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"Code of Practice for ISO 5167"

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CODE OF PRACTICE FOR ISO 5167

by

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0. Introduction

In 1977, an ISO working group was created (ISO/TC30/SC/WG8) in order to prepare a draft Code of Practice (COP) for the use of ISO 5167 (refer to the simplified standardization structure given in annex). Since then, it took more than 10 years to have a document ready. In what follows, the main steps of that work are recalled and some conclusions are drawn.

1. Main Time Steps of COP Preparation

1977/03/16-18	Working Group 8 created by ISO/TC30/SC2 at ESSEN meeting. WG 8 should propose a first design of the future document for next SC2 meeting. Chairmanship is vacant.
1980/04/23-24	SC2 meeting in PARIS. WG 8 has not started yet. Mr PEIGNELIN is appointed chairman of WG 8.
1981/03/04	WG 8 meets in PARIS. The objective of the COP and a first working plan are settled down.
1981/12/10-11	SC2 meeting in BRAUNSCHWEIG. Mr GRENIER is appointed chairman of WG 8.
1982/03/19	WG 8 meets in PARIS. A new plan of COP is designed (close to the actual one). Basic features are agreed. The very first papers are being looked at. Future papers are promised by a number of delegates.
1982/02/14	WG 8 meets in EAST KILBRIDE. Chapter 11, covering secondary instrumentation, is added. Numerous points are made, in particular on geometrical and mechanical requirements. COP is growing quickly.
1983/03/24-25	WG 8 meets two days in PARIS examining papers, rewording, criticizing, questioning, etc. It appears that many things are still unclear and need clarification. User guidance has to be increased.
1983/06/13-14	WG 8 meets two days in LONDON. The later changes and additions are discussed so that a draft can be presented at next SC2 meeting.
1983/07	The first COP draft is being circulated to SC2 members (SC2 doc. n°145).
1983/11/3-4	SC2 meets in GAITHERSBURG. The general features of COP are approved, but the paper is considered to be merely a first sketch of what COP should be. There should be more on nozzles and Venturi tubes, and there should be more information on calculations and physical data.
1984/06/14-15	WG 8 meets in PARIS. The numerous comments that were received after SC2 GAITHERSBURG meeting are taken into

account. WG 8 efforts apply essentially on calculation examples, uncertainties, physical data and secondary instrumentation.

1985/01 — The new version of COP is circulated to SC2 members (SC2 doc. n°162).

1985/06/25-27 — SC2 meets in STAVANGER. Merely editorial comments have been received. They have to be considered. In addition, computer programmes examples are being wished.

end 1985-early 1986 — Letter exchanges between the members of WG 8.

1986/08 — The new version of COP is circulated to SC2 members (SC2 doc. n°205). It is the thickest one (221 pages).

1986/11/19 — WG 8 meets in NEW YORK to take account of the latest comments that are available.

1986/11/19-21 — SC2 meets in NEW YORK. COP, as just revised by WG 8, is approved by SC2. Computer programmes examples shall be deleted. COP will be reworded in proper english language by BSI. It will have to be consistent with the new version of ISO 5167.

1987-1989 — Rewording, translation, re-typing, etc. COP should be made available quite soon now.

2. Problematic Starting, Difficult Ending

In the elaboration of the paper, two periods of time were long and difficult : the earliest and the latest ones.

It took a lot of time to be able to decide what should be the features of COP. At earlier stages, that document was supposed to be issued quite rapidly, and anyhow far before the next version of ISO 5167.

This was stated because ISO 5167, as published in 1980, had encountered strong criticisms and its revision had been decided since its very publication. At that time, COP was considered as a means to make the defects of ISO 5167 bareable to users. It was then supposed to correct the situation before the next version of the standard could be made available.

When starting to write something that could be incorporated into COP, people realised that the above vision was not realistic : whatever happens, COP had to comply with ISO 5167 statements, whether found satisfactory indeed or not. Unless WG 8 would have started on the writing of a new version of the standard (which it was not supposed to do), there should be no contradiction between both documents.

The information given in COP had then to comply with ISO 5167-1980 statements. But it should not be a simple repetition of what the standard already stated.

The dilemma was then : COP should go further than the standard. But, if the standard was not going far enough, it was obviously because on many points it had not been possible to reach agreement on more detailed statements. For more or less the same technical reasons that limited ISO 5167 statements, COP new proposals seemed bound to be rejected if too daring.

This explains while it was quite long and difficult to find the right style. Fortunately it was decided quite early that COP would not be a compulsory document, thus would be a technical report and not a standard.

As a guideline, WG 8 members came to decide that anything clear, reasonable, giving effective and practical guidance and not contradicting ISO 5167 statements would be acceptable and should be incorporated into COP and submitted to SC2 judgement. On the other hand, any sentence already included in the standard should be banned from COP. That open-minded attitude led to some developments that appeared eventually as non-needed, but it helped keeping a creative behaviour and allowed to achieve a rich document.

The particular situation of COP facing ISO 5167 standard posed also some very practical problems which were not that easy to solve. For instance, should COP be usable alone, or should it be usable only together with the standard ? In the earlier case, COP should include the standard statements. In the latter, how to make it easy for the user to refer to two separate papers dealing with the same subject in different styles ?

The last period was not easier than the first one. Some reasons can be found in the quite long duration of the project and in the huge size of the final paper. For instance, the final rewording lasted about one year and translation into french by the secretariat further longer (COP was worked out in its english version only, which helped a rapid progression but required a heavy task at the end).

An extra delay of more than one year came when it was clear that COP was not going to be published many years before the new version of ISO 5167. It was then needed to put COP in accordance with the new version of the standard, and consequently to wait for the latter to be available at a sufficiently advanced state.

It was also needed to retype large parts of the paper, as ISO is now publishing the drafts as they are, without any printing reprocessing, and the working documents had not always been made for that purpose.

Although those multiple delays are quite frustrating, it is not simple to decide what should have be done to have COP ready earlier : a better plannification of SubCommittee Secretariat charge plan would may be have permitted a faster translation, but it would not have made the new version of ISO 5167 available earlier.

The only attitude that could indeed lead to faster results would probably have consisted in not changing one's mind and keeping the objective of issuing COP without taking care of ISO 5167 revision. The counterpart would have been the necessity to revise COP as soon as new ISO 5167 was made available, but it could be that some revision will be needed in the near future anyhow.

3. Various stages of the document

In 1982 meeting in PARIS, COP was made of a few pages only. These were the first timid attempts to comment and give guidance. A first period of intense work happened between 1982 and 1983, that resulted in the first draft presented at GAITHERSBURG. The latter is a document of 77 pages that looks already quite like the final version : there is some guidance on calculation methods, mechanical problems and secondary instrumentation.

The main point that was not approved (and thus disappeared in the later versions) was a large table comparing all the techniques that could be used to measure the flow, including non-pressure difference devices.

A second period started then : it was indeed very active, as SC2 had approved almost all that had been written in COP and was just asking for more.

WG 8 concentrated on questions other than mechanical ones : edge sharpness, flatness, centering, straight lengths, flow straighteners, etc. were already covered, and more guidance was needed on calculations, uncertainties, physical data and secondary instrumentation. This period was not less active than the previous one and it appeared that many things were unclear or uneasy.

COP grew then almost to its final state and was presented at SC2 meeting in STAVANGER.

Many editorial comments were made, preventing COP to be approved by SC2 at that time. It was asked to incorporate some computer programmes examples.

COP entered then a rather editorial period during which the working group members exchanged information by telephone or mail. All the comments made at STAVANGER were taken into account, computer programmes examples were incorporated and a new version presented in NEW YORK. It was the biggest version of COP : 221 pages thick.

To prevent another delay due to many possible additional comments, the working group met in NEW YORK just before SC2 in order to take account of all the comments made since last version circulation.

The COP was then approved by SC2 provided the computer programmes examples would be removed (they appeared to be of less help than expected first). The final version was then 202 pages thick. British Standards Institution was asked for rewording COP in correct english language before the final paper to be sent to SC2 Secretariat.

4. ISO 5167 Code of Practice

It was very difficult to the members of the working group themselves not to get lost ("... paragraph 3.2.4 of the Code of Practice, dealing with clause 6.5.3.3 of ISO 5167, will now be referred to as 4.3.4 in the Code of Practice because of the addition of ...") untill a parallel numbering was adopted, making the clause numbers the same in both papers.

That posed again some problems at the latest stage because of ISO general requirements for clause numbering, making consequently a non continuous

numbering unacceptable. That question of numbering was eventually solved by adding some dummy paragraphs in COP so as to meet at the same time a parallel to ISO 5167 and continuous numbering.

On the technical side, many points had to be tackled.

At the earlier stage, merely mechanical and geometrical topics were studied. ISO 5167 is often unclear or evasive on what should be done practically to meet the various requirements. WG 8 had then to make some decisions and guess acceptable proposals. Although sometimes quite daring, they were practically all approved by SC2.

For instance, ISO 5167 states (Clause 6.5.1.1) that "no diameter measured in any plane (must) differ by more than 0.3 % from the value of D ...". In COP, it is assumed that this can be checked by measuring local diameters in few cross-sections, namely two in addition to those already used to establish the mean pipe diameter.

Another example is related to the question of the separation of upstream fittings : ISO 5167 requires minimum straight lengths for various upstream fittings, including single bend or multiple bends configurations listed in Table 1. But it does not specify which distance between two bends is necessitated so as to allow the downstream one to be considered as single. Furthermore, Note (5) of Clause 6.2.8 (b) states that Table 1 can be applied for multiple bends whatever the length between two consecutive bends. Strictly speaking, the user could then have to consider any bend as a multiple one, which can lead him to install quite long straight lengths. COP proposes then an alternative to Note 5 giving a criteria to decide whether a bend can be considered as single or not.

The flatness of an orifice plate is quite a delicate topic and COP tried to make clear the various sources of problems : machining, mounting arrangement stresses, deformation due to flow during normal operation or special actions.

The edge sharpness is also an important and difficult point related to orifice plates. It can be uneasy to obtain accurate measurements and then to interpret them. So, It was attempted to provide the user with the necessary information so that he can decide his own control process.

Chapter 11, that covers secondary instrumentation, is entirely new as ISO 5167 is not dealing with that subject. Most of it was then inspired from other existing standards and engineering books.

After mechanical and measurement topics came other ones.

A large effort had to be made upon the uncertainty calculations. The data needed to perform the computation are scattered in various parts of the standard, and many questions arose because most parameters are not statistically independent from each other. A whole section giving background, guidance and examples was prepared, showing in particular the effects of several meter runs in parallel.

Whilst preparing numerical examples of flow calculations, some efforts was needed to make three computer programmes to give the same results. This was

quite a surprise and, although the involved people were familiar with the equations and the computers, several differences were found when comparing the results on given sets of data and it was quite long to reach a perfect agreement. It appeared then useful to give substential guidance on the calculations procedures.

This task was quite difficult and long as there are many ways to present the iterative process needed in most cases and as it is always a hard task to be at the same time scientifically rigorous and easy to understand . A whole Annex was then written giving some theoretical background considerations, numerical examples. Computation flowcharts and examples of calculation sheets were also defined.

Incorporating computer programmes, although desired by SC2 members, was eventually considered of little help : it necessarily implies an arbitrarily choice among available languages. Moreover, the relevant information is somewhat drowned among commands that are purely dependent on the operating system or of less interest (eg. data acquisition or results editing subroutines). Despite many efforts, it was not possible to find a universal computer language permitting to write examples that would make programming really easier and safer for the user. As a substitute, many numerical examples were incorporated so that a user can check rapidly on a few data sets that his computer code is faultless.

The last topic covered by COP is related to physical data. These were strongly asked for by SC2 members, and they are partly responsible for COP size. Giving the right quantity of information is quite a hard task in that field : the number of fluids and the number of properties to be gathered can be very high, and the problem was indeed to select a reasonable amount of data, sufficient for a number of practical purposes.

Lastly, COP is very few dealing with primary devices other than orifice plates. Many efforts were made to gather specialists advices and information, new people were asked by SC2 at every meeting, but in vain. The reason for that situation might be that orifice plates are widely used and permit the lowest error level : it would be then less important to nozzles or venturi tubes users to improve the level of understanding and applicability of the standard if they feel satisfied with the actual situation. That guess needs anyway to be confirmed.

5. Future Perspective

COP is now about to be published as a Draft Technical Report. Despite all efforts that were made, reaching that point has demanded a lot of time. It will probably be needed to update it within the near future.

Indeed, most writing tasks were technically finished by 1985 and mostly editorial rewording was undertaken since then. On the other hand, several major developments have taken place in between and will be sources of important technical changes ;

The EEC campaign on orifice plate coefficients determination, continued by and linked to several other research programmes in Europe or USA, will likely

bring changes in discharge coefficient equations, required straight lengths tables and flow conditioners usage.

New state equations, using new experimental data sets, are or have been developed : AGA 8 or GERG equations are reaching accuracy levels far better than previous equations. Despite their increased complexity, that type of equation will undoubtlessly be used more and more because of the improvements they permit in calculations accuracy.

Research is being made on new flow conditioners or packages, in order to be able to obtain good accuracies within the shortest possible straight lengths. Such research present potential high economic advantages and could bring about quite new concepts, such as the use of non freely developed but yet repeatable flow profiles.

Obviously, it will be necessary in the future to take account of these new developments.

On a more general level, a fundamental question is whether such a system (a standard to be used together with a Code of Practice) is the best way.

On the one hand, it allows specialists not to have to bother with reading COP whilst less skilled people can refer to a rather thick and documented paper. It might also help to reach agreement more easily while preparing the standard itself as one can hope that COP will explain and make practical all the unclear or difficult statements.

On the other hand, one can wonder if writing a standard clause in an unclear way is really a good practice : having the statement approved by all body members will not ensure that the basic technical requirements covered by the clause are fulfilled in practice.

6. Conclusion

More generally, the trend to improve systems performance will probably bring more and more complexity in flow measurement standards. With the growth of scientific knowledge and the increasing need to optimize the cost of flow metering facilities, users will wish to take account of eg. geometrical effects in a more refined, thus more complex way, in order to avoid for instance unduly long straight lengths.

It is clear whatsoever that improving the technical level of both knowlegde and standardization will not be sufficient. An important effort will have to be made also on the ergonomial side : it is not really useful to have a perfectly correct standard (from a scientist point of view) that half people cannot apply perfectly.

COP can be considered as a first attempt in that direction. How useful and valuable is it ? It will be up to users to answer.

REFERENCES

[1] ISO Draft Technical Report 9464, "Code of Practice for ISO 5167", August 1989

[2] ISO/TC30/SC2 documents N° 145, 162, 205

[3] ISO International Standard 5167, "Measurement of fluid flow by means of orifice plates, nozzles and venturi tubes inserted in circular cross-section conduits running full", 1980

[4] ISO/TC30/SC2 meeting resolutions at ESSEN, March 1977

[5] ISO/TC30/SC2 meeting resolutions at PARIS, April 1980

[6] ISO/TC30/SC2 meeting resolutions at BRAUNSCHWEIG, December 1981

[7] ISO/TC30/SC2 meeting resolutions at GAITHERSBURG, November 1983

[8] ISO/TC30/SC2 meeting resolutions at STAVANGER, June 1985

[9] ISO/TC30/SC2 meeting resolutions at NEW-YORK, November 1986

Standardization Environment of Working Group 8

Simplified structures