

COMMISSION V - IIW  
**QUALITY CONTROL AND QUALITY ASSURANCE  
OF WELDED PRODUCTS**

## INTRODUCTION

The Indian Institute of Welding (IIW) a professional body, was established in the year 1966 with the objectives of providing focus on academic, research, industry and Government interactions and evolving cohesive approaches to develop and adopt the best welding technologies relevant to national needs.

Indian Institute of Welding has 16 Technical Commissions dealing with various aspects of Welding Technology.

### Commission V of IIW

Commission V of IIW deals with Quality Control and Quality Assurance of welded products. The objectives of the commission are :

1. Evolving relevant research and development programmes related to the subject matter of the Commission.
2. Writing of Abstracts of International Welding documents pertaining to Commission V and publish them in Indian Welding Journal.
3. Planning and Attracting Technical articles to International Institute of Welding for publication as documents.
4. Planning and attracting technical articles in Indian Welding journal.
5. Dissimination of information to members.

International Institute of Welding periodically sends original documents pertaining to activities of Commission V and these documents are carefully read in detail and the essence of the document is written as abstracts. From 1990 to 1994 Commission V of Indian Institute of Welding has published 50 abstracts in the Indian Welding Journal pertaining to Quality Control and Quality Assurance of welded products.

The topics covered are various NDT techniques, failure analysis, quality systems and certification, quality assurance, quality control etc.

### Quality Assurance and Quality Control (10 Documents)

A strategy has been evolved for individual standards implementation in the quality arena.

Brazilian Government has announced a new policy for the quality and productivity of Brazilica products and services. It deals with industrial strategy, market restrictions, quality system, standardisation and motivation for quality and productivity, training programmes and certification of laboratories.

ISO/DIS 9712 referred by DOC V 957 specifies the general principles for the supervision of welding both in the workshop and on site. It also deals with qualification and certification of NDT personnel.

Demand for computer aided quality system has considerably increased because of the advantages of increased quality, quick information

about the status of orders, repair work and quick delivery of final inspection certificates and high reduction of costs.

### Failure Analysis (1 Document)

Failure Mode and Effective Analysis (FMEA) has been identified as powerful technique to integrate the many factors involved and to review the design, manufacture and quality control aspects. The basic objective is to prevent inservice failures.

### Ultrasonic Testing (14 Documents)

Good agreement has been achieved in inspection of adhesion strength of protective and clad coatings by the ultrasonic and thermal methods.

Round robin test conducted by Dutch Welding Institute revealed that the rejection rate of unacceptable defects during manual ultrasonics was high and large. Variations and inconsistencies between results of various operators were found. Recommendations for better reliability with respect to probes, flaw detectors, operational procedures have been suggested.

PISC parametric studies were performed aiming to evaluate the effect of large number of variable parameters of a UT testing system and their influence on detection location and sizing of defects.

NDT Centre, Harwell has done some works on the application of UT to the characterisation of the melt pool and defect detection during welding of stainless steel and ferritic steels. It is concluded that an ultrasonic in-

strument that is capable of on line signal averaging is essential for an adequate signal/noise ratio.

IIW Commission V has come out with a draft handbook on the UT of austenitic clad materials. This book describes the problems and recommendations for examining austenitic clad materials.

Problems of developing the integrated microcomputer based system for UT of weldments have been highlighted.

Brazilian Society for NDT have come out with a programme on reliability of ultrasonic inspection. Parameters taken are amplitude of the echo, location of defect, determination of length of defect and identification of defects etc.

#### **Quality System Assessment and Certification (5 Documents)**

Global concept for testing and certification has been achieved through European Harmonisation CEN/CENLEC Activities. These activities are intended to improve the quality of the products, the production pro-

cesses and the testing and certification methods.

#### **FLUORESCENT PENETRANTS (3 DOCUMENTS)**

##### **Qualitative test have been conducted**

Qualitative test have been conducted for evaluation and characteristic of black light lamps and fluorescent penetrants. These were done evaluate quantitatively the reliability and sensitivity of the inspections.

Documents have been published on the problem of penetrant fluorescence measurement and on white light intensity effects on the fluorescent penetrant indications seeability under ultra violet light.

##### **Radiography (3 Documents)**

Documents have been published on the design of a new type of Image Quality Indication (IQI) consisting of a thin high density coating over a low density material. The new IQI has symmetrical shape which provide for rotational variance about two axes, high attenuating edges for easier detection and size independent of

orientation so that the magnification of the image can be calibrated.

Relative Operating Characteristics (ROC) method for assessing the accuracy of an RT inspection system has come into practice. This will indicate the accuracy of detection due to different detection methods of one equipment as well as to evaluate the performance of various inspection equipments or detection methods.

Other documents deal with residual stress measurement, insitu metallography and annual reports of various subcommissions.

**Table I** gives the entire list of Abstracts of documents and **Annexure I** gives the Abstracts.

The original documents are available for reference with Chairman, Commission V and can be obtained at the following address.

**Dr. Baldev Raj**  
Chairman, Commission V  
Indian Institute of Welding  
Director, Metallurgy & Materials Group  
IGCAR, Kalpakkam 603 102.

### *A request from the EDITOR*

Dear Readers,

We are inviting you to send articles on Welding and Allied Technology for publication in the forthcoming issues of the Indian Welding Journal as per guidelines.

Paper should be neatly typed on **Electronic Typewriter in double spacing in A4 size paper**. All photography should be of **140 X 85 mm**. Sketches and Graphs to be neatly drawn on tracing papers with **25 mm** margin on all sides. Sketches, Graphs, Photographs should be serially numbered with appropriate reference in the body of the paper.

Your prompt response on this matter should be appreciated.

Regards

-- Editor

**Table - I**  
**LIST OF ABSTRACTS OF IIW DOCUMENT**  
**SUBJECT : QUALITY CONTROL, QUALITY ASURANCE AND CERTIFICATION**

<b>Sl. No.</b>	<b>Doc. No.</b>	<b>Topic</b>
1.	V955 - 91	Quality Management and Quality Assurance "Vision 2000"- A Strategy for Individual Standards Implementation in the Quality Arena during the 1990's.
2.	V958 - 91	Quality Policies and Standardisations in Brazil for welded constructions.
3.	V957 - 91	"State of the Art" related to Welding Technology in Quality Assurance Inspection and Personnel Qualification.
4.	V960 - 91	Economic Advantages of CAQ (Computer Aided Quality) demonstrated by the example of a company specialised in the manufacture of welded stainless steel tubes.
5.	V954- 91	Working Group 3 of IIW Commission V "Quality Assurance in Welding Technology" - Annual Report 1990 - 91.
6.	V956 - 91	European Harmonisation CEN/CENELEC Activities and member countries response to Quality System Assessment and Certification.
7.	V929 - 90	Architecture and Implementation of International/European Standards and Certification systems in the Quality Assurance during the 1990's.
8.	V906 - 89/OE	Trends in Quality Assurance Development in the Welding Engineering.
9.	V906 - 89/OE	Example of an analysis for the introduction of a CAQ (Computer Aided Quality) System for the Boiler,making Industry.
10.	V915 - 89	Relations between conventional statistical Quality Control and Non-destructive Examination of welds.

**SUBJECT : ANNUAL REPORTS**

11.	V952 - 92	Sub Commission VF - Annual Report 1991
12.	V951 - 91	Sub Commission VE - Annual Report 1990-91.
13.	V949 - 91	Sub Commission VA - Annual Report 1991.
14.	V950 - 91/OE	Sub Commission VC - Annual Report 1990/91.
15.	V953 - 91	Commission V working group 2 NDT of offshore welded constructions - Annual Report 1990-91.
16.	V933 - 90	Sub Commission VE - Annual Report 89-90
17.	V934 - 90/OE	Annual Report of Sub Commission VC for 1989-90
18.	V935 - 90	Commission V working group 2 - Non Destructive Testing of offshore welded construction - Annual Report 1989/90.
19.	V940 - 89	On the problem of penetrant fluorescence measurement : Standards & Instrumentation.
20.	V925 - 90	Future work programme of Sub Commission VA
21.	V924 - 90	Annual Report 1990 for Sub Commission VA
22.	V928 - 90	Working group 3 of IIW Commission V - Quality Assurance in Welding Technology.
23.	V932 - 90	Annual Report 1990 - Sub Commission VF.

**SUBJECT : FAILURE ANALYSIS**

24. V959 - 91 Failure Mode and Effect Analysis (FMEA) in welded constructions. 1989 - 90.

**SUBJECT : ULTRASONICS**

25. V966 - 91 Comparison of Ultrasonic Echo and Thermal Inspection Methods  
26. V971 - 91 Reliability Optimisation of Manual Ultrasonic Inspection  
27. V973 - 91 PISC - III : A Status Report  
28. V976 - 91 PISC - II : Parametric Studies, Round Robin Tests on the Measurement of UT Instrument and Transducer Characteristics  
29. V975 - 91 Parametric Study on the Effect of UT Equipment Characteristics (EEC) on detection - location and sizing.  
30. V974 - 91 Work into PISC Program relevant to Qualification and Performance Demonstration of NDE Techniques  
31. V930 - 90 On line Ultrasonic Assessment of Weld Quality.  
32. V939 - 90 Handbook of the Ultrasonic Examination of the Austenitic Cladded Materials  
33. V885 - 88 NDT Offshore - A Review  
34. V892 - 88 Peculiarities of Automated Ultrasonic Testing of Welded Joints in special purpose structures welded by different methods.  
35. V893 - 89 Evaluation of the Reliability of Ultrasonic Inspection.  
36. V896 - 89 The increase in efficiency of the automated ultrasonic inspection.  
37. V898 - 89 The set of training devices for welded joints ultrasonic inspection operators  
38. V897 - 89 Automated Ultrasonic testing of pipeline welded joints.

**SUBJECT : RADIOGRAPHY**

39. ROC Study of Inspection Performance in Radiographic Testing of Welded Joints.  
40. V895 - 89 Typical Usage of Radiographic Systems - Replies to a survey.  
41. V894 - 89 Summary Report - X-ray Real-Time (Radioscopy) for Weld Inspection.

**SUBJECT : BLACK LIGHT AND FLUORESCENT PENETRANTS**

42. V879 - 88 Tests for Evaluation and Characterisation of Black Light Lamps and Fluorescent Penetrants  
43. V940 - 90 On the Problem of Penetrant Fluorescence measurements : Standards and Instrumentation  
44. V938 - 90 White light intensity effects of the fluorescent penetrant indication Seeability under ultraviolet light.

**SUBJECT : GENERAL**

45. V967 - 91 Development and Optimisation of NDT for Practical Use Nord Test NDT program - Project Presentation.  
46. V972 - 91 Assessment of Nuclear Reactor Fabrication - A regulatory view.  
47. V936 - 90 The reliability and cost effectiveness of Offshore Inspection  
48. VA441 - 90 Background Information from the NIST Sphere Development Program  
49. V908 - 89 Information on Practice for Underwater NDT  
50. V911 - 89 Flaw Growth Monitoring as an aid to lifetime Prediction.

## ABSTRACTS

**Doc. No. V-955-91**

Sub : ISO/TC 176 Quality management and quality assurance "Vision 2000" - A strategy for individual standards implementation in the quality arena during the 1990's.

**Abstract**

ISO TC 176 was established in 1979. This report reflects the position at the time of the meeting in Interlaken in October, 1990 and the progress of the work in the following months.

**Annex A** of the document illustrates the scope and committee structure. **Annex B** summarises the allocated secretariat assignments of TC 176 standard numbers, whereas **Annex C** establishes the link to Vision 2000.

Trends, concerns for TC 176, product categories, Industry/Economic sectors, goals, strategy, the expectations for the year 2000 are summarised in **Annex D**. **Annex E** shows the tasks and targets of the revisions and provides details on task distribution among the active member countries and on the persons involved.

ISO recommendations have been made to investigate the desirability and options to harmonize a series of standards passed by national countries with relevant ISO guides and to transform the results into international standards. This is dealt in **Annex F**.

**Annex G** confirms the extreme importance of the European Standardization work as well as the possibility of achieving a global introduction of European Standards and thus harmonization of a worldwide scale.

Rapid acceptance of Draft International Standards (ISO/DU) in the national standardization is given in **Annex H**.

**Annex I** deal with first summarized revision of quality terms and definitions as committee draft-ISO/CD 8402-1. **Annexes J & K** deal with quality management and quality system elements. **Annex L** gives the systems approach to the economics of quality. Dependability management is discussed in **Annex M**.

**Doc. No. : V-958-91**

**Sub** : Quality policies and standardisations in Brazil for welded constructions.  
by Brazilian Delegation.

**Abstract**

Until 1990, Brazilian companies has to work with several quality systems at the same time to satisfy the different requirements of different clients.

There was no official Brazilian code for welded constructions. Companies must work according to several codes like ASME, BS, API, AWS.

In November, 1990, the Brazilian government announced a new policy for the quality and productivity of Brazilian products and services.

This document deals with the new industrial strategy, market restrictions, quality system, standardisation, motivation for quality and productivity, training programmes and certification of laboratories.

**Doc. : V957-91**

**Sub** : ISO/CEN "STATE OF THE ART" related to Welding Technology in Quality Assurance. Inspection and Personnel Qualification.

**Abstract**

This European draft standard replaces various earlier drafts. This

draft standard provides general principles for the supervision of welding both in the workshop and on site. The future EN standard will serve the purpose of providing evidence that a manufacturer is capable of producing welded components in the pre-determined quality. The details about "Qualification and Certification of NDT personnel is dealt by ISO/DIS 9712, and is given in the document.

**Doc. No. : V-952-92****VF-178-91**

**Sub** : Sub commission VF - Annual Report, 1991.  
by Birger Hansen

**Abstract**

The fitness for purpose of welded structures document IIW/IIS-SST-1157-90 has been printed during the year. A list of all members of sub commission VF is included in the document.

**Doc. No. : V-951-91**

**Sub** : Sub commission VE - Annual Report, 1990-91  
by Chairman Paul Holler

Working party for eddy current modelling had discussed the current and future work and the objects for modelling were changed to austenitic claddings.

One document on the characterization of black - light lamps and liquid penetrants was prepared for publication and presented in the 91 - Annual assembly.

The working party for the residual stress measurements in welds had agreed not to update the IIW handbook (VE 847-87) since there is no necessity for this. It has been agreed that the handbook can be published by the American Welding Society.

**Doc. No. : V-959-91**

**Sub :** Failure Mode and Effect Analysis (FMEA) in Welded Constructions.  
**by :** Brazillian Delegation

**Abstract**

The rate of quality assurance in Engineering Companies has changed. Its activities are no longer restricted to product inspection and testing, but the main objective is to prevent potential errors as early as possible. The application of analytical techniques to design, manufacture and quality control is becoming popular. It has been identified that failure mode and effect analysis is a very powerful technique to integrate the many factors involved and to review the design, manufacture and quality control aspects. The basic objective of a failure mode and effect analysis is to prevent inservice failures.

This document deals with the approach of the Analysis. The whole analysis is divided into parts like (a) Structure of data (b) FMEA technique which consists of situation analysis, risk prediction and priority.

**Doc. No. : V-960-91**

**Sub :** Economic Advantages of CAQ demonstrated by the example of a company specialised in the manufacture of welded stainless tubes.

**Abstract**

The amount of necessary documentation in the area of quality assurance is increasing continuously. Hence economical aspects and customers demand more and more for the application of Computer Aided Quality (CAQ) in this area.

This document deals with the some practical experiences with a CAQ system installed in a production line for longitudinal welded stainless steel tubes and especially with the economical advantages achieved by

the systematic application of this system all over the whole area of quality assurance.

Besides the advantages of increased quality, increased transparency of quality information all over the production, quick information about the status of orders and repair work and quick erection of final inspection certificates, a high reduction of costs could be achieved by the application of the installed CAQ System.

**Doc. No. : V-954-91**

**Sub :** Working group 3 of IIW Commission V "Quality Assurance in Welding Technology" - Annual Report 1990-91.

**Abstract**

This document deals with the number of European directives governing new European Standards. One of the main objective of WG 3 is to follow this new development and to report on the "Status quo" with emphasis on the subject of harmonisation in Quality.

During the period of report, progress was made on the development of new standards and revisions of the 9001/9002/9003 series in order to contribute readily acceptable standards to further European Standardisation.

It was emphasised to collect more data on the following topics :

- (1) On line inspection/monitoring
- (2) QA and the human factor
- (3) Fit for purpose evaluation with special emphasis on welded compound analysis for life extension and
- (4) Failure Mode and Effect Analysis (FMEA) in welded structures.

**Annex D** of the document gives the membership list.

**Doc. No. : IIW-V-967-91**

**Sub :** Development and optimization of NDT for practical use - NORD TEST NDT PROGRAMME - Project Presentation.

In this document, a review is given of the Nord Test NDT programme including the projects technical content, organisation, funding as well as results achieved and experience gained. In the Nord Test NDT programme conducted between 1984 - 1990, topics covered have been optional use of NDT and NDT results, reliability trials of commonly applied techniques, assessment of techniques and preparation of a handbook for defect sizing, the impact of computers and computing on NDT.

The technical contents of Nord Test NDT programme consists of the following parts.

- (1) Optical use of NDT & NDT results
- (2) Defect detection probabilities for different NDT techniques
- (3) Defect sizing and type estimation and
- (4) Handling and documentation of NDT results.

The results of the Nord Test NDT programme and the experience gained are summarized in the document.

**Doc. No. : V-949-91**

**Sub :** Annual Report of Sub Commission VA for 1991

This document deals with the activities of Sub commission VA during 1991. The paper "ROC - Study of inspection performance in radiographic testing of welded joints" by Heidt, Nockman, Thomson was accepted for application. Part I a film

system classification standard was accepted and proceeded by the annual assembly of commission V in Montreal.

The working party "Radioscopic systems for weld inspection" was very active during this period to produce the final editions of Part 1 and 2 of the standard proposal.

The working party "Radiographic acceptance criteria for weld inspection" finished its work with a publication about the reliability of radiographic weld inspection.

The future work of sub commission VA will concentrate on the fields of standardization and test reliability.

**Doc. No. : V-966-91**

**Sub :** Comparison of Ultrasonic Echo and Thermal Inspection Methods.

**by :** V.A. Troltski & V.I. Zagrebelny

**Abstract**

This document deals with problems concerning inspection of adhesion strength of protective and strengthening thermal - sprayed and clad coatings by the ultrasonic and thermal methods. These methods are compared on the basis of theoretical and experimental studies. The experimental studies on specimens having defects show good agreement between the results of both inspection methods. The advantages drawbacks and applications of these methods are described.

**Doc. No. : V-950-91/OE**

**Sub :** Submission VC Annual Report 1990-91

**Abstract**

This document contains the report of the intermediate meetings of Sub-Commission VC. The future work

(planned) of sub-commission V consists of the following :

1. Validation of ultrasonic techniques for Weld Inspection.
2. Characterization of ultrasonic probes for Weld Inspection.
3. Preparation of a revised manual for the ultrasonic inspection of ferritic welds.
4. Modern imaging techniques for automatic ultrasonic inspection methods and their importance for the weld Inspection.

**Doc. No. : IIW-V-971-91**

**Sub :** Reliability optimisation of manual ultrasonic Weld Inspection.

**Abstract**

The round robin program (1983 - 86) conducted by Dutch Welding Institute on a series of butt welded test plates revealed that by manual ultrasonics the correct rejection rate of unacceptable defects was of the order of 50% and large variations and inconsistencies between the results of various operators were found.

These results prompted to start a second phase of the NDT program with the aim to evaluate the factors which are responsible for the low reliability of manual ultrasonics.

This document deals with the recommendations for better reliability with respect to probes (transducers), flaw detectors, procedures, operators, etc.

**Doc. No. : IIW-V-972-91**

**Sub :** Assessment of Nuclear Reactor Fabrication-A Regulatory view.

**by :** Dr. R. D. Nicholson and Dr. B. Hemsworth

**Abstract**

HM Nuclear Installations Inspectorate in carrying out its control and regulatory function, ensures that the highest practicable standards are used for the fabrication of new nuclear plants or the repair and replacement of components in existing plants.

In this document, various issues are discussed which must be considered during the design and fabrication of components to ensure the required high quality. These have been divided into three main area, relating to materials, welding and inspection and indicate the range of assessments undertaken by Nuclear Installations Inspectorate.

**Doc. No. : V-953-91**

**Sub :** Commission V working group - 2 Non-Destructive Testing of offshore welded constructions - Annual Report 1990/91.

**Abstract**

This document deals with activities of the working group-2 during 1990-91. The technical topics dealt with are :

Reliability and comparative evaluation of surface techniques, offshore/underwater eddy current examination, fabrication versus in-service NDT. underwater NDT personnel qualification schemes, automated and remotely operated NDT equipments for underwater use. etc.

The future work for 1991/92 by the group will consist of :

- 1) Evaluate the necessity of and prepare for future revisions of DOC V-908-89 Information on practices for under-water Non-Destructive Testing.
- 2) Review special problem areas, new techniques and applications

systematize information of general interest and if the informations are relevant, it shall be reported as guideline or recommendation proposals.

**Doc. No. : IIW-V-973-91**

**Sub :** PISC-III - A Status Report  
**by :** S. Crutzen, P. Jehenson  
R. Nichols, J. Stronsnider

**Abstract**

The PISC Programme has the general objective of assessing procedures and techniques in use for the inspection of pressure components in particular the vessel and piping.

The programme is now in its third phase (PISC III). This document deals with the activities on the validation of the PISC II results (modification of the ASME Inspection Codes) on real structures containing service defects and the extension of PISC methodology on most important structural components made of different materials. The third phase insists on the capability demonstration with assemblies of real geometry containing realistic defects.

**Doc. No. : IIW-V-976-91**

**Sub :** PISC II PARAMETRIC STUDIES Round Robin Test on the measurement of UT Instrument and Transducer Characteristics.  
**by :** E.E. Borloo.

**Abstract**

Within PISC II, a Round Robin Test (RRT) was performed by 9 teams on the measurement of certain characteristics of UT instruments and transducers. The participating teams were requested to apply the measurement procedure they normally follow when characterizing their equipment or when performing maintenance control.

The obtained results have shown a broad dispersion, the reasons for which are commented upon and important guidelines are given for organising the tests which involve codes, standards, clear definitions of terms and clear indications of the settings of all the equipment variables that can affect the results.

**Doc. No. : IIW V-975-91**

**Sub :** Parametric study on the Effect of UT Equipment Characteristics (EEC) on Detection, Location and Sizing.  
**by :** F. Lakestani, E.E. Borloo, F. Merli.

**Abstract**

Within PISC II a parametric study was performed aiming to evaluate the effect of a rather large number of variable parameters of a UT testing system. Probe parameters, cable parameters and Instrument parameters have been considered individually and their effect on detection, location and sizing of defects is analyzed.

**Doc. No. : IIW-V-974-91**

**Sub :** Work in the PISC program relevant to Qualification and Performance Demonstration of NDE Techniques.  
**by :** R. Nichols, S. Crutzen, P. Jehenson, N. McDonald

**Abstract**

Performance demonstration for NDT has been an active topic for the past one decade. This often involves the training and qualification of personnel to achieve certification. From the PISC exercises it was suggested that in addition to the certification process, the techniques used should be proven techniques and appropriate test blocks (standards) should be available.

This document gives the conclusion that the NDT procedure has to be validated and tested for its performance and for the reliability of its applications on structures containing defects that, not necessarily being real ones, still do induce the real physical phenomena that the inspection techniques must be able to handle.

Mathematical model, involving a better understanding of the physical phenomena will also indicate which artificial defects could be used to replace natural ones for NDT Techniques validation and inspection team training.

**Doc. No. : V-956-91**

**Sub :** European Harmonisation GEN/ CENELEC ACTIVITIES and member countries Response to Quality System Assessment and Certification.

**Abstract**

The term "harmonisation" is defined as the correlation legislation relating to European national technical standards. The correlation of legislation in the community has made considerable headway because of the following developments for the last five years in the field of harmonisation.

- new concept (reference to standards)
- conversion from optional to compulsory harmonisation
- change from the principle of unanimous agreement in the Council to the principle of qualification majority
- Global concept for testing and certification

The document describes in detail about these and concludes that these activities are intended to improve the quality of the products, the production processes and the testing and certification methods.



**Doc. No. : V-879-88**

**Sub :** Tests for evaluation and characterisation of black light lamps and fluorescent penetrants.

**Abstract**

Non-destructive tests performed with penetrant liquids and magnetic particles are among the most common methods of inspection of the surface integrity of industrial components. The use of fluorescent products in the above methods for increasing the sensitivity of inspection requires a constant check of their properties. This document gives the data of the results of experimental tests carried out on some types of penetrant liquids and black light lamps by ENEA ERC (Energy Research Centre) and the Istituto Italiano della Saldatura (IIS) in Genoa.

The tests carried out on penetrant liquids and on black light lamps showed that the results obtained by testing some of their properties (eg. lightning power, spectral output, fluorescent intensity etc.) are not sufficient for the formation of correct qualitative evaluations if they are considered separately.

Experimental laboratory tests demonstrated that this is true also for testing other properties such as wetting properties, penetrant washability and sensitivity, developer absorption capacity, efficiency of sprays etc.

Those qualitative tests have to be extended in order to evaluate quantitatively the reliability and sensitivity of the inspections as a function of possible variations to the properties of the products or equipment.

**Doc. No. : V-933-90**

**Sub :** Subcommission VE - Annual Reports 1989/90

This document narrates the activities that have been carried out by Sub commission VE during the period

1989-90, and the future work programme for 1990-91.

Eddy current finite element modelling work has been started by NDT Centre Saarbrücken. With austenitic weldments the  $\sigma$  distribution (electrical conductivity, magnetic permeability) was measured at the surface of the weld to be modelled. The same distribution must be assumed beneath the surface using a successive approximation algorithm.

Working parties were formed to characterise black light lamps and liquid penetrants, characterisation of non-metallic welds, and residual stress measurements at the welds.

For 1990-91, the following programmes are planned.

1. Numerical modelling studies on electric, magnetic and electromagnetic techniques of NDT.
2. Analysis of methods to measure strain and stress, definition and realisation of a round robin action to determine the capability of the different measuring methods.
3. Study of the state of art for testing non-metallic weldments and preparation of an IIW document for the next annual assembly.
4. Preparation of an IIW document summarising the state of standardisation for characterisation of black light lamps, starting with activities to liquid penetrant inspection of welds.

**Doc. No. : V-934-90/OE**

**Sub :** Annual Report of Sub Commission VC for 1989-90.

This document gives the activities carried out by Sub Commission V C

during 1989-90 and future work planned for 1990-91.

A chapter on non-destructive testing for fitness for the purpose concept for weld structures had been completed and the working group will further focus its activities towards the goal of validation of UT techniques for weld inspection.

A document on ultrasonic inspection of clad components has been prepared.

The following works are planned for 1990-91.

1. Preparation of revised manual for the ultrasonic inspection of ferritic welds.
2. Validation of ultrasonic techniques for weld inspection.
3. Characterisation of ultrasonic probes for weld inspection.
4. Modern imaging techniques for automatic ultrasonic inspection methods and their importance for the weld inspection.

**Doc. No. : V-935-90**

**Sub :** Commission V working Group 2 "Non-destructive Testing of Off-shore Welded Constructions"- Annual Report 1989/90.

This document indicates the following main technical topics dealt by the working group during 1989-90.

- Reliability and comparative evaluation of surface techniques.
- Offshore/underwater eddy current examination.
- Fabrication versus inservice NDT.
- Underwater NDT equipment and personnel qualification schemes.
- New trends and developments in offshore NDT.

- Automated and remotely operated NDT equipment for underwater use.

During 1990-91, the working group has decided to revise the DOC V 908-89 "Information on Practices for Underwater Non-destructive Testing" and review special problem areas, new techniques and applications and collect and systematise information of general interest. These will be given in the form of guidelines or recommendations to IIW.

**Doc. No. : V-923-89**

**Sub :** Annual statement 1988-89 of Commission V of IIW  
**by :** R. S. Sharpe

This document consists of the Chairman's introductory comments and three sections A, B and C dealing with Pre Helsinki, Helsinki assembly and Post Helsinki proceedings respectively.

Section A deals with record of sub-commission, working group and working party meetings held during 88-89, publishing actions and sales of commission V documents.

section B deals with daily records of decisions taken during Commission V meetings, the substance of resolutions taken during Commission V at Helsinki, abstracts of Commission V papers presented and new terms of reference for other commissions approved.

Section C consists of forward work programme of Commission V, tentative dates for forthcoming meetings of the Commission, addresses of Commission V officials and list National delegates to Commission V.

The main achievement of the year was the completion and acceptance of IIW Guidance Document of Fitness-for-purpose. Another achieve-

ment was the active steps taken during the year to link the work programme of the commission more to ISO activity and the "fast route" for converting IIW documents into ISO standards.

**Doc. No. : V-940-90**

**Sub :** On the problem of penetrant fluorescence measurement; standards and instruments.

**Abstract**

**by :** M. Cevenini, F. Lezzi, R. Marmigi, F. Peri.

This paper describes the more important characteristics of the instrumentation and operating conditions in which the work was performed. Further, the analysis that were conducted in the series of experiments are dealt with. Detailed information is provided regarding the procedures used for the preparation of the test samples, the methods used for each single examination, the criteria used to evaluate the results and the constructive and functional features of the photofluorimeter used for the tests. The aim of the series of tests conducted was to verify the technical and functional suitability of the photofluorimeter. Penetrants having different grades of sensitivity were selected. In order to be able to clearly emphasize the response capability of the instrument to different values of fluorescence intensity.

The problems of liquid penetrant fluorescence measurements is of primary importance in the field of non-destructive evaluation, because they not only involve the chemical and physical properties of the products under test, but also the constructive and functional characteristics of the instrumentation to use in the analysis. Several standards referred to by the high - tech industries provide

precise indications as to the tests to carry out and the instrumentation to use for verifying the liquid penetrant fluorescence properties.

The authors firmly believe that clarification should be provided as to the need to use only sophisticated equipment, which provides absolute measurements of fluorescence intensity (in LUX) or rather the required test reliability and accuracy can be met by using instrumentation able to provide relative intensity values (as percentages). The need for this clarification results from the fact that since it is necessary to process the results so as to be able to evaluate them as percentages, the use of extremely accurate equipment has a marked impact on running costs and is therefore not really warranted.

**Doc. No. : V-938-90**

White light intensity effects on the fluorescent penetrant indication seeability under ultraviolet light.

**by :** G. Calcango, G. Costi, R. Marmigi.

**Abstract**

The seeability is of considerable importance in cases in which fluorescent products are employed, since the higher sensitivity of these products is due, in addition to the physical and chemical properties, to the particular contrast conditions present between the fluorescent indications and the darkness of the ambient in which the tests are performed.

This paper illustrates the results obtained in some experimental analysis aimed at verifying whether the sensitivity and reliability degree of a test by fluorescent penetrants carried out in an ambient not suitably darkened and with excessive white light, may be preserved by increasing exclusively the intensity of the ultraviolet light used for the test. The series of

tests described in this paper define the correlation existing between the intensity of the ultraviolet light and the intensity of white light and the seeability of the fluorescent indications by the operators' eyes. The tests clearly demonstrate the need to inspect components subjected to fluorescent penetrant examination under suitable light (lamp plus ambient) of 30 to 40 lux.

**Doc. No. : V-929-90**

**Sub :** Trends in architecture and implimentation of International / European standards and certification systems in the quality arena during the 1990's

**Abstract**

Based on the manifold changes and harmonising efforts which have emerged, this report attempts to deal with some priorities in respect of quality management in general qualification and conformance certification in particular. Consistant with developments in recent years and in view of the unification of the European market by early 1993. Special emphasis is laid on European requirements.

**Doc. No. : V-930-90**

**Sub :** The on-line ultrasonic assessment of weld quality.

**by :** C.B. Scruby, I. J. Stares, C. Duffill, B. C. G. Haywood.

**Abstract**

This paper presents some examples of recent work in the NDT Centre. Harwell Laboratory regarding applications of ultrasonics to the characterisation of the melt pool and defect detection during the welding of stainless and ferritic steels.

There is a growing industrial need for active methods to control weld qual-

ity on line. Ultrasonic waves are able to penetrate deep within the weldment, and provide vital information about the solid liquid interface and formation of defects, so that a feed back signal can be sent to control the welding parameters.

The experiments highlighted in this paper, demonstrate the physical principles involved in the technique, and show how the method could be used for on line weld process control. In addition, data are presented in which angled compression waves are used to monitor the root pass of V preparation butt joints in stainless and ferritic steels. Not only do these results confirm the potential of ultrasonic sensors for determining the weld pool dimensions on line, but they also demonstrate the detection of fabrication defects as they form while welding is in progress. It is, however, reported that the reflection from the interface are not as strong as might be desired. It is, therefore, concluded that an ultrasonic instrument that is capable of rapid on line signal averaging is essential for an adequate signal/noise ratio.

**Doc. No. : V-936-90**

**Sub :** The reliability and cost effectiveness of offshore inspection  
**by :** Olav Forli

**Abstract**

A review is presented based on available information on the reliability and cost effectiveness of inspection of offshore installations in service. The paper described current efforts to establish inspection reliability data for use in cost and safety optimisation of the inspection. General principles and systematic approaches to inservice inspection planning are presented with emphasis on steel platforms in the North Sea.

**Doc. No. : V-939-90**

**Sub :** Handbook on the ultrasonic examination of austenitic clad materials

Draft by Commission V of International Institute of Welding

**Abstract**

Austenitic caldding is commonly applied to ferritic base materials for corrosion protection. The fitness for service of the component depends on the quality, integrity and thickness of the caldding. The cladding structure strongly influences ultrasonic examination of the cladding itself as well as examination of the underlying base material and welds. Special procedures, therefore, are required to ensure effective examination of clad material.

This handbook describes the problems and gives recommendations for examining austenitic clad materials. Common cladding processes, possible irregularities and defects and propagation of ultrasound are discussed. Simplified descriptions of wave propagation are included as a bridge between theory and practical examination procedures. The information in this handbook can be used to develop examination procedures. This handbook is intended for ultrasonic examination practitioners, procedure developers and personnel interpreting examination results.

**Doc. No. : V-925-90**

**Sub :** Future work program of sub commission 5A

**Abstract**

The future work of SC V A will concentrate on the fields of standardisation and test reliability. The second part of a standard on film system classification will be finalised. A report on properties and

use of radiosopic systems for weld inspection will be prepared. Revision of ISO standards on weld inspection will be done.

**Doc. No. : V-924-90**

**Sub :** Annual Report 1990 for Sub-commission V A

This document narrates the work done by sub-commission V A on classification of film systems radiosopic systems for weld inspection, radiographic acceptance criteria for weld inspection, revision of ISO standard ISO 5579 and collection of reference radiographs.

It has also recommended Doc. V A-434-90 on Focal spot size measurements for microfocus x-ray sets by U.Madsen for publication. The paper gives comprehensive information about the different evaluation methods and important hints for the user of microfocal equipment.

**Doc. No. : V-928-90**

**Sub :** Working group 3 of IIW commission V "Quality assurance in welding technology". Annual Report 1989/90

This report insists on the need of Quality Management and Quality Assurance in the field of welding technology, work done in the areas of computer aided weld inspection and quality assurance, new aspects of on line inspection and quality assurance and the human factor are highlighted. It has also indicated the work program for 1990-91 which includes support of QA activities and weld inspection, monitoring to welding parameters for early prevention of weld defects and on line inspection by modern visual and dimensional checking.

**Doc. No. : V-932-90**

**Sub :** Annual Report 1990 Sub commission V F

This commission has fully concentrated during the period of report on the preparation and printing of the IIW recommendation on "IIW guidance on Assessment of the Fitness for Purpose of Welded Structures. Draft for Development".

**Doc. No. : V A-441-90**

**Sub :** Background information from the NIST sphere development program.

**Abstract**

The advent of image intensifying systems and automated image processing systems has introduced the need for evaluating the image quality in these cases. Conventional IQI's used as the plaque type or wire type are ideally suited for film radiography wherein the object and film are stationary. When image intensifiers are used, the object may be rotated and there is also the possibility of projective magnification. This paper discusses the design of a new type of image quality indicator consisting of a thin high density coating over a low density core. The new IQI would have symmetrical shape which would provide for rotational variance about two axes, high attenuating edges for easier detection and size independent of orientation so that the magnification of the image can be calibrated. As indicated by the author, experiments with these IQI's using films have indicated that their performance is quite satisfactory.

**Doc. No. :**

**Sub :** Study of inspection performance in radiographic testing of welded joints.

**Abstract**

Present day NDT techniques use image processing and signal analysis to a very large extent. In most of these techniques the signal to noise ratio or the ratio of true indications to false ones should be quite high. In these cases, a threshold signal is normally fixed above which the counts are made. The accuracy of the inspection system is judged by this limit. In this paper, the authors explore the possibility of the use of relative or receiver operating characteristic method for assessing the accuracy of an inspection system, for a variety of thresholds. Experiments indicate that ROC could be used for indicating the accuracy of detection due to different detection modes of one equipment as well as to evaluate the performance of various inspection equipments or detection methods.

**Doc. No. : V-885-88**

**Sub :** NDT Offshore - A Review  
**by :** Mr. O. Forli, Chairman of Working Group 2 of Commission-V of IIW

**Abstract**

This paper is based on the developments that have taken place in the offshore NDT techniques and applications. This deals with the conventional NDT techniques followed by divers and also the present day attempts to use automated and remotely operated techniques and structural integrity monitoring.

Visual examination is performed underwater by divers. Still photography, TV cameras and video recording are used as aids.

Magnetic particle testing is the dominant underwater NDT method for detection of surface breaking cracks and if correctly used with qualified personnel, the same quality of examination will be obtained as in rou-

tine testing. On offshore constructions, the main application is in service, to detect fatigue and other service induced cracks on node and other welds. In most cases, fluorescent magnetic particles are used and viewed in ultraviolet light.

Underwater ultrasonic testing is mainly performed manually for detection and mapping of corrosion. Weld examination is considered too complicated to perform on a large scale and is only used for diagnostic purposes and in connection with repair etc. For thickness measurement, digital meters are most commonly applied.

Automated ultrasonic equipment has been in use under water since 1981 and is now quite extensively applied. The main use has been for mapping of corrosion and lamellar cracking on pipelines and risers and to examine girth welds on riser and platform legs.

Crack depth measurement based on AC potential drop is available for crack depth measurement under water. Such tools are available for critical crack assessment to provide inputs for fracture mechanics evaluation approach. Also, the ultrasonic time-of-flight technique has been developed for used underwater to obtain quantitative information about crack.

Radiography is not common to use directly in water, but gamma radiography is used for the testing of hyperbaric welds. If applied directly from air, it may be necessary to remove water from the beam path by using air filled cones, balloons or similar devices.

Acoustic emission is still in its infancy as an off-shore structural integrity monitoring technique.

The paper establishes that reliable

NDT tool as mentioned above are available to assess more accurately areas which might be subject to fatigue or corrosion. It is possible to optimise inspection efforts for qualitative and quantitative inspection. Further cost saving can be envisaged through the use of remotely controlled or automated techniques and monitoring systems to reduce diving inspection time.

**Doc. No. : V-908-89**

**Sub :** Information on practices for underwater non-destructive testing

**Abstract**

The objective of this document are to give technical information on NDT techniques for underwater welded constructions, as a guidance. The guidance is given with the aim to have NDT underwater performed at the same quality levels as above water.

This document is limited to testing of welds as well as parent material of welded steel constructions such as offshore platforms, pipelines, harbour installations, ship hulls etc. Commonly used NDT methods are described in detail. Information on acceptance criteria is not included in the document as relevant criteria are strongly dependent on construction type and environment, consequence of failure, national regulations, agreement between vendor and purchaser etc.

It is suggested that the application of underwater NDT methods can be during fabrication, installation and underwater repair as well as for in-service inspection. The document insists on extensive theoretical and practical training of the operator for the NDT techniques in question.

Included in this document are NDT methods which reveal material

discontinuities and those which describe material properties which have a significant effect on structural integrity. This includes conventional NDT methods such as ultrasonic and magnetic particle testing, visual examination and structural integrity monitoring. Electrochemical potential measurements are suggested to monitor the functioning of cathodic protection systems on underwater parts and thus indicate possible corrosion damage.

This document contains a list of other methods and techniques which are less frequently used. The methods are gamma radiography, automated ultrasonic testing, ultrasonic time of flight diffraction technique, AC potential drop crack depth measurement, eddy current testing, hardness and replica techniques.

This document has highlighted the application of different NDT methods by indicating their predominant use. It has also indicated the ongoing development of new underwater NDT techniques.

**Doc. No. : V-905-89-OE**

**Sub :** Trend in Quality Assurance Development in the Welding Engineering.

**Abstract**

After outlining the general tendencies in quality assurance, the report goes on to show what developments in future may be expected on this aspect in the welding engineering. The document covers the planning phase, the technical code of rules, quality assurance with manual (product control) and fully mechanized or automatic welding processes (process control), quality assurance systems and their certification.

**Doc. No. : V-906-89-OE**

**Sub :** Example of an analysis for the introduction of a CAQ (Computer Aided Quality) system for the boiler making industry.

**Abstract**

This document deals with the possible applications of a CAQ system in conventional welding technology and the advantages which may be derived therefrom. The document which mainly consists of tables, flow charts, and system layouts is concerned with the installation of a computer system, designed to support the general administration and organisation of weld inspection in a boiler making and pressure vessel manufacturing company. The main goals of a CAQ system are : centralised Q-control, increased actuality of quality information, less paper work for workshop inspectors, up-to-date information on inspection progress reduced type work for using acta basis reduction in costs.

**Doc. No. : V-892/88**

**Sub :** Peculiarities of automated ultrasonic testing of welded joints in special purpose structures welded by different methods  
**by :** V. L. Nalda, G. A. Krug, R. K. Kairetdtionov, A. A. Tkchenko.

**Abstract**

The increasing requirements to the reliability of various welded structures stipulate the urgency of the erection of autocated non-destructive testing installation.

Computer facilities used to process the signals in ultrasonic testing and as a result the increase in its information potential as well as the possibility to completely automate the UST process provide the wide application of ultrasonics in different welding methods control.

The general requirements for the ad-

vanced ultrasonic installations are :

- high test rate which correspond to production speed
- comparatively short time of adaptation for items of other types
- continuous monitoring
- reproducible test results
- completely automated process
- periodic functional check of installation and due to this high operating reliability
- flexible and perfect programme for evaluation of unsoundness and record of test results.

The document highlights the problems of developing the integrated microcomputer based system for ultrasonic testing and various kinds of welding and weldments. The specific integrated UTS installations and the outlooks for the development of this direction in the USSR, the defect configuration identification in particular are considered.

**Doc. No. : V-893/89**

**Sub :** Evaluation of the reliability of ultrasonic inspection.  
**by :** Carlos, Soligo, Camerini.

**Abstract**

This document deals with a cooperative research programme developed by Brazilian Society for non-destructive testing for evaluation of the reliability of ultrasonic inspection of welded joints. The parameters taken for evaluation are : amplitude of the echo, location of the reflector, determination of the reflector length and height and identification of the reflector.

The document presents the results obtained by fourteen qualified inspectors inspecting ten metres of weld performed by the submerged

arc process on plates 38 and 45mm thick. The plates contained a total number of 29 different defects of the "lack of fusion" type.

The research programme revealed that the detectability of defects by ultrasonic testing was good. The inspectors evaluated the length and depth parameters with a sound degree of precision. The parameter of amplitude displayed poor correlation with the parameters of lengths and area of discontinuity. Further studies are suggested for determination of the respective causes. It was also brought out that the processes of measuring the height of the discontinuity was unknown to many inspectors. The data obtained in this cooperative project were fairly broad in nature, permitting statistical analysis in greater depth.

**Doc. No. : V-896/89**

**Sub :** The increase in efficiency of the automated ultrasonic inspection  
**by :** V. A. Troltskil, Yu. K. Bondarenko, Y. B. Eskov.

**Abstract**

This document deals with NDT of welded joints and ways for solving problems of the increase in assessment accuracy of results of defect oscopy in the USSR by means of visualization. Such systems decrease well known contradictions of results of UT and RT. The visualization of UT makes it possible to determine the sizes of defects in different planes to evaluate the type of defect.

The document indicates that the typical signs of the modern trends in the lager diameter pipe NDT method advancement and application are : inspection process automation, computer aided inspection process controls and test results processing, improvement of the indication systems and the inspection visual display

quality connection of the inspection installations to production lines.

The industrial application of micro-processor opens the prospects for creating the appropriate systems with softwares and acoustic tract digital data processing unit interfaces. This will greatly improve the inspection objectivity and productivity.

The document deals with various types of automatic inspection system. It indicates that there exists the possibility to completely automate the ultrasonic testing processes with the help of versatile manipulators which are computer controlled by the main programme and additional adaptive systems for automatic control. Thus the defect detection process should be accomplished by the round robin programme and the defect measurement process should include the adaptation elements or run by the programme with variable parameters which depend on a particular defect.

**Doc. No. : V-898/89**

**Sub :** The set of training devices for welded joint ultrasonic inspection operators

**by :** K. Bondarenko, A. K. Gurvich, B. Eskov

**Abstract**

This document deals with training devices for welded joint ultrasonic inspection operators. Reliability of work of a weld ultrasonic inspection operator depends on his skill and experience, intellectual and psychophysiological properties, efficient working conditions, duration of work etc. Reliability of work of the operator can be improved by adding the operation with the training devices into his training programme to develop the above mentioned habits and properties. Typical training devices

like HK-155, HK-156 and HK 157 are explained in this document.

**Doc. No. : V-897-1989**

**Sub :** Automated ultrasonic testing of pipeline welded joints

**by :** V.A. Troitskii, I.Ya, Shevchenko, V. E. Baldakov.

**Abstract**

In the oil and gas industry, pipe fracture is most often the cause of short term and prolonged interruptions of pipeline operation. One of the causes of fracture can be low quality of the welded butt made in the shop or site. Very high quality of pipe welded joints are required for this purpose. Assessment of quality is done by ultrasonic and X-ray radiography techniques.

This document describes the equipment for automatic ultrasonic testing of pipe welded joints during their production and during pipeline mounting. Experimental datas comparing ultrasonic and X-ray techniques are highlighted in this document.

**Doc. No. : V-911-89**

**Sub :** Flaw growth monitorings as an aid to lifetime prediction.

**by :** M. G. Silk, A. D. Whapham, C.P. Hobbs.

**Abstract**

Due to the construction of more and more new plants, the demand for increasing precision in nondestructive flaw sizing technique is also growing. Monitoring the growth of the flaws by newer NDT techniques has come in a long way as an aid to lifetime predictions of plants. Both the time of flight diffraction (TOFD) technique and the alternating current potential drop (ACPD) technique might achieve precision of 0.25 mm or better in estimating flaw growth. The monitoring approach will prove to have economic benefits.

This document reviews the justification for monitoring and presents experimental flaw monitoring data. Theoretical and experimental approach to this effect have been dealt in detail in this document. From the analysis it is shown that monitoring to determine flaw growth rate is the technique which will provide quantitative data for assessment. It is claimed that monitoring will reduce the amount of unnecessary repair and if repair is required the timing of the repair will be optimised. Monitoring thus result in savings in repair and shut down times without impairing the essential safety of structures.

**Doc. No. : V-915-89**

**Sub :** Relations between conventional statistical quality control and non-destructive examination of weld.

**Abstract**

Industries manufacturing in large series or in mass production use statistical quality control methods as an important tool in their quality management system.

This document aims in drawing relations between conventional statistical quality control and nondestructive examination of welds. Advanced application of fitness for purpose criteria in welding relies heavily on probabilistic methods. This also applies to NDT. The document insists that it is essential to distinguish between the statistical methods employed in a conventional statistical quality control and the statistical analysis of the results from nondestructive examinations performed as a part of probabilistic approach. The document has taken reference from various IIW, ISO documents for defining standards, acceptance quality level, classification of discontinuities, inspection procedure etc.

**Doc. No. : V-895/89**

**Sub :** Typical usage of radioscopic systems : Replies to a survey  
**by :** J.A. Siewers

**Abstract**

The image quality indicators used till date are basically meant for film radiographic applications wherein they measure parameters as contrasts and spatial resolution. With the advent of real time radioscopic systems, the object can be oriented in a variety of ways and examined without manual intervention. While in film radiography it was possible to place the IQI appropriately between exposures for easy detection, this is not so in case of real time systems. Further, the existing IQI would not be

able to measure all the important features of these systems as geometric distortion etc. A survey was conducted to ascertain the features users would like to have in IQI's meant for real time systems. This paper essentially summarises the results of the survey. It was observed from the replies that an array type IQI which could evaluate the entire field is preferred by many. Based on the replies it was decided to design an appropriate array IQI and have a round robin evaluation.

**Doc. No : V-894/89**

**Sub :** Summary Report : X Ray real time (RADIOSCOPY) for weld inspection.

**Abstract**

This paper describes in brief the various equipments available for real time radioscopic systems as the conversion screen, image intensifier tube, linear arrays etc. After a brief overview of the state of art in X-ray equipment, image recording and digital image processing techniques, the use of modulation transfer functions for performance evaluation of radioscopic equipment is dealt with. The advent of automatic recognition of weld defects and its advantages is also dealt with. This report is essentially a summary of the progress reports 1,2,3 and 4 on the subject mentioned above.

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## Attention !! CANDIDATES APPEARING IN AM-IW EXAMINATION

### Modification in Rules of AM-IW Examination

Rules 6.2, 6.3 and 6.4 have been modified as detailed below :

- 6.2 (a) Before appearing at the Part A Examination, a candidate must have atleast one year of professional experience in the field of Welding or in allied areas in an Industry/Research Organisation/Educational Institution.
- 6.2 (b) Before appearing at the Part B Examination, a candidate must have passed or been exempted from Part A and passess a minimum total of two years of professional experience in the field of Welding or in allied areas in an Industry/Research Organisation/Educational Institution.
- 6.3 No. candidate shall be eligible for appearing in the Final Theoretical Examination in Part C, unless he/she
  - (a) has cleared Part A and Part B (Including exemptions, if any).
  - (b) has atleast three years of working experience in the field of Welding or in allied areas in an Industry/Research Organisation/Educational Institution, and
  - (c) has successfully undergone a minimum of one course in Welding Technology at a recognised Educational Institution/ Welding Institution/Research Organisation.
- 6.4 No candidate shall be eligible for submitting the dissertations/project reports on any two elective papers from Part D unless he/she
  - (a) has cleared Part C, for which, no exemption is provided for, and
  - (b) has undergone an agreed training for a period of 3 to 6 months under the supervision of a Fellow/Member of the Indian Institute of Welding in a reputed Industry/Research Organisation/Educational Institution.

For further details, please contact The Indian Institute of Welding, 3A, Loudon Street, Calcutta - 700 017