

Internationell svetskonstruktör, IWSD - Kursprogram

Welding for designers (M1 & M7)

Modul 1: WELDING TECHNOLOGY / Svetsteknologi

1.1 Welding terminology/svetsterminologi, 3 timmar

Objective:

The students will understand key terms and abbreviations and be acquainted with basic standards pertaining to welding and welded joints.

Scope:

Definitions and terminology related to:

- basic types of welded joints;
- joint preparation;
- fusion joints.

Expected result at comprehensive and standard levels:

Review standard terminology in EN ISO 17659 "Welding. Multilingual terms for welded joints with illustrations".

Review standard terminology in EN ISO 4063:2000 "Welding and allied processes – Nomenclature of processes and reference numbers".

Present proper terms when discussing with welding engineers and welding technicians.

Illustrate how to locate information from relevant standards.

Classify various types of fusion joints based on proper terminology.

Classify various weld joint types based on proper terminology.

Classify weld preparations based on proper terminology.

1.2 Welding symbols and design drawings/ Svetsbeteckningar, 3 timmar

Objective:

The students will be acquainted with welding symbols and characters used in design drawings and how to produce engineering drawings for production.

Scope:

Welding symbols

Weld drawing characters

Weld process abbreviations

Expected result at comprehensive and standard levels:

Review standard EN 22553:1994 "Welded, brazed and soldered joints – Symbolic representation on drawings".

Interpretation of correct welding process based on standard representations.

Illustrate correct markings or engineering drawings for a weld process.

Explain specifications for weld quality for design and inspection.

Explain the procedure for edge preparation and the common symbols used.

1.3 Overview of welding processes / översikt över svetsprocesser, 9 timmar

Objective:

The student will become acquainted with the most common welding processes designated and designations for welding processes.

Scope:

For mechanical and process engineering the following welding process are recommended. The specific processes included in this section may vary depending on the target industry of the audience.

Manual metal arc

MIG/MAG

TIG

Submerged arc

Electron beam

Laser welding

Resistance welding

Friction stir welding

Expected result at comprehensive and standard levels:

Explain the working principals of the most common welding processes.

Explain the goals for selecting a suitable welding process for an application.

Review nomenclature in EN ISO 4063:2000 "Welding and allied processes – Nomenclature of processes and reference numbers".

Explain the range of applications for the methods being presented.
Explain constructional and material requirements for the welding processes.
Illustrate proper welding parameters for an application.
Explain the selection of welding consumables.
Formulation and interpretation of a welding procedure specification (WPS).

1.4 Materials and weld metallurgy/Material och svetsmetallurgi, 10 timmar

Objective:

The students will understand effects of welding on the material metallurgy. This includes effect on material microstructure, hardness, hot cracking, ductility, etc.

Scope:

Welding of constructional materials and their properties in the as-welded condition

Basics of welding metallurgy

Effect of heat input

Fe-C equilibrium- and TTT- diagrams

Microstructures and the effect on the mechanical properties of weld

Typical imperfections and errors

Expected result at comprehensive and standard levels:

Explain aspects of welded joint design to ensure ductility.

Illustrate the control of heat input for weld processes.

Explain basic aspects of control the microstructures by heat input.

Explain proper selection of filler materials for common applications.

Review common weld imperfections and their sources.

Explain methods to avoid common weld imperfections.

Module 7: FABRICATION, COSTS, QUALITY AND INSPECTION / Tillverkning, kostnader, kvalitet och inspektion

7.1 Fabrication costs and cost reduction, 8 tim

Objective:

The students will understand the average cost levels of various fabrication processes and how they affect the total cost of a product

Scope:

Joint preparation costs

Filler material cost

Welding speed and machine costs

Fixed and marginal costs

Semi finished components

Expected result at comprehensive and standard levels:

Compute example on the influence of weld throat thickness on weld cost.

Illustrate typical division of welding costs for different types of welding operations.

Review typical production process and their relationship between cost and productivity.

Comparison of costs levels for manual welding, mechanized welding and robot welding.

Review of case studies in fabrication cost reduction.

7.2 Fabrication friendly design, 10 tim

Objective:

The students will have be acquainted with the costs of common fabrication processes of a welded structure and how these costs can be minimized during the design process. The student should know how to communicate these "fabrication friendly" concepts is a design drawing.

Scope:

Production costs

Manufacture friendly design

Automated and robotized production

LCC

Production measures

Expected result at comprehensive and standard levels:

Explain the influence of design in the total cost of a finished product.

Explain the principals of life cycle costs.

Review industrial case studies on product cost reduction.

Present limitations and advantages of various automated and robotized processes and how these influence design.

Explain general steps to reduce the overall costs of a structure.

Review different and often conflicting measures of fabrication productivity.
Illustrate good and bad examples of design drawings for efficient fabrication costs.

7.3 Quality assurance in welding fabrication, 4 tim

Objective:

The students will be acquainted with the role, methods and requirements for quality assurance in welding fabrication

Scope:

Quality standards involved
Weld imperfections
Acceptance of imperfections
Quality systems for production

Expected result at comprehensive and standard levels:

Review fundamental aspects of a quality system for fabricated structures.
Explain and identify typical defect types in welded joints.
Review typical corrective actions for reducing weld flaws.
Review of relevant standards for quality control, e.g., ISO 9001 "Quality management systems", EN 3834-series "Quality requirements for welding technology", ISO 6520-1:1998 "Welding and allied processes. Classification of geometrical imperfections in metallic materials- Part 1 fusion welding", ISO 5817:2003 (EN 5817) "Welding – Fusion welded joints in steel, nickel titanium and their alloys – Quality level for imperfections" and ISO 10042:2006 "Arc Welding Joints in Aluminium and its Weldable Alloys - Guidance on Quality Levels for Imperfections".

7.4 Inspection methods and criteria, 3 tim

Objective:

The students will have be acquaint with the common inspection methods of welded structures and their applicability

Scope:

Inspection methods
Destructive testing:

- Charpy;
- Tensile;
- Bending;
- Etc.

Non-destructive testing:

- Magnetic particle;
- Ultrasonic;
- Etc.

Expected result at comprehensive and standard levels:

Explain the technical limitations of common non-destructive inspection methods.
Explain the function of common destructive test procedure.
Introduce documentation relevant to the inspection of welded joints.
Review of relevant standards for quality control, e.g., (ISO 5817:2003) "Arc-welded joints in steel – Guidance on quality levels for imperfections", ISO 15614-1 "Welding Procedure Tests For The Arc Welding Of Steel", EN 571-1 "Non destructive testing. Penetrant testing. Part 1: General principles", EN 583-1 "Non-destructive testing. Ultrasonic examination. Part 1: General principles", etc.