



American Welding Society  
INTERNATIONAL AGENT

**BETZ is the only Accredited Test Facility for  
American Welding Society, USA.**

**BETZ is also an International Agency for AWS to conduct  
Seminars and Certification Exams.**

 **BETZ is also a corporate partner for ASNT.** 

**AMERICAN WELDING SOCIETY – CERTIFIED WELDING ENGINEER  
AWS-CWEng Calendar for 2015**

Month	Seminar Date	Exam Date	Seminar City	Exam City
January	24 to 30	31 <sup>st</sup> Jan'15	Chennai	Chennai
February	21 to 27	28 <sup>th</sup> Feb'15	Chennai	Chennai
March	24 to 30	31 <sup>st</sup> Mar'15	Mumbai	Mumbai
April	23 to 29	30 <sup>th</sup> Apr'15	Chennai	Chennai
May	23 to 29	30 <sup>th</sup> May'15	Chennai	Chennai
June	23 to 29	30 <sup>th</sup> Jun'15	Chennai	Trichy
July	24 to 30	31 <sup>st</sup> Jul'15	Chennai	Chennai
August	23 to 29	30 <sup>th</sup> Aug'15	Chennai	Chennai
September	23 to 29	30 <sup>th</sup> Sep'15	Mumbai	Mumbai
October	24 to 30	31 <sup>st</sup> Oct'15	Chennai	Chennai
November	23 to 29	30 <sup>th</sup> Nov'15	Chennai	Chennai
December	22 to 28	29 <sup>th</sup> Dec'15	Chennai	Coimbatore

**BETZ ENGINEERING & TECHNOLOGY ZONE  
(Educational & Training Division)**

Door # 21, Dharakeshwari Nagar 1<sup>st</sup> Street, Sembakkam,  
Tambaram to Velacherry Main Road, Chennai – 600 073, INDIA.

Phone: +91 44 22780291/65364123/22670206

Mobile: 9551665684/9551665683/9551665681

E-mail: registration@welding-certification.com, betzzone@vsnl.net

Website: [www.welding-certification.com](http://www.welding-certification.com)



## Fees Structure:

### Seminar & Examination

Parts	1 & 2	3 & 4
Seminar Fee	Rs. 30,000/-	Rs. 40,000/-
A/C- Accommodation Charges	Rs. 5000/-*	Rs. 5000/-*
Examination Fee	US \$ 750	US \$ 750
Service Tax (as per Govt. Norms @ 12.36%)	Rs. 3708/-	Rs. 4944/-

\* Accommodation on first come first serve basis only.

#### MODE OF PAYMENT:

- ❖ The Seminar fees with Service Tax (Either Part 1 & 2 or Part 3 & 4) can be paid as Cheque/Demand Draft in favor of “**BETZ ENGINEERING & TECHNOLOGY ZONE,**” payable at **CHENNAI**.
- ❖ The examination fees in US\$ 750 (Either Part 1 & 2 or Part 3 & 4) can be paid as Demand Draft in favor of “**AMERICAN WELDING SOCIETY,** Payable at **USA**.

All the necessary documents along with DD and filled registration form should be sent to (our Admin Office) following address:-

### **BETZ ENGINEERING & TECHNOLOGY ZONE**

#74, First Street, Jeevan Nagar,

Adambakkam, Chennai -600 088.

Phone: 044-65364123/22670206, Mobile: 9551665683/9840175179

### REGISTRATION PROCESS

- Registration/application is to be completed preferably 4 weeks prior to the commencement of the seminar, to avoid any late fees or disappointments.
- Upon completion of the registration process, candidates can collect their copy of study materials and AWS QC1:2007 certification handbook. This will help you to start your preparations immediately.

## ELIGIBILITY

In order to qualify for a certified welding engineer the candidate must be an individual

- Having Bachelor of Engineering (B.E) degree and a minimum of one (1) year relevant experience.
- Having Bachelor of Technology (B.Tech.) degree and a minimum of two (2) years relevant experience.
- Having other related Bachelor of Science (B.Sc.) degrees and a minimum of five (5) years of relevant experience.
- Having an Associate in Applied Science (A.A.Sc.) degree and a minimum of ten (10) years of relevant experience.
- Who have successfully completed high school or an equivalent program and a minimum of fifteen (15) years relevant experience.

## Exam pattern

The AWS Certified Welding Engineer (CWEng.) examination consists of four parts. Parts 1 and 2 must be successfully completed in order to take Parts 3 and 4. The first two parts (1 and 2) of the exam are closed book and covers fundamentals of basic science and applied science. Exam will be of two hours for each part of written type with multiple-choice questions (total time of four hours). Part 1 consists of 35 questions of multiple choices and Part 2 has 25 questions of multiple choices. Both the Parts are given together and must be passed together. If the candidate fails in any one part, only that part must be repeated.

Examinations for Parts 3 and 4 are open book examinations on welding related disciplines and practical welding and related applications. Each examination is three hours in length (Duration). Part 3 has 45 questions of essay type. Part 4 has 39 questions of multiple choice types. Candidates that successfully pass Parts 1 and 2 will be invited to sit for Part 3 and Part 4 examinations and a separate application must be submitted to AWS.

*Candidates must pass each of the four examinations with an individual score of not less than 60% and attain a minimum weighted percentage of 70% for all 4 Parts.*

## Seminar Pattern – Parts # 1&2

This Six days course focuses on the fundamental knowledge in Basic Sciences (Part # 1) of Mathematics, Physics, Chemistry and applied sciences of strength (Part # 2) of Materials, Heat Transfer & Fluid Mechanics and Electricity.

- 2 days seminar will be conducted to cover the fundamentals of basic sciences of Part-1 examination that covers all the facets of AWS B5.16, knowledge of mathematics, physics and chemistry.
- 3 days seminar will be conducted to cover the Applied science fundamentals of Part-2 examination that covers the area of strength of materials, heat transfer, fluid mechanics and electricity.
- 1 day will be totally dedicated to discussion & review of Parts 1 and 2.

## Part #1 – Basic Science Fundamentals

### Mathematics:

- Simple Calculations (multiple choices)
- Special Functions (exp, log)
- Trigonometric Functions (sin, cos, tan, cot, sec, csc, degrees, radians)
- Algebraic Equations (linear, quadratic, polynomial)
- Graphs And Equations (slope, intercept, roots, derivatives, minimum, maximum, interpolation and extrapolation)
- Geometry (common geometric shapes)
- Hyperbola, Parabola
- Complex Numbers
- Calculus (fundamentals of differential equations)
- Statistics (population and samples: normal distribution, mean, standard deviation and variance)
- Simple correlation: linear regression via least squares method, r<sup>2</sup> correlation)

### Physics:

- Unit Conversion (dimension, mass, temperature, time, energy, power)
- Mass, Weight, Volume, Density
- Force, Energy, Work Done, Power
- Stress, Strain, Hooke's Law (elasticity)
- Moment and Momentum
- Temperature, Heat, Temperature Measurement, Thermocouples, Pyrometers
- Thermal Properties of Materials (Thermal Conductivity, Thermal Expansion, Thermal stress and strain)

### Chemistry:

- Symbols (elements and inorganic compounds—gases, fluxes, etc.)
- Molecular Weight and Stoichiometry
- Acids and Bases
- Balance Chemical Equations
- Gas Combustion Reactions (chemical heat generation) and oxidation-reduction reactions
- Ideal Gas Law (pressure, volume, temperature)
- Mass Balance (as in E7018 coating decomposition to gas, slag and metal)
- Bulk and Chemical Analysis Methodologies
- Reactivity, Toxicity, Environmental Effect, Disposal.

## Part #2 – Applied Science Fundamentals

### Strength of Materials:

- Load, Deformation (elastic and plastic, buckling), Stress- Strain, Young's Modulus, Shear Modulus, Stress- Strain Curve (yield stress, ultimate tensile stress, elongation) and tensile stress
- Shear stress computation
- Welded member cross-section effect
- Mechanical testing (tensile, bend, fracture toughness, hardness, creep, and fatigue) and data interpretation
- Law of Conservation of Energy/Momentum
- Stress analysis
- Typical engineering material properties

### **Heat Transfer and Fluid Mechanics:**

- Heat Conduction, Convection and Radiation, Thermal Conductivity and Diffusivity, Heat Transfer Coefficients of Engineering Materials and Fourier's Law
- Heating Rate and Cooling Rate
- Industrial Heating Methods, Power Consumption and Gas Flow Rates
- Laminar and Turbulent Flow (reynold's number), Dew Point and Relative Humidity, Pressure and Regulators Venturi Effect and Gas Velocity Calculation
- Atmospheric Pressure and Hyperbaric Conditions
- Vacuum Equipment and Measurements

### **Electricity:**

- Current, Voltage, Resistance, Impedance and Circuits
- Ohm's Law
- Kirchhoff's Law
- Resistance Loss and Current Rectification
- Power Generation
- AC/DC, polarity
- Power Factor
- Electromagnetic Properties
- Right-Hand Rule
- Current and Voltage Measurements (devices and principles)

## **Seminar Pattern – Parts # 3&4**

These six days course focuses on the knowledge in welding related disciplines and practical welding related applications.

- 5 days of the seminar will be conducted to cover the NDE / weld discontinuities, welding heat sources, arc physics, welding processes and controls, welding and joining metallurgy, weld design, weld design safety, quality assurance and quality control in accordance with codes, specifications, other standards and / or drawings.
- 1 day will be totally dedicated to discussion & review of parts – 3 and 4.

### **Part #3 – Welding Related Disciplines (Essay Exam)**

#### **NDE/Weld Discontinuities:**

- NDE processes (radiographic, ultrasonic, magnetic particle, liquid penetrant, Eddy Current, etc.—characteristics, advantages and limitations)
- NDE symbols

#### **Welding Heat Sources and Arc Physics:**

- Power Source Static and Dynamic Characteristics (open circuit voltage and short circuiting current, slope)
- Differences Between CC And CV Designs (principle of self- adjusting)
- Welding Arc Characteristics (current and voltage relationship, arc length effect)
- Electron Emission (ionization potential, work function, electrode material, shielding gas and arc stability)
- Arc Temperature and Degree of Ionization (shielding gas influence)
- Magnetic Arc Blow (work lead location and condition)

- Lorentz Force (effect on droplet detachment and on adjacent power cables)
- Shielding Gas Drag Force (effect on droplet detachment and metal transfer mode) weld penetration and width for different shielding gases

### **Welding Processes and Controls:**

- Arc Welding Processes (SMAW, GMAW, FCAW, GTAW, SAW, PAW)
- Resistance Welding Processes (RW, high frequency RW), high energy density welding processes (LBW, EBW)
- Cutting Processes (OFC, CAC, and PAC)
- Surfacing Processing (SW, THSP)
- Solid-State Welding Processes (FRW, FW)

### **Welding and Joining Metallurgy:**

- Crystal Structure of Metals (FCC, BCC, HCP, unit cells, lattice parameter, c/a ratio, atom positions, interstitial positions)
- Melting and Solidification, Phase Transformations and Phase Diagrams (eutectic, eutectoid, peritectic and
- monotectic, lever rule calculation) metallurgy and weldability of typical engineering materials (low carbon structural steels, cast irons, stainless steels, nickel alloys, aluminum alloys, titanium alloys, etc.) microstructure (e.g., ferrous alloys—grain boundary ferrite, acicular ferrite, bainite, martensite, austenite, delta ferrite, etc.) and mechanical properties
- Carbon Equivalent (CEIIW, Pcm, expressions, alloying content and carbon content effect)
- Hydrogen Assisted Cracking (heat-affected zone cracking, cold cracking) base metal matching (e.g., electrodes with high strength steels)
- Solidification cracking (segregation of impurity atoms, shrinkage cracking, lamellar tearing)
- Delta Ferrite in Stainless Consumables, Specifications for Consumables (categories; all position, rutile, basic)
- Flux metal Reactions (oxygen and sulfur control in weld pool)
- Typical Temperature Range of a Heat Source
- Temperature Distribution in a Weldment
- HAZ Formation
- Multi pass Thermal Experience, Reheated Weld Metal Properties
- Weld Macro and Micro-Graph Interpretation
- Solidification Profile and Preferred Grain Orientation (epitaxial growth)
- Origin of Weld Ripples
- Special Attributes of Base Metal (as-cast structure, deformation texture and oxide on flame cut surfaces)
- Thermal Treatments (preheat, post heat, inter pass influence on weld cooling rate and residual stress distribution)
- Solid-State Transformations in Welds (different forms of ferrite, bainite, and martensite, sigma phase in stainless steels, Guinier-Preston type precipitates zones and ageing in aluminum alloys)
- Corrosion (sensitization in stainless steel welds and stress corrosion cracking in welds).

### **Weld Design:**

- Structural fabrication requirements, sectional properties and stress gradient
- Stress triaxiality, weld symbols, hardness and microhardness (e.g., across a weld cross section)
- Tensile properties, ductility, toughness, fillet break test (influence of second phase and porosity), ductile fracture, brittle fracture, fatigue (initiation, propagation, failure, high-cycle, low-cycle), temperature and strain rate effect.

## **Brazing and Soldering:**

- Characteristics of Brazing and Soldering
- Fluxes and Substrates
- Capillary Action
- Wetting and Spreading
- Contact Angle
- Joint Clearance
- Viscosity
- Liquidus and Solidus
- Flow of Molten Filler in Horizontal and Vertical Joints (Maximum Penetration and Rate)
- Filler Metal Systems (Sn-Pb solders, Ni and Cu based alloys, Ag-Cu based brazing alloys)
- Intermetallic Compound Formation.

## **Safety:**

- Recognize health hazards relating to welding (fumes, toxic gases, noise and radiation)
- Recognize safety hazards (electric shock, compressed gases, fire, welding in a confined space, welding on Containers, piping and moving equipment)
- Recognize precautions to avoid injury
- Possess a working knowledge of safety and fire codes.

## **Part #4 – Practical Welding and Related Applications**

### **Exam using references on the application of welding engineering concepts in the areas of:**

- Welding safety, Weldment design, Welding Metallurgy, Materials, Welding Process Selection, NDE including Visual Weld Inspection, Quality Assurance, Quality Control in Accordance With Codes, Specifications, other Standards, and /or Drawings.

## **Training Venue**

All seminars will be conducted in our own state of the art training & research division situated in 12000 Sq. ft. premises near Tambaram, Chennai.

**As the slot are limited to **Four Candidates** per Seminar the allocation would be on**

**"FIRST COME - FIRST SERVED" basis**

You are invited to make use of this opportunity and we look forward to interact with you during this Technical Qualification Program

Thanks and Regards

**RG. Ganesan**

**Head-Inspection services**

**Mob: 9840175179**

**BETZ ENGINEERING & TECHNOLOGY ZONE**

**#74, First Street, Jeevan Nagar, Adambakkam, Chennai -600 088, INDIA.**

**Tel: +91 44 65364123/22670206**

**Email: [registration@welding-certification.com](mailto:registration@welding-certification.com), [betzzone@vsnl.net](mailto:betzzone@vsnl.net)**

**Web: [www.welding-certification.com](http://www.welding-certification.com)**