

Competence Profiles – Guidance for applicants and Assessors

PART 2 – INDUSTRY CLASSIFICATION (ME) – MAINTENANCE ENGINEERING

Introduction

Maintenance can be defined as the totality of the arrangements necessary to ensure that the designed performance attributes of an asset are sustained throughout its working life, with the minimum impact on its availability to the user. The balance of costs may from time to time dictate that maintenance is either increased to avoid breakdown, or reduced to save cost when breakdowns can be tolerated. It may also be necessary for maintenance to include a degree of design improvement to enhance asset performance or meet new regulatory requirements or economic conditions, and this may be carried out as part of a mid-life rework.

There is now an increasing need for maintenance to be managed by professional engineers, due to: -

- The increased performance requirements for modern engineering assets, resulting in greater loss from unplanned outages
- The potential hazards arising from modern assets which typically may generate greater power, utilise high working pressures and temperatures
- The complexity of modern assets, with potential hazards that may not be evident to even a skilled and experienced team leader
- The trend towards contracting-out various support services, requiring careful specification of the services expected, co-ordination of the various parties and monitoring of performance
- The trend in some industries towards turnkey contracts, requiring the provision of working assets at specified times, so that the supplier is responsible for maintenance as well as the supply of the asset
- The increased expectations of society, including both continuity of service and safety, reflected in the regulatory regimes for some industries

Maintenance engineers may be employed in a wide variety of positions. The degree of access to the original design documentation of the asset for which they are responsible will vary greatly, as will the degree of managerial and technical support within their employing organisation.

Some examples are: -

Maintenance Engineer's Position	Comments
Responsible for specifying maintenance requirements in the organisation of the Original Equipment Supplier.	Will generally have access to full design and manufacturing data as it emerges. Service data and actual maintenance experience may not be available in the case of industries using bespoke equipment manufactured in small batches.
Responsible for the implementation of normal maintenance in the organisation of the Original Equipment Supplier and Maintainer.	Will generally have access to full design and manufacturing data. Performance indicators will be specified and closely monitored. There may be some lack of continuity of maintenance experience if this type of arrangement is new to the industry.

Maintenance Engineer's Position	Comments
Responsible for the implementation of normal maintenance in the organisation of the operator.	Technical support may range from virtually none to having a full corporate engineering function available. Design and performance data may be fully available, or it may be non-existent, possibly to the extent that reverse engineering may be necessary on occasion. The requirements will vary through the asset life, from supporting type testing and commissioning, normal maintenance, mid-life refurbishments, to managing the end-of life period, when some failures and cannibalisation may be acceptable.
Responsible for the specification and contracting out of periodic overhaul or refurbishment in the organisation of a lessor.	There will usually be adequate technical support as well as design and construction data. However, the opportunities to see the asset in service and to obtain access to service history may be restricted.
Responsible for the implementation (and possibly the development of a specification to meet performance targets) of periodic overhaul or refurbishment in the organisation of a contractor.	The contractor's scope of work will normally be closely defined, although there are some performance-based contracts in which the contractor will have to define the requirements to meet the desired life and performance specification. However, the opportunities to see the asset in service to obtain access to service history may be severely restricted.
Responsible for developing maintenance specifications and implementation solutions in a consultancy company.	Requires a high degree of all-round engineering and industry structure knowledge, combined with inter-personal skills. May deal with Original Equipment Manufacturers, operators, lessors and contractors. Will need to obtain all technical and performance data from the customer and/or their suppliers.
Responsible for maintenance in a museum or heritage organisation.	Will require a degree of reverse engineering and adaptation from commercial use to heritage use, with modern technology where appropriate. Funding and technical support may be lacking.
Responsible for maintenance Certification and approval activities in one of the regulatory bodies.	Expert knowledge of regulations required. Will require an ability to review submissions and evaluate compliance. Maintaining the understanding of maintenance activities may be a problem.

Note that the above covers contractors as well as those directly employed by the organisations above.

From the above it is obvious that there can be no criteria based on job titles, numbers of staff supervised, or other across the board standard. Irrespective of the candidate's employer and post held, the core competencies relate to standard setting and implementation of standards, but may also involve analysis of engineering function without design data. It is therefore essential to obtain evidence of the candidate's competences, bearing in mind that his/her responsibilities may involve other industry standards.

Requirements for election or transfer to member

The great variety of posts and responsibilities within maintenance engineering means that it is necessary to consider the requirements carefully, possibly requiring reference to the relevant industry standard e.g. for the electricity supply industry. Those responsible for standard setting should be fully aware of the underpinning processes, such as Failure Mode and Effect Analysis (FMEA), Reliability Centred Maintenance (RCM) analysis, Quantified Risk Assessment, materials supply, etc. and should have an understanding of the processes involved in maintenance planning, including safe systems of

work. Those involved in the implementation of the standards will need to be aware of these processes and to be responsible for planning and carrying out the maintenance, leading and developing the maintenance team and taking appropriate action in the event of any unplanned events.

Those responsible for managing these activities through a sub-contractor should have a thorough understanding of the processes that they are procuring and the risks they are guarding against, and must also have a clear appreciation of their safety responsibilities.

Where major upgrading or refurbishment is involved, there will be a requirement to manage this as a project in its own right. Involvement in such a project may provide the opportunity to demonstrate a greater depth of understanding of the underlying engineering principles and to exercise engineering judgement and/or budgetary control to a greater extent than is needed for routine maintenance. Recovery following breakdown or accident may also provide similar opportunities.

Assessment of Competences

Professional mechanical engineering responsibilities for the positions described above will, of course, depend to a large extent on the particular location, the type of asset being maintained and the individual's job description. Clear and comprehensive organisation charts, supported as necessary by charts showing the relationship with other parties involved, will be key to the appraisal process.

Where an applicant appears to spend the **majority** of his/her time in project engineering or project management, (refurbishing or upgrading the asset, for example) assessors may find it helpful to refer to the section entitled "Engineers in Project Management Roles" which appears later in Part 2 of this manual. Similarly, in the case of applicants employed by manufacturers, having responsibility for specifying the maintenance requirements of the asset, where there may be some overlap with design activities, the guidance to assessors in the section covering "Manufacturing Industries" may be useful.

Competence statements A and B

Successful applicants will be able to demonstrate their use of a combination of general and specialist engineering knowledge and understanding of the operation of the asset being maintained. It is essential that they should be able to demonstrate an understanding of the risks arising from the asset's operation and maintenance. They should be able to use their knowledge of the asset to assess these risks, using recognised techniques including FMEA, RCM analysis and Quantified Risk Assessment in order to define appropriate maintenance tasks and intervals. They should also understand the environmental considerations involved in the operation and maintenance of the asset.

Candidates should be aware of the potential application of existing and emerging technology, whether it be through the application of new lubricants or other consumables, the application of environmentally friendly materials, new monitoring and fault finding techniques, new plant and equipment, or upgrading the asset by minor modifications.

Applicants engaged primarily in project engineering or management should provide, and assessors should seek, evidence of responsibility for technical specifications, technical risk management, evaluation of technical solutions and monitoring against technical performance standards, including safety and reliability. This is particularly important where the project is managed through a contractor.

Candidates should be able to demonstrate their ability to identify any unacceptable risk arising from the operation and/or maintenance of the asset and to take the appropriate action.

Examples of situations or activities that may give mechanical engineers the opportunity to achieve and demonstrate professional competence in these areas, include:

- "Clean sheet" studies of maintenance requirements for an asset, either in a design and manufacturing environment or in support of the operator of the asset.
- The identification of potential areas of work to eliminate maintenance problems, improve performance, or reduce risk.
- Work done to exploit the asset, and improve its performance or throughput, reduce downtime, or other improvement.

- Participation in the upgrading and refurbishment of an asset, taking into account the operational history of the asset. This may involve achieving compliance with new, more stringent safety or environmental regulations.
- Candidates should show their application of new technology where appropriate to improve regulatory compliance, reliability, costs and safety. The functionality of the asset with the new design elements should be considered and the appropriate techniques used to identify potential risks and the necessary control measures, including the specification of maintenance tasks.
- Secondment in any of the above areas to overseas or other locations where support facilities may be severely limited.

Where, because of the diversity of services offered by their employer, applicants work in areas of engineering other than maintenance their technical competence may be better judged by reference to the appropriate section of this manual, e.g. the gas industry.

Competence statement C

Given the wide range of positions and responsibilities that may apply, applicants are not necessarily expected to have line management responsibility or experience in order to meet the required level of competence in this section. Also, engineers who have moved into highly specialist technical rôles, e.g. in manufacturer's engineering departments, specialist suppliers and consultancy companies, may have minimal management responsibilities. Such applicants would be expected to have a high degree of autonomy in planning and monitoring their activities and care should be taken to explore the interface between them and their colleagues and supervisors and their responsibilities through any contractual chain.

Examples of situations or activities that may give engineers the opportunity to achieve and demonstrate competence in these areas, include:

- The planning and personal supervision of regular asset maintenance activities and of refurbishment and/or upgrading projects.
- The development of maintenance and/or operational strategies for new or existing assets and the formulation of new procedures and systems for additional items.
- The periodical review of maintenance and/or operational strategies taking account of service history, including safety and reliability outcomes and the formulation of new procedures and systems for new operational or regulatory requirements.
- Managing the supply of materials and other logistical elements necessary to support maintenance.
- The training and development of team leaders, technicians and skilled craftsmen.
- Active involvement in continuous quality improvements, encompassing the areas above.

Competence statement D

Communication and interpersonal skills should be assessed by consideration of both the Professional Review Report and interview performance. Assessors should look out for a report which has a logical structure, clearly aimed at presenting a portfolio of evidence against each of the five competence statements, while providing a qualitative description of activities and achievements.

Assessment of verbal communication skills should analyse the ability to give clear, concise and relevant answers that address the question without digression and provide sufficient, but not superfluous detail.

Additional evidence of competence in this area may be sought by investigating:

- Whether the applicant routinely makes presentations to in-house management at various levels, outside clients and contractors; subjects could include project plans, business plans, regulatory compliance, risk assessment, environmental impact, etc.
- Whether the applicant is involved in contract liaison and negotiations - systems, procedures, method statements, safety, etc.
- Whether the applicant can demonstrate team-building activities. It is possible that the team may be drawn from different organisations working together.
- Whether the candidate would have the ability to negotiate with senior management and/or clients the need for potentially costly action necessary to safeguard safety and/or future operational performance.

Competence statement E

The observance of safe working procedures, including compliance with the Health and Safety at Work Act, as well as internal and national codes of practice, is inherent in all UK-based maintenance activities. Applicants should be able to demonstrate their understanding of the regulatory requirements and their commitment to achieving compliance. Where there is a contractual chain, it is particularly important that the applicant understands where the overall responsibility for safety lies and the responsibilities of the individual parties.

If, as increasingly occurs, the applicant is involved with work carried out overseas, it may be neither practicable nor desirable to impose UK standards throughout. Nevertheless, the applicant should understand the extent of application of UK law and the appropriate application of local standards.

Evidence of professional integrity and commitment should include a Self-Development Action Plan, in any convenient format, outlining how the applicant intends to maintain and enhance competence through personal development. The Plan should include short, medium and long-term goals and explain how these are likely to be achieved. Assessors should be aware that SARTOR 3 interprets Continuing Professional Development (CPD) as commencing at the point where Chartered status is attained; therefore applicants are not required to provide a record of courses attended, etc. when applying for corporate membership.

Examples of CPD activities recognised by the Institution as acceptable include:

- extra qualifications such as an MBA, Diploma in Engineering Management, IOSH, etc.
- any relevant technical or business courses
- conducting or attending workshops
- attending, presenting or participating in seminars and conferences
- presenting or attending lectures
- writing technical papers
- reading technical articles and journals
- distance or open learning
- secondments and job rotation
- updating in own and other fields of work
- Institution meetings or events
- active IMechE committee work
- learning a foreign language
- involvement in government activities
- community and charity work

Requirements for election or transfer to Fellow

The following senior engineering posts should be considered as generally likely to meet the requirements for the class of Fellow:

Director

Site manager for a major maintenance facility

Senior engineers having skills recognised across their industry sector

Applicants will generally have significant responsibilities for resources (both financial and manpower) and also have wide understanding of strategic, commercial and financial issues. They are likely to be experts in their particular fields, e.g. having expertise related to the asset being maintained, logistics support, condition monitoring, etc. and to be “champions” for their directorate, company or industry sector.

Valid applications for election or transfer to Fellow may be received from other engineers with established reputations in important positions of responsibility in engineering science or practice. This applies to engineers in manufacturing companies and their suppliers and in firms that design and manufacture maintenance plant and equipment, as well as in operating and maintaining companies. In addition to demonstration of achievements and standing in their field of engineering science or practice, applicants would be expected to participate in external forums, for example by promoting the importance of engineering issues in debate with Government and other bodies, via the Institution. In any case, an involvement in the professional development of young engineers would be expected, as would documentary evidence of Continuing Professional Development.

Further examples of suitable CPD activities not covered under the requirement for Competence Statement E above include:

- MPDS mentoring
- Acting as an IMechE Membership Panel interviewer

For candidates applying directly for the class of Fellow, a Professional Review Report similar to that required for the class of Member would be required in addition to an interview. In particular, this report must contain additional supporting evidence detailing:

- The position of senior engineering responsibility held by the applicant
- The applicant's contribution to the professional development of young engineers
- How the applicant intends to keep up to date regarding developing technologies, from both a technical and a commercial standpoint.

Finally, a Development Action Plan detailing a future programme of CPD would be required from applicants in either category (transfer from Member or direct election).