

- Abstracts of IIW Documents

IIW Commission VIII : Health & Safety

Reported By - Dr. M.B. Surendranath Lal,
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IIW Doc : VIII - 1488-89

Supplement to ISO 3690. 4th Draft.

HYDROGEN DETERMINATION OF TEST WELDS MADE IN UNMANNED HYPERBARIC WELDING SIMULATORS

Abstract

Hyperbaric fusion welding has frequently become part of welding operations for installation and repair of underwater steel structures including pipeline systems.

Due to increased ambient pressure and possibly high humidity an even higher hydrogen pick up of the weld metal than at atmospheric welding may appear, followed by accelerated hydrogen assisted cracking.

Development and qualification of hyperbaric welding procedures are often carried out using unmanned hyperbaric simulators. For assessment of hydrogen contents the following additional rules to the existing ISO 3690 standard are required for the unmanned and remote controlled performance of the test welding.

IIW Doc : VIII - 1489-89

Supplement to ISO 3690. 3th Draft.

HYDROGEN DETERMINATION OF TEST WELDS MADE IN MANNED HYPERBARIC SIMULATORS OR IN MANNED SUBSEA HYPERBARIC HABITATS

Abstract

Installation and repair of underwater steel structures including pipelines and risers are most frequently carried out by hyperbaric fusion welding. At increased water depth the effects of ambient pressure and humidity may result in higher hydrogen pick up of the weld metal than at 1 bar conditions, followed by increased hydrogen assisted cracking. Apart from unmanned simulators, development and qualification of hyperbaric welding procedures is carried out either within large scale manned simulators or in manned subsea hyperbaric habitats, as designed for fabrication welding.

For assessment of hydrogen contents the following additional rules to the standard ISO 3690 are required for hyperbaric welds made in manned hyperbaric simulators and subsea habitats.

IIW Doc : VIII - 1490-89

OZONE IN THE BREATHING ZONE OF WELDERS

A. Nemcova and H. Mackova (Czechoslovakia)

Abstract

Gases, the products accompanying welding and cutting processes, contaminate the workplace and jeopardize health of the workers by their toxic influence. At higher exposure ozone poses the potential danger for welders.

Tables 1 to 11 summarize the results published in the catalogue of solid and gaseous toxic substances generated at welding processes.

IIW Doc : VIII - 1491-89

CHROMIUM (VI) IN WELDING AEROSOLS

L. Olah and H. Mackova (Czechoslovakia)

Abstract

Toxic substances in welding aerosols contaminate the working environment in the weld shops. Chromium in the welding aerosols, particularly in the form of Cr (VI) represents, from the toxicological point of view, one of the most significant harmful substances.

Tables 1 to 6 summarize the results presented in the catalogue of solid and gaseous toxic substances generated at welding processes.

IIW Doc : VIII - 1494-89

COMMENTS ON DOC. VIII - 1472-89 ABOUT THE INFLUENCE OF NITRIC OXIDE ADDITIVES IN SHIELDING GASES ON OZONE FORMATION

E. Smars (Sweden)

Abstract

The author's conclusion that the addition of a small amount of NO to the shielding gas gives no benefits concerning the welder's safety and health is based on incorrect interpretation of some measurements without a complete understanding of the ozone formation and transport mechanisms. There are convincing measurements and documentation, among others by independent institutes, which show that the risk for the welder of being exposed to unwanted levels of ozone is considerably reduced by using shielding gases doped with NO.

We agree that in all arc welding both general and local ventilation should be used and where possible the air flow conditions around

the welder should be made to direct the fume plume away from the welder. However this is far from always possible in practice. NO-doped shielding gases are a complementary method for reduction of the ozone level when TIG welding any material and MIG/MAG welding steel.

IIW Commission X : Residual Stresses Stress Relieving and Brittle Fracture

*Reported by - Dr. S. Prasannakumar
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IIW Doc : X - 1189-89

THE CRACK COMPLIANCE METHOD FOR RESIDUAL STRESS MEASUREMENT

Weili Cheng and Iain Finnie, U.S.A.

Abstract

Residual stresses due to welding are of concern in many applications. Though non-destructive techniques are available for residual stress measurement at or near the surface, the through thickness variation of residual stress requires sections or repetitive layer removal for proper assessment. In this document, a new technique called "Crack Compliance Method", which has been developed to assess the through thickness variation of residual stress is reported.

In the crack compliance method, a narrow slot of progressively increasing depth is introduced into a part, while measuring strain or deflections. Solutions for the change in compliance due to a crack are used with experimental measurements to deduce the state of stress which existed on the plane of the cut. Since the material removal in this process is minimised, the method is less time consuming and is believed to be more accurate.

IIW Doc : X - 1197 (Part-1), X-1198 (Part-3) - 89

THE APPLICATION OF AN ENGINEERING CRITICAL ASSESSMENT IN DESIGN, FABRICATION AND INSPECTION TO ASSESS THE FITNESS FOR THE PURPOSE OF WELDED PRODUCTS

Part-1 : Instantaneous failure (Assessment Procedures)

Part-3 : Instantaneous failure (Selection of test methods)

Abstract

These two documents are forming part of a fuller detailed document covering the various aspects of critical assessment procedures and tests for fitness for purpose of welded joints. At this stage of development of various techniques, Commission-X of IIW has decided not to publish a single recommended procedure for

assessment of discontinuities with respect to instantaneous failure, but indicate the basic requirements to be satisfied. This document describes the data required for analysis, basic principles underlying assessment methods in the three areas of the fracture mechanics methods. Finally, it gives a validation check list which should be answered for any assessment method.

In the Part-3 (Doc. IIW/X-1198-89), a description is given of some of the current practical assessment methods used in different countries and industries. While in Part-1, basic principles were spelt out, in this Part-3, the detailed methods of assessment under the heading viz. Fracture Mechanics based methods, Structural testing methods and Crack arrest based methods.

IIW Doc : X - 1187-88

APPLICATION OF MATHEMATICAL METHODS FOR IMPROVING THE TECHNOLOGY OF CAST IRON WELDING

USSR Academy of science (Welding Committee)

Abstract

Welding of cast-iron is a complex technological process, the development of which requires deeper understanding of the role played by various factors in achieving the joint quality - these factors being chemical composition, physical and mechanical properties of base and filler materials, welding conditions, and workpiece geometry.

Further, it is established that the ability of cast iron to form quality welded joints depends on the dispersion of graphite inclusions, and solubility limit of carbon in the weld metal. The requirements are specified for the electrode materials for cast iron welding as to the solubility limit of carbon.

Also, the residual stresses are calculated for the welded joints of cast iron of the tube to tube-plate type and various ways of reducing the stresses are found.

IIW Doc : X - 1188-89

RECOMMENDATIONS ON FRACTURE MECHANICS TESTING

NORDTEST (Norway, Denmark, Sweden, Finland)

Abstract

The present recommendation is the second stage of the NORDTEST project on Fracture Mechanics Testing. The objective with the recommendation has been to present a state of the art with respect to the practical application of fracture mechanics testing standards. This includes both a critical review of requirements already specified in the standards, and new variables gained from the experience of testing of weldments.

Within IIW, a working group set up to propose guidelines of fracture mechanics testing of weld metal and HAZ, has published a draft document IIW/X-1113-86. This NORDTEST recommendation is a contribution to the above work.

These recommendations aim at being of practical help to the industry, research institutions, governmental organisations in the Nordic countries so as to unify a Nordic view on such standards.

IIW Commission XII - Flux and gas shielded electrical welding processes

*Reported by - Mr. A. C. Lahiri
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IIW Doc : XII - 1103-89

PHASE TRANSFORMATION GAMMA -> DELTA -> GAMMA IN THE HEAT AFFECTED ZONE OF WELDED JOINTS DURING WELDING OF STRUCTURAL CARBON, LOW AND MEDIUM ALLOY STEELS

*B. A. Fedoseev, A. G. Lamzin, A. S. Gubanov,
Yu. I. Rubenchik, Yu. A. Sterenbogen,
A. V. Denisenko*

Abstract

It is shown that at the methods and conditions of welding with a high heat input (electroslag, submerged arc welding) the relatively wide area of fusion zone is subjected to gamma - delta - gamma transformations. This transformation defines to a considerable extent, the structure, the level of chemical heterogeneity and properties of the heat-affected area and the welded joint as a whole.

24 References included covering Russian, German, French, Scandinavian, and U. K. publications.

IIW Doc : XII - 1101-88

WELDING WITH FLUX-CORED WIRES AND WAYS OF THEIR DEVELOPMENT

I. K. Pokhodnya

Abstract

The report reviews the development of flux-cored wire and welding procedures in the U.S.S.R. The main types of flux-cored wires are characterised as gas-shielded types and self-shielded types. Some special purpose flux-cored wires are developed for automatic welding of vertical, horizontal and circumferential welds e.g. electroslag, electrogas & SAW processes. Particular stress are given also in studying the technological and design problems associated with manufacture of modern industrial flux-cored wires. Methods for calculation of main technological parameters in wire manufacturing process are, also, created.

IIW Doc : XII - 1147 - 89

QUALITY ASSURANCE AND THE APPROVAL OF WELDING CONSUMABLES.

C. V. Sevenhaven

Abstract

A few additions to IIW Doc : XII - 1017 - 87 : Quality Assurance/Quality Control with respect to weld filler metal is discussed.

The importance of including a good functioning Q.A system in the approval of welding consumables by independent certifying bodies is emphasised:

The new method of working of The Association Control as, one such certifying body, which already includes Q.A in its approval of welding consumables, is described. The inclusion of such an authorisation (approval) can form an important means of reducing the purchasing costs of welding consumables.

The importance of striving towards International Standardisation in the field of the certification and authorisation (approval) of welding consumables is underlined.

IIW Doc : XII - 1148 - 89

RECENT ADVANCES IN INVERTER CONTROLLED GAS SHIELDED ARC WELDING POWER SOURCES AND THEIR APPLICATIONS IN JAPAN

-Hideyuki Yamamoto

Abstract

This report summarises Japanese trends of arc welding processes and power sources, especially, recent advances of inverter controlled power sources with various kinds of new current wave control method for gas shielded metal arc welding processes.

The features of inverter controlled machine are not only compact and light weight design but also various improvement of weldability and control of arc welding phenomena such as metal transfer, arc plasma characteristics, bead formations, etc., and these features will contribute to much more automatising of arc welding.

IIW Doc : XII - 1146 - 89

THE EFFECT OF WAVE SHAPE ON THE REDUCTION OF SPATTER GENERATION DURING HIGH SPEED PULSED MAG WELDING

Hideyuki Yamamoto, Shoji Harada, Tetsuo Yasuda

Abstract

In pulsed MAG welding process, usually generation of spatter is little because of absence of short circuiting during metal transfer. But when the welding speed is accelerated to some extent (1.5 to 2.0 m/min.), spatter generation increases considerably due to lowering of arc voltage. In turn, it creates number of problems e.g. wire sticking, clogging of welding torch, jigs, sensors etc.

In this report, a pulse power source having transistor inverter control, capable of presetting of pulse wave form, is mainly used.

The effect of pulse form on the spatter generation rate is investigated in a high speed pulsed MAG welding through-high speed photography, and -statistical analysis of pulse by a current and voltage wave form analyser using a personal computer.

Results of these experiments revealed that there is a strong correlation between the shortcircuiting frequency in pulse and transition durations and the spatter generation rate. Based on knowledge gained a new wave form control is developed to reduce the spatter generation, to about one fifth of counterpart of the conventional power source for pulsed MAG welding.

IIW Commission XIII : Fatigue Testing

Reported by - Prof. V.M. Radhakrishnan
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IIW Doc : XIII - 1344 - 89

FATIGUE CRACKING IN AN ORTHOTROPIC BRIDGE DECK.

ENQUIRY OF THE IIW ON FATIGUE FRACTURES OCCURRING IN WELDED STRUCTURES.

Abstract

In this paper the fatigue failure in an orthotropic bridge deck has been analysed. The failure occurred in trapezoidal deck stiffeners in an orthotropic steel suspension bridge. The stiffeners were 6.5 mm thick while the deck to which they were fillet welded was 11mm thick.

Cracks have been induced due to fatigue under traffic conditions. The paper suggests to avoid unnecessary welds in fatigue loaded structures. Temporary welds like those attaching the floatation diaphragms etc., should be removed after use and the surface of the structure carefully ground to remove all traces of the weld. The effect on fatigue life of all welds in the final structure must be considered at the design stage. Load transfer over a relatively small area creates a hard spot resulting in high local bending stresses.

IIW Doc : XIII - 1345 - 89

FATIGUE FAILURE OF CLOSURE WELD IN A TUBULAR MEMBER.

ENQUIRY OF THE IIW ON FATIGUE FRACTURES OCCURRING IN WELDED STRUCTURES

Abstract

In this report fatigue failure of closure weld in a tubular member is investigated. The failure occurred in a brace member of a tubular offshore oil recovery platform operating in the North Sea. The structure was subjected to wave loading which resulted in a random load stress spectrum in the structure. The brace members experience predominantly axial stresses resulting from bending of

the main legs of the platform.

Investigation revealed that the brace member failed by fatigue crack growth from a welding defect. The paper emphasizes the need for good quality butt welds in tubular sections.

IIW Doc : XIII - 1349 - 89

INFLUENCE OF DESIGN PARAMETERS ON THE FATIGUE PROPERTIES OF ADHESIVE BONDED/ SPOT WELDED BOX STRUCTURES.

N. T. Williams and T. B. Jones.

Abstract

The effects of design parameters on the fatigue properties of adhesive or spot welded box structures have been studied and reported in this paper. The optimum fatigue properties of both spot welded and adhesive bonded structures are reported to have been achieved when the section is designed such that the joint is loaded in shear rather than in tension. When loaded in shear, failure occurred in the structure rather than in the weld or bonded joint.

An increase in sheet thickness leads to a marked improvement in the fatigue properties. With spot welded structures weld size and weld pitch markedly improved the fatigue properties. For the welds of the same boundary length, weld shape did not influence the results.

IIW Doc : XIII - 1358 - 89

DEVELOPMENT OF THE METHOD TO EVALUATE THE FATIGUE LIFE OF SPOT WELDED STRUCTURES BY FRACTURE MECHANICS.

R. Yuuki and T. Ohira.

Abstract

Fracture Mechanics seems to be the most possible approach to the evaluation of the fatigue life or strength of the spot welded structures in an automobile body. However, there exists difficulty to analyse the stress intensity factors K, for a spot in the structure.

In this paper the system 'BEM-SPOT' coupling a finite element analysis and a boundary element analysis has been developed to evaluate the K values for a spot in the structure. The authors claim that this system can predict the fatigue life of a spot welded structure based on fracture mechanics.

IIW Doc : XIII - 1359 - 89

ON FATIGUE STRENGTH OF SPOT WELDED JOINT IN COATED STEELS.

T. Satoh, J. Katayama and M. Ueda.

Abstract

In this paper the results of the investigations carried out to estimate the fatigue strength of spot welded joint in coated steels. The study covers the metallurgical aspects of spot welded joints subjected to fatigue loading conditions. Columnar structure outside the conventional nugget has been observed. The fatigue strength near the endurance limit is equal to that of the mild steel. The fatigue crack in spot welded joints in coated steels initiates always from interface of mother sheet.

IIW Doc : XIII - 1360 - 89

INFLUENCE OF SECTION DESIGN AND LOADING REGIME ON THE FATIGUE PROPERTIES OF SPOT WELDED / ADHESIVE BONDED BOX SECTIONS.

T. B. Jones and N.T. Williams.

In this paper the results of a series of empirical investigations aimed at examining the influence of section geometry and loading regime on the fatigue properties of box sections fabricated either by spot welding or by adhesive bonding are presented.

These indicate that optimum performance is achieved when the section design is such that the joint is loaded in shear rather than in torsion. Fatigue tests under variable amplitude loading conditions suggest that the use of Miner's rule would in general provide a safe estimate of fatigue life for spot welded structures based on results obtained under constant amplitude loading conditions. In contrast, with adhesive bonded structures the extent to which the fatigue life is underestimated would render the use of Miner's rule unacceptable, particularly under high load conditions.

IIW Commission XV : Fundamentals of Design & Fabrication of Welding

*Reported by - Mr. P. R. Natarajan
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IIW Doc : XV - 626 - 87

THE EFFECT OF WELDING RESIDUAL STRESSES ON THE BUCKLING LOADS OF COLUMNS, PLATES AND SHELLS MADE OF STEEL.

Abstract

The geometrical imperfections and residual stresses due to welding process reduce the ultimate buckling loads of columns, plates and shells. The effect of the residual welding stresses on the actual buckling loads is dealt in this report.

In the case of columns, in the European column curves, the reduction for welded sections is not more than 10% in any case. It is around 7% for plates with 4 edges supported, according to the tests carried out in Darmstadt Technische Hochschule. For plates with free longitudinal edges, the maximum deviation is around 12% as per the tests carried out at the University of Cambridge. In the case of plates with clamped edges, the difference is smaller than 5%. However, it is rather difficult to make any generally valid statement on the effect of residual stresses on buckling loads on plates. It is still more difficult in the case of shells.

A number of references on this topic (27 papers) are given in the report. Comparisons have been made between box sections and I-sections in the welded state and in the hot-rolled and subsequently stress-relieved state. Effect of heat treating and flame cutting are

discussed in detail. For columns and plates, tables and graphs are given to show the effect of welding residual stresses has on the buckling load. The increase in load carrying capacity due to stress relieving is also discussed. In many cases, especially if the member is not loaded in compression, the benefit due to stress relieving is small.

IIW Commission XV : Fundamentals of Design & Fabrication of Welding

*Reported by - P.R. Natarajan
Chairman, Indian Commission XV*

IIW Doc : XV - 698 - 89

WELDING UNDER LOAD

Abstract

The report gives a method of analysis to estimate the effect of welding structural members under load on their load carrying capacity. First, a procedure is given to calculate the amount of heat in relation to the arc power and to establish the temperature field. Then, the influence of the temperature distribution on the load carrying capacity. With the increase of temperature, the yield stress, ultimate strength and Young's modulus of steel decreases. With these parameters, determination of reduction of area of cross section due to temperature is explained. Then, procedures to calculate the deformation caused by longitudinal and transverse welds in the unloaded members and to evaluate deformations due to welding the loaded member are given. During welding, safety of the structure must be verified at three different time points.

IIW Doc : XV - 701 - 89

DESIGN RECOMMENDATIONS FOR HOLLOW SECTION JOINTS

Abstract

The document deals with recommendations for the analysis and design of predominantly statically loaded, single plane, joints in lattice structures composed of hollow sections with round, square or rectangular shape or combinations of these with open section chords. Seamless and welded hot finished hollow sections, cold formed or cold formed and stress relieved hollow sections, and hot rolled H and I sections conforming to relevant ISO/European standards are covered by the recommendations. Limit state design approach is followed. Joints of various types like T, Y, X, K, N and KT have been covered. The design resistance of welded joints is given for axial bending and combined loads. Joints with overlap have also been covered. Quality requirements for structural hollow sections and recommended weld details are also given in appendices. The recommendations cover only simple joints. Complex joints with stiffeners, gussets, etc. have not been covered. Some of the latest research finding like the UEG Publications based on European Offshore Research on tubular joints have been referred. Since the recommendations are mainly for predominantly statically loaded structures, no mention is made about stress concentration and fatigue behaviour of the joints. No mention is also made about residual stresses in welded joints.

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