



Supply and Services / Approvisionnement et Services
Canada / Canada

CLAIM FOR PROGRESS PAYMENT
RÉCLAMATION DE PAIEMENT PARTIEL

USE SUPPLEMENTARY CLAIM FORM DSS-MAS 1112 AS REQUIRED TO RECORD DETAIL
AU BESOIN, INSCRIRE LES DÉTAILS SUR LA FORMULE DE RÉCLAMATION SUPPLÉMENTAIRE DSS-MAS 1112

CONTRACTOR - ENTREPRENEUR Arjay Engineering Ltd		CLAIM NO. - N° DE LA RÉCLAMATION	DATE December 31/92
ADDRESS - ADRESSE 2495 Haines Road Mississauga, Ontario L4Y 1Y7			
Development of Void Fraction Meter, for measurement of gas hold-up at high temperature and pressure.			
FILE NO. - N° DU DOSSIER 06SQ.23440-9-9155	SERIAL - SÉRIE 23440-9-9155/01-SQ	ITEM - ÉLÉMENT - CLASSE 234-131-000000-501202	CONTRACT PRICE - PRIX DU CONTRAT \$49,693.00

CONTRACTOR'S REPORT OF PROGRESS (IF MORE SPACE IS REQUIRED PLEASE USE SEPARATE SHEET)
COMPTÉ RENDU DES TRAVAUX PAR L'ENTREPRENEUR (SE SERVM, AU BESOIN, D'UNE AUTRE FEUILLE)

-0433 (37,270.00-Crown's Share)

During this period, finalization of design criteria & deminsional verification took place. Since the active research portion of the operation was complete, details of a working model remained. At present, the finalized parts are being received and will be assembled for shipment to Canmet in Ottawa. A finalized report will be written and the expected completion of this project is now within 60 days.

APPENDIX "C"

DISCLOSURE CERTIFICATION

To be completed by the Contractor and returned to:

Dr. R.G. Agarwal
Senior Science Procurement Officer
Science Branch
Science and Professional
Services Directorate
Supply and Services Canada
11Cl, Place du Portage, Phase III
11 Laurier Street
Hull, Quebec
K1A 0S5

CONTRACT TITLE: DEVELOPMENT OF A VOID FRACTION METER FOR MEASUREMENT
OF GAS HOLDUP AT HIGH TEMPERATURE AND PRESSURES [Part
of the Program of the Federal Panel on Energy
Research and Development (PERD)]

SSC FILE NUMBER: 06SQ.23440-9-9155

CONTRACT FILE NO: 23440-9-9155/01-SQ

"We certify that all applicable disclosures were
submitted in compliance with General Conditions
Research and Development and in accordance with
the contract and the Science Branch Contracting
Officer's instructions."

SIGNATURE: 

PRINT NAME: Greg Reeves

TITLE: Mgr

COMPANY NAME: Arjay Engineering Ltd.

Mississauga, Ontario

DATE: MAY 31. 93



**ARJAY ENGINEERING LTD
GUARANTEE**

We hereby guarantee this instrument to be free from defects in workmanship and materials; and if found defective in workmanship or materials upon being returned prepaid, within one year from date of purchase, to our factory, it will be repaired or replaced at factory without charge. However, if upon being returned and after inspection, there is evidence that the instrument has been subjected to tampering, careless handling, improper or faulty application or installation, the above guarantee shall not be applicable and we shall have the right in any such case, to make a charge to cover the cost of repairs, servicing and transportation expense. The undersigned assumes and shall have no liability for consequential damages resulting from the use or misuse of the instrument.

The foregoing guarantee is in lieu of all other guarantees or warranties, expressed or implied, and all other obligations or liabilities, contractual or otherwise, either to the original purchaser of said instrument or to any other person whomever.

For service call ARJAY Engineering Ltd. directly: (416)276-2208
or
U.S. Toll Free 1-800-347-9487

For service inquiries we require the following information:

Your ARJAY Model is: _____
Serial Number is: _____

JUNCTION BOX
EXPLOSION PROOF
CLASS I, GROUP C,D
CLASS II, GROUP E,F,G
TYPE 4

PROBE HEAD

PHC-9070
PULSE CARD

1/2" NPT

4.25'

135

316 SS PROCESS FITTING

RATED AT 1500 P.S.I.

3/4" NPT PROCESS ENTRANCE THREAD

- STANDARD DUTY

1" NPT PROCESS ENTRANCE THREAD - HEAVY DUTY

2.00'
(STYP)

FLANGE
(OPTIONAL)

ENCLOSURE DIMENSIONS:

2.75' V X 10' H X 4.85' DEEP

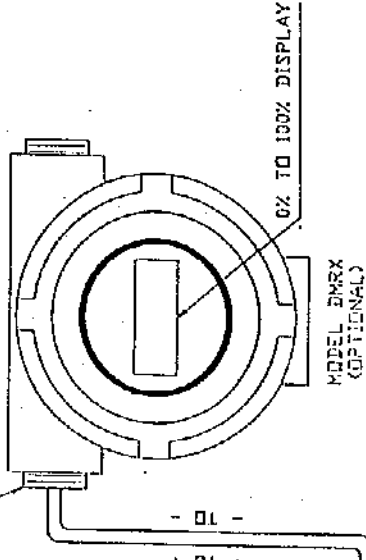
MOUNTING DIMENSIONS:

1.325' V X 9.500' H

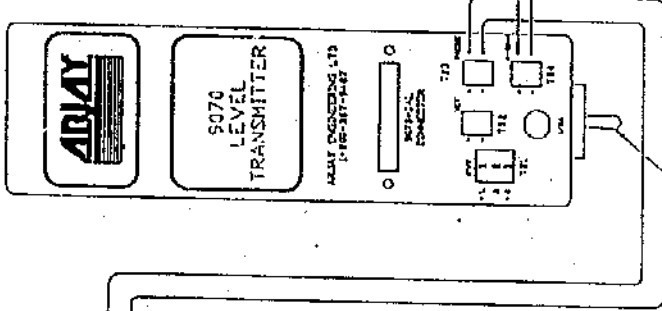
MOUNTING HOLE (4) DIAMETER:

0.150' WIDE SLOT (4)

1/2" NPT



MODEL 9070 - 115



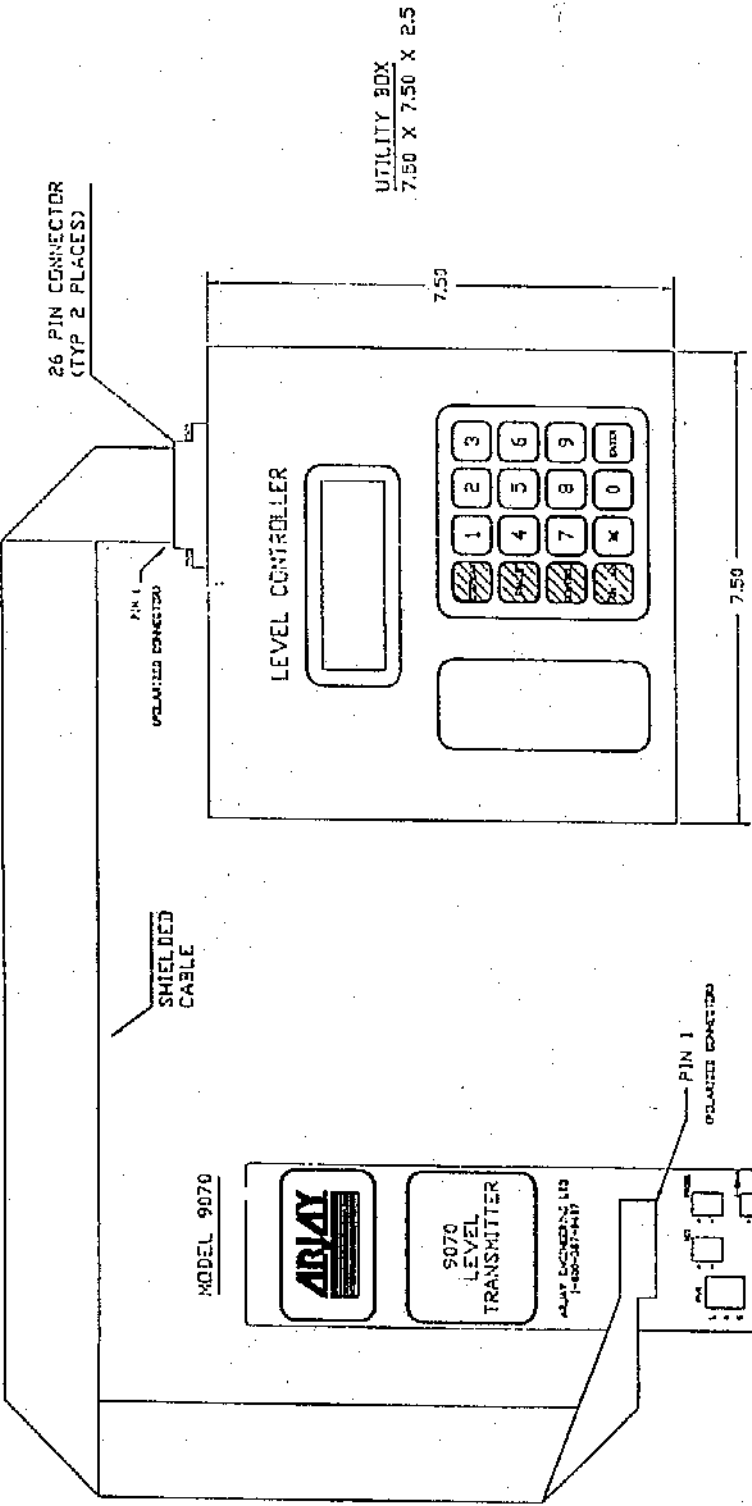
POWER:
ON/OFF SWITCH

NOTE:
SWITCH POWER OFF WHEN
INSTALLING CALIBRATOR

NOTE: TB1
115 VAC OR 24 VDC OR 12 VDC
POWER INPUT PER MODEL NUMBER
CUSE PIN 1 & 3 FOR 12 VDC OR 24 VDC

ALL DIMENSIONS ARE IN INCHES

REV	DATE	DESCRIPTION	APPROVED
REVISIONS			
ARJAY ARJAY ENGINEERING LIMITED		PROJECT:	
NO.	REV.	DATE	DESCRIPTION
C.P. NO. 111152			PROJECT TITLE
			9070 DIMENSION
			& WIRING DWG
SCALE	DWG. NO.	REV.	DATE
N.T.S.	92005200	1	0



UTILITY BOX
7.50 X 7.50 X 2.5

26 PIN CONNECTOR
(TYP 2 PLACES)

PIN 1
POLARIZED CONNECTOR

SHIELDED
CABLE

MODEL 9070

LEVEL CONTROLLER

9070
LEVEL
TRANSMITTER

ARJAY ENGINEERING LTD
1-800-387-6417

PIN 1
POLARIZED CONNECTOR

POWER
ON/OFF SWITCH

NOTE:
SWITCH POWER OFF WHEN
INSTALLING CALIBRATOR

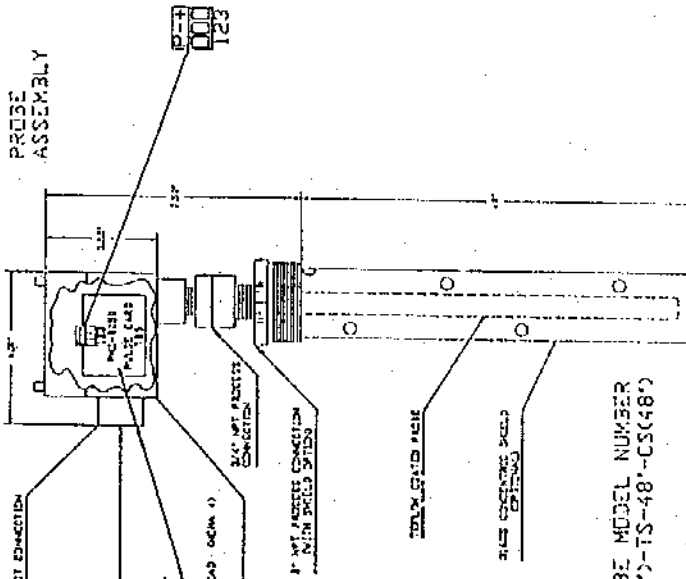
CALIBRATOR

7.50

7.50

REV	DATE	DESCRIPTION	OK'D BY
REVISIONS			
ARJAY ENGINEERING LIMITED		CUSTOMER	
9070CAL		FIELD CONNECTIONS	
SCALE	REV. NO.	FILE NO.	QTY.
A.T.S.	92004800		1
			0

ALL DIMENSIONS ARE IN INCHES

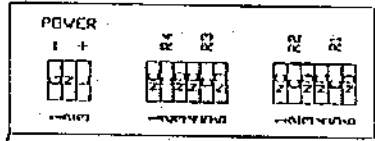


PROBE MODEL NUMBER
1SC27-TS-48*-CS(48)

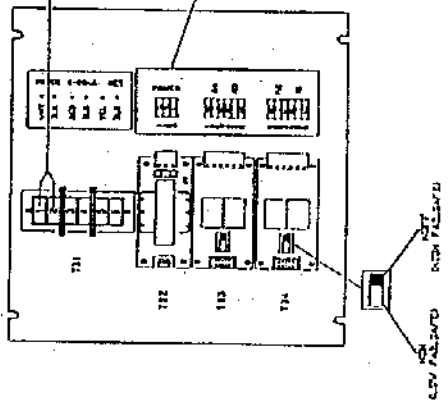
3/4" FEMALE CONDUIT CONNECTION
3/4" FEMALE CONDUIT CONNECTION
1/2" LEVEL DATE
2 1/2" ALUMINUM JUNCTION HOOD - OSHA 1)

NOTE: POWER CONNECTION IN VAC OR 24 VDC AS PER REQ. FOR 24 VDC OR 22 VDC

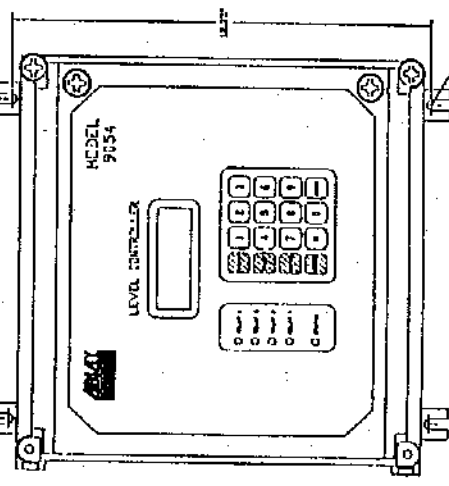
NOTE: TO 24 DIMENSIONS IN VAC OR 24 VDC AS PER REQ. FOR 24 VDC OR 22 VDC



SUBPLATE



CONTROLLER MODEL NUMBER
9054-115-CA4X



ENCLOSURE FRONT VIEW

ENCLOSURE
11.89 X 11.89 X 8.5 DEEP
NEMA 4X

ALL DIMENSIONS ARE IN INCHES

4. DRAWING	ENCLOSURE FRONT VIEW	10/23/92
5. REVISION	ENCLOSURE FRONT VIEW	10/23/92
1. DIMENSION	ENCLOSURE FRONT VIEW	10/23/92
2. DIMENSION	ENCLOSURE FRONT VIEW	10/23/92
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100. DIMENSION	ENCLOSURE FRONT VIEW	10/23/92

ARJAY ENGINEERING LIMITED

PROJECT: _____

9050/9052/9054/9054-DWS
CONTROLLER LAYOUT AND
FIELD WIRING CONNECTIONS

SCALE: AS SHOWN

DATE: 10/23/92

1 6



ZERO AND SPAN VALUES

25. If you pressed "2", the display will read "SET 4-20mA OUT". The 4-20 mA output signal may be offset from the 0-100% level operation (ie. 4 mA = 10%, 20 mA = 90%). Enter the desired per cent value for the 4 mA output (zero) (ie. 010.5). Press ENTER. Enter the desired per cent value for the 20 mA output (span) (ie. 090.5). Press ENTER. The display will now read "CONTROL SETTINGS" or "CONTROL SET".
26. Control calibration is now complete. Press DISPLAY. The unit display will read "LEVEL". If you have a Remote Access Panel, press the unit number you wish to now calibrate or continuously display "LEVEL".

I. DIAGNOSTICS (Raw Data Readings)

The micro-controller will provide the user with raw data if required.

27. Press FUNCTION. The display will read "FUNCTION". Press 2. The display will read "DIAGNOSTICS". The display will provide the user with the capacitance of the probe, the transmitter frequency that is being sent to the controller from the probe. Press 1 or 2 to fix the mA output to 4mA or 20mA. This is used for testing. The mA output will be fixed only while in the diagnostic menu. Press FUNCTION to return to function menu.
28. Press 3 to view the Tag No. of the controller. The Tag No. is used in remote access applications only. Each controller in a remote access network must have its own unique tag no. (range 1 to 15).

Press DISPLAY to return the display to the LEVEL format. Select the unit number and enter if you have a Remote Access Panel.



18. If "MANUAL" (Option 1) calibration is desired, press "2". For the first known level vs. capacitance, enter the level in per cent. Press ENTER. The display will now ask for the capacitance value at this level. Enter the value and press ENTER. Repeat the above for the second point.
19. Press "3" to enter the maximum display range or maximum capacity of the vessel in the previously selected units (ie. inches). Key in this value in the selected units (ie. 100 inches) and press ENTER.

H. CONTROL CALIBRATION

20. Press CONTROL. The display will read "CONTROL SETTINGS" or "CONTROL SET" (for remote access only).
21. Press 1 to select alarm settings for relay activation and go to Step 22, or press 2 to determine the zero and span values for the 4-20mA output and go to Step 25.

ALARM SETTINGS

22. If you pressed 1 the display will read "ALARM SETTINGS" or "ALARM SET". To set alarm values press 1. Enter the desired per cent alarm setting for relay 1 using 5 digits (ie. 020.0). Press ENTER. The system will guide you through relays 2, 3 and 4. The display will automatically return to the "ALARM SETTINGS" menu.
23. Press 2 to enter a time delay on the relay activation. This will suppress the relay switching until the unit has been engaged in an alarm condition for the prescribed time. Enter time in seconds (0-99) (ie. 35), press ENTER.

For Failsafe selection on relays 1, 2, 3 & 4, (Models 9052 & 9054) a dipswitch is located directly on the relay board. Refer to Dwg. 92002400 for location details.

High Failsafe = NOFF
Low Failsafe = NON

24. Press 3 to enable the relay. The display will read ON in the lower right corner. This activates the relay operation for use with remote alarms and devices. To disable the relays for maintenance or calibration press 4. Press CONTROL. The display will read "CONTROL SETTINGS". If you are using the 4-20mA output, press "2". If not, go to STEP 26.



G. PROCESS CALIBRATION

12. Press CONTROL. The display will read "CONTROL SETTINGS" or CONTROL SET (for remote access only)
13. Press 1. The display will read "ALARM SETTINGS" or "ALARM SET" (for remote access only).
14. Verify the relays are disabled by the word "OFF" in the lower right corner of the display. If the display reads "ON", press 4. The display should now read "OFF".
15. Press CALIB to now calibrate the unit. The display will read "TANK CALIBRATION" or "CALIBRATION" (for remote access only). Select "AUTO" or "MANUAL" calibration as follows:
 1. AUTO - (This is the most common calibration method). Two points of level are required for calibration. The level distance between the two points should be at least 5% to provide greatest accuracy.
 2. MANUAL (Option 1)- Two known points of capacitance vs. level for the vessel are entered into the system. If "MANUAL" calibration is desired proceed to Step 17.
 4. MANUAL (Option 2)- Enter SLOPE (in pF/%) and OFFSET (pF for 0% level)
16. If "AUTO" calibration is desired, press "1". Enter the level of material presently in the tank in per cent of the total level. The * key is the decimal point. NOTE: If a digit is entered wrong, press DISPLAY to go back one digit. There are 5 digits to enter including the decimal point. For greater accuracy it is suggested to enter the values to the nearest 1/100 of a per cent (ie. 31.04). After the level is entered, press ENTER.
17. The display will now ask for a second point. If you have a Control Access Panel (CAP) with 9070 units, Press "2" (pt#2) to calibrate the second point of the level unit you are calibrating or Press "CALIB" to enter a calibration point of another unit. The memory will hold all previously entered calibration points. This will allow you to enter one level point for each of your tanks and then enter all second points at another time when a level change has occurred through normal process conditions. The level in the vessel must be altered up or down at least 5%. Once this is completed, enter the altered level of material in the tank in per cent (ie. 72.068). After the level is entered, press ENTER. Go to Step 19.



If you read "REMOTE ACCESS", key in the unit number controller you want to access for calibration and press "ENTER". The display will acknowledge the unit style (ie. 9070) and read "LEVEL".

During the following calibration procedure the Remote Access Panel will continuously ask you to confirm the unit number controller you are addressing, by displaying "ENTER NEW #". This is to assure that another unit is not falsely re-calibrated. To override this press your unit number and "ENTER" to continue.

F. ARJAY CONTROLLER FUNCTION PARAMETERS CALIBRATION

The ARJAY controller is programmed to the specific pulse card used on the probe. This is to optimize the accuracy of the unit. Three numbers are required. These numbers are included on the specification sheet at the back of this manual, as well as on the side of the pulse card terminal block. The numbers listed are for the pulse card shipped with the controller from the factory. Entry verification is required or re-entry if a different pulse card is used.

8. Press FUNCTION. The display will read "FUNCTION". Press 1 to configure the pulse card to the transmitter. The display will read "XMTR CONFIG" (Press 2 for manual entry). Note: 1 and 3 are for factory use. If the "A" value is the same as the value verified on the specification sheet, press ENTER. If the value is different than the value of the pulse card, enter the new digits (ie. 0.03) (the * key is the decimal point). press ENTER. NOTE: If a digit is entered wrong, press DISPLAY to go back one digit.
9. The display will now ask for the "K" value. If the "K" value is the same as the value verified on the specification sheet, press ENTER. If the value is different than the value of the pulse card enter the new digits (ie. 115). Press ENTER.
10. The display will now ask for the "C" value. If the "C" value is the same as the value verified on the specification sheet, press ENTER. If the value is different than the value of the pulse card enter the new digits (ie. 100.5). Press ENTER. The display will read "FUNCTION".
11. Press 4 to select engineering unit for level. Select desired unit by number (ie. 1 for inches) the display will go back to the FUNCTION menu. Press DISPLAY to return to the LEVEL display.



Choose the mounting locations in accordance with good instrument practice. Extremes of ambient temperature and vibration should be avoided. (See specifications).

1. Install the pulse card (PMC Circuit) into the probe head, making sure both legs are grounded to the body. Connect the probe lead, supplied on the probe end, to the terminal marked "P".
2. Using two wire shielded cable, connect the +&- terminals on the pulse card (located in probe head) to terminals marked + & - in remote level monitor (NOTE: "B" is negative, "W" is positive).
3. Use No. 16 gauge wire for connections. The maximum length of this wire is one kilometer.
4. Use shielded wire connecting the shield to the negative at the terminal. DO NOT connect the shield at the probe end. DO NOT run wires over 24VDC in the same conduit as the probe wires.
5. Connect the capacitance probe per the wiring drawings included with this manual.
6. Connect the power requirement and control wiring per the drawings included with this manual. NOTE: Additional equipment added after factory manufacture may alter wiring requirements. Verify the drawings in this manual match the equipment supplied.
7. If you have a hand held calibrator (used for 9070 probe mount units) connect the calibrator to the unit prior to applying power.
8. Apply power to the instrument or panel.
9. The unit is now ready for calibration. If the unit display reads "ERROR: NO XMTR SIGNAL" and status light is red, check all field wiring and connections for faults.
10. The display will read as follows:

9050 (integral):	" <u>LEVEL</u> "
9070 (hand held):	" <u>LEVEL</u> "
9070 (remote access panel):	" <u>REMOTE ACCESS</u> "

<u>Model Type</u>	<u>Description</u>
9050	- LCD, 4-20mA output
9052	- LCD, 4-20mA output, 2 alarm contacts
9054	- LCD, 4-20mA output, 4 alarm contacts
9070	- 4-20mA output
9074	- 4-20mA output, 4 alarm contacts

C. PROBES

ARJAY'S probes are provided in a variety of styles and types for various specific applications involving liquids or granular materials. Usually insulated rod type probes are used. Proximity probes can be provided to detect level without contacting the monitored material.

VERTICAL PROBE MOUNTING: A vertically mounted probe should be installed so that the desired control points occur along the length of the probe. The zero and span settings can be adjusted to include the full length or just a small section of the probe. The probe requires a metal reference ground such as the sides of the tank or hopper, a reference rod, or a concentric shield around the probe. The reference ground must be parallel to the probe to provide a linear signal.

D. PROBE INSTALLATION

Screw the probe into the 3/4" NPT opening (standard probes) or 1" NPT opening (heavy duty probes). Flanges and shields are available as optional equipment. The entrance configuration may vary depending on application requirements. Use wrench on lower hex only. Take care in installing probe. The insulation of the probe is important to the function of the instrument.

CAUTION: The probe fittings are a compression type with teflon ferrules assembled by applying torque between the two sections. The fittings are sealed at the factory to provide a compression seal capable of withstanding high pressures. Once opened, they cannot be reassembled without new ferrules.

E. ELECTRONIC INSTALLATION

Examine the instrument for possible shipping damage.

IMPORTANT: If for any reason it is determined that parts should be returned to the factory, please notify the nearest ARJAY Sales Representative prior to shipping.

MODEL 9050/9052/9054 & 9070 SERIES
INSTALLATION AND CALIBRATION MANUAL

A. DESCRIPTION

The ARJAY RF Level Control Systems are based on a micro-controller to monitor the level changes of materials (liquids and solids) in vessels of various configurations and use.

Calibration is achieved through a keypad and display unit which is similar to all instruments.

Your calibration unit is designated below:

<u>Your Model</u>		<u>Your Calibrator</u>
9050		integral to unit
9052		integral to unit
9054		integral to unit
9070	Style "A"	hand held
9070	Style "B"	remote access panel

Calibration does not require an empty and full vessel. A selection of two level points on the probe are required for automatic calibration.

B. OPERATION

There are basically 3 distinct operations of the level system.

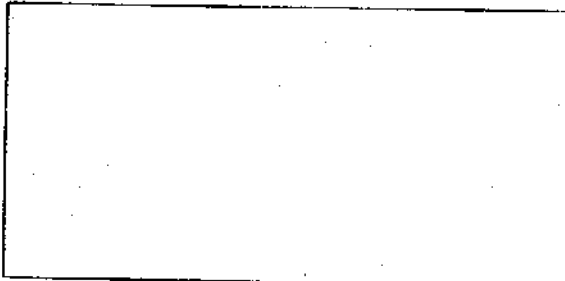
1. The Capacitance Probe inserted into the vessel provides a means to detect capacitance change through level changes. A proper ground reference is extremely important to the operation of the unit.
2. The Pulse Card, Model PMC-RF, which is installed in the head of the probe. The circuit translates the capacitance of the probe into a frequency pulse which can then be transmitted to the remote controller. Take care during the installation of this card to insure there are no wires shorting out the card. Again, grounding is important. Be sure both mounting screws are securely fastened.
3. The Remote Controller receives the frequency pulse signal and performs the necessary operations to provide an output to its' calibrated level. Displays, alarms and output are available according to Model type.



ARJAY ENGINEERING PRODUCTS AND SERVICES

CATAGORY	DESCRIPTION	
Capacitive Level Probes	Flanged Standard Duty Concentric Proximity Plate	Flexible - Anchored Flexible - Plain tip Flexible - Weighted <u>Custom probes</u>
Capacitance Level controllers	Low cost On/Off Continuous Level	Bridge and RF technology
Capacitance Flow Controllers		Applications: Level monitoring and control Material composition monitors Intrusion/proximity monitors Hydrocarbon float sensors for hazardous spills Leak sensors for liquid sensitive locations
pH/ORP and Conductivity Controllers		Open Channel Flow measurement
Turbidity/Suspended Solids Monitoring		Sensors and fittings 2 channel Intelligent Transmitters / Controllers
Industrial Control Engineering		Industrial grade Inline and Open Channel Applications Transmitter/Controller with self cleaning sensor assembly
Industrial Custom Controls		Electrical Panel engineering and wiring Instrument design for custom control/monitor applications

REPRESENTED BY:



ARJAY ENGINEERING Ltd.

2495 Haines Rd.
Mississauga, Ontario, Canada
L4Y 1Y7

Phone: (416) 276 2208

Fax: (416) 277 2588

TOLL FREE NORTH AMERICA WIDE

1-800-387-9487

For more information please contact your local representative or call us directly.



CONTINUOUS LEVEL TRANSMITTERS WITH THE ARJAY LEVEL-EASE SYSTEM MODEL 9070 - (Remote Mount Transmitter)

INTRODUCTION

Arjay Level Controls have been designed for flexibility, durability and most important, reliability. Models are available for a wide range of level measurement and control applications and include probe mounted, remote, on/off and continuous level systems.

THEORY OF OPERATION

A probe mounted in a tank forms a capacitor with the walls of the vessel. The capacitance of this arrangement is directly proportional to the level of material in the tank and may be measured to provide signals and controls.

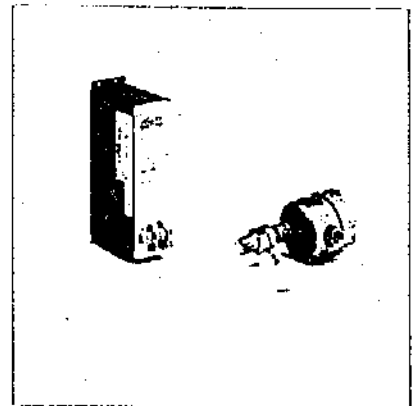
The Arjay Level-Ease 9000 System uses an RF (radio frequency) methodology to measure the vessel capacitance. This technique minimizes the effects of other electrical properties of the probe, vessel and the contents of the vessel and focuses only on tank capacitance. As a result, measurement error due to coating buildup on the probe is ignored. The controller may be located up to one km away from an Arjay probe via inexpensive 2-wire shielded cable.

DESCRIPTION

The 9070 was specifically designed for applications involving multiple tanks. The transmitters are centrally located in one cabinet with an Arjay CAP (Central Access Panel) to access each controller for diagnostics, calibration and level indication. Each unit provides an independent 4-20mA output.

SPECIFICATIONS

POWER:	120VAC/60hz +/-10% or 24vVAC24vVDC@ 0.15 Amp
ENVIRONMENT:	Controller: -20 C to 60 C Pulse Card: -40 C to 80 C
ENCLOSURE:	Subplate mount 2.75W X 10H X 4.85D" Nema 1 Optional - Nema 4x (fiberglass) (suffix DN4X)
DISPLAY:	CAP (Arjay Control Access Panel) LCD; 4line with bargraph, % & selectable units
ANALOG OUTPUT:	4-20mA @ 0.5% resolution
ACCURACY:	+/- .2%
RESOLUTION:	.002%
INTERFACE:	Hart Protocol (RS-485)
PROBE:	Available for use with any Arjay Probe

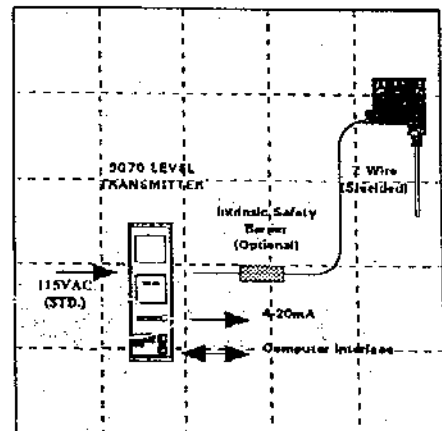


Model 9070



FEATURES

- 2 point automatic calibration
- RF technology (ignores coatings)
- Arjay pulse card system for simple, safe remote control, calibration and maintenance.
- Interchangeable and expandable components
- Direct & inverse 4-20mA output with offset features
- Central Access Panel for multiple tanks
- No moving parts



90700293

For ordering information consult the product sheet or your local representative.
Technical support hotline 1-800-387-9487



CONTINUOUS LEVEL MONITORING WITH THE ARJAY LEVEL-EASE SYSTEM MODELS 9050, 9052 & 9054

INTRODUCTION

Arjay Level Controls have been designed for flexibility, durability and most important, reliability. Models are available for a wide range of level measurement and control applications, and include probe mounted, remote, on/off and continuous level systems.

THEORY OF OPERATION

A probe mounted in a tank forms a capacitor with the walls of the vessel. The capacitance of this arrangement is directly proportional to the level of material in the tank and may be measured to provide signals and controls.

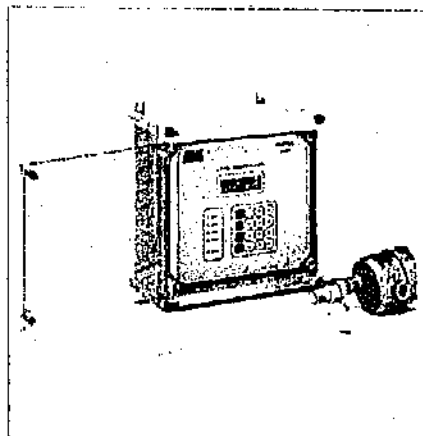
The Arjay Level-Ease 9000 System uses an RF (radio frequency) methodology to measure the vessel capacitance. This technique minimizes the effects of other electrical properties of the probe, vessel and the contents of the vessel and focuses only on tank capacitance. As a result, measurement error due to coating buildup on the probe is ignored. The controller may be located up to one km away from an Arjay probe via inexpensive 2-wire shielded cable.

DESCRIPTION

The unit provides a standard 4 line display to continuously indicate level, volume, per cent, etc. Also, the display provides diagnostics and calibration access. Relay control action is available as well as custom software for specialty applications.

SPECIFICATIONS

POWER:	120VAC/60hz +/-10% or 24VAC/24VDC @ 0.15 Amp
ENVIRONMENT:	Controller: -20 C to 60 C Pulse Card: -40 C to 80 C
ENCLOSURE:	12H X 12W X 8D" (approx.) Nema 4x (fiberglass)
CONTROL RELAYS:	Model 9050: none Model 9052: 2 independent relays Model 9054: 4 independent relays Relays 10amp, 240VAC., SPDT dry Hi/Low field selectable
FAILSAFE:	0-99 Sec. adjustable
TIME DELAY:	LCD; 4 line with bargraph, % & selectable units
DISPLAY:	4-20mA @0.5% resolution
ANALOG OUTPUT:	+/- .2%
ACCURACY:	.002%
RESOLUTION:	Hart Protocol (RS-485)
INTERFACE:	Available for use with any Arjay Probe
PROBE:	

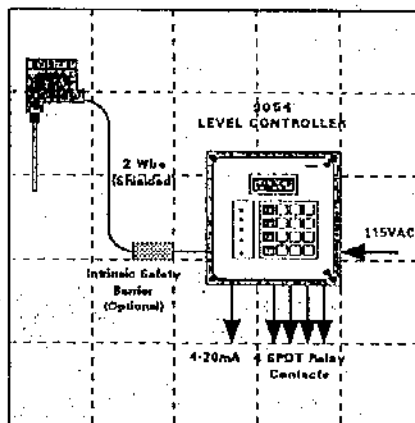


Model 9054



FEATURES

- 2 point automatic calibration
- RF technology (ignores coatings)
- Arjay pulse card system for simple, safe remote control, calibration and maintenance.
- Interchangeable and expandable components
- Direct or inverse 4-20mA output with offset capability
- RS-485 Network/Hart Protocol
- Multi calibration software available with menu selection
- No moving parts



INVOICE

INVOICE NO.



ARJAY ENGINEERING LTD.

2495 Haines Road
 MISSISSAUGA, ONTARIO, CANADA L4Y 1Y7
 TEL: (416) 277-4541 FAX: (416) 277-2588

CUSTOMER NO.

BILL TO:

CANMET
 555 Booth St.
 Ottawa, Ontario
 K1A-0G1

SHIP TO:

Attn: Catherine Hogan

DATE		SHIP VIA		F.O.B.		TERMS	
<i>Mar 21/83</i>		<i>PURCH. APD.</i>		OUR PLANT MISSISSAUGA			
PURCHASE ORDER NUMBER		ORDER DATE		SALES PERSON		OUR ORDER NUMBER	
		<i>Contract</i>				<i>2763.</i>	
QUANTITY			ITEM NUMBER	DESCRIPTION	UNIT PRICE	EXTENDED PRICE	
QTY. REQ.	SHIPPED	B.O.					
<i>1</i>	<i>1</i>	<i>0</i>	<i>1.</i>	<i>Ref:</i> <i>FILE # O6SQ.23440-9-</i> <i>9155.</i> <i>VOID FRACTION</i> <i>PROJECT.</i> <i>CAPACITANCE MONITOR</i> <i>INCLUDING:</i> - <i>One Model 9054</i> <i>Controller</i> <i>S/N 933386</i> - <i>One probe assembly</i> <i>with 2 probes</i> - <i>One Support assembly</i> <i>with spiral sensor</i>			

W.O./B.O. COPY COMPLETED BY _____
 COMPLETE PARTIAL FINAL PARTIAL



The unit should be pressurized prior to heating to ensure proper seals. With the cooling wrap in place, the temperature can then be gradually increased to the desired level.

For initial readings, the probe Capacitance will be monitored. With the controller powered up, press the FUNCTION key. A menu will be displayed. Press "2" for diagnostics. A capacitance reading will display.

The switch on the unit side will allow you to select either the level probe or the Gas Hold-up spiral sensor. For initial tests, record the capacitance for probe #1 with minimum and maximum gas injection. Record the capacitance for probe #2 with minimum fluid level and maximum fluid level.

Using the lowest capacitance reading of the two probes and the highest reading, the 4-20mA output can be set to allow recording.

This procedure will be detailed in the report.

Please give me a call if we can be of any assistance.

Regards,

A handwritten signature in black ink, appearing to read "Greg", written over a horizontal line.

Greg Reeves



March 29, 1993

Attn: Charlene Hogan
Canmet

Re: Void Fraction Project

Contract # 06SQ.23440-0-9155

Charlene:

Enclosed please find the following components for the void fraction test unit:

1. Model 9054 Capacitance Controller
2. Probe Assembly
3. Pyrex Support tube with Spiral Sensor

We will forward further drawings with the report, however, if you want to get started with tests in the autoclave, the following gives a quick overview.

Probe Installation

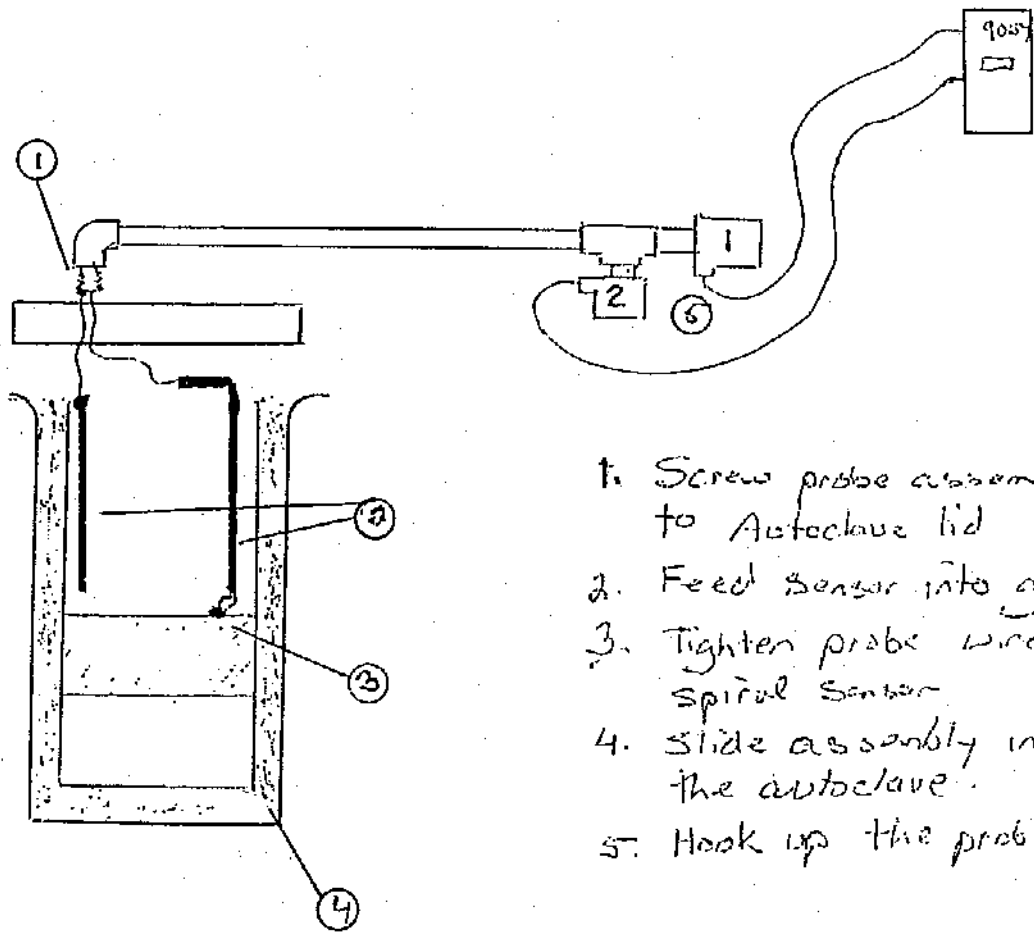
1. Feed the probe wires through the autoclave lid and screw the probe pipe assembly to the lid.
2. Feed one probe down each Glass tube in the Pyrex Support Column.
3. Tighten the open wires to the Spiral Sensor.
4. Slide the Support Column into the autoclave.
5. Check that the two probes are not shorting out at the top and support with wire if necessary. Bolt close the autoclave.
6. Hook up the two cables from the controller to the probes.
Note: The cable and probes are numbered.

As previously discussed, the probe pipe assembly was to allow you to wrap the pipe with a cooling system. This would reduce the temperature at the probe fittings to ensure the pressure seal.

ARJAY ENGINEERING LTD.
2495 Haines Road, Mississauga, Ontario, Canada L4Y 1Y7

tel: (416) 277-4541
telex 06-961368 (Can-Am)
fax: (416) 277-2588

ASSEMBLY PROCEDURE



1. Screw probe assembly to Autoclave lid
2. Feed sensor into glass tubes
3. Tighten probe wires to spiral sensor
4. slide assembly into the autoclave.
5. Hook up the probe wiring.



55 Six Point Road, Toronto, Ontario, Canada M8Z 2X3
 Tel. (416) 239-8161 • Fax (416) 239-8241

G.S.T. # R-105516231

CODE	ACCOUNT No.	DATE ENT'D.	TERMS	CUSTOMER ORDER No.	VERSATILE S.O. No.
	2758	01/05/93	NET 30	79657	63012

SOLO TO
 ARJAY ENGINEERING LTD.,
 2395 HAINES ROAD,
 MISSISSAUGA, ONTARIO
 L4Y 1Y7

SHIP TO
 ARJAY ENGINEERING LTD.,
 2495 HAINES ROAD,
 MISSISSAUGA, ONTARIO
 L4Y 1Y7

G.S.T. NO.	PROV. ST. LIC. No.	SHIPPING INSTRUCTIONS	SHIPPED VIA	DATE SHIPPED
EXTRA	EXEMPT	CALL GREG REEVES 277-4541		

ITEM No.	QUANTITY ORDERED	CATALOG NUMBER	DESCRIPTION	QUANTITY DUE	UNIT PRICE	QUANTITY SHIPPED	SCHEDULED DELIVERY
1	1	TC	SPECIAL COND. TYPE K 1/8 OD 316SS HGO CABLE 2" STRIPP. BEYOND SAUREISEN SEALED END THEN 7.5" SHEATHED BELW TRANS. SINGLE COND. CONN. 48" GG-20-K W/OVERBRAID		53.50		01/18/93
	5	TC	FEET GG-20-K WITH S.S. OVERBRAID.		1.00		01/18/93

CAN MET.

Comm. before

Terms are Net 30 Days. Prices are F.O.B. Our Plant — Toronto. All deviations are subject to our acceptance resulting from changes and/or cancellations. Claims must be made within seven days from receipt of delivery. Material cannot be returned without written consent.

General and Technical Information

Corning is a worldwide technologically oriented company producing specialized products for science, industry and the home. The company is the world's largest manufacturer of specialty glasses and has operations or affiliates in 24 countries.

The history of parts of the Corning organization goes back more than 200 years, but it was in 1912 that Corning developed low expansion durable borosilicate glass, building on and making practical earlier work on borosilicates in Germany. Some 10 years later arrangements were made for this type of glass to be made under "license" in England and France by companies which are now part of the Corning organization.

The development of this type of glass resulted in a host of products for the home and laboratory, many identified by the P/REX trademark. Then in 1940, work was carried out in England which led to the development of laboratory scale glassware into larger equipment on the scale described in this catalog.

In the field of chemical processing, Corning companies in England, France, Germany, and the USA have manufacturing and fabricating plants. Equipment described in this catalog is available through Corning or your local Corning distributor.

This catalog is intended primarily as an aid to the design of glass process systems. Our aim has been to present concise, factual data in sufficient detail to enable the reader to specify correctly from our wide range of components. This catalog describes only those items normally used in the U.S. Special configurations of most items can be made to meet your requirements.

In order to help the reader to locate the data required, we have divided the contents into sections which broadly classify the components according to their most common applications. Inevitably, some of the classifications may be arbitrary, since many components can be used in a variety of different applications. Please consult the index at the back of this catalog to locate the component or components of interest to you.

PROPERTIES OF BOROSILICATE GLASS

The components described in this catalog are, unless stated otherwise, made of borosilicate glass. It is a glass with low thermal expansion, excellent chemical durability, and high resistance to thermal shock.

CHEMICAL RESISTANCE

Borosilicate glass is inert to almost all materials with the exception of hydrofluoric acid, hot phosphoric acid and hot strong caustic solutions. Of these, hydrofluoric acid has the most serious effect and, even when a solution contains a few parts per million, attack will occur.

Phosphoric acid and caustic solutions cause no problems when cold but at elevated temperatures corrosion occurs. Caustic solutions up to 30% concentration can be handled safely at ambient temperatures.

MECHANICAL STRENGTH

The mechanical properties of glass differ from those of metals. The lack of ductility of glass prevents the equalization of stresses at local irregularities or flaws and the breaking strength varies considerably about a mean value. This latter is commonly found to occur at a tensile strength of about 700 kg/cm² (1000 psi).

The glass should be adequately supported and appropriate allowance should be made for special conditions such as high temperatures, dense liquids, etc. Subject to the above, maximum working pressures are as specified in the table on the following page.

WORKING TEMPERATURES

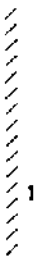
Borosilicate glass retains its mechanical strength and will deform only at temperatures which approach its strain point. The practical upper limit for operating temperatures is much lower and is controlled by the temperature differentials in the glass, which depend on the relative temperatures of the contents of the equipment and the external surroundings.

Provided borosilicate glass is not subjected to rapid change in temperature, creating undue thermal shock, it can be operated safely at temperatures up to 450°F (232°C). The normal limiting factor is actually the gasket material.

The degree of thermal shock (usually defined as sudden chilling) which it can withstand depends on many factors, for example: stresses due to operating conditions; stresses imposed in supporting the equipment; the wall thickness of the glass, etc. It is therefore undesirable to give an overall figure but, as a general guide, sudden temperature changes of up to about 216°F (120°C) can be accommodated.

At sub-zero temperatures, the tensile strength of borosilicate glass tends to increase and equipment can be used with safety at cryogenic temperatures.

It is always advisable to discuss any difficult applications with our engineers.



PYREX[®] Tubing and Rod

PYREX[®] brand 7740 glass tubing and rod is the preferred borosilicate glass for a variety of industrial, scientific and architectural applications. From fuel filter tubes and oil cups to ozonator tubes, from sealing glass to spacer rings, and lighting sheaths to glass walls and tunnels, Pyrex tubing and rod offers a material that reaches all facets of our lives.

PYREX brand 7740 tubing is offered in stock sizes from .079" O.D. to 7" O.D. with a variety of wall thicknesses designated as standard, medium and heavy wall products. All PYREX stock tubing and rod is offered in 48" lengths with ends cut.

Stock rod for sealing and slicing is available in sizes from .079" to 1 1/2" diameters.

Corning also offers small bore capillary tubing with diameters of .216"-.354" and bore sizes from .020" to .100".

Non-stock sizes in the same O.D. ranges described above, in lengths up to 150", are available on a special order basis from your local Corning Industrial Supplies Distributor.

NOTE: For information on Corning's pressure-rated tubular gage glass products, please consult the Corning Gage Glass catalog.

In all cases, before placing a Corning PYREX[®] or VYCOR[®] brand product into your process, read the Use and Care section of this product catalog and the Use and Care sheet provided with the product. Pay strict attention to maintenance instructions.

Tubing and Rod

PYREX® Glass Code 7740

PYREX® Brand Tubing—7740 Heavy Wall

Code	O.D. In.	O.D. Variation ± In.	Wall In.	Wall Variation ± In.	Approx. Lbs. Per Ft.	Approx. Pieces Per Case	Approx. Total Ft. Per Case	Approx. Avg. Lbs. Per Case
237650	3/8	.012	.0787	.008	.07	96	384	27
237500	1/2	.012	.094	.008	.11	61	244	27
237660	5/8	.012	.094	.008	.15	45	180	27
237510	3/4	.012	.125	.013	.24	28	112	27
237360	7/8	.0157	.125	.014	.28	30	120	34
237520	1	.0157	.156	.0157	.40	24	96	38
237530	1 1/4	.0275	.156	.0157	.53	18	72	38
237540	1 1/2	.0275	.156	.0157	.64	12	48	31
237550	1 3/4	.039	.156	.0157	.76	10	40	30
237560	2	.039	.188	.019	1.05	4	16	17
237570	2 1/4	.039	.188	.019	1.19	4	16	19
237580	2 1/2	.053	.188	.019	1.33	4	16	21
237590	2 3/4	.056	.188	.019	1.48	4	16	24
237600	3	.059	.188	.019	1.60	4	16	26
237610	3 1/4	.062	.188	.019	1.77	4	16	29
237620	3 1/2	.065	.188	.019	1.91	4	16	31
237630	4	.065	.250	.025	2.85	2	8	23
237640	4 1/2	.065	.250	.025	3.20	2	8	26
237670	5	.065	.250	.025	3.60	2	8	29
237680	5 1/2	.0787	.250	.025	4.00	2	8	32
237690	6	.0787	.312	.031	5.40	2	8	43
237700	6 1/2	.0787	.312	.031	5.90	1	4	24
237710	7	.0866	.375	.038	7.55	1	4	30

Lengths—3/8" to 1" O.D., 48" ± approximately 1/4", ends cut only.

1 1/4" O.D., 48 1/4" ± approximately 1/4", ends cut only.

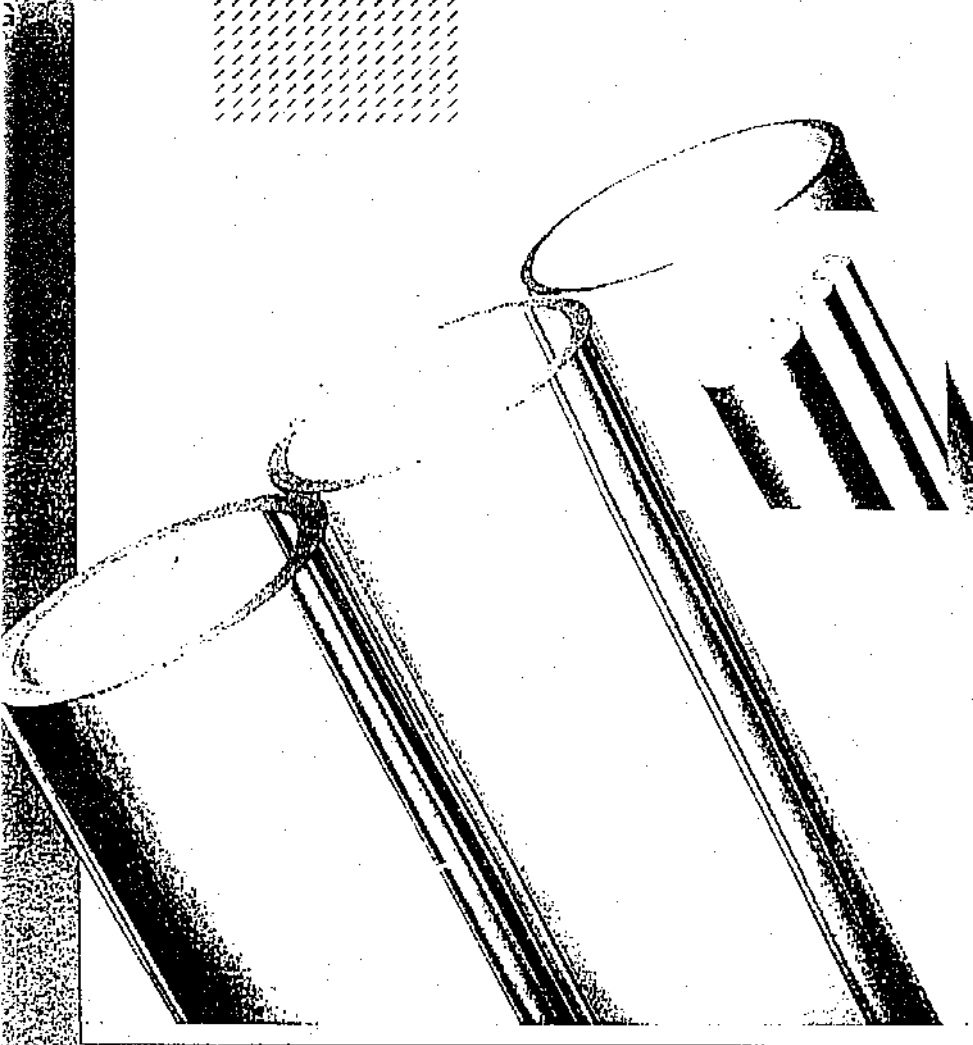
Over 1 1/4" O.D. and wall thickness greater than .200", 48 1/4" ± approximately 1/4", ends cut only.

Over 1 1/4" O.D. and wall thickness .200" and less, 48 1/4" ± approximately 1/4", ends trimmed and glazed.

tubing and Rod

PYREX® Glass Code 7740
VYCOR® Glass Code 7913

Industrial Supplies

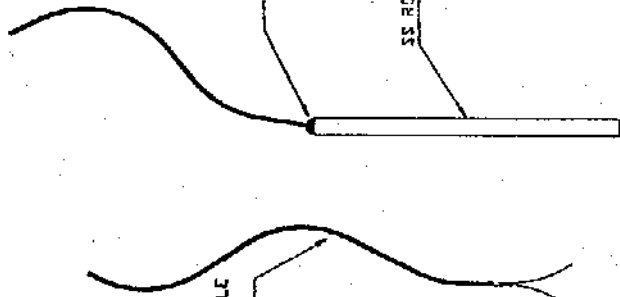


SPOT WELDS SUPPORT GUIDES TO SPIRAL SENSOR

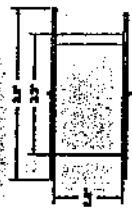


TOP VIEW

HIGH TEMPERATURE BRAIDED THERMOCOUPLE WIRE

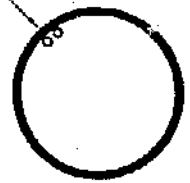


SIDE VIEW



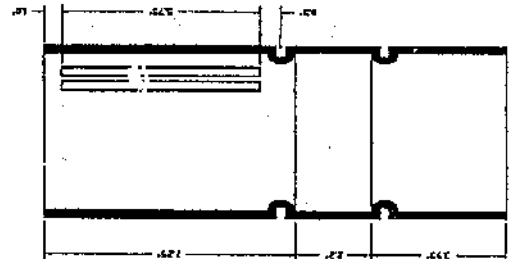
SPIRAL SENSOR (316SS)

GLASS TUBES (2) FOR SENSOR PROBE AND WIRE



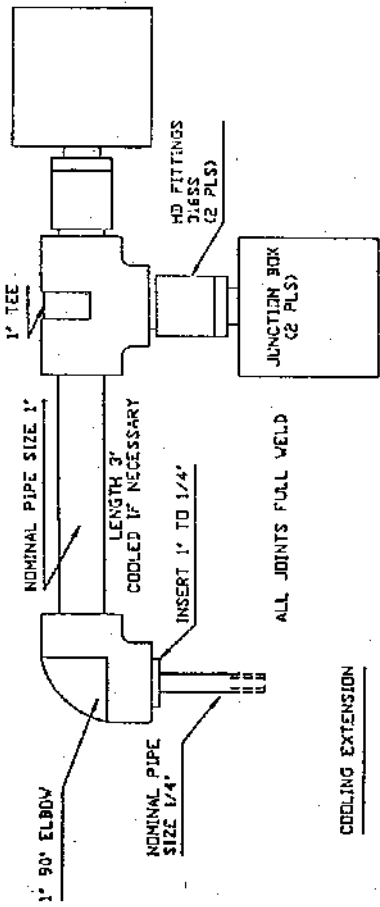
TOP VIEW

WALL O.D. 3" WALL THICKNESS .25"



SIDE VIEW

PYREX INSERT ASSEMBLY



ALL JOINTS FULL WELD

COOLING EXTENSION

REV	DATE	DESCRIPTION	REVISIONS	DRN/APPD

ARJAY ENGINEERING LIMITED

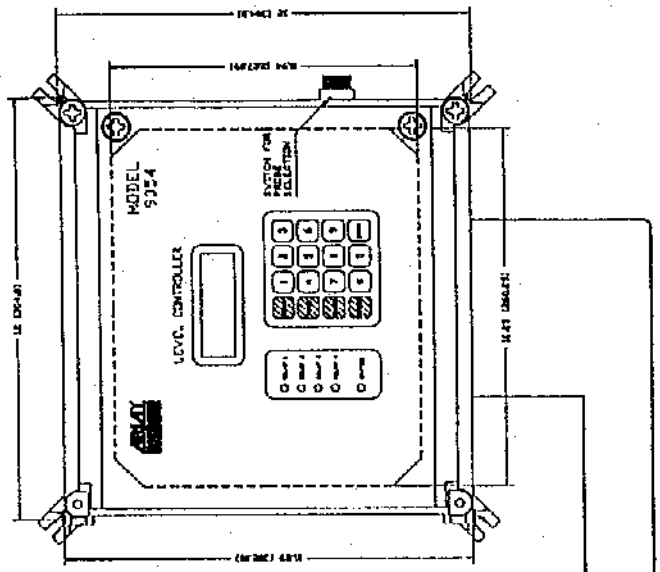
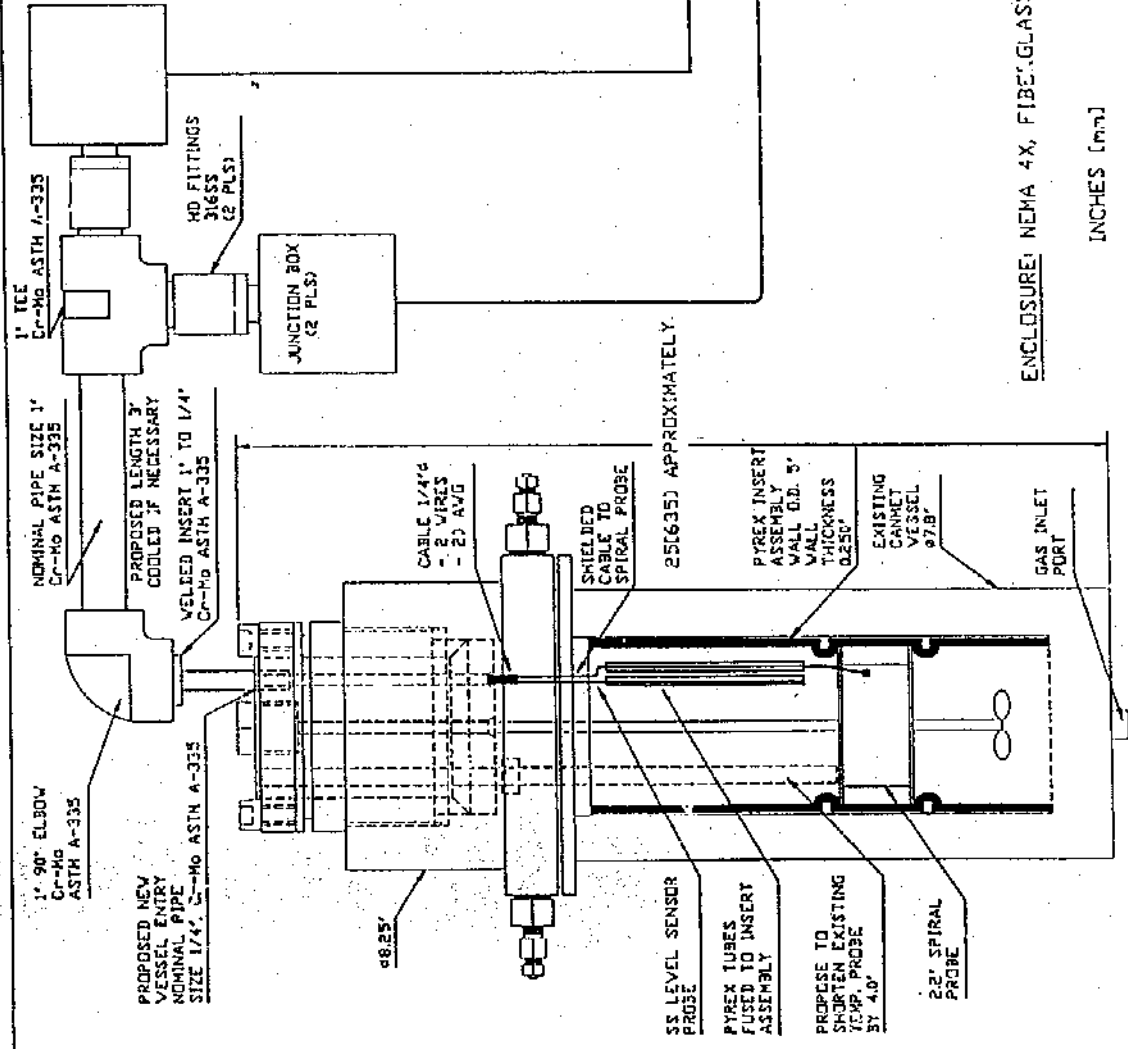
PROJECT: **CANMET**
06SQ.23440-0-9155

VOID FRACTION SENSOR ASSEMBLY
DETAIL

SCALE: 1/3

NO. 93001701

REV: 1 0

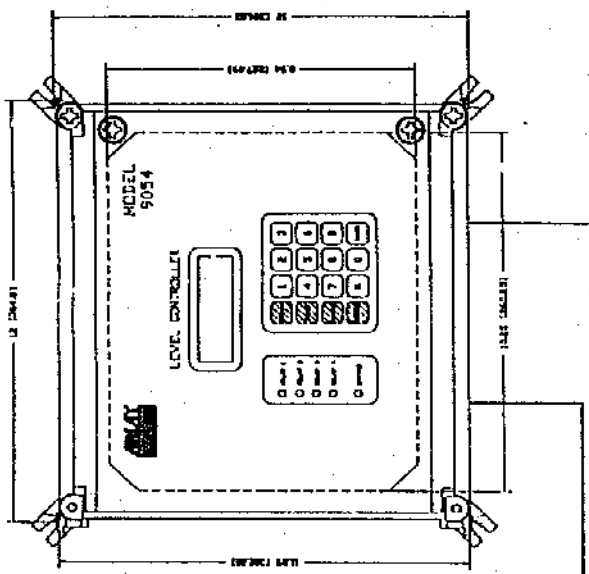
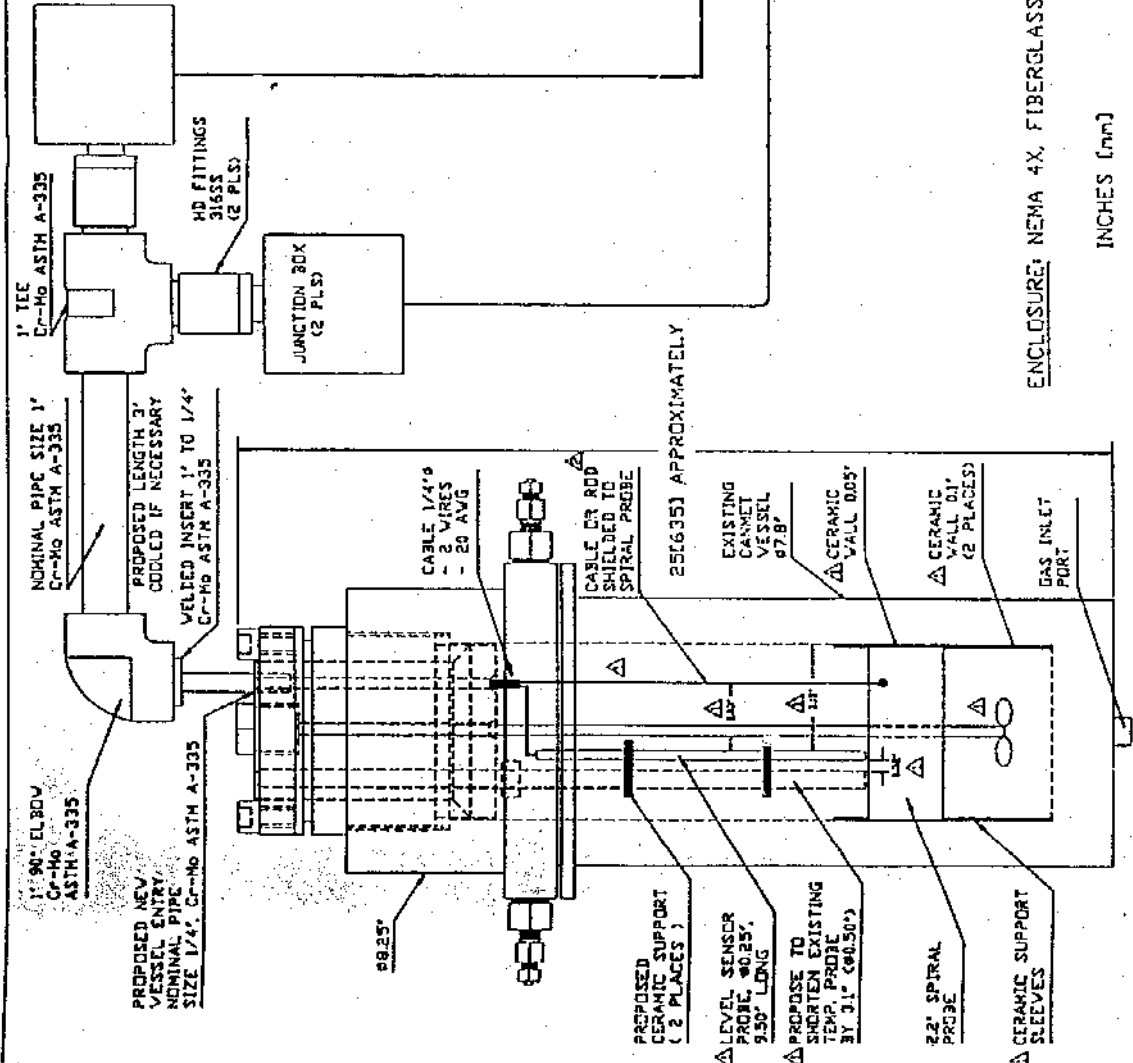


REV	DATE	DESCRIPTION	BY	APP'D

		PROJECT: CANMET
P.T.A. # 25 5 193	I.T.E. # 25 5 193	TITLE: VOID FRACTION CAPACITANCE SYSTEM FINAL ASSEMBLY
SCALE 1/8" = 1"	SHEET NO. 10	TOTAL SHEETS 10
93001700		1 0

ENCLOSURE: NEMA 4X, FIBERGLASS
 INCHES (mm)

25(635) APPROXIMATELY.



2 16/92	CHANGE REQUESTED BY C.M. HOGAN		
1 17/92	CHANGES REQUESTED BY C.M. HOGAN		
REV. DATE	DESCRIPTION	OK'D	APP'D
	REVISIONS		

PROJECT:		VOID FRACTION CAPACITANCE SYSTEM	
ARJAY ENGINEERING LIMITED		CANMET	
DATE	BY	DATE	BY
11/10/91	C. P.	11/10/91	
SCALE	1:1	SCALE	1:1
NO. OF SHEETS	1	NO. OF SHEETS	2
ENCLOSURE: NEMA 4X, FIBERGLASS		INCHES (mm)	
91C02100			

Drawings and Applications

Drawing No.	Title
91002100	Void Fraction Capacitance System - original design with ceramic inserts
93001700	Void Fraction Capacitance System Final Assembly - revised insert design as submitted
9300170	Void Fraction Sensor Assembly Detail - sensor assembly component dimensions as submitted

Product Notes

1. Corning Tubing and Rod	4 Pages
2. VMI Cable ordering numbers	1 Page
3. Assembly Procedure	1 Page
4. Assembly Procedure Letter (Mar29/93)	2 Pages
5. Packing List copy	1 Page
6. 9050 Manual	10 Pages
7. Disclosure Certificate	1 Page

Probe #1	Capacitance Reading with minimum gas hold-up	_____
Probe #1	Capacitance Reading with maximum gas hold-up	_____
Probe #2	Capacitance Reading with minimum fluid level in autoclave	_____
Probe #2	Capacitance Reading with maximum fluid level in autoclave	_____

Press "CALIB". The display will provide a menu of calibration options. Press "2" for manual calibration. The display will ask for the level in %. Enter 0.0 and press enter. The display will ask for the first point of capacitance. Enter the lowest capacitance reading that was obtained from the autoclave tests. Press enter.

The display will ask for a second % level. Enter 100% and press enter. Now enter the highest capacitance reading obtained. Press enter. Now press "DISPLAY" to return to the continuous display mode. The 4-20mA will be set up similar to one of the following arrangements.

- | | 4 mA | | 20 mA |
|----|-------|---|---------------------|
| A. | ----- | . | Level probe |
| | ----- | . | Void fraction probe |
| B. | ----- | . | Level probe |
| | ----- | . | Void fraction probe |
| C. | ----- | . | Level probe |
| | ----- | . | Void fraction probe |
| D. | ----- | . | Level probe |
| | ----- | . | Void fraction probe |

The software program design could allow for multiple calibrations and can accommodate the two different probe inputs. This special calibration feature is not part of the project, but could be initiated as a further project development.

Any questions or concerns regarding the project may be directed to:
 Greg Reeves
 Arjay Engineering Ltd.
 1-800-387-9487

The glass insert allows for a tube support for the bare 316SS level probe as well. When these two probes are connected to the instrumentation package, a complete integral monitoring package exists whereby the operator can switch between the Void Fraction Spiral probe or the vertical level probe.

Electronic Package

During the development stage of this project ARJAY Engineering Ltd. was, under separate development, incorporating micro-controller technology into its' capacitance instrumentation products. The resulting monitor actually alleviated much of the sensitivity concerns of the smaller probes that were imposed on the project. The unit can monitor small changes of capacitance with repeatable results. While initial testing was performed using alternative instruments, the final unit provided to Canmet was of the newer design.

The electronic package consists of one Model 9050 controller and two probe mounted pulse cards. Each pulse card monitors a designated sensor. A two way switch at the main control box allows the operator to manually determine which probe is to be monitored. Since the controller design is typically used for one probe to monitor tank levels, attention must be given to the calibration and operation for the purposes this research project.

Manual Capacitance Readings

The actual capacitance of the probe can be monitored and recorded to determine changes in the gas hold up or level.

Access the "diagnostics" of the unit through the FUNCTION key. This is a visual reading only of the sensor to which the controller is connected (via the selector switch).

Signal Output Control

A 4-20mA output signal is available for control and recording purposes. Since two probe inputs are being considered the zero and span 4 to 20mA may not necessarily correspond to the 0 to 100% of one probe.

That is, to set the 4mA, the lowest capacitance reading is required. The 20mA corresponds to the highest capacitance reading which may happen to be obtained from the other probe.

To set up the 4-20mA output record the following:

Technical Discussion

Details of Task 1 through 4 can be found within the Progress Reports submitted during the projects' progress. This discussion will concentrate on Task 5; the actual design considerations of the final probe. Tasks 1 through 4 provided a background of verification to determine that Task 5 would be a viable project if the sensor design constraints could be met.

Sensor Design

The original sensor design incorporated 5 sections of sensing probe. In a bubble column, each sensor surface area was significant enough to monitor a capacitance change due to gas hold up. Each sensor section was approximately 3 feet in length.

When the actual design characteristics were considered for Task 5 it was found that the sensor surface area was significantly smaller and did not produce a reliable, repeatable change. Actually, the sensor length was to be reduced from three feet to less than two inches each. Additionally, the sensor diameter was to be decreased from one half inch to one eighth inch. This decreased the actual surface area of the sensor from 56.54 square inches to .7854 square inches, or 98.6%. The substantial decrease in size was due to the requirement of operating the sensor in a small autoclave supplied by CANMET.

After discussion with Canmet, it was determined that the autoclave version did not require multiple probes and one probe would suffice. Also, a probe dedicated to liquid level only would aid in the data requirement of the model. ARJAY concentrated on these new parameters of a single probe in a small vessel. Under the circumstances of a large tower, the multi-sensor probe could be used if further developments for research or commercial requirements demanded.

To increase the surface area of the sensor while minimizing the height of the probe, the spiral probe design was designed as discussed in the Task 4 report. The support system was a concern because the spiral assembly could not touch the autoclave wall. This would "ground out" the probe rendering it useless. Originally a ceramic support assembly was discussed and adopted for production but disbanded after Canmet suggested build up and coating problems were prevalent in the vessel.

The resulting material of choice was the finalized PYREX insertion. ARJAY reviewed the requirements with PEGASUS BIOTECHNOLOGY who have had experience in PYREX applications and design functions. Diagram 93001701 provides an overview of the glass insert used.

Executive Summary

The following is, in part, from the "Statement of Work" as provided in the original contract by CANMET.

The program is to further test and optimize the very preliminary design and construct and test a prototype for operation at hydrocracking conditions. The program was divided into tasks.

A brief summary by Task Number is recorded as follows.

Task 1. A cradle system of multiple sensors attached to a bubbler column initiated this project. The ARJAY Capacitance level monitor (Model 8370) was used to retrieve various readings from the sensors. Results were positive in finding a relationship between gas hold up and capacitance.

Task 2. A multiple sensor probe was designed by ARJAY to allow complete submersion into the bubble column. Under these physical conditions, the ARJAY capacitance monitor was able to record linear relationships between gas hold up and capacitance.

Task 3 & 4. Continued tests by the University of Waterloo using Varsol and air provided data on various correlations that confirmed the potential benefits a completed model would have.

Task 5. Various considerations of the actual end use of a Void Fraction Meter altered the original probe design significantly during this stage. Since the probe was to be used in a small autoclave, space restrictions and probe sizes reduced the physical design ability and output strength of the sensor.

It was determined that a two probe system would be used.

One probe would be used for gas hold up measurement and the second probe would monitor actual level. The reading strength was increased, however, the physical demands of space, temperature, and pressure required the sensor fittings to be mounted remote from the autoclave cap using a pipe extension. Water cooling of the pipe and fittings will allow the fittings to maintain the pressure rating.

Although the sensor design went through several design changes, it is felt that the final model will serve the original parameters of providing a usable reading of gas hold up within a high pressure/high temperature autoclave.

Eventual refinements to the model would make this a commercially viable Void Fraction Meter.

The probe and electronics are now with Canmet for design refinements and testing under actual autoclave operating conditions.

The research and development portion of this contract by ARJAY Engineering Ltd. is complete. This report describes the physical and operational aspects of the Void Fraction Monitor provided to CANMET.