Recommendations Concerning Survey Instruments Maintenance and Quality Specification

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ABSTRACT

Do we need standards? For what and whom?

In the following paper our intention is to report about the activities inside the ISO/TC 172 SC6, where FIG Commission 5 is official Liaison and participate actively to the work with standards. For those purposes we want to present what FIG means and expects from standards and shows how the new updated ISO standards fulfil these expectations. This can be illustrate with some examples of "simplified procedures" for determining of the achievable precision of survey instruments (EDM, Levels) published end of November 2001.

Furthermore we present some FIG recommendations about maintenance and quality specifications of instruments to the users, manufacturers, owners, authorities and universities institutions.

RÉSUMÉ

Avons nous besoin de normes? Pourquoi et pourqui?

Dans le present rapport notre intention est de parler des activitées de ISO/TC172 SC6, avec laquelle la Commission 5 de la FIG a le status de membre Liaison officiel et participe activement aux travaux en cours. Pour cette raison nous voulons presenter ce que la FIG comprend et expecte de ces normes et montrer comment ces nouvelles normes ISO satisfont à ces demandes. Ceci peut-être illustré par des examples venant des "procedures simplifiées" publiées novembre 2001 pour déterminer sur le terrain la précision achevable par des instruments de mesure tels que des DME et des niveaux.

De plus nous presentons quelques recommandations FIG adressées à la fois aux usagers, aux propriétaires, aux constructeurs, aux authoritées et aux enseignants concernant l'entretien et sur l'état qualitatif des instruments de mesurage.

ZUSAMMENFASSUNG

Brauchen wir Standards-Normen? Für was und für Whem?

Im folgenden Vortrag sprechen wir von der Arbeiten der ISO/TC172 SC6 in der die FIG Kommission 5 beteidigt ist als offizieler Liaison Mitglied und auch aktivt in den Arbeiten teil nihmt. Wir möchten zeigen was die FIG von Standards-Normen erwartet und wie diese neuen Standards dieser Erwartungen entsprechen. Dieses kan erleuchtert werden mit den Beispielen der “Simplified = Einfachen Methoden” für die Bestimmung der Präzision Messgeräten im Felde sowie EDM und Nivelliere die im November 2001 bei ISO publiziert wurden.

Weiterhin geben wir einige FIG Anweisungen angehend dem Unterhalt und der Qualitätssicherung der Messgeräte zu den Anwender, den Eigentümmer, den Instrumenthersteller, den Behörden und auch den Hochschuhlen.

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1. THE TODAY STATUS

The surveying profession has been subject to rapid technical evolution concerning both techniques and equipment.

Today ISO the International Standard Organisation is finalising the updating and harmonisation of earlier standards for older instruments for example EDM, theodolites and levels. Standards for new instruments as digital levels, laserplanes, total stations, commonly used by the today Surveyors have been started during the last years. Since 1997 several Technical Commissions inside ISO (TC59/SC4 and TC172/SC6) dealing with the same subjects have been integrated into TC172/ SC6, this in order to eliminate the duplication of standards for the same instrument used for different applications.

2. FIG INVOLVEMENT - HISTORICAL BACKGROUND

Before 1990 FIG was not much interested and involved in the ISO standards activities.

The complexity, diversity and multitude of standards and the special ISO-language made it very difficult for FIG member to understand and apply standards. They often complicated more the surveyor life than they were to any help.

At the FIG Congress in Helsinki (Finland) 1990 FIG Commission 5, responsible for questions related to survey methods and instruments, establish a WG for producing "*recommendations for routine checks of Electro-optical distance meters* ". The results published 1994 at the FIG Congress in Melbourne reach a great success inside the profession and have been translated in several languages.

Since that time several members from FIG-C5 are directly engaged in the ISO work for the updating or establishment of new standards. 1999 FIG obtained the Class A liaison status to ISO/TC 172 SC6, and J-M Becker represents FIG.

3. THE ISO OBJECTIVES

The ISO objective for the standards is to specify *field procedures* to be followed each time the achievable precision or "accuracy" for a given surveying instrument used together with its ancillary equipment (tripod, staffs, etc) has to be determined. This will allow the surveyor to investigate that the precision given by the measuring equipment is appropriate to the intended-measuring task.

The Surveyor has to be convinced that if he apply the standards it will help him, otherwise he will not apply them. For these reasons the surveyor require *user friendly standards*, low time consuming for implementation (about ½ hour) (low-costs) with results are easy to be interpreted.

4. FIG REQUESTS ON STANDARDS

Few years ago still 2 or 3 standards existed for each type of instruments which complicated the choice for their application. FIG works hardly to clarify simplify and reduced them.

Also ISO/ TC 172 SC6 has followed the FIG requests on standards in its work namely: only *one standard* for each type of instrument, for use *anywhere*, *whiteout* any *special* ancillary equipment, by *common field operators*.

The standards have to be user friendly.

This means that the surveyor who applies these standards is able before any fieldwork to answer to the following question: ***"****Can I achieve the required precision ("accuracy") in the project with my equipment, yes or no?"*and make the appropriate decision.

5. ACTUAL STATUS FOR DIFFERENT INSTRUMENT STANDARDS

In the following I want to report about the results presented by ISO/TC 172 SC6 at its last meeting in November 2001 in TOKYO/ Japan. All standards from the first generation of standards are in agreement with the new ISO and FIG objectives and represent an important step forward to produce *user friendly standards.*

- The standards have been updated and modernised. This means that they can be used for *two purposes*: first for a *simplified (field) test* and secondly for a *full test (laboratory or field)* to determine the achievable precision of one *measuring system*: Instrument + ancillary equipment (tripod, staff, etc) + observers (actual team members), under existing environmental conditions at a specific time.
- The following new standards are definitive and accessible for use since end November 2001:
  ISO 17123 part 2:*"Levels"*
  ISO 17123 part 3: "*Theodolites"*
  ISO 17123 part 4: "*EDM"*
  They replace all the earlier existing standards for these instruments.
- New standards under preparation for the following instruments:
  ISO 17123 part 5: " *Electronic tacheometer*"
  ISO 17123 part 6: " *Rotating lasers*"
- Proposals have been discussed and the final publication is expected for year 2003
- First attempt and discussions have been done about a new standard for "*Optical plumbing instruments*": ISO 17123 part 7.

– Furthermore proposals have been made concerning a new standard for "*Measuring tapes* – Steel and Textile tapes ". Much more work has to be done before a final version of the standard can be published.

6. FIG RECOMMENDATIONS TO THE PARTNERS IMPLICATED IN THE MAINTENANCE AND QUALITY SPECIFICATIONS OF SURVEY INSTRUMENTS

These recommendations are not only for the users but also the owners, the manufacturers, authorities and university institutions. All of them are involved in the survey process and partly responsible for the final quality of the results. Therefore it is good to point out the specific responsibilities for each one. We try to do this in a simplified form as bullet sentences.

6.1 Recommendations to the Users (surveyors, etc)

– Require a calibration document from the manufacturer at the delivery
– Be familiar with your equipment and read the technical documents: possibilities and limitations
– Follow the manufacturer instructions for proper handling
– Check the instrument performance regularly: repeatability and suitability
– Monitor continuously the instrument health in a logbook from the beginning
– Before each project check the functionality and suitability of the equipment
– For each specific work-type use appropriate equipment
– Report all changes, weaknesses, errors, etc to the manufacturer, owner and other users.

Note: It is important that the users are familiar with the ISO standards and their procedures to determine the "precision" of the used measuring system (= team) and follow the health of their equipment. This will in a long term save time and money and is fundamental in the QM process.

6.2 Recommendations to the Owners:

– They have to understand the need and benefit for regular check
– Give time and facilities to the field operator to do these checks
– Ensure that the instrument-operator really do this checks and calibrations
– Check that the appropriate equipment is used for each specific project
– Follow the annotations in the instrument "*Health logbook*"
– Buy only quality certified equipment
– Inform other users, manufacturers, etc, about your problems.

Note: The owner has to understand the importance of regular check and support their employees to do them regularly. To many owners forgot this and stress the operators to jump intentionally or not over these periodic checks. Unfortunately modern equipment can easily

distract/ influence the operator to believe that everything on the display is of good quality which not necessary is the case. The consequences can be very costly.

6.3 Recommendations to the Manufacturers

- Give clear information about the technical specifications: time for warm up, etc.
- Give realistic information about the performances: not only the possibilities but also the limitations in their use. This is very important to eliminate impossible applications not adequate for that equipment
- Supply with a copy of the final test document before delivery that confirms the instrument performances.
- Calibrate each instrument after reparation or exchange of major components.
- Include in the operating software routines for field quality checks and calibration in accordance with the new ISO standards.
- Include also an internal logbook for monitoring the instrument health
- Inform and warn all users about any weaknesses, faults discovered after delivery
- Inform all users about software upgrades.

Note: Manufacturers to often do not inform about the limitations and restrictions in use of their instruments as for example precautions to be taken before beginning measurements (warm-up time, acclimatisation to the outside temperature, etc). This will create a lot of bad surprise for the user (insufficient quality, lose of time, bad results) who lose his confidence in his equipment.

6.4 Recommendations to the Authorities

- Inform all actors about standards, guidelines and official regulations
- Specify which kind of instrument who has to be used for each specific work item
- Require that all equipment have to be calibrated regularly (for example each year)
- Establish appropriated facilities for that purpose (national or regional control and calibration field or laboratory)
- Include obligatory quality control in all public tenders and check they application
- Contribute to the creation, updating, and diffusion of standards.

Note: The Authorities in many countries are trying to be “ISO certified” but at the same time most of them do not contribute to the standard work, diffusion and application control. Furthermore in many countries no calibration facilities exist, hear the Authorities have a strong responsibility to establish them. Standards questions are a very important part in the process for QM (Quality Management).

6.5 Recommendations for the Universities Institutions

- Test all new and current equipment
- Report about the possibilities, limitations and weaknesses to all partners

- Report also about how to operate to minimise the error budget when using different equipment: "*best use practice*"
- Ensure that the students are trained to carry out routine checks and calibrations in accordance with existing standards and regulations
- Make the students aware about the error sources and their minimisation
- Contribute to the elaboration and diffusion of guidelines, standards, etc
- Collaborate with the users, manufacturers, ISO to upgrade guidelines and standards

Note: Today only a minority of Institutions is involved in the standardisation work, this has to be changed. Student's needs to be more involved in this process to better understand the needs for standards, maintenance and calibration of instruments.

7. RECOMMENDATIONS TO FIG AND ISO

Still inside the ISO procedures subsist some points that complicate the establishment, diffusion and implementation of the new standards and are a serious handicap to their popular use. We can illustrate this by some examples:

- The people involved in the establishment or updating of standards has to find their own financial sponsors both to support their work and their travel expanses. This made it difficult for many experts to participate in this work and eliminate young people from it.

- The procedure and time necessary to create a new standard or to upgrade an old one is still to long. When the finalised standards are available for application on the market, their value is less actual and often no more demanded (the use of the instrument belongs mostly to the past), the standards have mostly a historical value!

- The fact that the standards are not free of charge dissuades many surveyors to use them. If ISO wont to reach the Users the standards must be free of charge and easy to understand. Two solutions can be hardly recommended: the first one is that the Manufacturers automatically integrate all standards in their software package, the second one is that ISO give free access on Internet to the standards.

- The influence from individuals (End-Users) on the updating or creation of standards is still too much complicate and restricted by the national standard organisations. Better influence through direct communication between the ISO TC's and the Users has to be established.

FIG C5 has the intention to publish a popular version of the "simplified test method" for each instrument type on its WEB, so that all Surveyors easily can make use of them.

8. CONCLUSIONS

FIG Commission 5 is very happy about the progress made during the last years by the ISO/TC172 SC6 both regarding the updating and harmonisation of earlier standards and on

the establishment of new standards. In both cases the results are in good concordance with the FIG (End-Users) requests this will facilitate their application by the Surveyors. This is also the result of the good collaboration between FIG C5 and ISO/TC 172 SC6 during the last years. This co-operation has to continue in the future for the benefit of all surveyors.

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BIOGRAPHICAL NOTES

Jean-Marie Becker was professor in Engineering Survey at the Royal Institute of Technology, Stockholm-Gävle, Sweden. He is chair of FIG Commission 5 (Positioning and Measurement), chair of NKG WG for Height determinations and member of ISO/TC172 SC6. He is former head of Geodetic Production Division at Lantmäteriet (National Land Survey=NLS) of Sweden and developer of ML, MTL , MXYZ techniques. He was also responsible for the realisation the Swedish Height Network. He is at present working mainly with international questions at NLS for FIG , ISO and NKG.