DISTRIBUTION SHEET

To DISTRIBUTION	From DC LARSEN	Page 1 of 1
		Date Nov 30, 1994
Project Title/Work Order ENGINEERING TEST PLAN FOR TANK 241-101-SY IN SITU VISCOMETER, REV 2 (WHC-SD-WM-TP-219)		EDT No. N/A
		ECN No. 617085

Name	MSIN	Text With All Attach.	Text Only	Attach./ Appendix Only	EDT/ECN Only
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Central Files (2)	L8-04	X			
OSTI (2)	L8-07	X			
RE BAUER	L6-37	X			
GT BEAR	R1-51	X			
JL DEICHMAN	H4-19				X
GL DUNFORD	R2-36				X
LE EFFERDING	H0-33	X			
JM GRAY	S7-54	X			
CE HANSON	H5-09				X
R JOHNSON	H5-09	X			
GD JOHNSON	R2-78				X
NW KIRCH	R2-11				X
LS KROGSRUD	R3-08	X			
DC LARSEN (5)	R1-51	X			
JW LENTSCH	R2-78	X			
ML MCELROY	S1-57	X			
DR NUNAMAKER (2)	T4-07	X			
FE PANISKO	P8-34	X			
MA PAYNE	R2-50				X
RW REED	R1-51	X			
SH RIFAAY	S6-12				X
MH SHANNON	H4-61				X
RG SOBOCINSKI (2)	H5-09	X			
TI STOKES	H5-09	X			
Waste Tank Operations Shift Office	T4-01	X			

K PASAMEHMETOGLU

PO BOX 1663
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ENGINEERING CHANGE NOTICE

Page 1 of 4

1. ECN NO 617085

Proj.
ECN

2. ECN Category (mark one) Supplemental ☐ Direct Revision ☒ Change ECN ☐ Temporary ☐ Standby ☐ Supersedeure ☐ Cancel/Void ☐		3. Originator's Name, Organization, MSIN, and Telephone No. DC LARSEN, Test Engineering, R1-51, 373-5995		4. Date Nov 30, 1994										
		5. Project Title/No./Work Order No. HYDROGEN MITIGATION	6. Bldg./Sys./Fac. No. 241-SY-101	7. Impact Level SQ										
		8. Document Numbers Changed by this ECN (includes sheet no. and rev.) WHC-SD-WM-TP-219, Rev 1-A	9. Related ECN No(s). N/A	10. Related PO No. N/A										
11a. Modification Work [] Yes (fill out Blk. 11b) [X] No (NA Blks. 11b, 11c, 11d)		11b. Work Package No. N/A	11c. Modification Work Complete N/A _____ Cog. Engineer Signature & Date	11d. Restored to Original Condition (Temp. or Standby ECN only) N/A _____ Cog. Engineer Signature & Date										
12. Description of Change Transferred procedural responsibilities of the Test Supervisor to the Test Director. Added minor technical clarifications and additional equipment identifiers.														
13a. Justification (mark one) <table border="0"> <tr> <td>Criteria Change []</td> <td>Design Improvement [X]</td> <td>Environmental []</td> </tr> <tr> <td>As-Found []</td> <td>Facilitate Const. []</td> <td>Const. Error/Omission []</td> </tr> <tr> <td></td> <td></td> <td>Design Error/Omission []</td> </tr> </table>						Criteria Change []	Design Improvement [X]	Environmental []	As-Found []	Facilitate Const. []	Const. Error/Omission []			Design Error/Omission []
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13b. Justification Details Responsibility for performance of testing transferred from Special Projects to Test Engineering. Minor technical clarifications provided by cognizant engineer after first use of procedure in-field.														
14. Distribution (include name, MSIN, and no. of copies) See attached distribution sheet				RELEASE STAMP OFFICIAL RELEASE BY WHC DATE DEC 06 1994 <i>Ata 4</i>										

ENGINEERING CHANGE NOTICE				Page 2 of 24	1. ECN (use no. from pg. 1) 617085																																																																																																
15. Design Verification Required ☐ Yes ☒ No	16. Cost Impact <table style="width: 100%; border: none;"> <tr> <td colspan="2" style="text-align: center; border-bottom: 1px solid black;">ENGINEERING</td> <td colspan="2" style="text-align: center; border-bottom: 1px solid black;">CONSTRUCTION</td> </tr> <tr> <td style="width: 25%;">Additional</td> <td style="width: 25%;">☐ \$ N/A</td> <td style="width: 25%;">Additional</td> <td style="width: 25%;">☐ \$ N/A</td> </tr> <tr> <td>Savings</td> <td>☐ \$ N/A</td> <td>Savings</td> <td>☐ \$ N/A</td> </tr> </table>			ENGINEERING		CONSTRUCTION		Additional	☐ \$ N/A	Additional	☐ \$ N/A	Savings	☐ \$ N/A	Savings	☐ \$ N/A	17. Schedule Impact (days) Improvement ☐ Delay ☐																																																																																					
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18. Change Impact Review: Indicate the related documents (other than the engineering documents identified on Side 1) that will be affected by the change described in Block 12. Enter the affected document number in Block 19.																																																																																																					
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UNREVIEWED SAFETY QUESTION SAFETY REVIEW FORM
(Per WHC-IP-0842, 15.9)

Page 1 of 2

REFERENCE DOCUMENT(S):

ECN No. 617085

PCA No. na

Work Pkg No. na

Other (Specify) WHC-SD-WM-TP-219

TITLE: ENGINEERING TEST PLAN FOR TANK 241-101-SY IN SITU VISCOMETER, REV 2 (WHC-SD-TP-219)**AUTHORIZATION BASIS:**

The authorization basis for the screening will be the "Hanford Site Tank Farm Facilities Interim Safety Basis, WHC-SD-WM-ISM-001, Rev.0", referred to as the ISB. Tank 241-SY-101 is on the Flammable Gas Watch List. A viscometer testing activity is planned for this tank to obtain in situ measurements of the rheological properties within the tank waste. All safety requirements as defined in the Safety Assessment for the Proposed Pump Operation to Mitigate Episodic Gas Releases in Tank 241-SY-101 LAUR-92-3196, Rev. 13, referred to as the SA, have been implemented into this procedure. The new proposed change transfers Test Supervisor responsibilities to a Test Director and adds minor technical clarifications and additional equipment identifiers.

Does the PROPOSED CHANGE:**A. Represent a change to the facility as described in the AUTHORIZATION BASIS documentation?**☐ N/A ☒ No ☐ Yes/Maybe

Basis: The above mentioned reference item was evaluated with the authorization basis. All safety requirements as defined in the SA, LAUR-92-3196 Rev. 13, have been implemented into this procedure. The proposed change serves to clarify and provide an additional margin of safety for viscometer installation, operation, and removal.

B. Represent a change to procedures as described in the AUTHORIZATION BASIS?☐ N/A ☒ No ☐ Yes/Maybe

Basis: The above mentioned reference item was evaluated with the authorization basis. The proposed change is motivated by a concern for additional supervisory control.

C. Represent a test or experiment not described in the AUTHORIZATION BASIS documentation?☐ N/A ☒ No ☐ Yes/Maybe

Basis: Same basis as in Part A above.

D. Does the change impact:• Implemented OSRs or IOSRs? ☐ N/A ☒ No ☐ Yes/Maybe• Approved IOSR Compliance Implementation Plans? ☐ N/A ☒ No ☐ Yes/Maybe

Basis: None of the OSRs or IOSRs place any limits on additional supervisory controls or technical clarifications and equipment identifiers.

Based on the above, a Safety Evaluation ☐ DOES ☒ DOES NOT
need to be performed for this change

UNREVIEWED SAFETY QUESTION SAFETY REVIEW FORM
(Continued)

USQE No. 1 Gregory J. Gauck

Print Name

USQE No. 2 Andrew E. Wilder

Print Name

Signature Gregory J. Gauck

Date 6 Dec. 1994

Signature A E Wilder

Date 6 Dec 94

RELEASE AUTHORIZATION

Document Number: WHC-SD-WM-TP-219, REV 2

Document Title: ENGINEERING TEST PLAN FOR TANK 241-SY-101 IN SITU
VISCOMETER

Release Date: 12/6/94

**This document was reviewed following the
procedures described in WHC-CM-3-4 and is:**

APPROVED FOR PUBLIC RELEASE

WHC Information Release Administration Specialist:

Kara M. Broz

December 6, 1994

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A-6001-400.2 (09/94) WEF256

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et

<p align="center">SUPPORTING DOCUMENT</p>		<p>1. Total Pages <i>38⁰35</i></p>
<p>2. Title</p> <p>ENGINEERING TEST PLAN FOR TANK 241-SY-101 IN SITU VISCOMETER</p>	<p>3. Number</p> <p>WHC-SD-WM-TP-219</p>	<p>4. Rev No.</p> <p align="center">2</p>
<p>5. Key Words</p> <p>VISCOMETER, IN SITU, VENTILATION FLOW, CABLE TENSION, LANL, PNL, DENSITY, VELOCITY, RADIATION AREA, LOAD CELL, SAFETY ASSESSMENT, TEST WORK SHEET, WATER ADDITION.</p> <p><i>EMB 12/6/94</i></p> <p align="center">APPROVED FOR PUBLIC RELEASE</p>	<p>6. Author</p> <p>Name: RG SOBOCINSKI</p> <p><i>[Signature]</i></p> <p>Signature</p> <p>Organization/Charge Code</p> <p>Test Engineering/7CH30/N2B26</p>	
<p>7. Abstract</p> <p>To obtain in situ measurements of the rheological properties within tank 241-SY-101, this document will implement the test strategy defined in PNLMIT-041994, acquisition and Reduction of Data Obtained in Tank SY-101 with the Ball Rheometer. Instructions for all sequences are defined within the procedure. All safety requirements as defined in LA-UR-92-3196, A Safety Assessment for Proposed Mixing Operations to Mitigate Episodic Gas Releases in Tank 241-101-SY have been implemented into this procedure.</p>		
<p>8. RELEASE STAMP</p> <div style="border: 1px solid black; padding: 10px; width: fit-content; margin: auto;"> <p align="center">OFFICIAL RELEASE BY WHC</p> <p align="center">DATE DEC 06 1994</p> <p align="center"><i>Sta. 4</i></p> </div>		

WHC-SD-WM-TP-219
Revision 2

ENGINEERING TEST PLAN
FOR
TANK 241-SY-101 IN SITU VISCOMETER

November 1994

TI Stokes
KL Pearce

Westinghouse Hanford Company
P.O. Box 1970
Richland, Washington 99352

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ENGINEERING TEST PLAN FOR TANK 241-SY-101 IN SITU VISCOMETER

1.0 INTRODUCTION

Pacific Northwest Laboratory (PNL) and Los Alamos National Laboratory (LANL) have been evaluating various methods of measuring the rheological properties of the waste material contained in Tank 241-SY-101. Knowledge of the rheological properties is essential for understanding the behavior of the waste and for the success of many of the mitigation and remediation methods. The in situ viscometer was developed to obtain in situ measurements of the waste. The design of the viscometer is based on a falling-ball viscometer commonly used for Newtonian fluids. The report, *Theory of Operation for the Ball Rheometer* (PNLMIT-012694), discusses in detail the concepts involved and outlines additional laboratory experiments to be performed to support development of test guidelines for Tank 241-SY-101.

Acquisition and Reduction of Data Obtained in Tank SY-101 with the Ball Rheometer (PNLMIT-041994) documents the results of all of the laboratory experiments conducted and the general strategy for in situ testing and provides the background for this test plan.

2.0 OBJECTIVE

The intent of the viscometer instrument is to obtain in situ measurements of the waste rheological properties. The measurable parameters include the cable tension, velocity of the ball, and the elevation of the ball. Testing will, at a very basic level, provide the data necessary for analytically determining: a) the density as a function of depth, b) the fluid yield stress and viscosity as a function of depth, and c) the location of fluid interfaces such as the fluid surface, convective (C)/nonconvective (NC) boundary (if one still exists), and possibly the tank bottom or the impenetrable settled layer immediately below the NC layer.

Tests will be conducted over several shifts. Completion of testing is dependent on the data obtained. Initially, tests will be conducted to obtain the measurable parameters from the top of the tank to the bottom. These requirements may change if the results indicate additional tests are warranted.

3.0 SCOPE

This procedure is applicable to all test activities associated with the viscometer instrument when installed on Waste Tank 241-SY-101 and implements

the generic test guidance found in PNLMIT-041994. For equipment-specific information and operating mode instructions refer to *SY-101 In Situ Viscometer Instrument Operation and Maintenance Manual* (WHC-SD-OMM-009). For control-of-field work (mainly craft support) refer to *Instructions for Installation and Removal of Viscometer Instrument in Tank 241-SY-101* (TFPE-YP-0205).

Use of the viscometer in any other application will require a detailed engineering review of all PNL/LANL research, this test plan, safety aspects covered in *A Safety Assessment for Proposed Pump Mixing Operations to Mitigate Episodic Gas Releases in Tank 241-SY-101: Hanford Site, Richland, Washington* (LA-UR-92-3196; Safety Assessment), and the engineering work plan.

4.0 DESCRIPTION OF TEST

4.1 TEST ITEM

The viscometer is a computer-controlled device which raises and lowers a 3.6-inch diameter sphere at a constant velocity. The software enables four types of tests to be run: 1) dynamic density, 2) static density, 3) calibration, and 4) constant velocity. Detailed information can be found in the Viscometer OMM (WHC-SD-OMM-009).

4.2 TEST ENVIRONMENT

The viscometer will be attached to either Riser 4A or 11B of Waste Tank SY-101. This location will place the viscometer inside the fenced radiation area. The control console will be mounted 250 feet away, outside the fence in a non-radiation area.

4.3 EQUIPMENT AND FACILITIES

4.3.1 Tools

The installation work plan (TFPE-YP-0205) lists all specific hardware and tools that are required to install, maintain, or remove the viscometer from the riser.

4.3.2 Custom Machinery and Unique Hardware

All equipment listed on Installation Drawing H-2-818363 is required for viscometer operation. The major items include the viscometer assembly, control console with weather protection, instrument and power cables, a clean ball and cable assembly, and alternate range load cells.

In addition, a water lance (H-2-89487), decontamination spool piece (H-2-821443), and decontamination pump and hoses (SK-2-61341) are also required for successful operation of the viscometer.

4.3.3 Space

Risers 4A and 11B must be clear and ready to use. An area around the risers must be clear to allow easy access during work activities. An area (10 feet x 10 feet) east of the DACS trailer and north of the fence is required for setup of the control console.

4.3.4 Utilities

The in situ viscometer system requires a 480 VAC, 3 Phase, 4-Wire, 30 amp service with disconnect capability. Instrument and power cables are connected directly to the viscometer enclosure and run out of the radiation zone to the control console. The required instrument and power cables are supplied with the control console.

Water for the decon spray system shall be provided from a water truck. The decontamination pump has a capacity of 3.5 gpm at 3000 psig. Water temperature at the truck shall not exceed 130°F.

4.4 DATA

4.4.1 Parameters Measured

The parameters to be measured are the speed, position, and cable tension associated with the 3.6-inch diameter sphere.

4.4.2 Precision Required

SY-101 In Situ Viscometer Instrument System Design Description (WHC-SD-WM-SDD-043) documents the final design, calibration requirements, and overall system accuracies.

4.4.3 Range

A wide range of drag loads are anticipated; therefore, interchangeable load cells ranging from 15 to 500 lbs will be available at the test site. The encoders, tachometers, instrument cables, computer, and data acquisition boards have been designed to span the correct ranges for testing.

Ranges

Speed:	0 to 1 m/s, up or down
Position:	Top of riser to bottom of tank
Loads:	0 to 250-lb cable tension

4.4.4 Critical Instrument Systems

4.4.4.1 Force Measurement. This system's major components are the load cells, load cell amplifier, data acquisition board, and computer. These have all been calibrated at the WHC Standards Lab and the applicable components have the correct identifying stickers on them.

4.4.4.2 Position Measurement. This system's major components are the optical encoder, computer, proximity sensor, gearboxes, and drum diameter.

4.4.4.3 Velocity Measurement. This system's major components are the tachometers, signal conditioners, data acquisition board, computer, gearboxes, and drum diameter.

This equipment is intended for long-term service with some of it being in a radiation zone and contaminated; therefore, yearly calibration updates will not be performed. The cognizant engineer is responsible for tracking the hours of service, conditions of service, and for evaluating the calibration data from an in-service calibration run. The cognizant engineer may then order replacement parts and calibrate them prior to installation, calibrate existing parts, or decide the equipment is still within calibration to allow continued testing. Initial calibration sheets will be stored in an appendix of the system design description (WHC-SD-WM-SDD-043).

4.5 CRITERIA/CONSTRAINTS

Testing may only begin with the signature approval (Appendix A, step 4.2.6) of the designated Test Director, a Lead Scientist, and a field PIC (Operations-appointed Person-in-Charge). Shift office must be contacted prior to initiating any testing. West Area Shift Manager must provide signature approval (Appendix A, step 5.1.6) authorizing tests to be run for the designated time period.

5.0 EXPECTED RESULTS

As this is a first-of-a-kind experiment conducted within the tank, the exact data output is unknown. The raw data to be recorded are force, velocity, and position feedback. Success of any one test is not determined until the raw data have been processed.

The camera inside the tank will provide some indication of success in sinking the sphere.

6.0 TEST PROCEDURE

The test procedure must be preceded by successful completion of the installation work plan (TFPE-YP-0205) which will also be used if any maintenance or removal activities are required.

The viscometer test procedures are attached as Appendix A of this document.

7.0 SAFETY

All Safety Assessment operational controls are referenced in the test procedure (Appendix A). Following the test procedure ensures that no viscometer-specific safety controls are violated. Personnel shall comply with the Tank Farm Health and Safety Plan (WHC-SD-WM-HSP-002) during this procedure.

Equipment and personnel hazards unique to the viscometer instrument are discussed in Section 3.0 of the Viscometer OMM (WHC-SD-OMM-009).

The cable will become contaminated during use, and repeated extractions from the waste will tend to draw waste into the viscometer. A remote radiation detector will continuously monitor radiation levels at the enclosure and will alarm if levels exceed tank farm background levels.

8.0 QUALITY ASSURANCE

No Quality Assurance verifications are required during the performance of this procedure; however, a representative of QA shall review the completed procedure to verify compliance and accuracy in accordance with the requirements contained herein. Satisfactory QA review shall be indicated by signature in the space provided.

9.0 ORGANIZATION AND FUNCTION RESPONSIBILITIES

9.1 WHC TEST ENGINEERING

Test Director:

- Overall responsibility for maintaining and controlling test activities.
- Reviews interim and final test results.
- Monitors operations for compliance with the procedure.
- Signs or initials for completion of all procedure steps unless specifically noted otherwise.
- Overall test responsibilities and assignment of responsibilities.

- Provides liaison with shift manager, DACS Test Engineer, PIC, and TRG for test activities.
- Select load cell to be installed.

DACS Test Engineer:

- Shall be present inside DACS area at all times during viscometer operation to ensure that tank conditions are constantly being monitored.
- Report all changes in tank conditions to Test Director.

Viscometer Control Console Operator:

- Operate the viscometer equipment at the direction of the Test Director.

9.2 WHC MITIGATION EQUIPMENT

Cognizant Engineer:

- Provide technical assistance to the Test Director, as required.
- Determine equipment calibration requirements.

9.3 NATIONAL LABORATORY

Pacific Northwest Laboratory (PNL)
Los Alamos National Laboratory (LANL)

Lead Scientist:

- Determine specific test to be performed and test sequence following the general test strategy outlined in PNLMIT-041994.
- Prepare test work sheets for each specific test.
- Review interim and final test results.

9.4 TEST REVIEW GROUP (TRG)

- Approve water additions greater than 200 gallons in any 24-hour period.
- Approve interim procedures to cover abnormal occurrences not covered in the test plan.
- Approve test restart following a test abort due to abnormal occurrences.

9.5 WEST TANK FARMS OPERATIONS

Shift Manager:

- Provides approval for start of viscometer testing.
- Overall responsibility for stopping test at any time.
- Responsible for remaining cognizant of all testing activities and assuming direct control of all activities during Abnormal Events or Emergencies.

Person-in-Charge (PIC):

- Directs field (craft) activities associated with the viscometer test.
- Present at the test site during all tank intrusive activities associated with the viscometer test.

9.6 OTHERS

Any and all persons responsible for signing or initialing any steps during testing shall provide a sample signature and initial with their printed name on the Signature Verification Sheet, Appendix B.

10.0 SCHEDULE

The viscometer is scheduled for operation in SY-101 in FY95. Further testing will be performed as required following interpretation of the initial test results.

11.0 REPORTS

The data obtained from these tests shall be issued in a report prepared by PNL and/or LANL. This report shall include data interpretations and be retrievable (ie, issued as a WHC supporting document or as a formal controlled LANL or PNL document). A copy of the raw data and test logbook contents shall be submitted to Process Engineering.

A test logbook will be maintained by the Test Director. All pertinent observations, off-normal events, sketches, photographs, etc., shall be logged. Chronological tests conducted shall also be logged. The test logbook shall be signed and dated at the completion of each testing period.

12.0 REFERENCES

1. WHC-SD-OMM-009, *SY-101 In Situ Viscometer Instrument Viscometer OMM.*
2. WHC-SD-WM-SDD-043, *SY-101 In Situ Viscometer Instrument System Design Description.*
3. TFPE-YP-0205, *Instructions for Installation and Removal of Viscometer Instrument in Tank 241-SY-101.*
4. PNLMIT-012694, *Theory of Operation for the Ball Rheometer.*
5. PNLMIT-041994, *Acquisition and Reduction of Data Obtained in Tank SY-101 with the Ball Rheometer.*
6. LA-UR-92-3196, *A Safety Assessment for Proposed Pump Mixing Operations to Mitigate Episodic Gas Releases in Tank 241-SY-101: Hanford Site, Richland, Washington.*
7. WHC-SD-WM-HSP-002, *Tank Farm Health and Safety Plan.*
8. WHC-SD-WM-MA-014, *Mitigation Test Management Plan.*
9. H-2-818363, *In Situ Viscometer/Void Fraction Instr Systems Installation.*

13.0 DATA SHEETS

Data shall be recorded as specified in Appendix A: SY-101 In Situ Viscometer Test Procedure. Additional data is to be collected on computer disk by the viscometer controlling software and video or still images may be recorded. Appendix C: Viscometer Test Work Sheet provides a record of individual tests and settings specified by the Lead Scientist. In addition, the Test Director shall maintain a chronological log of major events and observations associated with this test. Appendix B: Signature Verification Sheet shall be used to maintain sample signatures and initials of test participants.

All of the above listed methods of data collection will be included as part of the official record of SY-101 viscometer testing. The appendices are considered *consumable items* and may be reproduced as needed.

APPENDIX A: SY-101 In Situ Viscometer Test Procedure

APPENDIX A: SY-101 In Situ Viscometer Test Procedure**1.0 Introduction**

The general test strategy outlined in PNLMIT-041994 will be used by the Lead Scientist to determine specific tests and sequence of tests to be performed in the field. One column on the Test Work Sheet (TWS) shall be prepared for each specific test. Not all tests are identifiable in advance; therefore, column(s) of the TWS may be prepared prior to testing in the field and while testing in the field. Once the TWS column has been approved by the Test Director and Lead Scientist, the operating parameters are input into the software program developed for the viscometer and the program is run.

The test procedure leaves certain parameters to the Lead Scientist and Test Director to vary at their discretion in the field. Test parameter flexibility is required for this testing project to succeed.

2.0 Test Condition Limits**2.1 Safety Assessment/Evaluation Controls**

- 2.1.1 DACS shall be manned by a qualified Test Engineer during viscometer testing to monitor tank conditions.
 - The DACS Test Engineer shall immediately notify the viscometer Test Director of any alarm or abort signals received or abnormal conditions occurring during testing.
- 2.1.2 Operations that may lead to gas releases are not permitted in Tanks 101-, 102-, or 103-SY while viscometer operation is in progress.
- 2.1.3 Engineered safety controls are described in the system design description document (WHC-SD-WM-SDD-043).
- 2.1.4 If cable tension exceeds 250 pounds and motion has stopped, then the viscometer ball is defined as *stuck*.
 - During normal operation, if the maximum cable tension exceeds the range of the installed load cell, steps to change out the load cell or remove the ball shall be followed in accordance with Section 6.6.
- 2.1.5 The ball must be fully retracted before the isolation valve can be closed (except for stuck-ball condition).

- 2.1.6 The isolation valve must be closed before the enclosure can be opened (except for stuck-ball condition).
 - Opening the viscometer enclosure with the isolation valve open shall be treated in accordance with open-riser work controls.
- 2.1.7 Water addition is limited to 100 gal/d (may be increased to 200 gal/d with TRG approval) and 1000 gallon total (total includes operation and removal).
 - Temperature of water added shall not exceed 130°F.
- 2.1.8 Respiratory protection requirements shall be determined by the field representative from Industrial Health, Safety, and Fire Protection. The level of protection for personnel will be based on the field measurements and the requirements in the Tank Farm Health and Safety Plan.
- 2.1.9 The radiation detector shall be unplugged if an open-tank condition exists.

2.2 Radiation and Contamination Control

- 2.2.1 A remote reading low-range radiation detector will be attached to the viscometer. Radiation readings shall be monitored while viscometer measurements are taken. Readings above background levels indicate that the viscometer decon system is ineffective and additional washing of the viscometer ball and cable is required.
- 2.2.2 The decontamination system will be activated during withdrawal of the cable/ball assembly at 15-foot intervals. Radiation readings greater than 100 mrem/hr indicate that excessive waste is being drawn into the enclosure (2 mrem/hr contact readings corresponds to approximately 1 gram of waste). Decontamination of the inside of the enclosure is required if greater than 65 grams of waste is indicated.
- 2.2.3 When the bottom 10 meters of the cable is pulled into the enclosure four times, or some combination resulting in 40 meters (i.e., eight withdrawals of 5 meters of contaminated cable), a radiation survey shall be conducted to ensure that waste within the enclosure does not exceed 65 grams.
- 2.2.4 Radiation levels external to the viscometer must be within 100 mrem/hr on contact (20 mrem/hr at 30 cm) to allow opening the viscometer enclosure for maintenance and reconfiguration operations. When this level is exceeded, the inside of the viscometer enclosure shall be decontaminated.

2.3 Limits and Precautions

- 2.3.1 DACS monitoring shall be performed continuously during viscometer operation.
- 2.3.2 Transition to Section 6.0, "Abnormal Occurrences," shall be made if any monitored parameter or procedural control is exceeded (i.e., severe weather, out-of-range tank conditions, excess water, and ball-operating anomalies).
- 2.3.3 Equipment and personnel precautions specific to the viscometer instrument are listed in Section 3.0 of the Viscometer OMM (WHC-SD-OMM-009).

3.0 General Information

Each procedure step or substep contains a completion box. These take the form of "Initial/Date" boxes, placekeeper boxes, or boxes in which to record specified data. Appropriate entry in the box signifies completion of the associated step or substep. Routing statements (steps that refer to actions in another section or procedure) shall be returned to and signed for after completion of the referenced actions. Steps that require continuous action will not contain a completion box.

Test Director shall sign for completion of test procedure steps (except where noted) based on reports from actual performers. This is to prevent paperwork from becoming contaminated. Test Director shall not sign until actual performer reports that the step has been completed. The viscometer test shall be conducted in verbatim compliance with these procedures.

Test Director shall keep a log of total water additions during testing and relay information to shift manager at completion of testing.

Decontamination for periods longer than 1.5 minutes may be performed at the Test Director's discretion.

Decontamination may take place simultaneously with retraction under Test Director's direction.

4.0 Prerequisites

The following conditions must exist and actions taken before performance of this test procedure:

4.1 Initial Conditions

- 4.1.1 The decontamination system is ready to operate. A valve (or equivalent precaution) between the pump and decon spool piece is closed.

Initial / Date:

- 4.1.2 The viscometer is attached to Riser 4A or 11B in accordance with Tank Farms Work Plan TFPE-YP-0205.

Initial / Date:

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- 4.1.3 The electrical bonding strap between the viscometer and the tank is properly grounded (visual inspection).

Initial / Date:

- 4.1.4 A monitor showing the in-tank camera view is positioned near the control console.

Initial / Date:

- 4.1.5 Before viscometer activity proceeds, there shall be no indication of seismic activity.

Initial / Date:

- 4.1.6 The HEPA filter system is properly installed and aligned.

Initial / Date:

4.2 Prerequisite Actions

- 4.2.1 **STATION** a Test Engineer in the DACS trailer to perform monitoring of tank parameters.

Initial / Date:

- 4.2.2 **ESTABLISH** two-way radio communications between personnel in the DACS trailer and Test Director. **VERIFY** the following systems are functional:

- 4.2.2.1 Temperature measurement system:

MIT 17C

☐

MIT 17B

☐

- 4.2.2.2 In-tank camera system:

DACS

☐

remote monitor at Viscometer Control Console

☐

Note: *If K1 exhauster is out of service, viscometer operations are allowed with TRG approval.*

- 4.2.2.3 Primary (K1) exhauster and auxiliary (P28) exhauster are both available.

K1 ☐

P28 ☐

- 4.2.3 **REQUEST DACS to VERIFY the following initial conditions AND begin continuous tank data monitoring:**

- Primary ventilation flow rate through SY-101 is between 400 and 700 cfm. ☐

- **CALCULATE** the ventilation flow ratio in the box below **AND** verify that it is ≥ 0.66 . Complete calculation based on data reports from DACS Test Engineer:

Calculation for Ventilation Flow Ratio

$$\frac{(\text{FTE50003 cfm}) - (\text{FTE50001 cfm})}{(\text{FTE50001 cfm})} = \geq 0.66$$

DACS Tag FTE50003 = SY Tank Farm Exhaust Flow

DACS Tag FTE50001 = Vent Header Flow (101-SY only)

[DACS Tag FTE50002 may be used in place of FTE50001]

Initial / Date:

- Tank dome pressure is less than -1.0 inch water gauge. ☐
- Waste level < 404 inches. ☐
- Maximum hydrogen concentration is < 0.75 percent by volume. ☐
- Initial hydrogen concentration is < 500 ppm **AND** > 10 ppm. ☐
- Maximum ammonia concentration is < 3000 ppm. ☐

- 4.2.3.1 **REQUEST DACS CONTACT** central fire facility at 373-2745 or the Patrol Operations Center at 373-3800, and verify that no range fires exist within 5 miles of the tank farm.

Initial / Date:

Note: For fire or adverse weather activity, DACS personnel shall determine whether viscometer operations shall be terminated. If activities are to be terminated, place tank in a safe shutdown condition as soon as possible.

- 4.2.3.2 **REQUEST DACS CONTACT** Hanford Meteorological Station at 373-2716 and verify that no significant adverse weather activity (thunderstorm or tornado) is reported or predicted to occur in the vicinity of the S Complex within 1 hour of start of viscometer activities.

Initial / Date:

- 4.2.4 **HPT ENSURE** remote reading low-range radiation detector (Model EC4-3, or equivalent) is in place, operating, and set to 10 mrem/hr for "alert alarm" AND 30 mrem/hr for "high alarm". **VERIFY** that the alarm indicator can be seen from the viscometer control console.

Initial / Date:

- 4.2.5 **CONDUCT** a pretest briefing on the equipment hazards possible during testing. The briefing shall include discussion of Section 3.0 of the Viscometer OMM (WHC-SD-OMM-009)

Initial / Date:

- 4.2.6 **OBTAIN** the required testing approval signatures:

Test Director

Date

Lead Scientist

Date

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Note: *The S Complex area has the potential for ammonia to exceed the IDLH limit of 500 ppm.*

4.2.7 **PIC ENSURE** only essential workers are present in the S Complex.

(PIC)

Person-in-Charge

Date

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5.0 Procedure - Normal Operation

All procedure steps shall be performed in the order specified unless otherwise noted.

5.1 Test Area Preparation

- 5.1.1 **VERIFY** that all of the prerequisites (Section 4.0) of this test procedure have been met.

Initial / Date:

- 5.1.2 **DON** appropriate protective equipment for working within the containment tent and DACS trailer as specified by the field representative from Industrial Health and Safety.

Initial / Date:

- 5.1.3 **RECORD** initial water meter reading:

Water Meter Reading:

Initial / Date:

- 5.1.4 **ENSURE** the following valves are in the designated position:

- V-5 CLOSED
- V-2 CLOSED
- V-4 OPEN

☐
☐
☐

Initial / Date:

- 5.1.5 **PERFORM** system startup procedure in accordance with sections 6.1.1 through 6.1.4 of the Viscometer OMM (WHC-SD-OMM-009).

Initial / Date:

- 5.1.6 **OBTAIN** West Area Shift Manager approval to begin viscometer testing for the day (24-hour approval). Shift manager signature (and date) is required to authorize start of testing.

(HP)

West Area Shift Manager

Date

- 5.1.7 **ENSURE** viscometer enclosure pressure gauge (PI-1) and ventilation flowmeter (FI-1) both read zero.

Initial / Date:

5.2 In Situ Testing

- 5.2.1 **OPEN** isolation valve (V-1).

Initial / Date:

- 5.2.2 **THROTTLE** HV-4 as necessary to attain the following results in the viscometer enclosure:

- Approximately 1 inch H₂O vacuum (as indicated on PI-1 or by indicator on the Viscometer Control Console)
- AND**
- Greater than .065 inches H₂O (3.5 cfm) ventilation flow (as indicated on FI-1).

Initial / Date:

- 5.2.2.1 **IF** the proper pressure and flow cannot be established, then close the isolation valve (V-1). Troubleshoot problem in accordance with TFPE-YP-0205.

- 5.2.3 **RECORD** ventilation flow indicator (FI-1) reading to verify air flow has been established through the enclosure:

Flow (in. H₂O):

Initial / Date:

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- 5.2.4 **ENSURE** air flow has been established for 15 minutes before continuing. Test Director sign and date to confirm 15 minute vent period has been satisfied.

(HP)

Test Director

Date

- 5.2.5 **ENERGIZE** the drive motor in accordance with section 6.1.5 of the Viscometer OMM (WHC-SD-OMM-009).

Initial / Date:

- 5.2.6 **START** recording the video, IF a VCR is available (N/A, if not available).

Initial / Date:

- 5.2.7 **LOWER** ball through the tank riser in accordance with Section 6.2 of the Viscometer OMM (WHC-SD-OMM-009).

Initial / Date:

- 5.2.8 **OBSERVE** ball leaving riser and entering dome space (in-tank camera monitor). **NOTE** if cable touches riser wall. **RECORD** elevation reading when dome entry was made.

- 5.2.8.1 **IF** cable is touching riser wall **AND** VCR is not available, **THEN** provide a sketch of the interference in the test logbook.

Cable touching walls
(yes or no):

Elevation:

Initial / Date:

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Note: Maximum operating ball velocity is 100 cm/sec.
Higher operating speed in the range of 100-200 cm/sec
requires TRG-approved justification and test plan.

- 5.2.9 LEAD SCIENTIST PREPARE a Test Work Sheet (TWS; Appendix C) following the general test strategy outlined in data document PNLMIT-041994. Include the Operating Mode and values for all applicable software control variables.
- 5.2.10 TEST DIRECTOR ENTER values from TWS into the computer following instructions in Section 6.2 of the Viscometer OMM (WHC-SD-OMM-009) for the mode selected.
- 5.2.11 PERFORM ball rheometer test. TEST DIRECTOR INITIAL TWS column to indicate completion of individual test.

Note: Step 5.2.12 may be reperformed as often as conditions warrant.

- 5.2.12 PERFORM decontamination of the cable WHEN the bottom 10 meters of cable has been retracted into the enclosure in any combination resulting in 40 meters (eg, 8 retractions of 5 meters of contaminated cable). Decontamination procedures are found in Section 6.6 of the Viscometer OMM (WHC-SD-OMM-009).
- 5.2.13 REPEAT steps 5.2.9 through 5.2.12 until all ball rheometer tests for the current test day have been conducted.
- 5.2.14 STOP VCR tape, IF recording video. ENSURE video tape is labeled and dated. (N/A if not recording.)

Initial / Date:

Note: Software will automatically stop retraction of the ball after 4.5 meters of upward travel. A dialogue box will appear on the computer screen prompting for decontamination.

Note: TRG approval is required if the ball is to be left in the waste for an extended test period (more than one day).

- 5.2.15 PERFORM final decontamination in accordance with Section 6.6 of the Viscometer OMM (WHC-SD-OMM-009). IF decontaminating simultaneously with withdrawal, THEN limit maximum speed of cable/ball retraction to 1 cm/sec.

Initial / Date:

- 5.2.16 **ENSURE** air flow has been established for 15 minutes before continuing. Test Director sign and date to confirm 15 minute vent period has been met.

(HP)

Test Director

Date

- 5.2.17 **PERFORM** system shutdown in accordance with Section 6.7 of the Viscometer OMM (WHC-SD-OMM-009).

Initial / Date:

- 5.2.18 **ENSURE** viscometer enclosure pressure gauge and ventilation flow indicator both indicate zero.

Initial / Date:

- 5.2.19 **NOTIFY** shift manager, DACS Test Engineer, and HPT that testing for the day is concluded.

Initial / Date:

- 5.2.20 **RECORD** final water meter reading:

Water Meter Reading:

Initial / Date:

- 5.2.21 **CALCULATE** total water usage for this day's testing:

Final water meter reading (step 5.2.20):

Initial water meter reading (step 5.1.3): -

TOTAL USAGE:

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- 5.2.22 **DISCONNECT** instrument and power cables, decon hoses, etc. under direction of the PIC.

Initial / Date:

A Quality Assurance review has been conducted as defined in Section 8.0 of this document.

Quality Assurance

Date

6.0 Procedures - Abnormal Occurrence(s)

This section addresses those situations evaluated in the LANL Safety Assessment and applies those controls on a case-by-case basis. However if workers are in imminent danger as a result of any abnormal occurrences, then the procedures listed below may be superseded by either the Test Director or shift manager (ie, shift manager may direct evacuation of farm area).

In the event of an abnormal occurrence, these procedures are provided as a guideline to place the viscometer system, all associated equipment, and as far as possible, the tank itself into a safe shutdown condition. Restart of testing following an abnormal occurrence requires that the cause of the occurrence is known and all test approval authorizations have been obtained.

6.1 General Site Emergency (OPS Notification Required)

- 6.1.1 **PRESS** the emergency stop button; this shuts off power to the viscometer.
- 6.1.2 **CLOSE** decontamination block valve.
- 6.1.3 **EVACUATE** the area per shift manager's direction.

6.2 Communication with DACS Lost or Not Available

If viscometer operation is not yet initiated:

- 6.2.1 **TERMINATE** all activities until the proper communication is established.
- 6.2.2 **RESTART** procedure at Test Director's direction.

If viscometer operation is initiated:

- 6.2.3 **COMPLETE** the individual test, then **PRESS** the emergency stop button.

6.3 Range Fire/Tornado/Seismic

- 6.3.1 **PRESS** emergency stop button immediately and **RECALL** support personnel from tank. If the hazard is not critical, shut down system in accordance with standard procedures in the Viscometer OMM (WHC-SD-OMM-009) prior to recalling personnel.

6.4 Lightning

6.4.1 **PRESS** emergency stop button immediately.

6.4.2 **IF** time permits:

6.4.2.1 **DISCONNECT** all cables from control console and viscometer enclosure. **ROLL** cables up and place in storage.

6.4.2.2 **DISCONNECT** decontamination hoses from decon spool piece. Roll hose up and place in storage.

6.4.3 **RECALL** support personnel from tank.

6.5 Ball Overspeed

If the velocity indicator displays a value above 100 cm/sec, machine failure has occurred. Perform the following steps:

6.5.1 **PRESS** the emergency stop button.

6.5.2 **RETRIEVE** the ball using the low-speed motor. If the low-speed motor is not adequate, **PREPARE** a field work package to manually retrieve the ball in accordance with Section 8.0 of the Viscometer OMM (WHC-SD-OMM-009).

***Note:** Ball retrieval should be completed prior to mixer pump operation. However, mixer pump bumping is allowed if the discharge jets are not aimed at the ball/cable location.*

6.5.3 **PERFORM** system shutdown in accordance with Section 6.7 of the Viscometer OMM (WHC-SD-OMM-009).

6.6 Excessive Cable Tension

***Note:** Isolation valve may be closed as much possible without damaging the wire. Do not reopen valve until enclosure is resealed.*

If the value of the "load" indicator is greater than the value displayed in the "load cell type":

6.6.1 For load cell type 2224 **PERFORM** ball removal procedure in accordance with Section 8.0 of the Viscometer OMM (WHC-SD-OMM-009).

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6.6.2 For all other load cell types **PERFORM** load cell change-out in accordance with Section 7.0 of the Viscometer OMM (WHC-SD-OMM-009) and Section 5.9 of the installation and removal instructions (TFPE-YP-0205).

6.6.3 Testing may resume at the Test Director's discretion, with the concurrence of the Lead Scientist.

6.7 Excessive Tank Dome Pressure (DACS Notification Required)

If dome pressure increases above -1 inch water gauge:

6.7.1 **PRESS** the emergency stop button.

6.7.2 **IF** DACS confirms a burp is occurring, unplug the radiation detector and evacuate the area immediately.

6.8 Elevated Radiation Alarm

If the radiation monitor positioned near the viscometer enclosure alarms:

6.8.1 **PRESS** emergency stop button. **EVACUATE** area around riser.

Note: *The HPT may reset alarm points to higher values, not to exceed 100 mrem/hr.*

6.8.2 **REQUEST** HPT investigate cause of alarm:

6.8.2.1 **IF** the alarm is false, testing may resume at point of exit in the procedure, at the discretion of the Test Director.

Note: *HPT can authorize retraction of ball to home position prior to initiating a work package.*

6.8.3 **IF** the alarm is not false, prepare work package for resolution, if required.

6.9 Waste Level (DACS Notification Required)

If the waste level goes out of range (> 404 inches):

6.9.1 **PERFORM** system shutdown in accordance with Section 6.7 of the Viscometer OMM (WHC-SD-OMM-009).

6.10 Gas Concentrations (DACS Notification Required)

If the hydrogen concentration is greater than 0.75 volume percent or ammonia is above 3000 ppm:

- 6.10.1 **PUSH** the emergency stop button immediately. Leave the isolation valve in whatever position it was in.
- 6.10.2 **EVACUATE** the area immediately.

6.11 Ventilation Flow (DACS Notification Required)

If the DACS-monitored ventilation header flow rate drops below 400 cfm or goes above 700 cfm:

- 6.11.1 **PRESS** emergency stop button.

Note: Leaving equalizer valve (V-2) open will provide a leak path to atmosphere.

- 6.11.2 **VERIFY** enclosure equalizer valve (V-2) is closed.

6.12 Excess Water Addition

- 6.12.1 **OBTAIN** TRG approval prior to exceeding water limitations.

If more than 200 gallons of water per day are accidentally used:

- 6.12.2 **PERFORM** system shutdown in accordance with Section 6.7 of the Viscometer OMM (WHC-SD-OMM-009).
- 6.12.3 **NOTIFY** shift manager and TRG of total water usage.
- 6.12.4 **EVALUATE** why excess water has been used.

6.13 Ball Would Not Sink

A water lance may be required to penetrate the crust or some depth of the waste. Use of water lance shall be determined by Test Director.

If lancing is required:

- 6.13.1 **PERFORM** system shutdown in accordance with Section 6.7 of the Viscometer OMM (WHC-SD-OMM-009).

- 6.13.2 **NOTIFY** TRG and Shift Manager.
- 6.13.3 **DEPLOY** lance in accordance with applicable sections of the installation and removal instructions (TFPE-YP-0205).
- 6.13.4 **REINSTALL** viscometer instrument in accordance with TFPE-YP-0205.
- 6.13.5 **RESTART** test at Step 4.0 of this test procedure.

6.14 Ball Did Not Make it Through Riser

If the ball will not pass through the riser in accordance with Section 6.0 of the Viscometer OMM (WHC-SD-OMM-009), then riser damage or blockage is indicated. (More than one attempt is permitted, but speed control in WHC-SD-OMM-009 must be adhered to.)

- 6.14.1 **PERFORM** system shutdown in accordance with Section 6.7 of the Viscometer OMM (WHC-SD-OMM-009).
- 6.14.2 **NOTIFY** TRG and Shift Manager.

6.15 Other Tank - Gas Release Activities

- 6.15.1 **PERFORM** emergency system shutdown in accordance with Section 6.8 of the Viscometer OMM (WHC-SD-OMM-009).
- 6.15.2 **EVACUATE IF** conditions warrant.

6.16 Isolation Valve Will Not Close

- 6.16.1 **EVALUATE** cause and take appropriate corrective action.

6.17 Water Temperature Exceeded

- 6.17.1 **TERMINATE** decontamination activities.
- 6.17.2 **IF** water temperature can be lowered to within acceptable limits ($\leq 130^{\circ}\text{F}$), **THEN** continue with the operation.

APPENDIX B: Signature Verification Sheet

Each person signing for any part of this document shall provide a sample signature and initial for record keeping purposes. This sample need only be provided once and is considered part of the official record of this test. Indicate in the FUNCTION column the signature authority represented (ie, Test Director, QA, Lead Scientist, etc.).

NAME (print)	SIGNATURE	INITIAL	FUNCTION

APPENDIX C: Viscometer Test Work Sheet

Date							
Time							
Test #							
Operating Mode ¹							
Velocity Set Point ² (cm/sec)							
Record Data ³ (On Off)							
Record Duration ⁴ (cm)							
Direction (Up Down)							
Counterbalance (newtons)							
Load Cell ⁵ (newtons)							
Lead Scientist (initial)							
Test Completed (Test Director Init.)							

¹Available modes of operation are:

C = Calibration

D = Dynamic Density

S = Static Density

V = Constant Velocity

²Choose a value between .05 and 100 cm/sec.

³To record data in Constant Velocity (V) mode this switch must be set to On. Data will be written to disk in all other modes, regardless of setting.

⁴Only available if Record Data is set to On.

⁵Choose from 67, 111, 222, 445, 1112, or 2224.