

EXPLOSIVE ATMOSPHERES IEC 60079 PART 19: EQUIPMENT REPAIR, OVERHAUL AND RECLAMATION & IECEx CERTIFIED SERVICE FACILITY SCHEME THE ROUTE TO COMPLIANCE

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Abstract – Prior to the introduction of the IECEx Certified Service Facility Scheme, service facilities (i.e. repairers of Ex Equipment) had to satisfy either regulatory accreditation, user accreditation or even specific manufacturer accreditation with widely variable requirements. In many instances service facilities had have multiple accreditations from regulators and users. In some countries these requirements were mandatory and in others voluntary. This paper provides information on IEC 60079-19 Ex equipment overhaul, repair and reclamation and gives examples of the improvements a well established service facility had to introduce, to satisfy an IECEx ExCB that their personnel, processes and procedures meet the requirements of the IECEx Certified Service Facility Scheme. The examples given relate to Service Facilities operating in the UK.

Index Terms

EASA Electrical Apparatus Service Association
IEC – International Electrotechnical Commission
IECEx – IEC System for Certification to Standards relating to equipment for use in explosive atmospheres.
ExCB – Certification Body within an IECEx Scheme
IECEx Scheme – IECEx System has 4 Schemes which include certification of Ex Equipment, Ex Service Facilities & Ex Competent Persons
ISO – International Organisation for Standardisation
QMS - Quality Management Systems
UKAS United Kingdom Accreditation Service

1. INTRODUCTION

Repairs of Ex electrical equipment have been carried out to 'good engineering practice' since Ex electrical equipment was first manufactured. In 1984 the BEEMA/AEMT Code of Practice [1] was introduced in the UK for the repair of Ex electrical equipment, this was adopted as an IEC standard IEC 60079 Part 19 [2] in 1993. This standard was amended, changing it from a code of practice to a standard and was published as IEC60079-19 Issue 2 [3] in 2006 and as EN60079-19 in 2007. The 2006 standard introduced additional requirements during overhaul & repair of Ex Equipment, during recovery of repaired components & new requirements for competency of persons. This edition of

the standard removed the exclusion for mining and introduced all explosive atmospheres including dusts but retained the exclusion for explosives.

In 2010 the 3rd issue of IEC 60079-19 [5] was published changing some of the requirements and introducing additional requirements.

In 2006 the IECEx System [4] introduced a scheme for the Certification of Service Facilities working to IEC 60079-19. This required ExCB's, approved by the IECEx Certified Service Facility Scheme, to assess Service Facility's personnel, processes, procedures & QMS for compliance with IEC 60079-19 and the IECEx Scheme Rules and documentation. After a Service Facility has been Certified, an ongoing surveillance audit program will be set up, by the ExCB, to ensure that the Service Facility maintains compliance with IEC 60079-19.

One of the issues that needed attention, after the IECEx Service Facility Scheme had been set up, was how to standardise the assessment of competency of the personnel involved in overhaul & repair of Ex Equipment.

In 2009 IECEx launched a new Certificate of Personnel Competency Scheme (CoPC) covering personnel working in or where their work could affect safety in an Explosive Atmosphere. The IECEx CoCP Scheme covers 10 Units of Competency as detailed in IECEx Operational Document OD 0504 [6] with the 5th Unit of Competency covering Responsible Persons & Operatives involved in the overhaul & repair of equipment to IEC 60079-19.

2. IEC 60079-19

This is an International Standard for the overhaul and repair of Ex Equipment, as is detailed above this standard has been developed from a Code of Practice for the overhaul of electrical equipment for use in explosive atmospheres

The standard has 12 sections and 3 appendices. The first 3 sections cover the scope of the standard, normative references and terms & definitions.

Section 4 covers the general requirements, which applies to all service facilities and all Ex protection types. These requirements include the general principles of overhaul and repair, some guidance relating national legislation and then the most important areas of Instructions for users and repairers.

The instructions for repair facility (service Facility) Clause 4.4 covers a wide range of requirements including competency, documentation, reclamations,

alterations, temporary repairs, rotating machines and inverters.

The remaining 8 sections cover the specific requirements applicable to each protection type eg Ex d, Ex p, Ex e, Ex n Ex l etc. Each section typically includes requirements clarifying its application, repair and overhaul, reclamation, and alterations & modifications.

The three appendices are normative providing additional information for the user and repairer. The first appendix clarifies how the overhauled or repaired equipment is marked by the repairer. The second appendix clarifies how an Operative or Responsible Person demonstrates their competency. The third appendix clarifies the determination of maximum air gap of reclaimed parts for Ex d equipment.

IEC 60079-19 is never used in isolation it is always used in conjunction to the IEC protection type standards used when certifying the equipment. For example for an Ex d machine certified in 1984 in the UK by EECs, the service facility would also need to have BS 5501 Part 1 (General Requirements) and BS 5501 Part 5 (Flameproof enclosure 'd')

3. IECEx Service Facility Scheme

Publication of an international standard does not ensure standardisation on its own. The publication of a standard provides industry with 'agreed technical requirements'. The way in which these 'agreed technical requirements' are applied determines the level of standardisation. And in reality all the excellent work of IEC TC31J 60079-19 [7] can be in vain if Ex Repairers (Service Facilities) apply the 'agreed technical requirements' differently in their own manner.

The question any Ex Equipment user needs to answer is "How do we know that a Service Facility is operating in accordance to the requirements of IEC 60079-19", especially in a competitive commercial environment"?

The Ex Equipment user can carry out a second party assessment of their potential Service Facilities, but does the Ex Equipment user have:

- Sufficient resources to undertake such assessments and on-going surveillance of Service Facilities
- Sufficient personnel with technical knowledge and understanding for such activities
- Desire to undertake such assessments in the knowledge that they then carry all associated liabilities

The IECEx Certified Service Facility Scheme provides Ex Equipment users:

- A single assessment and certification process applied world wide
- The Service Facility Certificate of Conformity becomes an extension of IECEx's on-line Ex Equipment C o C system
- The system is managed and maintained by the Ex industry it is set up to serve.

- Cost savings by preventing development and maintenance of multiple systems at National levels

Clause 5.1 of the Service Facility Scheme Rules IECEx03 [8] states:

"the IECEx Certified Service Facility Scheme provides the means for Service Facilities to obtain an IECEx certificate that is intended to provide the international Ex community with confidence that such Service Facilities undertake repair and overhaul work in accordance with the technical and quality system requirements of the IECEx Service Facility Program."

The Service Facility has to understand and meet the requirements of IEC 60079-19 and the IECEx Service Facility Scheme, as detailed below in figure 1, and be able to demonstrate this competency to their IECEx Certification Body (ExCB).

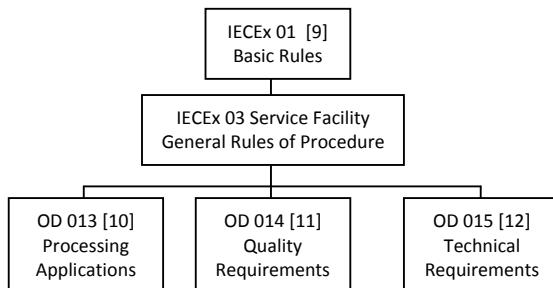


Fig 1. Requirements of IECEx Service Facility Scheme

The Service Facility needs to have an effective Quality Management System (QMS) based on the requirements of ISO 9001 and the requirements of IECEx OD 014.

The IECEx Service Facility process has two areas of assessment before a Certificate of Conformity can be issued, these are:-

- Assessment to verify that the service facility complies with the requirements of IEC 60079-19 & OD 015
- Assessment to verify that the service facility QMS complies with OD 014

This process is shown in figure 2.

When these requirements and all outstanding non-conformances have been resolved to the satisfaction of the IECEx ExCB a Facility Audit Report (FAR) is produced following which a Certificate of Conformity is issued and published on the IECEx web site.

When the IECEx ExCB issues an IECEx Certificate of Conformity, the ExCB is confirming the service facilities capability to consistently carry out overhaul and repair activities in compliance with IEC 60019:19 and the IECEx Scheme requirements, within the scope listed on the certificate.

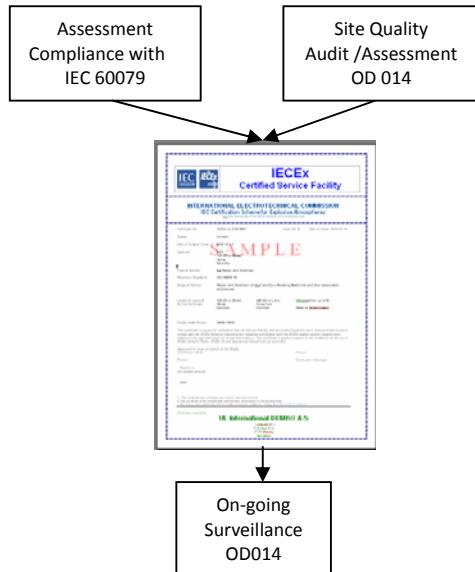


Fig 2. Overview of the IECEEx Assessment Process

4. Scope of Competency

The first issue to be addressed by the Service Facility is to define the scope against which they want to be Certified, i.e. the boundaries of their Ex repair service.

The scope details the type of equipment (motor, switchgear, transformers, etc.) and the protection types (Ex d, Ex e, Ex p Etc.) for which the Service Facility claim to have competency. The scope in effect details the range of competency which needs to be assessed by the ExCB which will include assessment of all aspects of the Service Facility including personnel competency, process & test equipment control, Ex equipment procedures, recovery processes etc.

The service facility scope can be amended when additional competencies and/or equipment have been acquired.

5. Responsible Person

IEC 60079-19 Clause 4.4.1.1 requires:

"The repair facility shall appoint a person ('Responsible Person') with the required competency (see Annex B), within the management organization, **to accept responsibility and authority for ensuring that the overhauled/repaired equipment complies with the certification status agreed with the user**. The person so appointed shall have a working knowledge of the appropriate explosion protection standards and an understanding of this standard."

This requirement means that it is the Responsible Person (RP) takes the final decision that Ex Equipment is in compliance and can be returned to the customer. Normally this decision is taken by the branch management typically the Works or Branch Manager.

Changes are required to the Service Facility Management Systems to ensure that for Ex Equipment the final decision to dispatch is only given after the RP has authorised it.

In particular the Branch Manager has to delegate authority for Ex Equipment to the Responsible Person so that the Responsible Person (RP) has the final control of the overhaul & repair of Ex Equipment and therefore they have had to develop new method of managing Ex Equipment within the branch.

IEC 60079-19 requires Service Facility to have agreed with the customer (Ex Equipment User) the certification status of the Ex Equipment after overhaul or repair before any work is commenced. It is the responsibility of the RP to ensure this requirement has been satisfied and that any commercial implications, e.g. change of scope of work at any stage of the process, have been resolved by the Branch or Works Manager.

The responsibilities of the RP impinge on many other areas of service facility management in particular in the operation and management of the Quality Management System (QMS) requiring changes to the QMS

6. Operatives

The service facility has a duty of care under H&S legislation to employ competent persons and to ensure employees being trained are suitably supervised.

This service facility has defined 'IEC 60079-19 Operatives' (OP) as those persons whose decisions would have an impact on the certification status of Ex Equipment. This would include personnel making measurements, for example of flame paths on Ex d equipment or rewinding an Ex electric motor. These 'Operatives' work under the surveillance of the Responsible Person.

However other operatives involved in the overhaul and repair processes do not need to be independently assessed as competent to IEC 60079-19 although they need to be aware of the requirements of IEC 60079-19, in particular the essential safety features of Ex Equipment and the company's procedures for Ex Equipment.

Amongst those other operatives, who are not required to be independently assessed as competent, are those who use metal spray and welding techniques during the recovery of component parts which can not be replaced by spare parts. These operatives have a different competency verification requirement specified in IEC 60079-19 which will be covered in greater detail in section 8

7. Ex Personnel Competency

Annex B of IEC60079-19 details the area of competency required by the 'Responsible Person' and 'Operators' and in Clauses 3.2 & 3.3 of the annex there is a requirement that the RP & OP have to demonstrate their competency.

Even though this Annex is classified as "Normative" IECEx Service Facilities are required to demonstrate that their personnel involved in the overhaul and repair of Ex Equipment have competency equal to the "Normative" competencies detailed in Annex B or have been assessed as competent by an IECEx ExCB operating within the IECEx Certificate of Personnel Competency Scheme.

Having failed to get its previous training provider to upgrade its training provision to meet the requirements of IEC 60079-19 the service facility decided to work with the UK based Electrical Apparatus Service Association Region 9, European & World Chapter (EASA R9) to develop a training course with assessment meeting the competency requirements of IEC 60079-19. The Technical Adviser to EASA R9 was appointed chairman of a committee to develop this program.

As the representative of EASA's 2,100 members from 58 countries at IECEx since 2003, EASA R9's Technical Adviser was aware of the requirements expected by IECEx during assessments, he therefore knew that any assessment of competency would need to be to International Standards and that any organisation assessing the competency of persons would need to operation to ISO/IEC17024 [13]; a standard for bodies certifying the competency of persons.

Although EASA R9 developed and delivers the training, the assessment of competency of the RP's and OP's is conducted by SIRA Certification Services (SCS). SIRA Certification Services operates schemes for the certification of competency of persons and have been accredited by the United Kingdom Accreditation Service (UKAS). SCS is a sister company of SIRA Test & Certification which is a Notified Body within the EU and an IECEx ExCB within the IECEx Equipment and Service Facility Schemes.

An EASA steering committee was established to manage the scheme; this included the establishment of a question bank & detailing specific practical assessments, which enables the candidates to demonstrate their competency in the areas specified in Annex B of IEC 60079-19.

The range of practical assessment require the applicants to demonstrate specific activities which includes identification of equipment protection type standard, use of measurement tools, identification of defective components, selection of appropriate recovery procedures, records of measurement. There are a total of 12 practical assessments for personnel being assessed for Overhaul & Repair together with a conventional examination to assess attainment of knowledge.

EASA & SCS agreed that any assessor observing and monitoring the practical assessments needed to have practical knowledge of Ex Equipment repair. Suitable competent assessors were identified, assessed and subsequently employed by SCS to conduct the practical assessments under their control and SCS's operating procedures.

The EASA training was structured to meet the requirements detailed in IEC 60079-19 and as well as providing the underpinning knowledge it also exercised the practical skills which would be assessed by SCS. A library of artefacts was established with known faults with separate artefacts for use in training and assessment.

To ensure the assessment of competency of the applicants was being conducted in compliance with ISO/IEC 17024 EASA R9 required the Scheme to be independently assessed by UKAS; the UK national accreditation service.

The cost of this training program with fully independent assessment of competency is significantly higher than previous Ex Repair training courses, but there has been a benefit for the Service Facility management. The RP's & OP's after being assessed as competent are more diligent in their activities and more pro-active in ensuring the overhauled or repaired equipment is in full compliance with the certification status agreed with the customer and the records required by IEC 60079-19 are well maintained.

The need for such a rigorous assessment of competency was justified by the results of the first course in 2005, where only 30% of the applicants were assessed as competent.

All the EASA R9 member companies, using this EASA/SCS Scheme, have had to introduce additional preparation for personnel presenting themselves for assessment and the EASA training had to be modified to address weaknesses in candidate competency identified during the first assessments of competency.

EASA also changed the assessment of competency by SCS, from taking place immediately after training, to 2 weeks after training, thus permitting applicants to address weak areas identified during training

The current success rate is well into 90% as a result of these measures, and as a result of a realisation by the applicants that this 'demonstration of competency' was a totally different type of assessment than they had previously experienced, necessitating greater attention during training and much better preparation before assessment.

As required in IEC 60079-19 all training is refreshed and competency re-assessed after 3 years and the first re-assessments occurred in November 2009.

EASA R9 has proposed that they will work with SCS and BASEEFA to take the assessment of competency for personnel involved in Overhaul & Repair of Ex Equipment into the IECEx Scheme for the Assessment of Competency of Persons during 2012.

The service facility has committed to have all RP's and OP's, in their branches where Ex Equipment is repaired, certified as competent via the EASA R9 / SCS Scheme and to have those branches Certified as Competent through the IECEx Certified Service Facility Scheme.

8. Recovery Procedures

Although the service facility had successfully been recovering Ex Equipment components for more than 50 years the documentation and records of this process did not meet the requirements of IEC 60079-19 or IECEx.

One major change necessitated the introduction of a drawing to detail the parts of the component being repaired together with any inspections and measurements required. This needed to be communicated to the customer and the agreement of the customer to the recovery procedures sought.

Another new document was required to record the decision/logic in developing the recovery procedure and the processes being used.

Generally there was a need for much better recording of recovery activities in the mechanical repair department which included:

- Metal removed (thickness)
- Results of NDT
- Material added (thickness)
- Final component measurements
- Traceability of measuring instruments

All the operatives involved in recovery procedures have had to have training in the use of the new procedures and records

9. Recovery Operative Competency

IEC 60079-19:2006 Clause 4.4.2.3.1 introduced a new requirement requiring the verification of competency of reclamation operatives:-

"Operators of reclamation techniques, e.g. welding, metal spraying, shall be required to undertake a practical skill test in the technique before being permitted to utilize the technique for the first time and every three years thereafter. If the operator has not used the technique in the previous six months, he shall undertake a re-test."

The service facility had to set up systems to test the bond strength of the different metal spray techniques by having the metal spray operatives produce test pieces which are sent for bond strength testing for each techniques used and having welders produce test pieces which are sectioned to verify weld penetration and weld process. All bond strength testing and weld section inspection are carried out by specialist engineering personnel outside the branch.

Providing the operatives have evidence of continuity of practice in their recovery technique the practical test will be repeated every 3 years.

There is a further requirement which entails the verification of bond strength of any new reclamation technology, which is permitted in IEC 60079-19, before it is used on any Ex Equipment component recovery. In reality this is only common sense and good engineering practice.

Although this requirement has been dropped from the 2010 issue of IEC60079-19, this service facility intends to maintain this requirement as supporting evidence when conducting an assessment of any reclamation as required in IEC 60079-19 Clause 4.4.2.2.5

10. Quality System

IECEx OD 014 requires a Service Facility to have a QMS meeting the requirement of ISO 9001, however it is not an IECEx requirement that the QMS is independently certified to ISO 9001 [13].

The service facility has a robust QMS based on ISO 9001 which has been in operation and independently audited since 1981. The earliest QMS was to the Central Electricity Generating Board (CEGB) requirements before BS 5750 [14] the forerunner of BS ISO 9001.

The current service facility QMS is based on ISO 9001:2008 and the company is audited by BSI, as a result all the requirements of the IECEx OD 014 were already included.

However there were many parts of the QMS in particular the branch specific Procedure and Process Documents (PPD's) which required amendment to reinforce the IECEx QMS requirement as detailed in OD 014 and more importantly to integrate the responsibility and authority of the Responsible Person into the QMS and into its review and management.

The service facility uses a calibration company accredited by UKAS and as a result the traceability of instrument calibration to international and national standards was not an issue since that was the standard the service facility has always worked to.

Historically all the service facility procedures, which include measurements, required full traceability to the measuring instrument used. There always has been total confidence that all measuring instruments used were in calibration, however over the years the effectiveness of the recording of the identification number of the measuring instrument was not as good as it should be and this had to be reinforced.

Due to the nature of service business where it is normal that every job is different, no sampling techniques are used and 100% of measurements are taken and recorded.

Procedures for purchasing needed some minor amendment but when this included sub-contracting of a recovery procedure which could affect Ex equipment compliance then much greater assessment and monitoring of the sub-contractor was required and this will include auditing of the sub-contractor by the IECEx ExCB.

The service facility's QMS required the retention of all job related records for 2 years, with the option to retain certain records longer to meet specific customer requirements and a specific requirement to retain the job records of Ex Equipment overhauls and repairs for 5 years, it was therefore a minor change to include the

retention of the Ex job records for 10 years. All we had to do was to go out and purchase some additional filing cabinets.

The QMS management review needed amendment to ensure the active participation of the RP and the scope of the management review expanded to include a specific review of how effective the QMS was to meet the requirements for Ex Equipment overhaul & repair to IEC 60079-19.

11. Advantages for Ex Equipment Users

The user of Ex Equipment has the ultimate responsibility to ensure that all equipment he uses is safe for the purpose for which is being used and this includes any Ex Equipment which has been overhauled or repaired.

Therefore the user has the responsibility to ensure that the sub-contractor they use for overhaul and repair is competent.

Clause 4.3.4 of IEC 60079-19 specifies this requirement as follows:-

"The user shall ascertain that the repair facility concerned can demonstrate compliance with the relevant stipulations of this standard."

An IECEx Service Facility will provide the Ex Equipment user a job report, in accordance with the requirements of IEC 60079-19, supplied with the overhauled or repaired Equipment. This is essential information for the 'initial inspection' as required by IEC 60079-17 [16] before the repaired equipment is returned to service.

The IECEx Service Facility Scheme provides Ex Equipment users a method of identifying sub-contractors that have been independently assessed as competent by Ex certification bodies with expertise in the certification of Ex Equipment by a process which is itself audited and assessed by IECEx.

The IECEx Certificate of Conformity for a service facility enables the user to have confidence that their Ex Equipment will return in conformance to their requirements as agreed with the service facility and be safe to return to service.

However IECEx Certified Service Facility Scheme will only benefit users, when the users make the possession of a current IECEx Certificate of Conformity, verifiable on the IECEx web site, as a pre-requisite of doing business

12. Advantages for Ex Service Facilities

The IECEx Service Facility Scheme provides the service facility an independent assessment, by Ex competent assessors, that their QMS procedures for the overhaul and repair of Ex Equipment are effective. Therefore they can have confidence that the Ex Equipment they have repaired and overhauled will be safe to return to service and will have supporting evidence.

The service facility will be able to use their IECEx Certificate of Conformance to demonstrate to their customers that they have been independently assessed as competent.

The service facility overall performance will be enhanced by the diligence of the RP and the attention to detail in overhaul and repair of Ex Equipment

13. Conclusion

The service facility has been able to have six branches certified under the IECEx Scheme by 2011 and are working to have the next 2 branches registered during 2012.

Meeting the requirements of the IECEx Service Facility Scheme has not been a major problem for this service facility since they have a robust QMS from the early 1980's and have been providing services to a very wide range of customers not only in the petrochemical and pharmaceutical industries but power generation, nuclear, automotive, MoD and many other industry sectors with specific QMS requirements.

However other service facilities, which have been operating without or with minimal Quality Management Systems, will find it much more difficult to meet the requirement of the IECEx Scheme.

IECEx has published IECEx 03A [17] which is a guide to help Service Facilities understand what they need to do to qualify for an IECEx Service Facility Certificate.

<http://www.iecex.com/guides.htm>

It is not the size of the company which enables a service facility to be Certified by IECEx it is the ability of the company management to control the processes and to ensure the personnel conducting the work are competent that ensures compliance with IEC 60079-19 and the IECEx Scheme.

14. References

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- [7] IEC TC31J 60079-19, IEC Technical Committee, Equipment for Explosive atmospheres IEC 60079-19 maintenance team
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- [12] OD 015, Ex OD 015 Version 2, additional requirements for IECEx Service Facilities involved in repair, overhaul and modification of Ex equipment
- [13] ISO/IEC17024:2003, Conformity assessment – General requirements for bodies operating certification of persons
- [14] ISO 9001:2008, Quality management systems – Requirements
- [15] BS 5750: 1979, Quality Systems, Part 1 specification for design/development, production, installation and servicing
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15. Vita

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