

- Abstracts of IIW Documents

IIW Commission VIII : Health & Safety

Reported by - Dr. M.B. Surendranath Lal,
Chairman, Indian Commission VIII

IIW/IIS Doc : VIII-1475-89

SHOULDER PAIN IN INDUSTRY : AN EPIDEMIOLOGICAL STUDY ON WELDERS

P. Herberts, R. Kadefors, G. Andersson and I. Petersen.

Abstract

The occurrence of supraspinatus tendinitis in a group of welders at a shipyard was investigated and compared with the occurrence of this condition in a group of office clerks. The study showed a prevalence ratio of 18 per cent in the welders, significantly higher than in the clerks. The average age (38 years) in the group with pain did not differ significantly from the average age in the entire group of welders. It is concluded that supraspinatus tendinitis is not exclusively an aging phenomenon, but that welding as an occupation plays an etiological role.

IIW/IIS Doc : VIII-1476-89

SHOULDER PAIN AND HEAVY MANUAL LABOR

*P. Herberts, R. Kadefors, C. Hogfors and G. Sigholm
(Sweden).*

Abstract

The problem of the increasingly common shoulder pain syndromes in industry was investigated by biomechanic and epidemiologic methods. Rotator cuff tendinitis constitutes a major problem in people with arduous occupations, i.e., shipyard welders (prevalence ratio, 18.3%), and steel plate workers (16.2%). Static work seems to induce symptoms at an earlier age. The clinical diagnosis was supraspinatus tendinitis. The biomechanic studies confirmed the view that the shoulder muscles are heavily loaded when the arm is elevated. Excessive hand tool mass increases the strain markedly in some muscles, particularly the supraspinatus and the infraspinatus. The hypovascularity of the supraspinatus tendon is then likely to be accentuated by high intramuscular pressure that reduces the blood flow through the muscle. The strain on the supraspinatus muscle in overhead work is an important factor contributing to prolonged shoulder disability. An analysis of the distribution of loads imposed on the shoulder in practical working situations can be based on observations of working postures and external forces.

The study points clearly at the risk in evaluating problems in the musculoskeletal system on the basis of questionnaires only.

This study has clearly shown that supraspinatus tendinitis is not exclusively an aging phenomenon.

A fact of interest in this investigation is that supraspinatus tendinitis is equally common in the two groups studied, but it appears at an earlier age in the welders than it does in the plate-workers. The single important difference between the two types of occupations is that welding can be characterized as an almost exclusively static work, whereas plate-working is dynamic in character. The possibility that static work entails a higher risk for

chronic shoulder pain is of course of the greatest interest from the point of view of occupational health. It has direct bearing on ergonomic planning of welder's work and workplaces.

IIW/IIS Doc : VIII-1477-89

HANDLING EQUIPMENT FOR MANUAL WELDING

M. Zackrisson

Abstract

Manual welding is a tough job. The welder is exposed to fumes, heat, luminescence, noise, vibration, high physical strain and risk of accident.

The high physical strain is an accepted hazard in the welding profession. But insurance statistics indicate that this high physical strain is unacceptable. The trend to replace MMA welding with MIG/MAG welding increases the physical strain on the welder, a situation which does not look good for the future.

There are basically two different ways to reduce the high physical strain during welding:

- o Improvement of the welder's working position and relieving welding gun weight. There is equipment for this purpose presently available, such as positioners, fork tables and support arms.
- o Mechanisation of the welding process. Two types of mechanisation equipment will be taken up here: firstly a robot which is so easy to programme that it can be used for small series, and secondly, mobile travel carriages for the welding equipment applied mainly to large objects.

IIW/IIS Doc : VIII-1484-89

CAUSE SPECIFIC MORTALITY AMONG WORKERS EXPOSED TO WELDING FUMES AND GASES: A HISTORICAL PROSPECTIVE STUDY

F. Merlo, M. Constantini and M. Doria

Abstract

The present study was designed to investigate whether a causal relationship exists between occupational exposure to welding fumes and gases and an increased mortality from respiratory tract cancers and bladder and kidney cancers. A cohort of workers exposed to welding fumes was identified among all the workers - active and retired - employed in the shipyard of Genova, Italy.

The study shows that oxyacetylene welders have experienced a higher than expected mortality from all deaths, all cancers, respiratory tract cancers, and bladder and kidney cancers. These findings are confirmed both by SMR and Cox's regression analysis. Indirect adjustment for smoking habits allowed to estimate increased risks for respiratory cancers of 20-30%, figures that are much lower than the 130-230% increases estimated by SMR analysis.

The findings of the study confirm the association between site specific cancers and occupational exposure to specific welding fumes. The fact that increased risks for respiratory tract cancers and bladder and kidney cancers were detected only among oxyacetylene welders seems to support the suggested hypothesis of a causal link between these site specific cancers and the exposure to polycyclic aromatic hydrocarbons.

IIW/IIS Doc : VIII-1485-89

OZONE IN ARC WELDING

E. Smars and L. Sipek

Abstract

Ozone is a strongly oxidizing substance which even at very low concentrations has a negative effect on the human body. In gas shielded arc welding it is found in quantities which can give rise to concentrations in the welders breathing zone above the hygienic threshold limit value (TLV).

The mechanisms of formation and decomposition of ozone is very complicated and depend in a very complex way on welding method, welded material, arc current, arc voltage, arc length, type of shielding gas composition, type of weld, welding torch position etc. It is therefore almost impossible to predict the level of ozone production for a specific welding situation. The strong reactivity of ozone with nitric oxide and its sensitivity to catalytic decomposition is of great importance for the net amount of ozone formed in welding.

In most cases ozone in concentrations of importance is found only in the plume of warm air mixed with fume, shielding gas and other gases rising from weld spot. Only in GMA welding of aluminium and aluminium alloys important ozone concentrations can be found outside the plume, within a distance of a meter or so. Therefore, ozone can be a problem only for the welder and his assistant, but not for other people on the premises.

IIW/IIS Doc : VIII-1486-89

OZONE AND NITROGEN OXIDES IN GAS SHIELDED ARC WELDING

Abstract

This paper describes briefly the results of five years' research into the formation of ozone and nitrogen oxides in connection with gas shielded arc welding. A detailed description is given of amounts of these pollutants generated and how the concentrations vary in space under controlled airflow conditions. Methods are described of reducing ozone generation.

IIW Commission X : Residual stresses, stress Relieving and Brittle Fractures

*Reported by - Dr. S. Prasannakumar
Chairman, Indian Commission X*

IIW Doc : X-1101-86

THE EFFECTS OF PWHT ON THE TOUGHNESS OF SHIELDED METAL ARC WELD METALS FOR USE IN CANADIAN OFFSHORE STRUCTURE FABRICATION

J. E. M. Braid and J. A. Gianetto, (United Kingdom)

Abstract

The effects of Post-weld Heat Treatment on the toughness of shielded metal arc welds were investigated. C-Mn and C-Mn-Ni electrodes were used to make butt welds in 40mm thick C-Mn micro-alloyed steel and the joints were subjected to post-weld heat treatment of two hours at 600°C. Toughness was assessed both by Charpy specimens and CTOD specimens. There was no change in Charpy toughness after PWHT for C-Mn weld metals while C-Mn-Ni weld metals showed a loss of toughness. The toughness behaviour of C-Mn-Ni welds is attributed to more embrittlement by carbide precipitation.

IIW Doc : X-1109-86

DYNAMICAL ASPECT OF COLD CRACKING PARAMETER

Yukio, UEDA and You Chul Kim, (Japan)

Abstract

In this paper, a series of theoretical analyses are performed for restraint stress-strain produced in the weldmetal of the oblique Y-groove weld cracking test specimen, by varying the kind of steel, heat input, pre-heat temperature and base plate thickness. A dynamical measure for cold cracking is defined in terms of restraint intensity and restraint stress-strain. Accuracy of the cold cracking susceptibility parameters PW and PHA are investigated from the dynamical point of view and usefulness of the newly proposed dynamical measure, restraint strain, is demonstrated.

IIW Doc : X-1114-86

A CASE OF REHEAT CRACKING ON HSLA STEEL WELDMENTS

I. Rak and V. Gliha, (Yugoslavia)

Abstract

Stress relief heat treatment on weldments of thick walled vessels of HSLA steels represent a complex problem. In this document, a case is reported on SRHT of Q&T steel weldments of 70 and 135mm thick plates.

While the steel producer does not recommend thermal stress relieving, SRHT was carried out to satisfy codes. During thermal stress relieving, long cracks appeared due to high residual stresses and had to be repaired. Further experiments were carried out to determine steel susceptibility against reheat cracking.

IIW Doc : X-1115-86

ACOUSTIC EMISSION APPEARANCE DURING FORMING OF REHEAT CRACKING

I. Rak and J. Legat, (Yugoslavia)

Abstract

The main point of research mentioned in this document is to search the cause of acoustic emission activity which appears at low rate of loading at stress relieving temperature. To identify whether the acoustic emission signals appear as a result of dislocation slip which originates from Frank-Read source or as a result of micro-cracks forming on the coarse grain boundaries, different loading levels were used and metallographic analyses by scanning electron microscope for each level was done as well.

IIW Doc : X-1135-87

THE EFFECT OF THICKNESS ON FRACTURE TOUGHNESS OF WELDS IN STEEL

K. Satoh, M. Toyoda and F. Minami. (Japan)

Abstract

The effect of size on fracture toughness is also recognised in welded joints. Since mechanical and metallographical heterogeneity exists in welds, procedure has to be evolved for evaluating the results of tests on heterogeneous welds. In the present work, CTOD tests on multipass welds have been carried out with specimens of different thickness. The weakest link model is made applicable to evaluate the dependence of cleavage toughness on thickness. The same model is also applicable to analyse the effect of the size of C. G. Haz on fracture toughness of welds.

IIW Doc : X-1139-87

WELD METAL CHARPY - CTOD CORRELATIONS FOR COLD MARINE APPLICATIONS

J. E. M. Braid, (United Kingdom)

Abstract

Empirical correlations between CTOD and 35J Charpy transition temperature have been made for weld metals at -10°C and -30°C test temperatures. Results at -10°C conform to the applicable UK Dept. of Energy requirements. Though submerged arc welds give higher CTOD values, it is recommended that for the purposes of design codes and standards, the correlations based on shielded metal-arc weld and flux cored arc weld data only be used, since achievement of specific toughness levels is necessary in out of position of welds.

IIW Doc : X-1140-87

THE QUALITY OF CORROSION RESISTANT WELD OVERLAYS

P. Veron, (Spain)

Abstract

During postweld heat treatment at around 600°C, the interface between the low alloy steel and the austenitic stainless steel overlay is damaged by carbon migration and high thermal stresses. According to some manufacturing experiences, this can lead to lack of bonding at this interface under extreme conditions. Knowledge of the cracking mechanism involved in this relatively simple case of PWHT should improve the understanding of austenitic / ferritic weld interface disbanding under other conditions as in field service or hydrogen - induced cracking or creep damage.

IIW Doc : X-1149-87

SERVICE AND TECHNOLOGICAL REQUIREMENTS FOR WELDED JOINTS RELATIVE TO CONTINUITIES

V. A. Vinokurov, (U.S.S.R.)

Abstract

This document is one of the efforts to develop data regulating the admissible defects in welded joints on the basis of "fitness for purpose" - approach. For the same, it is important to properly understand the terms service requirements and technological requirements. The technological requirements should always be considered as necessary and sufficient if they significantly surpass the requirements resulting from service conditions.

IIW Doc : X-1164-88

AN EXPERT SYSTEM FOR SPECIFYING WELDING PROCEDURES FOR A PRESSURE VESSEL

Shuichi Fukuda, Yoichi Kamio and Yutaka Kita, (Japan)

Abstract

This document presents a PC version system WELSYS2 which is a design type expert system for determining WPS (Welding Procedure Specification) for a high strength steel pressure vessel. The system is written in programming languages OPS83, MS-C and dBASE III. Because of the limitations of memory space of 640 KB of MS-DOS operating system, the available knowledge is restricted to fit into this framework.

IIW Doc : X-1166-88

EXPERIMENTAL INVESTIGATION OF RESIDUAL STRAIN FORMATION

R. G. Adamov, Cand. M. D. Novopashin, Dr. V. P. Larionov, (U.S.S.R.)

Abstract

Notable advances have been made to investigate experimentally (and theoretically) welding stresses and strain formation. But, the kinetics of plasto-elastic deformations is not yet clearly understood. The existing experimental and design methods give restricted information on kinetics of strain in high temperature affected zone. In this document, quantitative evaluation of thermal deformation cycles in the heat affected zone is carried out, with the help of a heat resisting grid used for registering weld deformations.

IIW Commission XIII : Fatigue Testing

*Reported by - Prof. Dr. V.M. Radhakrishnan
Chairman, Indian Commission XIII*

IIW Doc : XIII-1268-88

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

Abstract

This is the revised version of the draft document for critical assessment. It deals with the data required for assessment, probability of survival, assessment of known flaws, and estimation of tolerable sizes of flaws. Design and calculations approaches are dealt with clearly.

IIW Doc : XIII-1306-88

SIZE EFFECTS IN MACHINE COMPONENTS AND WELDED JOINTS

P.J. Haagenen, T. Slind and O. Orjasaeter

Abstract

In this paper the main factors affecting the size effect in machine components and welded joints are reviewed. Some engineering rules dealing with this effect are also discussed. Prediction models for fatigue life including crack initiation and crack propagation stages have been used to calculate the effect of section thickness under various conditions. Experimental data from literature and from tests have been evaluated with respect to the influence on the size effect from stress concentrations and the relative amount of crack initiation vs crack propagation. The results indicate that observed size effects depend mainly on the severity of the notch and on the accuracy of geometric scaling. Implications for design and suggested modifications to design rules are discussed.

IIW Doc : XIII-1307-89

FATIGUE CRACK GROWTH UNDER RANDOM LOADING - THE EQUIVALENT LOADING APPROACH

A. Bignonnet, Y. Sixou and J.M. Verstavel.

Abstract

The paper deals with fatigue crack growth under stationary Gaussian loading process. Specific fatigue testing has been performed to verify the validity of using an equivalent loading to describe the crack growth under random loading. The statistical moment of mth order (m : exponent of the Paris law) of the load distribution was formally introduced as the equivalent load.

IIW Doc : XIII-1311-89

LOCAL STRESS PARAMETERS AT THE WELD SPOT OF VARIOUS SPECIMENS

D. Radaj, Z. Zhaoyun and W. Mohrmann.

Abstract

In this paper the authors have assessed the strength of spot welded joints by analysing the local stress parameters at the edge of the weld spot, the hot spot structural stress, the notch stress and the stress intensity. The latter are determined by means of finite element and boundary element calculation. The relations for the load bearing capacity of the weld spots in various specimens and load cases have been derived. The effect of variation in plate thickness and weld spot diameter on the load bearing capacity is also discussed with the example of tensile shear and cross tension specimen.

IIW Doc : XIII-1312-89

LOCAL FATIGUE STRENGTH CHARACTERISTIC VALUES FOR SPOT WELDED JOINTS

D. Radaj

Abstract

In this paper the author has compiled the local fatigue strength characteristic values for spot welded joints in the form of endurable local strains, structural stresses and stress intensity factors. Such strain or stress amplitudes endured dependent on number of cycles are hitherto known only for unalloyed and high tensile strength steels. Strength hypotheses for locally multi-axial stress and strain parameters have also been discussed by the author.

IIW Doc : XIII-1313-89

THE INFLUENCE OF UNDERCUT ON THE FATIGUE STRENGTH OF WELDS

H. Petershagen

Abstract

This document is a revision of document XIII-1120-84. In this revised document discussions held in the commission and its working group are considered and additional data are included. The recommendations made with respect to the classification of welds with undercut are in accordance with the 'recommendations for assessment of weld imperfections in respect to fatigue' and the 'IIW recommendation on the application of an engineering critical assessment in design, fabrication and inspection to assess the fitness for purpose of welded products'.

IIW Doc : XIII-1331-89

FATIGUE STRENGTH OF SPOT WELDED BEAMS IN HIGH STRENGTH STEELS - PROGRESS REPORT

J.O. Sperle and M. Jonsson

Abstract

In this paper the authors present the results of fatigue tests carried out on non-load carrying and load carrying spot welded beams of mild steel as well as dual phase and HSLA types of high strength steel. The tests were performed at $R = -1$ under constant amplitude loading with and without occasional overloads. The fatigue strength of the non-load carrying beams increases almost in direct proportion to the increase in yield strength. The load carrying beams show a fatigue strength which increases along with the base metal strength; however, this increase is less than that of

non-loading beams. Occasional overloads give a 2-4 times increase in fatigue life for the dual phase steel.

IIW Doc : XIII-1314-89

COLLAPSE OF A GANTRY CRANE

Abstract

In this report the failure of a gantry crane is analysed and reported. The construction concerned is a gantry crane used during erection and overhaul of large buildings. Its horizontal structure consisted of a triangular cross section built up from profiles which served as a catwalk. The crane collapsed towards its fixed support. The probable reason is a fracture in the upper articulated tension beam. The failure is mainly attributed to fatigue load. The joint is classified as Class 71 joint.

IIW Doc : XIII-1315-89

FATIGUE STRENGTH OF NON-PENETRATING BUTT WELDS IN DH36 SHIPBUILDING STEEL

H. Petershagen

Abstract

Considerable savings in the production cost can be achieved by introducing non-penetrating butt welds into the design of ship structures. The author has carried out fatigue tests with ship steel grade DH36 and plate thickness from 15 mm to 30 mm. The welding parameters were selected according to practice and kept constant for all plate thickness. The butt welds were axially loaded parallel and transverse to the weld.

The results of 15 mm plates with full penetration welds fit well into the existing data. In the case of a non-penetrating weld the crack started from the weld root. For parallel load the welds could be classified as a K2 detail according to the Rules of Germanischer Lloyd, while the results for transverse load indicated a K4 detail. Fracture mechanics based crack propagation calculations permit a safe fatigue life estimate. Tests were also carried out with post-weld heat treated specimens to show the influence of residual stresses.

IIW Doc : XIII-1326-89

GEOMETRICAL PARAMETERS OF BUTT AND FILLET WELDS AND THEIR INFLUENCE ON THE WELDED JOINT FATIGUE LIFE

V.V. Yakubovskii and I.I. Valteris

Abstract

The results of geometrical parameters in butt and fillet welded joints in steels of various strength grades have been systematized and generalised in this paper. On the basis of the analysis the values are recommended for the weld dimension distribution parameters, which are the most markedly effected by the welding process and technology.

IIW Doc : XIII-1327-89

IMITATIVE SIMULATION OF WELDED JOINT FATIGUE UNDER LOW CYCLE LOADING

U.F. Lukjandu and A.S. Korobrsou.

Abstract

In this paper the authors develop an imitative framework which takes into account random character of initiation, growth and coalescence processes of separate cracks. The model predicts exactly the serviceability of welded joints.

IIW Commission V : Testing, Measurement and Control of Welds

Reported by - Baldev Raj
Chairman, Indian Commission V

IIW Doc : V-908-89 INFORMATION ON PRACTICES FOR UNDERWATER NON-DESTRUCTIVE TESTING Abstract

The objectives 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 level 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 ultrasonics and magnetic particles testing. 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.

IIW Doc : V-906-89/OE 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 organization 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 act a basis reduction in costs.

IIW Doc : V-892/88 PECULIARITIES OF AUTOMATED ULTRASONIC TESTING OF WELDED JOINTS IN SPECIAL PURPOSE STRUCTURES WELDED BY DIFFERENT METHODS

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 automated non-destructive testing installations.

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 advanced ultrasonic installations are :

- o high test rate which correspond to production speed
- o comparatively short time of adaptation for items of other types
- o continuous monitoring
- o reproducible test results
- o completely automated process
- o periodic functional check of installation and due to this high operating reliability
- o 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 of various kinds of welding and weldments. The specific integrated UST installations and the outlooks for the development of this direction in the USSR, the defect configuration identification in particular are considered.

IIW Doc : V-893/89 EVALUATION OF THE RELIABILITY OF ULTRASONIC INSPECTION

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 45 mm 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 process 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 analyses in greater depth.

**Editor's note: Photocopy of the original documents are available at a nominal cost.
Please write to the Editor, using the Readers' Card.**
