To: Our New Clients

From: Eric Cantrell, Engineer Sales Consultant

We are please to announce DM3 Density Meter the highest standard in the Density Meter industry, with far more accountability and less maintenance compare to Nuclear Density Meter and others. Please call today: 1-407-505-4513 (office) 1-407-591-8499 (cell phone) or email: eric.cantrell@sciamworldwide.com to secure your DM3 Density Meters.

# DM3 Density Meter

The **SCIAM DM3© Non-Nuclear Density Meter** is a major advancement in continuous in-line density measurement of mining, dredging, sewage and similar slurries in pipes from 50 – 1000mm (2" – 40") internal diameters. **DM3** operates at < 0.5% full scale accuracy and is repeatable to ± 0.1% full scale.


**DM3** incorporates linear, accurate and direct measurement of mass per unit volume to calculate density. It provides an innovative alternative to ineffective techniques currently used which include nuclear, ultrasonic and microwave methods. **DM3** is simple to maintain, vibration insensitive, partially land burial and tilt and roll compensated for dredging at sea. The measurement may be calibrated in % dry solids, wet density or specific gravity (sg).

Slurry is continuously weighed using a patented, high resolution density transducer as it passes through an obstruction free flow tube. The flow tube is of optimal length to provide a truly representative mass of the slurry. The density of the slurry is then measured by the transducer at 110 times/second to ensure accurate and repeatable

sensing. The flow tube also provides the necessary straight upstream pipe run for magnetic flow meters used in **DM3** mass flow systems.

The **DM3** flow tube has reinforced walls up to 36mm (1.5") thick and incorporates a highly abrasion resistant natural gum rubber liner. As such, long life is assured, even with the most abrasive media containing sharp rocks, sand and tailings. Alternative options are available for special applications which deal with high pressures and/or temperatures. The **DM3** flow tube is uniquely and easily field replaceable.

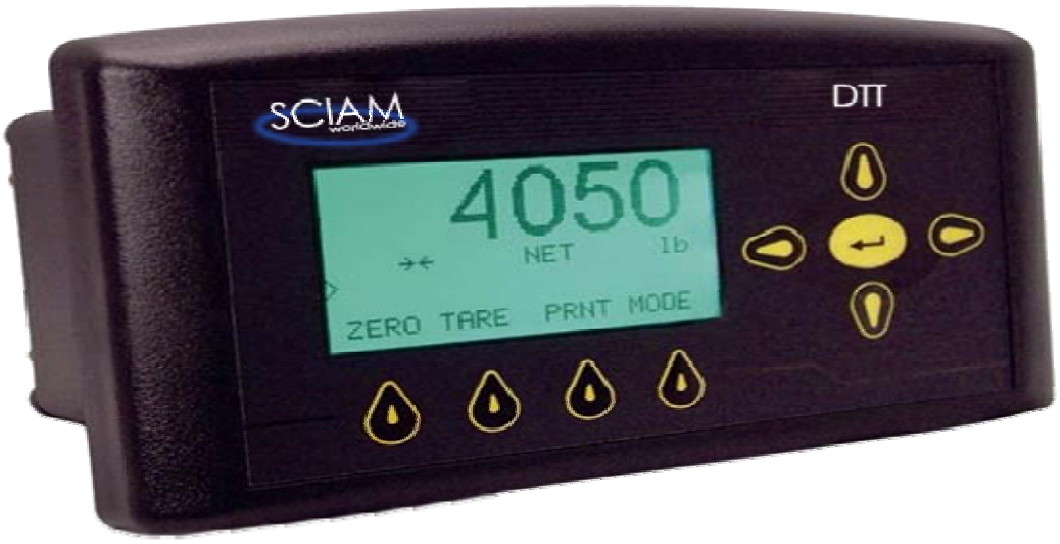
The density transducer provides a signal to a remote microprocessor based **DM3 Transmitter**. With the push of a button, diagnosis with NIST traceable calibration and verification of **DM3** is accomplished, without the need for test weights. Display, analog signals and a comprehensive selection of digital communications are available.

## Features

- Accurate, uniquely NIST traceable, direct mass measurement for % dry solids, wet or dry sg
- Obstruction free, natural gum rubber, abrasion resistant flow tube with up to 36mm thick walls
- Simple to install and maintain
- Unique field replaceable flow tube
- Certified CE for electro-magnetic compatibility and CSA, UL Explosive Proof Class 1, Div. 2
- Fail safe design – slurry in flow tube contained within external pressure chamber
- SG digitally programmable by remote microprocessor for ranges 1.0 – 1.5 to 1.0 – 3.0
- Mass flow systems available using magnetic flow meters and mass flow computer, wet or dry units
- Burial on land or wave roll compensated for sea-going dredgers

# DM3 Transmitter

The **SCIAM DM3 Density Transmitter** is used in conjunction with the **DM3** to transmit density and technical data. It's linear density measurement may be calibrated in % dry solids, wet density or wet specific gravity in panel or wall mounted enclosures. The unique combination of vibration compensated **DM3** in-line density meters and an anti-vibration algorithm in the transmitter allows for a direct measurement of mass per unit volume system to measure density in heavy industrial environments, bringing an innovative alternative to ineffective methods currently in use.




The **DM3 Transmitter** is uniquely NIST traceable and suitable for on-site NTEP approval, with its performance characteristics stored in its internal memory. On-site automatic calibration and verification of the system is a simple as a press of a button, making it instantaneously ready for use.

Access to the **DM3 Transmitter** configuration is simple using any computer connected via the ethernet port using a standard browser. The **DM3 Transmitter** also provides access to control information and instrument parameters. This may be shared electronically with production or off-site maintenance personnel to further optimize production efficiency.

An internal SD memory card slot is installed to store critical configuration details, calibration, and configuration data and protects the **DM3** Transmitter from corruption. Should a new parameter be entered, the DM3 Transmitter automatically updates the new value in its memory via the SD card. This data can also be modified using any computer.

The **DM3 Transmitter** can be easily diagnosed on-site. Systematic maintenance tests, electrical test characteristics, stability, and zero testing to be performed and to help isolate any problems should they occur.

The **DM3 Transmitter** may be mains powered, or via solar using its 24V dc supply with a solar panel, allowing it's use in remote areas. A comprehensive range of network options are available, as well as a standard RJ45 Ethernet communication, 4-20mA and 0 – 10V analog output signals.

# DM3 Processor


**SCIAM** offers a processor which is designed to take the 4 – 20 mA outputs from a **SCIAM DM3 Transmitter** and flow signal from a volumetric flow meter. Sciam recommends only volumetric flow meters known to have an acceptably low signal to media noise ratio. Magnetic flow meters with correct liners and grounding, suitable for mining, dredging and similar slurries are recommended.

The processor accurately multiplies the density and volumetric flow signals to provide a 4 – 20 mA output proportional to mass flow rate. It is then programmable using 4 push buttons on the front panel to provide a digital display, record and outputs for wet or dry totalized mass flow and mass flow rate, wet density or wet sg, or % dry solids.

The processor also has the capability to log data to an internal memory, removable memory and connects to ‘Historian’ software via Ethernet. Settings for alarms and alerts are also programmable using the processor.

# Recommended Flow Meters

**SCIAM Worldwide** offers flow meters to be used in conjunction with the **SCIAM DM3 Density Meter©** to calculate mass flow. Every flow meter recommended by **SCIAM** offers characteristics particularly suitable for the measurement of volumetric flow of highly abrasive mining, dredging and similar slurries.

Each are selected because they are purely volumetric – unaffected by change of media density or viscosity. The multiplication of the output from a **SCIAM DM3 Density Meter©** and the flow meter provides mass flow. All SCIAM recommended flow meters are obstruction-less, in sizes from 50 to 1000mm internal diameter (2”- 40”).

Flow meters are normally installed downstream of a **SCIAM DM3 Density Meter©**, as such, the **SCIAM DM3 Density Meter©** provides the requisite straight length of pipe necessary for accurate mass flow measurement.

In order to qualify for certification by **SCIAM’s** stringent quality assurance, selected flow meters must have particularly high coil magnetizing current and exciter frequencies. This guarantees excellent signal to media noise ratio, which guarantees an accuracy of < ± 0.5% even when measuring the most aggressive and ‘noisiest’ of slurries. The liners are normally thick walled polyurethane or soft natural rubber, selected for its high resistance to abrasive slurries.

# DuPont Industry "satisfied client" we converted Nuclear Density Meter to our DM3 "Non-Nuclear Density Meter"

### Maxville Mine

### Starke, FL 32901 USA

| | |
|---|---|
| **Product Supplied:** | **400mm [16"] DM3** |
| **DM3 Replaced:** | **Nuclear Density Meter** |
| **Application Type:** | **zircon concentrate slurry** |
| **Pressure:** | **7 bar g / 100 psig** |
| **Temperature:** | **Ambient** |
| **Average Total:** | **75,000 tons per day** |


DuPont approached **SCIAM** with the intention of removing all hazardous nuclear devices from their mining operations within Florida. **SCIAM** proposed to retrofit all existing nuclear density meters with the **SCIAM DM3 density meter**. In addition to the removal of potential safety risks and maintenance burdens, DuPont now benefits from increased accuracy, reliability and a significantly reduced maintenance burden.

# Sample Applications

Chemical Sample Applications

Power Sample Applications

Pulp & Paper
Sample Applications

Oil & Petro Chemical
Sample Applications

Food Sample Applications

Dredging Sample Applications

# CE Certification Declaration

**SCIAM Worldwide** hereby declares that the density transducer incorporated in the **SCIAM DM3 Non-Nuclear density meters** are in conformity with the following EEC Directives and Harmonized Standards:

Test Standards to EN 61326:1997 “Electrical equipment for measurement, control and laboratory use. Compliance was demonstrated to the following standards and tests.

## EN50081-2 Emission Tests:

- CISPR 11/22 Class “A” Main Power Line Conducted Disturbance Emissions Test Group 1 (0.15 – 30 MHz)
- CISPR 11/22 Class “A” Radiated Radio Frequency Emissions Test, Group 1 (30 – 1,000 MHz)
- EN61000-6-2 Immunity Tests:
- IEC 61000-3-2 Harmonics (3 – 39th harmonic current)
- IEC 61000-3-3 Flickers and Voltage Fluctuations
- IEC 61000-4-2 Electrostatic Discharge (+ 8kV Air, ± 4kV Contact Discharge)
- IEC 61000-4-3 RF Radiated Immunity (10V/m from 80 – 1000MHz, 80% AM @ 1 KHz)
- IEC 61000-4-4 Electrical Fast Transient/Burst ( ± 2kV AV Line, ± 1 kV I/O Lines)
- IEC 61000-4-5 Lightening Surge (AC ± 2 kV Common Mode, ± 1 kV Differential Mode)
- IEC 61000-4-6 RF Common Mode (150 kHz – 80 MHz, 3 Vrms 80% AM 1 kHz)
- IEC 61000-4-11 Voltage Dips, Short Interruption (100% @ 0.5 and 1 Cycle)

# FAQ

## How does SCIAM ensure accuracy?

- Normal Plant Media Vibration: < 0.1%
- Temperature Error Coefficient: ± 0.0008 / °F
- Two Plane Tilt: ± 20° Results In < ± 0.2%
- Density Transducer Error: < ± 0.1%
- Pressure Error Coefficient: Negligible
- Flow Tube Wear: < 0.1%
- Overall Error: < ± 0.5% Of Full Scale

## How does the SCIAM DM3 System compare with microwave density meters?

Microwave techniques are used to measure density of slurries by sensing the phase shift of microwaves passing through a slurry and comparing the phase shift with water. Slurries having a reasonably constant electrical relative permittivity (also called dielectric constant) are suitable, such as slurries used in sewage treatment, paper pulp and the food industry. However, mining, dredging and inorganic slurries are not suitable because of their large variation in relative permittivity, which causes a noisy signal and unacceptable errors.

Pipe sizes are also normally limited to 12″ diameter (300mm) using microwave techniques. Even then, the sensing path is narrow across the diameter of the microwave flow tube. Media either side of this narrow path simply does not get measured, which leads to large errors or ambiguity over the long term. Response time is typically limited to 1 – 100 seconds, dependent on the homogeneity of the slurry and its variation in relative permittivity. This again results in large errors or ambiguity over the long term.

By comparison, the DM3 has a response time of 45 milliseconds from zero to full scale and a truly representative and continuous sample is measured directly as mass per unit volume. Nothing is lost in the measurement, nothing is lost in compromised speed of response, resulting in higher accuracy over short and long terms.

## How does the SCIAM DM3 compare with ultrasonic density meters?

Ultrasonic techniques may be used to measure the density of slurries by emitting ultrasonic waves to a receiver at the opposite side of a pipe diameter. A strong echo is received with low % solids or density, but as the density or % solids increase the sonic energy is absorbed by the particles and the signal weakens. However, the system suffers from it’s own modus operandi, since as the % solids increase typically > 10%, the signal to noise ratio increases to the extent that dynamic damping is required. Such damping is not the true average of the randomly dispersed noise, which can significantly affect accuracy.

Damping affects the response time to typically 30 seconds to minutes, which in turn can cause long term errors. Changes in the % solids or density are simply not measured.

The signal is also affected by high media velocity, which does not appear in manufacturer's specifications.

Pipe sizes are normally less than 16″ (400mm). Larger pipes use insertion sensor techniques, but these are subject to rapid wear in mining and dredging slurries, with significant errors due to misrepresentation of variation in % solids and density of the media over the complete pipe cross section.

Under normal conditions accuracy is typically + – 1000 mg/liter to +- 5% of full scale, dependent on the sonic attenuation of the media and variation in % solids, and provided the media velocity is not too high. Additional errors and are due to the line of sonic waves across the pipe diameter being thin and not taking account of the variation in % solids either side of them. Prices vary considerably with manufacturers from about $5000 to $15,000.

By contrast, the DensiTech measures a truly representative mass per unit volume of media, in length and diameter, interrogates it at 110 times a second, and has a response time of 45 milliseconds. The measurement is direct, not inferred, traceable to international primary standards and, in terms of variation in media density or % solids, nothing is missed.

## What are SCIAM DM3's long term cost benefits in reduced downtime and 'green' operation?

During the long term life of its flow tube, DM3 requires no periodic downtime for maintenance, except an occasional on-site calibration check. This may be quickly achieved by running water through the DM3 in situ, without taking it out of the pipe line. No test weights are necessary, just a 3-second push of a DM3 transmitter button to automatically diagnose the complete system. If acceptable this revalidates DM3's original calibration, uniquely and directly to international weight standards, such as NIST.

Compare this with a nuclear density gauge: Wipe tests are required typically twice per year and must be reported to authorities. This requires typically one hour per gauge. An annual site survey must be reported, typically one day, dependent on number of gauges, by a specially trained safety officer. The cost in a typical dredging or mining operation, including safety operators wage or fee, runs into $50,000 to $120,000 per year. At the end of the nuclear gauge life a nuclear source disposal fee normally runs into $10,000. Calibration is inferred, not traceable; the nuclear gauge should taken off-line, cleaned, and down time is additive cost.

## How does SCIAM's DM3 compare with a nuclear density gauge?

DM3 brings a refreshing change to measuring the density of mining and dredging slurries, retrospectively only done by nuclear gauges. Unlike nuclear devices, with DM3 there are no wipe tests, no governmental surveys, no costly safety officers, no possible health hazards, and no costly transport or disposal of nuclear sources.

DM3 interrogates mass per unit volume at 110 times per second, bringing a response time of 45 milliseconds to any changes in the media density. In a mass flow system, this brings a new dimension of savings due to long term accuracy. A nuclear device has a response time often in minutes, meaning significant lost data, which in turn could result in tens or thousands of dollars per year in lost revenue.

A nuclear gauge measures just a thin 'slice' of the media, both across the pipe diameter and longitudinally. This is hardly representative of the media, meaning much of the true density is not measured. By contrast, DM3 interrogates a truly representative and continuous sample, accounting for density variation across. the complete diameter and several feet in length of the media. DM3 also measures uniquely every 9 milliseconds, and nothing is lost.

DM3 has a direct measurement of mass per unit volume, traceable to international standards, such as NIST and Canadian Weights and Measures. No special test weights for on-site calibration are necessary. Just a 3-second push of a button diagnoses the system and revalidates the original calibration in-situ. Nuclear gauges infer density by measurement of nuclear radiation, are not traceable and should be removed from the pipe line, thoroughly cleaned, and calibrated, with costly down-time.

## Why gum rubber?

SCIAM's obstruction- less rubber flow tubes are designed for long service life when used with highly abrasive dredging and mining slurries. The flow tubes are a customized composite structure, typically 1" (25mm) thick. They have a ½" (13mm) thick liner of gum rubber, while the outer structure is of a harder rubber, reinforced with multiple weaves of polyester. This allows the flow tube to be flexible so that the weight of the slurry passing through it is readily transferred to the density transducer measuring its mass. We say measuring mass because the SCIAM system accounts for variation of gravitational force at different parts of the world. Yes, the SCIAM system is that sensitive.

Inside the DM3 the rubber flow tube is supported by the density transducer. In operation the flow tube and density transducer movement is just a few tenths of a thousandth of an inch (a few microns) for a full scale change in density. As such, it is virtually solid state performance.

The gum rubber is natural and offers superior wear resistance, even with the highest velocities at which today's mining and dredging slurries are pumped. The gum rubber has

been successfully used for years when handling dredging slurries, abrasive rocks, sands, coal, tailings, fly ash, lime, clay, cement, as well as slag and many other materials. The high demands of the mining industry are successfully met when measuring highly abrasive iron, copper, platinum, bauxite, gold and other metallic or non-metallic ores.

Gum rubber is an elastomer. While steel or ceramics present a rigid surface to the particles and larger solids of a slurry, gum rubber has the huge advantage of having the highest possible resilience. The kinetic energy of pumped slurries eventually generates cracks and deformations on a rigid surface, compromising its service life. By contrast, the internal surface of SCIAM's gum rubber locally deflects on the impact of slurry particles, ores, stones or rocks, and absorbs their kinetic energy. The localized deflection of the gum rubber then returns to its original form. The outer polyester reinforced harder rubber construction ensures integrity, even at high static pressures. Vibrations due to 'pink' media noise, as well as pumps, rock crushers and other machinery in the vicinity are simply absorbed by the SCIAM flow tube and by the low natural frequency of the DM3 itself.

The angle at which particles, ores, stones or rocks strike the inner diametrical surface of a flow tube is decisive in determining its wear. Laboratory tests and practical experience show that gum rubber is more resistant than other materials when the impact angle is less than 5º or greater than 50º. With mining and dredging slurries, the angle of impact is normally significantly less than 5º, and often close to 0º. The carrier liquid is almost always process water, which has no corrosive effects on the gum rubber, but rather acts as a lubricant, further extending service life to many years.

## Reducers & Expanders – When To Use

Reducers and expanders are sometimes connected to a SCIAM density meter for use with a downstream magnetic flow meter or the customer's downstream pipe. They are flanged spool pieces, normally having the same flange sizes each end of a tapered flow tube, and normally lined with polyurethane for good service life. They are offered by SCIAM Worldwide for 2 basic reasons:

- To avoid local turbulence caused by significantly large variations in diameters of a SCIAM density meter and a downstream magnetic flow meter or customer's pipe work. Such local turbulence could result in measurement errors of the magnetic flow meter.
- To avoid premature liner wear caused by abrasive slurry acting on sudden diameter changes.

## The rules for selection are as follows:

- DM3 Inlet:
  - Knowing the customer's pipe internal diameter (ID), select the same or next size up DM3 ID.
  - Example: Customer's pipe ID is 425 mm. Select an 18" DM3 (ID 18" = 457mm).
  - This avoids using an expander or reducer at the inlet of the DM3 and will not cause measurement errors.
- DM3 Outlet Into Customer's Pipe (No Magnetic Flow-meter):
  - If the customer's pipe ID is arithmetically less than 0.3" (8 mm) of the DM3 ID then a reducer is advised. It will have the same ID as the DM3 one end and the same diameter as the customer's pipe ID at the other end to provide smooth transition.
- DM3 Outlet Into A Downstream Endress & Hauser 55S Magnetic Flow Meter:
  - For DM3 ID sizes 2" (50.8mm) to 12" (305mm) the E+H 55S mag meter has virtually the same size as a DM3, No expander or reducer is necessary.
  - For DM3 ID sizes 14" (356mm) and larger use the next size larger 55S mag meter with polyurethane liners and next size larger for all sizes of 55S mag meters with natural rubber liners. The errors will be negligible up to 24" 55S mag meters without an expander.
  - If the ID of the E+H 55S mag meter is arithmetically greater than 0.5" (13mm) of the customer's downstream pipe ID, then a reducer is advised. This will have the same ID as the E+H 55S one end and the same ID as the customer's downstream pipe ID at the other end to provide smooth transition.

Apply the same rules based on ID when dealing with magnetic flow meters other than E+H.

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