗是必要的工作，其實施是由公正的公證公司執行校驗監證工作，交易雙方派員參與。

此次馬來西亞 LNG 船（Puteri ZAMRUD）於馬來西亞 Pasir Gudang 之 MMHE (Malaysia Marine And Heavy Engineering Sdn. Bhd.) shipyard 進行檢修，同時進行相關計量設備之校驗工作，包括：(1) 浮筒式液位計量系統(2) 電容式液位計量系統(3) 溫度量測系統(4) 壓力量測系統(5) 船身俯仰暨傾斜指示器，由新日本海事檢定協會 NKKK(NIPPON KAIJI KENTEI KYOKAI.)以公正的公證單位代表執行校驗監證。

目　次

一、 目的

中油公司每年自國外進口大量液化天然氣（LNG），以供應國內市場所需，目前永安廠是國內最大液化天然氣（LNG）卸收單位，LNG 卸收數量係以船上之計量設備爲依據，此套計量設備之準確性，影響交易雙方之權益甚巨，所以對船上計量設備進行測量及校驗是必要的工作，其實施是由公正的公證公司執行校驗監證工作，交易雙方派員參與，此次 Puteri ZAMRUD 船上計量設備量測及校驗工作之監證者包括：船方代表 MISC、馬來西亞液化天然氣公司 MLNG (Malaysia LNG Sdn. Bhd.)、台灣中油公司代表及日本海事檢定協會（NKKK）代表。校驗工作是由新日本海事檢定協會（NKKK）以第三者的公證單位在場執行校驗監證。

此次馬來西亞 LNG 船（Puteri ZAMRUD）進行相關計量設備之校驗工作，包括：(1) 浮筒式液位計量系統(2) 電容式液位計量系統(3) 溫度量測系統(4) 壓力量測系統(5) 船身俯仰暨傾斜指示器，上述各項量測校驗結果及方法（如附件）。

二、 行程

十一月二十五日：啓程前馬來西亞 Pasir Gudang。

十一月二十六日：參與相關計量設備之校驗工作。

十一月二十七日：參與相關計量設備之校驗工作及彙整各項測試資料，檢討測試結果。

十一月二十八日：返程回國。

三、概述

1、　參與此次測試人員

(1) 台灣中油股份有限公司(買方代表)：
溫 秀 祥

(2) MISC (船方代表)：
Captain Pavan Kumar Shivan Ditta
Captain Farooq Hussain

(3) MLNG (賣方代表)：
Mr. Kenneth George Ng,
Mr. Hakim M Hatta

(4) NIPPON KAIJI KENTEI KYOKRI(NKKK 新日本海事檢定協會代表)：
Mr.Adi Ahnad

2、貨艙計量原理

由於 LNG 船承載之貨物是超低溫可燃性液化天然氣，其貨艙必須密閉，計量時無法以類似原油船自貨艙口直接測量液位，以計算交運體積及重量之方式進行，須採取 Custody Transfer System 方式計量，在貨艙內適當位置安裝液位、溫度、壓力等感測器，將感測到的物理量，以及船身俯仰、傾斜的物理量，同時傳送至貨艙計量系統中的 CT-IV 電腦工作站，進行計量運算，並將結果同時以圖形及數字方式顯示於監視器螢幕，另外並以印表機印出數據，以便做爲買賣雙方計算貨物數量之依據。

本艘 LNG 船 PuteriZAMRUD 上共計有四個貨艙，當貨艙裝載 LNG 後，其液位變化會造成電容式液位感測器之電容量產生變化，經由電腦運算即可轉換爲相對之液位值，並參考船身俯仰、傾斜的物理量後，計算出儲槽內 LNG 之體積。

四、計量設備校驗工作程序及測試結果

1、浮筒式液位計系統

（1）零點校正

將浮筒降至 COLUMN 最底部，以標準鋼尺測量浮筒導線從槽頂至槽底最大長度，校正其零點位置。

（2）準確度測試

做完零點校正後，選定滿刻度範圍之 20%(5100mm)及 80%(20400mm)兩個位置測試液位計之準確度，以標準鋼尺量測其實際高度並與顯示器之讀值比較，確認其誤差是否合乎規格要求。

（3）經實地檢視並量測四個貨艙內浮筒式液位計零點校正及準確度，量測結果均符合規格之要求。九十七年十一月二十七日現場重新驗證，量測結果均符合規格之要求。

（4）經校正後，槽上的液位錶由 NKKK 人員鉛封。

2 電容式液位計系統

電容式液位計系統的量測原理是貨艙內液位的變動，經電容感應器感測電容的變化，傳送電流變動信號至液位轉換器模組，液位轉換器模組經數位化後送至控制處理器，控制處理器將數位信號轉換成不同刻度範圍及不同工程單位的物理量。但因貨艙內尚未進料，無法實際檢測液位，因此採用原製造商提供之乾式校正（DRY CAL）方式進行各組電容感應器之測試，其測試方法如下。

（1）首先貨艙計量系統電腦工作站執行 DRY CAL 工作。

（2）再進行貨艙計量系統電腦工作站內的 DRY TEST 功能進行測試。

（3）檢驗並記錄空槽狀態下之數據，啓動 DRY TEST，分別以每一節電容器之實際值及 DRY CAL 預設之組態規劃值計算每一節之液位數據。

（4）檢驗並記錄滿槽狀態下之數據，啓動 DRY TEST，分別以模擬之滿刻度數值計算每一節電容器之液位數據。

（5）經實地測試船上四個貨艙內電容式液位計的 DRY TEST 功能，量測結果均符合規格之要求。

3 溫度量測系統

貨艙內的溫度指示器是測量艙內 LNG 之實際溫度，以便在以液位 算成體積時加入溫度補償，確保體積準確度，其測試方法如下：

（1）以標準電阻箱模擬溫度變化，測試溫度量測迴路之準確度，並比較工作站監視器螢幕之顯示值與印表機輸出之數據是否相符。

（2）測試時以電阻箱接於迴路上，並分別送出 171Ω、297Ω及 500Ω之電阻值，其對應之溫度分別是 0℃、-100℃及-160℃三點，逐 一進行量測並檢視其誤差是否合乎規格要求。

（3）經實地檢視並測試四個貨艙溫度量測系統的準確度，量測結果均符合規格之要求。

4、壓力量測系統

壓力量測之目的是爲掌握貨艙內液化天然氣的蒸氣壓，其測試方式如下：

（1）以壓力信號產生器及數位式標準壓力表，測試壓力傳送器及其迴路之準確度，並比較工作站監視器螢幕之顯示值與印表機輸出之數據是否相符。

（2）測試前須先做數位式標準壓力表歸零校正。

（3）測試時以壓力信號產生器接於迴路上，並依序分別送出 810、1100、1390 mbar 絕對壓力之壓力信號，逐一進行量測並檢視其誤差是否合乎規格要求。

（4）經實地檢視並測試四個貨艙壓力量測系統的準確度，量測結果均符合規格之要求。

5、船身俯仰暨傾斜指示器

俯仰暨傾斜量測之目的是爲提供貨艙容量計算時之修正係數，其測試方式如下：

（1）以 4,/12,/20 mA 標準電流信號產生器分別模擬船身俯仰及傾斜程度的信號，測試貨艙計量系統內 I/A 模組之準確度，並比較工作站監視器螢幕之顯示值與印表機輸出之數據是否相符。

（2）測試時以標準電流信號產生器接於 I/A 模組迴路上。

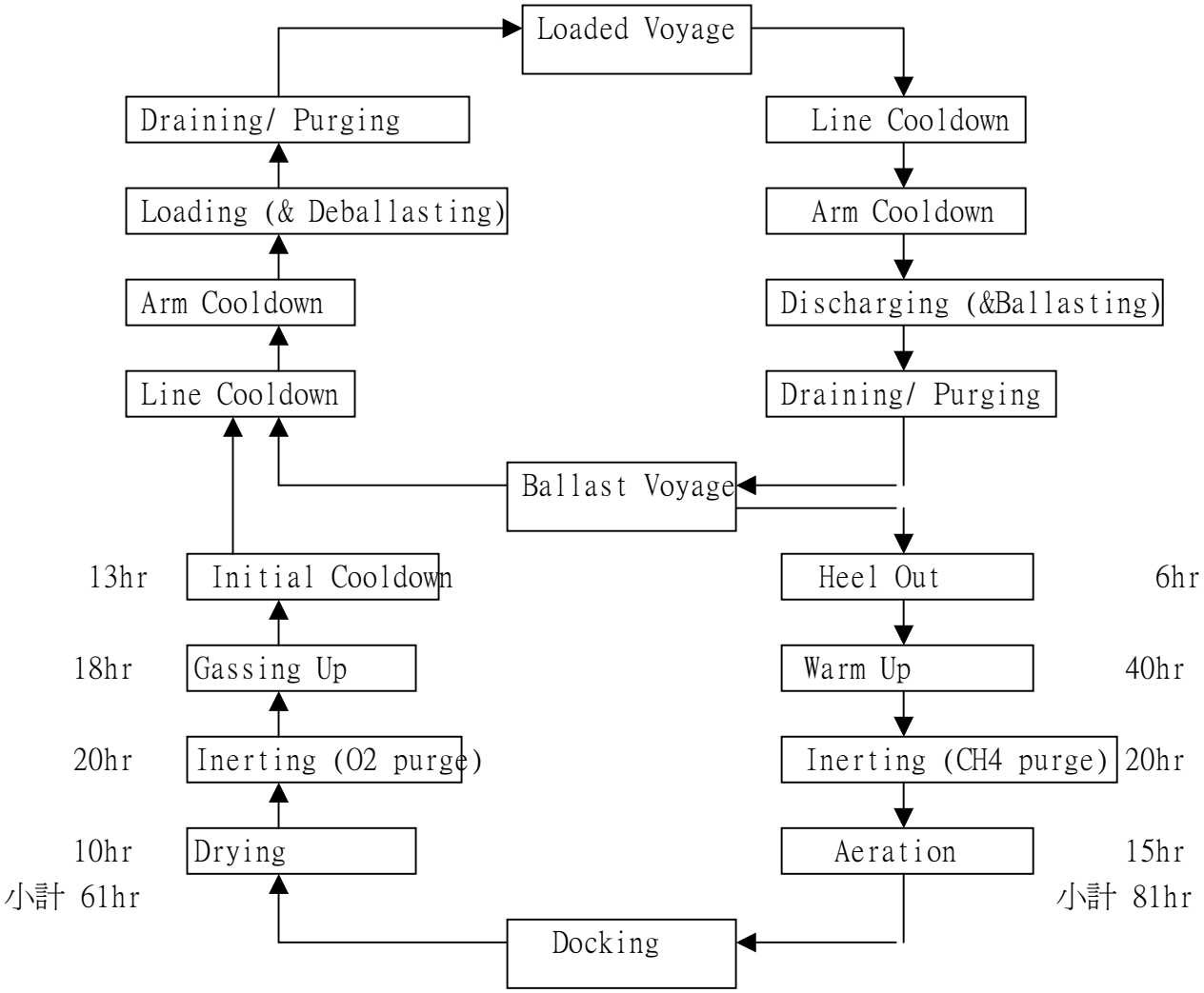
（3）以標準電流信號產生器依序分別送出 4 mA、12 mA 及 20 mA 之電流信號，其對應之側傾程度分別是 13.02 P(to port side)、0.0 (even)及 13.02S(to starboard side)三點，逐一進行量測並檢視其誤差是否合乎規格要求。

（4）以標準電流信號產生器依序分別送出 4 mA、12 mA 及 20 mA 之電流信號，其對應之俯仰程度分別是 8.06m（by stern）、4.03 m(even)及 16.12m（by head）三點，逐一進行量測並檢視其誤差是否合乎規格要求。

（5）經實地檢視並測試貨艙船身俯仰暨傾斜指示器的準確度，量測結果均符合規格之要求。

五、船貨處理及船艙構造摘要：LNGC PUTERI ZAMRUL

1. 船貨處理流程：



3 weeks

LNG船上架歲修基本上約需 4 weeks.

2. Cargo tank 構造：Gaz Transport type double membrane tank
The following describe the cargo tank structure from the cargo to the hull.
Primary membrane: cryogenic invar (a 36% nickel steel) with 0.7mm thick
Primary insulation: a layer of plywood boxes filled with perlite
Secondary membrane: cryogenic invar (a 36% nickel steel) with 0.7mm thick
Secondary insulation: a layer of plywood boxes filled with perlite

3. 詳細船貨處理及船艙構造之說明：請參閱 Cargo Operating Manual of LNGC PUTERI ZAMRUL

六、心得與建議

1.新日本海事檢定協會出具其於九十七年十一月二十六日至十一月二十七日對船上四個 membrane tank 之量測儀器之校驗報告，以證明量測儀器有效性，其量測及校驗結果均在容許誤差範圍內。

2.此次參與計量設備量測及校驗工作之監證，讓筆者更了解 LNG 船計量系統的運作。

3.LNG 船計量設備進行校驗工作期間，可一併研究 LNG 船之結構與 LNG 船上 cargo operation 之相關設備，如此對 LNG 船到台灣港口卸收 LNG 作業有很大的助益，特別是當 LNG 卸收作業發生異常時，較能準確的立即採取最佳應變處理方式，以防止 LNG 洩漏或擴大之工安事件。

七、附件

1. 當場參加 CTM 量測人員簽名表----------附件一(簽名表單)
2. 浮筒式液位計校正結果與 CTM 量測方法--------附件二(page2~3)
3. 電容式液位計校正結果與 CTM 量測方法--------附件三(page4~9)
4. 溫度量測校驗結果與 CTM 量測方法----------附件四(page11~15)
5. 壓力量測校正結果與 CTM 量測方法----------附件五(page16~17)
6. 船身俯仰暨傾斜指示器校驗結與 CTM 量測方法---附件六(page18~19)
7. 設備測試原件認證書----------附件七(original)

NIPPON KAIJI KENTEI KYOKAI
SINGAPORE OFFICE

PROCEDURE & TEST RESULTS

OF

CTMS ONBOARD TEST ON

S.S. " PUTERI ZAMRUD "

NOVEMBER 2008

MALAYSIA MARINE AND HEAVY ENGINEERING SDN. BHD.

MALAYSIA

* FLOAT LEVEL GAUGE
* CT-IV LEVEL SYSTEM (MAIN)
* CT-IV TEMPERATURE SYSTEM (SERVICE & SPARE)
* CT-IV PRESSURE SYSTEM
* CT-IV TRIM & LIST
* ON-LINE VALIDATION DEMO

CUSTODY TRANSFER MEASURING SYSTEM
FOR
S.S. " PUTERI ZAMRUD "

This is to confirm that all the test carried out on 26th and 27th November, 2008 onboard vessel S.S. " PUTERI ZAMRUD " at MALAYSIA MARINE AND HEAVY ENGINEERING SDN. BHD. complies with the procedure and specification required.

Mr Kenneth George Ng
MISC Berhad

Mr Wen Hsiu Hsiang
Chinese Petroleum Company

Mr Lukmanul Hakim M. Hatta
Malaysia LNG

Capt Pavan Kumar Shivan Ditta
MISC Berhad

Adi Ahmad
NKKK Singapore

CUSTODY TRANSFER MEASURING SYSTEM
FOR
S.S. " PUTERI ZAMRUD "

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SUMMARY OF CTMS ONBOARD TEST RESULTS

S.S. " PUTERI ZAMRUD "

PLACE : MALAYSIA MARINE AND HEAVY ENGINEERING SDN. BHD.
DATE : 26TH AND 27TH NOVEMBER 2008

Float Type Level Gauge	Maximum Error	Criteria
Local	3 mm	± 7.5mm

Main Gauge	Max. Sensor Error (ES) mm	Max. Error (ED) mm	Integrated Error (mm)	Criteria/ Spec.
Capacitance Type Level Gauge VDU	0.4	1.0	1.1	± 7.5mm
Capacitance Type Level Gauge Printer		1.0	1.1	± 7.5mm

Temperature Measuring System VDU	Service Max. Error	Spare Max. Error	Criteria/ Spec.
@ -160 °C	0.04 °C	0.03 °C	± 0.2 °C
@ -100 °C	0.04 °C	0.03 °C	± 1.5 °C
@ 0 °C	0.06 °C	0.05 °C	± 1.5 °C
Temperature Measuring System Printer	**Service Max. Error**	**Spare Max. Error**	**Criteria/ Spec.**
@ -160 °C	0.04 °C	0.03 °C	± 0.2 °C
@ -100 °C	0.04 °C	0.03 °C	± 1.5 °C
@ 0 °C	0.06 °C	0.05 °C	± 1.5 °C

Pressure Gauge (800 mbarA to 1400 mbarA)	Max. Error	Max. Error %	Criteria
VDU	0.6 mbar	0.10 %	±1% (6mbar)
Printer	0.6 mbar	0.10 %	

Trim	Max. Error	Int. Error	Criteria
VDU	0.00	0.00 %	± 0.5%
Printer	0.00	0.00 %	± 0.5%
List	Max. Error	Int. Error	Criteria
VDU	0.00	0.00 %	± 0.5%
Printer	0.00	0.00 %	± 0.5%

On-Line Validation Demo : SATISFACTORY

Accuracy Test of Float Gauge for Vessel S.S. " PUTERI ZAMRUD "

Accuracy Test

Taking the float up to 20% (5100 mm) of tank height and measure the height of the float by steel tape.

Moving the float up and down slightly, repeat the measurement 3 times. Height measured as above shall be averaged then the difference between the averaged height and the simulated level shall be calculated.

Move the float up to 80% (20400 mm) of tank height and repeat the above procedure.

Integrated Error

Larger difference calculated at 2 test levels is adopted as maximum error of the float gauge.

Seal

Gauge head of each float gauge shall be sealed by the customs officer or by NKKK surveyor.

Remark

(a) Locking the float with a plunger at top storage position, the indication shall be noted as maximum indication.

(b) Minimum reading shall be confirmed.

ACCURACY TEST OF FLOAT LEVEL GAUGE SYSTEM

VESSEL NAME : S.S. " PUTERI ZAMRUD " DATE : 26th & 27th November 2008
PLACE : MALAYSIA MARINE AND HEAVY ENGINEERING SDN. BHD.

Temperature Correction (mm) : 10.3E-6 x L x (T-20) Tension Correction (mm) : 3.685E-6 x L x 50 N

	Tank No.		1			2			3			4		
	Serial No.		3995-1			3995-3			3995-2			3995-4		
Zeroing	Set Point		189			198			192			193		
	Local		189			198			192			193		
	Error		0			0			0			0		
Accuracy Check	Tank Temperature °C		27.3			27.1			27.2			27.1		
	1/5 H Temperature Correction		0			0			0			0		
	1/5 H Tension Correction		-1			-1			-1			-1		
	Correction = Counter - Tape		Counter	Tape	Correction	Counter	Tape	Correction	Counter	Tape	Correction	Counter	Tape	Correction
			1000	257	743	1000	250	750	1000	265	735	1000	240	760
	1/5 Tank Height Checkpoint (TANK NO.1- 4 : 5100)		Counter Value	Measure Value	Actual Value	Counter Value	Measure Value	Actual Value	Counter Value	Measure Value	Actual Value	Counter Value	Measure Value	Actual Value
		1 Local	5,100	4,356	5,098	5,100	4,352	5,101	5,100	4,365	5,099	5,100	4,342	5,101
		2 Local	5,100	4,356	5,098	5,100	4,352	5,101	5,100	4,365	5,099	5,100	4,341	5,100
		3 Local	5,100	4,355	5,097	5,100	4,352	5,101	5,100	4,365	5,099	5,100	4,341	5,100
		Ave.	5,100	4,356	5,098	5,100	4,352	5,101	5,100	4,365	5,099	5,100	4,341	5,100
		Diff.	2			1			1			0		
	4/5 H Temperature Correction		+1			+1			+1			+1		
	4/5 H Tension Correction		-4			-4			-4			-4		
	4/5 Tank Height Checkpoint (TANK NO.1 - 4 : 20400)		Counter Value	Measure Value	Actual Value	Counter Value	Measure Value	Actual Value	Counter Value	Measure Value	Actual Value	Counter Value	Measure Value	Actual Value
		1 Local	20,400	19,657	20,397	20,400	19,654	20,401	20,400	19,665	20,397	20,400	19,641	20,398
		2 Local	20,400	19,657	20,397	20,400	19,653	20,400	20,400	19,665	20,397	20,400	19,641	20,398
		3 Local	20,400	19,657	20,397	20,400	19,654	20,401	20,400	19,665	20,397	20,400	19,641	20,398
		Ave.	20,400	19,657	20,397	20,400	19,654	20,401	20,400	19,665	20,397	20,400	19,641	20,398
		Diff.	3			1			3			2		
Maximum Reading (Local)			28,668			28,670			28,686			28,688		

Unit : mm Whessoe Fig. 3304

Accuracy Test of Capacitance Type Level Measurement System

Objective

Test the
- Computer
- Stored Values
- Dry Cal
- Configuration

Procedure
- Perform Dry Cal via the workstation
- Call up the Dry Test function via the workstation
- Verify and record the empty values on the appropriate form attached.

The dry test function is performed in two steps :
- EMPTY values
- FULL values

For the EMPTY values the Dry Test function computes the liquid level in each segment using the actual values of each segment and the values stored by the Dry Cal and the configuration. The expected results are 0000.

For the FULL values the Dry Test function computes the liquid level in each segment using the simulated full values.The expected results are shown on the data sheets.

The expected results are

- The length of the segment at the temperature indicated by the temperature system.
- The full segment top height at the temperature indicated by the temperature system.

The column height error shall be confirmed.

The RSS (Root Sum Squared) of the maximum difference shall be confirmed based on the following formula.

$$E_1 = \sqrt{ES^2 + ED^2}$$

E_1 : Maximum system error

ES : Maximum error of the sensor linearity

ED : Maximum error of the computer

CT-IV TEST DATA FOR CAPACITANCE LEVEL SYSTEM

Tank No. 1 - Main VESSEL : S.S. " PUTERI ZAMRUD "

In-Tank Temp : 27 °C DATE : 26th November 2008

VDU

Channel		Empty Channel Value (m)	Full Segment Length Value (m)	Segment Length Per Table 1 (m)	Segment Length Error (mm)	Column Height At Top Of Flange (m)	Column Height Per Table 2 (m)	Column Height Error (mm)
Ref	-	0.000	0.360	0.360	0	0.386	0.386	0
First	(1)	0.000	4.992	4.992	0	5.018	5.018	0
Second	(2)	0.000	5.019	5.018	1	10.037	10.036	1
Third	(3)	0.000	2.710	2.710	0	12.746	12.747	1
Fourth	(4)	0.000	2.609	2.609	0	15.356	15.356	0
Fifth	(2)	0.000	5.018	5.018	0	20.374	20.374	0
Top	(5)	0.000	5.022	5.022	0	25.396	25.396	0

Printer

Channel		Empty Channel Value (m)	Full Segment Length Value (m)	Segment Length Per Table 1 (m)	Segment Length Error (mm)	Column Height At Top Of Flange (m)	Column Height Per Table 2 (m)	Column Height Error (mm)
Ref	-	0.000	0.360	0.360	0	0.386	0.386	0
First	(1)	0.000	4.992	4.992	0	5.018	5.018	0
Second	(2)	0.000	5.019	5.018	1	10.037	10.036	1
Third	(3)	0.000	2.710	2.710	0	12.746	12.747	1
Fourth	(4)	0.000	2.609	2.609	0	15.356	15.356	0
Fifth	(2)	0.000	5.018	5.018	0	20.374	20.374	0
Top	(5)	0.000	5.022	5.022	0	25.396	25.396	0

Note:
(1) Segment Length Error = Full Segment Length Value - Segment Length Per Table 1
(2) Column Height Error = Column Height At Top Of Flange - Column Height Per Table 2
(3) Number In Bracket ( ) Means The Kind Of Segment Shown In Table 1 attached

Column Height Maximum Error (VDU) 1 mm
Column Height Maximum Error (Printer) 1 mm

CT-IV TEST DATA FOR CAPACITANCE LEVEL SYSTEM

Tank No. 2 - Main VESSEL : S.S. " PUTERI ZAMRUD "

In-Tank Temp : 26 °C DATE : 26th November 2008

VDU

Channel		Empty Channel Value (m)	Full Segment Length Value (m)	Segment Length Per Table 1 (m)	Segment Length Error (mm)	Column Height At Top Of Flange (m)	Column Height Per Table 2 (m)	Column Height Error (mm)
Ref	-	0.000	0.360	0.360	0	0.386	0.386	0
First	(1)	0.000	4.992	4.992	0	5.018	5.018	0
Second	(2)	0.000	5.018	5.018	0	10.036	10.036	0
Third	(3)	0.000	2.710	2.710	0	12.746	12.746	0
Fourth	(4)	0.000	2.609	2.609	0	15.356	15.355	1
Fifth	(2)	0.000	5.019	5.018	1	20.374	20.373	1
Top	(5)	0.000	5.022	5.022	0	25.396	25.396	0

Printer

Channel		Empty Channel Value (m)	Full Segment Length Value (m)	Segment Length Per Table 1 (m)	Segment Length Error (mm)	Column Height At Top Of Flange (m)	Column Height Per Table 2 (m)	Column Height Error (mm)
Ref	-	0.000	0.360	0.360	0	0.386	0.386	0
First	(1)	0.000	4.992	4.992	0	5.018	5.018	0
Second	(2)	0.000	5.018	5.018	0	10.036	10.036	0
Third	(3)	0.000	2.710	2.710	0	12.746	12.746	0
Fourth	(4)	0.000	2.609	2.609	0	15.356	15.355	1
Fifth	(2)	0.000	5.019	5.018	1	20.374	20.373	1
Top	(5)	0.000	5.022	5.022	0	25.396	25.396	0

Note:
(1) Segment Length Error = Full Segment Length Value - Segment Length Per Table 1
(2) Column Height Error = Column Height At Top Of Flange - Column Height Per Table 2
(3) Number In Bracket ( ) Means The Kind Of Segment Shown In Table 1 attached

Column Height Maximum Error (VDU) 1 mm
Column Height Maximum Error (Printer) 1 mm

CT-IV TEST DATA FOR CAPACITANCE LEVEL SYSTEM

Tank No. 3 - Main VESSEL : S.S. " PUTERI ZAMRUD "

In-Tank Temp : 27 °C DATE : 26th November 2008

VDU

Channel		Empty Channel Value (m)	Full Segment Length Value (m)	Segment Length Per Table 1 (m)	Segment Length Error (mm)	Column Height At Top Of Flange (m)	Column Height Per Table 2 (m)	Column Height Error (mm)
Ref	-	0.000	0.360	0.360	0	0.386	0.386	0
First	(1)	0.000	4.993	4.992	1	5.019	5.018	1
Second	(2)	0.000	5.018	5.018	0	10.036	10.036	0
Third	(3)	0.000	2.710	2.710	0	12.746	12.747	1
Fourth	(4)	0.000	2.610	2.609	1	15.356	15.356	0
Fifth	(2)	0.000	5.019	5.018	1	20.375	20.374	1
Top	(5)	0.000	5.023	5.022	1	25.397	25.396	1

Printer

Channel		Empty Channel Value (m)	Full Segment Length Value (m)	Segment Length Per Table 1 (m)	Segment Length Error (mm)	Column Height At Top Of Flange (m)	Column Height Per Table 2 (m)	Column Height Error (mm)
Ref	-	0.000	0.360	0.360	0	0.386	0.386	0
First	(1)	0.000	4.993	4.992	1	5.019	5.018	1
Second	(2)	0.000	5.018	5.018	0	10.036	10.036	0
Third	(3)	0.000	2.710	2.710	0	12.746	12.747	1
Fourth	(4)	0.000	2.610	2.609	1	15.356	15.356	0
Fifth	(2)	0.000	5.019	5.018	1	20.375	20.374	1
Top	(5)	0.000	5.023	5.022	1	25.397	25.396	1

Note:
(1) Segment Length Error = Full Segment Length Value - Segment Length Per Table 1
(2) Column Height Error = Column Height At Top Of Flange - Column Height Per Table 2
(3) Number In Bracket ( ) Means The Kind Of Segment Shown In Table 1 attached

Column Height Maximum Error (VDU) 1 mm
Column Height Maximum Error (Printer) 1 mm

CT-IV TEST DATA FOR CAPACITANCE LEVEL SYSTEM

Tank No. 4 - Main VESSEL : S.S. " PUTERI ZAMRUD "

In-Tank Temp : 27 °C DATE : 26th November 2008

VDU

Channel		Empty Channel Value (m)	Full Segment Length Value (m)	Segment Length Per Table 1 (m)	Segment Length Error (mm)	Column Height At Top Of Flange (m)	Column Height Per Table 2 (m)	Column Height Error (mm)
Ref	-	0.000	0.360	0.360	0	0.386	0.386	0
First	(1)	0.000	4.991	4.992	1	5.017	5.018	1
Second	(2)	0.000	5.018	5.018	0	10.037	10.036	1
Third	(3)	0.000	2.710	2.710	0	12.747	12.747	0
Fourth	(4)	0.000	2.609	2.609	0	15.355	15.356	1
Fifth	(2)	0.000	5.018	5.018	0	20.374	20.374	0
Top	(5)	0.000	5.022	5.022	0	25.396	25.396	0

Printer

Channel		Empty Channel Value (m)	Full Segment Length Value (m)	Segment Length Per Table 1 (m)	Segment Length Error (mm)	Column Height At Top Of Flange (m)	Column Height Per Table 2 (m)	Column Height Error (mm)
Ref	-	0.000	0.360	0.360	0	0.386	0.386	0
First	(1)	0.000	4.991	4.992	1	5.017	5.018	1
Second	(2)	0.000	5.018	5.018	0	10.037	10.036	1
Third	(3)	0.000	2.710	2.710	0	6.000	12.747	6747
Fourth	(4)	0.000	2.609	2.609	0	15.355	15.356	1
Fifth	(2)	0.000	5.018	5.018	0	20.374	20.374	0
Top	(5)	0.000	5.022	5.022	0	25.396	25.396	0

Note:
(1) Segment Length Error = Full Segment Length Value - Segment Length Per Table 1
(2) Column Height Error = Column Height At Top Of Flange - Column Height Per Table 2
(3) Number In Bracket ( ) Means The Kind Of Segment Shown In Table 1 attached

Column Height Maximum Error (VDU)	1	mm
Column Height Maximum Error (Printer)	6747	mm

VESSEL NAME : S.S. " PUTERI ZAMRUD "

Table 1: Full Segment Length (Meter)

Segment Type	Temperature °C										
	@ 25	22	23	24	25	26	27	28	29	30	31
Reference -	0.360	0.360	0.360	0.360	0.360	0.360	0.360	0.360	0.360	0.360	0.360
Reference/Support (1)	4.992	4.992	4.992	4.992	4.992	4.992	4.992	4.992	4.992	4.993	4.993
Standard Segment (2)	5.018	5.018	5.018	5.018	5.018	5.018	5.018	5.018	5.018	5.019	5.019
Standard Segment (3)	2.710	2.710	2.710	2.710	2.710	2.710	2.710	2.710	2.710	2.710	2.710
Standard Segment (4)	2.609	2.609	2.609	2.609	2.609	2.609	2.609	2.609	2.609	2.609	2.609
Top Segment (5)	5.022	5.022	5.022	5.022	5.022	5.022	5.022	5.022	5.022	5.023	5.023

Table 2: Column Height (Meter)

Segment Type	Temperature °C										
	@ 25	22	23	24	25	26	27	28	29	30	31
Ref -	0.386	0.386	0.386	0.386	0.386	0.386	0.386	0.386	0.386	0.386	0.386
First (1)	5.018	5.018	5.018	5.018	5.018	5.018	5.018	5.018	5.018	5.019	5.019
Second (2)	10.036	10.035	10.036	10.036	10.036	10.036	10.036	10.037	10.037	10.037	10.037
Third (3)	12.746	12.745	12.745	12.746	12.746	12.746	12.747	12.747	12.747	12.747	12.748
Fourth (4)	15.355	15.354	15.354	15.355	15.355	15.355	15.356	15.356	15.356	15.357	15.357
Fifth (2)	20.373	20.372	20.372	20.373	20.373	20.373	20.374	20.374	20.375	20.375	20.376
Sixth (5)	25.395	25.393	25.394	25.394	25.395	25.396	25.396	25.397	25.397	25.398	25.398

This table is made using the next formula:

$H^t = (1 + a \times (t - 25)) \times H$

Where: $a = 21.96 \times 10^{-6}$

H = Full Segment Length at **25** °C

H^t = Full Segment Length at **t** °C

Accuracy Test of Temperature Measuring System

Resistance Thermal Detector (RTD)

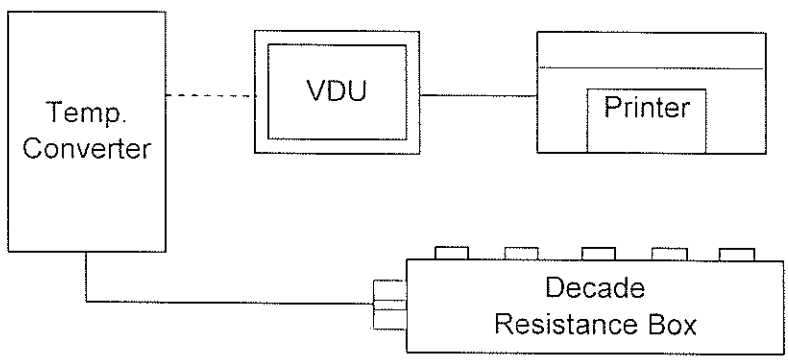
Condition of cabling and mounting of the RTDs shall visually be inspected.

Display and Printer

Feed 500 ohm, 297 ohm and 171 ohm which represent 0 °C, -100 °C and -160 °C respectively to the temperature converter from a precision decade resistance box. Compare the temperature output from the VDU and the Printer with each RTD's characteristics.

Integrated Error

The maximum difference between the temperature output fromthe Displays and the Printer and the RTD's characteristics shall be regarded as the integrated error.



CT-IV TEST DATA FOR TEMPERATURE SYSTEM

Tank No. : 1
Tolerance : ± 0.2 °C (-165 °C to -145 °C) ± 0.3 °C (-145 °C to -120 °C) ± 1.5 °C (-120 °C to +40 °C)

Vessel Name : S.S. " PUTERI ZAMRUD "
Date : 26th November 2008

Service

Fitting Location		100%		75%		50%		25%		0%	
Serial Number		F39351-A1		F39351-A2		F39351-A3		F39351-A4		F39351-A5	
Sensor Characteristic	171 Ohm	-160.29		-160.25		-160.09		-160.22		-160.25	
For Test Kit	297 Ohm	-100.36		-100.28		-100.03		-100.27		-100.32	
(Standard Temperature)	500 Ohm	-0.25		-0.09		0.29		-0.14		-0.23	
Data Source		VDU	Printer	VDU	Printer	VDU	Printer	VDU	Printer	VDU	Printer
Actual	171 Ohm	-160.32	-160.32	-160.26	-160.26	-160.13	-160.13	-160.19	-160.19	-160.28	-160.28
Indicated	297 Ohm	-100.35	-100.35	-100.27	-100.27	-100.02	-100.02	-100.23	-100.23	-100.32	-100.32
Temperature	500 Ohm	-0.24	-0.24	-0.09	-0.09	0.29	0.29	-0.14	-0.14	-0.23	-0.23
Error For	-160 °C	0.03	0.03	0.01	0.01	0.04	0.04	0.03	0.03	0.03	0.03
Each	-100 °C	0.01	0.01	0.01	0.01	0.01	0.01	0.04	0.04	0.00	0.00
Checkpoint	0 °C	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Max. Error (VDU)	@ -160 °C	@ -100 °C	@ 0 °C	Max. Error (Printer)	@ -160 °C	@ -100 °C	@ 0 °C
	0.04	0.04	0.01		0.04	0.04	0.01

Spare

Fitting Location		100%		75%		50%		25%		0%	
Serial Number		F39351-A6		F39351-A7		F39351-A8		F39351-A9		F39351-A10	
Sensor Characteristic	171 Ohm	-160.05		-160.25		-160.35		-160.30		-160.25	
For Test Kit	297 Ohm	-99.88		-100.30		-100.44		-100.38		-100.30	
(Standard Temperature)	500 Ohm	0.66		-0.19		-0.34		-0.26		-0.15	
Data Source		VDU	Printer	VDU	Printer	VDU	Printer	VDU	Printer	VDU	Printer
Actual	171 Ohm	-160.05	-160.05	-160.24	-160.24	-160.35	-160.35	-160.28	-160.28	-160.25	-160.25
Indicated	297 Ohm	-99.87	-99.87	-100.29	-100.29	-100.42	-100.42	-100.35	-100.35	-100.29	-100.29
Temperature	500 Ohm	0.64	0.64	-0.19	-0.19	-0.33	-0.33	-0.26	-0.26	-0.14	-0.14
Error For	-160 °C	0.00	0.00	0.01	0.01	0.00	0.00	0.02	0.02	0.00	0.00
Each	-100 °C	0.01	0.01	0.01	0.01	0.02	0.02	0.03	0.03	0.01	0.01
Checkpoint	0 °C	0.02	0.02	0.00	0.00	0.01	0.01	0.00	0.00	0.01	0.01

Max. Error (VDU)	@ -160 °C	@ -100 °C	@ 0 °C	Max. Error (Printer)	@ -160 °C	@ -100 °C	@ 0 °C
	0.02	0.03	0.02		0.02	0.03	0.02

CT-IV TEST DATA FOR TEMPERATURE SYSTEM

Tank No. : 2
Tolerance : ± 0.2 °C (-165 °C to -145 °C) ± 0.3 °C (-145 °C to -120 °C) ± 1.5 °C (-120 °C to +40 °C)

Vessel Name : S.S. " PUTERI ZAMRUD "
Date : 26th November 2008

Service

Fitting Location		100%		75%		50%		25%		0%	
Serial Number		F39351-A11		F39351-A12		F39351-A13		F39351-A14		F39351-A15	
Sensor Characteristic	171 Ohm	-160.17		-160.26		-160.11		-160.16		-160.23	
For Test Kit	297 Ohm	-100.19		-100.32		-100.09		-100.15		-100.32	
(Standard Temperature)	500 Ohm	0.01		-0.17		0.15		0.15		-0.25	
Data Source		VDU	Printer	VDU	Printer	VDU	Printer	VDU	Printer	VDU	Printer
Actual	171 Ohm	-160.18	-160.18	-160.26	-160.26	-160.11	-160.11	-160.16	-160.16	-160.23	-160.23
Indicated	297 Ohm	-100.16	-100.16	-100.33	-100.33	-100.09	-100.09	-100.14	-100.14	-100.30	-100.30
Temperature	500 Ohm	0.01	0.01	-0.17	-0.17	0.13	0.13	0.16	0.16	-0.22	-0.22
Error For	-160 °C	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Each	-100 °C	0.03	0.03	0.01	0.01	0.00	0.00	0.01	0.01	0.02	0.02
Checkpoint	0 °C	0.00	0.00	0.00	0.00	0.02	0.02	0.01	0.01	0.03	0.03

Max. Error (VDU)	@ -160 °C	@ -100 °C	@ 0 °C	Max. Error (Printer)	@ -160 °C	@ -100 °C	@ 0 °C
	0.01	0.03	0.03		0.01	0.03	0.03

Spare

Fitting Location		100%		75%		50%		25%		0%	
Serial Number		F39351-A16		F39351-A17		F39351-A18		F39351-A19		F39351-A20	
Sensor Characteristic	171 Ohm	-160.27		-160.23		-160.18		-160.10		-160.09	
For Test Kit	297 Ohm	-100.33		-100.25		-100.15		-100.03		-100.00	
(Standard Temperature)	500 Ohm	-0.22		-0.03		0.10		0.23		0.30	
Data Source		VDU	Printer	VDU	Printer	VDU	Printer	VDU	Printer	VDU	Printer
Actual	171 Ohm	-160.27	-160.27	-160.25	-160.25	-160.18	-160.18	-160.12	-160.12	-160.07	-160.07
Indicated	297 Ohm	-100.31	-100.31	-100.26	-100.26	-100.14	-100.14	-100.02	-100.02	-99.99	-99.99
Temperature	500 Ohm	-0.21	-0.21	-0.03	-0.03	0.08	0.08	0.23	0.23	0.30	0.30
Error For	-160 °C	0.00	0.00	0.02	0.02	0.00	0.00	0.02	0.02	0.02	0.02
Each	-100 °C	0.02	0.02	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Checkpoint	0 °C	0.01	0.01	0.00	0.00	0.02	0.02	0.00	0.00	0.00	0.00

Max. Error (VDU)	@ -160 °C	@ -100 °C	@ 0 °C	Max. Error (Printer)	@ -160 °C	@ -100 °C	@ 0 °C
	0.02	0.02	0.02		0.02	0.02	0.02

CT-IV TEST DATA FOR TEMPERATURE SYSTEM

Tank No. : 3
Tolerance : ± 0.2 °C (-165 °C to -145 °C) ± 0.3 °C (-145 °C to -120 °C) ± 1.5 °C (-120 °C to +40 °C)

Vessel Name : S.S. " PUTERI ZAMRUD "
Date : 26th November 2008

Service

Fitting Location		100%		75%		50%		25%		0%	
Serial Number		F39351-A22		F39351-A25		F39351-A26		F39351-A27		F39351-A28	
Sensor Characteristic	171 Ohm	-160.32		-160.25		-160.22		-160.16		-160.21	
For Test Kit	297 Ohm	-100.39		-100.28		-100.22		-100.14		-100.24	
(Standard Temperature)	500 Ohm	-0.30		-0.15		0.01		0.14		-0.08	
Data Source		VDU	Printer	VDU	Printer	VDU	Printer	VDU	Printer	VDU	Printer
Actual	171 Ohm	-160.30	-160.30	-160.25	-160.25	-160.23	-160.23	-160.18	-160.18	-160.23	-160.23
Indicated	297 Ohm	-100.37	-100.37	-100.30	-100.30	-100.21	-100.21	-100.12	-100.12	-100.25	-100.25
Temperature	500 Ohm	-0.24	-0.24	-0.15	-0.15	0.03	0.03	0.14	0.14	-0.09	-0.09
Error For	-160 °C	0.02	0.02	0.00	0.00	0.01	0.01	0.02	0.02	0.02	0.02
Each	-100 °C	0.02	0.02	0.02	0.02	0.01	0.01	0.02	0.02	0.01	0.01
Checkpoint	0 °C	0.06	0.06	0.00	0.00	0.02	0.02	0.00	0.00	0.01	0.01

Max. Error (VDU)			Max. Error (Printer)		
@ -160 °C	@ -100 °C	@ 0 °C	@ -160 °C	@ -100 °C	@ 0 °C
0.02	0.02	0.06	0.02	0.02	0.06

Spare

Fitting Location		100%		75%		50%		25%		0%	
Serial Number		F37738-A1		F37738-A2		F37738-A3		F37738-A4		F37738-A6	
Sensor Characteristic	171 Ohm	-160.20		-160.30		-160.23		-160.31		-160.32	
For Test Kit	297 Ohm	-100.22		-100.40		-100.26		-100.39		-100.40	
(Standard Temperature)	500 Ohm	-0.06		-0.39		-0.08		-0.32		-0.34	
Data Source		VDU	Printer	VDU	Printer	VDU	Printer	VDU	Printer	VDU	Printer
Actual	171 Ohm	-160.17	-160.17	-160.31	-160.31	-160.24	-160.24	-160.32	-160.32	-160.32	-160.32
Indicated	297 Ohm	-100.20	-100.20	-100.41	-100.41	-100.27	-100.27	-100.38	-100.38	-100.40	-100.40
Temperature	500 Ohm	-0.01	-0.01	-0.38	-0.38	-0.06	-0.06	-0.32	-0.32	-0.35	-0.35
Error For	-160 °C	0.03	0.03	0.01	0.01	0.01	0.01	0.01	0.01	0.00	0.00
Each	-100 °C	0.02	0.02	0.01	0.01	0.01	0.01	0.01	0.01	0.00	0.00
Checkpoint	0 °C	0.05	0.05	0.01	0.01	0.02	0.02	0.00	0.00	0.01	0.01

Max. Error (VDU)			Max. Error (Printer)		
@ -160 °C	@ -100 °C	@ 0 °C	@ -160 °C	@ -100 °C	@ 0 °C
0.03	0.02	0.05	0.03	0.02	0.05

CT-IV TEST DATA FOR TEMPERATURE SYSTEM

Tank No. : 4
Tolerance : ± 0.2 °C (-165 °C to -145 °C) ± 0.3 °C (-145 °C to -120 °C) ± 1.5 °C (-120 °C to +40 °C)

Vessel Name : S.S. " PUTERI ZAMRUD "
Date : 26th November 2008

Service

Fitting Location		100%		75%		50%		25%		0%	
Serial Number		F37738-A9		F37738-A14		F37738-A19		F37738-A25		F37738-A31	
Sensor Characteristic	171 Ohm	-160.32		-160.27		-160.35		-160.17		-160.16	
For Test Kit	297 Ohm	-100.45		-100.33		-100.44		-100.14		-100.18	
(Standard Temperature)	500 Ohm	-0.39		-0.15		-0.35		0.12		-0.02	
Data Source		VDU	Printer	VDU	Printer	VDU	Printer	VDU	Printer	VDU	Printer
Actual	171 Ohm	-160.33	-160.33	-160.28	-160.28	-160.35	-160.35	-160.15	-160.15	-160.15	-160.15
Indicated	297 Ohm	-100.43	-100.43	-100.33	-100.33	-100.44	-100.44	-100.13	-100.13	-100.17	-100.17
Temperature	500 Ohm	-0.38	-0.38	-0.13	-0.13	-0.34	-0.34	0.13	0.13	-0.02	-0.02
Error For	-160 °C	0.01	0.01	0.01	0.01	0.00	0.00	0.02	0.02	0.01	0.01
Each	-100 °C	0.02	0.02	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.01
Checkpoint	0 °C	0.01	0.01	0.02	0.02	0.01	0.01	0.01	0.01	0.00	0.00

Max. Error (VDU)	@ -160 °C	@ -100 °C	@ 0 °C	Max. Error (Printer)	@ -160 °C	@ -100 °C	@ 0 °C
	0.02	0.02	0.02		0.02	0.02	0.02

Spare

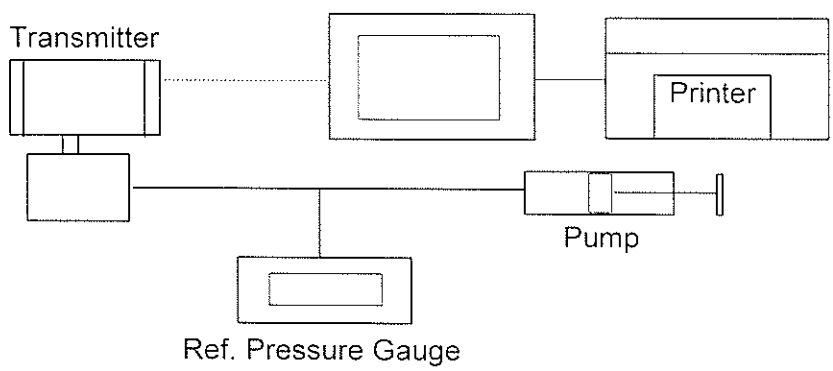
Fitting Location		100%		75%		50%		25%		0%	
Serial Number		F37738-A36		F37738-A40		F35214-A45		F35214-A46		F35751-A25	
Sensor Characteristic	171 Ohm	-160.30		-160.16		-160.33		-160.33		-160.28	
For Test Kit	297 Ohm	-100.36		-100.14		-100.40		-100.42		-100.26	
(Standard Temperature)	500 Ohm	-0.22		0.08		-0.33		-0.48		-0.04	
Data Source		VDU	Printer	VDU	Printer	VDU	Printer	VDU	Printer	VDU	Printer
Actual	171 Ohm	-160.30	-160.30	-160.17	-160.17	-160.32	-160.32	-160.33	-160.33	-160.26	-160.26
Indicated	297 Ohm	-100.34	-100.34	-100.13	-100.13	-100.38	-100.38	-100.43	-100.43	-100.25	-100.25
Temperature	500 Ohm	-0.21	-0.21	0.11	0.11	-0.33	-0.33	-0.46	-0.46	-0.04	-0.04
Error For	-160 °C	0.00	0.00	0.01	0.01	0.01	0.01	0.00	0.00	0.02	0.02
Each	-100 °C	0.02	0.02	0.01	0.01	0.02	0.02	0.01	0.01	0.01	0.01
Checkpoint	0 °C	0.01	0.01	0.03	0.03	0.00	0.00	0.02	0.02	0.00	0.00

Max. Error (VDU)	@ -160 °C	@ -100 °C	@ 0 °C	Max. Error (Printer)	@ -160 °C	@ -100 °C	@ 0 °C
	0.02	0.02	0.03		0.02	0.02	0.03

Accuracy Test of Pressure Measuring System

Pressure transmitter, VDU and Printer

Each pressure transmitter, a reference pressure gauge and a hand pump shall be connected as shown below. Simulated pressure of 810, 1100 & 1390 mbar is introduced to the transmitter.
The test shall be repeated for increasing and decreasing pressure.
The readout is recorded from the VDU and Printer.



Integrated Error

The maximum difference between the output from the VDU / Printer and the given pressure from the reference pressure gauge shall be defined as error of the pressure measurement.

CT-IV TEST DATA FOR PRESSURE SYSTEM FOR VESSEL S.S. " PUTERI ZAMRUD "

Ambient Temperature : 34.0 °C

Date : 26th November 2008

Atmospheric Pressure : 1010 mbar

Tolerance : ± 1% OF FULL SPAN (± 6 mbar)

Tank No.	Serial No.	Test Pressure (mbar) Readout (G)	DATA READOUT (mbar)				Average Output (C) = (A+B)/2		Error (mbar) (E) = (C-G)	
			Increasing (A)		Decreasing (B)					
			VDU	Printer	VDU	Printer	VDU	Printer	VDU	Printer
1	04230372	810	810.5	810.5	809.9	809.9	810.2	810.2	0.2	0.2
		1100	1099.9	1099.9	1100.2	1100.2	1100.1	1100.1	0.1	0.1
		1390	1390.3	1390.3	1390.1	1390.1	1390.2	1390.2	0.2	0.2
2	04131807	810	809.4	809.4	809.8	809.8	809.6	809.6	0.4	0.4
		1100	1100.0	1100.0	1100.0	1100.0	1100.0	1100.0	0.0	0.0
		1390	1390.6	1390.6	1390.6	1390.6	1390.6	1390.6	0.6	0.6
3	04200578	810	810.0	810.0	810.2	810.2	810.1	810.1	0.1	0.1
		1100	1100.0	1100.0	1099.8	1099.8	1099.9	1099.9	0.1	0.1
		1390	1389.9	1389.9	1390.1	1390.1	1390.0	1390.0	0.0	0.0
4	04200579	810	809.8	809.8	809.8	809.8	809.8	809.8	0.2	0.2
		1100	1100.0	1100.0	1099.9	1099.9	1100.0	1100.0	0.0	0.0
		1390	1389.9	1389.9	1390.4	1390.4	1390.2	1390.2	0.2	0.2

Range of Pressure Transmitter : 800 mbarA to 1400 mbarA

Max. VDU Error : 0.6 mbar

VDU (%) : 0.10 %

Max. Printer Error : 0.6 mbar

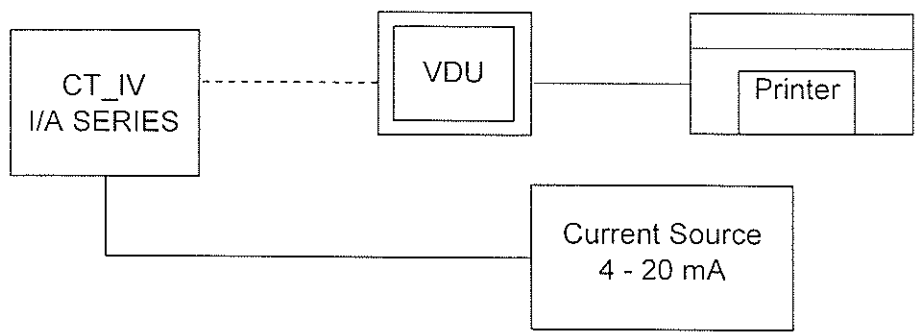
Printer (%) : 0.10 %

Accuracy Test of Trim and List Measuring System

Inspection Procedure for Trim and List :
This procedure shall be applied to verify the Trim and List function used on Foxboro Custody Transfer System.

Equipment Required :
4 - 20 mA Precision current source with valid calibration certificate traceable to National Standard

Setup :
Connect as follows



ACCURACY TEST RESULTS OF TRIM AND LIST MEASURING SYSTEM

Vessel Name : S.S. " PUTERI ZAMRUD "
Date : 26th November 2008

LIST

Unit : degrees

Port		STARBOARD		SIMULATED LIST (Degrees)	ACTUAL		Error	
INPUT (mA DC) TEST SIGNAL	BLOCK READING (L-Port) (A)	INPUT (mA DC) TEST SIGNAL	BLOCK READING (L-Stbd) (B)		VDU	Printer	VDU	Printer
20	12.856	4	3.098	13.02 (P)	13.02 (P)	13.02 (P)	0.00	0.00
12	7.979	12	7.977	0.00 (P)	0.00 (P)	0.00 (P)	0.00	0.00
4	3.098	20	12.855	13.02 (S)	13.02 (S)	13.02 (S)	0.00	0.00

(1) Input 4-20 mA signal to block "L-Port" and record values in Column A
(2) Input 4-20 mA signal to block "L-Stbd" and record values in Column B
(3) Set blocks "L-Port" and "L-Stbd" to mannual and set recorded values (Column A & B) and take reading from VDU & Printer

TRIM

Unit : m

AFT DRAFT		FORE DRAFT		SIMULATED LIST (Degrees)	SIMULATED TRIM (m)	ACTUAL		Error	
INPUT (mA DC) TEST SIGNAL	BLOCK READING (T-Har) (A)	INPUT (mA DC) TEST SIGNAL	BLOCK READING (T-Hav) (B)			VDU	Printer	VDU	Printer
20	14.896	4	1.590	13.02 (P)	16.12 (B/S)	16.12 (B/S)	16.12 (B/S)	0.00	0.00
12	10.018	12	6.468	0.00 (P)	4.03 (B/S)	4.03 (B/S)	4.03 (B/S)	0.00	0.00
4	5.138	20	11.344	13.02 (S)	8.06 (B/H)	8.06 (B/H)	8.06 (B/H)	0.00	0.00

(1) Set related blocks of Column C to mannual and set simulated values
simultaneously input 4-20 mA DC test signal to block "T-Har" Record Values and fill Column A
(2) Same procedure as in Step 1 but input 4-20 mA to block "T-Hav"
(3) Set related block of column C to mannual and set simulated values simultaneously set block
"T-Har" and "T-Hav" to mannual and set recorded values (Column A & B) and record reading

ORIGINAL

STANDARD GENERAL SUPERINTENDENCE TESTING LABORATORY PTE LTD
[SGSTL] [INTERNATIONAL INSPECTION & TESTING]

BLK 2022 #04-174 BUKIT BATOK IND. PARK ST. 23 SINGAPORE 659527
TEL: [65] 6563 7866 FAX: [65] 6560 1491 MOBILE: [65] 9668 9770 EMAIL: sgstl@pacific.net.sg

TAPE.MEASURE 50000 mm 'KDS'
S175-1 NKKK. 0408 C 26 01

CAL DATE: 17.04.2008
DUE DATE: 17.04.2009

CALIBRATION REPORT

APPLICANT: M/S NIPPON KAIJI KENTEI KYOKAI 62731411

EQUIPMENT: MEASURING TAPE BRAND: 'KDS' TYPE: STEEL
LENGTH: 50000 mm GRADUATION: 1 mm SERIAL # S175-1
MARK: MAKE: JAPAN

TEST CONDITION: TEMPERATURE: 20 C HUMIDITY: 55 %

RESULT OF CALIBRATION:

LENGTH : UNIT : mm MEASURED @ 50 N TENSION

REAL	READ	CORR.	% READ DISCREPANCY
1000.0	1000	0	0
5000.0	5000	0	0
10000.0	10000	0	0
15000.0	15000	0	0
20000.0	20000	0	0
25000.0	25000	0	0
30000.0	30000	0	0
35000.0	35000	0	0
40000.0	40000	0	0
45000.0	45000	0	0
50000.0	50000	0	0

INSPECTION:

1. 4 – 250 mm SECTION HAS A SLIGHT KINK , ITS ACCURACY REMAINED @ 50 N TENSION
2. BENT SLIGHT @ 1820 mm , ITS ACCURACY REMAINED @ 50 N TENSION
3. NO SEVERE TWIST NOR BEND OVER THE OTHER LENGTH OF TAPE
4. THE GRADUATION MARKINGS ARE BRIGHT & CLEAR.

CERTIFICATION: THE CALIBRATION SHOW MEASURING TAPE TYPE: STEEL
BRAND: 'KDS' LENGTH: 50000 mm GRADUATION: 1 mm SERIAL # S175-1
WHICH HAS AN ACCURACY WITH TOLERANCE < 0.01 % DISCREPANCY OF TAPE READING, IS IN CONFORMANCE WITH JIS B7512 1ST. CLASS STANDARD SPECIFICATIONS.

THE ESTIMATED UNCERTAINITY OF MEASUREMENT ASSOCIATED WITH THE TAPE READING IS < +/- 0.5 mm @ A CONFIDENCE LEVEL OF > 95 %.

STD. GENERAL SUPT. TESTLAB

M. K. TIANG, Manager

CALTEK PTE LTD

23 Tagore Lane, #03-19 Tagore 23 Warehouse, Singapore 787601
Tel: (65) 6452 0300 Fax: (65) 6452 0500
Email: caltek@singnet.com.sg Website: www.caltek.com.sg

CALIBRATION CERTIFICATE

CERTIFICATE NUMBER	: CTE 3579-08	**JOB NUMBER**	: CTJ 3799-08
DATE RECEIVED	: 21-Jul-08	**ISSUE DATE**	: 28-Jul-08

Instrument	: LOW OHM DECADE RESISTANCE BOX	**Ambient Temperature**	: 21 ± 2 ° C
Manufacturer	: TIME ELECTRONICS	**Relative Humidity**	: 55 ± 10 % R. H.
Model No.	: 1041	**Date Calibrated**	: 28-Jul-08
Serial No.	: 4431H06	**Recommended Due Date**	: 28-Jul-09
Customer	: **INVENSYS PROCESS SYSTEMS (S) PTE LTD**	**Range**	: —
	15 Changi Business Park Central 1	*(Tag No.)*	: —
	S'pore 486057	**Page**	: 1 of 2
		Status	: As Found

The described instrument has been calibrated at **Caltek** Laboratory under the ambient conditions stated above.

Caltek organisation and practices are in compliance with **ISO/IEC 17025**. The Quality System is in accordance with the **Quality Standard ISO 9001:2000.**

The reference measurement standards used are traceable to (**A*STAR**), Singapore and National Physical Laboratory (**NPL**), UK and National Institute of Standards and Technology(**NIST**) ,USA or other recognised National or Ir national Standards Laboratories.

METHOD OF CALIBRATION

1. The calibration method was carried out by In-house Technical Calibration Procedure CTTM-E06:2007 as a guide.

REFERENCE STANDARD(S) USED FOR CALIBRATION

	INSTRUMENT	S/N
1.	Digital Percision Multimeter	9409007

RESULTS OF CALIBRATION

1. The results of calibration are given on the attached calibration data sheet(s).
2. The expanded uncertainty of measurement associated with the calibration is ± 0.072% of reading estimated at a confidence level of approximately 95% with a coverage factor of k = 2.
3. The user should determine the suitability of the instrument for its intended use.

O.M.Yasir
Calibration Officer

G.Anand
Approved by

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CALIBRATION CERTIFICATE

CERTIFICATE NUMBER : CTE 3579-08
ISSUED DATE : 28-Jul-08
JOB NUMBER : CTJ 3799-08
PAGE : 2 of 2

Instrument Setting	Actual Reading	Low Limit	High Limit	Remark / Status
RESISTANCE TEST	RESIDUAL RESISTANCE = 0.0441 Ω			
0.01 Ω Step Range				
0.0106 Ω	0.01	0.0090	0.0110	Pass
0.0495 Ω	0.05	0.0450	0.0550	Pass
0.0895 Ω	0.09	0.0810	0.0990	Pass
0.1 Ω Step Range				
0.0972 Ω	0.10	0.0950	0.1050	Pass
0.4897 Ω	0.50	0.4750	0.5250	Pass
0.8804 Ω	0.90	0.8550	0.9450	Pass
1.0 Ω Step Range				
1.0033 Ω	1.00	0.9900	1.0100	Pass
5.0091 Ω	5.00	4.9500	5.0500	Pass
9.0112 Ω	9.00	8.9100	9.0900	Pass
10 Ω Step Range				
10.018 Ω	10.00	9.950	10.050	Pass
50.164 Ω	50.00	49.750	50.250	Pass
[illegible]298 Ω	90.00	89.550	90.450	Pass
10[illegible] Step Range				
100.046 Ω	100.00	99.90	100.10	Pass
500.394 Ω	500.00	499.50	500.50	Pass
900.616 Ω	900.00	899.10	900.90	Pass

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CALIBRATION CERTIFICATE

CERTIFICATE NUMBER	: CTE 3580-08	**JOB NUMBER**	: CTJ 3799-08
DATE RECEIVED	: 21-Jul-08	**ISSUE DATE**	: 28-Jul-08

Instrument	: mA CALIBRATOR	**Ambient Temperature**	: 21 ± 2 °C
Manufacturer	: JF INDUSTRY	**Relative Humidity**	: 55 ± 10 % R.H.
Model No.	: mA CAL	**Date Calibrated**	: 28-Jul-08
Serial No.	: 526543-04195	**Recommended Due Date**	: 28-Jul-09
Customer	: **INVENSYS PROCESS SYSTEMS (S) PTE LTD** 15 Changi Business Park Central 1 S'pore 486057	**Range** *(Tag No.)* **Page** **Status**	: --- : --- : 1 of 2 : As Found

The described instrument has been calibrated at **Caltek** Laboratory under the ambient conditions stated above.

Caltek organisation and practices are in compliance with **ISO/IEC 17025**. The Quality System is in accordance with the **Quality Standard ISO 9001:2000.**

The reference measurement standards used are traceable to (**A*STAR**), Singapore and National Physical Laboratory (**NPL**), UK and National Institute of Standards and Technology(**NIST**) ,USA or other recognised National or International Standards Laboratories.

METHOD OF CALIBRATION

1. The calibration method was carried out by In-house Technical Calibration Procedure CTTM-E01 & E06:2007 as a guide.

REFERENCE STANDARD(S) USED FOR CALIBRATION

	INSTRUMENT	S/N
1.	Multifunction Calibrator	6240001
2.	Digital Precision Multimeter	9409007

RESULTS OF CALIBRATION

1. The results of calibration are given on the attached calibration data sheet(s).
2. The expanded uncertainty of measurement associated with the calibration is estimated at a confidence level of approximately 95% with a coverage factor of k = 2.
3. The user should determine the suitability of the instrument for its intended use.

O.M.Yasir
Calibration Officer

G.Anand
Approved by

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CALIBRATION CERTIFICATE

CERTIFICATE NUMBER : CTE 3580-08
ISSUED DATE : 28-Jul-08

JOB NUMBER : CTJ 3799-08
PAGE : 2 of 2

Function Test	Instrument Reading	Low Limit	High Limit	Remark / Status
MEASURE MODE				
DC VOLTAGE TEST				
1.000 V	1.0	0.5	1.5	Pass
5.000 V	5.0	4.5	5.5	Pass
10.000 V	10.0	9.5	10.5	Pass
20.000 V	20.0	19.5	20.5	Pass
30.000 V	30.0	29.5	30.5	Pass
40.000 V	40.1	39.5	40.5	Pass
DC CURRENT TEST				
4.000 mA	4.001	3.988	4.012	Pass
8.000 mA	8.001	7.988	8.012	Pass
12.000 mA	12.003	11.988	12.012	Pass
16.000 mA	16.005	15.988	16.012	Pass
20.000 mA	20.005	19.988	20.012	Pass
SOURCE MODE				
DC CURRENT TEST				
3.9945 mA	4.00	3.988	4.012	Pass
7.9951 mA	8.00	7.988	8.012	Pass
11.9997 mA	12.00	11.988	12.012	Pass
16.0004 mA	16.00	15.988	16.012	Pass
19.9996 mA	20.00	19.988	20.012	Pass

FUNCTION TEST	RANGE	EXPANDED UNCERTAINTY
Measurement mode		
DC V	0 ~ 40 V	± 160 ppm of reading
DC A	0 ~ 20 mA	± 0.075% of reading
Source mode		
DC A	0 ~ 100 µA	± 17.5 ppm of reading
	100 µA ~ 20 mA	± 0.12 % of reading

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CALIBRATION CERTIFICATE

CERTIFICATE NUMBER	: CTP 4112-08	**JOB NUMBER**	: CTJ 3799-08
DATE RECEIVED	: 21-Jul-08	**ISSUE DATE**	: 29-Jul-08

Instrument	: DIGITAL PRESSURE CALIBRATOR	**Ambient Temperature**	: 21 ± 2 °C
Manufacturer	: AMETEK	**Relative Humidity**	: 55 ± 10 % R.H.
Model No.	: APC200CINDG	**Date Calibrated**	: 29-Jul-08
Serial No.	: 9221090	**Recommended Due Date**	: 29-Jul-09
Customer	: **INVENSYS PROCESS SYSTEMS (S) PTE LTD** 15 Changi Business Park Central 1 S'pore 486057	**Range**	: -830 mbar ~ 0 ~ 15 bar
		(Tag No.)	: ---
		Page	: 1 of 2
		Status	: As Found

The described instrument has been calibrated at **Caltek** Laboratory under the ambient conditions stated above.

Caltek organisation and practices are in compliance with **ISO/IEC 17025**. The Quality System is in accordance with the **Quality Standard ISO 9001:2000.**

The reference measurement standards used are traceable to (**A*STAR**), Singapore and National Physical Laboratory (**NPL**), UK and National Institute of Standards and Technology(**NIST**) ,USA or other recognised National or International Standards Laboratories.

METHOD OF CALIBRATION

1. The calibration method was carried out by In-house Technical Calibration Procedure CTTM-M03 & M09:2007 as a guide.

REFERENCE STANDARD(S) USED FOR CALIBRATION

	INSTRUMENT	S/N
1.	Dead Weight Tester	26486
2.	Pneumatic Pressure Calibrator	61013299

RESULTS OF CALIBRATION

1. The results of calibration are given on the attached calibration data sheet(s).
2. The expanded uncertainty of measurement associated with the calibration is estimated at a confidence level of approximately 95% with a coverage factor of k = 2.
3. The user should determine the suitability of the instrument for its intended use.

M.Mubarak
Calibration Officer

K.M. Shein
Approved by

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CALIBRATION CERTIFICATE

CERTIFICATE NUMBER : CTP 4112-08 **JOB NUMBER** : CTJ 3799-08
ISSUED DATE : 29-Jul-08 **PAGE** : 2 of 2

APPLIED ACTUAL VALUE	INSTRUMENT READING					
	ASCENDING			DESCENDING		
	Before Adj	After Adj	Error	Before Adj	After adj	Error
mbar	**mbar**	---	**mbar**	**mbar**	---	**mbar**
-802.0	-800	---	2.0	-800	---	2.0
-402.0	-400	---	2.0	-400	---	2.0
bar	**bar**	---	**bar**	**bar**	---	**bar**
0.00000	0.0000	---	0.00000	0.0000	---	0.0000
5.00141	5.0000	---	-0.00141	5.0000	---	-0.0014
7.50163	7.5000	---	-0.00163	7.5000	---	-0.0016
10.00211	10.0000	---	-0.00211	10.0000	---	-0.0021
14.99741	15.0000	---	0.00259	15.0000	---	0.0026

Remark 1: The accuracy of the instrument is within ± 0.04% of rdg + 0.01% of f.s for pressure.
Remark 2: The accuracy of the instrument is within ± 0.05% of f.s for vacuum.

Mean Indicated Pressure (bar)	APPLIED PRESSURE (TEST PUMP)	REMARKS
	LEAK TEST	
-1.00	PASS	NIL
10.35	PASS	NIL
25.22	PASS	NIL
35.15	PASS	NIL

Remarks: Leak Test were done for 10 minutes for mean of 3 readings.

FUNCTION TEST	EXPANDED UNCERTAINTY
PRESSURE	± 0.026% of reading
VACUUM	± 0.044% of reading

CUSTODY TRANSFER MEASUREMENT DATA

SCHEDULE REPORT

START DATE (dd-mm-yyyy) : 27-11-2008
TIME (HH:MM) : 13:00
SHIP NAME : PUTERI ZAMRUD
PORT NAME :
CHIEF OFFICER :
VOYAGE NO. :
CARGO NO. : 12345

LIST (DEGREES) STARBOARD 0.51 AUTO
TRIM (METERS) BY STERN 1.10 AUTO

	TANK 1		TANK 2		TANK 3		TANK 4	TOTAL/AVERAGE
LEVEL (M)								
1ST	0.041		0.042		0.042		0.041	
2ND	0.041		0.042		0.042		0.041	
3RD	0.041		0.042		0.042		0.041	
4TH	0.041		0.042		0.042		0.040	
5TH	0.041		0.042		0.042		0.041	
AVERAGE LEVEL (M)	0.041		0.042		0.042		0.041	
TRIM CORRECTION (M)	-0.016		-0.026		-0.026		-0.024	
LIST CORRECTION (M)	0.006		0.013		0.014		0.014	
CORRECTED LEVEL (M)	0.031		0.029		0.030		0.031	
LIQUID VOLUME (CUB.M) (Corrected for LIST and TRIM)	16.540		34.911		37.447		34.024	
TOTAL LIQUID VOLUME (CUB.M) (Corrected for LIST and TRIM)								122.922

TEMPERATURE (DEG.C.)											
VAPOUR	T1	M	27.6	V	M	27.5	V	M	27.1	V	M	27.1	V
TOP	T2	M	27.6	V	M	27.5	V	M	27.0	V	M	27.1	V
MIDDLE	T3	M	27.6	V	M	27.5	V	M	27.0	V	M	26.9	V
MIDDLE	T4	M	27.6	V	M	27.6	V	M	26.9	V	M	26.8	V
BOTTOM	T5	M	27.50	L	M	27.46	L	M	26.85	L	M	26.79	L

AVG. VAPOR TEMPERATURE (DEG.C.)	27
AVG. LIQUID TEMPERATURE (DEG.C.)	27.2

VAPOUR PRESSURE (m BAR)	1022		1022		1010		1011	
AVERAGE VAPOUR PRESSURE (m BAR)								1016

FINISH DATE (dd-mm-yyyy) : 27-11-2008
TIME (HH:MM) : 13:01

BUYER 'S REPRESENTATIVE _____

_____

SELLER 'S REPRESENTATIVE _____

MASTER _____

INDEPENDENT SURVEYOR _____

File Config CTS EQUIP MAINT UTILITIES SftMnt User Manual Help

System Process 15:26 11-27-08 Local Application Startup

CHANGE ENV

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REPORTS

INITIAL

TANKS INFO

CTS

EQUIP

TEMP

TRIM & LIST

UTILITIES

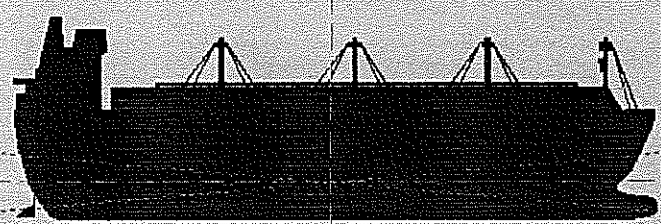
MAINT

TEMPERATURE SENSOR

TRIM & LIST MANUAL OVERRIDE

EQUIP

TRIM



CURRENT VALUE -1.11

VALUE

MEASURED AFTER	MEASURED FORE	CALCULATED
5.848	4.833	-1.11
AUTO	AUTO	ENTERED -2.99

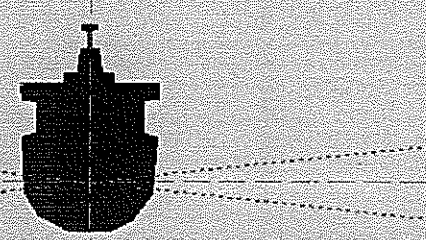
STATUS: AUTO

RANGE (- BY STERN ; +BY HEAD)

8.30

-16.36

LIST



CURRENT VALUE 0.46

VALUE

MEASURED STBD	MEASURED PORT	CALCULATED
5.529	5.183	0.46
AUTO	AUTO	ENTERED 13.02

STATUS: AUTO

RANGE (- BY PORT; + BY STBD)

13.02

-13.02

ACKNOWLEDGE ALL

/opt/menus/equip/TRIM_LIST.fdf softw_eng hist02 Overlays:0