

# The JLab *Pansophy* System

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# Pansophy

- In anticipation of both the CEBAF 12 GeV Upgrade project as well as the desire to enable better learning from R&D tests, a small effort was launched in 1999 to bring the convenience of modern web-based MIS tools to bear on the production and testing of SRF cavities and cryomodules.
- **Chief system requirements:**
  - One system used for all SRF projects at JLab
  - Content and structure is driven by technical project owners
  - Useful for capturing and tracking version-controlled procedures
  - Useful for enabling project QA
  - Useful for logging and tracking QC data
  - Useful for capturing and accessing all collected relevant data
  - Open for user-driven data analysis and “mining”
  - Robustly secured and maintainable
  - Low overhead

# Pansophy

*Pansophy* is now in full operation.

- The chief vehicles of the implementation of *Pansophy* are template-derived MS-Word files composed and approved by the responsible technical staff.
  - These **Travelers** contain, either directly or via imbedded hyperlinks, all necessary instructions (including drawings and reference procedures) for accomplishing the described work.
  - They also define the data to be acquired during execution of the work by entry fields and/or file uploads.
  - From these Travelers, *Pansophy* automatically creates the required Oracle™ database tables based on the data fields called-for therein.
  - Scripts transform the MS-Word files into Cold Fusion™ web-based forms with SQL writes and reads.

# Pansophy

## Travelers, continued

- Other than the composition of the travelers, all user interactions with *Pansophy* are via the web.
  - Completed travelers are browsable with the same procedures presented as during use, but with data-fields populated via live queries.
  - A variety of user-controlled query tools are also available.
- Project-specific **report** forms have been constructed which imbed systematic queries for repeated use.
  - Over 200 travelers were composed and used for the SNS cavities and cryomodules.
  - 54 travelers are in use supporting the CEBAF "C50" cryomodule rework project.
  - 70 travelers have been used for cavities & cryomodules in preparation for the 12 GeV Upgrade project.
- The development of *Pansophy* has been documented in the PAC '01, '03, '05, & SRF2007 proceedings, as well as ICALEPCS 2001.
- The JLab SRF Processes and Materials group in the SRF Institute includes in its mission the maintenance and development of *Pansophy* for JLab use.

# Pansophy


## Homepage

Pansophy - Mozilla Firefox

File Edit View Go Bookmarks Tools Help

http://pansophy.jlab.org/pansophy/

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 **Pansophy**  
A System of Universal Knowledge

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<b>Travelers</b>	<b>Logbooks</b>	<b>Support</b>	<b>DocuShare</b>
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- CEBAF
- FEL
- W.F.O.
- SRF
- Traveler Lists

- BNL
- SNS
- ILC

### Welcome to Pansophy

- Input Data Into Traveler
- View Data Pages
- View Data Traveler (Print)
- Query Database
- VTRF Graph

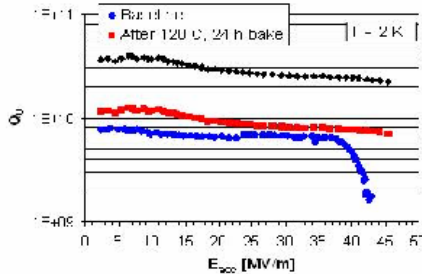
Pansophy is a database driven, web-based application for the collection and storage of data from various environments.

Using Travelers, staff members can define and control a process, and collect and stores data for future use.

In addition to the Traveler area, which is broken down into project sections and includes query functions, Pansophy also allows for the recording and recalling of information more informally in a variety of areas. These include Logbooks, QC/QA, VTA Project, and a link to DocuShare for document cataloging and storage.

#### Latest Test Results

Large Grain Nb cell cavity test, JLab/CBMM Technology  
LL Cavity 2.3GHz  
Epeak / Eacc = 2.072  
Hpeak / Eacc = 3.56 mT/M/m



Click the thumbnail for a full-size PDF

On Call: x | Home | DocuShare | Help | Contact Us | Administration Area

Done

# Pansophy

## Example: ILC EP Traveler

This view recalls a particular "instantiation" of this traveler, i.e. one particular use.

The screenshot shows the Pansophy web application interface. The browser window title is "index.htm - Mozilla Firefox". The address bar shows the URL: "https://pansophy.jlab.org/pansophy/projects/viewdata/TravelerForm.cfm?project=1". The page header includes the Pansophy logo and the text "A System of Universal Knowledge". A navigation menu contains "Travelers", "Logbooks", "Support", and "DocuShare". The main content area is titled "ILC Data View". A "Select Traveler" dropdown menu is open, showing a list of travelers with columns for ID, Name, and Status. The selected traveler is "27 AES 2 Op". Below the dropdown, the page shows "Page 0" and "Next" and "Last" buttons. The main content area displays the title "Electropolish Procedure 9-cell cavity" and a description: "This procedure covers performing electropolishing, water rinsing, cavity removal from the EP and a 9-cell cavity into its alignment cage. This procedure is intended for training and reference as well as daily use." Below the description is a table with three columns: "Revision:", "Date Released:", and "Technical Custodian:". The table contains the following data:

Revision:	Date Released:	Technical Custodian:
R1-0	5-Sep-06	J. Mammosser

The footer of the page contains the text "On Call: x | Home | DocuShare | Help | Contact Us | Administration Area". The browser status bar shows "Done" and the URL "pansophy.jlab.org".

# Pansophy

Example:

ILC EP Traveler  
AES3 1 Oct 2007  
Page 1

index.htm - Mozilla Firefox

File Edit View Go Bookmarks Tools Help

https://pansophy.jlab.org/pansophy/projects/viewdata/TravelerForm.cfm?project=... browsable

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Travelers Logbooks Support DocuShare

ILC  
Data View

Page 1

First Previous Next Last

SerialNum: AES3 ILC-CHEM-EP R1-0 Pg: 1 SeqNum: 26

### Electropolish Procedure 9-cell cavity

**Abstract-** This procedure covers performing electropolishing, water rinsing, cavity removal from the EP tooling and inserting a 9-cell cavity into it alignment cage.

**Procedure Use:** This procedure is intended for training and reference as well as daily use

Document #	Revision:	Date Released:	Technical Custodian:
ILC-CHEM-EP	R1-0	5-Sep-06	J. Mammosser

Step No.	Instructions	Data Input
	Procedure used for training or production?	Procedure Use <input type="radio"/> Training <input checked="" type="radio"/> Production
1	Record operators, process date and time and cavity label	Cavity Label <input type="text" value="AES3"/> CavUsers <input type="text" value="bgolden"/> CavUsers <input type="text" value="dbice"/> CavUsers <input type="text" value="-0-"/> Timestamp <input type="text" value="01-Oct-2007 11:50"/> <input type="button" value="NOW"/> (ex format 18-Jun-2005 16:30)

On Call: x | Home | DocuShare | Help | Contact Us | Administration Area

Done pansophy.jlab.org

# Pansophy

Example:

ILC EP Traveler  
AES3 13 Apr 2007

Page 8

The screenshot shows a web browser window with the following details:

- Browser: Mozilla Firefox
- Address Bar: <https://pansophy.jlab.org/pansophy/projects/viewdata/TravelerForm.cfm?project=ILC>
- Page Title: ILC Data View
- Navigation: Page 8, First, Previous
- Table Headers: SerialNum: AES3, ILC-CHEM-EP R1-0, Pg:8, SeqNum: 13
- Table Columns: Step No., Instructions, Data Input

Step No.	Instructions	Data Input
27	Don PPE and open cabinet door, rinse cavity and hardware surfaces with DI water hand gun. Then remove cavity holding carriage from the cabinet.	Comment <input type="text"/>
28	Remove rotary end sleeve flange and remove cathode from cavity	Cathode removal <input type="text"/>
29	Insert cavity holder fixtures and release cavity end clamps and blank cavity flanges with clean blankoffs. Record time all flanges blanked	Timestamp 13-Apr-2007 15:47 <input type="button" value="NOW"/> (ex format 18-Jun-2005 16:30)
29	Remove cavity from EP tooling and insert cavity into cage and align	cavity aligned <input type="checkbox"/>
30	Transport cavity to chemroom for US degreasing	Timestamp 13-Apr-2007 15:47 <input type="button" value="NOW"/> (ex format 18-Jun-2005 16:30)
31	Record additional process run details, upload process data and record identified repairs or improvements needed	Run Comments thermal couples a on fp end beampipe, b center cell equator, c fpc end beampipe  Run Data file <input type="text"/> <input type="button" value="Browse..."/> (041307EP_AES3.txt) (no special chars for filename)



# Pansophy

## ILC EP Traveler – User-selected query

index.htm - Mozilla Firefox

File Edit View Go Bookmarks Tools Help

https://pansophy.jlab.org/pansophy/projects/query/UserDefined2.cfm?project=ILC&area=ILC&traveler=ILC-CHEM-EP&revnum=R1-0

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Travelers Logbooks Support DocuShare

**Query Menu**

Enter Search Value

SerialNo  
CavityId  
VendorId

Enter Search Value

Enter Label

LabelId

Variable Grid  
User Defined  
Cross-Revision  
Cross-Traveler

List Travelers

Choose One

Choose a Project

Choose a Project

Choose a Project

Choose a Project

open closed all

List Travelers

open closed all

List NCRs

**User Defined Query - (ILC-CHEM-EP-R1-0)**  
Select checkboxes of Variables to be used in Query

Page 1	Query	Page 2	Query	Page 3	Query	Page 4	Query	Page 5	Query	Page 6	Query	Page 7	Query	Page 8	Query
Procedure Use	<input type="checkbox"/>	Cavity type	<input type="checkbox"/>	Cathode Details	<input type="checkbox"/>	Electrolyte history	<input type="checkbox"/>	Timestamp	<input type="checkbox"/>	polish time (min)	<input checked="" type="checkbox"/>	Timestamp	<input type="checkbox"/>	Comment	<input type="checkbox"/>
Cavity Label	<input checked="" type="checkbox"/>	Purpose of run	<input type="checkbox"/>	Date installed	<input type="checkbox"/>	Sump level %	<input type="checkbox"/>	Flow rate(lpm)	<input checked="" type="checkbox"/>	Voltage	<input checked="" type="checkbox"/>	drain time (sec.)	<input type="checkbox"/>	Cathode removal	<input type="checkbox"/>
p1sel1	<input type="checkbox"/>	Degreased	<input type="checkbox"/>	p3sel1	<input type="checkbox"/>	HF added (liters)	<input type="checkbox"/>	leak details	<input type="checkbox"/>	Current	<input checked="" type="checkbox"/>	Voltage on	<input type="checkbox"/>	Timestamp	<input type="checkbox"/>
p1sel2	<input type="checkbox"/>	BCP	<input type="checkbox"/>	p3sel2	<input type="checkbox"/>	Fill and dumps	<input type="checkbox"/>	Sump Temp1 (C)	<input type="checkbox"/>	Timestamp	<input type="checkbox"/>	Timestamp	<input type="checkbox"/>	cavity aligned	<input type="checkbox"/>
p1sel3	<input type="checkbox"/>	EP	<input type="checkbox"/>	Cavity mounting details	<input type="checkbox"/>	Sump Temp	<input type="checkbox"/>	Inlet Temp1 (C)	<input type="checkbox"/>	Process setup	<input type="checkbox"/>	Timestamp	<input type="checkbox"/>	Timestamp	<input type="checkbox"/>
Timestamp	<input checked="" type="checkbox"/>	HPR only	<input type="checkbox"/>	Checklist completed	<input type="checkbox"/>	Rotation No.	<input type="checkbox"/>	Outlet Temp1 (C)	<input type="checkbox"/>	Sump Temp2 (C)	<input type="checkbox"/>	Final pH	<input type="checkbox"/>	Run Comments	<input checked="" type="checkbox"/>
		Prior surface cleaning notes	<input type="checkbox"/>			pH rinse value	<input type="checkbox"/>	IV curve	<input type="checkbox"/>	Inlet Temp2 (C)	<input type="checkbox"/>	Timestamp	<input type="checkbox"/>	Run Data file	<input checked="" type="checkbox"/>
		RF tested	<input type="checkbox"/>			Sweep voltage	<input type="checkbox"/>			Outlet Temp2 (C)	<input type="checkbox"/>	Air handler on	<input type="checkbox"/>	Repairs identified	<input type="checkbox"/>
		Prior RF test notes	<input type="checkbox"/>			Sweep time	<input type="checkbox"/>			Timestamp	<input type="checkbox"/>				
		Cavity frequency RT	<input type="checkbox"/>			Number of samples	<input type="checkbox"/>								
		p2file1	<input type="checkbox"/>												

Submit

On Call: x | Home | DocuShare | Help | Contact Us | Administration Area

Done pansophy.jlab.org

# Pansophy

## User-selected query

### Example:

Response screen to preceding query

ILC EP Traveler

Entry in “Raw Data file” column is hyperlink to data acquired during EP run. User does what (s)he likes with in in e.g. Excel.

The screenshot shows the Pansophy web application interface. At the top, there is a navigation bar with links for Travelers, Logbooks, Support, and DocuShare. Below this is a "Query Menu" section with various search and filter options. The main content is a table titled "User Defined Query" with the following columns: SeqNo, Cavity Label, Timestamp, Flow rate (lpm), polish time (min), Voltage, Current, Run Comments, and Run Data file. The table contains 13 rows of data, each representing a different EP run. The "Run Data file" column contains hyperlinks to data files, such as "112006EP\_data.bt" and "041307EP\_AES3.bt".

SeqNo	Cavity Label	Timestamp	Flow rate (lpm)	polish time (min)	Voltage	Current	Run Comments	Run Data file
1	LL004	2006-11-20 14:37:00.0	10	150	14	147	Cleanup after leak, soaped down entire setup and all tooling	<a href="#">112006EP_data.bt</a>
2	A006	2006-11-28 11:18:00.0	10	51	14	330	all went fine, current was higher then normal	<a href="#">112806EP_data.bt</a>
3	A007	2006-12-06 14:08:00.0	10	50	17	200		
4	A006	2007-01-09 14:52:00.0	10	50	17	300		<a href="#">010907EP_data.bt</a>
5	A6	2007-01-30 18:27:00.0	10	50	17	308		<a href="#">013007EP_data.bt</a>
6	AES1	2007-02-21 15:14:00.0	10	100	19	240	need to look at this surface when dry before proceeding	<a href="#">022107AES1_data.bt</a>
7	AES1	2007-02-27 15:10:00.0	10	75	17	200		<a href="#">022707EP_AESb.bt</a>
8	A7	2007-03-01 14:15:00.0	10	50	17	300		
9	AES1	2007-03-15 13:12:00.0	10	50	17	100	cavity lift cylinder did not activate, had to clean ac contacts, cavity had acid in it for 30 minutes before draining	
10	AES2	2007-03-29 09:35:00.0	10	330	17	240		<a href="#">032907EP_AES2.bt</a>
12	AES1	2007-04-05 15:30:00.0	10	50	17	302		
13	AES3	2007-04-13 07:41:00.0	10	330	14	320	thermal couples A on fp end beampipe, b center cell equator, c fpc end beampipe	<a href="#">041307EP_AES3.bt</a>

# Pansophy

## Reports

- C50 examples – summary tables link to lower details

**Cryomodule Performance Report**

Cryomodule Serial Number: C50\_CM\_001

Buttons: OPERATIONS, **CMTF-ACC**, COM-TEST, CM ASSY

Cryomodule Location: NLD5

Cryomodule: Acceptance | Commissioning

Final Beamline Vacuum (torr): 8.7e-11

Final Insulating Vacuum (torr): 8.4e-7

Primary Static Heat Load (W): 12.4

Cavity	Location	1	2	3	4	5	6	7	8
Serial Number		ia016	ia010	ia082	ia079	ia070	ia091	ia077	ia078
Final Waveguide Vacuum (torr)	Commissioning								
	Acceptance	1.9e-8		6.2e-9		9e-9		6.7e-9	
Emaxop (MV/m)	Commissioning	13.6	12.2	12.8	11.2	12	11.5	15.5	13.1
	Acceptance	12.7	12	10.1	12.9	11	11.6	15.9	12
Emax (MV/m)	Commissioning	13.9	12.5	13.8	11.8	12.5	14.4	15.9	13.8
	Operational Limit	Commissioning	quench	quench	waveguide vacuum	quench	window temperature	waveguide vacuum	quench
Emax (MV/m)	Acceptance	13.3	12.4	13.3	15.1	13	14.8	16.1	12.4
	Operational Limit	Acceptance	warm window flange		waveguide		waveguide		

Field Emission Threshold (MV/m) Commissioning

Field Emission Threshold (MV/m) Acceptance

Qo at 12.5 MV/m Commissioning

Qo at Emaxop Commissioning

Qo/FE Graphs Commissioning

Qo at 12.5 MV/m Acceptance

Qo at Emaxop Acceptance

Qo/FE Graphs Acceptance

Qext (Fundamental Power Coupler) Commissioning

Qext (Field Probe) Commissioning

Acceptance

Lorentz Force Detuning (Hz / MV) Commissioning

Pressure Sensitivity (Hz / torr) Commissioning

Acceptance

Mechanical Tuners lower freq lin

upper freq lin

2 kHz or 4kHz

Frequencies f0 @ 2.4

f(pi) @ 2.4

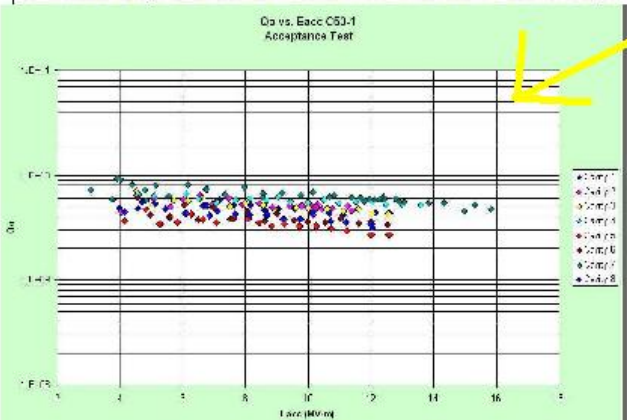
f(3pi/4) @ 2.4

f(2pi/4) @ 2.4

f(pi/4) @ 2.4

82 Upload the Qo vs. Eacc plot for all eight cavities (in pdf format).

83 Record the Qo vs. Eacc curvefit information for each cavity.



All Cavity Qo Graph

Qo C50\_01\_all.pdf  
(no special chars for filename)

Curvefit 1:  $Q_0 = -2.7456e7 + 3.9587e8 * E + 3.9725e9; 4.0 <= E <= 12.6$

Curvefit 2:  $Q_0 = -4.457e7 * E^2 + 5.9199e8 * E + 3.902e9;$

Curvefit 3:  $Q_0 = 1.5746e7 * -4.627e8 * E + 8.0576e9; 4.6 <= E <= 12.6$

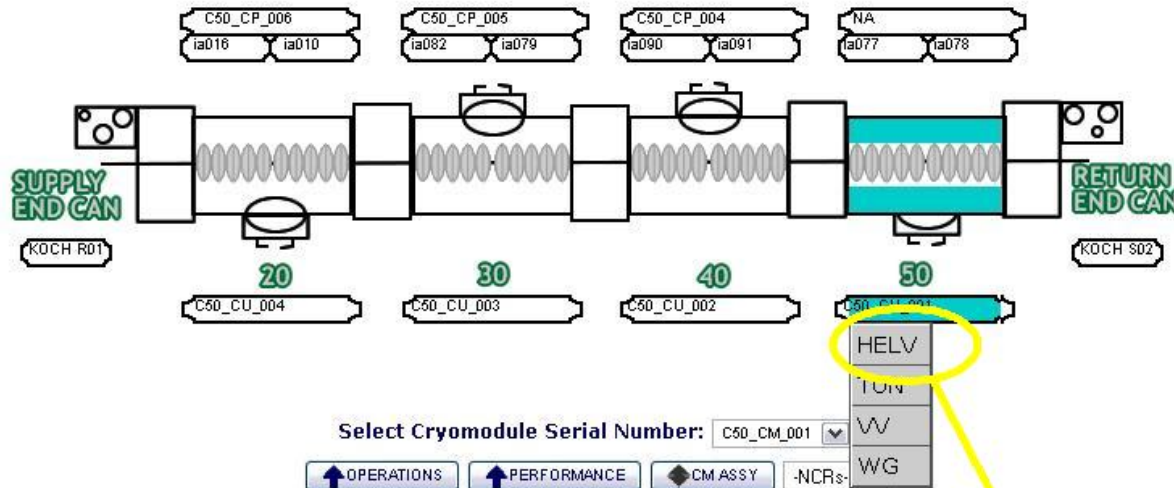
$Q_0 = 5.1699e6 * -1.7117e8 * E +$

# Pansophy

## Reports

### C50 Cryomodule Assembly Report

- **C50 examples** – reports enable “drill down” from completed assembly to smallest detail of traveler.



15 **Install co-axial cables and supports. Perform a TDR check on all connections. Record findings.**

**Comment**  
all TDR'S in same file.

**Cursor** ..... 8.340 ft/s  
Distance/Div ..... 2 ft/div  
Vertical Scale ..... 500 mV/div  
VP ..... 0.69  
Noise Filter ..... 1 avr  
Power ..... ac

**Cursor** ..... 8.040 ft/s  
Distance/Div ..... 1 ft/div  
Vertical Scale ..... 500 mV/div  
VP ..... 0.69  
Noise Filter ..... 1 avr  
Power ..... ac

**Tektronix 1502B TDR**  
Date 5-4-06  
Cable C50-01  
Notes CU-20  
Input Trace  
Stored Trace  
Difference Trace

**Tektronix 1502B TDR**  
Date 5-4-06  
Cable C50-1  
Notes Right cable  
CU-20  
Input Trace  
Stored Trace

(no special chars for filename)

Technician HW

Date 22-May-2006  
(e: date format 18-jun-2005)

Left

(TDR HELIUM VESSEL.bmp)  
(no special chars for filename)

Right

# Pansophy

## Reports

- C50 examples – dynamic navigation with imbedded queries

**C50 Cavity Pair Report**

Select Cavity Pair SerialNo: C50\_CP\_004

Rev No: R1-0  
106-05-15 11:00:00.0  
Back: F12 STBK

Assembly  
All Travelers  
NCRs  
Doglegs

UPPER Cavity  
LOWER Cavity  
Cavity Pair  
Assembly  
Inspections  
CMPL  
EVAC  
STKU  
STBK  
TSTD  
TOVR

↑ OPERATIONS   ↑ PERFORMANCE   ↑ CMASSY

All travelers related to the particular cavity pair assembly are found and dynamically placed into fly-out menus for convenient user access.

# Pansophy

## Reports

- **C50 examples** – mouse-over component leads to assembly traveler, leads to leak check detail, all from live queries

SerialNum: 7305

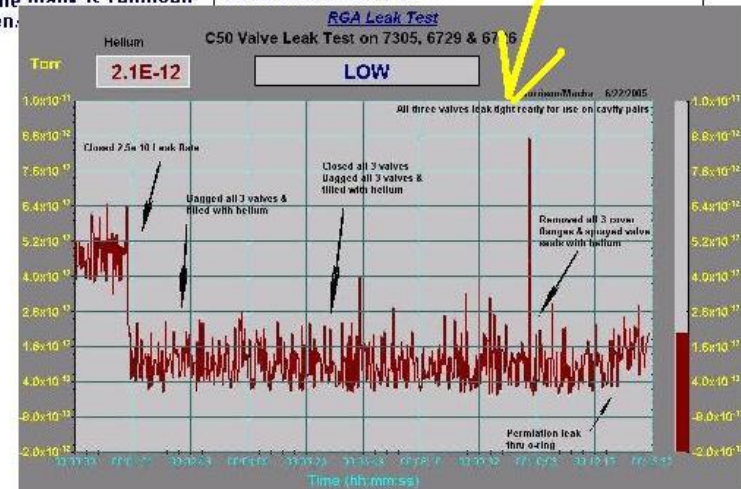
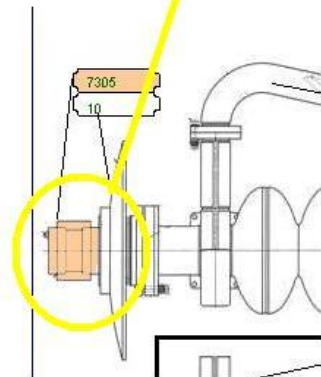
C50-CPR-ASSY-ENDD1 R1-0

SeqNum: 7

### Dish and Valve Sub-Assembly Traveler

**Abstract-** The purpose of this traveler is to capture data about the sub-assembly process of the dish and valve assembly. This will also provide a place to capture leak testing data.

Step No.	Instructions	Data Input
1	<p>Clean Valve components for ultra high vacuum as per procedure #CP-C-50CU' LV-CLN</p> <p>Bake-out valve components as per procedure #11151-A-9.10.2</p> <p>Assemble and leak test MDC valve using procedure #11151-A-9.10.4</p> <p>Note: When assembling the valve onto the manifold for leak test, ensure the seal plate is on the blank side of the valve. In other words pump on the guts of the valve so when the blank is removed air pressure is trying to push the seal plate open.</p>	<p>SerialNo <input type="text" value="7305"/></p> <p>Valve Serial Number</p> <p>Upload File <input type="text"/> <input type="button" value="Browse..."/></p> <p>(C50 Valve Leak Test on 7305, 6729 &amp; 6726.jpg) (no special chars for filename)</p> <p>Leak Test Chart File</p>



# Pansophy

## Correlations with Environmental Data

Background logged data can be associated with a particular operation via time stamps in travelers.

### Example:

Correlation of Traveler data with Cleanroom Air Particle Data

The screenshot displays the Pansophy Environmental Data interface. At the top, it shows the title "Environmental Data, Selected Date/Time Range" and a date range of 10/18/2007. Below this, there are dropdown menus for selecting data fields: "fine3 (Class 10 Room fine (>=3 microns) count)", "coarse3 (Class 10 Room coarse (>= 5 microns) count)", "flow3 (Class 10 Room relative airflow)", and "status3 (Class 10 Room status)".

The main area is divided into two panels. The left panel shows a table with columns for "TIME\_STAMP", "coarse3", and "fine3". A blue arrow points from a row in this table to the right panel. The right panel shows a line graph with a Y-axis ranging from 0 to 28. The graph displays two data series: "coarse3 (Class 10 Room coarse (>= 5 microns) count)" and "fine3 (Class 10 Room fine (>=3 microns) count)". A sharp peak is visible in the graph, corresponding to the time stamp 10/18/2007 10:08:37 in the table.

Below the graph, there is a "Travelers" section with a table of traveler data. A black arrow points from the "Travelers" section to the graph, indicating the correlation between the traveler data and the environmental data.

TIME_STAMP	coarse3	fine3
10/18/2007 10:00:05	0	2
10/18/2007 10:01:09	0	2
10/18/2007 10:02:13	0	0
10/18/2007 10:03:17	0	1
10/18/2007 10:04:21	0	0
10/18/2007 10:05:25	0	0
10/18/2007 10:06:29	0	0
10/18/2007 10:07:33	0	0
10/18/2007 10:08:37	1	2
10/18/2007 10:09:41	0	0
10/18/2007 10:10:45	0	0
10/18/2007 10:11:49	0	3
10/18/2007 10:12:53	0	0
10/18/2007 10:13:57	0	0
10/18/2007 10:15:01	0	0
10/18/2007 10:16:05	0	0
10/18/2007 10:17:09	1	1
10/18/2007 10:18:13	0	0
10/18/2007 10:19:17	0	1
10/18/2007 10:20:21	0	0
10/18/2007 10:21:25	0	0
10/18/2007 10:22:29	0	0
10/18/2007 10:23:33	0	0
10/18/2007 10:24:37	0	1
10/18/2007 10:25:41	0	0
10/18/2007 10:26:45	0	0

# Pansophy

## Comments from use:

- There is no substitute for clear, thoughtful work planning that is subsequently captured in the traveler composition.
  - This is the hardest work.
  - Else, GIGO.
  - Technology now makes access to data very easy, provided it is thoughtfully constructed.
  - *Pansophy* puts the burden of “thoughtfulness” on the responsible scientist or process engineer composing the traveler, the rest is relatively easy and efficient.
  - The Pansophy system is primarily a toolkit placed in the hands of the technical staff.
- Essentially **all** of the development and implementation of the Pansophy toolkit has been accomplished by two persons: Valerie Bookwalter and Bonnie Madre. Hiding the sweat, they make it look easy.



# Pansophy

- "A System for Managing Critical Knowledge for Accelerator Subsystems: *Pansophy*," C. Reece, V. Bookwalter and B. Madre, PAC2001.
- "The Jefferson Lab Quality Assurance Program for the SNS Superconducting Linac Accelerator Project," J. P. Ozelis, PAC2003.
- "Utilization of Integrated Process Control, Data Capture and Data Analysis in Construction of Accelerator Systems," V. Bookwalter, B. Madre, J. P. Ozelis, C. Reece," PAC2003.
- "The Use of Integrated Electronic Data Capture and Analysis for Accelerator Construction and Commissioning: *Pansophy* from the SNS Towards the ILC," Bookwalter, V.; Madre, B.; Ozelis, J.P.; Reece, C.E., PAC2005.
- "Flexible application of the JLab *Pansophy* Information System for Project Reports, Process Monitoring, and R&D Sample Tracking," V. Bookwalter, B. Madre, C. Reece," SRF2007.