

Image Cover Sheet

CLASSIFICATION

UNCLASSIFIED

SYSTEM NUMBER

510372



TITLE

IMPLEMENTATION OF ACCURACY CONTROL ON THE CANADIAN FRIGATE PROGRAM

System Number:

Patron Number:

Requester:

Notes: Paper #29 contained in Parent Sysnum #510343

DSIS Use only:

Deliver to: DK



Implementation of Accuracy Control
on the Canadian Patrol Frigate Program

by

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Saint John, New Brunswick, Canada, E2J 4E5

ABSTRACT

Marine structural materials technology has gained much attention from researchers due to the condition of structural designs being limited by materials capabilities.

In addition to the materials and joining technologies, structural performance is affected by initial states of alignment, distortion and residual stress. Since each of these areas adds expense to shipyard construction efforts, they are as much concern to the builder as they are to the research community. The formation of an Accuracy Control Department in 1985 was the Saint John Shipbuilding Limited (SJSL) response to these causes of unwanted rework.

This presentation traces the growth and accomplishments of SJSL Accuracy Control in the quantification of dimensional performance as practiced on the Canadian Patrol Frigate Program. Special studies and in-process guidance and direction required for final product conformance is described. Impacts to structural integrity due to trends in construction methodologies is reviewed.

ACCURACY CONTROL

**ACTIVITIES DIRECTED AT IMPROVING ELEMENTS
OF COST/SCHEDULE PERFORMANCE THAT ARE
IMPACTED BY DIMENSIONAL VARIABILITY OF
INTERIM PRODUCTS**

**SPECIFIC AREAS OF ACCURACY CONTROL
ACTIVITY**

RESIDUAL STRESSES

DISTORTION CONTROL

ALIGNMENT

- Saint John Shipbuilding Limited -

RESIDUAL STRESSES

REQUIREMENTS FOR OUTFITTING FOUNDATIONS

FLATNESS 0.1 - 0.5 MM

LEVEL 5 - 20 ARC MINUTES

MINIMIZE MACHINING ALLOWANCES

MINIMIZE MACHINING ON BOARD

CONDITION REPORT

HULL NO: 1222

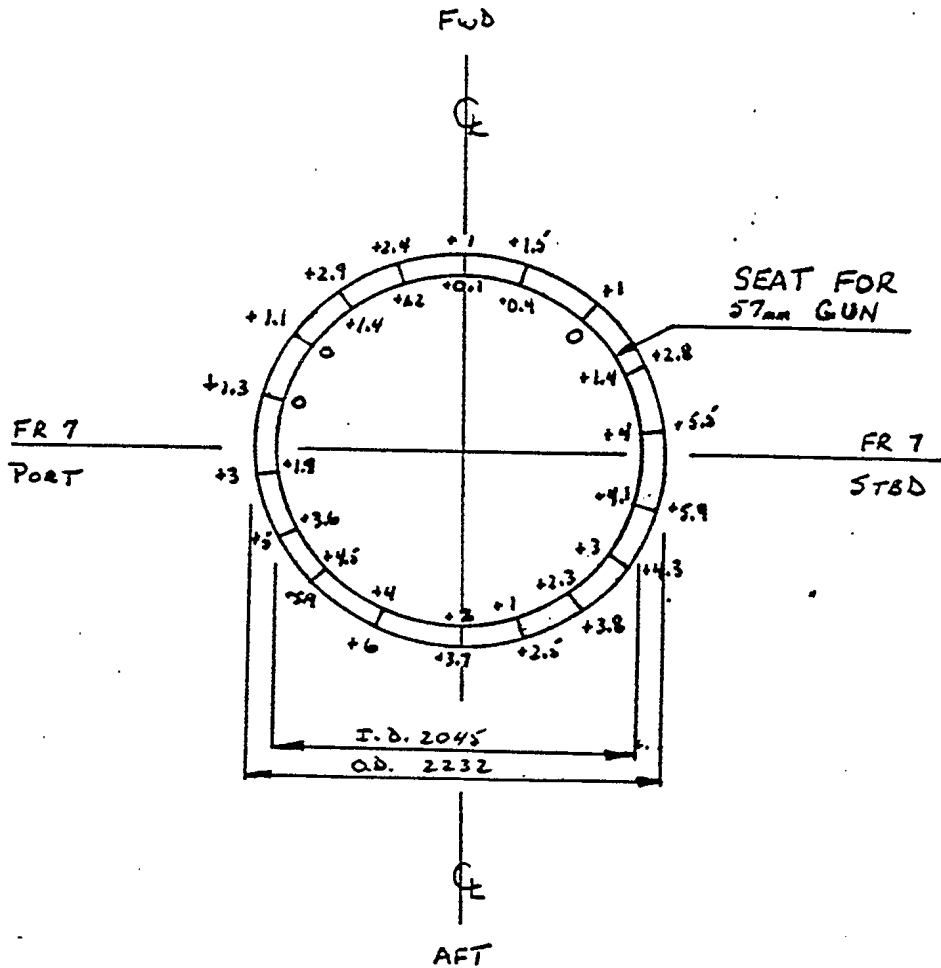
UNIT NO: 1250

ITEM: 57mm GUN SEAT

STATUS: FLATNESS CHECK - SEAT RESTING FREE ON DECK

DATE: MARCH 30/88

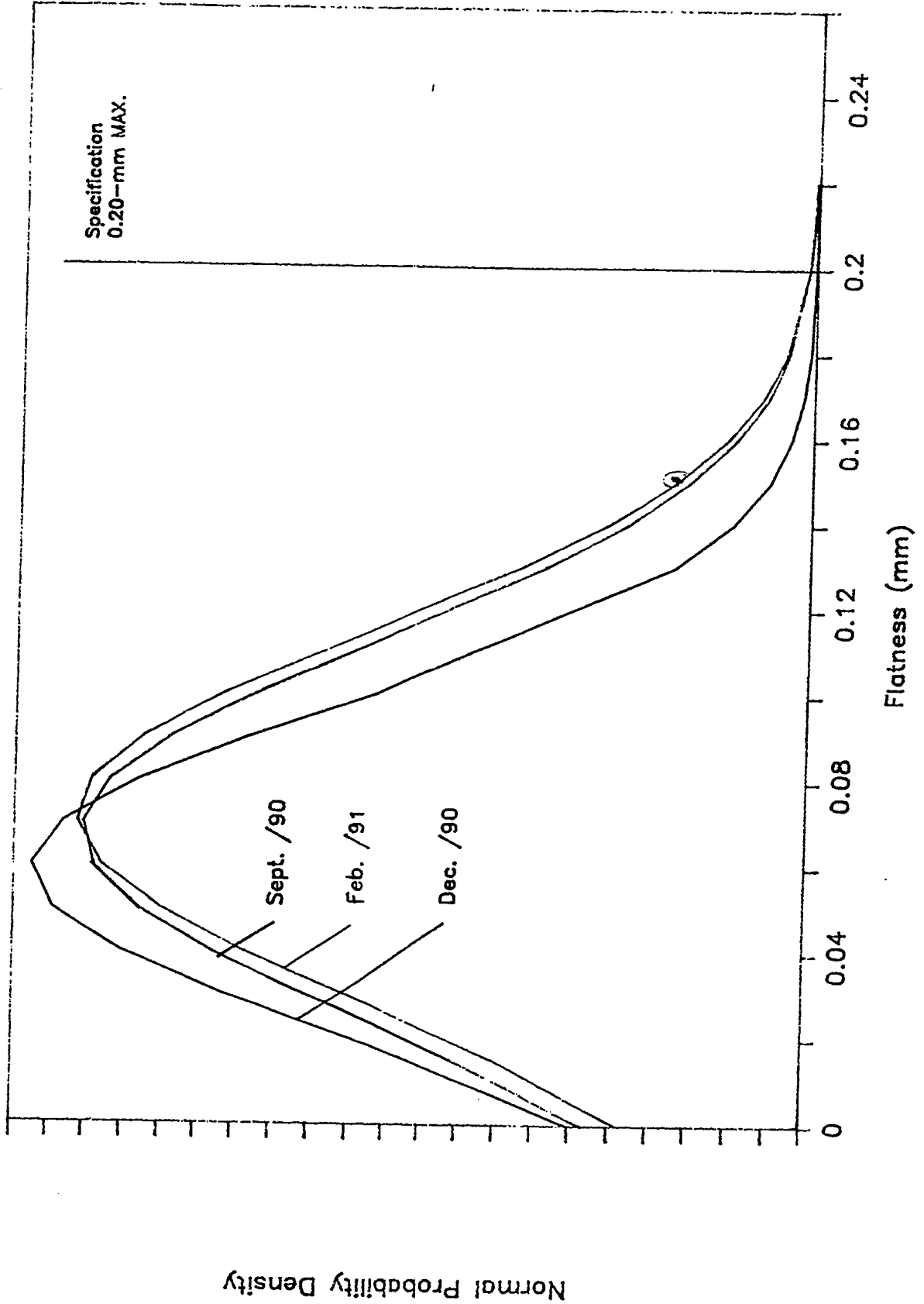
36 BOLTS



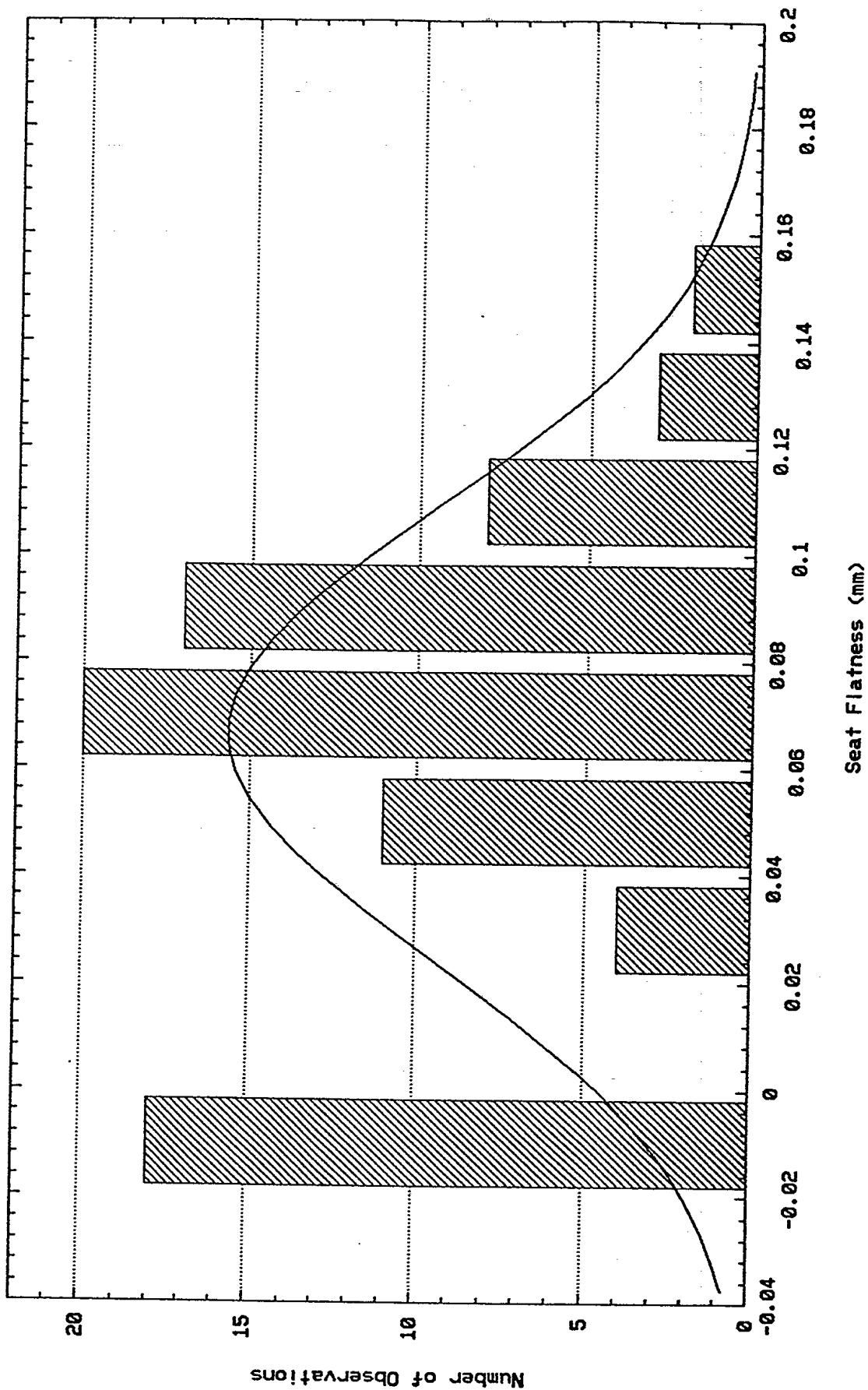
SURVEYOR: M. LANNIGAN, B. BROWN

REMARKS: 1) DEVIATIONS ARE FROM LOWEST POINT ON SEAT

CPF-04 Gun Seat Flatness

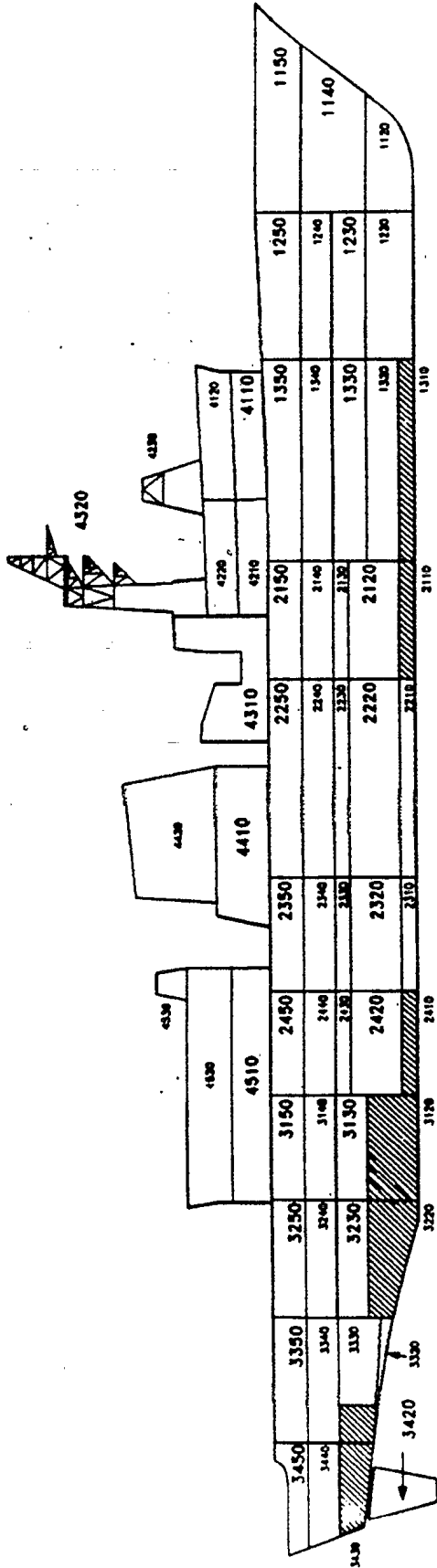


CPF-04 Gun Seat Flatness
Sept-90, Dec-90, and Feb-91



DISTORTION IN ASSEMBLIES

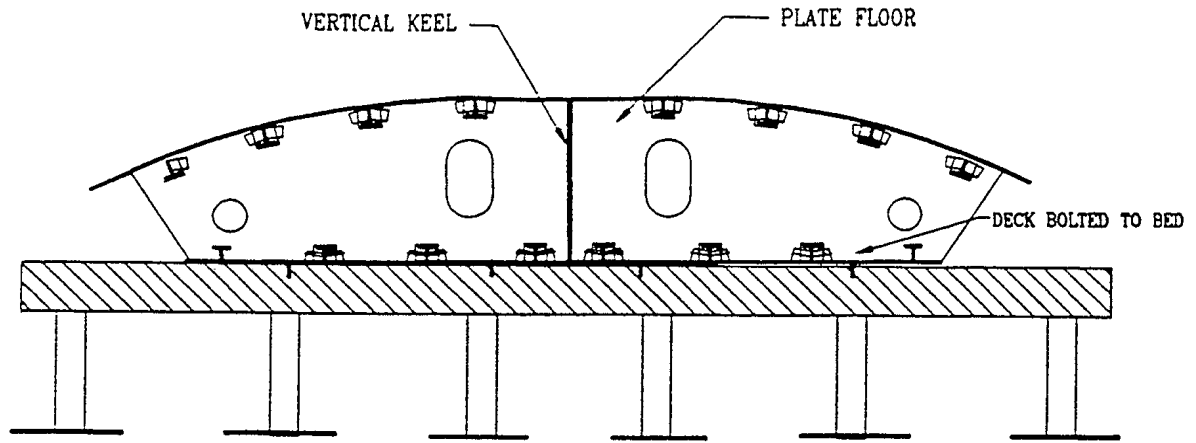
**REQUIREMENTS FOR DISTORTION CONTROL
MAINTAIN DESIGN DIMENSIONS FOR ASSEMBLIES
WITH LOW STIFFNESS AND WELDING
UNBALANCED ABOUT THE NEUTRAL AXIS**



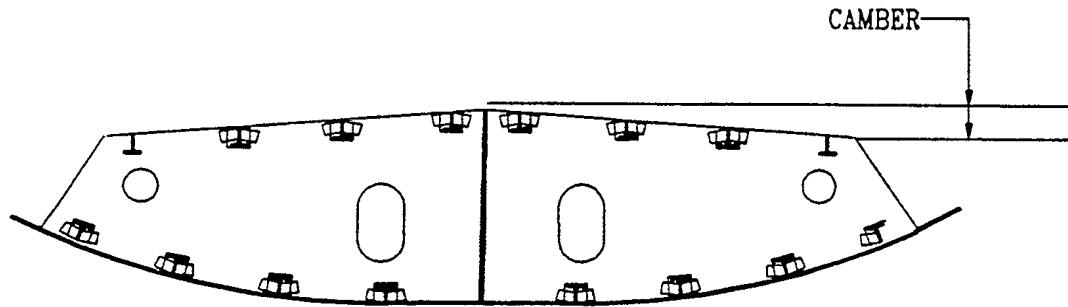
▨ PROBLEM UNITS (BUILT INVERTED)

**CPF - 01
PROFILE**

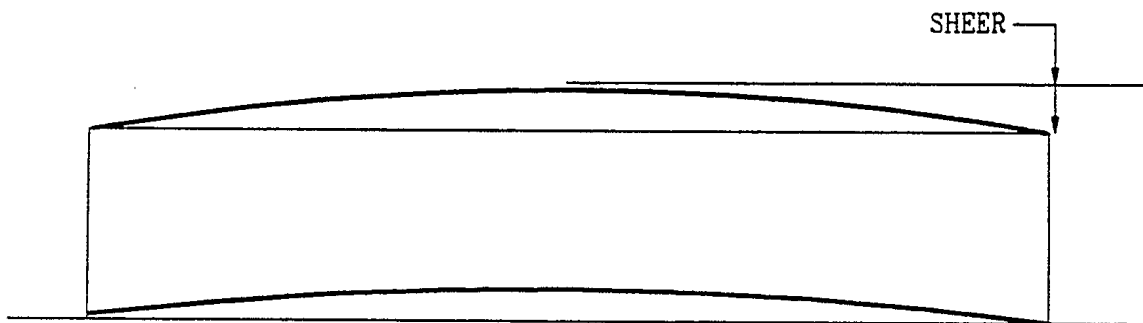
Exhibit 3: CPF - 01 UNIT DRAWING



CONSTRUCTION BED
(INVERTED UNITS)



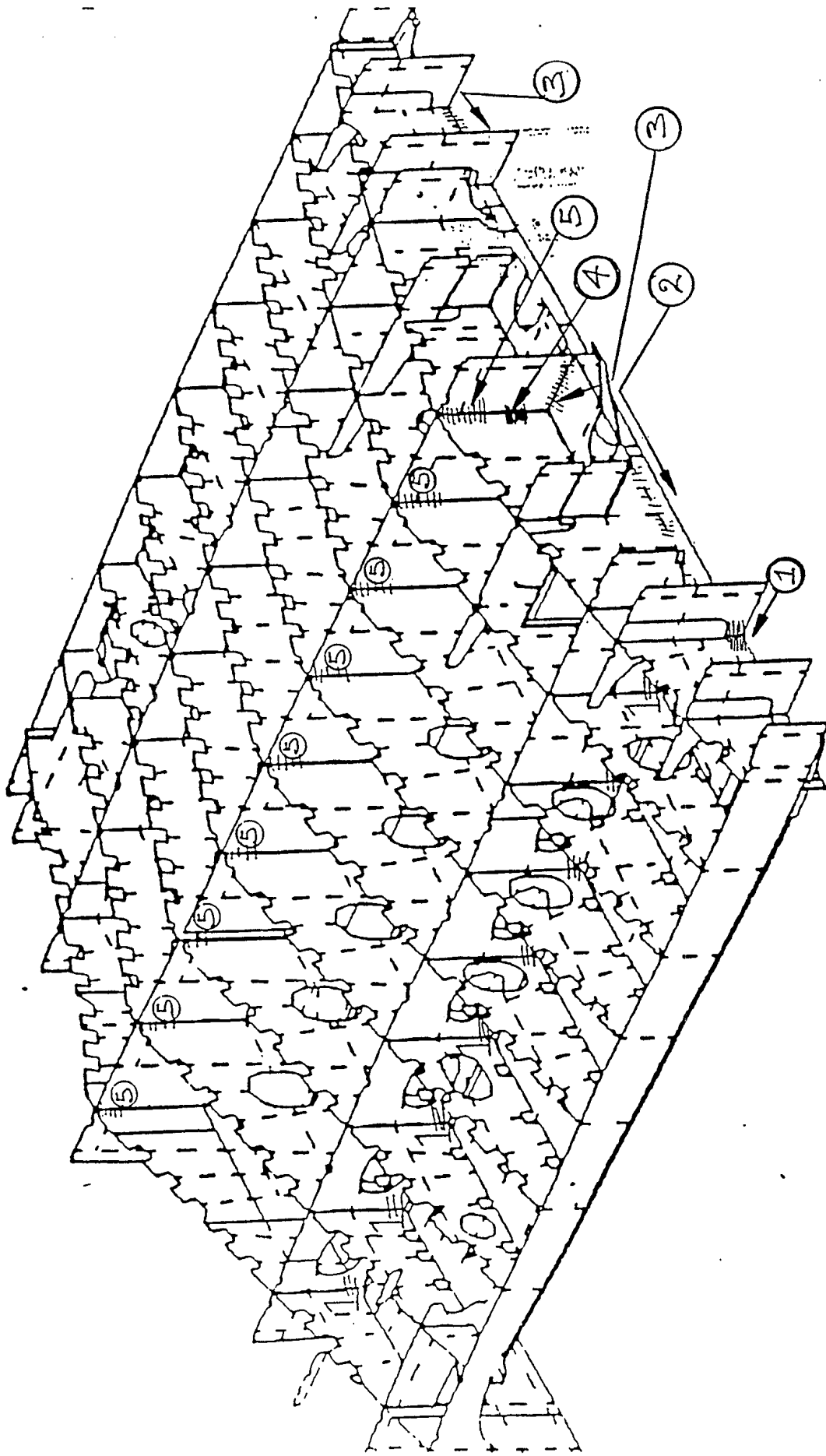
TRANSVERSE SECTION



LONGITUDINAL SECTION

(DISTORTION SCALE EXAGGERATED)

Exhibit 2: INVERTED UNIT DISTORTION



UNIT 2410 REVERSE CAMBER

102

ACCURACY CONTROL CHECK SHEET AC36
CONDITION REPORT

HULL NO.: 1222

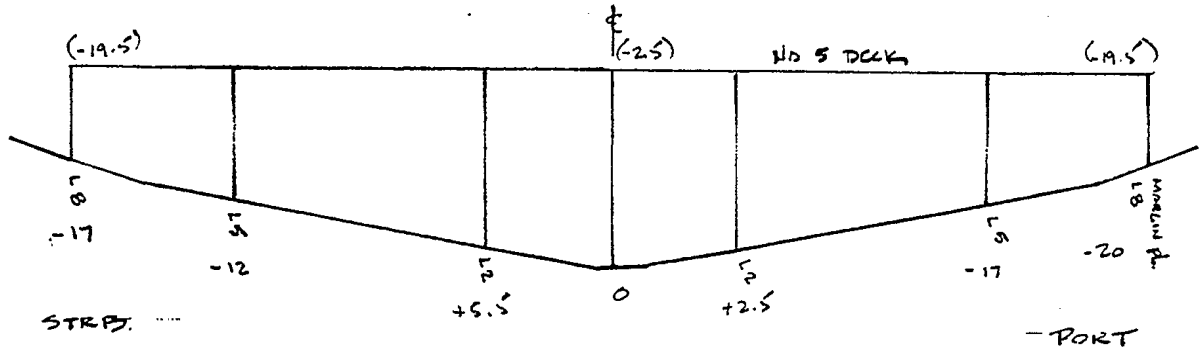
DATE: MAR. 13/87

UNIT NO.: 2110

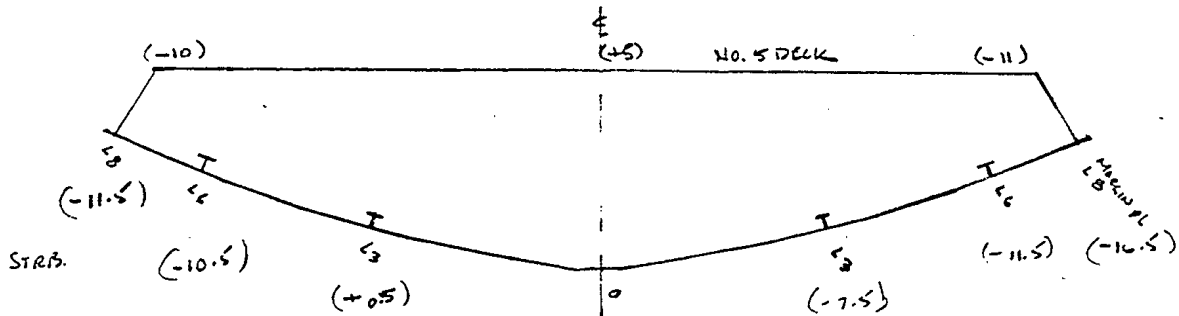
PAGE 1 OF

ITEM: SHELL AS-BUILT

STATUS: COMPLETED - PRIOR JOINING TO 2420



DETAIL 6C
SECTION AT FR. 25
LOOKING AFT.



DETAIL 7A
SECTION AT FR. 20.5
LOOKING AFT.

SURVEYOR: M. LONIGAN, H. PAYNE

TECHNICIAN:

REMARKS:

NUMBERS IN BRACKETS REPRESENT DEVIATION OF SHELL
HEIGHTS FROM DESIGN HEIGHTS

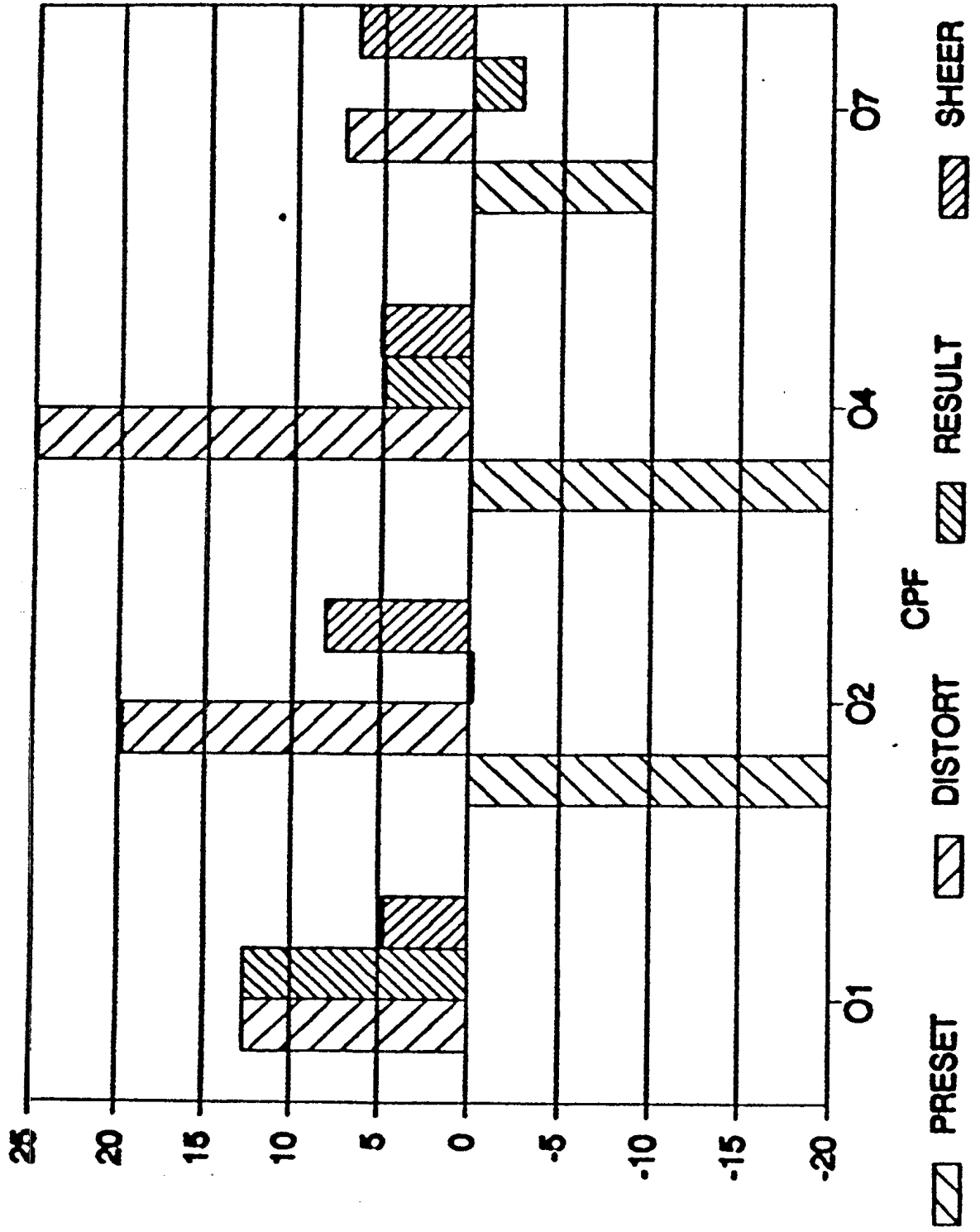


Exhibit 17: CPF-04 UNIT 2110 CAMBER

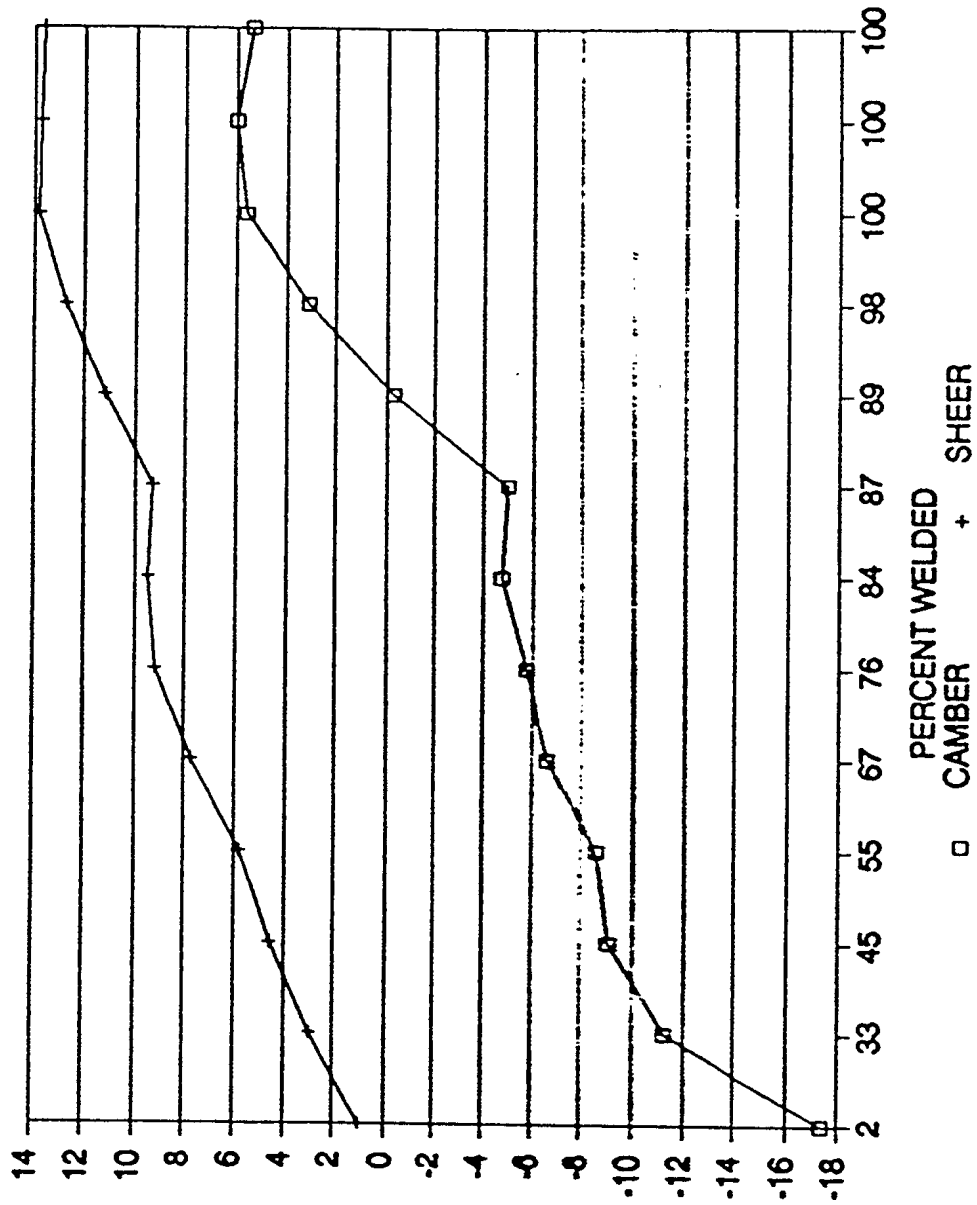


Exhibit 18: CPF-04 UNIT 2110 -- Distortion

ALIGNMENT OF STRUCTURE

REQUIREMENTS FOR MAINTENANCE OF ALIGNMENT

MINIMIZE PLATE TUCKING

**MINIMIZE FAIRING OR FRAMES/BARS AT UNIT
JOINS**

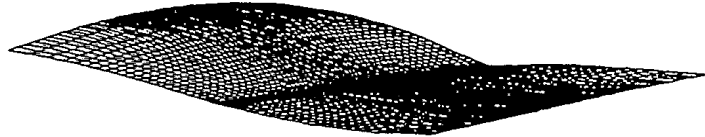
APPENDIX "A"

Test Panel #1
November 1990

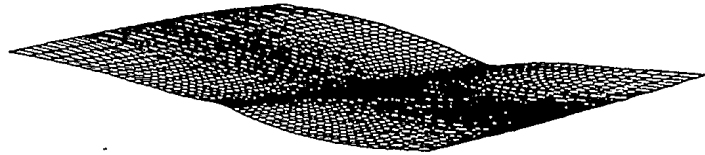
Attachment to
AC Report
Nov. 23/90

Thin Plate Welding Distortion Test

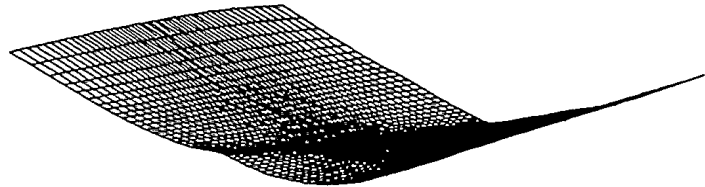
Butt Tacked



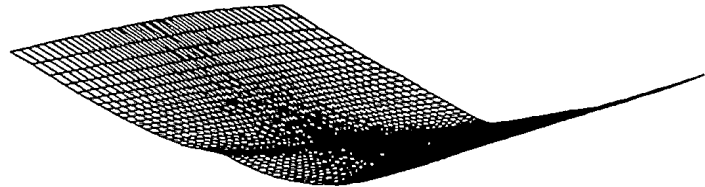
Butt Welded



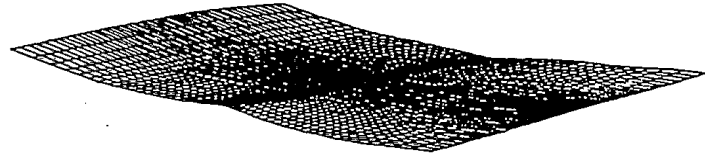
Bars Tacked



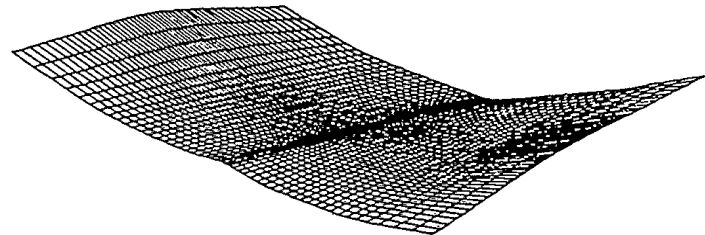
Bars Welded



Tripping Brackets Tacked



Tripping Brackets Weled



Note: Deflections perpendicular to plane magnified by 5X

Accuracy Control

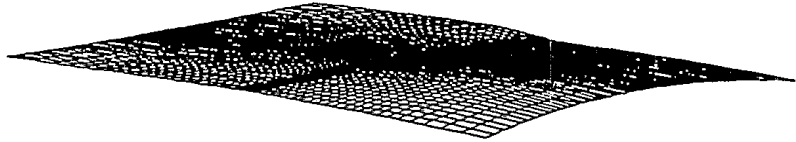
APPENDIX "A"

Test Panel #2
November 1990

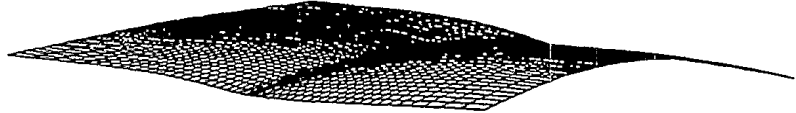
Attachment to
AC Report
Nov. 23/90

Thin Plate Welding Distortion Test

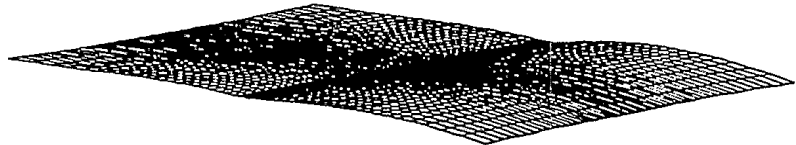
Butt Tacked



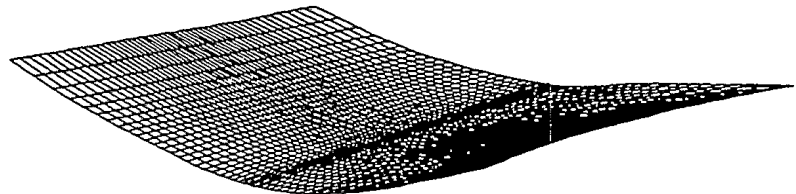
Butt Welded



Bars Tacked



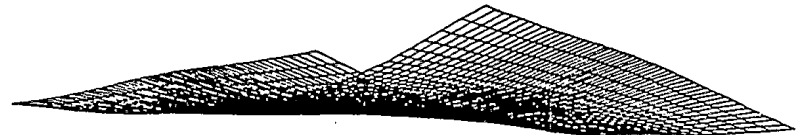
Bars Welded



Tripping Brackets Tacked



Tripping Brackets Weled



Note: Deflections perpendicular to plane magnified by 5X

Accuracy Control

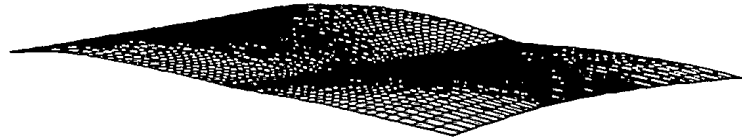
APPENDIX "A"

Test Panel #3
November 1990

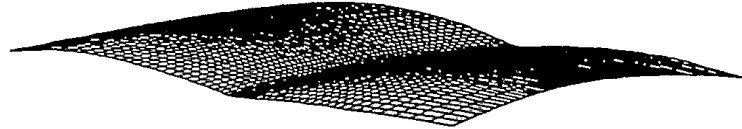
Attachment to
AC Report
Nov. 23/90

Thin Plate Welding Distortion Test

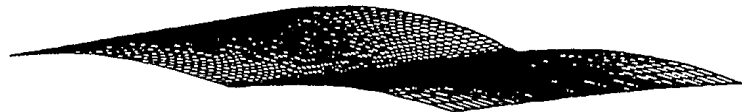
Butt Tacked



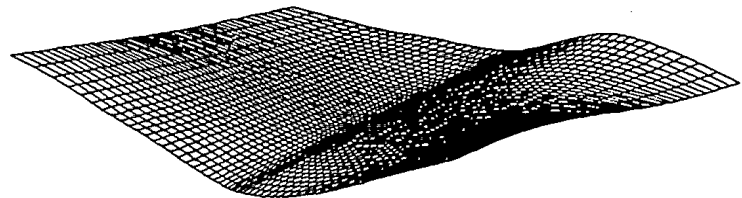
Butt Welded



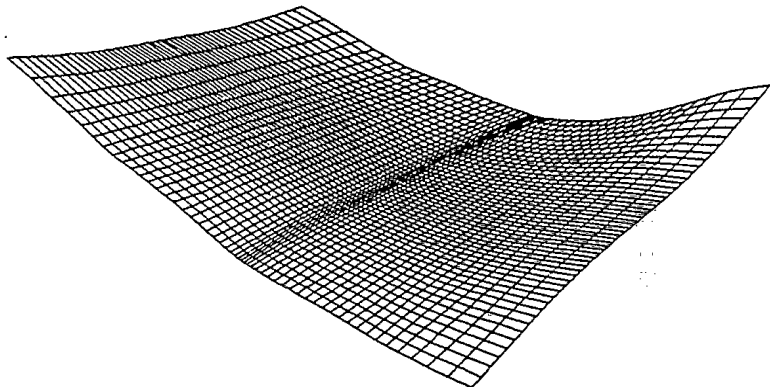
Bars Tacked



Bars Welded



Tripping Brackets Weled



Note: Deflections perpendicular to plane magnified by 5X

Accuracy Control

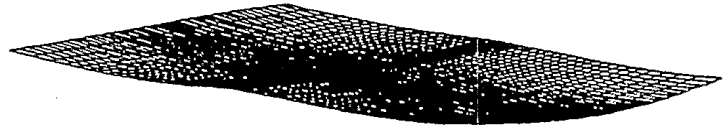
APPENDIX "A"

Test Panel #4
November 1990

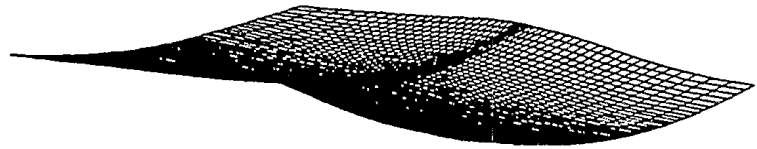
Attachment to
AC Report
Nov. 23/90

Thin Plate Welding Distortion Test

Butt Tacked



Butt Welded



Bars Tacked



Bars Welded



Note: Deflections perpendicular to plane magnified by 5X

Accuracy Control

WELDING PANEL TESTS - OCTOBER 1980
WELDING PARAMETERS

PANEL #1	HEAT (J/mm)			SEQUENCE			RESTRAINT			FITUP		
	SEAM	BAR	TRIPPING BRACKETS	SEAM	BAR	TRIPPING BRACKETS	SEAM	BAR	TRIPPING BRACKETS	SEAM	BAR	TRIPPING BRACKETS
FITTED	-	-	---	L-R	L-R	CL-OUT				1	0	0-2
WELDED	480	340		L-R	L-R	CL-OUT	NO	NO	---			

PANEL #2	HEAT (J/mm)			SEQUENCE			RESTRAINT			FITUP		
	SEAM	BAR	TRIPPING BRACKETS	SEAM	BAR	TRIPP	SEAM	BAR	TRIPPING BRACKETS	SEAM	BAR	TRIPPING BRACKETS
FITTED	-	-	---	L-R	L-R	CL-OUT				1	0	0-2
WELDED	400	340		L-R	L-R	CL-OUT	YES	YES	---			

PANEL #3	HEAT (J/mm)			SEQUENCE			RESTRAINT			FITUP		
	SEAM	BAR	TRIPPING BRACKETS	SEAM	BAR	TRIPPING BRACKETS	SEAM	BAR	TRIPPING BRACKETS	SEAM	BAR	TRIPPING BRACKETS
FITTED	-	-	---	L-R	L-R	CL-OUT				1	0	0-2
WELDED	320	620		L-R	L-R	CL-OUT	YES	YES	---			

PANEL #4	HEAT (J/mm)			SEQUENCE			RESTRAINT			FITUP		
	SEAM	BAR	TRIPPING BRACKETS	SEAM	BAR	TRIPPING BRACKETS	SEAM	BAR	TRIPPING BRACKETS	SEAM	BAR	TRIPPING BRACKETS
FITTED	-	-	---	CL-OUT	CL-OUT					1	0	0-2
WELDED	687	711		CL-OUT	CL-OUT		NO	NO	---			

WELDING PANEL TESTS - OCTOBER 1980
 Accuracy Control
 PANEL DEFLECTION (mm)

	AFTER SEAM WELDED		AFTER BARS WELDED		AFTER T/B WELDED	
	SEAM	BARS	SEAM	BARS	SEAM	BARS
PANEL #1	3.2	.73	2.1	0.4	1.05	0.8
PANEL #2	3.1	.81	1.5	0.6	1.5	1.1
PANEL #3	6.0	1.3	3.6	0.8	2.95	0.75
PANEL #4	3.8	.81	0.6	0.6	NA	NA

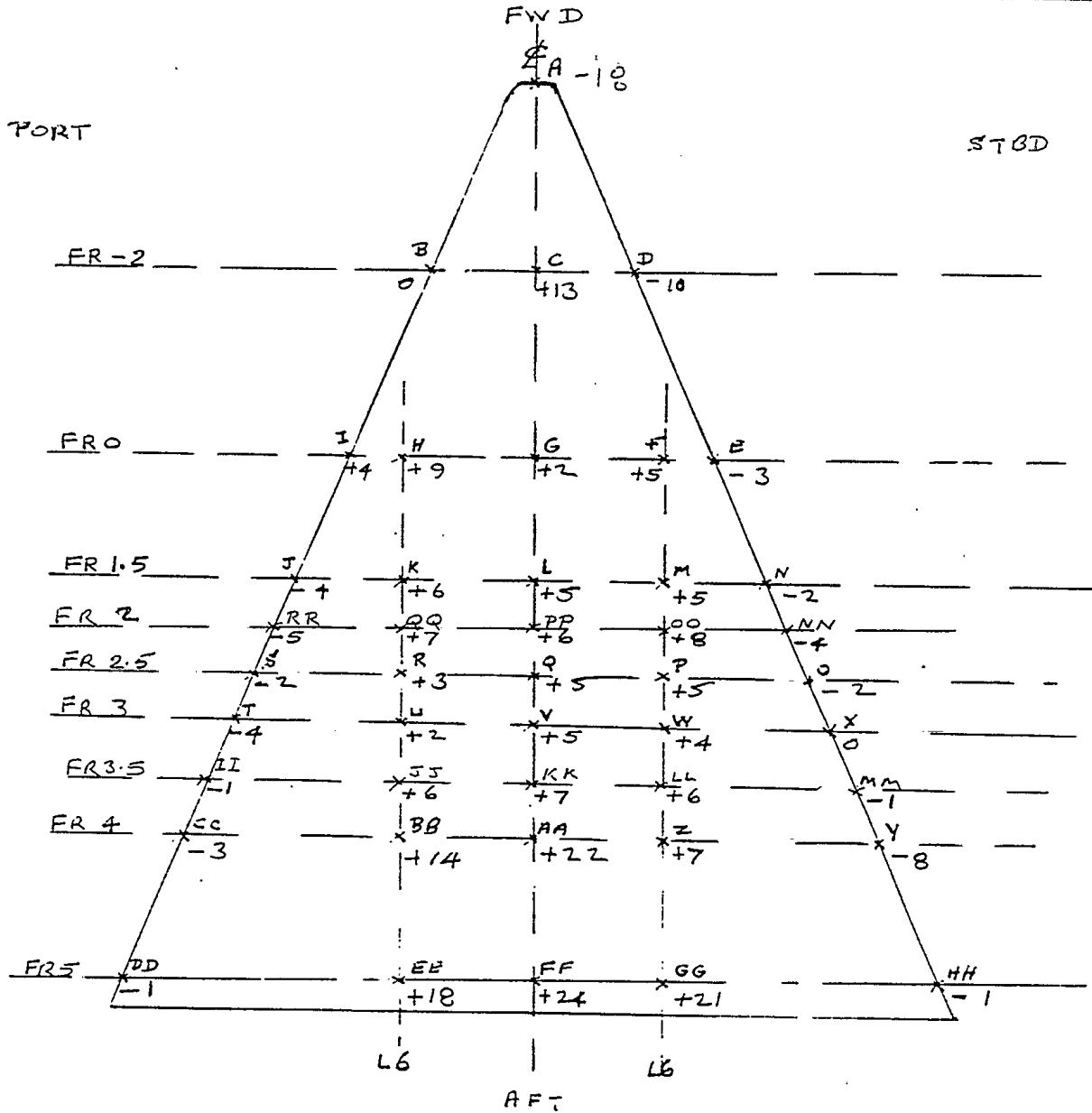
RATIO	CPF	TEST
PANEL BREADTH TO PLATE THICK	75	138
LENGTH TO BREADTH	1.7	4.5

CONDITION REPORT

HULL NO: 1222 | UNIT NO: 1150 | ITEM: Deck # 1 (HEAVTS)

STATUS: Before erection

DATE: Feb 22 '88



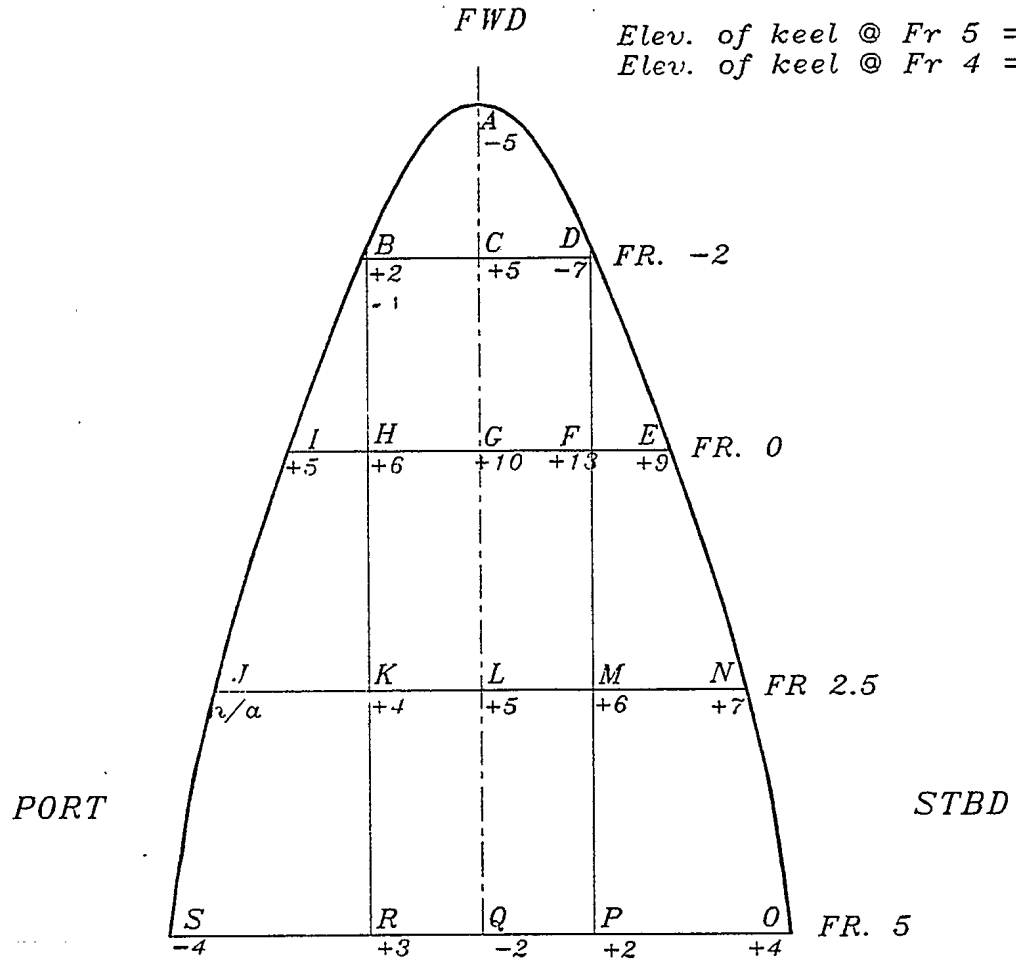
SURVEYOR: H. Panno R. Cassidy

REMARKS: 1) Deviations are from design

CONDITION REPORT

HULL NO: 2262 | UNIT NO: 1150 | ITEM: DECK #1

STATUS: As built prior to Blast & Paint | DATE: 01 November 1994



PLAN VIEW DECK 1

SURVEYOR: R. Cassidy, H. Payne

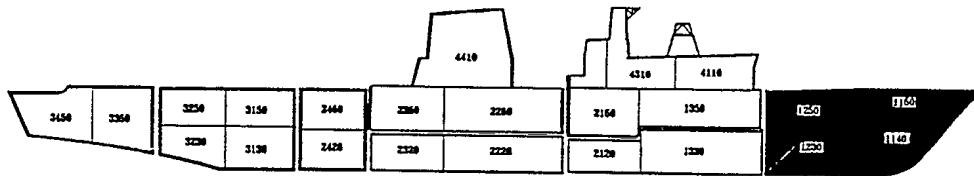
- REMARKS:
1. DEVIATIONS ARE FROM DESIGN
 2. U/S Keel @ Fr 5 held as design
 3. TARGET ELEVATION = +9

SAINT JOHN SHIPBUILDING LTD.

ACCURACY CONTROL

MEGA MODULE ERECTION PACKAGE

HULL: 2232



MEGA MODULE #1

SAINT JOHN SHIPBUILDING LIMITED

ACCURACY CONTROL

ERECTION FITUP COMPARISON

HULL: 2232

UNIT: Mega Module #1

DATE: 25-JAN-93

HALF-BREADTHS @ DECKS			
UNIT	DECK NO.	STBD SHELL	PORT SHELL
MM1 @ BUTT	1	+17	+9
MM7 @ BUTT		-3	-2
FAIRING		20	11
MM1 BUTT	2	+4	-4
MM7 @ BUTT		-1	-2
FAIRING		5	2
MM1 BUTT	3	-2	0
MM7 @ BUTT		+11	+9
FAIRING		13	9
MM1 BUTT	4	+4	+2
MM2 BUTT		N/A	N/A
FAIRING		N/A	N/A

COMMENT: Minor Fairing Required

ELEVATIONS @ DECK				
UNIT	DECK NO.	STBD SHELL	CENTER LINE	PORT SHELL
MM1 FR11	1	+1	-5	-1
MM7 FR12		+10	+7	+9
FAIRING		9	12	10
MM1 FR11	2	+4	+2	N/A
MM7 FR12		N/A	N/A	N/A
FAIRING		N/A	N/A	N/A
MM1 FR11.5	3	-3	-19	-2
MM7 FR12		0	-10	-3
FAIRING		3	9	1
MM1 FR11.5	4	N/A	N/A	+3
MM2 FR12		N/A	N/A	+6
FAIRING		N/A	N/A	3

COMMENT: Minor Fairing Required