RUDOLPH RESEARCH ANALYTICAL

TECHNICAL BULLETIN 935

For High Accuracy Applications

The DDM Series of Automatic Density Meters

United States of America
National Institute of Standards and Technology

9001:2008 CERTIFIED ISO RUDOLPH RESEARCH

NVLAP®

NVLAP LAB CODE: 200898-0
Accreditation to ISO/IEC 17025:2005

17025:2005 CERTIFIED ISO RUDOLPH RESEARCH



Rudolph Research Analytical, serving its customers with Integrity, Quality, and Innovation for over fifty years.

The Simplicity of Touch Screen Measur

Oscillating U-Tube with Viscosity Correction and Reference Oscillator

Rudolph DDM Density meters utilize an oscillating U-tube with full range viscosity correction and reference oscillator that allows for long term calibration stability and measurement at all temperatures with a single calibration.
(Patent # 7,735,353)

Full Feature VideoView™ with Automatic Scanning of Entire U-Tube

Rudolph's exclusive VideoView is protected under Patent #7,437,909 and provides superior high resolution visual bubble detection within your sample with live on-screen video viewing. Images can be saved with the sample results and may be viewed and or printed as desired.

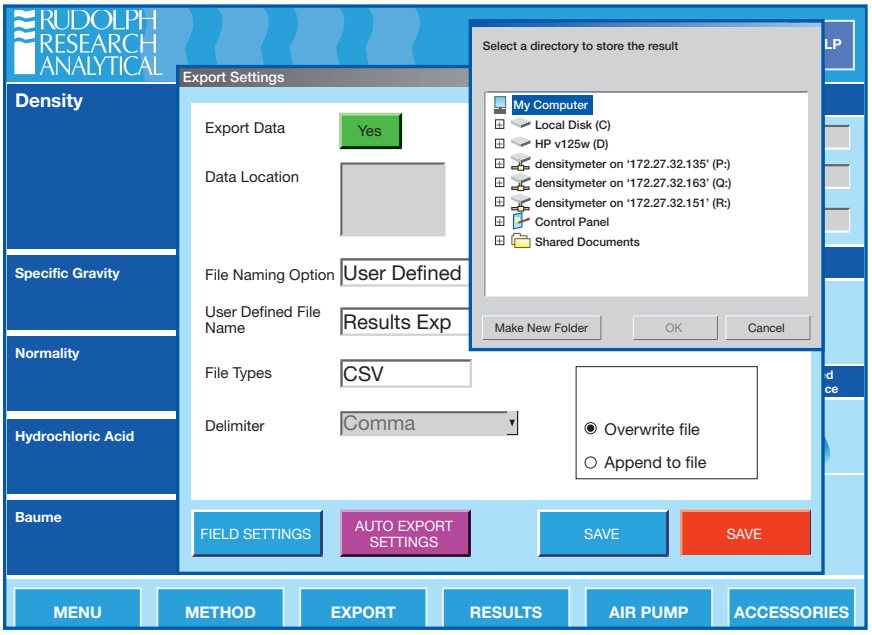
A full view of the entire U-tube is possible at 2X magnification. Further, the U-Tube can be scanned at 6X or 10X magnification so the user can see that the U-Tube is bubble free. The 10X magnification is also extremely helpful in detecting the cleanliness of the glass U-tube. The clarity, magnification and resolution are the very best available.



- Three magnified video assisted views of the entire cell are available, in 2X, 6X and a 10X magnifications
- Images may be saved with results for subsequent review
- Automatic Bubble detection is available which will flag the sample(s) with suspected bubbles

Computer Windows Embedded Based Flexibility

- 32 gigabytes of internal memory allows almost unlimited capacity for saving measurement data. All Rudolph DDM Series Density meters are network ready and data may also be saved directly to your server or to any desired directories
- Internet access is possible directly from all Rudolph DDM Density Meter touch screens. The disk protection feature protects the operating system against malware infections in networked environments
- Windows based navigation architecture is so intuitive that most operators will never read the manual, but should you wish to reference the manual, it is stored right on the Rudolph DDM's internal memory
- Copy methods, transfer concentration tables, download data, etc., via the USB ports on the front and back of the unit
- Five USB ports allow for quick and easy connection to a mouse, keyboard, printer, bar code scanner, or memory stick. Embedded Windows prevents any and all viruses and malware

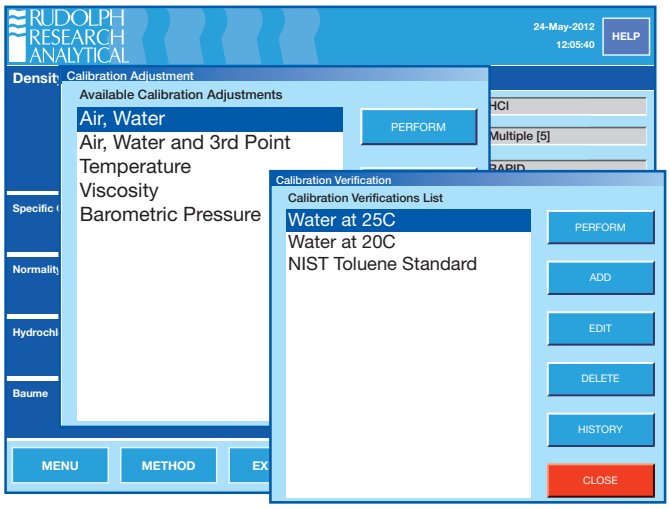


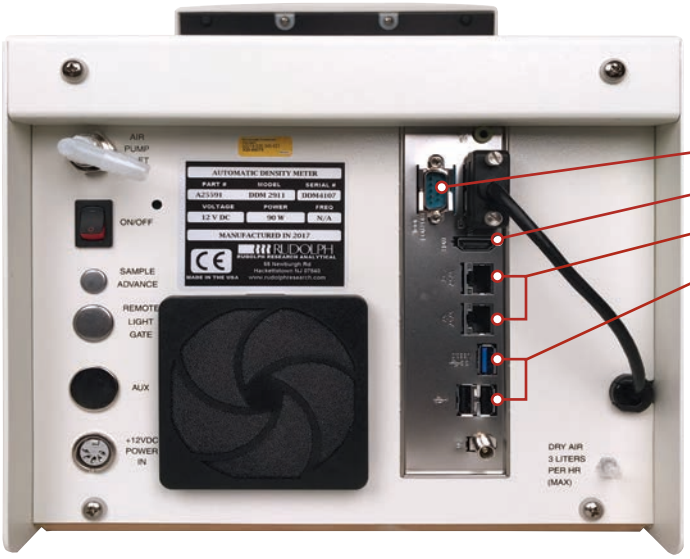
Rudolph Research Analytical 55 Newburgh Road, Hackettstown, NJ 07840 USA ▪ Phone: 973-584-1558 ▪ Fax: 973-584-5440 ▪ E-mail: info@rudolphresearch.com ▪ Internet: www.rudolphresearch.com

rement with the Flexibility of Windows®

cGMP/GLP Calibration

- Calibrate the Rudolph DDM Density Meter with 2 or 3 NIST Traceable Standards – calibrating with merely air and water appears inconsistent with cGMP/GLP compliance regulations
- Can print out complete method configuration, communication settings, as well as calibration verification and calibration adjustment data/history
- Measured values can be shown continuously as temperature stability is being reached or, at the discretion of the user, measured values will only be displayed once the measurement is complete
- Unlimited number of customizable calibration adjustments and calibration verifications possible
- Complete History of Calibration Adjustments and Verifications are available to View, Print, and/or Export
- Set calendar reminders as to when Calibration Verifications are due





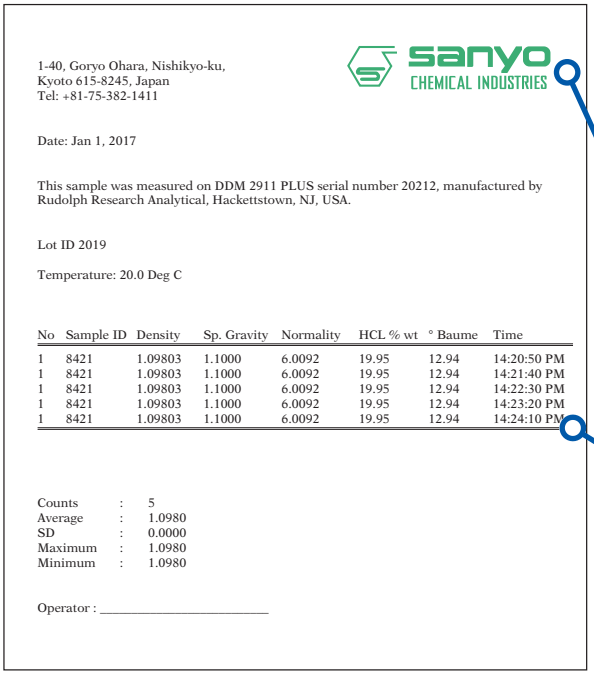
Versatile Communication Capability

The Rudolph DDM Density Meter's standard communication package includes:

- 1 RS232 port
- HDMI
- CAT 5 Ethernet Port for Network Cable Connection
- 5 USB ports -2 Front Located and 3 Rear Located

Allowing the capability to:

- Export measurement results with saved video view images to a thumb drive, store it locally on the C:\ drive, or easily send data to any external PC, LIMS, SAP, etc.
- Print measurement results to any local or networked printer. Most all printers are supported by Windows 7® but if required the driver may be added
- Save measurement data direct to your Network/Server



sanyo CHEMICAL INDUSTRIES

1-40, Goryo Ohara, Nishikyo-ku,
Kyoto 615-8245, Japan
Tel: +81-75-382-1411

Date: Jan 1, 2017

This sample was measured on DDM 2911 PLUS serial number 20212, manufactured by Rudolph Research Analytical, Hackettstown, NJ, USA.

Lot ID 2019

Temperature: 20.0 Deg C

No	Sample ID	Density	Sp. Gravity	Normality	HCL % wt	° Baume	Time
1	8421	1.09803	1.1000	6.0092	19.95	12.94	14:20:50 PM
1	8421	1.09803	1.1000	6.0092	19.95	12.94	14:21:40 PM
1	8421	1.09803	1.1000	6.0092	19.95	12.94	14:22:30 PM
1	8421	1.09803	1.1000	6.0092	19.95	12.94	14:23:20 PM
1	8421	1.09803	1.1000	6.0092	19.95	12.94	14:24:10 PM

Counts : 5
Average : 1.0980
SD : 0.0000
Maximum : 1.0980
Minimum : 1.0980

Operator : _____

cGMP/GLP Printing

Sample measurement reports are edited quickly and easily. Just import your logo to the Rudolph DDM Density Meter and send your company's customized certificate of analysis to your server or local printer.

Print your customized Certificate of Analysis including your company logo directly from the DDM Density Meter touch screen

Capable of making multiple measurements on a single sample and reporting complete statistical data and all measurement results

Rudolph Research Analytical 55 Newburgh Road, Hackettstown, NJ 07840 USA ▪ Phone: 973-584-1558 ▪ Fax: 973-584-5440 ▪ E-mail: info@rudolphresearch.com ▪ Internet: www.rudolphresearch.com

Versatility, Traceability, C

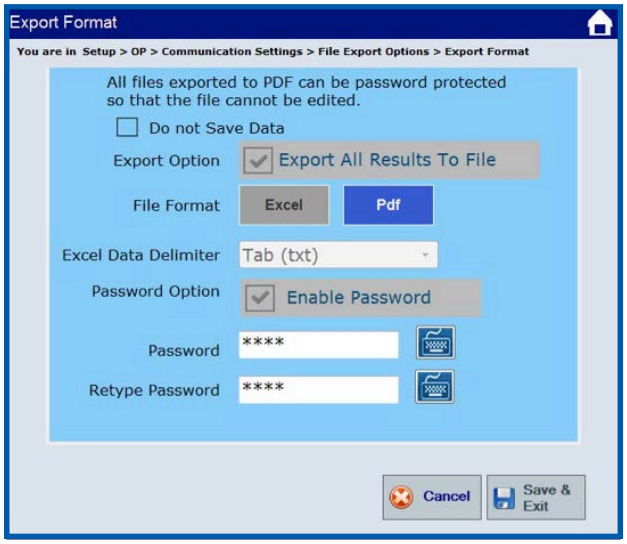
For Highly Regulated Labs, Full 21 CFR Part 11 Instrument Level Compliance

The United States Food and Drug Administration 21 CFR Part 11 regulation establishes the FDA's requirements for electronic records and electronic signatures (ERES) to be trustworthy, reliable, and essentially equivalent to paper records and handwritten signatures. The Rudolph DDM Density Meter user interface software's 21 CFR11 features fully support the requirements of 21CFR Part 11.

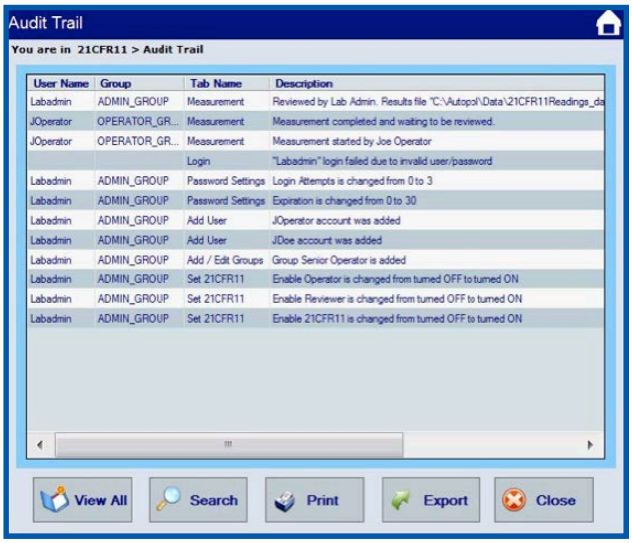
The Rudolph DDM Density Meter's 21 CFR Part 11 software module is easily enabled through the user friendly touch screen. This module gives you full compliance with:

- Electronic signature
- Access levels
- Internal write protected storage
- Unique passwords
- Write protected documents sent directly to server
- Audit Trail
- PDF Meta Data
- Unique and Settable User rights and privileges

Files may be Password Protected.



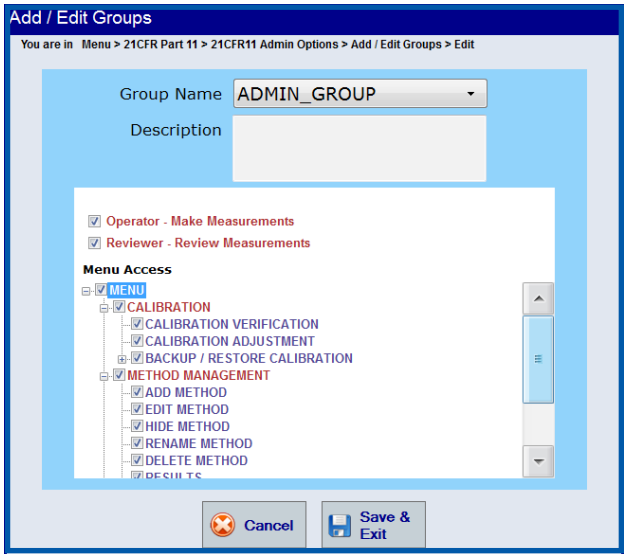
As Audit Trails are produced they are saved internally which can be viewed, exported or printed.



User Access Levels are set by the administrator.



User Rights



Rudolph Research Analytical 55 Newburgh Road, Hackettstown, NJ 07840 USA ▪ Phone: 973-584-1558 ▪ Fax: 973-584-5440 ▪ E-mail: info@rudolphresearch.com ▪ Internet: www.rudolphresearch.com

Compliance and Flexibility



NIST Traceable Calibration Standards

Rudolph knows how important it is to calibrate with Traceable Standards and therefore, we include either a NIST or other National Physical Laboratory (NPL) standard in the accessories provided with your density meter.

The Rudolph DDM Density Meter includes all the accessories for immediate use:

- Quick Start Guide
- IQOQPQ Documentation
- Rinse/Sample Waste Container
- Filling Nozzles
- Connecting Fittings & Tubing
- Traceable Standard
- Luer Syringes
- User Manual
- Tools

Flexible Method Management

Factory installed measurement methods allow for immediate selection of the correct method to match the most common applications.

For unique measurement applications, easily create a sample method using an unlimited number of Concentration Tables, Formulas, and Polynomials to match the measurement methods used in your laboratory.

Method Management

NAME	TYPE
AOAC Ethanol	Factory
Brix	Factory
Crude Oil	Factory
Density	Factory
Density Continuous	Factory
Density through Temperature	Factory
Density VC	Factory
Factory QC Testing	Factory
Fuel Oil	Factory
Lubricants	Factory
OIML Ethanol	Factory

ADD
COPY
HIDE
RENAME
VIEW
RESULTS
METHOD CONFIGURATION
CLOSE

Customized Methods:

- Concentration D2O – Heavy Water
- Proofing of Ethanol Sample
- Density of Gases
- Testing of aspartame and other artificial sweeteners
- Monomer Solutions
- Hydrogen Peroxide
- Determination of Partial Specific Volume
- ppm, Normality, Molarity
- % Toluene in Heptane
- Mole Fraction of Methanol
- Purity of sample testing
- Density of Gasses and Aerosols
- Potassium Permanganate
- Ultracentrifugation applications
- SG of Urine
- Sodium Hydroxide

Rudolph Research Analytical 55 Newburgh Road, Hackettstown, NJ 07840 USA ▪ Phone: 973-584-1558 ▪ Fax: 973-584-5440 ▪ E-mail: info@rudolphresearch.com ▪ Internet: www.rudolphresearch.com

Choose the sample handling

Syringe Injection

Samples can be easily loaded in the DDM series Density Meter by directly injecting your sample into the inlet port of the DDM. You can watch the sample progress through the U-Tube and monitor for bubbles. Need a closer look? View at 2X, 6X or 10X magnification. When your measurement is complete simply flush the U-Tube with your choice of solvent and use the convenient air tube to dry the U-Tube.

Who Should Use this System?

Laboratories who make only a few measurements per day. Users who wish to use very small amounts of sample – Only 1ml of sample is required.



Peristaltic Pump

Combining a Peristaltic Pump with a Rudolph Density meter makes sample loading and cleaning faster and more convenient. A Peristaltic Pump draws the sample into the Density Meter and could also load a Refractometer. The user drops a tube into the sample and starts the Peri Pump from the DDM display. The Peristaltic Pump draws the sample through one or two instruments and then measures. The measured sample is displaced to waste by the following sample.

Who Should Use this System?

Laboratories working with low viscosity samples such as beverages.

Users who don't mind utilizing 50 ml of sample for a measurement. A large amount of sample is needed to ensure all of the previous sample is displaced with the new sample.



solution for your application

Rudolph DDM with AutoFill™

AutoFill™ was developed by listening to customers who wanted an easier method of sample loading that they could decant right from their existing containers. Samples are easily poured right into the AutoFill™ sample well without having to come in contact with the sample; simply pour it in. From there the lid is closed and the sample is advanced to the U-Tube with the push of a button on the DDM touch screen. To clean, open the lid and pour in the solvent of your choice. Close the sample well lid again, press a button and the solvent is flushed through the U-Tube and air drying is automatically started.

Who Should Use this System?

Users who want to make many measurements each day and want an easy to load Density Meter with an equally easy cleaning routine.

Laboratories who do not want to come in contact with caustic acids, or bases.



AutoFill™ allows you to easily pour directly into the sample well.

Rudolph Research Analytical 55 Newburgh Road, Hackettstown, NJ 07840 USA ▪ Phone: 973-584-1558 ▪ Fax: 973-584-5440 ▪ E-mail: info@rudolphresearch.com ▪ Internet: www.rudolphresearch.com

Sample handling options for

Rudolph DDM with the Rudolph Easy Clean System (ECS)

The Rudolph ECS sampling system is an excellent choice if you need to significantly automate your sample loading and cleaning. Using Rudolph's ECS Auto Sampler is simple; the user brings the sample to the Density Meter in any container that has an opening and a sample volume of 3-4ml. A test tube or beaker is commonly used in a lab and a can or bottle is more common in industrial environments. The operator presses the fill button, waits a few seconds while the sample is drawn from the sample vessel, and the Density Meter U-Tube is filled with sample.

From that point the operation is completely automatic. The sample is measured and the data is recorded. Depending on how the system is configured the data may also be printed, saved to an Excel file, stored in the instrument, or transferred to a LIMS system.

Once measurement is complete, the sample is blown to a waste storage vessel using the built in air pump. The measuring cell is flushed with a solvent of the user's choice, flushed again with a second solvent such as acetone or alcohol that is fast drying and then blown with air to completely dry the system.

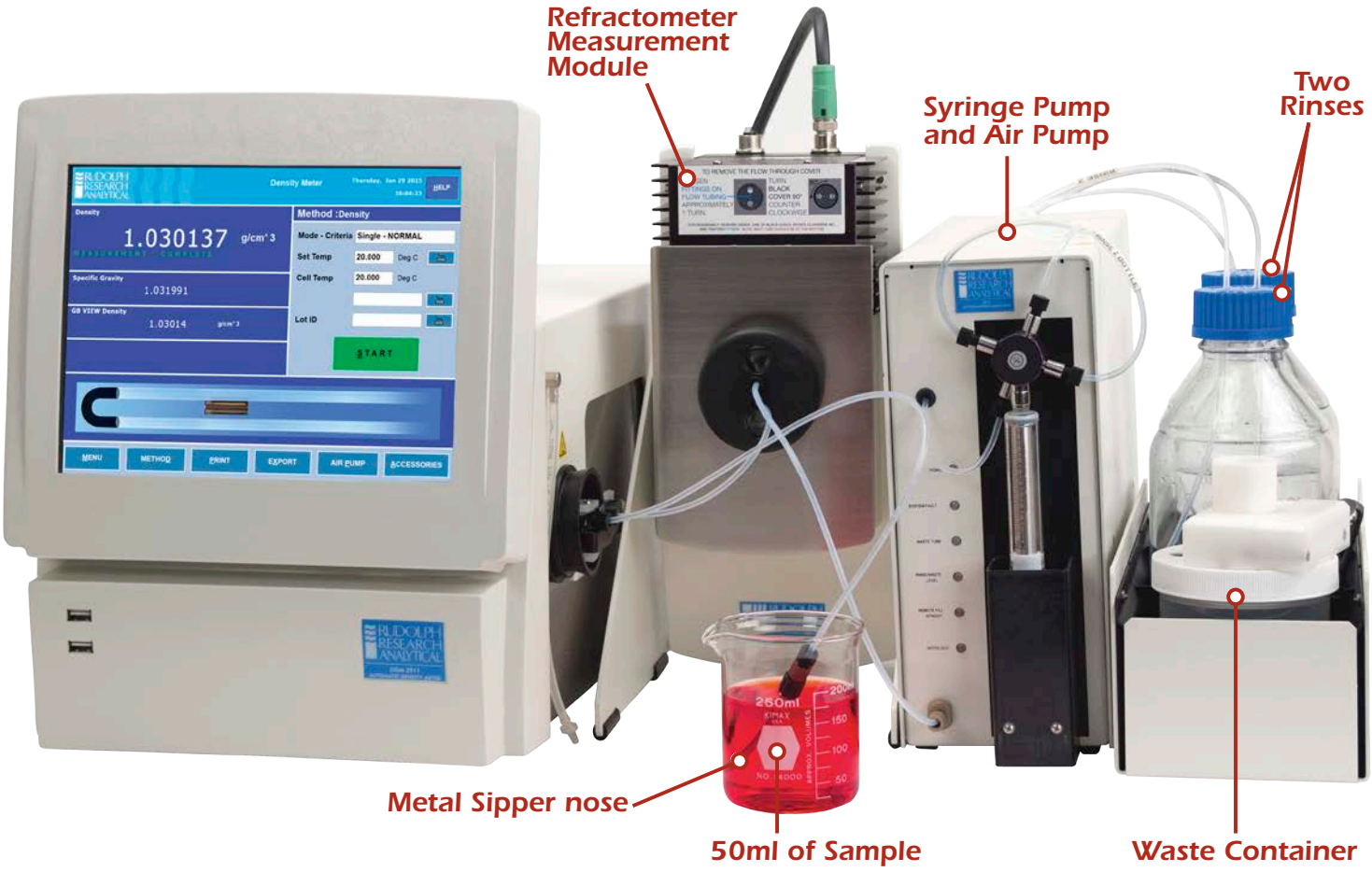
The dry and rinse times are user programmable. Utilizing a Windows™ interface the operator is able to select and adjust both rinse and air drying times for each unique sample.

Who Should Use this System?

Laboratories looking for a faster and semi-automatic sample loading and cleaning solution.

Laboratories that want to decant from their own vessels and sampling containers.

Laboratories working with acids, bases, and caustic samples.



high throughput laboratories

Automate your Laboratory with a Rudolph AutoFlex R837 Automation System

The DDM Series of density meters can be combined with various Rudolph Automation Systems and Sample Handling Accessories. Available are Peristaltic Pumping, Heated Sampler, the ECS (Easy Clean System), and the Rudolph R837 AutoFlex Sampler.

The Rudolph Research R837 AutoFlex is perfect for high throughput laboratories looking to increase productivity.

The R837 AutoFlex Sampler Facilitates:

- Customizable bottle size, Test Tube size, Boston Rounds:1oz, ½ oz, virtually any size
- Customizable Rack configurations: heated and unheated on the same carousel
- Automated sample introduction
- Flexible Method Selection: Suction mode, Pressure mode, Rinse and Dry Duration
- Programmable cleaning and drying
- Automatic solvent and waste level detection
- System Configuration minimal sample volume: 1.5 mL
- A heated interface is available
- Fast throughput, 2-5 min complete cycle time
- Automation saves operator time and increases your lab's efficiency
- An urgent-sample interruption can be made at any time

Operation is completely automatic. The sample is measured and the data recorded. Depending on how the system is configured the data may also be printed, saved as an Excel file or transferred to a LIMS system



Multiple measurements from one sample, with full automation and automatic cleaning and drying.

Description

Combine instruments with Automation to Measure: Refractive index, BRIX, Density, Specific Gravity, Optical Rotation, Color, Alcohol % vol/vol, Proof and more all from a single sample.

AutoFlex gives you the most flexibility in sample vial selection, sample handling and instrument combinations.

Ideal for high throughput Flavor, Fragrance, Alcohol, Chemical, Petroleum, Food Labs who run many samples each day and want automatic cleaning of the system.



Rudolph Research Analytical 55 Newburgh Road, Hackettstown, NJ 07840 USA ▪ Phone: 973-584-1558 ▪ Fax: 973-584-5440 ▪ E-mail: info@rudolphresearch.com ▪ Internet: www.rudolphresearch.com

AlcoTest-RI-J209

AlcoTest-RI-J209 Alcohol Production Test Solution

By Measuring Specific Gravity and Refractive Index the alcohol % by vol/vol can be determined for many products. This is a fast, single sample load solution for the Alcopops, Wine and Beer industries. The process of pre-distilling samples to remove the alcohol and adding back distilled water to replace any solids is eliminated. Simply load a sample into the system, the system measures the sample and using the AlcoTest software calculates the alcohol %.

AlcoTest-RI-J209 is ideal for

- High volume producers of Alcopops products with high solids and or high sugar based flavorings
- Producers of wine who wish to quickly measure Alcohol % by vol/vol
- Producers of beer and other malt beverages
- Distilled Products with Obscuration

For alcohol % by vol/vol the following accuracies apply

better ±0.01 % v/v with DDM 2911 PLUS – TTB Compliant for high proof spirits

better ±0.04 % v/v with DDM 2911

better ±0.07 % v/v with DDM 2910

For obscured products, accuracies will vary by product. Ask for a demonstration or sample study.



Rudolph Research Analytical 55 Newburgh Road, Hackettstown, NJ 07840 USA ▪ Phone: 973-584-1558 ▪ Fax: 973-584-5440 ▪ E-mail: info@rudolphresearch.com ▪ Internet: www.rudolphresearch.com

Densitometry

The Rudolph DDM series of density meters, with high precision Peltier temperature control of sample, has the features to meet the needs of today's industrial applications.



BEVERAGES, SPIRITS, WINE

- The US TTB requires 0.02% Ethanol accuracy for testing of % Ethanol in wine, beer, and spirits
- The DDM2911 Plus offers 0.01% accuracy for Ethanol testing
- Direct and accurate means of °Brix determination, °Plato, °Balling, Proof, % Solids



PHARMACEUTICAL

- Capable of 2,3,4 or more multiple measurements with standard deviation, mean, min and max reading for true cGLP/GMP compliance
- Complete IQ/OQ/PQ documentation.
- 21CFR 11 Compliance; Electronic Signature and Secure Data Storage
- Compliant with USP <841>ISO 17025, JP, BP and EP



FOOD, FLAVOR, FRAGRANCE

- Measure Density, Specific Gravity
- Checking of raw materials and product release
- Check batch consistency and ensure proper blending ratios
- Add refractive index, color and optical rotation with a R837 Automation solution



PETROLEUM, CHEMICAL

- Measure API, Density and Specific Gravity values in accordance with ASTM D1250, ASTM D4052, ASTM D4806, ASTM D5002, ASTM D5931, ISO 12185 and DIN 51757
- Measure in units of kg/m3, g/cm3, g/mL, pounds/gallon, specific gravity, Baumé and more

Alcohol Proof Testing



DDM 2911 PLUS Density Meter is Rudolph Research's TTB Approved Instrument for Alcohol Proof Testing.

The capability you need to easily test your spirits production and comply with TTB Requirements:

The DDM 2911 PLUS has built-in precision Electronic Temperature Control ensuring accurate and reproducible results. A Windows embedded OS allows the operator to save calibration and measurement data right to Excel™.

- With 0.00001 g/cm3 accuracy the DDM 2911 PLUS is an excellent choice for the Alcohol Beverage industry to measure alcohol concentration to determine alcohol Proof
- Easy to Use. Easy to Validate
- Windows Embedded OS
- Precision built-in electronic Temperature Control
- Easily combined with Rudolph's R837 Automation System
- 3 Year Domestic Warranty – 20 Year Service Guarantee

0.01% Alcohol Determination adding Precision to the Art of Craft Distilling

Rudolph Research Analytical 55 Newburgh Road, Hackettstown, NJ 07840 USA ▪ Phone: 973-584-1558 ▪ Fax: 973-584-5440 ▪ E-mail: info@rudolphresearch.com ▪ Internet: www.rudolphresearch.com

Specifications

	DDM 2909	DDM 2910	DDM 2911	DDM 2911 PLUS
Accuracy	**Density:** 0.0002 g/cm³ **Temperature:** 0.05 °C	**Density:** 0.0001 g/cm³ **Temperature:** 0.05 °C	**Density:** 0.00005 g/cm³ **Temperature:** 0.03 °C	**Density:** 0.00001 g/cm³ **Temperature:** 0.01 °C
Repeatability	**Density:** 0.0001 g/cm³ **Temperature:** 0.02 °C	**Density:** 0.0001 g/cm³ **Temperature:** 0.02 °C	**Density:** 0.00002 g/cm³ **Temperature:** 0.01 °C	**Density:** 0.000005 g/cm³ **Temperature Selectable:** 0.001 °C
Resolution	**Density:** 0.0001 g/cm³ **Temperature:** 0.01 °C	**Density:** 0.0001 g/cm³ **Temperature:** 0.01 °C	**Density:** 0.00001 g/cm³ **Temperature:** 0.01 °C	**Density:** 0.000001 g/cm³ **Temperature Selectable to:** 0.001°C
Density Range	0 to 3 g/cm³			
Temperature Range	0 °C to 95°C (controlled via Peltier)			
Pressure	0 to 10 bars			
Video Scanning & Magnification	Three magnified video assisted views of the entire cell are available, in 2x, 6x and a 10x magnifications with video scanning. Images maybe saved with results for subsequent review.			
Automatic Bubble Detection	Automatically warns operator of bubbles			
Measurement Modes	Continuous, Single, Multiple			
Measurement Technique	Mechanical Oscillating U-Tube Method			
Minimum Sample Volume	Less than 1mL			
Wetted Materials	Borosilicate glass, Teflon PTFE ECTFE			
Operating System	Windows Embedded; write protected software safe from malware and viruses			
Measurement Time:	30 - 60 seconds after thermal equilibration			
Display	10.4 inch diagonal TFT type LCD with wide viewing angle, anti-glare flat panel touch screen, 300 nits brightness, 800 x 600 pixels, chemical, scratch and spill resistant monitor, the industry's largest and most flexible interface			
Communication Interface	Touch Screen User Interface, 5 – USB Ports, 2 – RS232 Ports, Ethernet Port for Network Connection, Keyboard Bar Code Scanner, Mouse, Network Capabilities			
Remote Support	Troubleshooting, Diagnostics, Software Updates available via the Internet			
Internal Memory	32 GB Non-removable Compact Flash			
Operating Dimensions	18.36" (L) x 11.80" (W) x 13.90" (H) 46.61 cm (L) x 29.97 cm (W) x 35.30 cm (H)			
Shipping Dimensions and Weight	24.5" (L) x 17.5" (W) x 22" (H) 62cm (L) x 44cm (W) x 56cm (H)			
Shipping Weight	50 lbs. (23kg)			
Power Supply	85 to 260 VAC; 48 to 62 Hz			
Power Consumption	140 Watts at peak			
Origin of Manufacture and Design	USA			

Rudolph Research Analytical 55 Newburgh Road, Hackettstown, NJ 07840 USA ▪ Phone: 973-584-1558 ▪ Fax: 973-584-5440 ▪ E-mail: info@rudolphresearch.com ▪ Internet: www.rudolphresearch.com

12RRA935 5/17