

# **EASA European & World Chapter Limited**



***Reliable Solutions  
Today!***

**PERSONNEL COMPETENCE  
TRAINING SCHEME**

**for the**

**REPAIR AND OVERHAUL**

**of**

**EXPLOSIVE ATMOSPHERE EQUIPMENT**

**To**

**IEC 60079 – 19 : 2006**

**for**

**OPERATIVES & RESPONSIBLE PERSONS**

**SYLLABUS**

# Program Aims

The Successful Delegate will be able to: -

To maintain the requirements of the protection concept when carrying out overhaul and/or repair of Explosive Atmosphere Equipment and comply with the requirement of IEC 60079 -19 : 2006

# Contents

Induction: Including core knowledge.

Part 1 Health and Safety

Part 2 Quality

Part 3 Protection Principles of Ex Equipment, including explosive protection techniques.

3.5 Ex 'd'

3.6 Ex 'p'

3.7 Ex 'e'

3.8 Ex 'n'

3.9 – 3.13 Other Techniques Including Ex 'i', Ex 'o', Ex 's', etc.

Part 4. Requirements of IEC 60079 -19 : 2006

Part 5 Good Practice in Repair, Overhaul, and Rewinding of 3 Phase Electric Motors

## Part 1. Health & Safety.

Knowledge of Statutory Regulations and relevant standards affecting the repairs of hazardous area equipment including: -

Health and Safety at Work Etc. Act 1974 (HSWA)

Electricity at Work Regulations 1989 (EAWR)

Management of Health & Safety at Work Regulations: 1999

Repair and Overhaul for Apparatus Used In Explosive Atmospheres IEC 60079 -19 2006

Control of Substances Hazardous to Health Regulations 2002 amended 2005 (COSHH)

Provision and Use of Work Equipment Regulations 1998 (PUWER)

Dangerous Substance and Explosive Atmospheres Regulations 2002 (DSEAR)

Equipment and Protective Systems Intended for use in Potentially Explosive Atmosphere Regulations; 1996 ATEX Directive 94/9/EC

The Low Voltage Directive

**NOTE** – When training outside the UK reference to relevant local national standards and legislation must be applied.

### Including Duty on

- Manufacturers
- Users
- Repairers

### PART 1; DIRECTIVES, STANDARDS AND LEGISLATION. TABLE OF CONTENTS

#### 1.1 European Directives

##### 1.1.1 BACKGROUND

##### 1.1.2 TRADE DIRECTIVES

##### 1.1.3 HEALTH & SAFETY LEGISLATION

##### 1.1.4 DIRECTIVES RELEVANT TO ELECTRICAL WORK IN HAZARDOUS AREAS

- i) The ATEX 95 Directive (94 / 9 / EC)  
UK – Equipment and Protective Systems Intended for use in Potentially Explosive Atmospheres Regulations: 1996 (Enforced DTI Department of Trade & Industry & HSE)
- ii) The ATEX 137 Directive  
UK – Dangerous Substances and Explosive Atmospheres Regulations: 2002
- iii) The Low Voltage Directive  
UK – Electrical Equipment (Safety) Regulations; 1994
- iv) The EMC Directive.

##### 1.1.5 CE MARKING.

#### 1.2 Standards

##### 1.2.1 BSI (BRITISH STANDARDS INSTITUTION).

##### 1.2.2 EUROPEANS INTERNATIONAL STANDARDS BODIES

- (i) European Standards Bodies.
- (ii) International Standards Bodies.

### **1.2.3 STANDARDS NUMBERING WITH RESPECT TO ENGINEERING**

- (i) UK National Standards.
- (ii) European Standards.
- (iii) International Electrical Standards.

### **1.2.4 OTHER BODIES INVOLVED IN RELEVANT STANDARDS WORK**

- (i) The Institution of Electrical Engineers.
- (ii) The Institute of Petroleum (The IP).
- (iii) UKOOA The United Kingdom Offshore Operators Association.
- (iv) EEMUA -The Engineering Equipment and Materials Users Association.

### **1.2.5 STANDARDS FOR ELECTRICAL WORK IN HAZARDOUS AREAS**

- (i) Relevant to gases.
- (ii) Standards Tables –gases.
- (iii) Standards Relevant to combustible dusts.

## **1.3 Certification**

### **1.3.1 CERTIFICATION BY A NOTIFIED BODY**

- (i) What is a Notified Body?
- (ii) UK Notified Bodies.
- (iii) Test procedure for Certification.
- (iv) Certification identification marks.

### **1.3.2 Impact of ATEX 95 Directive on certification procedures.**

### **1.3.3 ASSESSMENT TO STANDARDS.**

- (i) Type tests.
- (ii) Routine tests.
- (iii) Sample tests.

## **1.4 Health and Safety Requirements in Law**

### **1.4.1 BASIC REQUIREMENTS CONCERNING THE WORKPLACE**

- (i) The principal acts and regulations.
- (ii) Basic Duties of Employer & Employee.

### **1.4.2 THE HEALTH AND SAFETY AT WORK ACT 1974. (&/or Regional Equivalent)**

- (i) Duties of Employers under HSW Act.
- (ii) General Duties of employees at work under HSW Act.

### **1.4.3 THE ELECTRICITY AT WORK REGULATIONS 1989. (&/or Regional Equivalent)**

- (i) Regulation 3
- (ii) Regulation 4
- (iii) Regulation 5
- (iv) Regulation 6
- (v) Regulation 16
- (vi) Examples of illegal situations

- 1.4.4 Provision and Use of Work Equipment Regulations.
- 1.4.5 The Management of Health and Safety at Work Regulations.
- 1.4.6 Personal Protective Equipment at Work Regulations.
- 1.4.7 Factory acts 1961.
- 1.4.8 Control of Substances Hazardous to Health COSHH Regulations. 2002 (as amended).
- 1.4.9 Dangerous Substances and Explosive Atmosphere Regulations 2002 (DSEAR)

**TABLES.**

- CH1-Table 1 BASE STANDARDS IN USE
- CH1-Table 2 STANDARDS RELEVANT TO FLAMMABLE GASES Cross references
- CH1-Table 3 STANDARDS FOR COMBUSTIBLE DUSTS

## Part 2. Quality

ISO 9000.2000  
QC & QA Procedures  
Records  
Competence  
Appropriate Equipment/ Methods  
Calibration of Equipment/Meters used in repair/testing  
Auditing

### **PART 2 ESSENTIAL ELEMENTS OF A QUALITY SYSTEM**

#### **2.1 KNOW THE OBJECTIVES FOR:-**

- (i) users at all levels
- (ii) customers
- (iii) statutory authorities
- (iv) to achieve benefits to the organisation.

#### **2.2 POLICY REQUIREMENTS**

- (i) Specific
- (ii) Measurable
- (iii) Achievable
- (iv) Realistic
- (v) Timely

#### **2.3 DESIGN AND IMPLEMENTATION**

- (i) Good Communications
- (ii) Involving and achieving 'buy in'
- (iii) Establishing Ownership
- (iv) Adequate Resources
- (v) Records and Traceability

#### **2.4 DESCRIBE THE REQUIREMENTS FOR AUDITING AND IMPROVING**

- (i) Carrying out audits
- (ii) Establishing facts
- (iii) Identifying non-conformance
- (iv) Identifying causes of non-conformance
- (v) Effects of non-conformance
- (vi) Continuous improvement

## Part 3. Protection Principles & Techniques

### GASES & VAPOURS AND AREA CLASSIFICATION APPARATUS or EQUIPMENT

#### TABLE of CONTENTS

#### 3.1 CHARACTERISTICS of GASES and VAPOURS

##### 3.1.1. GENERAL

- 3.1.2 Gas Subdivisions.
- 3.1.3 Types of flammable material.
- 3.1.4 Explosive limits.
- 3.1.5 Ignition Energy.
- 3.1.6 Relative density of vapour.

##### 3.1.7 IGNITION REQUIREMENTS.

- (i) The Fire Triangle.
- (ii) Flashpoint.
- (iii) Ignition temperature or, Auto Ignition temperature.

#### 3.2 TEMPERATURE CLASSIFICATION. T' RATING.

- (i) Selection of apparatus using the T' class rating.

#### 3.3 AREA CLASSIFICATION GASSES

##### 3.3.1 ZONES.

- (i) The concept of Zones..
- (II) Definition of Zones.

##### 3.3.2 THE EXTENT OF A ZONE.

- 3.3.3 Factors affecting the release rate of gas or vapour.
  - (i) The lower explosive limit (LEL)
  - (ii) Ventilation.
  - (iii) Relative density of released material
  - (iv) Other parameters

##### 3.3.4 GRADES OF RELEASE.

- (i) Continuous Grade of release.
- (ii) Primary grade of release.
- (iii) Secondary grade of release.

##### 3.3.5 ARTIFICIAL VENTILATION.

- (i) The three degrees of ventilation, as given in BS EN 60079-10.
- (ii) The three levels of availability of ventilation.
- (iii) Comfort levels.

##### 3.3.6 AREA CLASSIFICATION DRAWINGS

- (i) Markings.
- (ii) Combustible dusts.(note).

#### FIGURES:

FIGURE CH2 - 6 Representative Area Classification Drawing

## **TABLES:**

TABLE CH2 –Table 9:	Properties of a selection of flammable gases.
TABLE CH2 –Table 10:	Temperature classification.

### **3.4 EQUIPMENT TYPES, GENERAL**

#### **3.4.1 OVERVIEW.**

#### **3.4.2 ZONES OF USE.**

#### **3.4.3 EQUIPMENT PROTECTION LEVELS**

#### **3.4.4 EXPLOSION PROTECTION CONCEPTS.**

- (i) Protection types.
- (ii) Use in association with gas sub-divisions.
- (iii) Consideration regarding upper and lower explosive limits.
- (iv) Use of Gas Detection Equipment. Groups I and II
- (v) Simple apparatus.

#### **3.4.5 Ex 'COMPONENTS'.**

#### **3.4.6 TEMPERATURE CLASIFICATION,-APPARATUS**

- (i) Basis of classification.
- (ii) Operation in ambient' other than minus 20°C. to plus 40 °C.
- (iii) Operation in presence of combustible dust.

#### **3.4.7 CLEARANCE AND CREEPAGE DEFINITIONS.**

- (i) Creepage distance.
- (ii) Clearance distance.
- (iii) Separation distance.

### **3.5 TYPE OF PROTECTION. Ex 'd' Flameproof enclosure**

#### **3.5.1 DEFINITION.**

#### **3.5.2 STANDARDS & ZONES - FLAMEPROOF ENCLOSURE**

- (i) Design Standards.
- (ii) Zones of use. Type 'd'.
- (iii) Use with gas sub-divisions.

#### **3.5.3 CONSTRUCTION AND USE.**

- (i) Maximum Experimental Safety Gap. (MESG)
- (ii) Flame paths', gaps, flanges and threaded joints.
- (iii) Cable Gland entry, Type 'd'.
- (iv) Pressure piling.
- (vi) Explosion Pressure.
- (vii) Unauthorised Modifications.

### **3.6 TYPE OF PROTECTION. Ex 'p' Pressurised equipment**

#### **3.6.1 DEFINITION**

#### **3.6.2 STANDARDS & ZONES-, TYPE Ex 'p'.**

- (i) Design Standards.
- (ii) Zones of use.
- (iii) Use with gas sub-divisions.

### **3.6.3 GENERAL DETAILS. Ex 'p'.**

- (i) Pressurisation - a readily understood technique.
- (ii) Suitable for various sizes and types of equipment.
- (iii) Pressurisation of control rooms and analyser houses.
- (iv) Sources of pressurising medium.
- (v) Purging or pressurising.
- (vi) Continuous dilution.

### **3.6.4 PRESSURISING CRITERIA.**

### **3.6.5 SAFETY REQUIREMENTS. Ex 'p'.**

- (i) Control and Alarms.
- (ii) Use of spark arresters.

## **3.7 TYPE OF PROTECTION. Ex 'e' Increased safety**

### **3.7.1 DEFINITION**

### **3.7.2 DESIGN STANDARDS AND ZONES OF USE Increased Safety.**

- (i) Design Standards.
- (ii) Zones of use.
- (iii) Use with gas sub-divisions.

### **3.7.3 CHARACTERISTICS OF Ex 'e' APPARATUS.**

- (i) Non sparking.
- (ii) Robust and impact resistant.
- (iii) Terminations. Based on Both BS 5345 and BS EN 50019.
- (iv) Connection and Junction Boxes.
- (v) Rotating machines.
- (vi) Ingress protection.
- (vii) Fasteners.
- (viii) Other design variations of Type EEx 'e' equipment.
- (ix) Cable entry to EEx 'e' Enclosures.

## **3.8 TYPE OF PROTECTION 'N' or 'n' Reduced risk**

### **3.8.1 GENERAL & DEFINITION.**

- (i) Definition of Protection Type 'N'

### **3.8.2 DESIGN STANDARDS AND ZONES OF USE.**

- (i) Design Standards.
- (ii) Zone of Use. Ex 'n' or Ex 'N'.
- (iii) Use with gas sub-divisions.

### **3.8.3 CONSTRUCTION AND USE.**

- (i) Rotating machines.
- (ii) Ingress protection required.
- (iii) Energy limitation.
- (iv) Hermetically sealed device.
- (v) Enclosed break devices
- (vi) Encapsulated device.
- (vii) Restricted breathing.
- (viii) Glands for Ex 'n' Apparatus.

### **3.9 TYPE OF PROTECTION 'I' Intrinsic safety**

#### **3.9.1 DEFINITION of INTRINSIC SAFETY**

#### **3.9.2 FURTHER DEFINITIONS AND DETAILS**

- (i) Intrinsically safe circuit.
- (ii) Intrinsically safe apparatus.
- (iii) Associated apparatus.
- (iv) Normal operation.
- (v) Infallible component or assembly of components.

#### **3.9.3 STANDARDS and ZONES of USE**

- (i) Standards- Flammable gases.
- (ii) Zones of use.
- (iii) Simple apparatus.
- (iv) Other apparatus.

#### **3.9.4 BARRIERS. Used in Intrinsic Safety applications.**

- (i) Barrier function.
- (ii) Categories and integrity of barriers.
- (iii) Apparatus which may be connected to an 'is' barrier.
- (iv) Some basic requirements.
- (v) The basic shunt diode barrier without galvanic isolation.
- (vi) A complete Zener circuit.
- (vii) Design considerations.
- (viii) Galvanically isolated barriers.

#### **3.9.5 EARTHING of Intrinsically safe apparatus.**

- (i) The intrinsically safe earth connections.
- (ii) Earthing of Galvanic units.

#### **3.9.6 SURGE SUPPRESSION**

#### **3.9.7 VOLTAGES**

- (i) AC mains power supply voltage. Referred to as (Um).
- (ii) Hazardous area voltage. Referred to as (Uo).

#### **3.9.8 CIRCUIT CAPACITANCE AND INDUCTANCE**

#### **3.9.9 EXTERNAL TERMINATIONS, Clearances, Marking & Colour**

- (i) Clearance, distance in air- Definition.
- (ii) Creepage distance in air - Definition.
- (iii) Intrinsically safe creepage & clearances.
- (iv) Marking of connection facilities.
- (v) Colour.

#### **3.10 POWDER FILLING PROTECTION TYPE Ex 'q'.**

- (i) Zone of use.
- (ii) Applicable Standards.
- (iii) Protection method.

#### **3.11 OIL IMMERSION. PROTECTION TYPE Ex 'o'**

- (i) Zone of use.
- (ii) Applicable Standards.
- (iii) Protection method.

### **3.12 ENCAPSULATION, PROTECTION TYPE Ex 'm'**

- (i) Applicable Standards.
- (ii) Zone of use.
- (iii) Protection method.

### **3.13 SPECIAL PROTECTION; TYPE 's'**

- (i) Zone of use.
- (ii) Applicable Standards.
- (iii) Protection method.

### **3.14 CABLE GLANDS AND THEIR SELECTION**

#### **3.14.1 OBJECTIVES.**

#### **3.14.2 GLAND STANDARDS.**

- (i) Standards.

#### **3.14.3 EEx CABLE GLAND SPECIFICATIONS**

- (i) Ex 'd' gland specification details.
- (ii) Ex 'e' gland specification details.

#### **3.14.4 MECHANICAL GLAND CONSTRUCTION**

- (i) Gland body material.
- (ii) Barrier cable glands.

#### **3.14.5 GLAND MARKINGS**

- (i) Marking will include.

#### **3.14.6 SELECTION OF GLAND AND CABLE ENTRY DEVICE**

- (i) Non Barrier Glands.
- (ii) Other entry methods into Ex 'of' enclosures.
- (iii) Barrier glands, determination of need for.

### **3.15 MARKINGS ON EXPLOSION PROTECTED EQUIPMENT**

#### **3.15.1 ATEX**

#### **3.15.2 IEC Equipment Protection Levels (EPL's) for Gas Atmospheres**

#### **3.15.3 CERTIFICATION AUTHORITY MARK**

#### **3.15.4 MARKINGS REQUIRED BY IEC 60079-0**

- (i) Markings on complete equipment.
- (ii) Ex Component marking.
- (iii) Markings on small items.

#### **3.15.5 Additional Marking for Type of Protection**

### **3.16 INGRESS PROTECTION**

#### **3.16.1 THE IP CODE**

#### **3.16.2 DELUGE PROOF**

## **FIGURES:**

**FIG. 7: Typical arrangement of flange and spigot joints**

**FIG. 8: Basic Zener diode circuit.**

**FIG. 9: Practical Zener diode barrier.**

**FIG 10: Diagram of an instrument barrier.**

**FIG. 11: Construction of mechanical gland.**

**FIG. 12: The CE conformity mark.**

**FIG. 13: Certifying Authority marks.**

## **TABLES.**

**TABLE 1, 2 & 3: Standards referred to.**

**TABLE 10: Temperature classification.**

**TABLE 12; Protection types which may be used in Gas Zones.**

**TABLE 14: Extended table of allowable Flange gaps and joints.**

**TABLE 17: Alarm and shutdown requirements on pressure loss.**

**TABLE 18: Use of spark and particle barriers.**

**TABLE 19: Details of the IP code.**

## Part 4. Requirements of IEC 60079 -19 : 2006

### General Requirements (including reference to)

- IEC 60079 – 0, (General requirements)
- IEC 60079 – 1, (Flameproof enclosure ‘d’)
- IEC 60079 – 2, (pressurized apparatus ‘p’)
- IEC 60079 – 7, (Increased safety ‘e’)
- IEC 60079 – 11, (Intrinsic safety ‘i’)
- IEC 60079 – 14, (Installation in hazardous areas-other than mines)
- IEC 60079 – 15, (Type of protection ‘n’)
- IEC 60079 – 17, (Recommendations for inspection and maintenance)
- IEC 60079 – 19, (Repair and overhaul for apparatus used in explosive atmospheres-other than mines)
- IEC 60085 (Thermal classification of electrical insulation)
- IEC 60529 (Degrees of protection provided by enclosures-IP code)
- ISO 4526 (Metallic coatings- Nickel electroplating)
- ISO 6158 (Metallic coatings- Chromium electrodeposited)
- ISO 9000/2000 (Quality Management Systems-fundamentals)
- BS 229 (Flameproof enclosure of electrical apparatus)
- BS 889 (Flameproof electric lighting fittings)
- BS 1259 (Intrinsic safety ‘i’)
- CP 1003 (Code of practice- Electrical apparatus for use in explosive atmospheres)
- BS 4683-1 (Classification of maximum surface temperature)
- BS 4683-2 (Construction and testing of flameproof enclosures)
- BS 5345 (Code of practice for the selection installation and maintenance of electrical apparatus for use in potentially explosive atmospheres)
- BS 5501 ( Electrical apparatus for potentially explosive atmospheres)
- BS 7924 (Code of practice for the repair and overhaul of certified electrical apparatus intended for use in mines susceptible to firedamp)
- Ex N Draft re-Sparking. DD ENV 50269/1997
- BS EN 60034 (Rotating Electrical Machines)

### Combustible Dust

- BS EN 50281-1-1 (Protection by enclosure-construction and testing)
- BS EN 50281-1-2 (Selection installation and maintenance)
- IEC 61241-0 (Electrical apparatus – General Requirements)
- IEC 61241-2 (Electrical apparatus – Test Methods)
- IEC 61241-17 (Inspection and maintenance of electrical installations in hazardous areas)

## **IEC 60079 – 19 : 2006**

- Definitions
- Inclusions and Exclusions
- Roles & Responsibilities, User, Repairer
- Documentation: - including standards, certificates and records.
- Labelling/Marking information
  
- General Reclamation Procedures
  - Mechanical
  - Electrical
- Additional Requirements for different protection methods
  - Ex 'd'
  - Ex 'e'
  - Ex 'p'
  - Ex 'n'
  - Others Ex 'i' / Ex 'o' / Ex 'q' / Ex 'm'

Checking mechanical components for wear, corrosion, damage including flame paths, threads, bearings, bearing journals and housings, terminal boxes, fans, cowls, stator and rotor core laminations, nuts, bolts and fitments.

Checking electrical components for wear, corrosion, damage, signs of Overheating, overloading, including stators, rotors, cables, terminations, insulation/encapsulation systems.

### Annex B Competency

- Practical skills, experience and qualifications
- Range of Work
- Protection Methods
- Machine size and voltage
- Facilities
- Capability
- Resources
- Assessment (demonstration of competence)
- Indirect
- Direct

## **Part 5. Good Practice in Repair, Reclamation, and Rewinding of 3 phase Induction Motors**

- Disassembly & Reassembly Techniques
- Mechanical Inspection and Measurement including
- Inspect for damage or corrosion
- Use of standard measuring equipment (metric and imperial). Including Verniers', Micrometers, Depth Gauge, Surface comparator. To check size, tolerance, surface finish and clearance of components.
- Use of drawings/manuals/standards to check compliance of repaired equipment.
- Use of solvents/corrosive agents
- Copy Winding
- Winding Removal (Solvents/Heat/Burn out ovens)
- Inspection and Testing of Stator Cores
- Insulation Material
- Recovery of worn components
- Methods appropriate for Ex equipment
- Guidance from IEC 60079-19
- Paint Finish
- Testing and Records
- Quality Control and Auditing
- Reference to EASA/AEMT good practice guide to maintain efficiency
- Energy losses in induction motors