Approvals

Signing below indicates agreement that the execution of the Installation, Operational, and Performance Qualification Protocol for Crystallizer #4 located at 102 Commerce Street, Waynesville, NC at the Manufacturing facility is complete and the process is validated.

Project Team Member	Functional Area	Signature	Date
Patrick Owen	Engineering		8/5/13
Robert Willis	Maintenance		8/5/13
Jason Bumgarner	Production		8-5-13
Matt Haynes	Operations		8-5-13
Deborah Durbin	Quality		8-15-13

A copy of the executed protocol will be attached behind the report.

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I. PURPOSE:

The purpose of this report is to certify with documented evidence that Crystallizer #4 is installed properly, is operational, and functions as intended throughout its anticipated operating ranges. This will also serve as a baseline of documentation for the installation for future change control and trouble shooting. This final report provides documented evidence that the objectives, methodology, documentation, and test activities needed to complete the Installation Qualification (IQ), Operational Qualification (OQ), and Performance Qualification (PQ) for Crystallizer #4 located in the Manufacturing Building at 102 Commerce Street in Waynesville, NC were all executed and all acceptance criteria were met.

II. SUMMARY:

A Giles Authorization for Expenditure (AFE) was signed on December 27, 2012 to purchase and install Crystallizer #4 by May 1, 2013. Crystallizer #4 is located in the Manufacturing Building at 102 Commerce Street in Waynesville, NC. The vessel design was an exact copy of #2 and #3 Crystallizers. The machine will Crystallize USP Epsom Salt from Brine produced at Giles' Manufacturing facility.

The products impacted by this study were all Epsom Salt products manufactured by Giles Chemical.

The following tests were performed in this qualification:

Each item of Plumbing, Instrumentation, and Utilities was verified to be in place and allow for the specific function as outlined in the Installation Qualification.

It was verified that each motor is rotating in the correct direction, each flowmeter is oriented so as to give a positive flow reading, and control valves can open and close when the unit is in operation.

During the time of the Performance Qualification:

The Vacuum absolute pressure did not exceed 1.50 inches of Mercury in any observation

Fines Reduction Loop flow was not less than 15.0 gallons per minute in any observation

Fines Reduction Loop temperature was not outside of the range of 38.0 – 44.0 degrees Celsius in any observation

Discharge flow was not outside the range of 19-25 gallons per minute in any observation

USP testing of final product passed in all parameters

III. CONCLUSION

The results of the completed Installation Qualification (IQ), Operational Qualification (OQ), and Performance Qualification (PQ) protocol show that all the acceptance criteria have been met for all samples. All testing results provide documented evidence Crystallizer #4 located in the Manufacturing Building at 102 Commerce Street in Waynesville, NC is installed, operating, and performing as expected. Crystallizer #4 is considered to be validated.

IV. RECOMMENDATIONS

A. It is recommended that Crystallizer #4 located in the Manufacturing Building at 102 Commerce Street in Waynesville, NC be considered validated based on meeting the acceptance criteria of the IQ/OQ/PQ protocol.

V. REFERENCE:

E35-VAL-PIQ-301, Crystallizer #4 IQ/OQ/PQ Protocol, rev 0, 05/24/13

APPENDIX I: INSTALLATION QUALIFICATION

A. Installation Qualification

1. Location

Distance Criterion	Is the current area sufficient to allow access without obstructions (Yes/No)
Allow sufficient room around the machine for Maintenance and Operations to perform their duties	YES

2. Level

Verify that the instrument is level

Is the unit level? (Yes/No)	Acceptable (Yes/No)
YES	YES

3. Vessel

Criterion	Are all hatches and outlets tightened, plumbed, or blanked (Yes/No)
Ensure all hatches and outlets are tightened, plumbed, or blanked	YES

4. Plumbing

Specified Location	Plumbing present and connected to proper inlet and outlet (Yes/No)
Elbow Pump plumbing	YES
Brine Feed Line	YES
Fine Salt Loop Lines	YES
Discharge Line	YES
Mother Liquor Line	YES
Large Condenser Lines	YES

Small Condenser Lines	YES
Vacuum Pump plumbing	YES
Ejector Steam Line	YES
Vapor Pipe	YES
Vent Pipe	YES

5. Instrumentation

Specified Location	Instrument present and oriented properly (Yes/No)	Instrument Serial Number
Discharge Flow Meter	YES	H300D016000
Mother Liquor Flow Meter	YES	H102F916000
Brine Feed Flow Meter	YES	H102F816000
Fine Salt Loop Flow Meter	YES	H101F316000
Density Transmitter	YES	H101E71509C
Level Transmitter	YES	H101E81509C
Vacuum Transmitter	YES	H101E61509C

6. Utilities

a. Verify that unit is receiving its specified utility requirements.

Specified	Actual
460 V +/- 20V for Pump Drive Panel	474.5
115V +/- 10 for Controls	119.7
Air Present for Vacuum Control Valve	YES
Air Present for Fine Salt Loop Control Valve	YES
Steam Supply for Ejector	YES
Fine Salt Loop Steam	YES

APPENDIX II: OPERATIONAL QUALIFICATION

B. Operational Qualification

1. Vessel and Circulation

Description	Function	Did Item function properly (Yes/No)
Elbow Pump	Elbow Pump turns clockwise as viewed from the motor grill when the drive is "on"	YES
Circulation	With vessel filled with brine and Elbow Pump on circulation discharge should be visible from the top sight glass	YES

2. Feed System

Description	Function	Did Item function properly (Yes/No)
Brine Flow Meter	Flow meter directional arrow should point toward Elbow Loop plumbing	YES
Brine Pump	With Brine Pump on the motor should turn clockwise as viewed from the motor grill when the drive is "on"	YES
Brine Flow Meter	With valves open and pump on the Brine Flow Meter on the Brine Flow Meter should register a flow	YES

3. Vacuum System

Description	Function	Did Item function properly (Yes/No)
Vacuum Control Valve	With controller in Manual, valve should close at 0% and be fully open at 100%	YES
Vacuum System Utilities	Ensure steam is on Ejector and Water is on both Condensers	YES
Vacuum Sensor	When Vacuum System is on, the Vacuum Sensor should show the pressure dropping	YES

4. Discharge System

Description	Function	Did Item function properly (Yes/No)
Discharge Pump Motor	Ensure pump motor turns clockwise as viewed from the motor grill when the drive is "on"	YES
Discharge Flow	With vessel full, open both valves and put system set point on 22 gpm. Verify flow at Centrifuge.	YES

5. Fine Salt Reduction System

Description	Function	Did Item function properly (Yes/No)
Steam Control Valve	With controller in Manual, valve should close at 0% and be fully open at 100%	YES
Fine Salt Flow	Ensure flow meter shows flow with FS Loop pump on	YES
Steam Control	Ensure temperature in Fine Salt Loop rises when steam is called for	YES

6. Mother Liquor System

Description	Function	Did Item function properly (Yes/No)
Flow Meter	Ensure Flow Meter arrow points away from the Mother Liquor Tank and toward the Crystallizer	YES
Flow	Ensure that when valves are open that flow is observed on the Flow Meter	YES

APPENDIX III: PERFORMANCE QUALIFICATION

C. Performance Qualification

1. Vacuum

Time	Vacuum (< or = 1.50 inches Hg)	Did Item Meet Criteria (Yes/No)
13:00	1.10	YES
13:30	1.10	YES
13:59	1.10	YES
14:30	1.10	YES
15:01	1.08	YES
15:31	1.10	YES
16:00	1.10	YES
16:28	1.10	YES
17:00	1.10	YES

2. Fines Reduction Loop Flow

Time	Fines Reduction Loop Flow (Not Less than 15.0 gallons per minute)	Did Item Meet Criteria (Yes/No)
13:00	17.2	YES
13:30	17.4	YES
13:59	17.4	YES
14:30	17.2	YES
15:01	16.9	YES
15:31	17.2	YES
16:00	17.2	YES
16:28	17.0	YES
17:00	17.2	YES

3. Fines Reduction Loop Temperature

Time	Fines Reduction Loop Temperature (38.0 – 44.0 Degrees C)	Did Item Meet Criteria (Yes/No)
13:00	41.0	YES
13:30	41.8	YES
13:59	42.6	YES
14:30	41.8	YES
15:01	41.9	YES
15:31	42.4	YES
16:00	41.0	YES
16:28	41.3	YES
17:00	41.8	YES

4. Discharge Flow

Time	Discharge Flow (19 – 25 gallons per minute)	Did Item Meet Criteria (Yes/No)
13:00	21.0	YES
13:30	21.1	YES
13:59	21.0	YES
14:30	21.0	YES
15:01	21.0	YES
15:31	21.2	YES
16:00	21.1	YES
16:28	21.1	YES
17:00	21.0	YES

5. USP Testing

Date and Time Sample Taken : _____**07:00 8/03/2013**_____

Results: PASS

Note: USP Testing Results attached

Approvals

Signing below indicates agreement that the protocol is ready for execution of the Installation Protocol for Crystallizer #4 located at 102 Commerce Street, Waynesville, NC at the Manufacturing facility.

Project Team Member	Functional Area	Signature	Date
Patrick Owen	Engineering		5/24/13
Robert Willis	Maintenance		5/24/13
Jason Bumgarner	Production		5-24-13
Matt Haynes	Operations		5-24-13
Deborah Durbin	Quality		5-24-13

A final summary report that consists of results and conclusions based on the data collected after protocol execution will be written and approved. The executed protocol will be attached behind the report.

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I. PURPOSE:

The purpose of this protocol is to provide documented evidence of the proper installation of Crystallizer #4. This will serve as a baseline of documentation for the installation for future change control and trouble shooting. This protocol sets forth the objectives, methodology, documentation, and test activities needed to complete the Installation Qualification (IQ), Operational Qualification (OQ), and Performance Qualification (PQ) for Crystallizer #4 located in the Manufacturing Building at 102 Commerce Street in Waynesville, NC.

II. BACKGROUND:

2.1 Historical

Giles Chemical is a producer of Epsom Salt and has been producing Epsom Salt at the Waynesville facility since 1950. A variety of Crystallizers have been used. In 1988 an Oslo type Crystallizer (Crystallizer #1) was installed and subsequently Crystallizers #2 (1998), and #3 (2005) were also installed. All of the other older type Crystallizers were removed from the facility.

2.2 Current Project

A Giles Authorization for Expenditure (AFE) was signed on December 27, 2012 to purchase and install Crystallizer #4 by May 1, 2013. The vessel design was an exact copy of #2, and #3 Crystallizers. The machine will Crystallize USP Epsom Salt from Brine produced at Giles' Manufacturing facility.

The products that are impacted by this study are all Epsom Salt products manufactured by Giles Chemical.

III. SCOPE

This study will be performed on Crystallizer #4. This protocol will define the test procedures, documentation, references, and acceptance criteria used to establish that the system is installed properly, operates properly, and performs as expected. The executed protocol will verify that all acceptance criteria have been met, and that the Crystallizer meets current Good Manufacturing Practice (cGMP) requirements.

IV. SYSTEM DESCRIPTION:

1. OVERVIEW

Crystallizer #4 uses vacuum to cool a continuous stream of saturated brine to form crystals, which are then discharged to a centrifuge.

2. DESCRIPTION OF OPERATION

There are 6 systems in that make up Crystallizer #4. All are in operation when Crystallizer #4 is in operation:

a. Tank and Circulation System: The Crystallizer vessel holds a volume of crystal slurry and circulates it. This allows adequate time for crystal growth and selective discharge of larger crystal size distribution from fluidizing the slurry. This system consists of the main vessel, circulation pump, and circulation pump piping.

b. Feed System: The feed system supplies brine to the Crystallizer. This system consists of the Brine Feed Pump, Brine Feed Flow Meter, Variable Speed Drive, and pressure/level sensor.

c. Vacuum System: The vacuum system pulls a vacuum on the Crystallizer, allowing evaporative cooling to take place. The temperature in the vessel is controlled indirectly by the vacuum system because the vapor space approaches thermodynamic equilibrium with the slurry and the vapor space contains only water vapor. This system consists of a barometric condenser, cooling water pump, steam ejector, ejector condenser, liquid ring vacuum pump, vacuum control valve, and vacuum sensor.

d. Fine Salt Reduction Loop: The fine salt loop pulls smaller crystals from the upper part of the vessel, uses heat to dissolve them, and re-introduces the resultant brine into the circulation system. This system consists of fine salt loop piping, Fine Salt Loop Flow Meter, fine salt loop pump, fine salt loop heat exchanger, and fine salt loop steam control valve.

e. Discharge System: A continuous stream of crystal slurry is pumped from the crystallizer to a centrifuge. This system consists of discharge piping, discharge pump, discharge flow meter, and discharge pump variable speed drive.

f. Mother Liquor System: A portion of the liquid separated from the crystals at the centrifuge is returned to the crystallizer to make up for evaporative volume loss from the cooling process. This system consists of the mother liquor flow meter and mother liquor piping.

V. ROLES AND RESPONSIBILITIES

1. Engineering
   - ❖ Write and issue the protocol
   - ❖ Investigate protocol deviation reports
   - ❖ Execute the OQ and manage the data collection for the PQ.
   - ❖ Review raw data and originate interim notification to Quality Assurance
   - ❖ Write and route the final report
2. Quality Assurance
   - ❖ Review and approve the protocol.
   - ❖ Review and approve raw data and notifications.
   - ❖ Review, approve, and store the final report.
3. Maintenance
   - ❖ Provide Equipment Manuals needed to execute operational qualification.
   - ❖ Review and approve the protocol.
   - ❖ Execute the IQ.
   - ❖ Review and approve raw data and notifications.

- ❖ Review and approve the final report

4. Production
   - ❖ Execute the PQ.
   - ❖ Review and approve the final report.

VI. TEST PROGRAM

A. INSTALLATION QUALIFICATION

Objective

The objective of the installation verification is to document that each of the 6 systems that comprise Crystallizer #4 are installed properly and document the components of each system for future reference.

Equipment/Materials

Crystallizer #4

Ideal Digital Multimeter Model #61-340 (SN 100100221)

Level

Procedure

Perform each listed below for Crystallizer #4:

1. Location: Verify that the equipment is situated to allow sufficient room around the machine for Maintenance and Operations to perform their respective duties.
2. Level: Verify instrument is level.
3. Vessel: Ensure that all hatches and outlets are tightened, plumbed, or blanked
4. Plumbing:
   a. Ensure the Elbow Pump plumbing is in place
   b. Ensure the Brine Feed Pump and plumbing feeds from the Brine Feed Tank to the Elbow Pump Loop
   c. Ensure the Fine Salt Loop plumbing feeds from the vessel and returns to the Elbow Pump Loop
   d. Ensure the Discharge plumbing connects from the Discharge outlet to the Centrifuge inlet.
   e. Ensure the Mother Liquor plumbing feeds from the Mother Liquor Header to the Elbow Pump Loop
   f. Ensure the Large Condenser plumbing feeds from the Creek Tank to the Large Condenser and from the Large Condenser to the Hot Well

g. Ensure the Small Condenser plumbing feeds from the Creek Tank to the Small Condenser and from the Small Condenser to the Hot Well

h. Ensure City Water is available to the Vacuum Pump

i. Ensure Steam is available to the Steam Ejector

j. Ensure The Vapor Pipe connects from the top of the Crystallizer to the Large Condenser

k. Ensure the Internal Vent Pipe connects from the lower part of the Crystallizer to head of the unit.

5. Instrumentation

   a. Ensure the Discharge Flow Meter is in the Discharge Pipe

   b. Ensure the Mother Liquor Flow Meter is in the Mother Liquor Line

   c. Ensure the Brine Feed Flow Meter is in the Brine Feed Pipe

   d. Ensure the Fine Salt Loop Flow Meter is in the Fine Salt Loop plumbing

   e. Ensure the Level and Density, and Vacuum transmitters are installed on the body of the Crystallizer.

6. Utilities

   a. Electrical Requirements:

      - Ensure Voltage is correct to Pump Drive Panel
      - Ensure Voltage is correct to Instrumentation

   b. Air

      - Ensure Vacuum Control Valve has air pressure
      - Ensure Fine Salt Loop Control Valve has air Pressure

   c. Steam

      - Ensure Steam Ejector has steam
      - Ensure Fine Salt Loop has steam and condensate return

Acceptance Criteria

If each item of Plumbing, Instrumentation, and Utilities is in place and allows for the specific function as outlined, then Crystallizer #4 will be considered to be installed properly.

B. OPERATION QUALIFICATION

Objective

The objective of the operational verification is to document that the components of the 6 systems that comprise Crystallizer #4 are operable and oriented correctly for the machine to operate.

Equipment/Materials

Crystallizer #4

Procedure

Perform each listed task for Crystallizer #4 (all motors are to be observed as standing facing the "grill" end of the motor – not the output shaft):

1. Vessel and Circulation
    a. Ensure Elbow Pump is turning clockwise
    b. With fluid in the Crystallizer, turn on the circulator and ensure a flow is coming out in the headspace by looking through the top sight glass
2. Feed System
    a. Ensure flow meter arrow is pointing toward the elbow loop plumbing
    b. Turn on the brine pump and ensure the motor is turning clockwise
    c. Ensure brine will feed to Crystallizer and readout shows a flow
3. Vacuum System
    a. Put controller in manual and verify that the vacuum valve will open and close
    b. With fluid in the Crystallizer, turn on the vacuum system and ensure that it has both water and steam
    c. Check the vacuum sensor to determine that pressure drops when the system is on
4. Discharge System
    a. Ensure the pump motor is turning clockwise when the pump is on.
    b. With the vessel full open the valves and turn on the discharge pump. With the system set point on 22 gpm observe if flow comes out at the centrifuge
5. Fine Salt Reduction System
    a. Put controller in manual and verify that steam valve will open and close
    b. With the vessel full, turn on the fine salt loop pump and enter a set point of 41 C in the controller. Verify with the flow meter that there is flow and that the temperature rises when steam is called for.
6. Mother Liquor System

a. Ensure the flow meter arrow is pointing toward the direction of the flow (from ML tank to Crystallizer)

b. Open valves and ensure Mother Liquor flows to the Crystallizer and verify that the flow meter reads a flow.

Acceptance Criteria

Verification that each motor is rotating in the correct direction, each flowmeter is oriented so as to give a positive flow reading, and control valves can open and close when the unit is in operation.

C. PERFORMANCE QUALIFICATION

Objective

The objective of performance testing is to document that Crystallizer #4 performs the functions required by Giles Chemical.

- The vacuum pulled by the vacuum system is sufficient to cool the brine solution to 35 degrees C
- That the Fines Reduction Loop will heat a flow of at least 15 gallons per minute to 41 +/- 3 degrees C
- That the discharge system will discharge 22+/-3 gallons per minute for at least 1 hour without stopping.
- That the plant product USP Testing results will pass with Crystallizer #5 running.

Equipment/Materials

Crystallizer #4

Brine

Mother Liquor

Calibrated Instrumentation Installed on the Crystallizer

Procedure

Fill and run #4 Crystallizer according to procedure for at least 24 hours before making observations.

Perform each listed task for Crystallizer #4:

1. Vacuum
    a. Observe vacuum reading every 30 minutes for 4 hours
2. Fines Reduction Loop
    a. Observe Fines Reduction Loop flow and temperature every 30 minutes for 4 hours

3. Discharge System
    a. Observe the Discharge flow every 30 minutes for 4 hours
4. Plant USP Testing
    a. Obtain a product sample and test for USP parameters in the QA Laboratory

Acceptance Criteria

Vacuum absolute pressure cannot exceed 1.50 inches of Mercury in any observation

Fines Reduction Loop flow cannot be less than 15.0 gallons per minute in any observation

Fines Reduction Loop temperature cannot be outside of the range of 38.0 – 44.0 degrees Celsius in any observation

Discharge flow cannot be outside the range of 19-25 gallons per minute in any observation

USP testing of final product must pass in all parameters

VII. CALIBRATION

Verify that all instrumentation is calibrated at the time of installation.

- Ideal Digital Multimeter Model #61-340 (SN 100100221)
- Discharge Flow Meter
- Brine Feed Flow Meter
- Level Probe
- Vacuum Probe
- Fines Reduction Flow and Temperature Meter

VIII. REFERENCE:

P12-PR-200-026 rev 3 "Crystallizer Operations" Giles Chemical, 2012

P12-PR-200-028 rev 6 "Filling and Starting a Crystallizer" Giles Chemical, 2012

CRYSTALLIZER #4: INSTALLATION QUALIFICATION

A. Installation Qualification

1. Location

LOCATION			
Distance Criterion	**Is the current area sufficient to allow access without obstructions (Yes/No)**	**Verified By**	**Date**
Allow sufficient room around the machine for Maintenance and Operations to perform their duties	YES	PEP	8/1/13
Comments:			

per 8/1/13

2. Level

Verify that the instrument is level

LEVEL			
Is the unit level? (Yes/No)	**Acceptable (Yes/No)**	**Verified By**	**Date**
YES	YES	PEP	8/1/13
Comments:			

per 8/1/13

3. Vessel

VESSEL			
Criterion	**Are all hatches and outlets tightened, plumbed, or blanked (Yes/No)**	**Verified By**	**Date**
Ensure all hatches and outlets are tightened, plumbed, or blanked	YES	PEP	8/1/13
Comments:			

per 8/1/13

Reviewed By: Ashley Williams **Date:** 8/6/13

4. Plumbing

Plumbing			
Specified Location	**Plumbing present and connected to proper inlet and outlet (Yes/No)**	**Verified By**	**Date**
Elbow Pump plumbing	Yes	PEJ	8/1/13
Brine Feed Line	Yes	PEJ	8/1/13
Fine Salt Loop Lines	Yes	PEJ	8/1/13
Discharge Line	Yes	PEJ	8/1/13
Mother Liquor Line	Yes	PEJ	8/1/13
Large Condenser Lines	Yes	PEJ	8/1/13
Small Condenser Lines	Yes	PEJ	8/1/13
Vacuum Pump plumbing	Yes	PEJ	8/1/13
Ejector Steam Line	Yes	PEJ	8/1/13
Vapor Pipe	Yes	PEJ	8/1/13
Vent Pipe	Yes	PEJ	8/1/13
Comments:			8/1/13 PEJ

Reviewed By: Ashley Williams **Date:** 8/12/13

5. Instrumentation

Instrumentation				
Specified Location	**Instrument present and oriented properly (Yes/No)**	**Instrument Serial Number**	**Verified By**	**Date**
Discharge Flow Meter	Yes	H300D016000	PE	8/1/13
Mother Liquor Flow Meter	Yes	H102F916000	PE	8/1/13
Brine Feed Flow Meter	Yes	H102F816000	PE	8/1/13
Fine Salt Loop Flow Meter	Yes	H101F316000	PE	8/1/13
Density Transmitter	Yes	H101G71509C	PE	8/1/13
Level Transmitter	Yes	H101E81509C	PE	8/1/13
Vacuum Transmitter	Yes	H101E61509C	PE	8/1/13
Comments:				8/1/13 PE

6. Utilities

a. Verify that unit is receiving its specified utility requirements.

UTILITIES			
Electrical			
Specified	**Actual**	**Verified By**	**Date**
460 V +/- 20V for Pump Drive Panel	474.5V	PE	8/1/13
115V +/- 10 for Controls	119.7V	PE	8/1/13
Air			
Air Present for Vacuum Control Valve	Yes	PE	8/1/13
Air Present for Fine Salt Loop Control Valve	Yes	PE	8/1/13
Steam			
Steam Supply for Ejector	Yes	PE	8/1/13
Fine Salt Loop Steam	Yes	PE	8/1/13
Comments:			8/1/13 PE

Reviewed By: Ashley Williams **Date:** 8/6/13

CRYSTALLIZER #4: OPERATIONAL QUALIFICATION

B. Operational Qualification

1. Vessel and Circulation

Vessel and Circulation				
Description	**Function**	**Did Item function properly (Yes/No)**	**Verified By**	**Date**
Elbow Pump	Elbow Pump turns clockwise as viewed from the motor grill when the drive is "on"	Yes	PC	8/1/13
Circulation	With vessel filled with brine and Elbow Pump on circulation discharge should be visible from the top sight glass	Yes	PC	8/1/13
Comments:				PC 8/1/13

2. Feed System

Feed System				
Description	**Function**	**Did Item function properly (Yes/No)**	**Verified By**	**Date**
Brine Flow Meter	Flow meter directional arrow should point toward Elbow Loop plumbing	Yes	PC	8/1/13
Brine Pump	With Brine Pump on the motor should turn clockwise as viewed from the motor grill when the drive is "on"	Yes	PC	8/1/13
Brine Flow Meter	With valves open and pump on the Brine Flow Meter on the Brine Flow Meter should register a flow	Yes	PC	8/1/13
Comments:				PC 8/1/13

Reviewed By: Ashley Williams **Date:** 8/6/13

3. Vacuum System

Vacuum System				
Description	**Function**	**Did Item function properly (Yes/No)**	**Verified By**	**Date**
Vacuum Control Valve	With controller in Manual, valve should close at 0% and be fully open at 100%	Yes	PE	8/1/13
Vacuum System Utilities	Ensure steam is on Ejector and Water is on both Condensers	Yes	PE	8/1/13
Vacuum Sensor	When Vacuum System is on, the Vacuum Sensor should show the pressure dropping	Yes	PE	8/1/13
Comments:				PE 8/1/13

4. Discharge System

Discharge System				
Description	**Function**	**Did Item function properly (Yes/No)**	**Verified By**	**Date**
Discharge Pump Motor	Ensure pump motor turns clockwise as viewed from the motor grill when the drive is "on"	Yes	PE	8/1/13
Discharge Flow	With vessel full, open both valves and put system set point on 22 gpm. Verify flow at Centrifuge.	Yes	PE	8/1/13
Comments:				PE 8/1/13

Reviewed By: Ashley Williams **Date:** 8/6/13

5. Fine Salt Reduction System

Fine Salt Reduction System				
Description	**Function**	**Did Item function properly (Yes/No)**	**Verified By**	**Date**
Steam Control Valve	With controller in Manual, valve should close at 0% and be fully open at 100%	Yes	PE	8/1/13
Fine Salt Flow	Ensure flow meter shows flow with FS Loop pump on	Yes	PE	8/1/13
Steam Control	Ensure temperature in Fine Salt Loop rises when steam is called for	Yes	PE	8/1/13
Comments:				PE 8/1/13

6. Mother Liquor System

Mother Liquor System				
Description	**Function**	**Did Item function properly (Yes/No)**	**Verified By**	**Date**
Flow Meter	Ensure Flow Meter arrow points away from the Mother Liquor Tank and toward the Crystallizer	Yes	PE	8/1/13
Flow	Ensure that when valves are open that flow is observed on the Flow Meter	Yes	PE	8/1/13
Comments:				PE 8/1/13

Reviewed By: Ashley Williams **Date:** 8/6/13

CRYSTALLIZER #4: PERFORMANCE QUALIFICATION

C. Performance Qualification – to be performed with Crystallizer #4 operating for at least 24 hours and at steady state

1. Vacuum

Performance Qualification Data				
Time	**Vacuum (< or = 1.50 inches Hg)**	**Did Item Meet Criteria (Yes/No)**	**Verified By**	**Date**
1300	1.10	yes	PS	8/2/13
1330	1.10	yes	PS	8/2/13
1359	1.10	yes	PS	8/2/13
1430	1.10	yes	PS	8/2/13
1501	1.08	yes	PS	8/2/13
1531	1.10	yes	PS	8/2/13
1600	1.10	yes	PS	8/2/13
1628	1.10	yes	PS	8/2/13
1700	1.10	yes	PS	8/2/13
Comments:				PS 8/2/13

Reviewed By: Ashley Williams **Date:** 8/6/13

2. Fines Reduction Loop Flow

Performance Qualification Data				
Time	**Fines Reduction Loop Flow (Not Less than 15.0 gallons per minute)**	**Did Item Meet Criteria (Yes/No)**	**Verified By**	**Date**
1300	17.2	Yes	Per	8/2/13
1330	17.4	Yes	Per	8/2/13
1359	17.4	Yes	Per	8/2/13
1430	17.2	Yes	Per	8/2/13
1501	16.9	Yes	Per	8/2/13
1531	17.2	Yes	Per	8/2/13
1600	17.2	Yes	Per	8/2/13
1628	17.0	Yes	Per	8/2/13
1700	17.2	Yes	Per	8/2/13
Comments:				Per 8/2/13

Reviewed By: Ashley Williams **Date:** 8/6/13

3. Fines Reduction Loop Temperature

Performance Qualification Data				
Time	**Fines Reduction Loop Temperature (38.0 – 44.0 Degrees C)**	**Did Item Meet Criteria (Yes/No)**	**Verified By**	**Date**
1300	41.0	Yes	PE	8/2/13
1330	41.8	Yes	PE	8/2/13
1359	42.6	Yes	PE	8/2/13
1430	41.8	Yes	PE	8/2/13
1501	41.9	Yes	PE	8/2/13
1531	42.4	Yes	PE	8/2/13
1600	41.0	Yes	PE	8/2/13
1628	41.3	Yes	PE	8/2/13
1700	41.8	Yes	PE	8/2/13
Comments:				PE 8/2/13

Reviewed By: Ashley Williams **Date:** 8/16/13

4. Discharge Flow

Performance Qualification Data				
Time	**Discharge Flow (19 – 25 gallons per minute)**	**Did Item Meet Criteria (Yes/No)**	**Verified By**	**Date**
1300	21.0	Yes	PSV	8/2/13
1330	21.1	Yes	PSV	8/2/13
1359	21.0	Yes	PSV	8/2/13
1430	21.0	Yes	PSV	8/2/13
1501	21.0	Yes	PSV	8/2/13
1531	21.2	Yes	PSV	8/2/13
1600	21.1	Yes	PSV	8/2/13
1628	21.1	Yes	PSV	8/2/13
1700	21.0	Yes	PSV	8/2/13
Comments:				PSV 8/2/13

5. USP Testing

Date and Time Sample Taken : 0700 8/3/13 **Verified By:** PSV

Results: (PASS) / FAIL (circle one) **Verified By:** PSV **Date:** 8/5/13

Note: Attach USP Testing Results to the Final Report

Reviewed By: Ashley Williams **Date:** 8/6/13

VII. CALIBRATION VERIFICATION

Equipment	Manufacturer	Model Number	Serial Number	Calibration Date	Verified By	Date
Multimeter	Ideal	61-340	100100221	ow manufacturer	PEG	8/1/13
Discharge Flow Meter	Endress + Hauser	Promag 53-P	H300D016aw	3/6/13	PEG	8/1/13
Brine Feed Flow Meter	Endress + Hauser	Promag 53P	H102F816000	1/14/13	PEG	8/1/13
Level Probe	Endress + Hauser	Ceraber S PMC71	H101E81509C	1/15/13	PEG	8/1/13
Vacuum Probe	Endress + Hauser	Ceraber S PMC71	H01E61509C	1/15/13	PEG	8/1/13
Fines Reduction Flow Meter	Endress + Hauser	Promass 83S	H101F316aw	1/14/13	PEG	8/1/13

Reviewed By: Ashley Williams **Date:** 8/6/13

ATTACHMENT I - PROTOCOL DEVIATION REPORT LOG

Log each Protocol Deviation Report in the table below. Attach the PDRs to this Attachment.

PDR #	DESCRIPTION	DATE INITIATED	DATE RESOLVED
Comments:			

PD 9/5/13

ATTACHMENT II. PROTOCOL DEVIATION REPORT (PDR)

General Information

System Name: _____ Protocol Number: _____

Deviation Report Number: _____ Protocol Step & Page No.: _____

Instructions

1. The validation specialist assigns a sequential report number for each deviation with a specific protocol. For example, 001, 002, etc. can be easily referenced in a report.
2. Reference the relevant protocol number, step and page number of the noted deviation above.
3. Complete the below listed sections. If necessary, use additional pages and attach any supporting info.
4. Include the original PDR(s) with the protocol as an attachment. Summarize the impact of the deviation in the Validation Report.

Description of Deviation:

Investigation Evaluation and Results:

Corrective Action and Resolution:

8/2/13

Overall Investigation Review:

Prepared By: _____ Date: _____

ATTACHMENT III - SIGNATURE IDENTIFICATION LOG SHEET

Identify in the table below any personnel involved in the execution of this protocol.

Name	Affiliation	Signature	Initial	Date
Patrick Owen	Engineering	Pat Owen	PO	8/1/13
Ashley Williams	Quality	Ashley Williams	AW	8/16/13

Giles Chemical, a division of Premier Magnesia, LLC.
102 Commerce Street Waynesville, NC 28786
USP Certificate of Analysis

Release Date: 8/5/2013

CUSTOMER: _____

CUST. REF: _____ SHIP DATE: _____

PRODUCT: Magnesium Sulfate - **USP** TRAILER NUMBER: _____

SHELF LIFE: 3 Years BILL OF LADING # : _____

LOT NUMBER: **1913** PO NUMBER # : _____

SHIPPER : _____ MANUFACTURED : _____

CUST. SERV. : _____ EXPIRATION: _____

I certify that this material meets all the requirements of the Giles Chemical sales specifications and the United States Pharmacopeia 35. Periodic testing has shown the samples to be consistently free of volatile organic impurities. Giles Chemical magnesium sulfate is manufactured under the guidelines of Current Good Manufacturing Practices (cGMP).

EPSOM SALT, Magnesium Sulfate - Heptahydrate, USP

METHOD	TEST	LOWER	UPPER	Test Results
VISUAL	Appearance	~~	~~	Clear
USP35	Chloride as Cl (%)	~~	0.014	< 0.014%
USP35	Heavy Metals As Pb (%)	~~	0.001	< 0.001%
USP35	Ignition Loss (%)	40.00	52.00	51.23%
USP35	Iron (ppm)	~~	20.00	< 20.00 ppm
USP35	$MgSO_4$ (Anhydrous wt. %)	99.00	100.50	99.90%
USP35	$MgSO_4$ (As is basis, %)	48.30	52.00	48.75%
USP35	pH 5% Solution	5.00	9.20	7.80
USP35	Selenium (%)	~~	0.003	< 0.003%
USP35	Mg^{2+} ID			Present
USP35	SO_4^{2-} ID			Present

ATTN:

ANALYST:

SIGNATURE ON FILE

Endress+Hauser

People for Process Automation

Flow Calibration with Adjustment

30263727-2982132

1000219296
Purchase order number

US-3004970133-10 / Endress+Hauser Flowtec
Order N°/Manufacturer

53P40-EL2B1AA0BAAA
Order code

PROMAG 53 P 1 1/2"
Transmitter/Sensor

H300D016000
Serial N°

–
Tag N°

FCP-6.C
Calibration rig

99.59059 us.gal/min (≙ 100%)
Calibrated full scale

Service interface
Calibrated output

0.7625
Calibration factor

-10
Zero point

82 °F
Water temperature

Flow [%]	Flow [us.gal/min]	Duration [s]	V target [us.gal]	V meas. [us.gal]	Δ o.r.* [%]	Outp.** [mA]
4.0	3.94	85.1	5.5924	5.6222	0.53	4.64
39.9	39.8	60.1	39.862	39.856	-0.01	10.39
40.0	39.8	60.2	39.926	39.931	0.01	10.40
100.2	99.8	50.2	83.424	83.483	0.07	20.04
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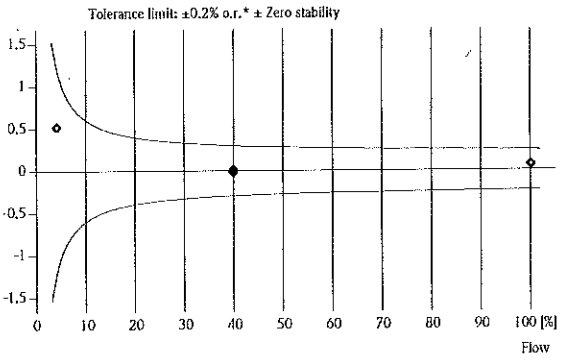
*o.r.: of rate
**Calculated value (4 - 20 mA)

Measured error % o.r.



For detailed data concerning output specifications of the unit under test, see Technical Information (TI), chapter Performance characteristics.

The calibration is traceable to the N.I.S.T. through standards certified at preset intervals.

Endress+Hauser Flowtec operates ISO/IEC 17025 accredited calibration facilities in Reinach (CH), Cernay (FR), Greenwood (USA), Aurangabad (IN) and Suzhou (CN).

03-06-2013
Date of calibration

Endress+Hauser Flowtec, Division USA
2330 Endress Place
Greenwood, IN 46143

Chad Key
Operator

Certified acc. to
ISO 9001, Reg.-N° 030502.2
ISO 14001, Reg.-N° EMS561046

Endress+Hauser

People for Process Automation

Flow Calibration with Adjustment

30258816-2944984

1000214704 Purchase order number	FCP-6.C Calibration rig
US-3004945709-30 / Endress+Hauser Flowtec Order N°/Manufacturer	99.59059 us.gal/min (≙ 100%) Calibrated full scale
53P40-EL0B1AA0BAAA Order code	Service interface Calibrated output
PROMAG 53 P 1 1/2" Transmitter/Sensor	0.7872 Calibration factor
H102F816000 Serial N°	10 Zero point
– Tag N°	76.1 °F Water temperature

Flow [%]	Flow [us.gal/min]	Duration [s]	V target [us.gal]	V meas. [us.gal]	Δ o.r.* [%]	Outp.** [mA]
4.0	3.99	85.1	5.6655	5.6858	0.36	4.64
40.0	39.8	60.1	39.903	39.908	0.01	10.40
40.1	39.9	60.1	39.967	39.966	0.00	10.41
100.1	99.6	50.1	83.258	83.268	0.01	20.01
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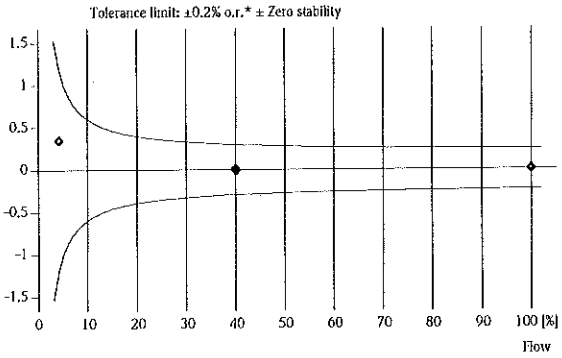
*o.r.: of rate

**Calculated value (4 - 20 mA)

Measured error % o.r.



For detailed data concerning output specifications of the unit under test, see Technical Information (TI), chapter Performance characteristics.

The calibration is traceable to the N.I.S.T. through standards certified at preset intervals.

Endress+Hauser Flowtec operates ISO/IEC 17025 accredited calibration facilities in Reinach (CH), Cernay (FR), Greenwood (USA), Aurangabad (IN) and Suzhou (CN).

David McCombs

01-14-2013

Date of calibration

David McCombs

Operator

Endress+Hauser Flowtec, Division USA
2330 Endress Place
Greenwood, IN 46143

Certified acc. to
ISO 9001, Reg.-N° 030502.2
ISO 14001, Reg.-N° EMS561046

Level | Pressure | Flow | Temperature | Liquid Analysis | Registration | Systems Components | Services | Solutions

Endress+Hauser GmbH+Co.
2340 Endress Place
Greenwood, In. 46143-9772

Final Inspection Report / Endprüfprotokoll

The manufacturer confirms that all measuring equipment used to assure the quality of the products has been calibrated and is traceable to national (e.g. DKD/DAkkS, NIST, NABL...) or international standards.

Der Hersteller bestätigt, dass die zu Qualitätsprüfungen des Erzeugnisses eingesetzten Messmittel gültig kalibriert waren und auf nationale (z.B. DKD/DAkkS, NIST, NABL...) bzw. internationale Normale rückführbar sind.

Cerabar S

TAG number — Messstellen-Nummer

Order code	Bestellcode	PMC71-SAC2K4AGAAA
Serial number	Seriennummer	H101E81509C
Extended order code	Erweiterter Bestellcode	PMC71-SAC2K4AGAAA
Sensor range	Sensor-Messbereich	0...800 inH2O abs
Adjusted measuring range	Eingestellter Messbereich	0...800 inH2O abs
Maximum permissible error	Max. zulässige Messabweichung	± 0.075 %
Output type	Ausgang	4...20 mA, HART
Software version	Softwareversion	02.10.54
Output mode	Ausgangsmodus	linear

GILES CHEMICAL

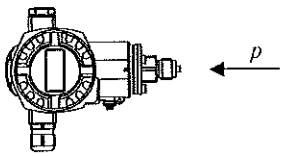
Customer order number	Auftragsnummer des Kunden	129155
E+H sales order number	E+H Auftragsnummer	71235087000060
Internal order number	Interne Auftragsnummer	1000214704/0060

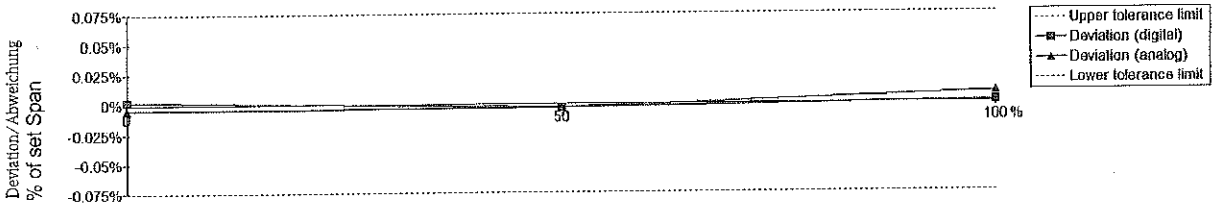
Ambient temperature	Umgebungs-Temperatur	22.6°C (± 1 °C)
Ambient humidity	Umgebungs-Luftfeuchte	22.7 %rel.F (± 10 %rel.F)
Ambient pressure	Umgebungs-Luftdruck	994.5 mbar (± 0.2 mbar)
Calibrated according to fix point method IEC 60770.	Prüfung nach Grenzpunktmethode gemäß IEC 60770.	

Measuring results / Messergebnisse

Calibration point	Nominal value ($p_{Ref.}$)	Measured value (digital readout)	Deviation (digital)	Nominal value (i_{Out} calculated)	Current output (analog)	Rel. deviation (analog)
Kalibrierpunkt	Sollwert ($p_{Ref.}$)	Istwert (Digitaler Wert)	Abweichung (digital)	Sollwert (I_{Out} berechnet)	Istwert Stromausgang (analog)	Rel. Abweichung (analog)
%	inH2O	inH2O	% of Span	mA	mA	%
0	12.9640	12.9842	0.00253	4.2593	4.2585	-0.0047
50	399.280	399.254	-0.00327	11.986	11.985	-0.0031
100	806.744	806.751	0.00088	20.135	20.136	0.0090

Calibration orientation
Kalibrierlage





Calibration carried out in output mode linear/
Kalibration erfolgte im Ausgangsmodus linear.

Measuring point in % of adjusted measuring range/
Messpunkt in % vom eingestellten Messbereich

We confirm that all tests, according to the Inspection and Test Plan (ITP), have been performed successfully. At the time of verification, the measuring points of the device indicated above were in compliance to the published valid technical specification (TI).

Wir bestätigen, dass alle Tests aus den Inspektions- und Testplänen (ITP) erfolgreich durchgeführt wurden. Das Gerät entsprach zum Zeitpunkt der Prüfung an den aufgeführten Messpunkten den gültigen technischen Spezifikationen (TI).

TI 383P

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Operator / geprüft durch 155448
Date of inspection / Prüfdatum 15. Jan 2013

Endress+Hauser
People for Process Automation

– End of document –
Ende des Dokumentes

Level | Pressure | Flow | Temperature | Liquid Analysis | Registration | Systems Components | Services | Solutions

Endress+Hauser GmbH+Co.
2340 Endress Place
Greenwood. In. 46143-9772

Final Inspection Report / Endprüfprotokoll

The manufacturer confirms that all measuring equipment used to assure the quality of the products has been calibrated and is traceable to national (e.g. DKD/DAkkS, NIST, NABL...) or international standards.

Der Hersteller bestätigt, dass die zu Qualitätsprüfungen des Erzeugnisses eingesetzten Messmittel gültig kalibriert waren und auf nationale (z.B. DKD/DAkkS, NIST, NABL...) bzw. internationale Normale rückführbar sind.

Cerabar S

TAG number	Messstellen-Nummer	
Order code	Bestellcode	PMC71-SAC2K4RAAAU
Serial number	Seriennummer	H101E61509C
Extended order code	Erweiterter Bestellcode	PMC71-SAC2K4RAAAU
Sensor range	Sensor-Messbereich	0...800 inH2O abs
Adjusted measuring range	Eingestellter Messbereich	0...800 inH2O abs
Maximum permissible error	Max. zulässige Messabweichung	± 0.075 %
Output type	Ausgang	4...20 mA, HART
Software version	Softwareversion	02.10.54
Output mode	Ausgangsmodus	linear

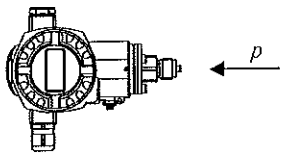
GILES CHEMICAL

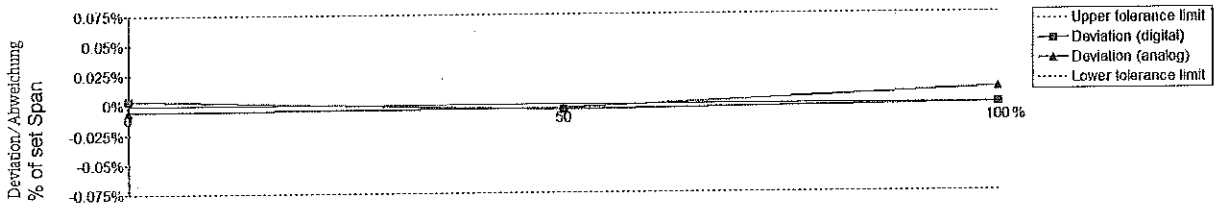
Customer order number	Auftragsnummer des Kunden	129155
E+H sales order number	E+H Auftragsnummer	71235087000050
Internal order number	Interne Auftragsnummer	1000214704/0050
Ambient temperature	Umgebungs-Temperatur	22.4 °C (± 1 °C)
Ambient humidity	Umgebungs-Luftfeuchte	22.4 %rel.F (± 10 %rel.F)
Ambient pressure	Umgebungs-Luftdruck	994.5 mbar (± 0.2 mbar)
Calibrated according to fix point method IEC 60770.	Prüfung nach Grenzpunktmethode gemäß IEC 60770.	

Measuring results / Messergebnisse

Calibration point	Nominal value ($p_{Ref.}$)	Measured value (digital readout)	Deviation (digital)	Nominal value (I_{Out} calculated)	Current output (analog)	Rel. deviation (analog)
Kalibrierpunkt	Sollwert ($p_{Ref.}$)	Istwert (Digitaler Wert)	Abweichung (digital)	Sollwert (I_{Out} berechnet)	Istwert Stromausgang (analog)	Rel. Abweichung (analog)
%	inH2O	inH2O	% of Span	mA	mA	%
0	12.3160	12.3479	0.00398	4.2463	4.2454	-0.0055
50	399.228	399.191	-0.00459	11.985	11.984	-0.0036
100	801.456	801.450	-0.00071	20.029	20.031	0.0122

Calibration orientation
Kalibrierlage





Calibration carried out in output mode linear/
Kalibration erfolgte im Ausgangsmodus linear.

Measuring point in % of adjusted measuring range/
Messpunkt in % vom eingestellten Messbereich

We confirm that all tests, according to the Inspection and Test Plan (ITP), have been performed successfully. At the time of verification, the measuring points of the device indicated above were in compliance to the published valid technical specification (TI).

Wir bestätigen, dass alle Tests aus den Inspektions- und Testplänen (ITP) erfolgreich durchgeführt wurden. Das Gerät entsprach zum Zeitpunkt der Prüfung an den aufgeführten Messpunkten den gültigen technischen Spezifikationen (TI).

TI 383P

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Dieses Dokument wurde elektronisch erzeugt und ist ohne Unterschrift gültig.

Operator / geprüft durch 155448
Date of inspection / Prüfdatum 15. Jan 2013

Endress+Hauser
People for Process Automation

End of document
- Ende des Dokumentes -

Endress+Hauser

People for Process Automation

Flow Calibration with Adjustment

30258846-2942979

1000214704
Purchase order number

US-3004945709-40 / Endress+Hauser Flowtec
Order N°/Manufacturer

83S25-1020/0
Order code

PROMASS 83 S 1"
Transmitter/Sensor

H101F316000
Serial N°

–
Tag N°

FCP-6.F
Calibration rig

132.2774 lb/min (≙ 100%)
Calibrated full scale

Service interface
Calibrated output

3.2299
Calibration factor

24
Zero point

77.1 °F
Water temperature

Flow [%]	Flow [lb/min]	Duration [s]	m target [lb]	m meas. [lb]	Δ o.r.* [%]
25.6	33.9	85.2	48.120	48.135	0.03
25.6	33.9	85.2	48.126	48.124	-0.01
99.4	131.4	30.2	66.139	66.140	0.00
99.5	131.6	30.2	66.205	66.204	0.00
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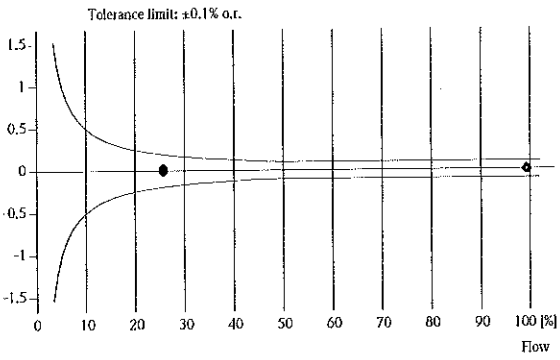
*o.r.: of rate

Measured error % o.r.



For detailed data concerning output specifications of the unit under test, see Technical Information (TI), chapter Performance characteristics.

The calibration is traceable to the N.I.S.T. through standards certified at preset intervals.

Endress+Hauser Flowtec operates ISO/IEC 17025 accredited calibration facilities in Reinach (CH), Cernay (FR), Greenwood (USA), Aurangabad (IN) and Suzhou (CN).

John Davis

01-14-2013
Date of calibration

John Davis
Operator

Endress+Hauser Flowtec, Division USA
2330 Endress Place
Greenwood, IN 46143

Certified acc. to
ISO 9001, Reg.-N° 030502.2
ISO 14001, Reg.-N° EMS561046

Endress+Hauser

People for Process Automation

Flow Calibration with Adjustment

30258873-2944985

1000214704 Purchase order number	FCP-6.C Calibration rig
US-3004945709-20 / Endress+Hauser Flowtec Order N°/Manufacturer	38.90256 us.gal/min (≙ 100%) Calibrated full scale
53P25-EL2B1AA0BAAA Order code	Service interface Calibrated output
PROMAG 53 P 1" Transmitter/Sensor	0.7457 Calibration factor
H102F916000 Serial N°	0 Zero point
– Tag N°	75.6 °F Water temperature

Flow [%]	Flow [us.gal/min]	Duration [s]	V target [us.gal]	V meas. [us.gal]	Δ o.r.* [%]	Outp.** [mA]
4.0	1.56	60.1	1.5642	1.5731	0.57	4.65
39.8	15.5	60.1	15.524	15.526	0.01	10.37
40.0	15.6	60.1	15.601	15.599	-0.01	10.40
100.3	39.0	60.1	39.103	39.138	0.09	20.06
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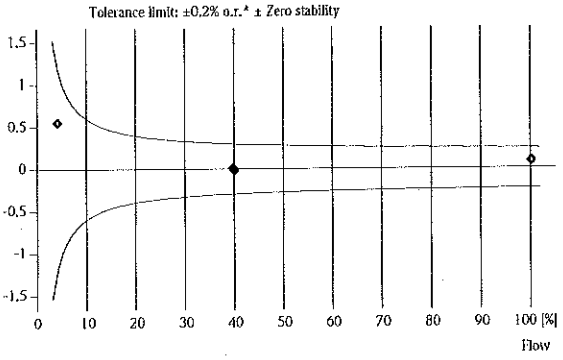
*o.r.: of rate

**Calculated value (4 - 20 mA)

Measured error % o.r.



For detailed data concerning output specifications of the unit under test, see Technical Information (TI), chapter Performance characteristics.

The calibration is traceable to the N.I.S.T. through standards certified at preset intervals.

Endress+Hauser Flowtec operates ISO/IEC 17025 accredited calibration facilities in Reinach (CH), Cernay (FR), Greenwood (USA), Aurangabad (IN) and Suzhou (CN).

01-14-2013
Date of calibration

Endress+Hauser Flowtec, Division USA
2330 Endress Place
Greenwood, IN 46143

Chad Key
Operator

Certified acc. to
ISO 9001, Reg.-N° 030502.2
ISO 14001, Reg.-N° EMS561046

Level | Pressure | Flow | Temperature | Liquid Analysis | Registration | Systems Components | Services | Solutions

Endress+Hauser GmbH+Co.
2340 Endress Place
Greenwood, In. 46143-9772

Final Inspection Report / Endprüfprotokoll

The manufacturer confirms that all measuring equipment used to assure the quality of the products has been calibrated and is traceable to national (e.g. DKD/DAkkS, NIST, NABI....) or international standards.

Der Hersteller bestätigt, dass die zu Qualitätsprüfungen des Erzeugnisses eingesetzten Messmittel gültig kalibriert waren und auf nationale (z.B. DKD/DAkkS, NIST, NABI....) bzw. internationale Normale rückführbar sind.

Cerabar S

TAG number	Messstellen-Nummer	
Order code	Bestellcode	PMC71-SAC2K4AGAAA
Serial number	Seriennummer	H101E71509C
Extended order code	Erweiterter Bestellcode	PMC71-SAC2K4AGAAA
Sensor range	Sensor-Messbereich	0...800 inH2O abs
Adjusted measuring range	Eingestellter Messbereich	0...800 inH2O abs
Maximum permissible error	Max. zulässige Messabweichung	± 0.075 %
Output type	Ausgang	4...20 mA, HART
Software version	Softwareversion	02.10.54
Output mode	Ausgangsmodus	linear

GILES CHEMICAL

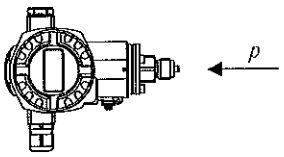
Customer order number	Auftragsnummer des Kunden	129155
E+H sales order number	E+H Auftragsnummer	71235087000060
Internal order number	Interne Auftragsnummer	1000214704/0060

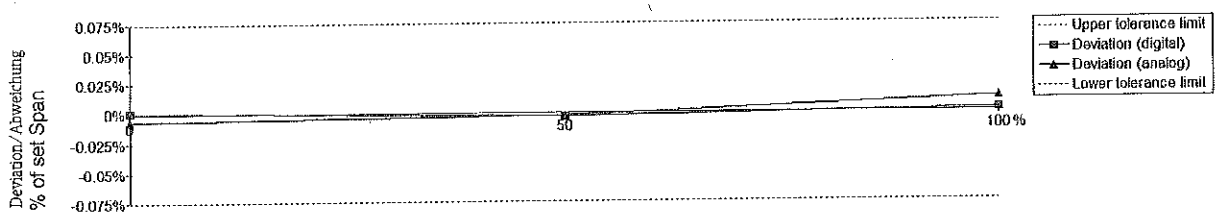
Ambient temperature	Umgebungs-Temperatur	22.6 °C (± 1 °C)
Ambient humidity	Umgebungs-Luftfeuchte	22.3 %rel.F (± 10 %rel.F)
Ambient pressure	Umgebungs-Luftdruck	993.8 mbar (± 0.2 mbar)
Calibrated according to fix point method IEC 60770.	Prüfung nach Grenzpunktmethode gemäß IEC 60770.	

Measuring results / Messergebnisse

Calibration point	Nominal value ($p_{Ref.}$)	Measured value (digital readout)	Deviation (digital)	Nominal value (I_{Out} calculated)	Current output (analog)	Rel. deviation (analog)
Kalibrierpunkt	Sollwert ($p_{Ref.}$)	Istwert (Digitaler Wert)	Abweichung (digital)	Sollwert (I_{Out} berechnet)	Istwert Stromausgang (analog)	Rel. Abweichung (analog)
%	inH2O	inH2O	% of Span	mA	mA	%
0	12.3400	12.3519	0.00149	4.2468	4.2458	-0.0061
50	399.000	398.975	-0.00316	11.980	11.980	-0.0028
100	804.200	804.217	0.00216	20.084	20.086	0.0118

Calibration orientation
Kalibrierlage





Calibration carried out in output mode linear/
Kalibration erfolgte im Ausgangsmodus linear.

Measuring point in % of adjusted measuring range/
Messpunkt in % vom eingestellten Messbereich

We confirm that all tests, according to the Inspection and Test Plan (ITP), have been performed successfully. At the time of verification, the measuring points of the device indicated above were in compliance to the published valid technical specification (TI).

Wir bestätigen, dass alle Tests aus den Inspektions- und Testplänen (ITP) erfolgreich durchgeführt wurden. Das Gerät entsprach zum Zeitpunkt der Prüfung an den aufgeführten Messpunkten den gültigen technischen Spezifikationen (TI).

TI 383P

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Operator / geprüft durch 155448
Date of inspection / Prüfdatum 15. Jan 2013

Endress+Hauser
People for Process Automation

- End of document -
Ende des Dokumentes -

Endress+Hauser

People for Process Automation

Standard Density Calibration with Adjustment

31065312-2942979-675807

PROMASS 83 S 1"
Transmitter/Sensor

H101F316000
Serial N°

FCP-6.F
Calibration rig

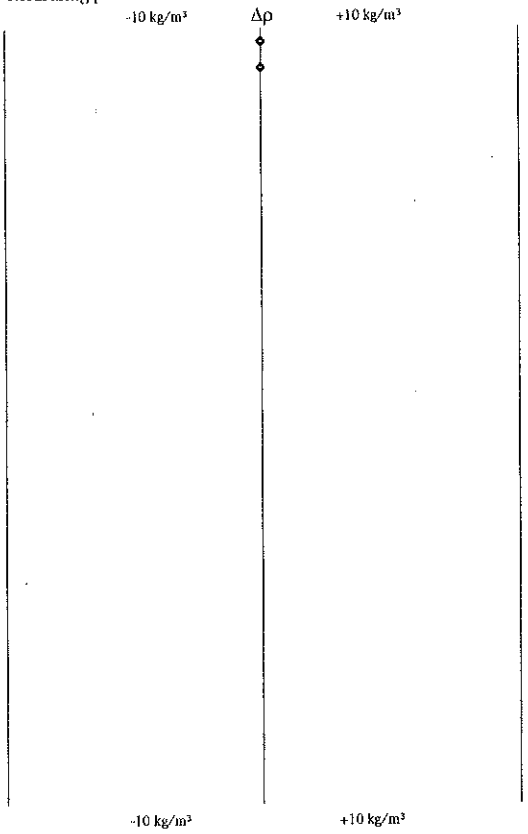
C0 = -2531.3 C1 = 1.5668E+9
Density coefficient

C2 = -7.6621E+5 C3 = -36033
Density coefficient

C4 = 1.1054E+14 C5 = -1.2950E-3
Density coefficient

Medium	Temp. [°F]	ρ target [kg/m³]	ρ meas. [kg/m³]	Δρ [kg/m³]	Freq. [Hz]
Air	71.6	1.20	1.20	0.00	822.3
Water	77.2	997.94	997.94	0.00	707.6

Measuring precision · Tolerance limit - - - - -



Endress+Hauser Flowtec operates ISO/IEC 17025 accredited calibration facilities in Reinach (CH), Cernay (FR), Greenwood (USA), Aurangabad (IN) and Suzhou (CN).

01-14-2013
Date of calibration

Endress+Hauser Flowtec, Division USA
2330 Endress Place
Greenwood, IN 46143

John Davis
Operator

Certified acc. to
ISO 9001, Reg.-N° 030502.2
ISO 14001, Reg.-N° EMS561046