Catalogues, Product Data Sheets and Manuals: tools to select instruments?

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1. Foreword

Everyone who deals with instrumentation uses catalogues and product data sheets (let say “data sheets”) to select the instruments to use.

Everyone who has to use instruments reads manuals to understand how to use the instruments.

The points are:

- Who deals with instruments?
- Who uses instruments?
- What are they looking for?
- Do they get the right answers from data sheets, manuals and catalogues?

They are not granted requests since the variety of subjects is very large and the scope of their activities is so different that the answers needs to be analyzed properly. But let start from the origin of the problem: What is a data sheet? What is a catalogue? What is an operation manual?

A data sheet is, or should be, the identification card of an instrument. It should be complete and self explaining in order to let anyone understand which are the specifications of the instruments, what an instrument is for, which are the peculiarities, what it can be expected in terms of metrological specifications, electrical, mechanical and environmental properties, used materials, geometry, etc…It should be written in such a form that it can be easily read and understand by a reader who has a minimum of knowledge about Instrumentation. On the basis of the data sheet content, a proper selection of the instruments should be possible insuring appropriate results for a specific application.

Is this the case?

Probably not.

A catalogue is, or should be, a general document containing a series of specifications and information to be used to select the type of instrument for a particular application. It should be organized in a way that enables the reader to understand the instrument specifications, the differences between different types of instruments or sensors, weather it is suitable for the specific application and what it requires to be used. It should be a sort of “vademecum” for those who have to understand what the Manufacturer proposes and what applications the instruments are suitable. Are they like this? Sometimes.

An operations manual instructs the user how to install, read, check and maintain the instrument. Are they like this? Generally, they are.

It appears that data sheets, catalogues and manuals do not always give the right answers to user’s questions: why? The answer is not unique. The answer is a sum of reasons which is interesting to analyze.

Data Sheets (Product Data Sheets).

Data sheet is, as indicated, the identification card of the instruments. But who is writing this card and what he is interested in presenting?

They are written by the Manufacturers who are interested, of course, in giving the technical specifications. They are, however, obviously interested in Commercial aspects and therefore are prone to enhance some aspects of their products and to shadow others. This is normal and, in some ways, *compulsory* if one considers that the customer’s selection of instruments is basically made by comparing data sheets as well as costs.

Receiving or losing an order on the basis of the content of data sheets leads Manufacturers to be very careful in detailing the content of the data sheets. Each Manufacturer try to emphasize, of course, its product presenting the specifications in the most attractive way while paying great attention to what competitors do. This results in data sheets that are very often similar in structure and content. This could be a positive point because it enables buyers to easily compare data sheets and to verify differences between different products. But the point is to understand what is the real meaning of information included on the data sheets. Is what we read self explanatory? Is it clear? Is it referred to some recognized standard or rules? Is it complete enough to enable a correct selection of the instrument? Does it really enable a reliable comparison of different products? Surely not, because they are written according to different standards, rules or guidelines. Surely not because they are written following different standards, rules or guidelines.

Another problem is related to the person who uses the data sheets. Data sheet are studied by designers, consultants, contractors, purchasing departments of private or public Companies as well as public authorities. Everybody has a different background and a different problem to solve. Someone is interested in looking for a special instrument to solve a particular problem; someone is interested mainly in metrological aspects, someone in reliability, robustness, environmental compatibility or simply to prices and delivery time. Everyone is looking for different information and requires, therefore, different answers from technical documents. How to cope with this? It is not easy since it covers a very wide range of requests for which there is no single answer.

Finally, attention must be paid to terminology: are we sure that the terms which are presented on data sheets are correct and describe what we intend? How can users be assured that terms are corresponding to the recognized standards and therefore can be assumed as "official"? This is a very important point since the use of appropriate and common terminology is essential for understanding instruments properties and to reliably compare different instruments when selecting an instrument.

Terminology, in general, is a quite complicate matter. What I'm writing in this paper can be accepted or not because the terminology I use is not correct (see "Data Sheet" or "Product Data Sheet) or can be interpreted in different way by the readers who are from different countries, have different native languages and different ways of thinking. One of the most critical points is, in fact, the difference between the readers – or users – background. The same term, if not referred to an internationally recognized standard, can be interpreted with different meaning and change completely the evaluation we make of an instrument. From this it is obvious that here is a need for a common language that is reference to an international standard.

Manufacturers shall have the right to present their products in the manner they consider the most appropriate and this is a must. No one should require the Manufacturers to standardize their documents; it would not be correct since it would represent a limit to their freedom

What needs to be done is to ask for a minimum of specifications to be reported on data sheets, referred to recognized standards and using a common recognized terminology. Manufactures can add any number of additional specifications that are considered important, peculiar or “attractive”.

Catalogues.

They are very good from the commercial point of view which is their main purpose.

Manufacturers have given them a quite attractive layout and are interesting to read. Most of them include references and applications which could be useful when selecting instruments.
They are more commercial than technical, therefore they follow the Manufacturers’ commercial policy more than technical rules. And this is correct.

Operation Manuals

Manuals are, in general, good and useful documents the users can follow to correctly install, read, check, maintain the instrument and process signal/data and present values to the Client.

The main problems with manuals are related to the two “extreme” approaches normally taken in preparing them. One extreme is the very simple, essential, basic manual with limited text and a lot of illustrations explaining how the instrument is assembled, how to disassemble, check, repair, and install using “step by step” philosophy described by means of the procedure sequence showed by illustration more so than by text. It is a document that enables users to quickly get answers to its problems and to enable unskilled people to handle, install and read the instruments. The negative aspect is that the instrument is shown as a black box to be installed and read without having a deep knowledge of its working principle, or knowledge of the pros and limitations based on the Manufacture’s experience, knowledge, research, technological development and, in general to the efforts underlying the design and production of the instrument.

The other extreme is that some manuals are a sort of textbook containing a lot of information which sometime can be intended as “redundant”. The users who is at site to install the instruments has to go through dozens of pages to find out how to fix or regulate an instrument or has to follows a number of mathematical formulas to understand how to convert an electrical signal into engineering unit. These manuals are dedicated to office engineers more than field engineers.

A compromise between the two extremes should be found even though it can be said that, in general, most manuals are good documents. They provide most of the answers the user is looking for. Again, the terminology probably needs to be defined in order to avoid misunderstandings and/or conflicts. Of course they should obviously be in agreement with the content of the data sheets

2. A brief overview to the situation

In order to support the information given in Section 1, documentation – especially data sheets - from some of the most well known international Manufacturers of geotechnical instruments have been analyzed. Most of the data sheets studied contain general information as well as similar metrological, environmental and mechanical specifications.

The most common metrological specifications are:

Range, Over Range, Accuracy, Resolution, Linearity, Thermal Zero Drift

Accuracy is the most important and interesting value: it is not referred to any standard. It has to be reminded that the definition of Accuracy is not exactly the same, for example, in IEC Guide 99 "*International Vocabulary of Metrology*" and in ANSI/ISA S.51.1. "*Process Instrumentation Terminology*" and implies a different approach.

Other terms which are use are: *Overload, Over Range, Sensitivity*.

Over Load and Over Range should have the same meaning, therefore why do not use the same term? And how is the behavior of the instruments when the range is overcome and the instrument is working within the Over Range? Some manufacturers indicate the behavior in the over range.

Regarding the environmental specs, the attention is focused on the temperature range, given as *Temperature Range* or *Temperature Limit* or *Temperature Operating Range*; moreover the effect of temperature is indicated as *Thermic Sensitivity Drift, Temperature*

Coefficient, or a *Compensated Temperature Limit* – which is different from the *Operational Temperature Limit* is indicated.

One environmental aspect which is always indicated and could be really useful to know is the degree of protection according to IEC529 (BSEN60529:199) or NEMA (250-2003) – at least standards are used, but it is necessary to state which one has to be used in order to avoid misunderstandings and mistakes -. This value - known as "IP" for IEC and with a numeral ranging between 1 and 13 for NEMA - indicates the protection of the instrument against solid objects and water. If for some instrument it is considered as obvious - piezometers, pressure cells, all "underground" or borehole instruments - for others could be necessary to know this index in order to assess the suitability of an instrument for a specific application, such as for surface tiltmeters, crackmeters, liquid settlement system, etc…, but not always it is indicated into the data sheets.

Two main points can be highlighted:

1. Metrological terms are not referred to any standards. This could be intended that they are referred to a reference standard but it is not, since there is not a recognized and universally accepted "reference standard". Therefore it is not clear what the reference is. Moreover, the values are indicated as +/- a percentage of "*f.s*." which states for "*full scale*" or "*full span"*. Is *full scale/span* the same as *Range*? Why use two terms?
2. There are some parameters which are presented by different terms or indicate different properties such as the ones related to temperature.

Regarding the other specifications, there are information regarding size, materials, weight, and some "specific" parameters typical for each instruments as, i.e. for piezometers, diaphragm deformation and mass, which can be useful to evaluate the suitability of the instruments in a specific application.

One point that should be mentioned is the use, in the data sheets, of the appropriate measuring units and their abbreviations. To specify a pressure, some of the checked data sheets use the unit [kg/cm^2] which is no longer accepted as an international measuring unit. It shall be substituted by Pascal [Pa] and its multiples [kPa] and [MPa]. Some Anglo-

Saxon Manufacturer uses the English units (psi, in, lb, etc) introducing the conversion table or the equivalent metric values. A unique solution should be recommended.

It appears, from what is reported above, that the data sheets are currently not self explaining of the instruments specifications and in particular they do not give users the possibility to correctly compare different products. Therefore something must be done to overcome these problems.

3. What to do

This paper is entitled *“Catalogues, Product Data Sheets and Manuals: tools to select instruments?”* The principal goal is to propose some changes to current procedures for creating these documents to insure that the users have adequate information not only for selecting instruments but also to document the true performances of them.

The actions are very simple and easy to apply considering, as a “*must*”, that the Manufacturers must be free to present their product in the way they consider to be the most appropriate according to its commercial policy and market strategy. No one wants to introduce some compulsory standards which create constraints or impose limit on the Manufacturers.

It must also be considered that legally the data sheet is an implied warranty that the product is suitable for the purposes stated under the conditions specified. The performance limits are, thus, the most important part of a data sheet.

Data Sheets

The suggestion is to share the opinion that data sheets have to contain a number of “common” specifications, referred to international standards using appropriate terminology. Obviously, they can include other instruments features the Manufacturers want to emphasize. They should be easy to read and leave no doubt about the meaning of each item they include.

Users should find the answers to their questions and can compare them in order to decide which instrument is the most appropriate.

With these key points in mind, let’s try to make a proposal on possible lay-out of instrument data sheets.

Data sheets should be divided into 4 sections:

– *Metrology*

– *Electric / Mechanics*

– *Environment*

– *General*

Metrology is the section that contains the specification which are, basically, the reference values used to "identify" the performances of the instrument.
It should contain a minimum number of terms and have to be referred to standards, both for terminology and for meanings.
Starting from Terminology, the standard which is proposed is the ISO IEC Guide 99 "*International Vocabulary of Metrology*" already mentioned. Being an ISO standard, it is implicitly accepted in Europe were it should be applied. It contains terms both in English and in French language. Terms not included into this standard should be avoided.

It has to be noted when speaking of terminology, the whole vocabulary used in technical documents should be in agreement with the reference standard in order to avoid any misunderstanding or confusion which could influence the choice of the instrument or the selection of a bidder. Also the terminology used in this paper might be reviewed and correct accordingly. Moreover it has to be considered that the use of common terminology will help those who are not English language native, to avoid translation mistakes and misunderstanding.

The metrological specifications ("*definitions from ISO IEC Guide 99"*) which are considered to be the basic ones are:

Measurement Principle: "*Phenomenon Serving as a basis of a measurement*". In instrumentation practice, describes the principle used to measure a specific measurand (*quantity intended to be measured*) and let the user to make the instrument selection according to its own experience or literature references for different applications, such as long term monitoring, short term and accurate laboratory measurement, not accessible installation and so on. Example: vibrating wire, potentiometer, resistive strain gauge, fiber optic (different principles), capacitive, etc..

__Range__ *(of a nominal indication interval): "absolute value of the difference between the extreme quantity values of a nominal indication interval. Sometime it is termed "span" of a nominal interval. The nominal indication interval is usually stated as its smallest and greatest quantity values".* In practice it indicates the maximum (and minimum if different from 0) value of the measurand that the instrument is able to measure correctly. Example: 350 kPa, 50 mm, 20 deg (-10 to +10), 200 °C (-50°C to +150°C), etc..

__Over range__: it is not a recognized term, but can be used as an indication of the maximum value the instrument can withstand without being damaged, and it is important in the selection process since indicates the "*margin of uncertainty*" – or error – in the parameter range that can be assumed or, from another point of view, the "*safety factor*" against possible overloads.. Measurements taken in the over range field have to be considered carefully; they might not respect the metrological specification indicated for the instrument used within the correct Range.

__Accuracy Class__: "Class of measuring instruments or measuring systems that meet stated metrological requirements that are intended to keep measurement errors or instrumental uncertainties within specified limits under specified operating conditions" Where Precision is *"closeness of agreement between a measured quantity and a true quantity value of a measurand"*. It indicates the maximum error that cannot be exceeded when a measurement if taken using a certain instrument under certain specified conditions. It has to be considered that this parameter refers to Laboratory conditions. Field conditions and measurement procedures may influence the instrument behavior; therefore the "field accuracy" can be different from the Laboratory one. This difference can be significant. Example: inclinometric probe accuracy in Laboratory and accuracy of the measurement inside an inclinometric casing; total pressure cell measurement accuracy in pressure tank during calibration and embedded in soil. Not to be confused with *Precision* that indicates "*the closeness of agreement between measured quantity values obtained by replicate measurements on the same or similar object s under specified conditions".*

One very important point is that it is not stated how to calculate either Accuracy or Accuracy Class. The Manufacturer is free to use its own procedure which should be in agreement with the standard metrological approach. This means that in order to understand the meaning of the values indicated on data sheets it is necessary to know how these values have been calculated; otherwise it is not possible to compare different values.

Dead Band: *"maximum interval through which a value of a quantity being measured can be changed in both directions without producing a detectable change in the corresponding indication"*. It represent the smallest change of the measurand that can be measured. It is important because it could be the discriminant between a "true" or "false" measurement due to noise or other external causes.

Stability: *"property of a measuring instrument, whereby its metrological properties remain constant in time*". It is quite important for long-term measurements and monitoring, especially for those instruments which are not accessible for checks and calibration after installation or for those devices/probes whose interval between calibrations is longer than normal.

Other specifications could be included by Manufacturers, as, for example:

Repeatability: "*measurement precision under a set of repeatability conditions of measurement*". It indicates the differences that can be expected when making a number of measurements of the same quantity under the same conditions. It could be important when measuring a quantity that is expected to be stable during the period when measurements are taken. Example: Set of daily optical measurements of a plumb line in a dam with no reservoir level changes.

Resolution: "*smallest change in a quantity being measured that causes a perceptible change in the corresponding indication"*. In practice I is not a crucial parameter because, for the electrical instruments normally used, it is largely biased by the read out system. For most of the common electrical instruments the resolution is a matter of the read out unit performances. Example: an instrument with a 4-20 mA output signal corresponding to a range of 50 mm displacement, connected to a 3 ½ digit read out unit will have an apparent resolution of 0.008 mA corresponding to 0.025 mm. If the same instrument will be connected to a 4 ½ digit read-out unit, the apparent resolution will be 0.0008 mA, corresponding to 0.0025 mm.

Hysteresis: *"The property of an instrument evidenced by the dependence of the value of the output, for a given excursion of the input, upon the history of prior excursions and the* *direction of the current traverse" (ref: ANSI /ISA-S51.1).* It could be a significant property when measuring a parameter whose value increases and decreases periodically or due to boundary conditions changes.

Of course any other parameters can be included according to Manufacturer's choice.

Electrical / Mechanical: is the section that contains the specification regarding "how to use" the instrument; in other words "*the reference information enabling a correct use of the instrument to obtain correct measurements*". Since most of the instrument are electrical, the focus of this section is related to electrical parameters. Nevertless for non electric instruments (i.e.: mechanical – manual crack meters, tape extensometers, rod extensometers, etc.. - or hydraulic – anchor cells, settlement gauges, etc.) specification on the correct way of using them will be reported.

Since these parameters are not "metrological", it is not possible to make reference to a standard such as the *ISO IEC Guide 99.* The Manufactures shall provide for the most important and critical information enabling the users to correctly use the instruments and collect consistent measurements. The basic parameters are

Power Supply (electrical): indicates the range of power (min and max supply voltage) and type of power (i.e.: V d.c., V a.c., dual excitation, etc.). The power consumption shall also be indicated. It is a basic parameter to know when using an electric instrument, whether it is connected to a data acquisition system or it is read by means of a manual read out unit.

Output (electrical): indicates type and range of the output signal the instrument provides according to the measured parameter change. It is a key parameter; it provides the type and range of the output the instrument provides and must be used to select the measuring device. It has to be considered that the output the Manufacture provides, is the *nominal* one (i.e.: 4-20 mA, 0-5 Vdc, -5 to +5 Vdc, etc.). The actual output will be indicated, for each instrument, in the calibration sheet.

Dimensions: Length, width, thickness, diameters, threads of instruments and mounting devices are fundamental to select the instruments and evaluate their suitability for a specific application.

Mounting / Connecting elements: Type, dimensions and characteristics of mounting and/or connecting devices, fixing elements, protections devices, etc.. have to be indicated for a complete knowledge of the instruments suitability.

Scale of displaying measuring instrument (mechanical): *"part of a displaying measuring instrument, consisting of an ordered set of marks together with an associated quantity value".* Indicated "how to read" the values on the measuring scale of the instrument. (i.e.: crack width in tenth of millimeters, convergence of a tunnel in millimeters, total pressure in kPa, etc.).

Moreover, other significant specifications should be included, such as:

Overvoltage protection limit of the electrical instruments; indicates the nominal maximum value of the voltage peak the instrument withstands. (reference could be made to different standards such as IEC 60). It could be important to specify how this protection is obtained in order to enable the user to correctly design the measuring chain.

Grounding connection for the electrical instruments; indicates how the instrument is connected to the ground. It is of crucial importance for a correct design of the measuring chain to increase its reliability and to reduce signal noise.

Warm-up time for electrical instrument; indicates the minimum delay time between excitation and stabilization of the output signal. It is important in automatic data acquisition system to set the proper reading procedure, avoiding to read false values.

Wiring for electrical instruments; indicates the type of the electrical connection and the number of conductors required for the connection cables.

Environmental: is the section that contains the specification regarding "*the conditions that a measuring instrument or measuring system is required to withstand without damage, and without degradation of specified metrological properties, when it is subsequently operated under its rated operating conditions"*.
Normal environmental conditions affecting geotechnical instrumentation are: temperature, humidity, presence of water, vibrations, shocks, mechanical stresses, chemical aggression, material compatibility. The Manufacturers shall indicate the limit of the conditions and their influence on the instruments performance.

The most important specifications to be provided are:

Temperature range: represents the *"absolute value of the difference between the minimum and maximum temperature the instrument withstands maintaining its metrological specifications".*

Temperature drift: is the change of the output signal value due to a change of the instruments ambient temperature for a constant value of the measurand. It is one of the most important specifications because almost all the instruments used on geotechnical measurements are exposed to temperature changes (instruments installed underground are generally not significantly affected by this phenomenon.

Waterproofing: "indicates the degree of protection of instruments against penetration of water inside the instrument body". Commonly it is referred to the IEC 60529 Standard "*Degrees of protection provided by enclosures (IP Code)".* The IP codes indicates the degree of protection of an enclosure against penetration of dust and water. For geotechnical instrumentation it is a mandatory specification because the instruments are generally exposed to rain, humidity, condensation and water pressure.

Chemical aggression: many instruments are in contact with aggressive media (atmosphere, water, soil). It is crucial to be informed about the compatibility of the instruments with these media. Therefore, Manufacturers have to indicate the material used in order to enable users to select the most appropriate instrument.

General: is the section of the catalogue or data sheet that contains the information the Manufacturers want to emphasize regarding their instruments. This should include a short description of the most significant features of the instruments. The typical suggested fields of application should be described with reference to instruments specifications such as long term stability, reliability, possibility of onsite re-calibration, as well as information regarding possibility to perform special measurements (i.e.: dynamic measurements – frequency range and amplitude) or to be used in special applications such as extreme environmental conditions or in conjunction with special data acquisition system or measuring devices.

One point the Author want to stress is that this section could be used to introduce the concept of "*Classification*" of the instrumentation as DiBiagio, Bruzzi, Pezzetti (FMGM 1999 – Singapore) and Bruzzi, Pezzetti, Sorun (FMGM 2003 Oslo). This concept is intended to give users a reference for selecting instruments according to the application. It is based on simple concepts of *long term stability* and *serviceability* and proposed different classes of instrumentation:

- Class 1: Instruments with long term stability and low probability of failure as proven by Manufacturer's experience;
- Class 2: Instruments with long term stability but probability of failure is not documented or proven by Manufacturer's experience as per Class 1;
- Class 3: Instruments with limited long term stability and low probability of failure as proven by Manufacturer's experience;
- Class 4: Instruments with limited long term stability but probability of failure is not documented or proven by Manufacturer's experience as per Class 3

It was a proposal to start introducing the concept to "classify" instruments according to their intended use as is done for many others technological products in common use. It was not intended to be a sort of judgment of the quality of the instruments but only a tool to help in selecting the most appropriate instrument for a specific application. Manufacturers were asked to identify in their production those instruments having the specifications required by the different Classes and to indicate this in their Catalogues and Data Sheets.

Unfortunately this idea failed because Manufacturers did not consider it, mainly because of its commercial implication. They were afraid it would serve as a tool for comparing instruments from different Manufacturers. But this was not the intent! The true intent was to ask Manufacturers to indicate which of their instruments are the most suitable for a specific application, considering that each application requires instruments that have the appropriate characteristics. And this is exactly what the Manufacturers do when a Client asks them to recommend a specific instrument for the intended use. They consider the situation, the need, the conditions and any other issue and then suggest the instrument. Why not including part of this process in the Technical Data Sheet?

The Author proposes to discuss this point again. It can be analyzed and solutions can be found, even different from the original one, but what really matters is that this could be a powerful tool and a great quality improvement in the instrumentation market.

Catalogues

Since Catalogues are, as indicated, more commercial than technical tools, no major comments will be given in this paper.

It has to point out, again, that terminology should be used according to recognized references and that the commercial information should contain some technical references in terms of type of application, operational conditions, boundary conditions, use opf the instruments and relevant measurements, and so on, in order to give the users the possibility to understand the peculiarity of the instruments.

Operation Manuals

Regarding instrument manuals, the situation is quite different. Most of them are of good quality and give enough information to the users. However, two points could be pointed out.

- An instrument manual should include both *theory and practice*.

  Theory regarding the use of the instrument and its geotechnical implication as well as theory regarding the type of sensor, the measuring principle and the output signal processing.

  Practice related to the best way to use the instrument. It should include the preferred procedures to check and install the instruments and to verify proper performance. When relevant, good geotechnical practice should be pointed out to install instruments in such a way to minimize soil disturbance in order to optimize its geotechnical performance.

- A manual should be a tool easy to use, even on site under adverse working conditions. Therefore, it is suggested to provide manuals which are user-friendly in the field. .

  "*Waterproof*" documents, digital documents to be read by palm PC, Smartphone, laptop PCs, audio/video documents to be used with MP3, IPod etc, could be an interesting evolution of the standard documents normally used.

What is really needed is to convince users to read the manuals before using the instruments. Therefore, they should have text that is comprehensive but easy to read, with a lot of illustrations showing how to proceed, step by step, to prepare, check, install, connect and read an instrument. Manuals with a large number of pages written in small font characters with no illustrations are not useful because no one (or very few) read them especially when working at site and need to solve a problem.

4. Conclusions

The ideas presented in this paper are intended as suggestions to improve the quality of the documents we all use when working for a geotechnical measurement.

It seems quite strange to discuss this point, but it has to be considered that in our sector we are far away from the level other technological sectors have reached. As an example we can consider what we face when we have to buy a washing machine or a PC.

For both these "*instruments*" we find data sheets containing information we can use to compare different models and brands. Washing machine have also a sort of *Classification* described with a letter and a number of signs "+" (Class A, Class B, Class A+, Class A++, etc..) which immediately give a clear identification of the product performances and, therefore, if it is suitable for the intended use.

PCs are described by a number of specification we all are used to read and understand in order to select the most appropriate for the application: type of microprocessor, RAM memory, HD capacity, screen size and graphic resolution, number of ports, etc..

It is clear that the selection process in these cases is easier and, mainly, more "*technical*".

Why not to do something similar for geotechnical instrumentation?

The author is strongly convinced that this will be a great step forward to improve the quality of geotechnical instrumentation which requires for good, complete, correct and comparable information from technical documents. This information must be available.

The way to reach this goal is not easy but we must start!

All the ideas presented in this paper could be discussed, modified, changed, improved; new concepts can be introduced; new approaches can be suggested, but the scope shall be the same: improve the quality and the professionality in our field of activity. considering the key role of instrumentation Experts, Consultants and Service Companies are essential to obtain good results

One important point of discussion will be the Standards to be used as reference.

The solution will arise from an open discussion among all those interested. Some standards are available, as the ones mentioned; some others could be introduced and evaluated. Who has to do this?

A key role in this process will be plaid by the Manufacturers: they are the one who can decide if this proposal will be accepted or not. Without their strong support it will be not possible to reach the goal.

The Author strongly hopes the major Manufacturers will accept to open the discussion on this theme as a starting point to make this great step forward. They have to discuss among them and share opinions and ideas to prepare the basis for the improvement which will enhance specific peculiarities, capabilities, experiences, investments and researches in order to present a new practical and "*philosophical*" approach to the activity of Geotechnical Field Measurement.

References

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