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IIW Commission V

Quality Control and Quality Assurance of Welded Products

Annual Report 1996/97

Thomas A. Siewert

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Materials Reliability Division
Materials Science and Engineering Laboratory
National Institute of Standards and Technology
Boulder, Colorado 80303-3328

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U.S. DEPARTMENT OF COMMERCE, William M. Daley
TECHNOLOGY ADMINISTRATION, Mary L. Good, Under Secretary for Technology
NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY, Arati Prabhakar, Director

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The Annual Report 1996/97 for Commission V, Quality Control and Quality Assurance of Welded Products, of the International Institute of Welding includes (a) minutes, resolutions, and the future program adopted at its Annual Assembly in September 1996, (b) the organization, officials, and delegates, (c) schedules of meetings, and (d) the status of documents published by Commission V. It reviews current research and work on standardization.

Key words: eddy-current inspection; nondestructive evaluation; quality assurance; ultrasonic inspection; welding; x-ray inspection

1. Introduction

Commission V, Quality Control and Quality Assurance of Welded Products, of the International Institute of Welding (IIW) meets annually to review the past year's accomplishments and to discuss future activities. In September 1996, the Annual Assembly met in Budapest, Hungary, to review commission activities and accomplishments during the past year and to discuss future endeavors. The minutes of the Annual Assembly 1996 included in this report are based on notes taken during the meeting and on IIW documents V-1075-96, V-1076-96, and V-1077-96 (daily minutes of the Annual Assembly).

The organization, officials, and delegates of Commission V are outlined in Appendix A, along with the subcommittee and working group meetings held during the past year. Although substantial progress occurred in the past year, as evidenced by the documents listed in Appendix B, we can improve our productivity by encouraging more professionals to contribute to the work of Commission V.

Currently, Commission V is concentrating on the following areas:

- Validation of nondestructive testing (NDT) techniques,
- NDT to assess fitness for purpose,
- NDT acceptance criteria for weld-quality classes,
- quality assurance in welding technology,
- radioscopic systems (including preparation of ISO standard proposals),
- radiographic imaging,
- classification of radiographic film systems (including preparation of ISO standard proposals),
- ultrasonic imaging and automated ultrasonic testing,

- revision of the manual for ultrasonic examination of ferritic welds,
- investigation of low-frequency eddy currents for examining the surfaces of ferritic welds and austenitic material and the structure of Al welds,
- the use of liquid penetrants to inspect welds,
- inspection of offshore welded constructions,
- review of the requirements of ISO 5817,
- digitization of radiographic film.

National delegates to Commission V are listed in Appendix A.5.

2. Minutes of the Annual Assembly 1996

For the International Institute of Welding, Commission V focuses on inspection and quality control of welds. This report summarizes the information presented at the Annual Assembly in 1996, which includes descriptions of both research and draft ISO standards being developed from the research data. The information comes from the various multinational subcommissions, working groups, and task groups within Commission V. Thus, this summary provides an up-to-date review of research activities in the countries represented and advance notice of standardization activities.

Commission V includes subcommissions that concentrate on quality assurance in welding technology and the principal techniques for nondestructive inspection (x-ray, ultrasonic, electrical, magnetic, and optical) and a working group whose task is inspection of offshore construction. This year, Commission V met September 4 through 6 in Budapest, Hungary. Forty-two delegates and experts from nineteen countries attended the meetings. Following are edited reports of the subcommissions and working groups, in order of their presentation.

2.1 Subcommission VA – Radiography-Based Weld Inspection Topics

In the absence of the Subcommission Chairman, H. Heidt, Helmut Weeber gave a short summary of the status of the projects and read the report (IIW Document V-1063-96) of the progress over the past year. He mentioned that the intermediate meeting of the Submission scheduled for Paris in December was canceled because many of the Subcommission members were unable to find transportation during the French transport strike. Fortunately, no critical decisions were planned for the meeting and progress continued as scheduled.

He described the new draft DIS of ISO 5579 (NDT: Radiographic Examination of Metallic Materials by X- and Gamma Rays). They have incorporated the changes suggested at the 1993 ISO TC 135 and the 1994 ISO TC 135 SC 5 meetings. The result will be a draft that combines the original IIW structure with some of the parameter definitions of EN 444. This DIS addressed the criticism of the present standard by containing more precise requirements.

Interest in developing a classification for film systems continues. Dr. Weeber reported on the recent effort in ISO and EN on this topic. ISO draft 11699-1 and EN Standard 584-1 were both developed in cooperation of the members of this subcommission. However, there are several differences between them, although they both meet the needs of weld radiography. The ISO members appear to support their version, and it will likely become a standard in this form.

The working party on radiosopic systems for weld inspection met with the corresponding task group in CEN TC 138 WG 1 (Radiography). Interested individuals in ISO TC 135 were invited since there has been insufficient interest in ISO to form a group on this topic. These joint meetings are resulting in the wide distribution and discussion of the IIW standard proposals and should promote international standardization. The current topic of discussion is a classification system for radiosopic systems based on application and equipment capabilities. A round robin is underway to determine the characteristic parameters. I encourage participation by the ASTM E07.01 members, so they can help shape the draft document (and reduce the chance of a negative vote during subsequent ISO balloting). The round robin should indicate whether a general classification system is feasible. These meetings also include presentations on recent developments in the state of the art in the equipment, such as CCD cameras, image processing, and automatic interpretation.

Dr. Weeber reported that the new reference radiograph catalog (for use in conjunction with ISO 5817) is ready for final approval by the IIW leadership at this Annual Assembly. New film transfer techniques are being investigated to promote avoidance of wear of the original radiographs. I invited the delegates and experts to come up at the break and after the meeting to examine the copy that was provided by Detlef von Hofe. During the review of the radiograph catalog at the end of the meeting, some of the delegates expressed concern that the quality of the copies was significantly inferior to that of the ones that were distributed by DVS. Dr. von Hofe replied that this set was not intended to be of the same quality of the originals, but was intended for use in evaluating test pieces by interpreting the imperfections and classifying them by size. After further discussion, we drafted a resolution that states that the quality of the present reproductions is unsuitable for use in training and other purposes (text included near the end of this report).

There have been several presentations at previous intermediate meetings on film digitizing equipment and the need to evaluate the capabilities of these media by quantitative measures. The Commission recognized this interest and at the 1994 Annual Assembly added the topic of film digitization to the work list for the subcommission. At the 1995 intermediate meeting, Ben Nightingale of E07 described the ASTM activities in film digitization and may serve as liaison between the two groups. The activity will be the subject of a new task group, proposed to include: Ben Nightingale (GE-USA), Hannelore Wessel (BAM-Berlin), Dr. Mattis (Siemens-Erlangen), Mr. Oellrich (Preussen Elektra-Hannover), a representative from AGFA-Belgium, and a representative from Kodak. Anyone else interested in participating should contact the Chairman, Dr. Heidt.

No new activities have been added; recent additions to the work program include:

- Film digitization,
- additional guidelines on the use of ISO 5817,
- discussions about validation, statistical methods and acceptance criteria.

At a previous meeting, I had been asked to determine if there were long-term plans to reintroduce the old NIST standard for x-ray film density. At this meeting, I reported that I had learned that the old calibration equipment was no longer considered adequate, and they were awaiting the shipment of replacement equipment. I suggested that those who were interested in this standard should contact the researcher, Dan Dummer, by email at dummer@garnet.nist.gov, or the Standard Reference Materials Program office at SRMINFO@enh.nist.gov.

2.2 Subcommission VB – Quality Management in Welding Technology

The chairman, P. Kunzmann, gave a summary of the progress since the last Assembly (IIW Document V-1064-96). No intermediate meeting was held this year, due to illness of the chairman. The working program was updated and restated as: (a) formulating a concept for quality management in welding (to clarify the relationship between existing standards and investigate the need for new standards), (b) formulating a guideline for quality management in welding (to help the user to select a quality management system adequate for their organization), and (c) collecting information on computer aided quality control, on-line weld monitoring, fitness for purpose, and acceptance criteria in welding (to define the need for further support in applying these tools).

He gave an overview that described how the globalization of markets and product liability concerns are driving the standardization of quality control systems. In turn, this requires international standards. He reported how both EN and ISO have developed large families of standards for controlling quality (that cover most of the various aspects in controlling quality). These various quality standards are being grouped according to the 20 quality items in ISO 9000 and 3834. The result should be a much more logical system for all the quality-related standards. He distributed a preliminary list of these standards, and asked who would be willing to help to complete this list (organized by the various elements of ISO 3834) as an activity of Subcommission VB. C-G. Lindevald of Finland, K. Verma of the U.S., and M. Scasso of Italy are willing to assist (by correspondence) in developing this list.

Z. Lukacevic presented his report on degradation of weld quality at starts and stops (IIW Document V-1074-96). In the following discussion, we indicated that Prof. Lukacevic is willing to revise the document based on the comments of the delegates. One suggestion was that he include the carbon equivalent of the plate. Another question was whether he had measured the residual stresses. We resolved to produce a revised version and submit it to appropriate commissions with an interest in this (text included near the end of this report).

Krishna Verma volunteered to prepare a report for the subcommission on the use of run-on, run-off tabs for control of the hardness of the starts and stops. He plans to have this ready for discussion at the next intermediate meeting in January, for possible presentation at the next Annual Assembly.

On guidelines on quality management, Dr. Kunzmann indicated that the rapid growth in quality standards has made our guideline (IIW-902-88) obsolete and we should update it. A very useful addition to the new guide would appear to be an expert system, which would collect the relevant conditions on the welding task, then would determine the relevant quality procedures for a quality management system. This is a whole new task that would start with a blank expert system shell, then add the various rules. This will be task of the next intermediate meeting. This idea generated a great deal of discussion about what should be included. G. Tahash, M. Scasso, and P. Szelagowski volunteered to participate.

Dr. Kunzmann gave a presentation "The State of the Art (what is currently implemented in production) in On-line Weld Monitoring". He stated that on-line weld monitoring is being used, while on-line control is still only a topic of research. He distributed a copy of a report "On Line Weld Monitoring– CAQ in Welding – State of Technology and Practical Experiences in Germany" by E. Oster of Rudersdorf FRG. He is planning to prepare a questionnaire on the practical application of computer-assisted quality in welding and on-line monitoring, to see what has been done.

Also, we proposed a microseminar for 1998 on the use of standards in quality control. He will try to organize this in cooperation with the Select Committee on Standardization.

To get a faster start on these activities, the intermediate meeting will be moved earlier in the year, and is proposed for January 23, 1997 at the Institut de Soudure in Paris.

2.3 Subcommittee VC – Ultrasonically Based Weld Inspection Topics

The Subcommittee VC Chairman, H. Wustenberg, gave a short summary from his report of the activities during the past year (IIW Document V-1065-96). The intermediate meeting of the subcommittee was held at the Institut de Soudure in Paris, France on December 11, 1996. He organized his presentation around the four working groups: Validation of Ultrasonic Weld Inspection Methods, Ultrasonic Inspection of Austenitic Welds, Characterization of Ultrasonic Equipment for Weld Inspection, and Automation and Imaging for the Ultrasonic Inspection of Welds.

The working group on ultrasonic inspection of austenitic welds and clad components, now led by Mr. Hennaut of Belgium, held one meeting this last year. The group is now revising the handbook on inspection of austenitic stainless steel, based on their experiences with the clad handbook, and plans to include a chapter on the ultrasonic inspection of dissimilar welds. The outline for the next edition of the Handbook on the Ultrasonic Examination of Austenitic Welds is: Inservice Inspection, Instrumentation and Data Displays (but not specific to individual companies), Signal Processing, Dissimilar Welds, The Effect of Welding Procedure, and several other topics.

Discussion about revision of the specification for the IIW ultrasonic calibration block continues. The European Union has rejected the initial suggestions that were developed within the IIW, so they may have their own ideas on the organization of the standard. Nevertheless, I forwarded several comments of U.S. experts that were sent to me just before the Annual Assembly by T. Jones, the Chairman of ASTM Committee E07.02.

Mr. Chauveaux of the Institut de Soudure has withdrawn as the chair of the working group on "Automation and Imaging for the Ultrasonic Inspection of Welds" due to the press of other business. Dr. Wustenberg is looking for a new chairman. The primary goal of this working group is to update an old report on automated UT inspection (VC-460-87). The updated document will include descriptions of the recent improvements in digital control and storage capabilities, which greatly strengthen the capabilities of the technique, and provide guidance on the interpretation of the data.

The working group on validation of ultrasonic techniques for weld inspection is following the activities of the European Network for Inspection Qualification (ENIQ). This group is primarily concerned with the nuclear industry, and the working groups hopes to broaden their work to cover general inspection. Details on this program are included on the subcommittee document VC-907-94/OE. In the absence of volunteers willing to develop this idea independently, the IIW activity will occur in conjunction with EN activity.

Last year we had a short discussion about the difficulties in the inspection of electrosag welds by ultrasound. Some issues include the procedures to develop calibration blocks that accurately represent welds, and whether this technique will give similar results to other ultrasonic techniques. K. Verma agreed to develop a position paper on the problems for the next intermediate meeting and will mail it to Prof. Wustenberg by October.

The Europeans are considering the use of ultrasonic time-of-flight diffraction as a method for defect detection and sizing. In the absence of sufficient interest to proceed separately within the IIW membership, future activity will occur in conjunction with the European effort. This may result in a draft standard for ISO balloting.

The future work program of subcommission VC includes:

- Revision of the Handbook on the Examination of Austenitic Welds,
- revision of the IIW document concerning ultrasonic inspection, especially for the IIW calibration block,
- validation of ultrasonic techniques for weld inspection,
- review of automatic ultrasonic inspection methods, and revision of the manual on this topic,
- inspection of electroslag welds, and
- inspection of spot welds.

The next meeting of the subcommission is proposed for Tuesday, January 21, 1997 at the Institut de Soudure. It was suggested that the 1998 meeting once again be planned to be held in conjunction with the ASTM January meeting in Fort Lauderdale.

2.4 Subcommission VE – Weld Inspection Topics Based on Electrical, Magnetic, and Optical Methods

The Subcommittee Chairman, G. Dobmann, presented a review of recent activities (IIW Document V-1066-96).

The subcommittee had one intermediate meeting on December 12, 1995 at the Institut de Soudure in Paris. At that meeting, J. Moulder of the Iowa State University presented his work on eddy current modeling and agreed to prepare an overview paper for the working party that is interested in this topic. The overview paper is expected for the Annual Assembly in San Francisco.

The working party on characterization of black light lamps (chaired by R. Marmigi of Italy) is preparing a document "Technical evaluation of liquid penetrants for hot surfaces in the weld testing field". In the absence of the chairman, Francesco Peri reported their progress. So far, they have evaluated four types of red penetrants at 130°C on aluminum blocks with good success, but have had variable results when used on NiCr test panels. Fluorescent penetrants will be evaluated next. The report should be completed by the next Annual Assembly.

Francesco Peri chairs the working party on characterization of nonmetallic welds. He has prepared and circulated a questionnaire on experimental research and standardization activities, but has received replies from only two countries. The questionnaire will be distributed again to the delegates. Anyone with information to contribute should contact Dr. Peri. We expect to have at least a preliminary report by the next meeting.

A thematic ENRESC (European Network for Residual Stress Characterization) is being organized. Participation is expected from many European institutes, including TWI, The National NDT Centre (Harwell), and IzFP.

The future working program includes:

- Activation of the working party on eddy current (sizing of flaws and replacement of magnetic particle examination, low-frequency application for volumetric inspections) which might be chaired by J. Moulder,
- preparation of a document "Characterization of the Inspection Media for Liquid Penetrant Testing," IIW Recommendations for ISO standardization,
- preparation of a document on the application of liquid penetrant testing in welding, with different annexes that describe the application of this technique for specific industries,
- preparation of a document describing the inspection of hot surfaces with penetrants,
- activation of the working party on non-metallic welds (collection of responses to a questionnaire),
- harmonization of the European initiatives on residual stress measurements, and
- participation in a microseminar on modeling at the 1997 Annual Assembly.

John Moulder of Iowa State University presented his report "Predicting the Performance of Eddy Current Probes," IIW Document V-1067-96. The source of this effort is due to the difficulties in understanding the differences between probes produced by various manufacturers and estimating the sensitivity of a given probe. Some of the causes of these differences are due to the type of ferrite used in the probe, the winding procedure, and even damage of the probe during its use. He described his work with photoinductive calibration. He showed data on five probes (of the same model, and so presumed to be identical) that showed a variation of 375% in field strength. With this data on probe performance, the associated model permits determination of probability of detection curves for these probes. The following discussion brought out how a similar activity for ultrasonic probes 20 years ago led to substantial improvements in probe quality and the common ability to have probes mapped today.

Gerd Dobmann presented the report "Lifetime Extension – The Contribution of a Low and Multifrequency Eddy Current Technique to Assure the Integrity of the Cladding in Nuclear Power Plant Pressure Vessels," IIW Document V-1067-96. He described how economic considerations are driving the inspection of older pressure vessels, to see if they are still suitable for service. Evaluation of these vessels based on fracture mechanics showed that inclusion of the cladding in the stress calculations would substantially increase the resistance to cracking, but this was based on an assumption of cladding of sufficient quality. Their measurement system was designed to determine whether this assumption was valid. The equipment features include the ability to cover the range of 10 Hz to 10 MHz, and a high-speed (10 Mbit/s) serial bus to allow the measurement devices (probes, analog boards, and DSP board) to be separated from the data storage system (PC). He showed the ability of this system to separate measurements of attributes such as delta ferrite content and surface breaching cracks.

Gerd Dobmann also presented the report "Online Closed Loop Control of Spot Welding - An Example of Process integrated Nondestructive Testing," IIW Document V-1068-96. This

technique uses a transmitter and a receiver on the opposing spot welding electrodes to send ultrasonic signals through the weld. This technique shows a reduction, then an increase of the signal during the formation of the weld. A model revealed that this is due to the formation of the nugget (melting), then a change in the phase velocity as the metal continues to heat. For aluminum, the surface oxide adds an additional complexity, but the model can handle this as well. The discussion brought out the fact that this technique has also been proven on galvanized steel.

Pavel Merinov translated a presentation by Anatoly Doubov "Express Method of Weldment Inspection Using Magnetic Metal Memory". This is a new document that will be given a Subcommission VE document number and will be discussed at the next intermediate meeting. This presentation described equipment that is used in Russia to assess the tendency for degradation in a structure before actual defects are detected by the traditional NDE techniques. They propose a round robin with input being accepted until November 1996. The discussion brought out questions about the calibration of the results. Such data could be developed during the round robin.

2.5 Working Group 2 – Inspection of Offshore Welded Constructions

In the absence of the chairman, A. Raine, O Forli presented the annual report of the working group, IIW Doc. V-1070-96. The working group held two intermediate meetings in 1995, one in May and one in September.

The emphasis of the working groups continues to be toward remotely operated vehicles and toward the inspection of topside structural and pressurized components (away from interest in single-diver subsea inspection that had characterized the group in the past). The interest in remotely operated vehicles is being driven by the need to inspect in greater depths and in more dangerous environments, while the interest in the topside structures is being driven by the difficulty in inspecting for corrosion and cracking through lagging and coatings, and in failures in more complex metallic materials. The working group is evaluating inspection parameters for duplex and super-duplex steels and for titanium, as these relatively exotic materials find use in offshore structures.

This year, the working groups have made a number of presentations on offshore NDE including two papers that will be published in Insight (the British Journal of NDE) and three papers submitted to Commission V (Documents V-1071-96 to V-1073-96). In addition, Document V-908-89 "Information on Practices for Underwater Non-Destructive Testing" is being revised.

Trends in offshore inspection include:

- Less underwater inspection, but more topside inspection,
- more extensive use of newer electromagnetic techniques,
- extensive use of remotely operated vehicles,
- cost- or risk-based inspection optimization, and
- the use of high technology materials.

The working program for the group includes:

- Revision of IIW Document V-908-89,
- review of new problem areas and new techniques, such as:
 - personnel qualification systems for offshore NDT,
 - reliability of offshore NDT techniques and compilation of test trial data,
 - comparison of surface inspection techniques,
 - offshore and underwater electromagnetic techniques and applications,
 - underwater NDT equipment,
 - recent developments in automated and remotely operated NDT systems,
 - downhole inspection,
 - recent developments in local and global structural integrity monitoring techniques for offshore structures, and
 - inspection systems, planning and cost optimization, including probabilistic techniques.

2.6 Miscellaneous Commission V Items

In my role as Chairman, I reported on the Commission's activities and accomplishments for the last year. The complete report is available from the Secretariat as IIW Document V-1059-96.

Also in the opening session, O. Forli summarized the Nordtest report "Guidelines for Replacing NDE Techniques with One Another," Nordtest Technical Report 300. It presented a procedure for evaluating the relative sensitivity of two NDE techniques to detection and characterization of a flaw, especially when one of the techniques is novel or unproven. This allows lower cost techniques to replace more expensive techniques. Since NDE involves both detection and characterization, this report compared both the detection and characterization sensitivities of the two techniques. The comparison can be performed at various levels: direct, relative, absolute, and comparison of probability-of-detection curves, with the choice being determined by the similarity of the two techniques and the amount of data that is available. This generated the most spirited discussion of the whole meeting as the various experts tried to point out all the potential problems that might occur if the users of such a concept are not aware of all the subtle shortcomings of each technique. The next step in their work is the development of validation procedures.

We also heard a proposal by the Russian delegate, Nicolai Khimchenko, to translate (from Russian to English) some Russian books that compare the Russian NDE standards to those of other countries, for sale by IIW. The following discussion brought up an important issue: Will these books be of sufficient interest to justify the effort in translation and editing? Another comment was that the comparisons might not be complete. For example, the GOST standards might only be compared to one other international standard, not the standard of the person who might buy the book. At the end of the meeting, the discussion continued and there was the suggestion that we begin this effort within individual subcommissions, as they express interest. This can occur only if we get participation by the Russians at the intermediate meetings. In this case, we could review the progress at the annual meetings, and possibly decide to do a complete translation and review.

Pavel Merinov presented a report from Dr. Gulova of the Russian Delegation "Nondestructive Quality Control of Structures". This report describes the use of multiple inspection techniques (ultrasound, radiography, and acoustic emission) to control the quality of new structures such as a bank building and a large pipeline. They invite cooperation in the future.

3. Resolutions of the Annual Assembly 1996

3.1 Resolution 1

Commission V wants Document V-1074-96 "Weld Quality Degradation at Starts and Stops" transmitted to Commissions IX, X, XI, and SCUW for their information. A revised copy will be submitted in several months.

3.2 Resolution 2

Using digitization for reproducing radiographs is considered an important step forward in making suitable copies in large numbers, but the quality must be maintained. Copies of lower quality may show the features that must be considered when evaluating radiographs, but they are not acceptable for training or similar purposes. The quality of the present reproductions is too poor, and they should not be sold by the IIW until the quality is improved. Subcommittee VA could assist in the review of each batch of reproductions or advise on duplication techniques.

3.3 Resolution 3

Commission V plans to hold a microseminar "Recent Improvements in NDE Modeling" on one morning of the 1997 Annual Assembly. The microseminar will cover modeling of various NDE processes, validation, training, design, and evaluation of results.

3.4 Resolution 4

Commission V forwards documents V-1067-96 on lifetime extension of pressure vessels through eddy current inspection, V-1068-96 on closed-loop control of spot welding, and V-1069-96 on prediction of eddy current probe performance for publication in *Welding in the World*.

3.5 Resolution 5

Subcommittee VB proposes to organize a seminar on the subject "Standards for Quality Management in Welding Shops" at the IIW Annual Assembly in Hamburg, Germany. Subcommittee VB asks CRNORM for cooperation.

4. Work Program of Commission V

4.1 Subcommission VA – Radiography-Based Weld Inspection Topics

Subcommission VA will concentrate on the following:

- Classification of film systems;
- completion of a standard on radiosopic systems: The Working Party is preparing a three-part standard about the properties and use of radiosopic systems for weld inspection. There will be an experimental phase to evaluate the practicality of the standard. After completion of parts 1 and 2, drafting of part 3 remains,
- revision of ISO standards: Subcommission VA supports ISO TC 44 and TC 135 with text proposals for the revision of weld inspection standards, such as the current review of ISO 5817,
- assessment of reliability of radiography: New statistical tools (Receiver Operation Characteristic, ROC) will be applied to the question of a quantitative assessment of radiography,
- evaluation of NDT acceptance criteria in relation to weld quality classes,
- examination of the new collection of reference radiographs for welds prepared by the German Welding Society and evaluation of its suitability as a basis for a new IIW reference collection,
- digitization of film.

4.2 Subcommission VB – Quality Management in Welding Technology

Subcommission VB will concentrate on the following:

- Formulation of a concept for quality management in welding (to clarify the relationship between existing standards and to investigate the need for new standards),
- formulation of a guideline for quality management in welding (to help the user select a quality management program adequate for their organization),
- collection of information on computer-aided quality control, on-line weld monitoring, fitness for purpose, and acceptance criteria in welding (to define the need for further support in applying these tools).

4.3 Subcommission VC – Ultrasonically Based Weld Inspection Topics

Subcommission VC will concentrate on the following:

- Validation of ultrasonic techniques for weld inspection.
 - collection of all available information on studies of the performance of NDT (PISC, Nordtest, Institute de Soudure, NIL) and compilation of results from such studies,
 - identification of main application areas for validation programs,
 - definition of the structure of a typical validation program and presentation of the results of the validation,

- characterization of ultrasonic probes for weld inspection,
- preparation of a revised manual for the ultrasonic inspection of ferritic welds (based on the experience gained during the preparation of the new European standard),
- assessment of modern imaging techniques for automatic ultrasonic inspection methods and their importance for the weld inspection,
- clarification and verification of use of the IIW ultrasonic calibration block,
- assessment of on-line weld monitoring by ultrasonic methods,
- collaboration with Subcommittee VA on the review of ISO 5817.

4.4 Subcommittee VE – Weld Inspection Topics Based on Electrical, Magnetic, and Optical Methods

Subcommittee VE will concentrate on the following:

- Numerical modeling studies on electric, magnetic, and electromagnetic techniques of NDT for defect detection and sizing in austenitic cladding. The working party in question has agreed upon a near-future research program to compare the software packages that are in use,
- round-robin action on residual-stress measurement techniques,
- testing of nonmetallic weldments and preparation of an IIW document on the topic,
- liquid-penetrant inspection of welds, including the preparation of an IIW document to summarize the state of standardization for characterization of black-light lamps.

For 1994/96 the work has concentrated on the following:

- Activation of the Eddy-Current Working Party. Topics are: surface examination of ferritic welds, including sizing and replacement for magnetic-particle examinations, low-frequency application for volumetric inspections, i.e., of austenitic cladding or aluminum weldments,
- preparation of either written recommendations or a handbook on the characterization of black-light equipment,
- preparation of a document on the application and the procedure of the inspection of hot weldments by using liquid penetrants,
- preparation of a document on the characterization of the inspection media for the inspection of hot weldments by liquid penetrants,
- preparation of a document on the relative fluorescence-intensity measurements (low-cost equipment for on-site applications),
- preparation of a document on the use of the meniscus test for penetrants by image processing,
- thermography for surface inspection and welding process control,
- activation of the Working Party on the inspection of nonmetallic weldments;
- reconciliation of European initiatives on residual-stress measurements.

4.5 Subcommission VF – Weld Defects and Their Significance

No work is planned for 1996/97, apart from necessary follow-up work related to *IIW Guidance on Assessment of the Fitness for Purpose* (SST-1141-89).

4.6 Working Group 2 – Inspection of Offshore Welded Constructions

Working Group 2 will concentrate on the following:

- Revision of "Information on Practices for Underwater Non-Destructive Testing," IIW V-908-89 (IIS/IIW-1033-89),
- review of special problem areas, new techniques, and applications; collection and organization of information of general interest; report to IIW, if appropriate, in the form of guideline or recommendation proposals. This work shall include, but not be limited to the following topics:
 - reference documents on NDT of offshore constructions,
 - personnel qualification schemes for underwater NDT,
 - reliability of offshore NDT techniques and compilation of trial results,
 - comparative evaluation of surface techniques and the preparation of guidelines,
 - examination of offshore, underwater eddy-current tests and the preparation of a "green paper,"
 - fabrication versus in-service NDT of offshore constructions,
 - underwater NDT equipment,
 - recent developments in automated and remotely operated NDT for offshore use,
 - preparation of a survey of ongoing and planned developments and existing equipment,
 - downhole inspection,
 - pipeline inspection,
 - recent developments in local and global structural-integrity monitoring techniques for offshore constructions,
 - inspection systematics, planning, cost effectiveness, and optimization, including the use of probabilistic assessment.

Appendix A. Organization, Officials, and Delegates

A.1 Organization of IIW Commission V, Quality Control and Quality Assurance of Welded Products

A.1.1 Subcommissions

- VA Radiography-Based Weld Inspection Topics
 - Working Parties
 - Classification of Film Systems
 - Radioscopic Systems for Weld Inspection
 - Validation of Radiographic Techniques for Weld Inspection
 - Revision of ISO Standards
- VB Quality Management in Welding Technology
- VC Ultrasonically Based Weld Inspection Topics
 - Working Parties
 - Ultrasonic Examination of Austenitic Welds
 - Validation of Ultrasonic Techniques for Weld Inspection
 - Characterization of Ultrasonic Probes for Weld Inspection
- VE Weld Inspection Topics Based on Electrical, Magnetic, and Optical Methods
 - Working Parties
 - Stress Measurement Techniques
 - Liquid Penetrants and Black-light Lamps
 - Eddy-Current Modeling
 - Inspection Techniques for Nonmetallic Joints
- VF Weld Defects and Their Significance

A.1.2 Working Group

- 2 Inspection of Offshore Welded Construction

A.2 Officials of the International Institute of Welding

CHIEF EXECUTIVE

M. Bramat

Institut International de la Soudure
 PARIS NORD II
 90 rue des Vanesses
 BP 50362
 F-95942 Roissy CDG Cedex
 France
 Tel. +33 1 49 90 36 00
 Fax +33 1 49 90 36 80

A.3 Officials of Commission V

CHAIRMAN

Thomas A. Siewert

National Institute of Standards and Technology
 NIST - Mail Code 853
 325 Broadway
 Boulder, Colorado 80303
 USA
 Tel. +1 303 497 3523
 Fax +1 303 497 5030
 e-mail thomas.siewert@nist.gov

CHAIRMAN, SUBCOMMISSION VA

Heinrich Heidt

MFPA Weimar an der Hochschule für
 Architektur und Bauwesen
 Amalienstrasse 13
 D-99429 Weimar
 Germany
 Tel. +49 30 3643 564 301
 Fax +49 30 3643 564 201/302

CHAIRMAN, SUBCOMMISSION VC

Herman Wüstenberg

Bundesanstalt für Materialprüfung
 Unter den Eichen 87
 D-12205 Berlin
 Germany
 Tel. +49 30 81046210
 Fax +49 30 811202
 Telex 183261 bamb d

VICE-CHAIRMAN

Michel Rousseau

Institute de Soudure
 PARIS NORD II
 90 rue des Vanesses
 BP 50362
 F-95942 Roissy CDG Cedex
 France
 Tel. +33 1 49 90 36 00
 Fax +33 1 49 90 36 50

CHAIRMAN, SUBCOMMISSION VB

Peter Kunzmann

Schweizerischer Verein für Schweißtechnik
 St. Alban-Rheinweg 222
 CH-4052 Basel
 Switzerland
 Tel. +41 61 317 84 84
 Fax +41 61 317 84 80

CHAIRMAN, SUBCOMMISSION VE

Gerd Dobmann

Fraunhofer-Institut für Zerstörungsfreie
 Prüfverfahren
 Universität, Gebäude 37
 D-66123 Saarbrücken
 Germany
 Tel. +49 681 3023855
 +49 681 3023801
 Fax +49 681 39580
 Telex 4421328 izfp d

CHAIRMAN, SUBCOMMISSION VF

Birger Hansen

FORCE Institutes
Park Allé 345
DK-2605 Brøndby
Denmark
Tel. +45 42968800
Fax +45 42962636
Telex 33388 svc dk

CHAIRMAN, WORKING GROUP 2

G. Alan Raine

Technical Software Consultants Ltd.,
Northern Office
Hawthorn House
7 Tollgate Road
Hamsterley Mill, Rowlands Gill
Tyne and Wear NE39 1HF
England, United Kingdom
Tel. +44 207 542 860
Fax +44 207 542 860

A.4 Honorary Members of Commission V**Jacques Dubresson**

23 Rue Volta Prolongée
F-92400 Courbevoie
France

Ronald Halmshaw

49 Crouchcroft
New Eltham
London SE9 3HX
England, UK

Hans-Jürgen Meyer

Klosterweg 111
D-90455 Nürnberg
Germany
(April–September and December)

P.O. Box 1455
ZA Manaba 4276
Republic of South Africa
(October–November and January–March)

Roy Sharpe

British Institute of NDT
1 Spencer Parade
Northampton NN1 5AA
England, UK

A.5 National Delegates to Commission V

In the following list of delegates, the IIW member association is given followed by the delegate's business address, if different.

ARGENTINA

J. L. Otegui

Fundacion Latinoamericana de Soldadura
Calle 18, No 4113
1672 Villa Lynch
Buenos Aires
Argentina
Tel. +54 1 753 4039
Fax +54 1 755 1268

AUSTRALIA

J. C. S. Bowler

Welding Technology Institute of Australia
Unit 3, Suite 2
9 Parramatta Road
Lidcombe, P.O. Box 28
NSW 2141, Australia
Tel. +61 2 748 4443
Fax +61 2 748 2858

business address:

4 Far View Ave.
Riverside
Tasmania 7250
Australia
Tel. +61 03 432133
Fax +61 03 448990

AUSTRIA

T. Varga

Österreichische Gesellschaft für
Schweisstechnik
Arsenal, Objekt 12
A-1030 Vienna
Austria
Tel. +43 1 798 21 68
Fax +43 1 798 21 6815

business address:

TU VIEN

1040 Wien, Karlplatz 13
Austria
Tel. +43 1 58801 3431
Fax. +43 1 5878196

BELGIUM

J. Charlier

Institut Belge de la Soudure
21 Rue des Drapiers
1050 Brussels
Belgium
Tel. +32 2 512 2892
Fax +32 2 512 7457

business address:

Universite Libre de Bruxelles
Faculté des Sciences Appliquées
50 Avenue Roosevelt
1050 Bruxelles
Belgium
Tel. +32 2 642 2791/2723/2793

BRAZIL

C. Wahba

Brazilian Committee of IIW
 Rua Sao Francisco Xavier 601
 Maracana
 20550-040 Rio de Janeiro - RJ
 Brazil
 Tel. +55 21 254 0203
 Fax +55 21 284 2191

business address:

BARDONI ATB IND..
 METALMECANICA S/A
 Rua Arlindo Bettio s/n.
 03828-000 Sao Paulo - SP
 Brazil
 Tel +55 11 702 2111
 Telex 1171560-1171636 abbx

BULGARIA

A. Skordev

National Welding Society
 Union of Mech. Engr. of Bulgaria
 Rakovski Street 108, POB 431
 Sofia 1000
 Bulgaria
 Tel. +359 2 877290
 Fax +359 2 879360

business address:

Head of Central Laboratory on NDT
 Central Institute of Mechanical Engineering
 12 Ho-Chi-Minh Boulevard
 Sofia 1574
 Bulgaria
 Tel. +359 2 723821

CANADA

(no nomination)

Canadian Council of the IIW
 391 Burnhamthorpe Road East
 Oakville, Ontario L6J 6C9
 Canada
 Tel. +1 905 257 9881
 Fax +1 905 257 9886

CHILE

(no nomination)

Centro Tecnico Chileno de la Soldadura
 Camino a Melipilla 7060
 P.O. Box 13850, Santiago
 Chile
 Tel. +56 2 571 777
 Fax +56 2 557 3471

CHINA

S. Li

Chinese Welding Society
 111 Hexing Lu
 Harbin 150080
 China
 Tel. +86 451 6322012
 Fax +86 451 6325871

CROATIA

Z Lukacevic

Croatian Welding Society
 Dure Salaja 1
 41000 Zagreb
 Croatia
 Tel. +385 41 512 689
 Fax +385 41 512 689

business address:

Mechanical Engineering Faculty
 Trg. I.B. Mazuranic
 35000 Sl. Brod
 Croatia
 Tel. +385 35 446 188
 Fax. +385 35 446 446

CZECH REPUBLIC

(no nomination)

Czech Welding Society
 Novotneho lavka 5
 110 01 Praha 1
 Czech Republic
 Tel. +42 2 23 10 124
 Fax +42 2 26 18 97

DENMARK

W. D. Kristensen

FORCE Institutes
 Park Allé 345
 DK-2605 Brøndby
 Denmark
 Tel. +45 43968800
 +45 42968446
 Fax +45 43962636
 Telex 33388 svc dk

EGYPT

(no nomination)

B. Zaghoul
 Central Metallurgical R&D Institute
 P.O. Box 87
 Helwan – Cairo
 Egypt
 Tel. + 20 790775
 Fax + 45 43 96 2636

FINLAND

P. Kopiloff

Suomen Hitsausteknillimen Yhdistys RY
 Mäkelänkatu 36 A2
 SF-00510 Helsinki
 Finland
 Tel. +358 0 773 2199
 Fax +358 0 773 2661

business address:

NDT Tekniikka Oy
 Teollisuustie 9 B
 SF-02700 Kauniainen
 Finland

FRANCE

M. Rousseau

Institut de Soudure
 PARIS NORD II
 90 rue des Vanesses
 BP 50362
 F-95942 Roissy CDG Cedex
 France
 Tel. +33 1 49 90 36 00
 Fax +33 1 49 90 36 50

GERMANY

G. Dobmann

Deutscher Verband für Schweißtechnik e.V.
 Postfach 10 19 65
 400010 Düsseldorf
 Germany
 Tel. +49 211 1 59 10

business address:

Fraunhofer-Institut für Zerstörungsfreie
 Prüfverfahren
 Universität, Gebäude 37
 D-66123 Saarbrücken
 Germany
 Tel. +49 681 3023855
 Fax +49 681 39580

GREECE

A. Tzogios

Hellenic Institute of Welding Technology
 c/o V. J. Papazoglou
 P.O. Box 64070
 GR-15710 Zografos
 Greece
 Tel. +30 1 7700671
 Fax +30 1 7759213
 Telex 221682 ntua gr

HUNGARY

F. Fucsok

Gepipari Tudományos Egyesület
 Fo utca 68
 P.O. Box 433
 1371 Budapest
 Hungary
 Tel. +36 1 202 0582
 Fax +36 1 202 0252
 Telex 225792

IRAN

B. Chobak

The Iranian Institute of Welding and NDT
 P.O. Box 14155-4686
 Tehran
 Iran
 Tel. +98 21 834 715
 Fax + 98 21 651 809

business address:

IRAN ITOK Engr. and Tech. Co.
 Technical Inspection Department
 24 Idgah Alley, Karegar Shomali St.
 Tehran 14146
 Iran

ISRAEL

G. Kohn

Israel Metallurgical Society
 Israel Institute of Metals
 Technion City
 P.O. Box 4910
 Haifa, 32000
 Israel
 Tel. +972 4 23 5104
 Fax +972 4 22 1581

business address:

Rotem Industries Inc.
 P.O. Box 9046
 Beer-Sheva, 84190
 Israel
 Tel. + 972-7-567877
 Fax + 972-7-554502

ITALY

G. Calcagno

Istituto Italiano Saldatura
 Lugobisagno Istria 15
 I-16141 Genova
 Italy
 Tel. +39 10 83411
 Telex 283054 saldis i

JAPAN

T. Kishi

Japan Institute of Welding
 1-11 Kanda Sakuma-Cho
 Chiyoda-ku
 Tokyo 101
 Japan
 Tel. +81 33253 0488
 Fax +81 33253 3059

KOREA

(no nomination)

The Korean Welding Society
 P.O. Box 6
 Daeduk Science Town
 Dae-jon 305-343
 Korea
 Tel. +82 42 861 2696
 Fax +82 42 861 1172

MEXICO

(no nomination)

Colegio de Ingenieros Mechanicos
 y Electricistas
 Oklahoma 89
 CP 03810
 Mexico D.F.
 Mexico
 Tel. + 52 5 5231123
 Fax + 52 5 5437902

THE NETHERLANDS

A. Arun Junai

Nederlands Instituut voor Laastechniek
Krimkade 20
NL-2251 KA Voorschoten
The Netherlands
Tel. +31 71 61 12 11
Fax +31 71 61 14 26

business address:

Production Technology Department
TNO Institute of Production and Logistics
Research
Apeldoorn Branch
PO Box 541
NL-7300 AM Apeldoorn
The Netherlands
Tel. +31 55 49 30 71
Fax +31 55 49 31 08

NEW ZEALAND

P. Hayward

New Zealand Welding Committee
HERA House, 17-19 Gladding Place
P.O. Box 76-134
Manukau City, Auckland
New Zealand
Tel. +64 9 2622885
Fax +64 9 2622856

business address:

Certification Board for Inspection Personnel
HERA House, 17-19 Gladding Place
P.O. Box 76-134
Manukau City, Auckland
New Zealand
Tel. +64 9 2622885
Fax +64 9 2622856

NORWAY

O. Førli

Norsk Sveiseteknisk Forening
P.O. Box 7072 Homannbyen
N-0603 Oslo
Norway
Tel. +47 22 46 58 20
Fax +47 22 46 18 38

business address:

Det norske Veritas Industry AS
Veritasveien 1
N-1322 Høvik
Norway
Tel. +47 67 57 88 33
+47 67 57 72 50
Fax +47 67 57 74 74
Telex 76192 verit n

POLAND

T. Wnek

Instytut Spawalnictwa
16/18 ul BI Czeslawa
44-100 Gliwice
Poland
Tel. +48 32 31 0011
Fax +48 32 31 4652

PORTUGAL

A. Lopes Pereira

Instituto de Soldadura e Qualidade
Estrada Nacional 249 - km 3
Cabanas/Leiao (Taguspark)
Apartado 119
2781 Oeiras Codex
Portugal
Tel. +351 1 4211307
+351 1 4429649
Fax +351 1 4211406

business address:

Estrada da Luz; 169; 5E
1600 Lisbon
Portugal

ROMANIA

(no nomination)

Institute of Welding and Materials Testing
 Bv Mihai Viteazul Nr 30
 1900 Timisoara
 Romania
 Tel. +40 56 191827
 Fax +40 56 192797

RUSSIA

N. Khimchenko

The Russian Welding Society
 Volgogradsky p., 41
 109316, Moscow
 Russia
 Tel. +095 173 98 21
 Fax. +095 173 07 87

SLOVAKIA

P. Pálffy

Vyskumny Ustav Zvaracsky
 Racianska 71
 832 59 Bratislava
 Slovakia
 Tel. +42 7 279 6111
 Fax +42 7 254 867

SLOVENIA

G. Rihar

Zveza Drustev Za Varilno
 Tehniko Slovenije
 Ptujjska 19
 61000 Ljubljana
 Slovenia
 Tel. +386 61 221 631
 Fax + 386 61 349 282

SOUTH AFRICA

(no nomination)

South African Institute of Welding
 Western Boulevard, off Main Reef Rd.
 City West, Johannesburg
 P.O. Box 527
 Crown Mines, 2025
 South Africa
 Tel. +27 11 836 4121
 Fax +27 11 836 4132

SPAIN

German Hernandez

c/o CESOL
 C/ Maria de molina, 62, 8 A
 28006 Madrid
 Spain
 Tel. +34 (9)1 562 49 12
 Fax +34 (9)1 411 03 70

SWEDEN

C. Johansson

Svetskommissionen IVA
 Box 5073
 S-102 42 Stockholm
 Sweden
 Tel. +46 8 7912900
 Fax +46 8 679 9404
 Telex 17172 iva s

business address:

SAQ Kontroll AB
 Bultvagen 1
 S-45175 Uddevalla
 Sweden
 Tel. +46 522 12041
 Fax +46 522 30520
 Telex 2524 swetest s

SWITZERLAND

P. Kunzmann

Schweizerischer Verein für Schweißtechnik

St. Alban-Rheinweg 222

CH-4052 Basel

Switzerland

Tel. +41 61 317 84 84

Fax +41 61 317 84 80

UKRAINE

Yu. K. Bondarenko

National Welding Committee

E. O. Paton Welding Institute

Bozhenko Str. 11

252 650 Kiev-5

Ukraine

Tel. +7 044 227 4288

Fax +7 044 268 0486

Telex 131139 radok su

UNITED STATES

T. Siewert

American Council of IIW

550 NW LeJeune Road

P O Box 351040

Miami, Florida 33135

USA

Tel. +1 305 443 9353

Fax +1 305 443 7559

Telex amweld soc 519245

business address:

Materials Reliability Division

NIST - Mail Code 853

325 Broadway

Boulder, CO 80303

USA

Tel +1 303 497 3523

Fax +1 303 497 5030

E-mail thomas.siewert@nist.gov

UNITED KINGDOM

G. Alan Raine

UK Section of the IIW

The Welding Institute

Abington Hall

Abington, Cambridge CB1 6AL

United Kingdom

Tel. +44 223 891162

Fax +44 223 894180

Business address:

Technical Software Consultants Ltd.,

Northern Office

Hawthorn House

7 Tollgate Road

Hamsterley Mill, Rowlands Gill

Tyne and Wear NE39 1HF

England, United Kingdom

Tel. +44 207 542 860

Fax +44 207 542 860

A.6 Attendance Record – Annual Assembly 1996

Name	Country	Function	4 Sept.	5 Sept.	6 Sept.
Siewert, T.	USA	Commission Chairman/Delegate	×	×	×
Varga, T.	Austria	Delegate	×		×
Staufner, H.	Austria	Observer	×	×	
Resch, M.	Austria	Observer		×	×
Charlier, J.	Belgium	Delegate	×	×	
Wu, L.	China	Delegate			×
Li, Y.	China	Expert			×
Lukacevic, Z.	Croatia	Delegate	×	×	×
Metwally, W.	Egypt	Delegate			×
Kopiloff, P.	Finland	Delegate	×	×	×
Lindewald, C.-G.	Finland	Expert	×	×	
Salmi, J.	Finland	Observer	×		
Dobmann, G.	Germany	Delegate/Chairman VE	×	×	×
von Hofe, D.	Germany	Expert	×	×	×
Wustenberg, H.	Germany	Expert/Chairman VC	×	×	
Szelagowski, P.	Germany	Expert	×	×	×
Weeber, H.	Germany	Expert	×	×	×
Fucsok, F.	Hungary	Delegate	×	×	×
Peri, F.	Italy	Expert	×	×	×
Pistone, V.	Italy	Observer		×	
Hour, M.	Italy	Expert		×	
Scasso, M.	Italy	Expert	×		
Chobak, B.	Iran	Delegate	×		×
Jeong, G.	Korea	Observer		×	
Junai, A.	The Netherlands	Delegate		×	×
Heerings, J.	The Netherlands	Observer		×	
Forli, O.	Norway	Delegate	×	×	×
Khimchenko, N.	Russia	Delegate	×	×	×
Dubov, A.	Russia	Expert	×	×	×
Merinov, P.	Russia	Expert	×	×	×
Gurova, G.	Russia	Expert	×		×
Sormin, F.	Russia	Expert	×	×	
Statnikov, E.	Russia	Observer	×		
Chernyeh	Russia	Observer		×	
Rihad, G.	Slovenia	Delegate		×	×
Johansson, C.	Sweden	Delegate	×	×	×
Dellby, O.	Sweden	Observer		×	
Kunzmann, P.	Switzerland	Delegate/Chairman VB	×	×	×
Lodanov, L.	Ukraine	Observer	×		
Verma, K.	United States	Expert	×	×	×
Tahash, G.	United States	Expert	×	×	×
DeNale, R.	United States	Observer	×	×	
Moulder, J.	United States	Expert	×	×	×

A.6.1 Attendance statistics

	4 Sept.	5 Sept	6 Sept	Any day
Participants:	31	33	27	43
Delegates:	11	12	15	16
Experts:	14	13	11	16
Observers:	6	8	1	11
Countries present	14	15	16	19

A.7 Subcommittee and Working Group Meetings 1995/97

Subcommission VA	13 January 1995	Fort Lauderdale, Florida, USA
	21 January 1997	Paris, France
Subcommission VB	17 March 1995	Basel, Switzerland
	23 January 1997	Paris, France
Subcommission VC	12 January 1995	Fort Lauderdale, Florida, USA
	12 December 1995	Paris, France
	20 January 1997	Paris, France
Subcommission VE	13 January 1995	Fort Lauderdale, Florida, USA
	13 December 1995	Paris, France
	22 January 1997	Paris, France
Subcommission VF	No meetings	
Working Group 2	4 May 1995	London, UK
	8 September 1995	Aberdeen, UK

A.8 Tentative Schedule for Commission V Meetings 1997/98

Tentative dates and places for subcommission and working group meetings in 1997/98 and for the Annual Assembly are:

Subcommission VA	January 1998	Paris, France
	January 1999	Fort Lauderdale, Florida, USA
Subcommission VB	June 1998	Paris, France
	January 1999	Fort Lauderdale, Florida, USA
Subcommission VC	January 1998	Paris, France
	January 1999	Fort Lauderdale, Florida, USA
Subcommission VE	January 1998	Paris, France
	January 1999	Fort Lauderdale, Florida, USA
Subcommission VF	No meetings	
Working Group 2	1997/1998/1999	UK
Annual Assembly	16 to 18 September 1998	Hamburg, Germany (Microseminar on standards in welding technology)
	1999	Portugal (Microseminar on influence of automation on acceptance criteria)

Appendix B. Recent Commission V Publications and Documents

B.1 Handbooks and Booklets

- V-939-90 *Handbook on the Ultrasonic Examination of Austenitic Clad Materials*
(IIS/IIW-1080-90)
Published by the CEC Joint Research Establishment, Ispra, Italy, 1994

B.2 *Welding in the World* Articles

- V-1034-94 “The Status of NDT Technology used for Welded Structures in China,” Shengtian Li and Zhihua Liu, (IIS/IIW 1245-94) *Welding in the World*, 35, no. 4, 1995.
- V-1035-94 “Characterization of Black Light Equipment: Critical Factors and Supporting Data,” (IIS/IIW 1247-94) *Welding in the World*, 36, no. 3, 1996.
- V-1044-94 “Welding Technology Margin and its Application in Welding Quality Assurance,” Zhihua Liu, Keqin Li, and Haojun Jiao, (IIS/IIW 1246-94) *Welding in the World*, 35, no. 6, 1995.

B.3 Commission V Documents 1995/96

Number	Title/Document Description
V-1055-95	Minutes of the Annual Assembly Meeting - 14 June 1995
V-1056-95	<i>Reference Radiographs for Assessment of Welding Imperfections according to ISO 5817</i> , introductory text for a new radiograph set proposed by Subcommittee VA
V-1057-95	Minutes of the Annual Assembly Meeting - 15 June 1995
V-1058-95	Minutes of the Annual Assembly Meeting - 16 June 1995
V-1059-96	Commission V Annual Report - 1995/96
V-1060-96	Agenda for 1996 Annual Assembly - Budapest
V-1061-96	Commission V Documents - 1995/96
V-1062-96	<i>Guidelines for Replacing NDE Techniques with One Another</i> , O. Førli, et al., Nordtest Technical Report 300
V-1063-96	Subcommittee VA Annual Report
V-1064-96	Subcommittee VB Annual Report
V-1065-96	Subcommittee VC Annual Report
V-1066-96	Subcommittee VE Annual Report
V-1067-96	"Lifetime Extension - The Contribution of a Low and Multifrequency Eddy Current Technique to Assure the Integrity of the Cladding in Nuclear Power Plant Pressure Vessels," G. Dobmann, R. Becker, M. Disqué, Ch. Rodner, and N. Both
V-1068-96	"Online Closed Loop Control of the Spot Welding - an Example of PINT (Process Integrated Nondestructive Testing)," E. Waschkes, to be published in <i>Schweissen and Schneiden</i> , October 1996.
V-1069-96	"Predicting the Performance of Eddy Current Probes," John Moulder and Norio Nakagawa
V-1070-96	Working Group 2 Annual Report
V-1071-96	"NDT Offshore: A Review," O. Førli and G.A. Raine
V-1072-96	"ROV Weld Inspection – The Next Stage," Alan Raine

- V-1073-96 "ROV Inspection of Welds – A Reality," G.A. Raine and M.C. Lugg
- V-1074-96 "Weld Quality Degradation at Starts and Stops," Z. Lukacevic and I. Mazuranic

B.4 Documents Recommended for Publication

1995 Assembly

Commission V recommends that the DVS Reference Radiograph set be adopted as the newest IIW reference radiograph set for use with ISO 5817. The new set will be titled "Reference radiographs for assessment of weld imperfections according to ISO 5817" and should be identified as IIW Document number V-1056-95, a class B document.

The older sets (both radiographs and a printed book, as listed in the IIW catalog) shall continue to be offered for sale.

Resolution 2 at the 1996 Annual Assembly discussed mandatory changes in the radiograph duplication techniques before the radiographs were suitable for sale.

1996 Assembly

Commission V forwards documents V-1067-96 on lifetime extension of pressure vessels through eddy current inspection, V-1068-96 on closed loop control of spot welding, and V-1069-96 on prediction of eddy current probe performance for publication in *Welding in the World*.

B.5 Sales of Commission V Documents

	<u>1995</u>	<u>1994</u>	<u>1993</u>	<u>1992</u>	<u>1991</u>
<i>Collection of Reference Radiographs of Butt Welds in Steel</i>	*	*	67	111	74
<i>Collection of Reference Radiographs of Butt Welds in Aluminum and Aluminum Alloys</i>	*	20	22	21	16
<i>Reference Radiographs (Blue Booklet)</i>					
English/French	*	2250	274	3252	56
English/French/3rd language			30	310	134
<i>Handbook on Radiographic Apparatus Techniques</i>					
English	33	19	24	47	60
French	48	53	123	54	166
Swedish	*	0	10	5	5
<i>List of Terms Used in the Ultrasonic Examination of Welds</i>	*	*	2	3	3
<i>Handbook on Ultrasonic Examination of Welds</i>					
English	19	33	38	39	75
French	44	76	33	8	83
Dutch	0	0	0	0	15
Finnish					
<i>Handbook on the Ultrasonic Testing of Austenitic Welds</i>					
English	3	3	43	26	26
French	0	52	3	3	4
German	1	12	31	7	31
<i>Evaluation of Ultrasonic Signals</i>	12	41	10	35	55
<i>Handbook on the Magnetic Examination of Welds</i>	6	77	29	45	23
<i>Automated Ultrasonic Weld Inspection</i>	*	*	*	*	*
<i>Guidelines for Quality Assurance in Welding Technology</i>	18	15	64	44	173
<i>IIW Guidance on Assessment of the Fitness for Purpose (SST-1141-89)</i>					
English	0	9	61	43	169
<i>Non-destructive Measurement and Analysis of Residual Stress in and around Welds — A State of the Art Survey (V-847-87)</i>	0	71	330		
Total items sold	<u>184</u>	<u>2731</u>	<u>953</u>	<u>4053</u>	<u>1168</u>

* information not available

