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BREATHALYZER ELECTRONIC CONTROLLED BY ARDUINO UNO PLATFORM

Cleymisom Queiroz da Trindade[1], Daniel Vitor Domont Ferreira[2], Carlos Alberto Tenório de Carvalho Júnior[3], Samuel Ferreira de Souza[4], Júlio Sancho Linhares Teixeira[5], Wilson Sacchi Peternele[6], Ciro José Egoavil Montero[7]

Abstract *— In a series of breathalyzer measures the amount of alcohol per liter of alveolar air, which is air from the lungs. The project aims to develop a breathalyzer, using the gas sensor MQ-3, an Arduino Uno microcontroller, one liquid crystal display and a Bluetooth module. For each concentration of alcohol sensor determines a value displayed on the Arduino Uno Serial Port 'COM3' with a range from 0 to 1023, this corresponds to variation of the output voltage ranging from 0 to 5 volt circuit for each concentration. The concentration is measured and displayed on the LCD in a mobile phone through an application, the determination of the concentration present in the air.*

Resumo *— Present a clear and objective manner, the steps for making the breathalyzer (breath), capable of issuing measured values for cell via Bluetooth. At first we will see the introduction basics of the instrument, its usefulness and electronic components that comprise it. Then there will be an account of the methodology and finally present the results obtained.*

Index Terms — Breathalyzer, Bluetooth technology.

I. INTRODUCTION

Breathalyzer is a device for determining the concentration of alcohol in a person , analyzing the exhaled air from the lungs. Currently the device is used by various police forces around the world to measure the alcohol level at which drivers are . The unit was created in 1974 by British scientist Tom Jones Parry , since the appliance is being implemented and with the evolution of unit rules have also changed . In Brazil , the National Traffic Council (CONATRAN) establish that from January 23, 2013 the number 432 resolution enters into force. This resolution aims to define the procedures to be followed by the traffic authorities and their agents in the surveillance of alcohol or other psychoactive substance dependence that determines which set apart the supervision of consumption by drivers of motor vehicles , alcoholic beverages and other psychoactive substances that determine addiction should be routine operational procedure of transit agencies and the confirmation of the change in psychomotor ability, due to the influence of alcohol or other psychoactive substance dependence that determines shall be given by means of at least one of the following procedures to be performed on the driver of a motor vehicle:

1- Blood test;
2- Test apparatus for the measurement of alcohol content in alveolar air (breathalyzer);
3- Verification of signs indicating the change of psychomotor ability of the driver.

The new resolution also further defines what is required the examination of BAC for victims of fatal traffic accidents and to establish the parameters for each type of alcohol concentration in (mg / l) milligrams per liter, as can be seen in table I.

TABLE I

Concentration (mg / l)	Situation Conductor
Less than 0.01	Fit to drive
0.01 to 0.30	Will answer an infraction
0.02 Higher than 0.30	Will respond by offense and crime

The breathalyzer, as well as several other embedded design, basically operates by using some electronic components that require an order to perform certain pre-established task. The physical part or hardware as stated covers various electronic components such as liquid crystal display (LCD), the MQ-3 sensor, resistors Arduino Uno, the Bluetooth module and connecting cables. The microcontroller ATMEGA 328 Arduino executes instructions programmed into a derivative of C, to be able to read the signal generated by the sensor, process the incoming data whose result will be displayed, and transmitted via Bluetooth to the mobile user language. Being developed an app for the Android system.

II. OBJECTIVES

- Plot the characteristic curve of operating the MQ-3 sensor.
- Perform Bluetooth communication between the module and a mobile device.
- Develop a prototype with error lower reading of 10%.

[1] Cleymisom Queiroz da Trindade, Acadêmico de Engenharia Elétrica da UNIR - Universidade Federal de Rondônia, Campus - BR 364, Km 9,5. CEP: 76801-059 - Porto Velho - RO, Brasil.
[2] Daniel Vitor Domont Ferreira, Acadêmico de Engenharia Elétrica da UNIR - Universidade Federal de Rondônia, Campus - BR 364, Km 9,5. CEP: 76801-059 - Porto Velho - RO, Brasil.
[3] Professor Doutor Carlos Alberto Tenório de Carvalho Júnior, Professor Adjunto da Universidade Federal de Rondônia, Campus - BR 364, Km 9,5. CEP: 76801-059 - Porto Velho - RO, Brasil.
[4] Samuel Ferreira de Souza, Acadêmico de Engenharia Elétrica da UNIR - Universidade Federal de Rondônia, Campus - BR 364, Km 9,5. CEP: 76801-059 - Porto Velho - RO, Brasil
[5] Pós Doutor Júlio Sancho Linhares Teixeira Militão, Professor Adjunto da Universidade Federal de Rondônia, Campus - BR 364, Km 9,5. CEP: 76801-059 - Porto Velho - RO, Brasil.
[6] Pós Doutor Wilson Sacchi Peternele, Professor Adjunto da Universidade Federal de Rondônia, Campus - BR 364, Km 9,5. CEP: 76801-059 - Porto Velho - RO, Brasil.
[7] Professor Mestre Engenheiro Ciro José Egoavil Monteiro.

III. METHODOLOGY

A. *STEP 1 - SEARCH AND SHOPPING*

Start a search was performed by microcontroller, we chose to use the Arduino Uno deck, to be a good option for beginners in C programming. Then-listed if needed to manufacture the circuit components, the research was carried out for each component and their respective roles within the breathalyzer, then after analyzing the best prices in online shops, was closed the budget that can be analyzed in table II.

TABLE II
VALUES OF COMPONENTS

components	Value Buying in Real
1 resistor 10kΩ	R$:0,20
7 resistors de 300Ω	R$:1,50
7 LED's	R$:3,00
LCD 16x2	R$:35,00
Sensor MQ-3	R$:25,00
1 potentiometer 10KΩ	R$:3,00
1 Arduino platform Uno	R$:65,00
1 Board phenolite	R$:15,00
1 Bluetooth module	R$:50,00
Total	R$:197,70

The processing block is constituted by a microcontroller ATMEGA328.

This Arduino Uno microcontroller operates the platform is a platform for open-source electronics prototyping, easy to use hardware and software, making it a great tool for development of micro-controlled systems. Using one of its analog inputs connects to the MQ-3 sensor whose sensitivity depends on factors like heating your inner strength and numbers of measurements performed sequentially. The sensor was calibrated using a procedure where it was subjected to various concentrations of alcohol, in order to establish groups that associate reading sensor through a serial port 'TO 3' to its equivalent in milligrams of alcohol per liter of water distilled. Finally, the sensor reading will be available on display and sent to any device via bluetooth module connected to Arduino Uno, along with its equivalent degree (alcohol concentration in mg / l).

B. *STEP 2 - MOUNT PART OF FHYSICS*

Check the operation of the Arduino Uno was performed, their minimum supply of 5 Volts, number of existing digital and analog ports. Then was added the LCD, this component required a lot of attention even with conecxão diagram in hand.

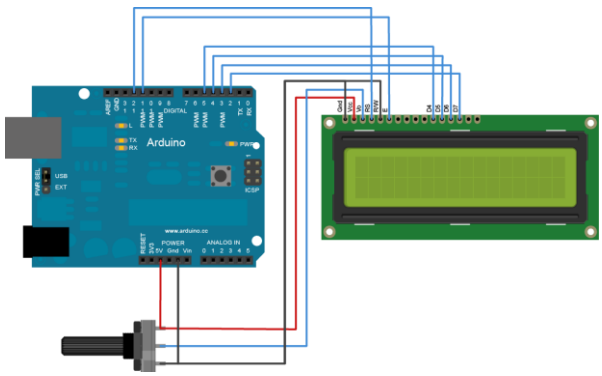


Fig. 1
DIAGRAM LCD INSTALLATION

Thereafter was added the 3-MQ this sensor device comprises an inductor sensitive to alcohol, and has six pins, as illustrated in Figure 2 below.

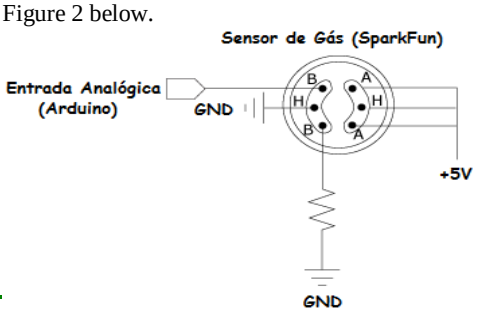


Fig.2
WIRING DIAGRAM SENSOR MQ-3

Finally, the Bluetooth module is connected in order to receive and send data to devices using Bluetooth technology such as mobile. His connection and easy just follow the steps connecting:

1. The TX pin of the Bluetooth module to the Arduino RX;
2. The RX pin of the bluetooth module in the TX Arduino;
3. The VCC pin module in the Arduino 5V;
4. The GND GND pin on the Arduino module.

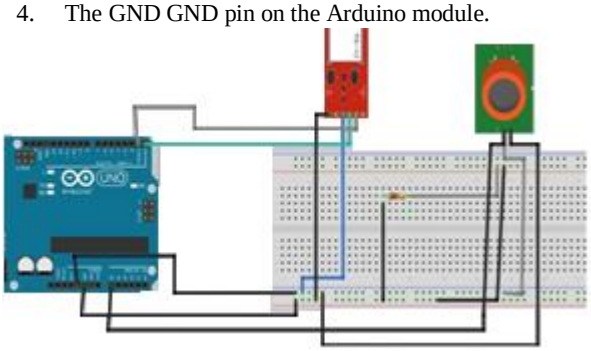


Fig.3
DIAGRAM SENSOR MQ-3 AND BLUETOOTH CONNECTION

With this assembly of physical components was completed.

C. *STEP 3 – MOUNT PART LOGIC (SOFTWARE)*

At this stage two objectives were set to optimize the process:
1º- Develop a code for the Arduino could collect the data provided by the "MQ-3" sensor;
2º- Develop an application easy to install so that anyone can install on your mobile device that contains the Android operating system;

The code was developed with non-integer variables, the sensor to receive different rates of alcohol sends the analog port, "When", an integer value between 0 and 1023, equivalent to 0 to 5V voltage. The obtained value is stored and converted by a mathematical function of sensor calibration and then the value is sent through the Bluetooth module for a device with Android technology.

The application development basically consisted of two stages: the first was to create a layout (a) for the application and the second stage programming (b) the application itself, this programming was performed using logical boxes easy to understand as illustrated in figure 4 and 5 below.

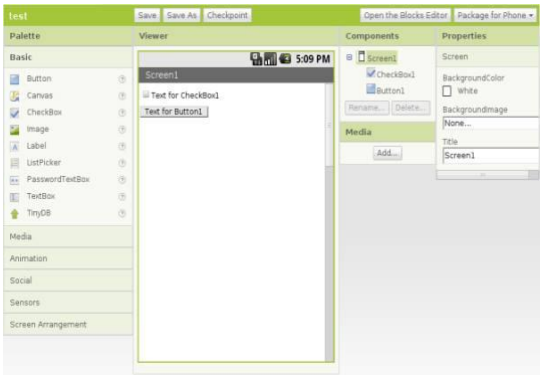


Fig.4
LAYOUT APPLICATION

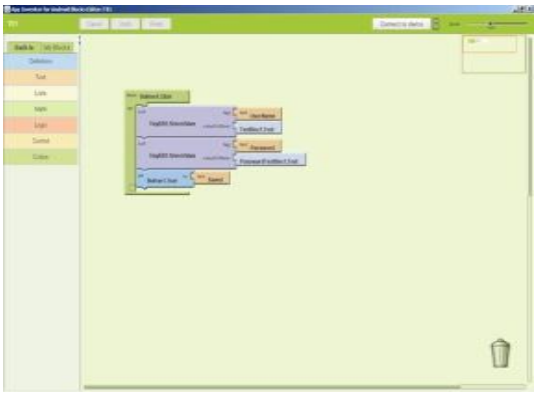


Fig.5
BLOCKS PROGRAMMING

D. STEP 4 – SENSOR CALIBRATION

Preparation of solutions offer:

For the preparation of solutions alcohol concentration using calculations of amount of substance concentration that will give the value of weight in a given volume for the correlation of concentration in one solution, it was necessary equations below are used [REF]:

$$M = n° \text{ solute / volume of solution } (L) = n_1 / V(L) \quad (1)$$

having:

$n_1 = \text{mass of solute / weight of solution} = m_1 / M_1$ (2)

Substituting the value of the molar mass equation in the molarity equation we get:

$$M = m_1 / M_1 \cdot V(L) \quad (3)$$

At the end of the calculations, a correction factor was used so that the use of alcohol with 95% purity not interfere with the final result, since an alcohol 100% for a pure concentration is necessary. To do this simply relate in a simple rule of 3 volume value obtained for the 95% alcohol and discovering the value of 100% alcohol. The use of distilled water enhances the elimination of errors during measurement values due to concentration of minerals in the water.

Implementation and Applied Logic in Programming:

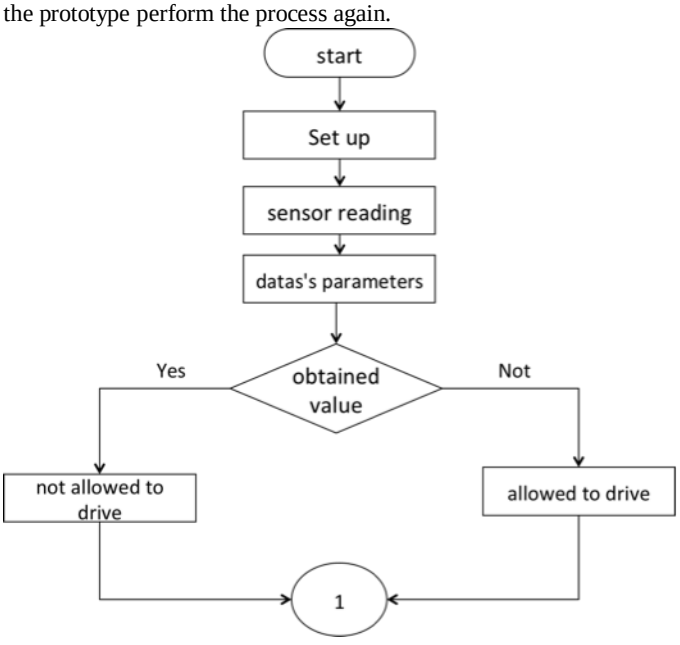
Basically , an external source via the USB port to the Arduino sends a voltage of 5 volts , the Arduino later sends an input voltage of 5 Volt sensor to the polarized , which is nothing more than an inductor in series with resistor 10K ohm. At each time interval that the sensor (inductive) conducts a voltage divider with a fixed resistance of 10K ohms , the voltage drop across the inductor depends upon the concentration of alcohol per liter in this environment. Thus an output voltage is determined, the determined voltage is in a range from 0 to 1023 due to the AD converter 10 bits. What actually happens is that for each value read voltage will have a corresponding concentration value , yielding a graph of concentration vs. output voltage .

As for the circuit assembly with LCD implemented , it was necessary to use data collected during calibration to construct a graph . This chart will be responsible for providing the function that will convert the values into the USB port in a concentration of alcohol mg / liter of air . You are following the code used to implement the LCD:

```
#INCLUDE <LIQUIDCRYSTAL.H>
#INCLUDE <MATH.H>
LIQUIDCRYSTAL LCD(12, 11, 5, 4, 3, 2);
INT SENSORPIN=0; //VARIÁVEL PARA GUARDAR O VALOR
LIDO PELO SENSOR
VOID SETUP(){
SERIAL.BEGIN(9600);
PINMODE(0,INPUT);
LCD.BEGIN(16, 2);}

VOID LOOP()
{
FLOAT Y = ANALOGREAD(SENSORPIN);
FLOAT X=(0.0004 * EXP(0.0079*Y));
SERIAL.PRINTLN(Y);
LCD.SETCURSOR(0,0);
LCD.PRINT(X);
LCD.PRINT("g\l");
DELAY(3000);}
```

Below is a flow chart that sets the operating logic of the prototype, which after the start of operation perform the reading and compare with your measurement parameters and thus sends to the display that read, if you read the display value allowed above may not drive a vehicle, otherwise you can drive the vehicle, after which the prototype perform the process again.



I. FLOW CHART

FLOW CHART OF OPERATION

IV. RESULTS

A. Step 1:

Several sensor readings were performed on different concentrations of alcohol per liter of water contained in each sample and found that for each concentration give a different output voltage.

Fig.6
SAMPLES OF MERGER.

The data relate to a particular voltage output to a given concentration, as shown in Figure 7 below:

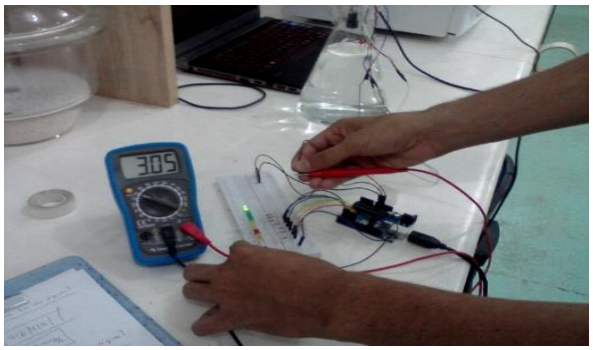


Fig.7
LIST OF OUTPUT VOLTAGE TO CONCENTRATION OF ALCOHOL

Table III shows the data and the concentration values related to the signal are presented::

TABLE III
VALUES OF CONCENTRATION / SIGN

concentration (mol/l)	Values Displayed on Digital Door
0	120
0,01	460
0,02	492
0,03	597
0,04	588
0,05	617
0,06	623
0,07	226
0,08	668
0,09	677
0,1	717
0,2	820
0,3	872
0,4	862
0,5	866

The curve of Figure 8 below demonstrates the trend plotted in black, revealing a relationship that does not match the expected, however it is concluded that a mistake was made in the calibration graph itself, was soon corrected and implemented a new function, now variable x will show the value of the concentration, ie the function is no longer logarithmic and became a polynomial in the case, a polynomial of degree 5, yielding a relative error of 15%, the polynomial of degree 5, was obtained by inspection constants; concentration (mol / l) and electrical signal 0-1013.

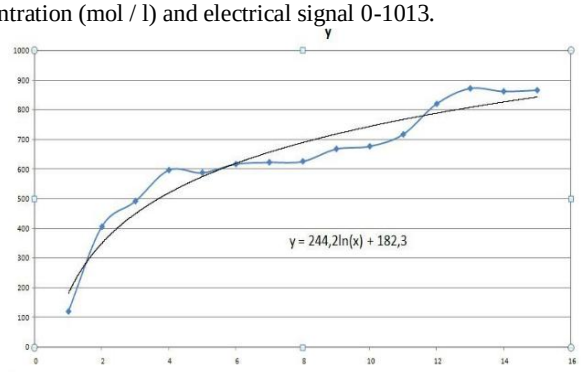


Fig.8
MISTAKEN FUNCTION.

In figure 9 shows the result of recalculation:

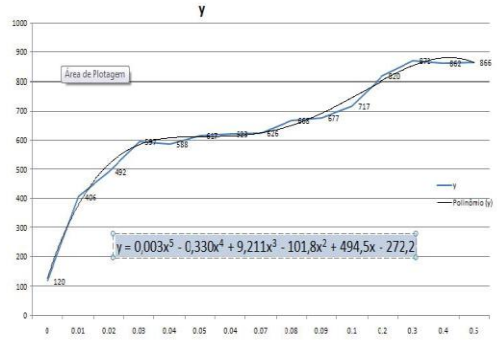


Fig.9
JOB WITH GOOD APPROACH.

There was improvement in the approximation of the function, as the chart demonstrates a disruption of the curve, so there is increase and decrease, if the observed values were reversed. Else the function is exponential to polynomial converted as shown in Figure 10 below:

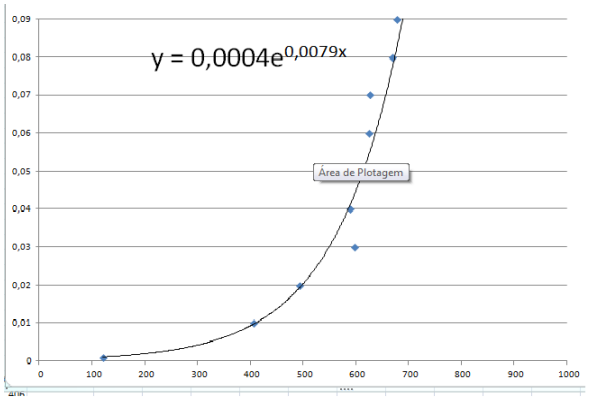


Fig.10
FUNCTION USED IN CALCULATING.

B. Step 2

Mounting the Circuit Implementation with LCD: Now with the function already established built - if the code or algorithm, resulting in the operation of the experiment. Figure 11 shows the mounting of the contact in the matrix circuit operating normally.

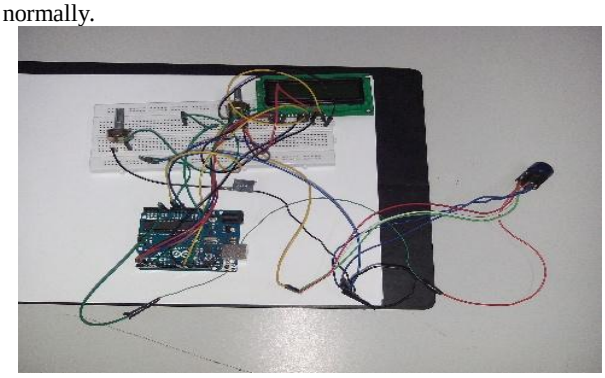


Fig.11
MOTHER OF CONTACT.

C. Step 3

Implementation of Printed Board: After the full operation of the circuit at the contact matrix passed the configuration for the printed board.

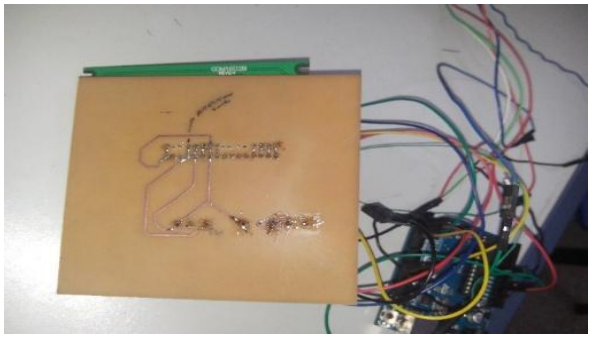


Fig.12
PRINTED CIRCUIT BOARD.

Upon completion of the mounting on the printed circuit board has been observed that the operation occurred in the normal manner. Figure 13 below illustrates the front image of the card.

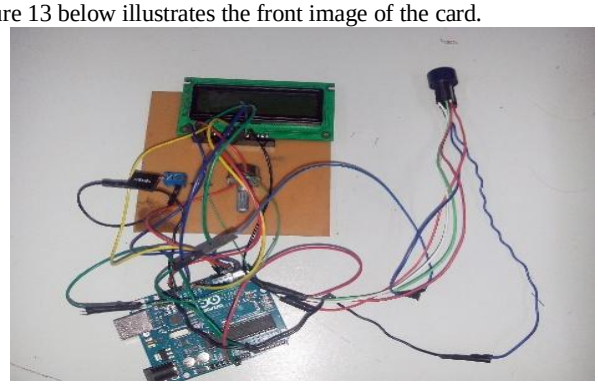


Fig.13
FRONT PLATE PRINTED IMAGE.

D. Step 3

With the implementation of the Bluetooth device with the instrument was better usability can easily be accessed by mobile phone, as shown below:

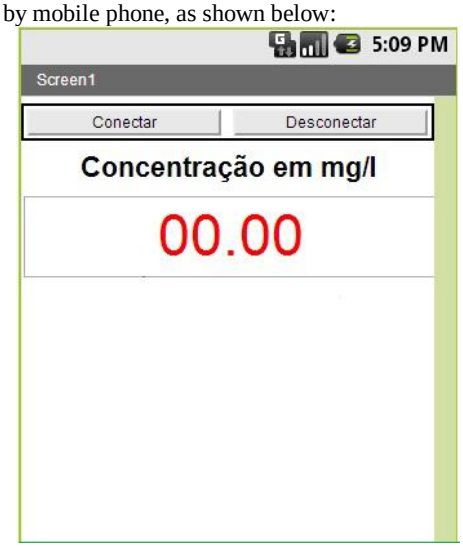


Fig.14
VIEW THE APPLICATION.

V. CONCLUSION

The result was satisfactory, because we can plot the characteristic curve of operating the MQ-3 sensor and perform Bluetooth communication between the module and a mobile device. The readings showed a minor error to a prototype sensor which is of low sensitivity and accuracy. Corrections were made in the project being on graphical analysis and sample dilution of alcohol per liter. The test proved 10% error in the measurement reading, which provides for an adjustment to the calibration curve.

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