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NORTH SEA FLOW METERING WORKSHOP

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"Automatic Transmitter Calibration Ideas and Practical Implementation"

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STATOIL

AUTOMATIC TRANSMITTER CALIBRATION IDEAS AND PRACTICAL IMPLEMENTATION

Introduction

The development of a new generation of instruments has improved the accuracy and stability, this have made it possible to increase the interval between calibration intervals without reducing the quality standard.

Calibration of the new instruments, requires reference instruments with better accuracy and calibration procedures.

Process transmitters with accuracies of +/- 0.15 % or better , require references which are five to ten times better. This means that a reference should have an accuracy of +/- 0.02 %.

Maintenance of metering systems are time consuming and depend havily on high quality calibration equipment and personell. A common problem is that the reference standards either are not accurate enough, or the instruments are used for applications they are not designed for.

New calibration and test methods are intended to reduce the maintenance expences and ensure good quality measurements.

New methods and technical implementation must not conflict with national codes and standards.

Statoil and other companies have been given dispensation for longer calibration intervals in cases where experience shows that the new equipment and methods are maintaining good quality.

Experience has proved that the calibration intervals can be reduced if high quality instruments are installed. Accurate

measurements depends on the whole instrument loop, it is therefore important to test all part of the instrument loop, together with the transmitter. The best solution is to calibrate the instrument with a reference instrument while they both are connected to a common process.

Statoil has installed Quartz reference tranducers. They are in use on the platforms both as field instruments and as laboratory standards.

Calibration with the transmitters on line with a stable process condition give the instruments the same condition from one interval to the next.

Experience with field calibration has shown that pressure transmitters have been stabil for a full year without drifting outside the specification. This would not have been possible without the new technique.

Technical implementation

Instruments must have long stability and high accuracy.

Tubings and fittings shall not create any leaks. It is therefore necessary to use instruments fittings that can be maintained with no danger of leaks if reinstallation should be necessary. Instruments that require dismantling more often than every 6 months, ougth to be installed with flexible hoses and quick connectors.

Manifolds must be installed to supply all transmitters with the same pressure in order to allow calibration of all pressure transmitters at the same time. The reference transmitter shall be connected to the same manifold such that pressure can ble applied to one or all transmitters simultaneously.

Signals from transmitters and the reference transmitter shall be connected to a test panel located close the metering computers. Signals from the reference must be transferred as a digital or frequency signal to minimize accuracy loss in signal transmission.

Automatic calibration requires a high precision voltmeter with a accuracy of 0.001 % (1-5 volt). The voltmeter must be able to measure the transmitters through a multiplexer (scanner).

Figur 1. Installation Hook Up

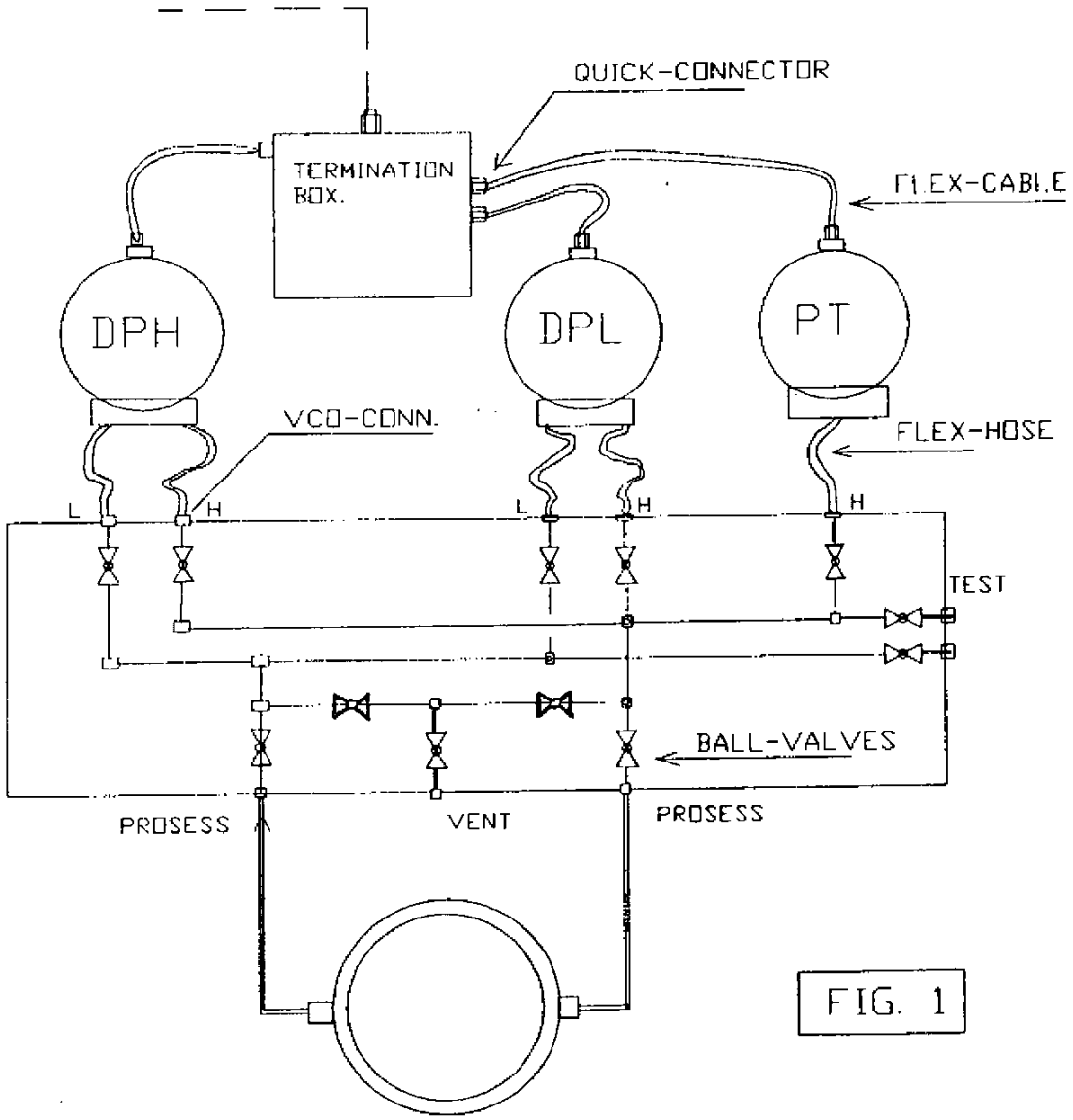
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FIG. 1

Pressure Calibration

By use of a smart calibration technique it is possbile to improve the accuracy of the tranducer. Calibration is performed at a standard laboratory with nine different temperatures intervals (-3 to 39) grad C and 5 different pressures.

During the measurement process the computer calculated the measured values according with the input factors from the reference laboratory.

The absolute accuracy is +/- 0.015 % scale, including hysterese, drift in temperature.

The resolution is (0.05 mbar) 210 bar. The signals are converted from a frequency pulsemodulated signal and are propotional to the pressure.

Calibration of pressure transmitters are done on line with a quart reference tranducer. The pressure is supplied directly from the process or from a nitrogen reservoir.

A personal computer is used to collect all data from the reference and process transmitters. The automatic logging program in the computer does not allow any approved logging before the process is stabil (within the defined limits). When the process is stable the deviation in tolerance is measured and either approved or disapproved.

Figure 2. Shows process hook-up of a reference tranducer in an actual installation.

Figure 3. Shows a graph of logging pressure online with one Quartz and two process transmitters over a period of 20 minutes.

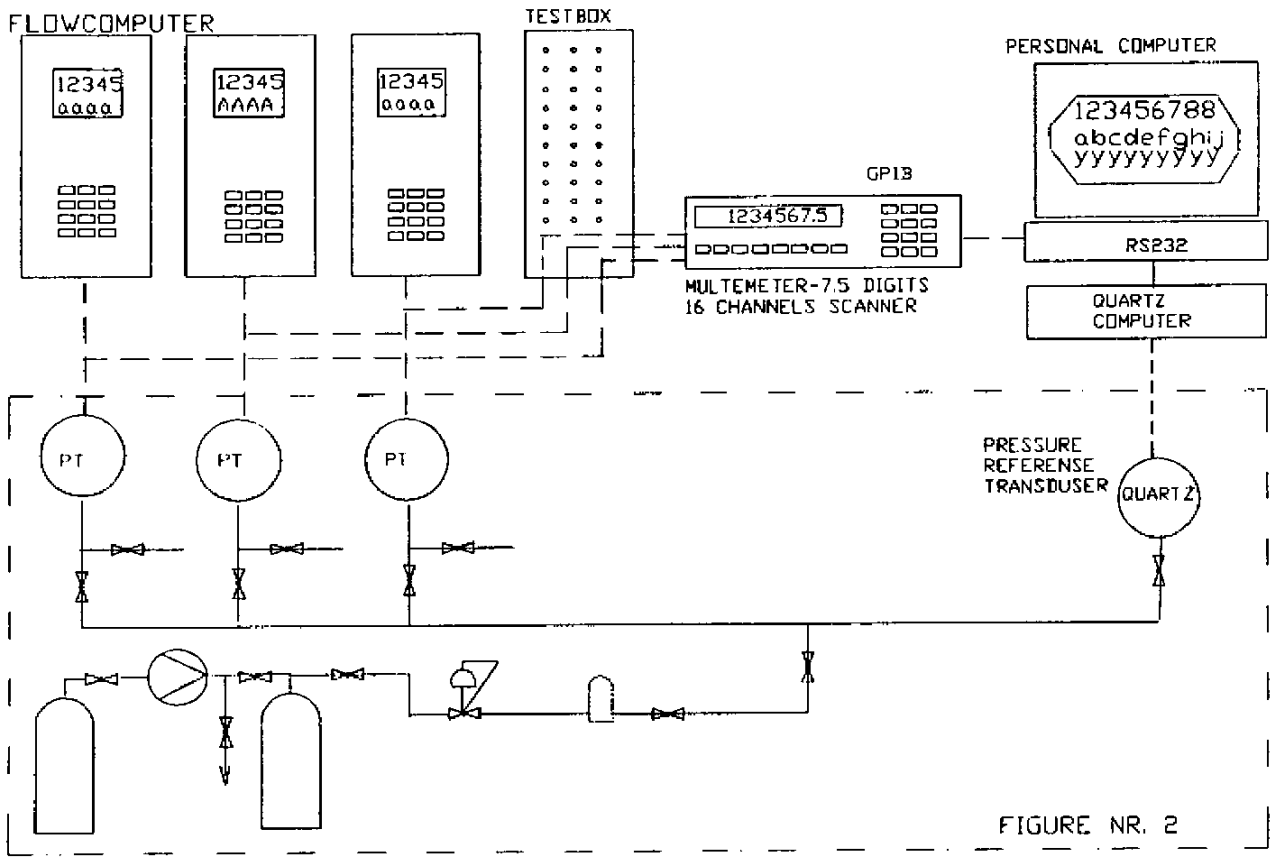
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FIGURE NR. 2

AUTOMATIC LOGGING OF PRESS. TRANSMITTER

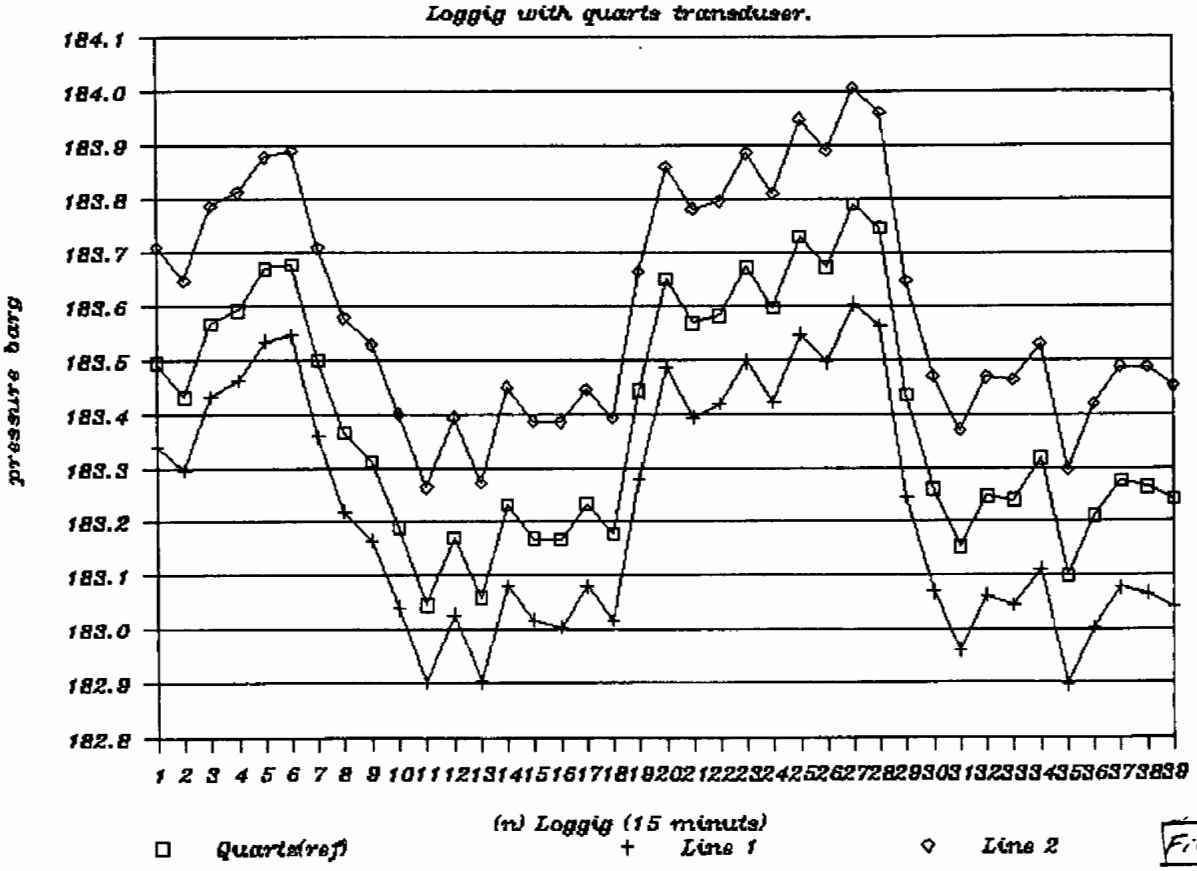
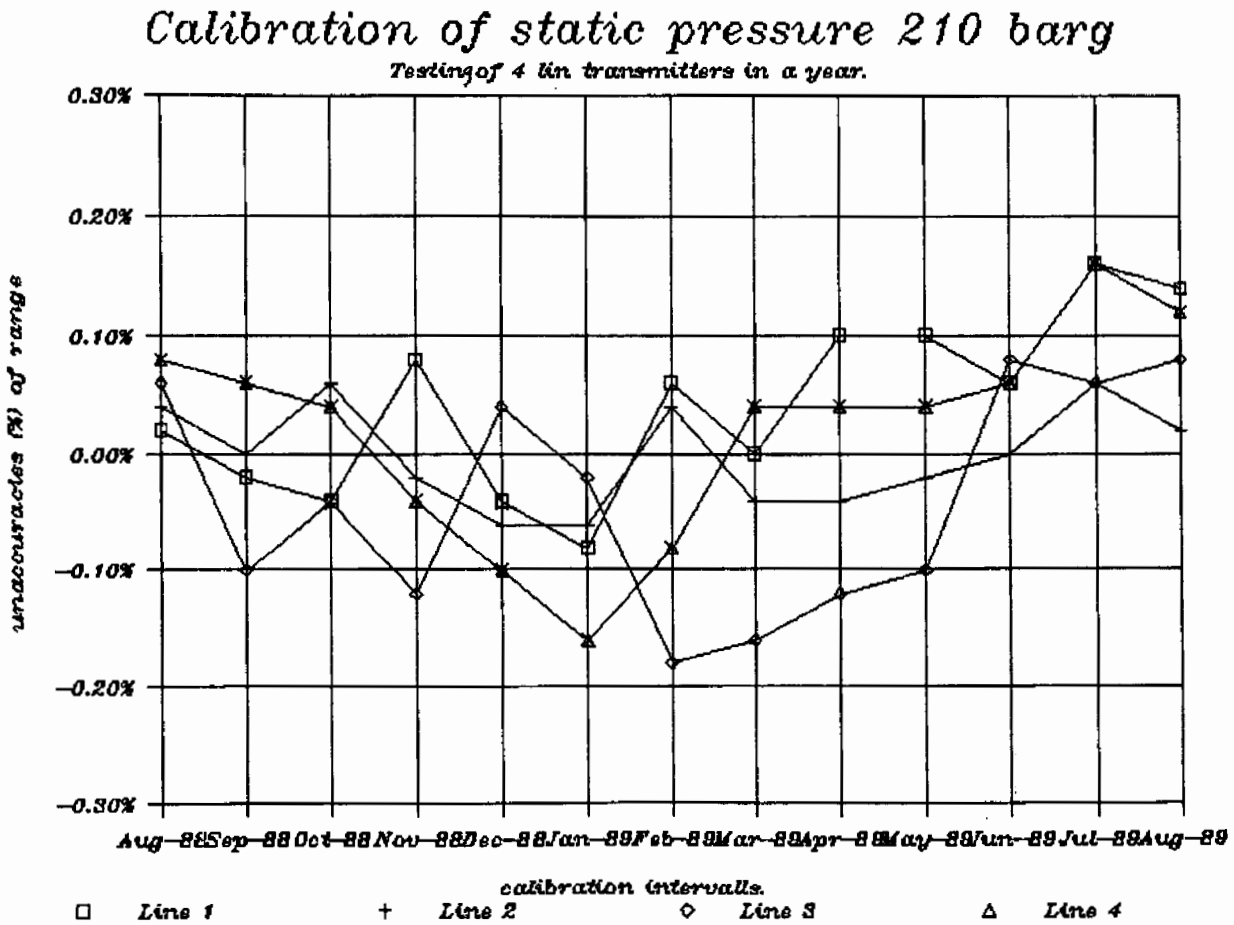


Fig. 3.

Testing of gass over one year.



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Calibration of differential transmitters

Calibration of differential transmitters with full pressure is normally done with a complicated deadwigth tester. These expensive instruments are constructed for standars laboratories and not suitable for platforms.

Calibration is done at the standards laboratories every three months. Foot print calibration at atmospheric pressure is done every month.

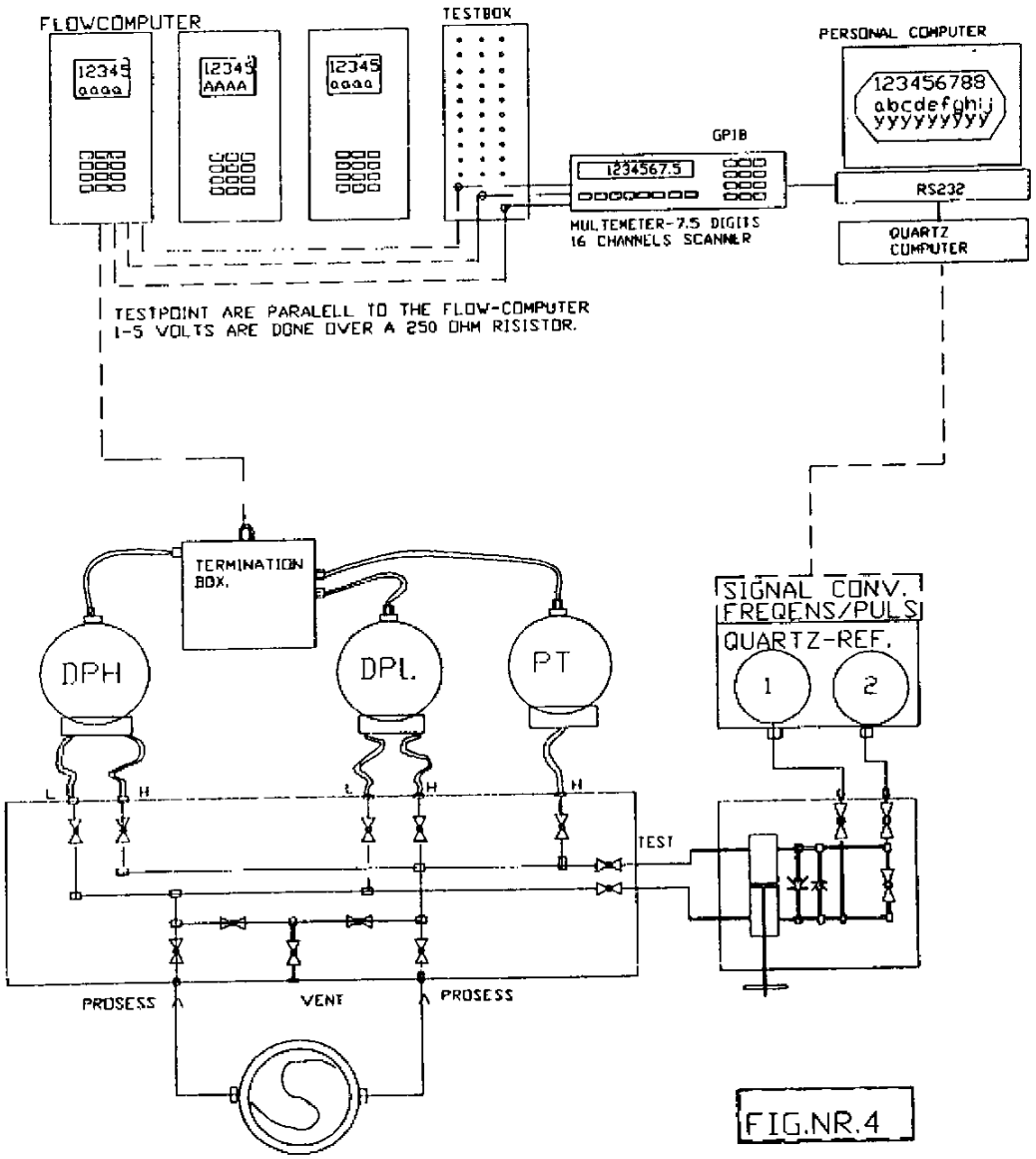
By use of two quart pressure transducers the differential pressure is tested with full static pressure.

Both transducers are zeroed at the same pressure before the differential pressure is measured. By comparing the readings form the two transducers, change or drift of the transducers will be discovered.

The measurement are done online and the signals are collected in the control room from the reference and process transmitters. A computer loggs the data continuously where stability and toleranse are measured. The computer logs the data via a precision multimeter (1-5) volt. Both transmitters are measured at the same time.

This method only checks the working point of the transmitters. Longer logging periods over several hours can be done to cover a bigger range.

Adjustment in the field over the whole instrument range has not been tested, some testing have been done by isolating the system while the differential pressure are kept in the system, and result shows that it can be very difficult to avoid small leaks. Adjustment of transmitters must be done at a stable condition, off line in a work shop where the instrument can be stabilized under static pressure before adjustment take place.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SIGNAL CONV.
FREQENS/PULS
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2
PROSESS
VENT
PROSESS

FIG.NR.4

Temperature calibration

Testing of instrument loops have been carried out in a 2 year period, and results have shown that the process temperatures at a crude metering station have a very stabil tamperature. The differences are less than +/- 0.15 grad C. The method compares all readings on the metering station during a tanker loading. Before the test can start, the prosess on metering station must be stabil. After the proving starts, the inlet temperature on the prover is used as the reference. All other transmitters in the system are than compared with the reference, an shall not have bigger deviation than 0.15 grad C.

The logging is performed with a multichannel multimeter which measures 1-5 volt over a 250 ohms resistor with an accuracy of +/- 0.01 %.

Experience has shown that the transmitters are very stabil, and normally no additional calibration is necessary.

The problewm is rather that the PT-100 elements become damaged or their resistance changes due vibration or other environmental factor.

Figure 5. Shows a process hook-up of metering system with logging equipment.

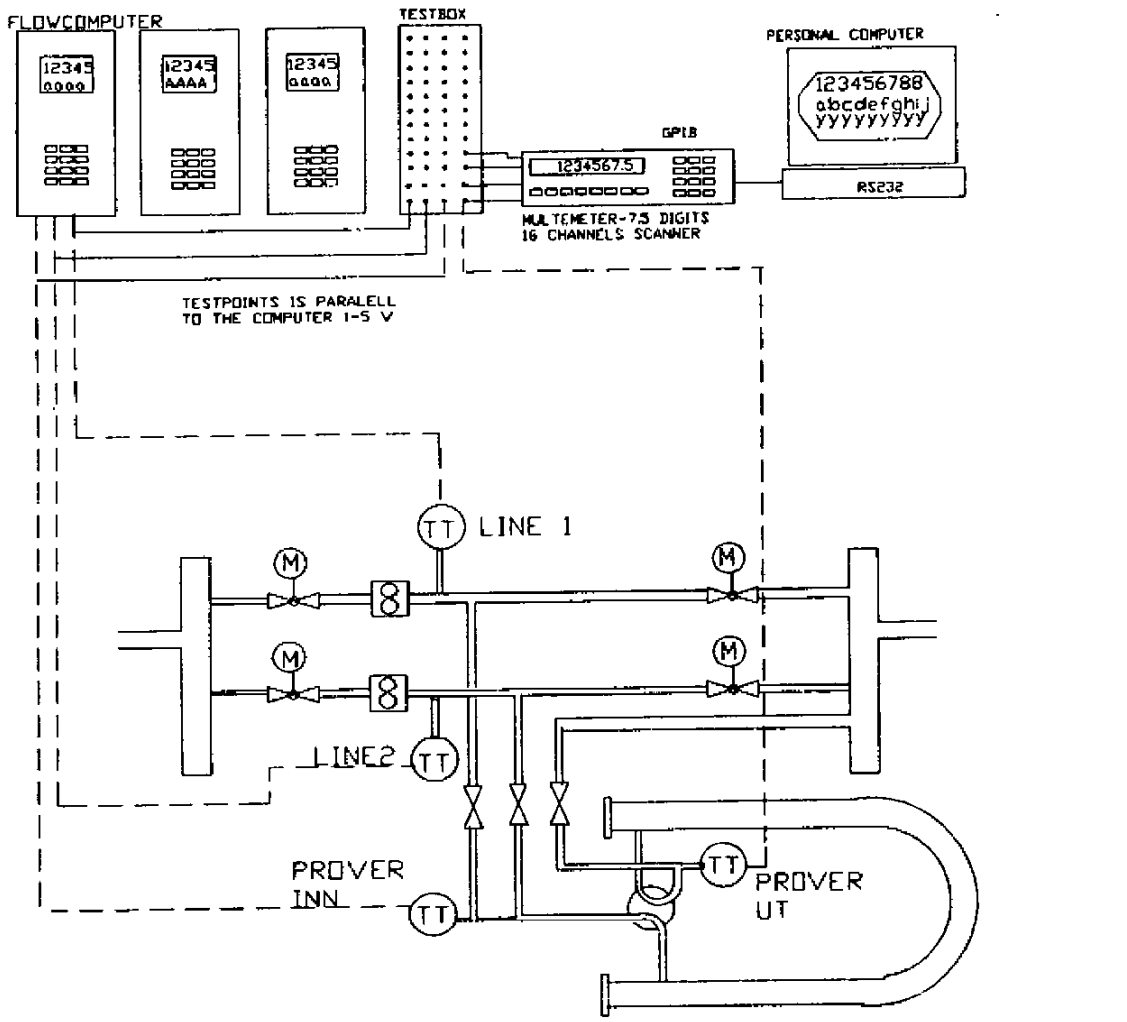
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FIGURE NR.5

References

[1] Paper presented at the North Sea Flow Measurement Workshop, a workshop arranged by NFOGM & TUV-NEL

Note that this reference was not part of the original paper, but has been added subsequently to make the paper searchable in Google Scholar.