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Operational Test Report for the AY-102 Enraf Densitometer Control and Acquisition System

John Huber
Lockheed Martin Hanford Corporation, Richland, WA 99352
U.S. Department of Energy Contract DE-AC06-96RL13200

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Abstract: This Operational Test Report documents the Enraf Series 854 AY-102 Operational Test Procedure, OTP-320-010. This report formalizes acceptance of the densitometer and Enraf Control Panel Software system for use on AY-102.

Kara A Broz 7/23/98
Release Approval   Date

DATE: JUL 2 4 1998
STA: 4
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ID: 68
Release Stamp

Approved for Public Release

HNF-2965
Revision 0

Operational Test Report for the AY-102 Tank Densitometer Control and Acquisition System

J. H. Huber
Single-Shell Tank Engineering

July 7, 1998

Table of Contents

1.0 Introduction

On June 2 through June 10, 1998, the AY-102 Tank Densitometer Control and Acquisition System was operationally tested per OTP-320-010 Revision A-0. The test was performed at the Department of Energy's Hanford Site, 200 East Area, 241-AY Tank Farm. The test validated the functionality of the Enraf 854 ATG Densitometer Gauge and Enraf Control Panel software for use by project W-320, Waste Retrieval Sluicing System (WRSS).

2.0 Description of Test

The purpose of the test procedure was two fold: (1) to verify the functionality of the Enraf 854 ATG as a Densitometer; and (2) to verify the functionality of the Enraf Control Panel Software density acquisition routines. The densitometer was previously acceptance tested per HNF-SD-WM-ATP-077. The software was previously acceptance tested per HNF-1991.

2.1 Criteria

The following criteria were used to determine whether the density acquisition system passed or failed the test.

2.1.1 Pass.

- The gauge responds correctly (as described in vendor documentation, Ref. 1) to all commands sent through the program.
- If gauge related error codes are encountered, they may be cleared either through the Portable Enraf Terminal (PET) or the program. However, the program, while running, must provide some indication of all the gauges' related errors encountered.
- Each flush nozzle on the flushing spool yields a minimum of 1.3 gpm of flow at 80 psig or greater.
- The program successfully instructs the gauge to obtain a tank sediment level.
- The program successfully instructs the gauge to obtain a single-point density measurement.

- The program successfully instructs the gauge to obtain a multi-point density measurement.

- The program successfully creates a text file containing the density data and assists the user in copying this file to floppy disk.

2.1.2 Fail.

- If any of the pass criteria are not met and cannot be immediately resolved.

- If the system crashes for reasons that are clearly related to program performance and cannot be immediately resolved.

3.0 Test Method and Test Equipment

The Enraf gauge was installed on tank 241-AY-102 riser 15E. The gauge was connected to an Enraf 858 Computer Interface Unit (CIU) located in 241-AY-801. A density displacer was used. The software was installed on a computer workstation with the following relevant specifications.

Make & Model:	AST Ascentia M Series
CPU:	Pentium 133MHz
Memory:	32 MegaByte
Harddrive:	1.5 GigaByte
Graphics Adapter:	Cirrus Logic 755X PCI 1.30A
Graphics Memory:	2MB
Monitor:	800x600 LCD (Laptop)
Display Setting:	16bit color, 800x600
Operating system:	Microsoft Windows 95 ver 4.00.950.B
Serial Number:	088100774164
Gov. Property Num:	WC63269

Visual Basic 5.0 was also loaded on this workstation in order to facilitate rapid turn-around of software revisions. A new executable was created for each revision and copied directly into the installed application directory.

The workstation was physically located in the 241-AY-801 building. The workstation was placed on a table near the Data Acquisition System (DAS) cabinet where the CIU was installed. The workstation was connected to the CIU via RS-232C cable. The CIU address was set to "0"; and the baud rate setting was 1200 (see Exception 1). The gauge address was set to "00".

A flush hose equipped with a calibrated pressure gauge was used to connect to each flush nozzle. Since a calibrated flow rate meter was not available, flow rate was calculated using flow totalizer readings and a stop watch.

4.0 Test Results

4.1 Discussion of Test Results

A reproduction of the master control copy of the operational test procedure is found in Appendix A. The data sheets containing all data taken are included as a part of Attachment A. Related calculations are found in Appendix B. The work instruction with sign-offs and data entries for follow up work request 2E-98-1244 is found in Appendix C.

On June 2, 1998, the operational test was started. The workstation was set up with only one exception (see Exception 1). The flush spool was successfully tested with all nozzles flowing at 1.3 gpm or greater at a pressure of 120 psig. On June 8, a sediment check was attempted and obtained with one exception (see Exception 3). That same day, a single-point density measurement was obtained at the 280-inch level. However, the density value returned from the gauge was approximately .93 g/cm^3 which was somewhat lower than expected (see Exception 5). A multi-point density profile measurement was then attempted. But given the start level and sediment level required by the procedure, the program calculated a very large (though correct) number of measurements (23) to be obtained. Since an inordinate amount of time would be required to obtain 23 density measurements, the multi-point density profile measurement was then aborted until some minor programming errors could be fixed and new start level and sediment level could be determined for the multi-point density profile (see Exception 4).

On June 10, 1998 a multi-point density profile was obtained. The system operated without incident, However, density values were also lower than expected (see Exception 8).

On July 2, 1998, the volume of a new density displacer was measured in the shop using two methods in addition to the vendor's stated displacer volume. The displacer volume is engraved on the displacer. The vendor's stated displacer volume and measurements by the two methods to a precision of 0.1 cm^3 were within $\pm$ 0.5 cm^3. On July 3, the new displacer was installed. New density measurements were then obtained on July 6 which were within the expected range. As shown in section B.3 in appendix B, the measured densities on June 10, 1998 and July 2, 1998 can be justified.

4.2 Discussion of Test Exceptions

4.2.1 Exception 1

During the setup of the workstation and connection to the CIU, it was found that communication could not be achieved to the gauge when trying to function at 2400 baud. Vendor documentation was reviewed to determine the problem. No solution tried was effective. Since communication at 2400 baud was not a requirement, it was decided to set up the system for 1200 baud, which worked fine.

4.2.2 Exception 2

The program would not allow a displacer to be raised upward. It directed the user to affect the operation using the PET. Since raising of the displacer with the program was not a specific requirement, the PET was used as directed by the program. However, it was found later that the program code was intentionally written to require the use of the PET when the displacer was within 6 inches of the adapter flange (to protect the gauge force transducer). However, an error was found in the logic of the code. The error resulted in the requirement that the PET be used during <u>any</u> "raise" command. The code was revised and now works as intended.

4.2.3 Exception 3

When trying to perform a sediment check, the gauge display on the program, the PET and the gauge showed "### ###" (pound signs) after the level value instead of "!!! !!!" (exclamation points) or "in INN". Since the program is controlled by the "in INN" character string to tell when the sediment level is reached, the program went into an infinite loop. The Test Engineer had to decide when the sediment had been reached as evidenced by the unchanging level readings. The Test Engineer determined that the "WM" item in the gauge needed to be changed from "ANNN" to "AANN", which would "approve" the gauge for sediment level use.

The parameter was changed as described and the test was resumed. A quick check was made by entering command I2 to verify that pound symbols did not appear. The test was then resumed.

4.2.4 Exception 4

The system attempted a multi-point density profile without problems until it was noted that the second data point was obtained at a tank level equivalent to twice the interval below the first. The third and forth measurements were obtained at correct intervals. Also, the way the procedure was written, the system was going to attempt 23 data points which would require 69 minutes or more. The Test Engineer ordered an Abort.

The Test Engineer then troubleshooted and modified the program code to correct the double-interval problem. It was also decided to lower the start level to 89 inches, and raise the sediment level entry to 17 inches. This would yield 6 data points, reducing the time of the participants spent in the field by 51 minutes. The Test Engineer determined that 6 data points were sufficient to verify system operability.

4.2.5 Exception 5

During the original run of section 5.7, the Test Engineer noted that the specific gravity measurements were coming in too low (~.930). In order to gather troubleshooting information, the Test Engineer provided a set of steps to perform to obtain a displacer weight submerged in the liquid. This weight turned out to be 113 grams. It was agreed to continue testing, since the remaining test would verify operability of the workstation/gauge system regardless of the readings obtained by the gauge. It was believed that the problem with the specific gravity readings resided with the gauge and displacer setup parameters. The procedure was changed by a Process Change Authorization (PCA) to reflect the additional steps.

The 113-gram value was taken back to the office, along with the 242-gram free displacer weight. Given an expected specific gravity of 1.03, the calculated volume of the displacer should have been about 125 cm^3 as opposed to 140, which was originally entered into the gauge.

Additional information was requested from the vendor, including the actual equation used by the gauge to calculate density values. The equation (see Appendix B) revealed that the wire weight and submerged wire volume were included. This information was significant in that the wire material installed in Hanford gauges is 80%-Platinum-20%-Iridium which is approximately three times heavier than stainless steel wire. The wire weight values shipped with the gauges are the default stainless steel values. Calculations showed that if input correctly, the wire weight values for the

80%-platinum-20%-iridium wire would bring the density readings closer to the expected values. The 80%-platinum-20%-iridium wire is standard wire that is used in all Enraf level gauges at Hanford.

On July 3, 1998, a new displacer was installed after being carefully calibrated in the shop. On July 6, 1998, correct volume and wire weight values were entered into the gauge. A density reading was then obtained at the 280-inch level. The resulting measurement was 1039 Kg/m^3 which was within the range expected.

4.2.6 Exception 6

A number of typographical errors were found in the data sheet. Also, specific gravities were requested to be recorded when density values were actually needed and vice versa. The procedure was revised by a PCA to correct the errors.

4.2.7 Exception 7

Exceptions were not filled out in the field, but marked up directly on the procedure and agreed to by all participants. This was done to minimize time in the field (ALARA concerns). The exceptions were written up immediately at the conclusion of testing. A PCA was prepared and approved.

4.2.8 Exception 8

As indicated in exception 5, the densities were coming in too low. This issue is being handled as its own exception due to the seriousness of the problem.

A work package (2E-98-1244) was prepared to replace the displacer currently installed on the gauge with a carefully "calibrated" displacer. As mentioned in Exception 5, a new displacer was calibrated per this work package and installed. A field acceptance was performed as described in the work instructions of the package (See Appendix C).

The densitometer is now performing within specifications.

4.2.9 Exception 9

At step 5.7.24, the R9 value was not exactly equal to the last density recorded in the density log file. This is acceptable, since the R9 value should NOT be expected to be exactly equal to said value. The last value is, in fact, an average of R0 through R9, which may or may not be equivalent to R9 itself.

5.0 Conclusions and Recommendations

The results of the Operational Test Procedure show that the density acquisition system consisting of the Enraf Control Panel Software program and the Enraf 854 Densitometer functions as intended. The system is acceptable for use with Enraf 854 Advanced Technology Gauges and Enraf 858 Computer Interface Units. Specific recommendations have arisen from the testing which, if implemented, will greatly enhance and ensure the accuracy of the densitometer gauge.

5.1 Calibrate Density Displacers Prior to Installation

The accuracy of any given density measurement is highly dependent on the accuracy of the volume measurement of the displacer. As the displacer is continually dipped into the liquid to obtain a density or sludge measurement, waste will accumulate on the displacer. As enough waste builds up to affect the apparent volume, readings will become less accurate. Upon replacement of a density displacer, the tagged volume of the displacer will need to be verified to within 0.5 cm^3. An error analysis was performed in section B.3. For a density error of 5 Kg/m^3, the maximum allowed displacer volume error was found to be ±0.7 cm^3 for waste fluid with a specific gravity of 1.0. Review of the numerical calculation reveals that as the specific gravity increases the tolerance value decreases.

5.2 Find a Permanent Location for the Workstation

The computer workstation had to be set up by opening the DAS and CIU cabinet doors. The doors had to remain open to accommodate the RS-232C cable connection. Over time, this may jeopardize the integrity of the data obtained through the DAS and/or CIU through repeated setup and tear down of the workstation.

5.3 Wash Density Displacers and Wire Frequently

The wire was observed to accumulate waste product during the test. Since the internal electronics account for wire volume in the density calculation, waste build-up on the wire may effect the accuracy of the readings. Waste accumulation on the displacer will effect readings in the same manner. Waste accumulation will also increase dose rates at the gauge's drum housing, which further complicates gauge maintenance activities.

5.4 Do Not Use a New Density Displacer Greater than 250 grams in weight.

While preparing to perform work package 2E-98-1244, it was discovered that the closer in weight a displacer is to 300 grams, the greater the error in weight measurement. For example, a displacer actually weighing 291 grams was found to have a level gauge measured weight of 287 grams. Such a weight difference can significantly affect density measurement. In this case, the specific gravity of water at standard temperature and pressure would come in at .971 if the 287 gram value was used for the displacer free weight (as opposed to .998).

The vendor was contacted regarding this issue. They pointed out that our force transducer calibrations are performed within the range of 25 grams to 250 grams. Force transducer accuracy would falter outside of this range. This places a maximum limit on tank waste specific gravity to be approximately 1.7 depending on displacer volume. The maximum specific gravity limit of 1.7 is derived by dividing 225 grams, the maximum weight difference, by 135 cm^3, the nominal displacer volume, and dividing by reference density (1 gram/cm^3).

Although the weight of a new displacer should be less than 250 grams, it is acceptable to allow the weight to increase to 255 grams as waste accumulates on the displacer. This is provided the actual weight is always entered into the gauge's "DW" parameter. Numerical calculations were made in section B.6 on three cases where waste accumulates on the displacer. Analysis of these calculations show that if the gauges "DW" is reprogrammed the density error is less than 1%.

5.5 Enter Wire Weight Value into Gauge WW Item

Calculations per Appendix B indicate that the wire weight value, which defaults to that of 316 stainless steel, can significantly affect density readings. A wire weight value of 0.69 should be entered into the WW item in the gauge software. The 80%-platinum-20%-iridium wire is the standard wire used for all Enraf level gauges used at Hanford. The original Enraf level gauges were installed with stainless steel wire until a wire broke due to chloride induced cracks in the wire. Most of the risers where Enraf level gauges are now installed have polyvinyl chloride liners. These liners release small amounts of chlorine gas when they are irradiated from the tank waste.

6.0 References

(1) Instruction Manual Series 854 ATG Level Gauge, Enraf Inc., Part No. 4416.220, Version 2.2 (See CV-31560, vendor information file).

(2) Instruction Manual 854 ATG Density Software Package, Enraf Inc., Part No. 0000.564.4416.221-40, Version 1.0 (See CV-31560, vendor information file).

(3) System Requirements for Enraf Control Panel Software, Lockheed Martin Hanford Corporation, HNF-1569, dated February 25, 1998.

(4) PCA ETF-98-354, June 3, 1998 [PCA changed revision of OTP-320-010 from A-0 to A-1, and replaced pages 15, 33, and 42 in OTP-320-010.]

(5) PCA ETF-98-385, June 24, 1998 [PCA changed revision of OTP-320-010 from A-1 to A-2, and replaced pages 10, 16, 17, 20, 25, 31, 33, 44]

Appendix A

Acceptance Test Procedure
OTP-320-010
Master Control Copy

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TANK FARM PLANT OPERATIONAL TEST PROCEDURE WRSS

W-320 ENRAF SERIES 854 DENSITOMETER OPERATIONAL TEST

Last Full Revision: A-0
Release Date: 5/19/98
USQ Screening Number: TF-98-0317
Approval Designator: ES

POSITION/ORG	DELEGATE	DATE
NCO	D.R. Jones	5/15/98
Shift Manager	J.E. Andrews	5/15/98
QA Engineer	C.A. Sams	5/17/98
Safety Engineer	S.U. Zaman	5/17/98
Environmental Eng.	P.C. Miller	5/17/98
RadCon Engineer	R.J. Reeder	5/17/98
COG Engineer	J. Huber	5/16/98
Acceptance Review	D.C. Ashworth	5/19/98
Approval Authority	T.J. Kelley	5/18/98

Justification: Engineering request

Summary of Changes: New procedure for Project W-320

TABLE OF CONTENTS

1.0 PURPOSE AND SCOPE

1.1 PURPOSE

This procedure provides instructions for operational testing of the W-320 Enraf Advanced Technology Gauge Densitometer, Communications Interface Unit, and Enraf Control Panel software functions as designed. Testing is expected to take one week to complete.

1.2 SCOPE

This procedure involves the W-320 Enraf Densitometer system. Instructions are provided to verify correct operation of the level and density data acquisition system. Operational testing will verify that the hardware and software function according to intent.

The following items will be tested for operation (reference Figure 1):

- W-320 Enraf Series 854 Advanced Technology Gauge with density option installed.
- W-320 Enraf Series 858 Communication Interface Unit
- W-320 Enraf Control Panel software and interconnecting cables, running on a Windows95/NT workstation.

2.0 INFORMATION

2.1 TERMS AND DEFINITIONS

2.1.1 ECP - Enraf Control Panel

2.1.2 PET - Portable Enraf Terminal

2.1.3 CIU - Control Interface Unit

2.1.4 DST - Double-Shell Tank

2.1.5 gauge - refers to Enraf densitometer under test throughout this procedure.

2.2 RESPONSIBILITIES

2.2.1 Test Engineer:

- Provides technical support during testing.
- Provides programming support during testing.
- Reviews test documents to validate acceptance.
- Records equipment status and data per this procedure.
- Records data exceptions and other notes as required on the OTP data sheets.
- Prepares post testing documents.

2.2.2 Craft (TWRS Maintenance and/or Construction Forces):

- Provide assistance during OTP testing.
- Provide equipment for performance of this OTP.

2.2.3 Health Physics Technician:

- Performs radiological monitoring

2.2.4 Quality Control Inspector:

- Reviews recorded test data for accuracy and completeness at completion of test.

2.2 RESPONSIBILITIES (Cont.)

2.2.5 Test Director:

- Responsible for overall control of the testing process and change record authorization for this OTP.
- Ensures all required data are collected.
- Safe and productive accomplishment of testing.
- Ensures safe working conditions and practices.
- Ensures compliance with test documents and Technical Safety Requirements/Documents (TSRs/OSDs) during testing.
- Communicates and coordinates testing with DST Shift Manager.
- Ensures review and approval of all modifications to test procedures are completed prior to return to testing.
- Acts as a direct line of communication and centralized point of control during normal, abnormal, and casualty situations.
- Conducts pretest briefings, as required.
- Schedules/reschedules tests, as required.
- Conducts pre-job system walkdowns.
- Reviews test documents to validate acceptance.
- Verifies all test instrumentation is within current calibration cycle.

2.2.6 Operations (NCOs):

- Performs flushing of Enraf displacer and wire.
- Records test data, as required.

2.3 REFERENCES

- 6-TF-125, Enraf Series 854 Maintenance and Calibration
- TO-020-420, Clean LIT Tapes, Plummets and Displacers; Replace FIC/Robertshaw Tapes and Plummets
- H-2-824485, Densitometer Mechanical Installation
- H-2-8 546?, Enraf 854 Electrical Installation
- Instruction Manual, Series 854 Advanced Technology Gauges level gauge, Part No. 4416.220, Version 2.2, ENRAF B.V., The Netherlands
- Installation Info, Model 854 Advanced Technology Gauges Servo Powered Tank Gauge, Part No 4416.601, Version 1.0, ENRAF B.V., The Netherlands
- Instruction Manual 854 Advanced Technology Gauges density software package, Part No. 564.4416 221-40, Version 1.0, ENRAF B.V., The Netherlands
- Instruction Manual Series 847 Portable ENRAF Terminal, Part No. 4416 210, Version 1.1, ENRAF B.V., The Netherlands
- Instruction Manual, Series 858 Communications Interface Unit, Part No. 4416.500, Version 2.1, ENRAF B.V., The Netherlands

2.4 GENERAL INFORMATION

2.4.1 CHANGE CONTROL

2.4.1.1 Change control shall be in accordance with HNF-IP-0842.

2.4.1.2 The Test cognizant engineer may make and implement "on-the spot" changes/modifications to the Enraf Control Panel Software, as required, during testing. Software changes shall not constitute a procedure change. All software changes shall be documented as an EXCEPTION per Section 2.4.2.

2.4 GENERAL INFORMATION (Cont.)

2.4.2 EXCEPTIONS

2.4.2.1 Test exceptions are used to document unexpected results and identify appropriate actions, not to circumvent performance requirements.

2.4.2.2 All test exceptions shall be given a sequential number and recorded on Attachment 1, OTP-320-010 Test Log.

2.4.2.3 Attachment 2, OTP-320-010 Test Exception Report, shall be filled out to record and disposition each test exception.

2.4.3 ALARM RESPONSE

2.4.3.1 This procedure identifies all alarms expected as a result of testing and provides instructions for responding to those alarms.

2.4.3.2 Existing alarm response procedures shall be used when responding to unexpected alarms which occur during testing.

2.4.3.3 Unexpected alarms received during testing shall be logged as test exceptions and evaluated by the Test Director for effect on the test.

2.4.4 Contact Test Director and Test Engineer for additional instructions if changing plant conditions affect testing or delays extend test duration past end of the (testing) shift.

2.4.5 If during performance of this procedure, any of the following conditions are found, **IMMEDIATELY** notify the assigned Test Director and Test Engineer:

- Any equipment malfunction which could prevent fulfillment of functional requirements.
- Personnel error or procedural inadequacy which could prevent fulfillment of procedural requirements.
- Any other unexpected anomalies.

Test Director shall assess the effect on the plant and the test and direct either continuation of the test in the same section, proceeding to another attachment or section of the test, or suspension of the test per step 2.4.10 and establishing a safe condition for equipment.

2.4 GENERAL INFORMATION (Cont.)

2.4.6 Comply with HRS Lock and Tag requirements, HNF-IP-0842, Volume II, Section 4.9.

2.4.7 All Measuring and Test Equipment used during performance of this procedure to collect qualitative data, with the exception of timing devices, shall meet the following requirements:

- Be within its current calibration cycle as evidenced by an affixed calibration label.
- Be capable of the desired range.
- Have an accuracy (consistent with state-of-the-art limitations) equal to or greater than the accuracy specified in the procedure.

2.4.8 Timing measurements shall be made with commercially available timing devices.

2.4.9 SYSTEM STATUS

2.4.9.1 Record all necessary equipment configuration, comments, abnormal observations, participants, and all other data pertinent to the test on Attachment 1, OTP-320-010 Test Log.

2.4.9.2 Operations shall complete all normal ROUNDS DATA SHEETS (not part of this procedure) throughout performance of this procedure.

2.4.10 SUSPENSION OF TEST AND RESUMING TEST

2.4.10.1 Test Director may unilaterally, for any reason, stop testing and place equipment in a safe condition. All suspension of testing shall be documented on Attachment 1, OTP-320-010 Test Log.

2.4.10.2 If a section of the test is suspended for any reason prior to completing all steps, the Test Director shall establish initial conditions necessary to resume testing for that section. Previously completed sections need not be repeated unless directed by the Test Director to establish conditions required to resume the test.

2.5 RECORDS

The performance copy of the Operational Test Procedure and all completed attachments shall be filed as a permanent test record (Operational Test Report).

3.0 PRECAUTIONS AND LIMITATIONS

3.1 PERSONNEL SAFETY

NONE

3.2 RADIATION AND CONTAMINATION CONTROL

3.2.1 Raising a displacer that has been submerged in the tank waste may result in excessive radiation exposure when the displacer approaches the ball valve.

3.2.2 Work performed in radiological areas shall be reviewed by TWRS Radiological Control Engineering and Technical Support prior to release ([illegible]-IP-0842, Vol VII, Section 1.1).

3.3 ENVIRONMENTAL COMPLIANCE

NONE.

3.4 LIMITS

3.4.1 All portions of the test shall be completed before the system is either accepted or rejected.

3.4.2 All electrical and mechanical apparatus shall be operated as designed.

ACCEPTANCE CRITERIA

3.4.3 This Operational Test Procedure will be considered successful if all the following criteria are met:

3.4.3.1 Workstation/Computer

- Boots up to Windows95/NT
- Communicates to Advanced Technology Gauges via Communication Interface Unit using ENRAF Control Panel program
- Obtains tank density interface profiles.
- Obtains single point density measurement
- Outputs density data to text file
- Obtains sediment level.

3.4.3.2 Advanced Technology Gauge (Enraf)

- Responds with an error code = 000 or 0000 (indicating no problems) for XPU and SPU of Advanced Technology Gauge.
- Reports an II surface level within 1.5 inches of accepted waste level.
- Reports a density for unmixed supernatant between 0.98 and 1.1 specific gravity (spG).

3.4.3.3 Rinse Spool Assembly Spray Nozzle

- Flow through each spray nozzle is 1.3 Gallons per minute or greater when 80 psi (minimum) is applied.

3.4 LIMITS (Cont.)

(QC) 3.4.4 Indicates Quality Control (QC) hold points. When each hold point is reached, no further steps are to be performed until a QC representative has signed off required step(s).

(HP) 3.4.5 Indicates Health Physics (HP) hold points. When each hold point is reached, no further steps are to be performed until an HP representative has signed off required step(s).

4.0 PREREQUISITES

4.1 SPECIAL TOOLS, EQUIPMENT, AND SUPPLIES

The following supplies may be needed to perform this procedure:

- Portable Enraf Terminal (PET), Model Number 847
- 3.5 inch data diskette(s)
- Hose to fit rinse spool assembly flush connections to tank farm water supply
- Pressure gauge (water) capable of indicating 80 to 100 psi with an accuracy of ± 5 psi
- Flow meter capable of indicating 1 to 2 gpm with an accuracy of ± 0.1 GPM
- Fittings, as needed to connect hose, pressure gauge, and flow meter to tank farm water source. This will include a 1/4" male to 3/8" female quick-disconnect adapter for connecting the flush rig to each individual spray nozzle
- Stop watch
- Routine Liquid Level Flush Data Sheet (TO-020-420)
- Desktop/Laptop computer, IBM Compatible, 486/66/16MB RAM (minimum) running Windows95/NT with a minimum 1.0GB Harddrive and Enraf Control Panel software pre-installed as provided by the Test Engineer.

4.2 PERFORMANCE DOCUMENTS

- 6-TF-125, Enraf Series 854 Maintenance and Calibration
- TO-020-420, Clean LIT Tapes, Plummets and Displacers; Replace FIC/Robertshaw Tapes and Plummets
- TO-040-540, Water Surveillance and Usage

4.3 CONDITIONS AND ACTIONS

NOTE - Steps 4.3.1 through 4.3.9 may be performed in any order.

4.3.1 **CONDUCT** a pretest briefing for all personnel involved in the performance of this Operational Test Procedure.

- A daily pre-job briefing shall be performed by the Test Director and documented in Attachment 1, OTP-320-010 Test Log.

4.3.2 **VERIFY** Health Physics Technician support availability.

4.3.3 **PERFORM** a walkdown inspection of the work area for unusual and/or hazardous conditions.

TEST DIRECTOR INITIALS/DATE: RG / 6/2/98

4.3.4 **ESTABLISH** communication between control room and equipment locations.

TEST DIRECTOR INITIALS/DATE: RG / 6/2/98

4.3.5 **ENSURE** the official Operational Test Procedure copy and all other photocopies to be used during testing are the latest approved revision.

TEST DIRECTOR INITIALS/DATE: RG / 6/2/98

4.3.6 **REVIEW** Lock and Tag Logbook to verify all components are available for the test.

TEST DIRECTOR INITIALS/DATE: RG / 6/2/98

NOTE - Signature Log requirement is ongoing as new individuals become involved in the procedure.

4.3.7 **ENSURE** all personnel to be involved with performance of this procedure have completed Attachment 3, OTP-320-010 Signature Log.

4.3 CONDITIONS AND ACTIONS (Cont.)

4.3.8 **VERIFY** a copy of the latest 6-TF-125, "Enraf Series 854 Maintenance and Calibration" data sheet(s) are on hand for the gauge.

TEST DIRECTOR INITIALS/DATE: RG , 6/2/98

4.3.9 **OBTAIN** release from Operations management prior to continuing this test.

TEST DIRECTOR INITIALS/DATE: RG , 6/2/98

5.0 PROCEDURE

NOTE - "RECORD" in a step indicates that data and/or initials are to be entered on Attachment 4, OTP-320-010 Data Sheet when conditions in the step are met.

- Most Enraf Control Panel Program screens can be opened in more than one way; usually through "selecting" menu items with the ALT-x method, where x is the underlined menu letter by or by "mouse clicking" the desired item. Either method may be used.

5.1 SET PRELIMINARY CONDITIONS

5.1.1 **ENSURE** gauge displacer is above isolation ball valve.

5.1.2 **ENSURE** isolation ball valve is CLOSED and SECURE.

5.1.3 **ENSURE** power to computer is "OFF".

5.1.4 **RECORD** Section 5.1 complete.

5.2 INITIALIZE WORKSTATION

5.2.1 **ENSURE** power to Communication Interface Unit and gauge is ON.

5.2.2 **ENSURE** power to computer system ON.

NOTE - CASS/TMACS operator: 373-2618.

5.2.3 **ENSURE** workstation time is set to within ± 1 minute of Tank Monitoring and Control System (TMACS) system time.

- **IF** not, **DOUBLE-CLICK** the system clock on the Windows95 task bar **AND USE** the dialog window displayed to set the time and date.

5.2.4 **START** Enraf Control Panel program.

5.2 INITIALIZE WORKSTATION (Cont.)

NOTE - The ECP password must be obtained from the Test Engineer.

5.2.5 **WAIT** until "ECP Logon" screen OPENS,
THEN:

- **ENTER** the Operator's name in the "User Name" window.
- **ENTER** the password provided by the Test Engineer in the "Password" window.
- **SELECT** "Ok"

5.2.6 **VERIFY** "Enraf Control Panel" screen OPENS.

5.2.7 **RECORD** Section 5.2 complete.

5.3 CHECK COMMUNICATIONS AND GAUGE SETUP

5.3.1 SELECT "Setup" then "CIU Setup" from Enraf Control Panel.

5.3.2 VERIFY "CIU Setup" screen OPENS.

5.3.3 RECORD setup correct.

5.3.4 VERIFY setup parameters are configured per Table 1.

TABLE 1 - GAUGE SETUP PARAMETERS

PARAMETER	DESIRED VALUE	✓ = OK
Baud rate	~~2400~~ 1200 (RG 6-3-98)	✓
Turn Around	800	✓
Scan Rate	2	✓

PARAMETER	VALUE - Per Test Engineer
CIU address	0
Gauge Address	00
Comm Port	1

5.3.5 IF any parameters in Table 1 are incorrect, PLACE cursor in associated text window AND

CHANGE parameter.

5.3.6 WHEN all parameters are correct.

THEN SELECT "Ok".

5.3.7 RECORD gauge setup correct.

5.3.8 SELECT "Setup" then "Gauge Setup/Config." from Enraf Control Panel.

NOTE - Enraf Control Panel shows a progress bar as it polls the gauge.

5.3.9 WAIT while program connects to gauge,

THEN VERIFY "Gauge Setup/Configuration" screen OPENS.

5.3 CHECK COMMUNICATIONS AND GAUGE SETUP (Cont.)

NOTE - Two-letter "code" (xx) associated with each parameter is sent to gauge to change the respective parameter setting.

5.3.10 VERIFY gauge parameters are set correctly per Table 2.

TABLE 2 - GAUGE PARAMETERS

PARAMETER	DESIRED VALUE	✓ = OK
Level Dimension (LD)	Inches	✓
Density Dimension (DI)	Kg/m3	~~Seep.~~ XXX
Transmission Speed (TS)*	~~2400~~ 1200 [illegible] 6-3-98 RG 6-3-98	✓
Tank Top Level (TT)	6-TF-125 Data Sheet	✓
Reference Level (RL)	6-TF-125 Data Sheet	✓
SPU Error (ES)**	0000	✓
XPU Error (EP)**	000	✓
Density Scan Direction (SD)	Down	✓
Transmission Address (TA)*	Same as CIU Setup from Step 5.3.4	✓
Level Type (DE)	Innage	✓
Display Format (DF)	Level + Gauge Status	✓

* Must be changed using Portable Enraf Terminal (PET).
** Incorrect value must be resolved by Instrument Tech.

XXX See p 33 of 43 — 7/6/98 1100 density is in units of Kg/m³

5.3.11 CLOSE "Gauge Setup/Config" window.

5.3.12 IF any parameters in Table 2 are incorrect, CHANGE incorrect parameters as follows; OTHERWISE,

GO TO step 5.3.13.

NOTE - "Operate Enraf" screen can also be opened by selecting "Action" then "Operate Enraf".

5.3.12.1 SELECT "Send" from "Enraf Control Panel" screen.

5.3.12.2 VERIFY "Operate Enraf" screen OPENS.

5.3.12.3 PLACE cursor in "Command Entry" window.

5.3 CHECK COMMUNICATIONS AND GAUGE SETUP (Cont.)

5.3.12.4 ENTER "W1=ENRAF1" AND SELECT "Send".

5.3.12.5 WHEN the "Service Level Command..." screen opens, ENTER the password (obtained from the Test Director).

5.3.12.6 PLACE cursor in "Command Entry" window.

5.3.12.7 ENTER "W2=ENRAF2" AND SELECT "Send".

5.3.12.8 WHEN the "Service Level Command..." screen opens, ENTER the password (obtained from the Test Director).

5.3.12.9 ENTER desired parameter in "Command Entry" Window per Table 3, AND SELECT "Send".

TABLE 3 - PARAMETER ENTRY FORMATS

COMMAND	COMMAND FUNCTION
LD=I	SETS LEVEL UNITS TO "INCHES"
DI=K	SETS DENSITY UNITS TO "Kg/m3"
SD=U	SETS DENSITY SCAN DIRECTION TO "UP"
DE=I	SETS LEVEL TYPE TO "INNAGE"
DF=B	SETS DISPLAY TO READ LEVEL AND GAUGE STATUS
RL=+xxxxx.xx	SMALL x IS NUMBER TO BE ENTERED. ADD LEADING ZEROS IF NOT LISTED IN 6-TF-125 DATA
TT=+xxxxx.xx	SAME AS "RL" ABOVE
TI=ABxyz.D	ABxyz IS EQUIVALENT TO TANK NAME (AY102)

5.3.12.10 CHECK "Communication Record" window as follows:

A. IF response includes "&" (command accepted), GO TO step 5.3.12.11.

NOTE - Error message will also appear when command is not accepted.

B. IF response includes "!" (command NOT accepted), RESEND command AND

GO TO step 5.3.12.10.D.

5.3 CHECK COMMUNICATIONS AND GAUGE SETUP (Cont.)

C. **IF** response is three or less characters in length {e.g., "1@0"} (error in communications), **SELECT** "L" in "Enraf Control Panel" screen, **AND**

GO TO step 5.3.12.10.D.

D. **IF** command is accepted ("&") on second attempt, **GO TO** step 5.3.12.11; **OTHERWISE**,

GO TO Section 5.9.

5.3.12.11 **REPEAT** steps 5.3.12.9 and 5.3.12.10 for each parameter to be changed.

5.3.12.12 **ENTER** "EX" **AND SELECT** "Send".

NOTE - Gauge reinitialization is indicated by "I1" in line 2 of the gauge display and may take a minute or two to appear.

5.3.12.13 **WAIT** until gauge reinitializes.

5.3.13 **RECORD** gauge parameters correct.

5.3.14 **SELECT** "UN" in "Operate Enraf" screen.

5.3.15 **WAIT UNTIL** gauge displacer moves down to rest on isolation ball valve (unless already there).

5.3.16 **WAIT** until "Gauge Display" window shows "xxx.xx in INN" (xxx.xx represents a level in inches).

NOTE - When TG command is issued "Gauge Display" in "Enraf Control Panel" screen will show "TG" on second line and exclamation points next to level reading (xxx.xx !! !!!).

5.3.17 **SELECT** "TG" in "Operate Enraf" screen.

5.3.18 **WAIT** until "Gauge Display" window shows "xxx.xx in INN" (TG completed).

5.3.19 **RECORD** current "Gauge Display" window level reading, **THEN SELECT** "CA" in "Operate Enraf" screen.

Level Reading 680.76

5.3 CHECK COMMUNICATIONS AND GAUGE SETUP (Cont.)

CAUTION

After selecting "CA" and then "Yes" to the WARNING, the displacer should not be permitted to raise all the way to the ENRAF adapter flange before performing step 5.3.21. This may cause serious errors within the gauge.

5.3.20 **WHEN** "WARNING: You are about to Raise the Displacer" appears, **SELECT** "Yes".

5.3.21 **WAIT** no more than two seconds, **SELECT** "FR" in "Operate Enraf" screen.

5.3.22 **REQUEST** Health Physics Technician to monitor for increases in dose rates.

5.3.23 **ENSURE** "Gauge Display" window level reading increases (displacer raised).

5.3.24 **RECORD** Section 5.3 complete.

5.3.21.1 Ensure "..You must use PET..." message appears, then click okay. [initials] 6-3-98
RG 6-3-98

5.4 VERIFY RINSE SPOOL ASSEMBLY FUNCTIONS

5.4.1 IF isolation ball valve is CLOSED, **OPEN AND SECURE** isolation ball valve.

5.4.2 **TEST** rinse spool piece spray nozzles as follows:

5.4.2.1 **IF** using tank farm supply raw water, **GO TO** step 5.4.2.4.

5.4.2.2 **OBTAIN** truck with level indicating transmitter flush tank **OR** tank on skid.

5.4.2.3 **POSITION** flush pump and tank as close as possible to the densitometer.

NOTE - Authorization for the addition of flush water to either an active or inactive tank must be obtained from the Shift Manager. Operations supervisor's signature is required in Section 4.3 of this procedure and on the Data Sheet.

5.4.2.4 **RECORD** the tank number and tank liquid level on the Routine Liquid Level Flush Data Sheet from TO-020-420 **AND CHECK** the column for ENRAF.

5.4.2.5 **DISCONNECT** one of the existing densitometer hoses from one of the three spray nozzles **AND TAPE** the hose end.

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786-2

5.4 VERIFY RINSE SPOOL ASSEMBLY FUNCTIONS (Cont.)

128 psi

NOTE - The first connected nozzle shall be considered to be SPRAY NOZZLE 1.

5.4.2.6 **CONNECT** the flush assembly (see Figure 2) to the open spray nozzle.

NOTE - Marking the spray nozzles is beneficial in keeping track of which nozzles have been tested so that no nozzle is is tested more than once.

5.4.2.7 **MARK** the spray nozzle using any convenient method (e.g., marking pen, tape, chalk, rag hanging over the port, etc.).

5.4.2.8 **START** flush tank motor **OR OPEN** the raw water control valve, as applicable.

5.4.2.9 **ALLOW** pressure to stabilize **AND RECORD** pressure on OTP-320-010 Data Sheet.

5.4.2.10 **RESET** the stop watch.

NOTE - The stop watch needs to be started simultaneously with the reading of the water meter.

5.4.2.11 **REQUEST** an operator to read the water meter reading **AND START** the stop watch.

5.4.2.12 **RECORD** the water meter reading as the INITIAL water meter reading below.

302.79

INITIAL water reading (Nozzle 1) 35786.9 gallons

INITIAL water reading (Nozzle 2) 35784.6 gallons

INITIAL water reading (Nozzle 3) ~~35778.2~~ RG ~~35789.5~~ RG gallons ~~35781.8~~ 35781.9 788.8

NOTE - The stop watch needs to be stopped simultaneously with the reading of the water meter.

5.4.2.13 **WHEN** a minimum of 1 minute (60 seconds) has passed, **REQUEST** an operator to read the water meter reading **AND STOP** the stop watch.

5.4 VERIFY RINSE SPOOL ASSEMBLY FUNCTIONS (Cont.)

5.4.2.14 **RECORD** the water meter reading as the FINAL water meter reading below.

FINAL water reading (Nozzle 1) 35786.9 gallons

FINAL water reading (Nozzle 2) 35786.2 gallons

FINAL water reading (Nozzle 3) ~~357895~~ 35783.8 RG gallons

5.4.2.15 **RECORD** the time on the stop watch as the ELAPSED time below.

ELAPSED time (Nozzle 1) 60 seconds

ELAPSED time (Nozzle 2) 61 seconds

ELAPSED time (Nozzle 3) 6~~77~~ RG seconds

5.4.2.16 **CALCULATE** the flow rate using the following equations:

For Spray Nozzle 1:
FINAL water reading - INITIAL water reading = A (gal)

35789.0 - 35786.9 = 2.1 gal

A ÷ ELAPSED time = B (gal/sec)

2.1 ÷ 60 = .035 gal/sec

B x 60 sec/min = C (gpm)

.035 x 60 sec/min = 2.1 gpm

789.6

For Spray Nozzle 2:
FINAL water reading - INITIAL water reading = A (gal)

35786.2 - 35784.6 = 1.8 gal

A ÷ ELAPSED time = B (gal/sec)

1.8 ÷ 61 = ~~3~~ RG .034 gal/sec

B x 60 sec/min = C (gpm)

.034 x 60 sec/min = 1.8 gpm

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5.4 VERIFY RINSE SPOOL ASSEMBLY FUNCTIONS (Cont.)

For Spray Nozzle 3:
FINAL water reading - INITIAL water reading = A (gal)

~~35778.8~~ RG 35783.8 - ~~35789.5~~ RG 35781.9 = ~~11.3~~ RG 1.9 gal

A ÷ ELAPSED time = B (gal/sec)

1.9 ÷ 61 = .031 gal/sec

B x 60 sec/min = C (gpm)

.031 x 60 sec/min = 1.9 gpm

5.4.2.17 **STOP** flush tank motor **OR CLOSE** the raw water control valve, as applicable.

5.4.2.18 **RECORD** final water meter reading on Water Usage Data Sheet from TO-040-540.

5.4.2.19 **REPEAT** steps 5.4.2.6 through 5.4.2.18 **UNTIL** all three spray nozzles have been tested.

5.4.2.20 **RECORD** flow rate (gpm) for each of the three spray nozzles on OTP-320-010 DATA SHEET.

5.4.2.21 **DISCONNECT** flush assembly from nozzle.

5.4.2.22 **RECONNECT** the densitometer flush hose.

5.4.3 **DISCONNECT** flush assembly from water source.

5.4.4 **RECORD** Section 5.4 complete on OTP-320-010 DATA SHEET.

5.5 DETERMINE SEDIMENT LEVEL

5.5.1 **SELECT** DENSITY from "Enraf Control Panel" screen.

5.5.2 **WHEN** "Get Density Data" screen OPENS, **SELECT** "GET" next to "Sediment Level" window.

NOTE - Step 5.5.3 initializes communications if not already done.

5.5.3 **WHEN** "Dip Displacer?" warning appears, **SELECT** "YES".

5.5.4 **WHEN** "Input Wire Tension" window OPENS, **THEN:**

NOTE - Test Engineer may have operator click "Calculate" and use the "Buoyancy Calculation" to determine wire tension.

5.5.4.1 **OBTAIN** wire tension from Test Engineer,

5.5.4.2 **ENTER** obtained value in "Input Wire Tension" window,

5.5.4.3 **RECORD** "Wire Tension" value.

5.5.4.4 **CLICK** OK to input wire tension.

5.5.5 **WAIT** until sediment check is complete (as indicated by "System Status" window, located at bottom of "Get Density Data" screen, and "Output Log" window). ~~or until Test Engineer indicates to continue, clicking to Abort.~~ 6-12-98

5.5.6 **IF** prompted to restart Sediment Level Check (errors occurred), **REPEAT** steps 5.5.2 through 5.5.5.

5.5.7 **IF** repeated errors occur, **NOTIFY** Test Director and Test Engineer.

5.5.8 Test Engineer: **DETERMINE** whether heavier displacer is required, OR other causes.

~~5.5.8.1 Click stop scans button if it appears~~ 6-12-98

5.5.9 **IF** directed to install heavier displacer, **THEN:**

~~5.5.9.0 Click stop scans~~

5.5.9.1 **GO TO** procedure 6-TF-125, ENRAF SERIES 854 MAINTENANCE AND CALIBRATION.

5.5.9.2 **INSTALL** new displacer (300 grams max wt.),

5.5.9.3 **RETURN** to this procedure at Section 5.5.

5.5 DETERMINE SEDIMENT LEVEL (Cont.)

5.5.10 **SELECT** "Yes" when prompted to return displacer to tank waste surface.

5.5.11 **RECORD** Sediment Level on Attachment 4.

5.5.12 **PERFORM** Section 5.8,
THEN RETURN to step 5.5.13

5.5.13 **RECORD** Section 5.5 complete.

5.5.12.1 Repeat Steps 5.5.1 through 5.5.4

5.5.12.2 Wait until displacer is in liquid as directed by Test Engineer, then Click Abort.

5.5.12.3 Enter ~~Click~~ ~~Enter Command~~ [I1] in Operat Energ Window then click send

5.5.12.4 Click ~~Enter Command~~ [UN] in Operate Energ Window.

5.5.12.5 When Displacer reaches waste surface, Click CA then FR in Operate Energ window.

click Yes at Prompt then Click

[initials] 6-8-98

5.6 SINGLE INTERFACE DENSITY MEASUREMENT

NOTES - This section verifies the ECP software will obtain a single interface density measurement as designed.

- Step 5.6.1 halts all communications and resets program windows and internal flags.

5.6.1 **SELECT** "Connect" then "Reset Program" from "Enraf Control Panel" screen.

5.6.2 **ENSURE** isolation ball valve is OPEN.

5.6.3 **SELECT** "Density" from "Enraf Control Panel" screen.

5.6.4 **OBTAIN** a current waste level from TMACS, **AND RECORD.**

5.6.5 **ENTER** level recorded in step 5.6.4 minus 24 inches in "Start Level" window.

302.77 (Level from step 5.6.4) - 24 = 278.77 in.

5.6.6 **ENTER** sediment level from step 5.5.11 in "Sediment Level" window.

5.6.7 **ENTER** "-1" in "Interval (inches)" window.

5.6.8 **SELECT** Scan Direction "Down".

5.6.9 **SELECT** "Go".

5.6.10 **VERIFY** gauge animation indicates displacer moving DOWN, **AND RECORD.**

NOTE - Once displacer reaches Start Level, density measurement may take up to ten minutes.

- Dialogue window appears when density profile is complete.

5.6.11 **WAIT** until dialogue window with log file name and "View File?" prompt appears, **THEN SELECT** "Yes".

5.6 SINGLE INTERFACE DENSITY MEASUREMENT (Cont.)

5.6.12 **RECORD** the Density Data filename of the density log file.

Density Data Filename C:\PROGRAM FILES\ENRAF CONTROL PANEL\ .DAT DENSITY\20422000.DAT

5.6.13 **VERIFY/RECORD** "Output Log" file results:

5.6.13.1 File reports single density value

5.6.13.2 Density is at level entered in step 5.6.5.

5.6.13.3 Log file "Average Density" value.

5.6.13.4 Log file "Density" value.

5.6.14 **SELECT** "File" then "Exit" from the "ECP File Editor" screen.

5.6.15 **ENSURE** a 3.5 inch floppy disk is in the floppy drive **AND SELECT** "File" then "Copy DAT to floppy" from the "Enraf Control Panel" screen.

5.6.16 **ENSURE** the correct file from step 5.6.12 is shown in the "Copy to Disk?" screen.

5.6.17 **IF** the incorrect file name is shown, **CONTACT** the Test Engineer for assistance in locating the correct file.

5.6.18 **SELECT** "Yes" from the "Copy to Disk?" screen.

5.6.19 **IF** a floppy is not yet in the drive, **INSERT** it now **AND SELECT** "OK" at the "Insert disk into drive a:" screen.

5.6.20 **IF** the "Overwrite?" screen appears, **THEN SELECT** "Cancel" **AND CONTACT** the Test Engineer for assistance.

5.6.21 **CLICK** "Setup," **THEN SELECT** "PCET".

5.6.22 **WHEN** "SERVICE PASSWORD ENTRY" screen OPENS, **THEN ENTER** the password (obtained from the Test Director) **AND SELECT** "Ok".

5.6.23 **VERIFY** "PC Enraf Terminal" screen OPENS.

NOTE - "SC" is the command name to return the average density value calculated by the gauge. The gauge actually takes 10 measurements at the single point.

5.6.24 **ENTER** "SC" in "Command Entry" window **AND SELECT** "Send".

5.6 SINGLE INTERFACE DENSITY MEASUREMENT (Cont.)

5.6.25 **RECORD** "SC" value returned in "Communications Record" window, **AND VERIFY** it matches "Average Density" in step 5.6.13.3.

NOTE - "R0" (letter "R", number "0") is the command that returns the first measurement in the 10 measurement scan. R0 thorugh R9 will be the same number for an interface measurement.

5.6.26 **ENTER** "R0" (letter R, number zero) in "Command Entry" window **AND SELECT** "Send".

5.6.27 **RECORD** "R0" value returned in "Communications Record" window, **AND VERIFY** it matches "Density" in step 5.6.13.4.

5.6.28 **PERFORM** Section 5.8,
THEN RETURN to step 5.6.29.

5.6.29 **RECORD** Section 5.6 complete.

5.7 MULTIPLE INTERFACE DENSITY PROFILE

5.7.1 **SELECT** "Density" from "Enraf Control Panel" screen.

5.7.2 **ENTER** level from step 5.6.5 in "Start Level" window. ~~79.00~~ 89.

5.7.3 **ENTER** sediment level from step 5.5.11 in "Sediment Level" window. 17

5.7.4 **ENTER** "12" in "Interval (inches)" window.

5.7.5 **SELECT** Scan Direction "Down".

5.7.6 **SELECT** "Go".

5.7.7 **VERIFY** gauge animation indicates displacer moving DOWN, **AND RECORD.**

NOTE - Dialogue window appears when density profile is complete.

5.7.8 **WAIT** until dialogue window with log file name and "View File?" prompt appears, **THEN SELECT** "Yes".

5.7.9 **RECORD** the ~~Density~~ Data File. filename from the "ECP file Editor" screen.

Density Data Filename C:\Program Files\EnRAF control Panel\Density DAT \20422002.DAT DATE: x 06-10-1998 Time: 09:44:31

5.7.10 **RECORD** "Start Level" from 5.6.4 and "Sediment Level" from step 5.5.11.

5.7.11 **PERFORM** calculation for Expected Number Of Measurements on data sheet.

5.7.12 **VERIFY/RECORD** "Output Log" file results:

5.7.12.1 Number of density measurements in log file.

5.7.12.2 All density values 0.95 to 1.1 SpG.

5.7.12.3 Last log file "Density" value.

5.7.13 **SELECT** "File" then "Exit" from the "FCP File Editor" screen.

5.7.14 **ENSURE** a 3.5 inch floppy disk is in the floppy drive **AND SELECT** "File" then "Copy DAT to floppy" from the "Enraf Control Panel" screen.

5.7 MULTIPLE INTERFACE DENSITY PROFILE
REDLINE PAGE

NOTE - The PET need not be connected to the gauge if the ECP program is used. If the ECP is used, the "ENTER command" action is performed by either clicking the appropriate button in the "Operate Enraf" screen, or entering the command in the "Command Entry" window and then clicking the "Send" button or pressing <ENTER> to execute the command.

5.7.A **CONNECT** the PET to the gauge (if required).

5.7.B **ENTER** command [I2] to lower displacer into waste.

5.7.C **WHEN** the displacer reaches a level of 280 inches, **ENTER** command [FR].

5.7.D **ENTER** command [MF] to weigh the displacer.

5.7.E **WHEN** "FR" appears in the PET display, **ENTER** command [WQ].

5.7.F **RECORD** the displacer weight.

Displacer wt. in liquid 113.79130 grams

5.7.G **ENTER** command [I1], then [UN].

5.7.H **WHEN** the displacer reaches the waste surface, **ENTER** command [CA] to raise it approximately 6 inches above the surface. **STOP** the displacer with the [FR] command.

5.7.I **DISCONNECT** the PET from the gauge.

[signature] 6-10-98

89
17
62
6
12)62

5.7 MULTIPLE INTERFACE DENSITY PROFILE (Cont.)

5.7.15 **ENSURE** the correct file from step 5.7.9 is shown in the "Copy to Disk?" screen.

5.7.16 **IF** the incorrect file name is shown, **CONTACT** the Test Engineer for assistance in locating the correct file.

5.7.17 **SELECT** "Yes" from the "Copy to Disk?" screen.

5.7.18 **IF** a floppy is not yet in the drive, **INSERT** it now **AND SELECT** "OK" at the "Insert disk into drive a:" screen.

5.7.19 **IF** the "Overwrite?" screen appears, **THEN SELECT** "Cancel" **AND CONTACT** the Test Engineer for assistance.

5.7.20 **CLICK** "Setup", **THEN SELECT** "PCET".

5.7.21 **WHEN** SERVICE PASSWORD ENTRY screen OPENS, **THEN ENTER** the password (obtained from the Test Director) **AND SELECT** "Ok".

5.7.22 **VERIFY** "PC Enraf Terminal" screen OPENS.

5.7.23 **ENTER** "R9" in "Command Entry" window **AND SELECT** "Send".

5.7.24 **RECORD** "R9" value returned in "Communications Record" window, **AND VERIFY** it matches "Last Density" in step 5.7.12.3.

5.7.25 **CLOSE** the "PC Enraf Terminal" screen.

5.7.26 **PERFORM** Section 5.8, **THEN RETURN** to step 5.7.27.

5.7.27 **RECORD** Section 5.7 complete.

5.8 WASHING DISPLACER AND WIRE

NOTE - This section is performed as called out in other sections of this procedure. The ECP software is not used.

5.8.1 **IF** not already connected, **CONNECT** PET to gauge per Test Director instruction.

NOTES - Do not return displacer to the waste surface when flushing is complete.

- The 1/4" male to 3/8" female adapter is not needed for routine flushing, just the standard flush rig from TO-020-420.

5.8.2 **FLUSH** per procedure TO-020-420 **AND** 6-TF-125, Section 5.6, until the displacer visually appears to be clean and dose rate, as measured by the Health Physics Technician, is no longer being reduced, OR as directed by the Test Director.

5.8.3 **ENTER** command [W2=ENRAF2].

5.8.4 **ENTER** command [DW=+xxxxxxxxE+03] where .xxxxxxxx is the last recorded displacer weight on the 6-TF-125 data sheet (during flushing). +.22860000E+03

5.8.5 **ENTER** command [S1=+.xxxxxxxxE+03] where .xxxxxxxx is the DW value above minus 15 grams.

5.8.6 **REPEAT** step 5.8.5 for [S3] and [RM].

5.8.7 **ENTER** command = [EX].

5.8.8 **WAIT** for the gauge to reinitialize, **THEN**

ENTER command = [FR] (not returning displacer to waste surface).

(1) WQ = +.24296711E+03
-15
.227

(2) WQ = + .24464172 E+03
-15
229

5.9 FAULT RECOVERY

NOTE - The following steps are performed if a fault condition occurs with the gauge. It may not be necessary to perform all steps in order to recover.

5.9.1 **SELECT** "L" in "Enraf Control Panel" screen.

5.9.2 **WAIT** while program attempts to connect to gauge, if not already, and obtain a level reading.

5.9.3 **IF** "Gauge Display" window returns a valid level reading (xxx.xx in INN or !'s), **EXIT** this section.

5.9.4 **SELECT** "Setup, **THEN SELECT** "PCET".

5.9.5 **WHEN** "SERVICE PASSWORD ENTRY" screen OPENS,
THEN ENTER "ecpws" in password window **AND SELECT** "Ok".

5.9.6 **VERIFY** "PC Enraf Terminal" screen OPENS.

5.9.7 **SELECT** "Get a Level".

5.9.8 **IF** "Gauge Display" window shows valid level (xxx.xx in INN or !'s),
THEN SELECT "Close" in "PC Enraf Terminal" screen **AND**

RETURN to the section that called out this section.

5.9.9 **ENTER** "W2=ENRAF2" in "Command Entry" window **AND SELECT** "Send".

5.9.9.1 **WAIT** until "&" is returned in "Communications Record" window,
THEN WAIT approximately 15 seconds additional.

5.9.9.2 **ENTER** "EX" in "Command Entry" window **AND SELECT** "Send".

5.9.9.3 **WAIT** for gauge to reinitialize,
THEN WAIT approximately 30 seconds additional.

5.9.9.4 **SELECT** "Get a Level".

5.9 FAULT RECOVERY (Cont.)

CAUTION

If displacer is too high up in the riser when LT command is issued, it may be drawn too far up into the gauge causing permanent damage. The Test Director may verbally authorize LT command to be issued, but displacer must be halted before it enters the gauge (less than 3 seconds).

5.9.9.5 **IF** a valid level is returned,
THEN:

A. **SELECT** "LT" **AND WAIT** approximately 3 seconds,

B. **SELECT** "FR".

C. **IF** displacer RAISES,
THEN:

- **ENTER** "EP" in "Command Entry" window.
- **SELECT** "Send".
- **CHECK** error codes in "Communications Record" window.

- **ENTER** "ES" in "Command Entry" window.
- **SELECT** "Send".
- **CHECK** error codes in "Communications Record" window.

D. **IF** there are NO error codes, **SELECT** "Close" in "PC Enraf Terminal" screen **AND EXIT** this section.

5.9.10 **IF** gauge will not clear using above steps, **NOTIFY** Test Director.

5.10 TEST CLOSURE

5.10.1 **FILL OUT** a Water Usage data sheet encompassing the entire test usage.

(QC) 5.10.2 QUALITY CONTROL: **REVIEW** all attachments for completeness, legibility, and accuracy.

QUALITY CONTROL SIGNATURE/DATE: WR Adams / 7/6/98

5.10.3 Listed reviewers **SIGN** below indicating all acceptance criteria has been met and that the installed Enraf Advanced Technology Gauge Densitometer, Communication Interface Unit, and Enraf Control Panel software program is functional and ready for operational use.

TEST DIRECTOR: R. Gutierrez	DATE: 6/10/98
COG ENGINEER: [signature]	DATE: 7-6-98
DST SHIFT MANAGER: [signature]	DATE: 7-7-98

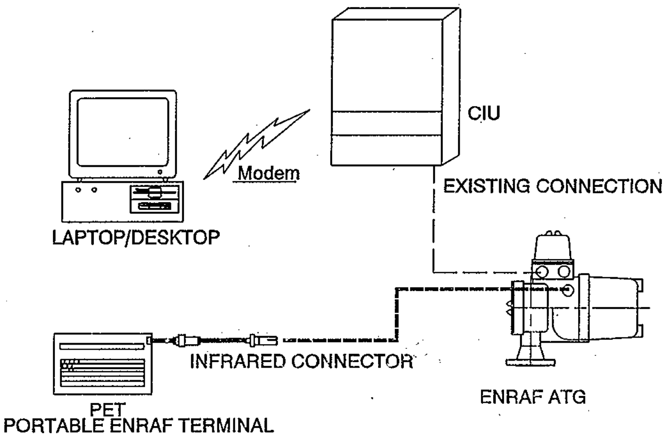
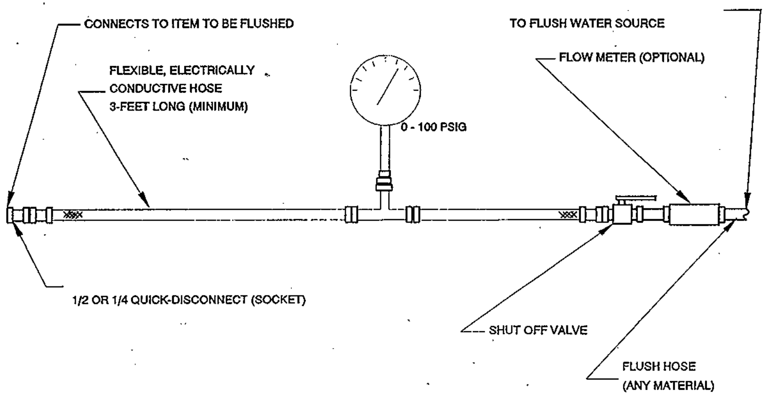


FIGURE 1 - DENSITOMETER TEST SETUP DIAGRAM

FIGURE 2 - SUGGESTED PRESSURE TEST SETUP

EXAMPLE ONLY



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ATTACHMENT 1 - OTP-320-010 TEST LOG

OTP-320-010 Page: 1 of 3

TIME/DATE	DESCRIPTION
0800/6-3-98	Held Pre-job at 272AW, package released for field work.
0830/6/3/98	Personnel all aced in E-1034-Rev 1
0855/6/3/98	arrived at AY change trailer, farm closed due to low flow alarm at A-Complex.
0930/6-3-98	Access to A Complex restored.
0945/6-3-98	commenced OTP-010, flushed three nozzles on densitometer.
	Inst. Tech set up portable lap top to CIU unit. Had minor problems setting up communication lines with instruments.
11:30/6-3-98	Exited farm for lunch
12:45/6-3-98	Entered Farm to continue OTP-010.
	Inst. Techs continued setting up the lap Top computer to the CIU.
1320/6-3-98	Low Flow alarm activated (evacuation alarm) in A-Complex, exited farm.
1350/6-3-98	Access to A-Complex restored.
1400/6-3-98	Continued with Section 5.3 of OTP, set up lap top with CIU.
1500/6-3-98	Exited A Complex. Inst. Techs completed Section 5.3 "Communications w/ Gauge and setup". Completed Section 5.4 "Rinse Spool Assembly functions". We are at Section 5.5

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ATTACHMENT 1 - OTP-320-010 TEST LOG

OTP-320-010	Page: 2 of 3
TIME/DATE	DESCRIPTION
1500/6/3/98	Continued from page 1.
	We stopped at this point due to time running
	out on us. Package 2E-98-937 suspended
	due to Operations attending Training class
	on W-320 sluicing on 6-4, 6-5.
	We will continue OTP-010 on 6-8-98.
	This page printed 6-3-98, 1635 pm. It is
	rev A-1 due to a PCA that was issued by
	Cog Eng. John Huber.
0900 6/8/98	Conducted pre-job for todays activities.
0930 6/8/98	Entered AY farm, programmed displacer weight
	and started OTP. Completed steps up
	to 5.7.7 The densitometer was
	unable to hold steady the 12 inch intervals
	that that were called out. Test Engineer to
	re-examine program tommorrow. We stopped
	at this step (5.7.7) to allow Test Engineer to
	look at program.
0800 6/10/98	Conducted pre-job for todays activities
	Opened up ball valve and lowered displacer
	to start section 5.7. Ran multiple
	checks on densitometer.

ATTACHMENT 1 - OTP-320-010 TEST LOG

OTP-320-010	Page: 3 of 3
TIME/DATE	DESCRIPTION
1100/7-6-98	Performed work package 2E-98-1244 to ~~reple~~
	calibrate a new displacer and install it on the gauge.
	This work supported disposition of exceptions 5+8.
	The new densities came in within tolerance & expected range
	(1039 kg/m3).

ATTACHMENT 2 - OTP-320-010 TEST EXCEPTION REPORT

OTP-320-010 Page: 1 of 9

TEST PROCEDURE NO. & SECTION:	TEST NAME:	EXCEPTION TRACKING NUMBER:
5.3.4 & 5.3.10	Densitometer OTP	001

DESCRIPTION OF PROBLEM:
The baud rate was changed to 1200 rather than 2400. Problems were encountered when trying to get the computer, CIU & gauge to communicate at 2400 baud. All worked fine at 1200. ~~[illegible]~~

ORIGINATOR: John Huber	ORG: SSTE	IMPACT ON TESTING: ☐ HOLD FOR RESOLUTION ☒ CONTINUE
	DATE: 6-12-98	TEST DIRECTOR: DATE:

DISPOSITION: Setup all communications baud rates (on computer, CIU & gauge) at 1200. Retest: rerun 5.3.

Change Incorporated by PCA: ~~ETF-98-0317~~ ETF-98-~~0317~~ 0385 [illegible] 7/7/98

DISPOSITION APPROVED BY: [signature] TEST ENGINEER

DISPOSITION AND RETEST REQUIREMENTS COMPLETED BY:	DISPOSITION ACTIONS COMPLETE VERIFIED BY:
[signature] Mike Geffre DATE: 7-7-98	R. Gutierrez Rich Gutierrez DATE: 6/17/98
QAE CONCURRENCE WITH DISPOSITION (if required): 7/7/98 [initials] ~~[illegible]~~ WL Adams DATE: 7/7/98	RETEST COMPLETE VERIFIED BY: for JH Huber per Telecon [signature] John Huber DATE: 7/7/98

TEST EXCEPTION CLOSED:

TEST ENGINEER: [signature] DATE: 7-6-98

TEST DIRECTOR: R. Gutierrez DATE: 7-7-98

ATTACHMENT 2 - OTP-320-010 TEST EXCEPTION REPORT

OTP-320-010 Page: 2 of 89

TEST PROCEDURE NO. & SECTION:	TEST NAME:	EXCEPTION TRACKING NUMBER:
5.3.20	Densitometer OTP	002

DESCRIPTION OF PROBLEM:
The computer program will not allow a displacer to be raised upward if it is above ~~ae~~ a certain level, and requires that the PET be used. (This addresses certain radiological concerns) The procedure didn't allow for this limit.

ORIGINATOR: John Huber	ORG: SSTE	IMPACT ON TESTING: ☐ HOLD FOR RESOLUTION ☒ CONTINUE
	DATE: 6-12-98	TEST DIRECTOR: DATE:

DISPOSITION: After step 5.3.20, ~~skip~~ click "ok" at the "You must use the PET..." prompt. Then skip the remaining steps of the section. It is not essential that the displacer be raised at this point. No retest required.

DISPOSITION APPROVED BY: [signature] TEST ENGINEER

Change incorporated by PCA! ETF-98-~~0317~~ 0385 [initials] 7/7/98

DISPOSITION AND RETEST REQUIREMENTS COMPLETED BY:	DISPOSITION ACTIONS COMPLETE VERIFIED BY:
[initials] R. Gutierrez (Rich) DATE: 6/17/98	Rich Gutierrez (Rich Gutierrez) DATE: 6/17/98
QAE CONCURRENCE WITH DISPOSITION (if required):	RETEST COMPLETE VERIFIED BY:
7/7/98 wka ~~[initials]~~ WK Adams DATE: 7/7/98	N/A ~~John Huber~~ [initials] 6-12-98 DATE:

TEST EXCEPTION CLOSED:

TEST ENGINEER: [signature] DATE: 7-6-98

TEST DIRECTOR: R. Gutierrez DATE: 7-7-98

ATTACHMENT 2 - OTP-320-010 TEST EXCEPTION REPORT

OTP-320-010		Page: 3 of ~~8~~ 9
TEST PROCEDURE NO. & SECTION: 5.5.5	TEST NAME: Densitometer OTP	EXCEPTION TRACKING NUMBER: 003

DESCRIPTION OF PROBLEM: When trying to perform a sediment check, the ~~dis~~ gauge display on the program, PET & gauge showed "### ###" after the level value instead of "!!! !!!" or "in INN". Since the program is controlled by the "in INN" characters to tell ~~the~~ when the sediment level is obtained, the program went into an infinite loop. The test engineer had to decide, by the unchanging level readings, when the sediment had been ~~et~~ reached. The test engineer determined that the WM item in the gauge needed to change from "ANNN" to "AANN" which would "approve" the gauge for sediment level use.

ORIGINATOR: John Huber ORG: SSTE DATE: 6-12-98	IMPACT ON TESTING: ☐ HOLD FOR RESOLUTION ☒ CONTINUE TEST DIRECTOR: DATE:

DISPOSITION: ~~Test engineer to res fix the program and section re run section 5.5. Test engineer to determin Change "WM" to "ANNN" in the gauge~~ - okay [initials] 6-12-98 and continue with test. Since the sediment level was already determined and the sediment check had been successful ~~at~~ in shop & training classes, no need to rerun 5.5 (ALARA reasons). But completely check operation by repeating 5.5.1 through 5.5.4, ~~and~~ allow displacer to sink in liquid and verify that "### ###" does not appear. PCA OTP to reflect change. Change incorporated by PCA: ETF-98-0385 [initials] 7/7/98

DISPOSITION APPROVED BY: [signature] TEST ENGINEER

DISPOSITION AND RETEST REQUIREMENTS COMPLETED BY: R. Gutierrez DATE: 6/17/98	DISPOSITION ACTIONS COMPLETE VERIFIED BY: R. Gutierrez (Rich Gutierrez) DATE: 6/17/98
QAE CONCURRENCE WITH DISPOSITION (if required): WKA 7/7/98 ~~N/A~~ WK Adams DATE: 7/7/98	RETEST COMPLETE VERIFIED BY: [signature] John Huber DATE: 7-6-98

TEST EXCEPTION CLOSED:

TEST ENGINEER: [signature] DATE: 7-6-98

TEST DIRECTOR: R. Gutierrez DATE: 7-7-98

ATTACHMENT 2 - OTP-320-010 TEST EXCEPTION REPORT

OTP-320-010 Page: 4 of ~~8~~ 9

TEST PROCEDURE NO. & SECTION:	TEST NAME:	EXCEPTION TRACKING NUMBER:
5.7 ~~(First Run)~~ QA	Densitometer OTP	004

DESCRIPTION OF PROBLEM: The ~~pr~~ system attempted a multi-point profile without problems until it was noted that the second data point was obtained at twice the interval, then the 3rd + 4th were obtained at correct intervals. Also, the way the procedure was written, the system was going to attempt 23 density data points. The test engineer ~~ordered~~ requested an Abort.

ORIGINATOR: John Huber	ORG: 5STE	IMPACT ON TESTING: ☐ HOLD FOR RESOLUTION ☑ CONTINUE
	DATE: 6-12-98	TEST DIRECTOR: DATE:

DISPOSITION: Test engineer to fix program such that correct intervals are obtained, and when re-running the section, enter a start level of 89" + a sediment level of 17" to yield 6 data points. (ALARA concern).

DISPOSITION APPROVED BY: [signature] TEST ENGINEER

OTP revised by PCA for steps ~~(new)~~ (modified) 5.7.2 and 5.7.3; ~~by~~ ETF-98-0385 ~~0385~~ QHB 7/7/98

DISPOSITION AND RETEST REQUIREMENTS COMPLETED BY:	DISPOSITION ACTIONS COMPLETE VERIFIED BY:
[signature] John Huber DATE: 7-6-98	R. Gutierrez Rich Gutierrez DATE: 6/17/98
QAE CONCURRENCE WITH DISPOSITION (if required):	**RETEST COMPLETE VERIFIED BY:**
7/7/98 wha ~~N/A~~ WLAdams DATE: 7/7/98	R. Gutierrez Rich Gutierrez DATE: 6/17/98

TEST EXCEPTION CLOSED:

TEST ENGINEER: [signature] DATE: 7-6-98

TEST DIRECTOR: R. Gutierrez DATE: 7-7-98

ATTACHMENT 2 - OTP-320-010 TEST EXCEPTION REPORT

OTP-320-010 Page: 5 of 8 9

TEST PROCEDURE NO. & SECTION:	TEST NAME:	EXCEPTION TRACKING NUMBER:
5.7	Densitometer OTP	005

DESCRIPTION OF PROBLEM:
During original ~~test~~ run of 5.7, the ~~engin~~ test engineer ~~to~~ noted that the specific gravities were coming in too low. The engineer ~~requested that~~ provided a set of steps to perform that would obtain a displacement weight submerged in the liquid.

ORIGINATOR: John Huber	ORG: SSTE	IMPACT ON TESTING: ☐ HOLD FOR RESOLUTION ☒ CONTINUE
	DATE: 6-12-98	TEST DIRECTOR: DATE:

DISPOSITION: PCA the steps into the procedure. No retest required.

See Exception 008. [initials] 7/7/98

DISPOSITION APPROVED BY: [signature] TEST ENGINEER

DISPOSITION AND RETEST REQUIREMENTS COMPLETED BY:	DISPOSITION ACTIONS COMPLETE VERIFIED BY:
[signature] John Huber DATE: 7-6-98	R. Gutierrez Rich Gutierrez DATE: 6/17/98
QAE CONCURRENCE WITH DISPOSITION (if required):	**RETEST COMPLETE VERIFIED BY:**
7/7/98 WKA ~~N/A~~ WK Adams DATE: 7/7/98	N/A DATE:

TEST EXCEPTION CLOSED:

TEST ENGINEER: [signature] **DATE:** 7-6-98

TEST DIRECTOR: R. Gutierrez **DATE:** 7-7-98

ATTACHMENT 2 - OTP-320-010 TEST EXCEPTION REPORT

OTP-320-010	Page: ~~00~~ 6 of 89

TEST PROCEDURE NO. & SECTION:	TEST NAME:	EXCEPTION TRACKING NUMBER:
Attachment 4 Data Sheet	Densitometer OTP	006

DESCRIPTION OF PROBLEM: A number of typographical errors were found in the data sheet. ~~as well as~~ Also Sp G's were requested when density was required and vice versa.

ORIGINATOR:	IMPACT ON TESTING:
John Huber ORG: SSTE DATE: 6-12-98	☐ HOLD FOR RESOLUTION ☒ CONTINUE TEST DIRECTOR: DATE:

DISPOSITION: PCA the procedure to correct the data sheet typo's. However, markup the original data sheet and accept it as is for operational test report preparation. No retest required.

DISPOSITION APPROVED BY: [signature] TEST ENGINEER

Data Sheet (Attachment #4) was revised by PCA: ETF-98-0385 | 7/7/98

DISPOSITION AND RETEST REQUIREMENTS COMPLETED BY:	DISPOSITION ACTIONS COMPLETE VERIFIED BY:
[signature] John Huber DATE: 7-6-98	R. Gutierrez Rich Gutierrez DATE: 6/17/98
QAE CONCURRENCE WITH DISPOSITION (if required):	RETEST COMPLETE VERIFIED BY:
WKE 7/7/98 ~~N/A~~ WKAdams DATE: 7/7/98	N/A DATE:

TEST EXCEPTION CLOSED:

TEST ENGINEER: [signature] DATE: 7-6-98

TEST DIRECTOR: R. Gutierrez DATE: 7-7-98

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ATTACHMENT 2 - OTP-320-010 TEST EXCEPTION REPORT

OTP-320-010 Page: 7 of ~~8~~ 9

TEST PROCEDURE NO. & SECTION:	TEST NAME:	EXCEPTION TRACKING NUMBER:
OTP-320-010 General	Densitometer OTP	007

DESCRIPTION OF PROBLEM:
Exceptions were not filled out in the field, but marked ~~on~~ directly on the procedure. This was done to minimize time in the field (ALARA).

ORIGINATOR: John Huber	ORG: SSTE	IMPACT ON TESTING: ☐ HOLD FOR RESOLUTION ☒ CONTINUE
	DATE: 6-12-98	TEST DIRECTOR: DATE:

DISPOSITION:
Write up ~~exceptions~~ exceptions ~~in~~ at office, and get concurrence from original individuals involved in the test. No Retest required.

DISPOSITION APPROVED BY: [signature] TEST ENGINEER

DISPOSITION AND RETEST REQUIREMENTS COMPLETED BY:	DISPOSITION ACTIONS COMPLETE VERIFIED BY:
[signature] John Huber DATE: 7-6-98	R. Gutierrez (Rich Gutièrrez) DATE: 6/17/98
QAE CONCURRENCE WITH DISPOSITION (if required):	RETEST COMPLETE VERIFIED BY:
7/7/98 wka ~~N/A~~ WK Adams DATE: 7/7/98	N/A DATE:

TEST EXCEPTION CLOSED:

TEST ENGINEER: [signature] DATE: 7-6-98

TEST DIRECTOR: R. Gutierrez DATE: 7-7-98

ATTACHMENT 2 - OTP-320-010 TEST EXCEPTION REPORT

OTP-320-010		Page: 8 of 89
TEST PROCEDURE NO. & SECTION: 5.7	TEST NAME: Densitometer OTP	EXCEPTION TRACKING NUMBER: 008

DESCRIPTION OF PROBLEM: ~~the~~ As indicated in ~~excptt~~ exception 005, the densities were coming in too low.

ORIGINATOR: John Huber ORG: SSTE DATE: 6-12-98	IMPACT ON TESTING: ☐ HOLD FOR RESOLUTION ☒ CONTINUE TEST DIRECTOR: DATE:

DISPOSITION: At completion of ~~the~~ testing, initiate and execute a work package to replace the displacer and troubleshoot. The retest action here is to complete the new work package and resolve the out-of-specification densities.

DISPOSITION APPROVED BY: [signature] TEST ENGINEER

Work Package 2E-98-01244/W was initiated and successfully completed. [initials] 7/7/98

DISPOSITION AND RETEST REQUIREMENTS COMPLETED BY: [signature] John Huber DATE: 7-6-98	DISPOSITION ACTIONS COMPLETE VERIFIED BY: R. Gutierrez (Rick Gutierrez) DATE: 7-6-98
QAE CONCURRENCE WITH DISPOSITION (if required): [signature] Ron Cowgill DATE: 7-6-98 WK Adams 7/7/98	RETEST COMPLETE VERIFIED BY: N/A DATE:

TEST EXCEPTION CLOSED:

TEST ENGINEER: [signature] DATE: 7-6-98

TEST DIRECTOR: R. Gutierrez DATE: 7-6-98

ATTACHMENT 2 - OTP-320-010 TEST EXCEPTION REPORT

OTP-320-010		Page: 9 of 9
TEST PROCEDURE NO. & SECTION: Data Sheet/Multipoint 5.7	TEST NAME: ~~Op.~~ Densitometer OTP	EXCEPTION TRACKING NUMBER: 009
DESCRIPTION OF PROBLEM: ~~At step~~ Step 5.7.24, the R9 value was not equal to the last density recorded in the density log file.		
ORIGINATOR: John Huber ORG: SSTE DATE: 6-12-98	IMPACT ON TESTING: ☐ HOLD FOR RESOLUTION ☒ CONTINUE TEST DIRECTOR: DATE:	
DISPOSITION: ~~It~~ The R9 value should not be expected to equal the last value listed on the log file. The last value is ~~of~~ in fact, an average of R0 through R9, which may or may not be equal to R9. No retest required. DISPOSITION APPROVED BY: [signature] TEST ENGINEER		
DISPOSITION AND RETEST REQUIREMENTS COMPLETED BY: [signature] John Huber DATE: 7-6-98	DISPOSITION ACTIONS COMPLETE VERIFIED BY: R. Gutierrez Rich Gutierrez DATE: 6/17/98	
QAE CONCURRENCE WITH DISPOSITION (if required): wla ~~N/A~~ 7/7/98 WLAdams DATE: 7/7/98	RETEST COMPLETE VERIFIED BY: N/A DATE:	

TEST EXCEPTION CLOSED:

TEST ENGINEER: [signature] DATE: 7-6-98

TEST DIRECTOR: R. Gutierrez DATE: 7-7-98

ATTACHMENT 3 - OTP-320-010 SIGNATURE LOG

All persons involved in procedure performance, data recording, and verification or evaluation of test steps shall complete a log entry.

NAME (PRINT)	SIGNATURE	INITIALS
LG Hartley	LG Hartley	LH
Tim Pyle	[illegible]	TAP
Laura B Weiss	Laura B. Weiss	LW
Eric Hudspeth	[illegible]	E.H.
Michael B Geffre	MB Geffre	MG
R L TALBERT	R L [illegible]	RT
DK DICKEY	DK Dickey	DKD
R. Gutierrez	R. Gutierrez	RG
R A SPICER	RAS	RAS
ROBERT TAYLOR	Robert Taylor	RT
EVAN D. CLEVELAND	Evan D. Cleveland	EDC
Wendy Adams	WL Adams	WLA
JAMES H BUSSELL	J H Bussell	JHB

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ATTACHMENT 4 - OTP-320-010 DATA SHEET

DATE OF TEST:			RECORD	
STEP NUMBER	ITEM	EXPECTED RESULT	AS-FOUND VALUE	INITALS
5.1.4	SECTION 5.1 COMPLETE	TEST DIRECTOR INITALS/DATE	N/A	RG 6-3-98
5.2.7	SECTION 5.2 COMPLETE	TEST DIRECTOR INITALS/DATE	N/A	RG 6-3-98
5.3.3	CIU SETUP CORRECT	YES	O	RG 6-3-98
5.3.7	GAUGE SETUP CORRECT	YES	OO	RG 6-3-98
5.3.13	GAUGE SETUP CORRECT	YES	Yes	[illegible] 6-3-98
5.3.24	SECTION 5.3 COMPLETE	TEST DIRECTOR INITALS/DATE	Complete	[illegible]
5.4.2.9	FLUSH WATER SUPPLY PRESSURE	PRESSURE ≥80 PSI	120 (psi)	RG 6-3-98
5.4.2.18 1st PASS	SPRAY NOZZLE 1 FLOW	≥1.3 GPM	2.1 (gpm)	RG 6-3-98
5.4.2.18 2nd PASS	SPRAY NOZZLE 2 FLOW	≥1.3 GPM	1.8 (gpm)	RG 6-3-98
5.4.2.18 3rd PASS	SPRAY NOZZLE 3 FLOW	≥1.3 GPM	1.9 (gpm)	RG 6-3-98
5.4.4	SECTION 5.4 COMPLETE	TEST DIRECTOR INITALS/DATE	N/A	RG 6-3-98
5.5.4.3	WIRE TENSION	+0.5000000E+03 ①	50	[illegible] 06-03-98
5.5.11	SEDIMENT LEVEL	LESS THAN 156.00	7.08	[illegible] 06-03-98
5.5.13	SECTION 5.5 COMPLETE	TEST DIRECTOR INITALS/DATE	N/A	RG 6-8-98
5.6.4	TMACS WASTE LEVEL	LESS THAN ~~156.00~~ 400.00 [illegible] 6-8-98 ②	302.77	RG 6-8-98
5.6.10	DISPLACER MOVES DOWN	YES	YES	RG 6-8-98
5.6.13.1	ONE DENSITY VALUE	YES	YES	RG 6-8-98
5.6.13.2	LOG DENSITY LEVEL	EQUAL TO SEDIMENT LEVEL	278.77	RG 6-8-98
5.6.13.3	LOG FILE AVERAGE	~~0.95 TO 1.1 SpG~~ ③ *	928.28 ~~(SpG)~~	RG 6-8-98
5.6.13.4	LOG FILE DENSITY	0.95 TO 1.1 SpG ④ *	92828 (SpG)	RG 6-8-98
5.6.25	SC	EQUAL TO LOG FILE AVERAGE	928.28	RG 6-8-98

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ATTACHMENT 4 - OTP-320-010 DATA SHEET

DATE OF TEST:			RECORD	
STEP NUMBER	ITEM	EXPECTED RESULT	AS-FOUND VALUE	INITIALS
5.6.27	RO	EQUAL TO LOG FILE DENSITY	927.52 ~~927~~ RG 6-8-98	RG 6-8-98
5.6.29	SECTION 5.6 COMPLETE	TEST DIRECTOR INITIALS/DATE	N/A	RG 6-8-98
5.7.7	DISPLACER MOVES DOWN	YES	YES	RG 6-8-98
5.7.10	(89 - 17) = JH ~~62~~ 72 ÷ 12 = 6			JH 6-9-98
5.7.11	(Start Level - Sediment Level) ÷ 12 = Expected No. Measurements (Drop Decimals)			
5.7.12.1	NO. OF MEASUREMENTS RETURNED	VALUE ±1	6	JH 6-9-98 RG 6-10-98
5.7.12.2	ALL DENSITY VALUES IN RANGE	YES (0.95 TO 1.1 SpG) ⑥	* NO	JH 6-9-98 RG 6-10-98
5.7.12.3	LOG FILE LAST ~~DENSITY~~ SpG 98	0.95 TO 1.1 SpG ⑤	*.90232(SpG)	JH 6-9-98 RG 6-10-98
5.7.24	R9	EQUAL TO LOG FILE LAST DENSITY ⑦	* .89910	JH 6-9-98 RG 6-10-98
5.7.27	SECTION 5.7 COMPLETE	TEST DIRECTOR INITIALS/DATE	N/A	RG 6-10-98
5.10.3	TEST ACCEPTED	TEST DIRECTOR INITIALS/DATE	N/A	RG 7-6-98

COMMENTS (include step number): Comments below by GHP 7/7/98

① 5.5.14.3 ^ Revised value = 0.05000000E+03 — revised by PCA ETF-98-0385
② 5.5.14 ^ Revised value = 400.00 - revised by PCA ETF-98-0385
③ 5.6.13.3 ^ Log file average = 960 to 1100 Kg/m³, units changed from SpG to Kg/m³ - revised by PCA ETF-98-0385
④ 5.6.13.4 ^ Log file values = 0.96 to 1.1 SpG — revised by ETF-98-0385
⑤ 5.7.12.3 values = 0.96 to 1.1 SpG — revised by ETF-98-0385
⑥ 5.7.12.2 values - 0.96 to 1.1 SpG — revised by ETF-98-0385
⑦ 5.7.24 Density was changed to SpG — revised by ETF-98-0385

*See exception 005 & 008 for deviation on steps 5.6.13.3, 5.6.13.4, ~~5.6.28~~ 5.7.12.2, and 5.7.12.3. See exception 009 for deviation on step 5.7.24.

GHP 7/7/98

WORKING CO[illegible] Print[illegible] on: Jun 3, 98 6:58 am

PROCEDURE HISTORY SIGNATURE SHEET

Appendix B

Calculations

DESIGN CALCULATIONS

Prepared by: JH Huber/JH Bussell (for and JH Bussell) Checked by: PAT YOUNG (PAY) Page 1 OF 29
Date: 7/21/98 Date: 7/21/98

Subject: Analysis of Densitometer Density Readings

Introduction:

On June 8th, 1998 during execution of OTP-320-010, density readings of AY-102 liquid waste were obtained using the ENRAF 854 ATG Densitometer gauge. Readings were expected to be in the range of 960 Kg/m^3 to 1050 Kg/m^3. However readings were coming in at 930 Kg/m^3. It is desired to determine the equation governing the internal density calculations within the gauge. In addition, on June 10, 1998, a submerged weight of the displacer of 113.79 grams was obtained. The free weight of the displacer was recorded to be 242.12 grams. The displacer volume programmed into the gauge was 140.81 cm^3.

B.1 Derivation of the Density Equation

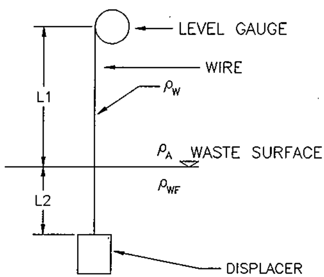


Figure 1

ρ_W = Wire Density
ρ_A = Ambient Air Density
ρ_{WF} = Waste Fluid Density
L1 = Wire Hang Length in Air
L2 = Wire Hang Length in Waste Fluid

Assumptions:

1. Hydrostatic influences are negligible due to relatively small size of displacer.
2. Density of the waste fluid is uniform to a point below the displacer.

DESIGN CALCULATIONS

Prepared by: JH Huber/JH Bussell
Date: 7/21/98

Checked by: PAT YOUNG
Date: 7/21/98

Subject: Analysis of Densitometer Density Readings

Free Body Diagram of the displacer:

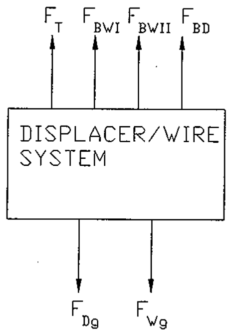


Figure 2

The body is at rest and static conditions apply, therefore vertical forces must sum to zero:

$$F_T + F_{BWI} + F_{BWII} + F_{BD} - F_{Dg} - F_{Wg} = 0 \quad (1)$$

Where :

F_T = Wire Tension Force Measured by Enraf Level Gauge
F_{BWI} = L1 Wire Buoyant Force in Air
F_{BWII} = L2 Wire Buoyant Force in Waste Fluid
F_{BD} = Displacer Buoyant Force
F_{Dg} = Displacer Weight
F_{Wg} = Weight of L1 and L2 Wire

DESIGN CALCULATIONS

Prepared by: JH Huber/JH Bussell Checked by: PAT YOUNG Page 3 OF 29
Date: 7/21/98 Date: 7/21/98

Subject: Analysis of Densitometer Density Readings

Rewritten in terms of density, ρ, gravitational acceleration, g, and the components' respective volumes, V, the forces become:

F_T = Measured Value by Enraf Level Gauge
$F_{BWI} = \rho_A V_{WL1} g$
$F_{BWII} = \rho_{WF} V_{WL2} g$
$F_{BD} = \rho_{WF} V_D g$
$F_{Dg} = \rho_D V_D g$
$F_{Wg} = \rho_W V_W g$

Where:

V_{WL1} = Volume of Wire Length L1 (in air)
V_{WL2} = Volume of Wire Length L2 (in waste fluid)
V_W = Volume of Wire Lengths L1 (in air) and L2 (in waste fluid)
V_D = Volume of Displacer
ρ_D = Density of Displacer
g = acceleration due to gravity

Substituting the relationship for the different force conditions into Equation 1, rearranging terms, and dividing by g yields:

$$\frac{F_T}{g} + \rho_A V_{WL1} - \rho_D V_D - \rho_W V_W = -\rho_{WF} V_{WL2} - \rho_{WF} V_D \qquad (2)$$

Solving for the density of the waste fluid yields:

$$\rho_{WF} = \frac{\rho_W V_W + \rho_D V_D - \frac{F_T}{g} - \rho_A V_{WL1}}{(V_{WL2} + V_D)} \qquad (3)$$

Equation (3) is the governing equation for the waste fluid density.

DESIGN CALCULATIONS

Prepared by: JH Huber/JH Bussell
Date: 7/21/98

Checked by: PAT YOUNG
Date: 7/21/98

Subject: Analysis of Densitometer Density Readings

B.1.1 Dimensional Analysis

a. The mass of the wire, L1 (in air) and L2 (in waste fluid), is given by:

$$M_W = \rho_W V_W$$

The units used for wire mass by the Enraf level gauge are grams with respect to the Enraf level gauge configuration. One programmable constant is used in the Enraf level gauge to calculate the mass of the wire:

[WW]=wire linear density in gm/m

The measured level parameter subtracted from the tank top constant [TT] provides the wire length in meters. The wire linear density is measured in air. The measured density includes the buoyant force. Hence the wire buoyant force in air term, $\rho_A V_{WL1}$, is not used by Enraf in their density calculation equation.

b. The free mass of the displacer is given by:

$$M_D = \rho_D V_D$$

The units used for the mass of the displacer are grams with respect to the Enraf level gauge configuration. Two programmable constants are used in the Enraf level gauge to define this equation:

[DW]=displacer free weight in gm (does not include the wire)

This displacer weight is in air.

[DV]=displacer volume

c. The submerged mass of the wire, L2, mass of the wire in air, L1, and the submerged mass of the displacer measured by the Enraf level gauge is given by:

$$M_s = \frac{F_T}{g}$$

DESIGN CALCULATIONS

Prepared by: JH Huber/JH Bussell Checked by: PAT YOUNG Page 5 OF 29
Date: 7/21/98 Date: 7/21/98

Subject: Analysis of Densitometer Density Readings

The units used for the mass of the submerged displacer and wire, L1 (in air) and L2 (in waste fluid) are grams. This quantity is a measured quantity. It can be manually obtained by requesting the weight of the displacer at the desired level.

d. The change in effective mass from the buoyant force from air on the wire, L1 (in air) is given by:

$$M_{WL1} = \rho_A V_{WL1}$$

This term is neglected by Enraf in their density calculation because it is small and wire weight is measured in air. See comparison of material densities shown below.

e. The units for V_{WL2} are in cubic centimeters. One programmable constant is used in the Enraf level gauge to calculate the immersed volume of wire:

[WV]=wire volume/length in cm^3/meter

The immersed volume is calculated by subtracting the level of the displacer from the tank level (surface). The resulting immersion depth is then multiplied by [WV] to obtain the immersion volume.

Equation (3) with units then becomes:

$$\rho_{WF}\ Kg/m^3 = \frac{M_W\ gm + M_D\ gm - M_S\ gm - (\rho_A V_{WL1})\ gm}{(V_{WL2}\ cm^3 + V_D\ cm^3)} \frac{Kg}{10^3\ gm} 10^6 \frac{cm^3}{m^3} \qquad (3)$$

DESIGN CALCULATIONS

Prepared by: JH Huber/JH Bussell Checked by: PAT YOUNG Page 6 OF 29
Date: 7/21/98 Date: 7/21/98

Subject: Analysis of Densitometer Density Readings

Now consider the following densities:

Material	Density
Air	0.001225 gm/cm^3
Waste Fluid	1 gm/cm^3 to 2 gm/cm^3
Wire Density	7.75 gm/cm^3 to 21.64 gm/cm^3

The buoyancy effects of air as fluid acting on the wire length L1 are negligible compared to the wire density (less than 0.01% of the wire density).

Rewriting Equation (3) neglecting the buoyancy of the wire in air term:

$$\rho_{WF}\ Kg/m^3 = \frac{M_W\ gm + M_D\ gm - M_S\ gm}{(V_{WL2}\ cm^3 + V_D\ cm^3)}\ \frac{10^3\ Kg\ cm^3}{gm\ \ m^3} \qquad (4)$$

Rewriting Equation (4) using the Enraf programmable constants defined above:

$$\rho_{WF}\ Kg/m^3 = \frac{[WW]*([TT] - D_n)\ gm + [DW]\ gm - M_S\ gm}{(([Y4] - D_n) * [WV]\ cm^3 + [DV]\ cm^3)}\ \frac{10^3\ Kg\ cm^3}{gm\ \ m^3} \qquad (5)$$

DESIGN CALCULATIONS

Prepared by: JH Huber/JH Bussell Checked by: PAT YOUNG Page 7 OF 29
Date: 7/21/98 Date: 7/21/98

Subject: Analysis of Densitometer Density Readings

Where:

Measured Quantities:

D_n=Level of displacer at a density measurement point in meters (This value is displayed in inches but for this calculation we will assume that it is in meters.)
[Y4]=is tank level (surface) in meters (This value is displayed in inches but for this calculation we will assume that it is in meters.)
M_s=Measured weight of submerged displacer and wire in grams

Programmed Constants (These constants are programmed when the Enraf level gauge is calibrated as a densitometer and are fixed.):

[WW]=wire linear density gm/m
[TT]=Tank Top level in meters (This value is programmed in inches but for this calculation it will be assumed that the value is in meters.)
[DW]=Displacer weight in gm
[DV]=Displacer volume in gm
[WV]=Wire linear density in cm^3/m

Rewriting Equation (4) in the form of the equation provided by Enraf:

$$\rho_{WF} Kg/m^3 = \frac{[DW]gm\ -\ Wire\ Tension(submerged)gm\ +\ Wire\ Weight\ gm}{([DV]\ cm^3\ +\ Immersed\ Wire\ Volume\ cm^3)} \frac{10^3 Kg\ cm^3}{gm\ \ m^3} \quad (6)$$

The wire tension term in the above equation includes the effective mass of displacer and attached wire. The wire weight term is mass of the wire, L1 (in air) and L2 (in waste fluid). Equation (7), below, was provided by Enraf. See page B-27 (calculation page 26) for a copy of the FAX from Enraf containing this equation.

DESIGN CALCULATIONS

Prepared by: JH Huber/JH Bussell Checked by: PAT YOUNG Page 8 OF 29
Date: 7/21/98 Date: 7/21/98

Subject: Analysis of Densitometer Density Readings

$$R_n Kg/m^3 = \frac{displacer\ weight\ gm - Wire\ Tension gm + Wire\ Weight\ gm}{(DV\ cm^3 + Immersed\ Wire\ Volume\ cm^3)} * A1 * \frac{10^3 Kg cm^3}{gm\ \ m^3} + amb.\ Air\ dens. + A2 \quad (7)$$

The terms A1 and A2 are calibration constants to permit a field calibration of the densitometer. Normally A1 is equal to 1.0 and A2 is equal to 0.0.

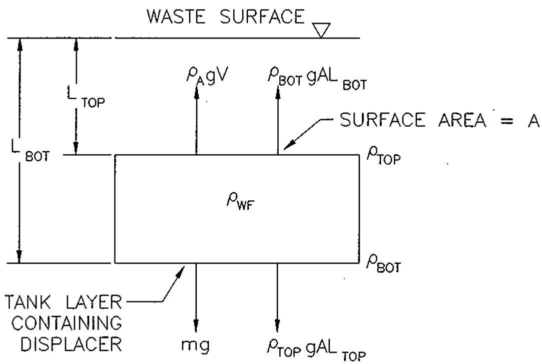
DESIGN CALCULATIONS

Prepared by: JH Huber/JH Bussell Checked by: PAT YOUNG Page 9 OF 29

Date: 7/21/98 Date: 7/21/98

Subject: Analysis of Densitometer Density Readings

Now consider the effect of buoyancy of waste layer on the measured density:



Where:

- A = Waste tank surface Area
- ρ_A = Density of air
- ρ_{TOP} = Waste fluid density at top of the tank layer containing the densitometer displacer
- ρ_{BOT} = Waste fluid density at bottom of the tank layer containing the densitometer displacer
- ρ_{WF} = Actual Waste Fluid Density
- mg = Weight of the tank layer containing the densitometer displacer
- g = Gravitational acceleration
- L_{TOP} = Distance to the top of the densitometer displacer
- L_{BOT} = Distance to the bottom of the densitometer displacer
- V = Volume of the tank layer containing the densitometer displacer
- m_{meas} = Measured mass of the tank layer containing the densitometer

The weight of the tank layer containing the displacer is:

$$m_{meas} g = gA(\rho_{TOP} L_{TOP} - \rho_{BOT} L_{BOT}) - \rho_A g V \quad (7A)$$

The pressure from the atmospheric pressure will cancel out because of the pressure difference in the term. The densities, ρ_{TOP}, ρ_{BOT}, ρ_{WF}, are nearly equal. Equation (7A) becomes after factoring out g and rearranging the first term in terms of the volume of the tank layer:

$$m_{meas} = \rho_{WF} V - \rho_A V \quad (7B)$$

Now solving for the measured density m_{meas}/V:

$$\rho_{meas} = \frac{m_{meas}}{V} = \rho_{WF} - \rho_A \quad (7C)$$

The variable, ρ_{meas}, is measured density of waste fluid. Now rearranging Equation (7C) to solve for ρ_{WF}:

$$\rho_{WF} = \rho_{meas} + \rho_A \quad (7D)$$

Equation (7D) is in the form of Equation (7) and the added ambient air density term has been justified. The programmable parameter [RF] should be programmed to 1.225 Kg/m^3 if it is desired to reference the density measurement to vacuum or [RF] should be programmed to 0.0 if is desired to reference the density measurement to air. In either case, the difference in measured density is very small, approximately 0.1%. For additional explanation, see section 3.2.1, Ambient air density correction, in reference 4.

DESIGN CALCULATIONS

Prepared by: JH Huber/JH Bussell — Date: 7/21/98

Checked by: PAT YOUNG — Date: 7/21/98

Subject: Analysis of Densitometer Density Readings

B.2 NUMERICAL ANALYSIS OF GAUGE DENSITY CALCULATION

From Vendor Fax information, Product Density (Rn):

$$Rn = \frac{DW(free) - DW(submerged) + Wire\ Weight}{DV + Immersed\ Wire\ Volume} * A1 * 1000 + amb\ Air\ dens. + A2$$

a. Calculate the AY102 tank waste density from data obtained on June 10, 1998 assuming Pt-Ir wire is being used and using the following assumptions:

Programmed Fixed Constants:

- [DW](free) = displacer weight = 242.12 gm
- [DV] = displacer volume =140.81 cm^3
- [A1] = Density correction factor = 1.0 (Ref. Vendor Fax)
- [A2] = Density correction offset = 0.0 (Ref. Vendor Fax)
- [RF] = amb. Air Dens.= 1.225 Kg/m^3 (Obtained from gauge)
  The density measurement is referenced to vacuum. This term is the change in density from buoyant force on the waste from air.
- [WV] = linear wire volume 0.032 cm^3/m (Obtained from gauge)
- [WW] = linear wire density 0.25 gm/m
- [TT] = tank top = 699.61 inches (Ref 6-TF-125 data sheet)
- [RF] = amb. Air Dens. = 1.225 Kg/m^3

Measured Values:

- [DW](submerged) = Wire Weight =113.79 gm
- Density Measurement Point Level = 280 inches
- Tank Level = 300 inches

Assumed Values

- Density of Platinum = 21.45 gm/cm^3 (Ref. 1)
- Density of Iridium = 22.42 gm/cm^3 (Ref. 1)
- Density of Pt + Ir Wire= 0.8*(21.45 gm/cm^3) + 0.2*(22.42 gm/cm^3) =
  21.644 gm/cm^3 (80%-Pt and 20% -Ir Wire)

DESIGN CALCULATIONS

Prepared by: JH Huber/JH Bussell (for and JH Bussell) Checked by: PAT YOUNG (P.A.Y.) Page 12 OF 29
Date: 7/21/98 Date: 7/21/98

Subject: Analysis of Densitometer Density Readings

Initial Calculations:

Extended wire length = TT - Level = 699.61 inches - 280 inches = 420.35 inches * 1 meter/39.37 inches = 10.68 meters

Wire Weight = 0.032 cm^3/m * 21.64 gm/cm^3 * 10.68 m = 7.40 gm

Immersed Wire Volume = Immersed Wire Length * [WV]

Immersed Wire Length = 300 inches - 280 inches = 20 inches * 1 meter/39.37 inches = 0.508 meters

Immersed Wire Volume = 0.508 meters * 0.032cm^3/m = 0.0162 cm^3

$$Rn_a = \frac{242.12\ gm - 113.79\ gm + 7.40\ gm}{140.81\ cm^3 + 0.0162\ cm^3} * 1.0 * 1000 \frac{Kg\ cm3}{gm\ m^3} + 1.225 \frac{Kg}{m^3} + 0.0$$

$$Rn_a = 965.04\ Kg/m^3 * \frac{gm\ m^3}{10^3\ Kg\ cm^3} = 0.965\ gm/cm^3 * \frac{cm^3}{1\ gm} = \underline{\underline{\mathbf{0.965\ SpG}}}$$

The above calculated specific gravity is a very interesting result since it is within the expected range specified in the OTP (0.96 to 1.1).

b. Now perform the calculation same calculation as in "a" assuming stainless steel wire:

Density of steel = 0.28 lb/in^3 * 1728 in^3/ft^3 * 16.018 Kg/m^3 / lb/ft^3 = 7750 Kg/m^3
(Conversion factor for Kg/m^3 to lb/ft^3 from Ref. 2)

7750 Kg/m^3 * 1000 gm/1Kg * 1m^3/1000000 cm^3 = 7.75 gm/cm^3

Wire Weight = 0.032 cm^3/m * 7.75 gm/cm^3 * 10.68 m = 2.65 gm

Wire Weight calculated by the gauge ([WW] = 0.25 gm/m):
0.25 gm/m * 10.68 m = 2.67 gm

Use the wire weight value, [WW], from Enraf level gauge in the calculation:

DESIGN CALCULATIONS

Prepared by: JH Huber/JH Bussell (signature) Checked by: PAT YOUNG (P.A.Y.) Page 13 OF 29
Date: 7/21/98 Date: 7/21/98

Subject: Analysis of Densitometer Density Readings

$$Rn_b = \frac{242.12\ gm - 113.79\ gm\ + 2.67\ gm}{140.81\ cm^3 + 0.0162\ cm^3} * 1.0 * 1000\ \frac{Kg\ cm3}{gm\ m^3} + 1.225\ \frac{Kg}{m^3} + 0.0$$

$$Rn_b = 931.45\ Kg/m^3 * \frac{gm\ m^3}{10^3\ Kg\ cm^3} = 0.931\ gm/cm^3 * \frac{cm^3}{1\ gm} = \underline{\underline{0.931\ SpG}}$$

The specific gravity is very close to the value measured on June 10, 1998 which was not within the expected range (0.96 to 1.1).

c. Now assume the displacer volume is 135cm^3, which is closer to design specification volumes.

Assume wire is Pt-Ir wire, wire weight = 7.40 gm.

$$Rn_c = \frac{242.12\ gm - 113.79\ gm\ + 7.40\ gm}{135\ cm^3 + 0.0162\ cm^3} * 1.0 * 1000\ \frac{Kg\ cm^3}{gm\ m^3} + 1.225\ \frac{Kg}{m^3} + 0.0$$

$$Rn_c = 1006.5\ Kg/m^3 * \frac{gm\ m^3}{10^3\ Kg\ cm^3} = 1.006\ gm/cm^3 * \frac{cm^3}{1\ gm} = \underline{\underline{1.006\ SpG}}$$

DESIGN CALCULATIONS

Prepared by: JH Huber/JH Bussell
Date: 7/21/98

Checked by: PAT YOUNG
Date: 7/21/98

Subject: Analysis of Densitometer Density Readings

d. It is evident from comparison of Rn_a and Rn_b that the wire weight is significant. The wire weight value for Platinum-Iridium wire needs to be converted to the format used by the gauge and programmed accordingly. (The wire weight value [WW] was reprogrammed in the Enraf level gauge by work package 2E-98-1244. See page C-16, work step 7.24.4, for this work instruction.)

Converting wire weight to [WW] format:

The [WW] value for stainless steel is 0.25 gm/m. This number is calculated by multiplying the [WV] value by the density of stainless steel as follows

[WV] * density of wire = [WW]:

0.032 cm^3/m * 7.75 gm/cm^3 = 0.248 gm/m ~ 0.25 gm/m

So, for the Platinum-Iridium wire:

0.032 cm^3/m * 21.64 gm/cm^3 = 0.692 gm/m ~ 0.69 gm/m

B.3 Error Analysis of Density Measurement

a. The analysis of the error can be developed by deriving the differential of Equation (3) and by summing the increments as the root of the sum of squares. This approach will provide a conservative error estimate.

Assume: Buoyant force of wire in the air term is negligible from Equation (3).. This term is three to four orders of magnitude smaller than the other terms. The term has been deleted starting with Equation (4) and this error analysis.

$$\Delta\rho_{WF} = \sqrt{\left(\frac{\partial\rho_{WF}}{\partial M_W}\Delta M_W\right)^2 + \left(\frac{\partial\rho_{WF}}{\partial M_D}\Delta M_D\right)^2 + \left(\frac{\partial\rho_{WF}}{\partial M_S}\Delta M_S\right)^2 + \left(\frac{\partial\rho_{WF}}{\partial V_D}\Delta V_D\right)^2 + \left(\frac{\partial\rho_{WF}}{\partial V_{WL2}}\Delta V_{WL2}\right)^2} \quad (7)$$

DESIGN CALCULATIONS

Prepared by: JH Huber/JH Bussell   Checked by: PAT YOUNG   Page 15 OF 29
Date: 7/21/98   Date: 7/21/98

Subject: Analysis of Densitometer Density Readings

Where:

ΔM_W = Error in wire mass measurement (L1 and L2)
ΔM_D = Error in displacer mass measurement
ΔM_S = Error in mass measurement of submerged displacer (wire + displacer)
ΔV_D = Error in displacer volume measurement
ΔV_{WL2} = Error in Immersed wire volume

Obtain the partial derivatives:

$$\frac{\partial \rho_{WF}}{\partial M_W} = K \cdot \frac{1}{(V_{WL2} + V_D)} \tag{8}$$

$$\frac{\partial \rho_{WF}}{\partial M_D} = K \cdot \frac{1}{(V_{WL2} + V_D)} \tag{9}$$

$$\frac{\partial \rho_{WF}}{\partial M_S} = K \cdot \frac{1}{(V_{WL2} + V_D)} \tag{10}$$

$$\frac{\partial \rho_{WF}}{\partial V_{WL2}} = K \cdot \frac{(M_2 + M_D - M_S)}{(V_{WL2} + V_D)^2} = \rho_{WF} \cdot \frac{1}{(V_{WL2} + V_D)} \tag{11}$$

$$\frac{\partial \rho_{WF}}{\partial V_D} = K \cdot \frac{(M_2 + M_D - M_S)}{(V_{WL2} + V_D)^2} = \rho_{WF} \cdot \frac{1}{(V_{WL2} + V_D)} \tag{12}$$

DESIGN CALCULATIONS

Prepared by: JH Huber/JH Bussell
Date: 7/21/98

Checked by: PAT YOUNG
Date: 7/21/98

Subject: Analysis of Densitometer Density Readings

Where:

$$K = 10^3 \frac{Kg\ \ cm^3}{gm\ \ m^3} \tag{13}$$

Substituting Equations (8) to (13) into Equation (7), group terms and move common factors outside the radical:

$$\Delta\rho_{WF} = \frac{K}{(V_{WL2} + V_D)} \sqrt{(\Delta M_W)^2 + (\Delta M_D)^2 + (\Delta M_S)^2 + (\frac{\rho_{WF}}{K} \cdot \Delta V_D)^2 + (\frac{\rho_{WF}}{K} \cdot \Delta V_{WL2})^2} \tag{14}$$

b. Analysis of error terms with respect to programmed constants in the Enraf level gauge

The purpose of the section is to provide short description of error sources.

Restating Equation (5) using the Enraf programmable constants defined above:

$$\rho_{WF}\ Kg/m^3 = \frac{[WW]*([TT] - D_n)\ gm + [DW]\ gm - M_S\ gm}{(([Y4] - D_n) * [WV]\ cm^3 + [DV]\ cm^3)} \ \frac{10^3\ Kg\ \ cm^3}{gm\ \ m^3} \tag{15}$$

The ambient air density, [RF] has not been considered in this analysis as it it fixed programmed constand.

DESIGN CALCULATIONS

Prepared by: JH Huber/JH Bussell
Date: 7/21/98

Checked by: PAT YOUNG
Date: 7/21/98

Subject: Analysis of Densitometer Density Readings

(1) ΔM_W =Error in wire weight
M_W = [WW]*([TT]-D_n)

[WW] is a programmable constant that does not change during operation of the Enraf level gauge.

[TT] is a programmable constant that does not change during the operation of the level gauge.

D_n is the level at which the density is measured.

Possible Errors:

1. Wire Length
   Level is specified to an accuracy of 1 mm and sensitivity of 0.1 mm.

2. Thermal expansion of the wire
   The wire is used in a relatively constant temperature environment.

(2) ΔM_D = Error in the displacer weight
M_D = [DW]

[DW] is a programmable constant that does change during the operation of the Enraf level gauge.

Possible Errors:

1. Initial weight or mass determination errors

2. Waste build-up on displacer weight from initial weight

(3) ΔM_S = Error in the weight of submerged displacer and wire
M_S = weight of submerged displacer and wire

Possible Errors:

1. Force transducer accuracy

2. Waste build-up on displacer and wire

DESIGN CALCULATIONS

Prepared by: JH Huber/JH Bussell
Date: 7/21/98

Checked by: PAT YOUNG
Date: 7/21/98

Subject: Analysis of Densitometer Density Readings

(4) ΔV_D = Error in displacer volume
V_D = [DV]

[DV] is a programmable constant that does not change during the operation of the Enraf level gauge.

Possible Errors:
1. Initial volume measurement determination errors
2. Waste build-up on displacer changing volume

(5) ΔV_{WL2} = Error in Immersed wire volume
V_{WL2} = ([Y4]-D_n)* [WV]

The wire weight for the entire wire L1 (in air) and L2 (in waste fluid) is based on the weight of the wire in air. The buoyant force on the immersed wire from the waste fluid is based on the measured density not on the actual density above the measurement point. However, the density of the waste fluid, in general, will be less than or nearly equal to the density at the measurement point. The other factor is that the ratio of the wire volume to the displacer volume is very small compared to the displacer volume, less than 0.05%. Thus, this error is negligible.

D_n is the level at which the density is measured.

Possible Errors:
1. Wire Length
   Level is specified to an accuracy of 1 mm and sensitivity of 0.1 mm.
2. Thermal expansion of the wire
   The wire is used in a relatively constant temperature environment.

DESIGN CALCULATIONS

Prepared by: JH Huber/JH Bussell Checked by: PAT YOUNG Page 19 OF 29
Date: 7/21/98 Date: 7/21/98

Subject: Analysis of Densitometer Density Readings

[Y4] = is tank level (surface)

Possible Errors:

1. Wire Length
   Level is specified to an accuracy of 1 mm and sensitivity of 0.1 mm.

2. Thermal expansion of the wire
   Wire is operated in a relatively constant temperature environment.

3. Waste build-up results in level error because of different immersion depth in waste

[WV] is a programmable constant that does not change during the operation of the Enraf level gauge.

Possible Errors:

1. Error is wire size

2. Waste build-up on wire changing wire volume per unit length

c. Now calculate the maximum mass error for a 5 Kg/m^3 density change:

Assume ρ_{WF} = 1000 Kg/m^3

Setting $\Delta\rho_{WF}$ = 5 Kg/m^3 and solving for ΔM_D:

$$\Delta M_D = 140.81\ cm^3 * \frac{gm\ cm^3}{1000\ Kg\ cm^3} * 5\ \frac{Kg}{m^3} = \pm 0.7\ gm$$

DESIGN CALCULATIONS

Prepared by: JH Huber/JH Bussell   Checked by: PAT YOUNG   Page 20 OF 29
Date: 7/21/98   Date: 7/21/98

Subject: Analysis of Densitometer Density Readings

d. Now calculate the maximum volume error for a 5 Kg/m^3 density change:

Assume ρ_{WF} = 1000 Kg/m^3

Setting $\Delta\rho_{WF}$ = 5 Kg/m^3 and solving for ΔV_D:

$$\Delta V_D = 140.81\ cm^3 * \frac{gm\ cm^3}{10^3\ Kg\ cm^3} * \frac{10^3\ Kg\ cm^3}{gm\ cm^3} * \frac{m^3}{10^3\ Kg} * 5\ \frac{Kg}{m^3} = \pm 0.7\ cm^3$$

DESIGN CALCULATIONS

Prepared by: JH Huber/JH Bussell Checked by: PAT YOUNG Page 21 OF 29
Date: 7/21/98 Date: 7/21/98

Subject: Analysis of Densitometer Density Readings

B.4 EFFECT OF WEIGHT DIFFERENCE ON FORCE TRANSDUCER

Some informal experiments were performed in the shop. It was noted that when requesting the gauge to weigh different calibrated weights, the force transducer was off by up to 4 gm at the high end (~300 gm) and less than 3 gm at the low end (~150 gm). The force transducer is calibrated at four points, 25 gm, 100 gm, 175 gm, and 250 gm. This indicates that force transducer error may be larger outside the calibrated range that within the calibrated range. This was discussed with the vendor who indicated that error should be linear within the range of the force transducer calibration. This range spans 25 gm to 250 gm. This is significant, because the weight error may not cancel when determining the difference between displacer free weight [DW] (free) and submerged weight, wire tension. Administratively, this means that procedures will need to be developed for in-field force transducer calibrations and displacer volume calibrations, and that displacer weights will need to be limited to 250 grams or less.

From B.3 above, the required weight error resulting in a 5 Kg/cm^3 change is ±0.7 gm. The specified density accuracy for instrument is ± 5 Kg/cm^3. As the weight error becomes larger the estimated error will increase proportionally with this error model.

B.5 THE EFFECT OF DISPLACER VOLUME ON DENSITY READINGS

From B.3, the maximum displacer volume error to limit the density error to 5 Kg/m^3 is ±0.7 cm^3. Thus, the volume of the displacer needs to be known within ~±0.5 cm^3.

DESIGN CALCULATIONS

Prepared by: JH Huber/JH Bussell | Checked by: PAT YOUNG | Page 22 OF 29
Date: 7/21/98 | Date: 7/21/98

Subject: Analysis of Densitometer Density Readings

B.6 NUMERICAL ANALYSIS OF THE EFFECT OF WASTE BUILD-UP ON DISPLACER ON DENSITY READINGS

A simplified numerical analysis will be performed considering 1 cm^3 of waste becomes attached to the displacer.

a. Assume that the specific gravity of the waste attached to the displacer is 1.0 and the waste has the same density as in B.2 c:

Displacer Measured Mass Change from Buoyant Forces = 1 gm - 0.931 gm = 0.07 gm

$$Rn_a = \frac{242.12\ gm - (113.79\ gm + 0.07\ gm) + 7.40\ gm}{135\ cm^3 + 1\ cm^3 + 0.0162\ cm^3} * 1.0 * 1000\ \frac{Kg\ cm^3}{gm\ m^3} + 1.225\ \frac{Kg}{m^3} + 0.0$$

$$Rn_a = 997.4\ Kg/m^3 * \frac{gm\ m^3}{10^3\ Kg\ cm^3} = 0.997\ gm/cm^3 * \frac{cm^3}{1\ gm} = \underline{0.997\ SpG}$$

b. Assume that the specific gravity of the waste attached to the displacer is 4.0 and the waste has the same density as in B.2 c:

Displacer Measured Mass Change from Buoyant Forces = 4 gm - 0.931 gm = 3.07 gm

$$Rn_b = \frac{242.12\ gm - (113.79\ gm + 3.07\ gm) + 7.40\ gm}{135\ cm^3 + 1\ cm^3 + 0.0162\ cm^3} * 1.0 * 1000\ \frac{Kg\ cm^3}{gm\ m^3} + 1.225\ \frac{Kg}{m^3} + 0.0$$

$$Rn_b = 976.5\ Kg/m^3 * \frac{gm\ m^3}{10^3\ Kg\ cm^3} = 0.977\ gm/cm^3 * \frac{cm^3}{1\ gm} = \underline{0.977\ SpG}$$

DESIGN CALCULATIONS

Prepared by: JH Huber/JH Bussell   Checked by: PAT YOUNG   Page 23 OF 29
Date: 7/21/98   Date: 7/21/98

Subject: Analysis of Densitometer Density Readings

c. Assume that the specific gravity of the waste attached to the displacer is 2.0 and the waste has the same density as in B.2 c:

Displacer Measured Mass Change from Buoyant Forces = 2 gm - 0.931 gm = 1.07 gm

$$Rn_c = \frac{242.12\ gm-(113.79\ gm + 1.07\ gm) + 7.40\ gm}{135\ cm^3 + 1\ cm^3 + 0.0162\ cm^3} * 1.0 * 1000\ \frac{Kg\ cm^3}{gm\ m^3} + 1.225\ \frac{Kg}{m^3} + 0.0$$

$$Rn_c = 991.3\ Kg/m^3 * \frac{gm\ m^3}{10^3\ Kg\ cm^3} = 0.9913\ g/cm^3 * \frac{cm^3}{1\ gm} = \underline{0.991\ SpG}$$

d. Results

SpG of Waste Attached to Displacer	Measured SpG	Error
No Waste Attached	1.006	
1.0	0.997	-0.9%
2.0	0.991	-1.5%
4.0	0.977	-2.9%

The above numerical analysis of three cases where waste builds up on the displacer shows that the measured density will be lower than the actual waste density. If the free weight of the displacer is reprogrammed with the new weight of the displacer then the density error can reduced by a significant amount. In the case of where the attached waste has SpG = 4.0, the error can be reduced to about -0.2%.

B.7 LIMIT ON WASTE SpG FOR 250 GRAM DISPLACER (VOL. 135 cm^3)

In B.4, it was stated that displacer weights will need to be limited to 250 gm or less. This limitation will place a corresponding limitation on waste density in which the densitometer can operate. There will be a waste specific gravity value at which the displacer will not sink. This calculation will assume a displacer volume of 135 cm^3, and using the tested 242 gm displacer mass.

The limit is equivalent to the SpG at which the buoyant force balances the displacer weight or in simpler terms, the displacer and waste fluid densities are equal :

$$Rn_{LIMIT} = \frac{242 \text{ gm}}{135 \text{ cm}^3} = 1.79 \text{ gm/cm}^3 * \text{cm}^3/1 \text{ gm} = \underline{1.79 \text{ SpG}}$$

B.8 CONCLUSIONS AND RECOMMENDATIONS

Three parameters were found to be of significance with regard to densitometer measurements.

1. Wire weight. The wire weights currently programmed in all ENRAF 854 ATGs are that for 316 stainless steel wire. However, the wire currently being used is 80%-Platinum-20%-Iridium, which is significantly heavier. Consequently,initial density readings were less than anticipated.

   RECOMMENDATION: Enter the 0.69 value into the [WW] item of the gauge. (The wire weight value [WW] was reprogrammed in the Enraf level gauge by work package 2E-98-1244. See page C-16, work step 7.24.4, for this work instruction.)

2. Force Transducer Error. The force transducer error is not linear for displacer weights outside of the calibration range. An accumulated error of as little as ±0.7 gram can effect the accuracy of density readings by as much as ±5 Kg/m^3.

   RECOMMENDATION: Develop procedure for in-field force transducer calibration and do not use displacers of weight 250 grams-force or greater.

DESIGN CALCULATIONS

Prepared by: JH Huber/JH Bussell
Date: 7/21/98

Checked by: PAT YOUNG
Date: 7/21/98

Subject: Analysis of Densitometer Density Readings

3. Displacer Volume. To acheive an accuracy of ± 5 Kg/m^3, the displacer volume must be verified to within ±0.5 cm^3.

   RECOMMENDATION: Develop procedure for initial displacer volume calibration to within 0.5 cm^3.

4. Ambient Air Density. The ambient air density, [RF], offsets the measured density to reference it to vacuum. If it is desired to reference it to air then the ambient air density, [RF], should be set to 0.0.

   RECOMMENDATION: Since the change is approximalely 0.1%, leave the ambient air density as is, [RF]=+.1225000e+01. It can easily be changed in the future.

References:

1. CRC Handbook of Chemistry and Physics, 50th Ed., The Chemical Rubber Co., Cleveland, Ohio, 1969.

2. Mechanical Engineering Reference Manual, 8th Ed., Professional Publications, Belmont, CA, 1990.

3. Instruction Manual Series 854 ATG Level Gauge, Version 2.3, Enraf Inc., March 1996 (Part No. 4416.220)

4. Instruction Manual Series HIMS Hybrid Inventory Management System with HPU/OPU-Board, Version 1.1, June 1998 (Part No. 4416.241)

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12 JUN '98 10:22 ENRAF B.V.

Enraf

FAX

6/12/98

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cc: Delft

Fax message

Fax to:	Enraf Inc.	From:	P. van Houten
Attention	Mr. G. Sellers	C.C.	E. Bretscher
Country	USA	Our ref.	.
Your ref.		Date	juni 12, 1998
Fax no.	Auto		

Number of pages (including this page): 1

Subject: **854 ATG DENSITY CALCULATION**

Dear Gayland,

With reference to the telephone conversation yesterday.

During the density measurement will be the density calculated as follow:

$$Rn = \frac{\text{displacer weight} - \text{wire tension} + \text{wire weight}}{DV + \text{immersed wire volume}} * A1 * 1000 + \text{amb. Air dens} + A2$$

displacer weight	= [DW]
wire tension	= averaged measured wire tension [WW]
wire weight	= wire weight with respect to [TT]
DV	= displacer volume item
immersed wire volume	= the volume of the immersed measuring wire (Y4 - Dn) * [WV] Y4 = Last valid innage I1 level Dn = density measurement n Dn = DN + (DK - DN) /9 * n, n between 0 and 9 DK = upper density measurement level DN = lower density measurement level
amb. Air dens	= Ambient air density [RF] item
A1	= density correction factor [A1] item
A2	= density correction offset [A2] item
factor 1000	= needed because the used dimensions of the items

The average wire tension, is the average of the 8 measurement cycles used with the TP measurement .
To calibrate the 854 density measurement in the field, the A1 and A2 items are added.

For the description of the IP and TP density scan refer to document no. 4416.221.

Regards,
Peter
Technical sales Support

Enraf

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7-15-98

Fax message

Fax to : Enraf Inc.
Attention : Mr. G. Sellers
Country : USA
Your ref. :
Fax no. :

From : M. C. van der Sloot
c.c. : P. v. Houten
Our ref. :
Date : 15 July 1998

Board

Number of pages (including this page) :

Subject : Servo density measurement on Waste Fluid

Dear Gayland,

I tried to follow the theory which is made up by Mr. Huber and I can follow all his formulas.
But to my opinion, there are two points wrong:

1) Assumption 1 (in paragraph B1) Displacer free mass includes wire mass.
   We compensate for the suspended (unrolled) wire mass (refer to the description in itemlist at item WW).

2) In the formulas there is a term for the buoyant force of the measuring wire in air.
   This, I do not understand. Theoretically, it is true. But when we enter the wire weight in item WW (for the standard measuring wire this is 0.25 g/m), that wire weight is the weight in air. Nobody specifies the weight of a measuring wire in vacuum.

Wire weight compensation

Item TT (tank top) must be set correctly, else the wire weight compensation is not working correct.
The amount of unrolled measuring wire is calculated by the 854 as:

(TT - LQ)

where: TT = tank top (mostly the height of the 854 mounting flange)
LQ = measured level

For the level measurement, the compensation works as:

setpoint' = setpoint + (TT - LQ) x WW

where:

setpoint = setpoint item S1
setpoint' = compensated setpoint
WW = wire weight

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The displacer weight is calculated by the 854 as:

weight = weight' - (TT - LQ) x WW

where: weight = compensated weight
weight' = measured weight

Density measurement

The wire weight compensation remains active during the density measurement as the displacer is completely immersed in the product.

An extra compensation is required for the immersed part of the measuring wire, which is subject to buoyance force.
Then we need item WV (wire volume). With the standard measuring wire, the wire volume is: $0.032\ cm^3/m$.

To be calculated as:

$$\tfrac{1}{4}\pi d^2 \times 100 = \tfrac{1}{4}\pi \times 0.02^2 \times 100 = 0.0314 \quad cm^3/m$$

where:
0.02 = diameter measuring wire [cm]
(diameter standard measuring wire: 0.2 mm)
100 = volume is taken over one metre length (1 m = 100 cm)

The default setting for item WV is +.32000000E-01 (floating point format)

When a density dip is made (either with a tank profile or an interface profile), the level value is stored (last valid level, item LV) and the distance of each of the ten density measurements is known (these are items D0, D1, ... D9).

The immersed amount of measuring wire volume is added by the displacer volume (item DV).

The compensation for the immersed part of the measuring wire is calculated by the 854 as:

DV' = DV + (LV - D*n*) x WV

where:

DV' = displacer volume plus immersed wire volume
DV = displacer volume
LV = last valid level)
D*n* = density innage level (*n* ranging from 0 to 9)
WV = wire volume

Enraf

The density is calculated by the 854 as:

$$R_n = \frac{Displacer\,weight - Wire\,tension + Wire\,weight}{Displacer\,volume + Immersed\,wire\,volume} \times A1 \times 1000 + A2 + RF$$

where:

Rn	=	measured servo density (*n*: 0 .. 9)
A1	=	density scale factor (normally not used)
A2	=	density offset factor (normally not used)
RF	=	ambient air density [$^{kg}/_{m}{}^3$]
Wire tension	=	the force in the measuring wire, measured by the 854 level gauge

The first part of the density formula is calculated in the dimension: $^{g}/_{cm}{}^3$, then multiplying by the factor 1000 converts the density to the dimension of $^{Kg}/_{m}{}^3$ and then the ambient air density (item RF) can be added.

The purpose for the ambient air density item is to provide the measured density as a density value in air (RF = 0), or as a density value in vacuum (RF = 1,225).

The density gain and offset factor (items A1 and A2) are normally not used.

This is all there is.

Back to the original problem

What remains is the fact that the measured density does not comply with the real density of the product.

1) We need data from the used measuring wire:
   its diameter
   its weight / length unit

   That has to be given in the corresponding items WV and WW.

2) Please check once more the displacer data:
   its weigth -> to be given in item DW
   its volume -> to be given in item DV

3) If possible and not done before, calibrate the force transducer with the test weights.

Regards,

Maarten van der Sloot

Enraf

Appendix C

2E-98-1244 Work Instruction
"Replace Densitometer Displacer"
Master Control Copy

================================WORK DOCUMENT (W110)================================

Page: 1 12:35:54 01 JUL 1998

1. Document Number 2E-98-01244/W *GENERIC WORK ITEM*
2. Work Item Title REPLACE DISPLACER FOR DENSITOMETER AY-102

===

3. Components
   Component Number Name
   N/A

   Temporary Number Name
   N/A

4. System 04 *EQUIPMENT INSTALL*

5. Location
   Facility 2E *EAST TANK FARMS*
   Bldg/Rm 241-AY Other AY-102 Other DENSITOMET

6. Symptom, Problem, or Condition
   REPLACE DRUM & DISPLACER FOR AY-102 DENSITOMETER.

7. Originator Name WOODY,BW Date 06/11/98
   Telephone No. 373-4471 MSIN S0-09

8. Charge Code

===

9. Priority 2
10. Phase Designator P2-3 *JUNE*

11. Cognizant Engineer POWERS,RL Phone 373-5933

12. Planning Required Y

13. Screener/Ops Review Signature X RODRIQUEZ,RS Date 06/11/98

===

14. Resolution By Signature X NUGENT,TE Date 06/16/98

15. Approvals

Code	Description	Signature	Date
CE	COGNIZANT ENGINEER	X HARTY,WM	06/16/98
CM	COGNIZANT MANAGER	X HARTY,WM	06/16/98
HP	HEALTH PHYSICS	X HAAN,TP	07/01/98
OTHER-1	OTHER TYPE PROFESSIONAL	X HUBER,JH	06/16/98
S	SAFETY	X GREGOR,JT	06/30/98
Q	QUALITY ASSURANCE	X SAMS,CA	06/30/98
OTHER-2	OTHER TYPE PROFESSIONAL	X ROCK,JE	06/30/98
PIC	PERSON IN CHARGE	X BISHOP,DJ	07/01/98

16. Resources Required

Res Code	Description	No.	Act Hrs
04	Operations Personnel	2	32 JEB 7-6-98

================================WORK DOCUMENT (W110)================================

*** RECORD COPY *** *** RECORD COPY ***

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==============================WORK DOCUMENT (W110)==============================

Page: 2 12:35:54 01 JUL 1998

1. Document Number 2E-98-01244/W *GENERIC WORK ITEM*
2. Work Item Title REPLACE DISPLACER FOR DENSITOMETER AY-102

18	Instrument Technician	2	24
54A	HEALTH PHYSICS TECHNICIAN	1	20
97	Quality Control	1	12
1AA	OPERATIONS/PIC	1	24
22	Electrician	1	8
24	Pipe Filter	1	8
96	Respiratory Tech.	1	8

JEB 7-6-98

==============================WORK DOCUMENT (W110)==============================

*** RECORD COPY *** *** RECORD COPY ***

1. Document Number 2E-98-01244/W *GENERIC WORK ITEM*
2. Work Item Title REPLACE DISPLACER FOR DENSITOMETER AY-102

		Signature	Date
17.	Pre-Work Review	X GUTIERREZ,RV	07/01/98
18.	Tagout Number		

		Type	Signature	Date
19.	Work Release	P	SEE PARTIAL RELEASE SHEET	________

20. Work Suspension (See Work Suspension Sheet)
PIC __________________________ ________

21. PIC BORROWMAN,JE PIC Org. 77140

Resolution/Retest

1 SCOPE:

1.1 This work package provides work steps to shop-calibrate a spare densitometer displacer and replace the existing Project W-320 ENRAF 854 Densitometer (WST-DIT-602A) drum and displacer in the field. The Densitometer is installed in Tank 241-AY-102, Riser 15E.

2 DESCRIPTION (Summary):

2.1 Perform shop-calibration of spare ENRAF Densitometer displacer per work steps in this work package (Steps 7.1 through 7.32).

2.2 Replace existing 241-AY-102 ENRAF Densitometer displacer and drum in field with shop-calibrated displacer and new drum per approved maintenance procedure 6-TF-125 and operating procedure TO-320-420, as required (Steps 7.33 through 7.41).

2.3 Adjust newly installed ENRAF Densitometer displacer volume per work steps in this work package (Steps 7.42 through 7.42.7).

2.4 Perform operational test of newly installed ENRAF Densitometer displacer per test steps this work package (Section 10).

2.5 Flush installed ENRAF Densitometer displacer per approved operating procedure TO-020-420 after operational testing (Section 10) is complete.

1. Document Number 2E-98-01244/W *GENERIC WORK ITEM*
2. Work Item Title REPLACE DISPLACER FOR DENSITOMETER AY-102

2.6 Restore area as required.

3 REFERENCE DOCUMENTS, PERMITS AND SPECIAL PROCEDURES:

3.1	6-TF-125:	ENRAF Series 854 Maintenance and Calibration.
3.2	TO-020-420:	Clean Level Indicating Transmitter Tapes, Plummets and Displacers; Replace Food Instrument Corporation/Robertshaw Tapes and Plummets.
3.3	H-2-817634:	Instm ENRAF Nonius Assy Installation & Riser Schedule.
3.4	H-2-818560, Sht. 05:	Project W-320 P&ID Tank 241-AY-102.
3.5	H-2-95413:	Instm Liquid Level Indication & Alarm Installation & Details.
3.6	ECN-644543	Level Gauge Upgrade.

3.7 Flammable Gas Review.

3.8 RWP E-1093.

3.9 Waste Planning Checklist.

3.10 Job Hazards Analysis (JHA).

3.11 Bill of Materials (BOM).

3.12 USQ # TF-98-0317, Rev. 002.

4 PRECAUTIONS, LIMITATIONS & NOTES:

4.1 Except for steps requiring HP hold point signatures, any steps in this instruction that are NOT required for completion shall be

1. Document Number 2E-98-01244/W *GENERIC WORK ITEM*
2. Work Item Title REPLACE DISPLACER FOR DENSITOMETER AY-102

indicated as such by entering ' N/A ' in the appropriate sign off space and explained on the Work Record Document.

4.2 Except for steps requiring HP hold point signatures, sections or steps of this work instruction may be performed out of sequence, with regards to maintenance or plant conditions.

NOTE - Steps 4.3 through 4.4 apply ONLY to the field work activities associated with densitometer displacer and drum replacement.

4.3 Per HNF-IP-1266, portions of this activity are classified as a "Dome Space Intrusive, Locally Waste Disturbing Operation" associated with an actively ventilated Facility Group 2 tank, 241-AY-102.

4.3.1 Flush connections are valved quick disconnects less than 1 in. in diameter. Drum and displacer replacement activities are performed with the isolation valve closed. Densitometer readings are taken with containment established and equipment is nonsparking.

4.3.2 Before installation of the flush connections to the spray nozzles, flammable gas entry monitoring requirements must be met as described in the work resolution.

4.3.3 There are no TSR controls associated with Ignition Source or Flammable Gas for the work steps identified in this JCS work package. Thus, HNF-IP-1266 5.9, 5.10, & 5.11 are not applicable.

4.4 An assessment of this work package was completed and found that there were no dome load concerns.

4.5 If displacer exposures exceed Radiation Work Permit whole-body exposure limits, IMMEDIATELY stop work, place equipment in a safe condition, and notify Supervisor/Lead or Cognizant Engineer.

1. Document Number 2E-98-01244/W *GENERIC WORK ITEM*
2. Work Item Title REPLACE DISPLACER FOR DENSITOMETER AY-102

==

5 MATERIALS AND EQUIPMENT REQUIRED:

NOTE - Materials and equipment required for shop calibration activities are listed in step 5.1; materials and equipment required for field work activities (densitometer displacer and drum replacement) are listed in step 5.2.

5.1 Equipment required (shop calibration work):

5.1.1 Enraf 854 ATG gauge w/calibrated force transducer.

5.1.2 Water-filled container, 15-in. deep (minimum).

5.1.3 Graduated beaker, 800 ml (minimum).

5.1.4 Thermometer, 0-212 deg F.

5.1.5 Density Displacer, RECORD tagged data:

Tagged Weight 242.1 grams

Tagged Volume 135 cm3

5.2 Equipment required (field replacement work):

5.2.1 See Bill of Materials (BOM).

5.2.2 See 6-TF-125, Step 4.1 (replacement).

5.2.3 See TO-020-420, Step 4.1 (flushing).

6 PREREQUISITES:

NOTE - This work package implements both shop work and field work. The prerequisite steps below apply ONLY to performance of field work activities starting with Step 7.33.

6.1 Conduct a PRE-JOB SAFETY MEETING using the Pre-job Safety Meeting form. Review appropriate Job Safety Analysis (JSA), and Radiation Work Permit (RWP) and other applicable permits.

1. Document Number 2E-98-01244/W *GENERIC WORK ITEM*
2. Work Item Title REPLACE DISPLACER FOR DENSITOMETER AY-102

6.2 Verify latest approved working procedures on the day work is to be performed.

SUPV ______________________ / 7-2-98
Supervisor/Lead Sign Date

6.3 If radioactive/hazardous waste as defined by TO-100-052 will be generated by the performance of this activity, the Waste Planning Checklist or Tank Farm Container Request Form shall be completed and delivered to Generator Waste Services (GWS) and a copy included in this work package.

6.4 Verify 241-AZ-702 Ventilation System (W-030) is operating at 241-AY Facility during work activities.

6.4.1 If active ventilation system fails or is shut down at 241-AY Facility during this activity, work shall cease until active ventilation is restored.

6.4.2 All personnel supporting this activity shall evacuate the farm and the immediate work area shall be placed in a safe shutdown mode.

6.4.3 Notify East Tank Farm Shift Manager.

6.5 If performance of this activity should require entry into areas that require respiratory protection, protection and monitoring requirements shall be identified by IH&S personnel. Specific instructions shall be addressed in the Pre-Job Safety Meeting.

6.5.1 IH&S is responsible for monitoring and establishing breathing air zones.

6.6 Notify CASS/TMACS operator (373-1005 or 373-2618) of testing activities on affected equipment and associated alarms before start of each shift.

6.7 Ensure batteries in portable ENRAF terminal are fully charged.

1. Document Number 2E-98-01244/W *GENERIC WORK ITEM*
2. Work Item Title REPLACE DISPLACER FOR DENSITOMETER AY-102

==

7 SPECIFIC WORK INSTRUCTIONS:

****
CALIBRATE DENSITY DISPLACER (SHOP CALIBRATION WORK):
****

7.1 FILL beaker with at least 400 ml of water and record actual water level:

Initial water level reading in beaker (miniscus) 700 ml.

7.2 PLACE displacer and snap hook into beaker and record actual water level:

Final water level reading in beaker (miniscus) 835 ml.

7.3 SUBTRACT initial water level reading from final water level reading:

835 (Final Level) - 700 (Initial Level)

= 135 (Displacer/Snap Vol.) ml (cm3)

7.4 INSTALL displacer and snap hook on ENRAF gauge.

7.5 PLACE gauge and displacer over large water-filled container.

7.6 SETUP gauge per manufacturer's instructions, with the following parameters:

RL =+00070.00
TT =+00105.00
MH =+00090.00
HH =+00100.00
HA =+00095.00
MZ =+00090.00
LA =+00001.00
LL =+00000.00

7.7 SET gauge Reference Level (RL) by placing a piece of wood or cardboard across opening of the water-filled container and allowing the displacer to come to rest on the wood/cardboard.

7.8. ENTER command [W2=ENRAF2].

7.9 ENSURE displacer is at rest on the wood/cardboard and gauge is reporting a valid level reading.

7.10 ENTER command [AR] and allow gauge to reinitialize.

7.11 ENTER command [EX] and allow gauge to reinitialize.

7.12 ENTER command [CA], wait 1 second minimum, then ENTER command [FR].

7.13 ENTER command [MF].

7.14 WHEN "FR" appears in gauge display, ENTER command [WQ] and record result.

WQ(FREE) = .24017086E+03 grams

7.15 Verify that WQ(FREE) is within +/- 3 grams of tagged weight recorded in Step 5.1.5

✓ Yes ____ No

SUPV [signature] / 07-02-98
Supervisor/Lead Sign Date

(QC) [signature] McWilliams, R. [illegible] / 7/2/98
Quality Control Sign Date

7.16 If WQ(FREE) is not within +/- 3 grams of tagged weight, then calibrate force transducer per manufacturer's instructions and repeat Steps 7.12 through 7.15.

7.17 REMOVE wood/cardboard from water-filled container and allow displacer to seek water level in container.

7.18 RECORD container water level from the gauge display:

1. Document Number 2E-98-01244/W *GENERIC WORK ITEM*
2. Work Item Title REPLACE DISPLACER FOR DENSITOMETER AY-102

==

Water Level 66.03 inches

7.19 SUBTRACT 8 inches from recorded water level:

~~58.03~~ 66.03 (initialed, 7/2/98) - 8 inches
Water Level

= 58.03 inches
Submerged Level

7.20 ENTER command [S2] and record value:

S2 = .05000000 E+03 grams

7.21 IF S2 does NOT equal 50 grams, THEN:

7.21.1 ENTER command [W2=ENRAF2].

7.21.2 ENTER command [S2=+.05000000E+03].

7.21.3 ENTER command [EX] and wait for gauge to reinitialize.

NOTE - After entering command [FR], do NOT press <ENTER> until displacer reaches Submerged Level calculated above.

7.22 ENTER command [UN] <ENTER>, [I2] <ENTER> then [FR].

7.23 MEASURE water temperature near displacer:

Water Temp. 73° Deg F

7.24 ENTER command [MF].

7.25 WHEN "FR" appears in gauge display, ENTER command [WQ] and record result:

WQ(Submerged) = +.10579097E+03 grams

7.26 ENTER command [UN] then [I1] to return displacer to surface.

7.27 PROVIDE Engineer with water temperature reading, obtain calculated water specific gravity and record below:

1. Document Number 2E-98-01244/W *GENERIC WORK ITEM*
2. Work Item Title REPLACE DISPLACER FOR DENSITOMETER AY-102

==========

.9977 SpG (g/cm3)
Water Specific Gravity

7.28 CALCULATE displacer volume as follows:

(.24017086E+03 (WQ(FREE)) - +.10599097E+03 (WQ(Submerged)))

/ .9977 (SpG) = 134.489 (Volume cm3)

7.29 Verify Tagged Volume (Step 5.1.5), Displacer/Snap Volume (Step 7.3) and Calculated Displacer Volume (Step 7.28) are all within +/- 0.5 cm3 of each other.

✓ Yes ___ No

SUPV [signature] / 07-02-98
Supervisor/Lead Sign Date

(QC) [signature] M.C. Wingfield / 7/2/98
Quality Control Sign Date

COG [signature] / 7/2/98
Cognizant Engineer Sign Date

7.30 If volumes are NOT within +/- 0.5 cm3 of each other, then stop work and notify Cognizant Engineer.

7.31 Cognizant Engineer to determine displacer volume value to be used.

7.32 Quality Control to retag displacer (with snap) for transport to field installation site with displacer volume determined by Cognizant Engineer and displacer weight and serial number from original tag and record below:

Displacer Volume: 135 cm3

Displacer Weight: 242.1 grams

Displacer Ser. No.: 98-01

(QC) [signature] M.C. Wingfield / 7/2/98

1. Document Number 2E-98-01244/W *GENERIC WORK ITEM*
2. Work Item Title REPLACE DISPLACER FOR DENSITOMETER AY-102

===

Quality Control Sign Date

****
REPLACE DISPLACER & DRUM (FIELD REPLACEMENT WORK):
****

7.33 Ensure prerequisites in section 6.0 have been met.

7.34 Quality Control to verify displacer and drum identification per BOM Suppl. #0 before installation.

(QC) K. W. [signature] / 7/3/98
Quality Control Sign Date

7.35 ENSURE all tagging and tape is removed from displacer before installation.

NOTE - Lockout/tagouts needed to support work activities are per HNF-IP-0842, Vol. II, Sect. 4.9.1, "Lock and Tag Program".

7.36 Operations install lock and tag or PLD to de-energize 241-AY-102 Densitometer to support the following work steps or as directed by Supervisor/Lead.

(Suggested isolation point: 241-AY-102, WST-HS-602B; H-2-95413 and ECN-64453).

7.36.1 Craft perform zero energy check as required to facilitate work activities.

NOTE - Fittings are less than 1-inch in diameter, therefore bonding is not required.

NOTE - Tank vapor space flammable gas concentrations may be verified via tank 241-AY-102 SHMS Cabinet (VTP-PNL-605B), if operable and calibrated, or by obtaining a physical sample at the Sampling Port located near VTP-PNL-605B SHMS cabinet.

7.37 Perform flammable gas entry monitoring as follows:

7.37.1 IF SHMS is operable, OBTAIN SHMS data

1. Document Number 2E-98-01244/W *GENERIC WORK ITEM*
2. Work Item Title REPLACE DISPLACER FOR DENSITOMETER AY-102

==========

and flammable gas concentrations as indicated in the table below before connecting flush assembly to spray nozzle.

Data Point	Required Condition	Condition/ Reading
SHMS Alarm Test	Alarms	✓
TROUBLE light YAL-02JAY-10-2	OFF	✓
H2 HIGH light YAL-02JAY-18-1	OFF	✓
WIDE RANGE (%H2) NIT-02JAY-6-1	< 0.625%	.006 ✓
NARROW RANGE (%H2) NIT-02JAY-12-1	< 0.625%	.008 ✓

RGM 7-3-96
NCO Initials / Date

NOTE - Initial recording of readings and signature for the first spray nozzle connection is documented in the spaces provided below. Subsequent recordings for the remaining spray nozzles shall be documented in the JCS Work Record.

7.37.2 IF SHMS is NOT operable, request IH&S Technician to obtain flammable gas sample at the Sampling Port at the tank 241-AY-102 SHMS Cabinet (VTP-PNL-605B) before connecting flush assembly to spray nozzle.

Flammable Gas Reading: 0.0%

Reading within limits: ✓ Yes ____ No

[signature] 7-3-98
IH&S Initial / Date

7.37.3 VERIFY that flammable gas concentration of tank vapor space is less than or equal to 25% of Lower Flammability Limit OR less than or equal to 0.625% H2 as read by VTP-PNL-605B SHMS.

[signature] 7-3-98
SUPV/Lead init / Date

7.37.4 IF flammable gas concentrations are greater than 25% of Lower Flammability Limit (LFL) OR greater than 0.625% H2 as read by VTP-PNL-605B SHMS, STOP work.

7.37.4.1 NOTIFY Shift Manager that an out-of-specification condition exists for BIO-TSR, AC 5.11.

7.37.4.2 COMPLETE actions as directed by Shift Manager.

7.38 FLUSH displacer at 241-AY-102 Densitometer per TO-020-420.

7.39 HPT perform radiation survey on removed displacer. At HPT or Supervisor/lead direction, shield displacer with rubber matting/padding.

7.40 REPLACE displacer and drum at 241-AY-102 Densitometer per 6-TF-125, Section 5.8.

7.41 REMOVE Lock and tags or PLD, as required.

****
ADJUST DISPLACER VOLUME (NONINTRUSIVE FIELD WORK):
****

7.42 Adjust ENRAF 854 Densitometer displacer volume and wire weight as follows:

7.42.1 Connect ENRAF PET to Densitometer.

7.42.2 Enter command [W2=ENRAF2].

NOTE - Cognizant Engineer will provide displacer volume (DV) value to use for installation.

7.42.3 Enter command [DV=.XXXXXXXXE+XX]. 7.1350000 E+03

7.42.4 Enter command [WW=.69000000E+00].

7.42.5 Enter command [EX].

7.42.6 Wait for gauge to reinitialize ("I1" appears in display).

7.42.7 Enter command [FR] to keep displacer from coming to rest on isolation ball valve.

7.42.8 Disconnect ENRAF PET from Densitometer.

7.43 If required, nonintrusive troubleshooting may be performed as necessary to facilitate displacer and drum replacement.

7.43.1 Craft perform zero energy check as required to facilitate nonintrusive troubleshooting of densitometer as directed by Supervisor/Lead.

7.43.2 Install lock and tag or PLD as required to facilitate nonintrusive troubleshooting of densitometer as directed by Supervisor/Lead.

8 RESTORATION ACTIONS:

8.1 Supervisor/Lead document work performed and any problems encountered and record on JCS Work Record. Ensure job site has been cleaned and all waste has been placed in proper containers.

8.2 Request HPT to perform post-job survey of work area and job waste to verify radiological conditions are at pre-job levels or better.

(HP) BRENT ROBLES
HP Print Name

B Robles 12-3-98
HP Signature Date

1. Document Number 2E-98-01244/W *GENERIC WORK ITEM*
2. Work Item Title REPLACE DISPLACER FOR DENSITOMETER AY-102

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9 POST-MAINTENANCE TESTING:

9.1 N/A

10 OPERATIONAL FUNCTIONAL TESTS:

****
TEST DENSITOMETER DISPLACER (FIELD OPERABILITY TEST):
****

NOTE - These steps may be performed using either PET or ENRAF Control Panel (ECP) software. If using ECP software, "ENTER command..." shall be interpreted as "SELECT appropriate ECP command for..."

10.1 Ensure prerequisite steps in Section 6.0 are met.

10.2 HPT to perform pre-job survey of work area.

[initial] / 7-6-98
HPT Initial / Date

10.3 OPEN isolation ball valve.

10.4 ENTER command [UN].

10.5 ENTER command [I1].

10.6 ENTER command [DK=+00280.00] (this is a level below waste surface).

10.7 ENTER command [DN=+00280.00].

10.8 WHEN displacer reaches waste surface and "in INN" appears on gauge display, ENTER command [IP] (causes ENRAF to obtain a density reading at 280.00 inches).

10.9 WHEN "I1" appears in line 2 of gauge display, enter command [SC] and record result:

+01039.21 kg/m3
Average Density at 280.00 inches

10.10 VERIFY Average Density reading is between

1. Document Number 2E-98-01244/W *GENERIC WORK ITEM*
2. Work Item Title REPLACE DISPLACER FOR DENSITOMETER AY-102

960 Kg/m3 and 1050 kg/m3.

✓ Yes ___ No

SUPV J E Borraman / 7-6-98
Supervisor/Lead Sign Date

(QC) [signature] / 7-6-98
Quality Control Sign Date

COG [signature] / ~~6~~ 7-6-98
Cognizant Engineer Sign Date

10.11 ENTER command [I2].

10.12 WHEN displacer reaches approximately 280.00 inches, enter command [FR] and record level.

279.29 inches
Submerged Level

10.13 ENTER command [MF].

10.14 WHEN "FR" appears in line 2 of gauge display, enter command [WQ] and record result:

+.10338306E+03 grams
WQ(Submerged AY-102)

.24366307
.10338306
.14028001

10.15 ENTER command [DW] and record value:

+.24366307E+03 grams
WQ(FREE)

10.16 ENTER command [DV] and record value:

DV +.13500000E+03 cm3

10.17 CALCULATE density as follows:

(+.24366307E03 - +.10338306E+03)
WQ(FREE) WQ(Submerged AY-102)

/ +.13500000+E03 = 1.039 ~~kg/m3~~ g/cm³
DV Density

[initials] 7-6-98
JEB 7-6-98

10.18 Verify Average Density Reading (Step 10.9) and Calculated Density (Step 10.17) are within

1. Document Number 2E-98-01244/W GENERIC WORK ITEM
2. Work Item Title REPLACE DISPLACER FOR DENSITOMETER AY-102

===

+/-.010 ~~kg/m3~~ g/cm3 of each other. 7-6-98
JES 7-6-98

✓ Yes ___ No

SUPV [signature] / 7-6-98
Supervisor/Lead Sign Date

(QC) [signature] / 7-6-98
Quality Control Sign Date

COG [signature] / 7-6-98
Cognizant Engineer Sign Date

10.19 If density values are NOT within +/- 10 kg/m3 of each other, then stop work and notify Cognizant Engineer.

10.20 Perform troubleshooting to facilitate testing densitometer as directed by Cognizant Engineer.

10.20.1 Craft perform zero energy check as required to facilitate testing densitometer as directed by Supervisor/Lead.

10.20.2 Install lock and tag or PLD as required to facilitate testing densitometer as directed by Supervisor/Lead.

10.21 REPEAT entry monitoring steps 7.37.1 through 7.37.4.2 as required before connecting flush assembly to spray nozzle.

10.22 FLUSH displacer at 241-AY-102 Densitometer per TO-020-420.

10.23 When flushing complete, POSITION displacer approximately 80 inches below isolation ball valve (with isolation ball valve OPEN).

10.24 Supervisor/Lead document work performed and any problems encountered and record on J-5. Ensure job site has been cleaned and all waste has been placed in proper containers.

10.25 Request HPT to perform post-job survey of work area and job waste to verify radiological conditions are at pre-job levels or better.

HPT Initial: VO Date: 7-6-98

22. Reference Documents

Reference Documents	Type
HNF-IP-1266	MISC
WHC-SD-WM-HSP-002	MISC
HNF-SD-WM-TSR-006	MISC
TO-100-052	PROC

	Signature	Date
23. Field Work Complete	J E Barraman	7-6-98
24. Ops_Acceptance		
25. Post Review		

DOCUMENT ACCEPTANCE REVIEW FORM

Page 1 of 1

ETF-98-385 — Procedure Change Number

~~TF-96-0390~~ TF-98-0387 Rev 3 — USQ Screening No.

~~N/A~~ SQ — Approval Designator

OTP-320-010 — Document No.

~~A-1~~ A-2 — Rev./Mod.

Prepared By: John Huber — Name

Cog Eng/SSTE — Title/Organization

- [x] Plant Operating Procedure
- [ ] Alarm Response Procedure
- [ ] Operator Round Sheet
- [ ] Facility Sampling Schedule
- [ ] Criticality Specifications
- [ ] Other Type Document
- [ ] Maintenance Procedure
- [ ] Operating Specification Document (Requires Checklist)

- [ ] New or Revised - Full Review Required
- [x] Procedure Change Authorization
- [ ] Administrative Change

W-320 Enraf Series 854 Densitometer Operational Test — Document Title

- [x] Procedure Changes/Changed Pages/Summary of change Pages 10, 17, 20, 25, 31, 33, 44, 16

PROCEDURE REVIEWERS SIGNATURES

DOCUMENT IS ACCEPTABLE

As Is	With Changes Noted	Signature	Print Name	Title/Org	Date
[x]	[ ]	(Signature - Certified Operator/User) [signature]	Michael B Gethke	Inst. Spec.	6/10/98
		Ensures that the procedure has been field validated and comments incorporated.			
[x]	[ ]	(Signature - QA Engineer) [signature]	WL Adams	QAE/DST	6/24/98
[x]	[ ]	(Signature - Safety Engineer) [signature]	S.U. Zaman	Nuclear Safety	6/24/98
[x]	[ ]	(Signature - Shift Manager or Operations Support Manager) [signature]	R. Gutierrez	OE/DST	6/16/98
		Verifies documentation is complete, including Change Summary Signature Sheet and ensures Radiological review is complete or marks Radiological Controls as N/A			
[ ]	[ ]	(Signature - Radiological Controls) N/A	(Print Name)	(Title/Org)	(Date)
[ ]	[ ]	(Signature - Other)	(Print Name)	(Title/Org)	(Date)
[x]	[ ]	(Signature - Cognizant Engineer) [signature]	John Huber	Cog Eng/SSTE	6-12-98
		Ensures that the technical aspects of the procedure are correct, and that the procedure has been reviewed per the approval designator. Enters the USQ Screening No.			

PROCEDURE WRITER

(Signature)	(Print Name)	(Title/Org)	(Date)
[signature]	DC Ashworth	TFPG	6/24/98

APPROVAL AUTHORITY

(Signature)	(Print Name)	(Title/Org)	(Date)
[signature]	MR Kembel	SM/DST	6/18/98

DOCUMENT ACCEPTANCE REVIEW FORM

ETF-98-354
Procedure Change Number

TF-96-0678
USQ Screening No.

NA ES
Approval Designator

Prepared By

John Huber
Name

Cog Eng / SSTE
Title/Organization

OTP-320-010
Document No.

A-0 A-1
Rev./Mod.

- [x] Plant Operating Procedure
- [ ] Operator Round Sheet
- [ ] Criticality Specifications
- [ ] Maintenance Procedure
- [ ] Alarm Response Procedure
- [ ] Facility Sampling Schedule
- [ ] Other Type Document
- [ ] Operating Specification Document (Requires Checklist)

- [ ] New or Revised - Full Review Required
- [x] Procedure Change Authorization
- [ ] Administrative Change

W-320 Enraf Series 854 Densitometer Operational Test Procedure.
Document Title

- [x] Procedure Changes/Changed Pages/Summary of change: Pages 15, 33, 42 typographicals

PROCEDURE REVIEWERS SIGNATURES

DOCUMENT IS ACCEPTABLE

As Is	With Changes Noted	Signature	Print Name	Title/Org	Date
[x]	[ ]	(signed) (Signature - Certified Operator/User) Ensures that the procedure has been field validated and comments incorporated.	LG Hartley	NCO/DST	6/2/98
[x]	[ ]	(signed) (Signature - QA Engineer)	Charles A. Sams	QAE/DST	6-2-98
[x]	[ ]	(signed) (Signature - Safety Engineer)	LARRY THOMAS	ENGR/TWRS NS	6-2-98
[x]	[ ]	(signed) (Signature - Shift Manager or Operations Support Manager) Verifies documentation is complete, including Change Summary Signature Sheet and ensures Radiological review is complete or marks Radiological Controls as N/A	R. Gutierrez	OE/DST	6-2-98
[ ]	[ ]	NA (Signature - Radiological Controls)			
[x]	[ ]	(signed) (Signature - Other)	PC Miller	BCO	6/2/98
[x]	[ ]	(signed) (Signature - Cognizant Engineer) Ensures that the technical aspects of the procedure are correct, and that the procedure has been reviewed per the approval designator. Enters the USQ Screening No.	Co. John Huber	Cog Eng/SSTE	6-2-98

PROCEDURE WRITER

Signature	Print Name	Title/Org	Date
(signed)	R.W. Johnson	Tech Wtr/TWRS P.	6/3/98

APPROVAL AUTHORITY

Signature	Print Name	Title/Org	Date
Lm Walker	Lm Walker	OE/DST	6/2/98