Professionalism through Certification

The Institute for RFID Education, Research and Certification

Professional Level Examination

Examination Preparation Guide & Curriculum

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1 Introduction

1.1 Purpose

The purpose of this document is to provide candidates, tutors and examiners an outline of the subject areas and content that are within the scope of the RFID Professional Institute Professional Level examination.

It is intended to be used as a guide to what to study guide for those wishing to gain certification from the RFID Professional Institute at Professional level.

1.2 Scope

All RFID related subject areas that could be examined by the RFID Professional Institute at Professional level.

1.3 Document Management

All versions of this document are managed and controlled by the RFID Professional Institute Board of Directors. The Board is also the owner of the processes involved with managing this document and future iterations of this document and is responsible for maintaining this document.

2 The Professional Level Exam

The RFID Professional Institute Associate Level exam is the second level in the RFID Professional Institute examinations designed to test the candidate's knowledge and understanding of RFID technology and how to apply it.

The Associate Level exam focused on establishing that the candidate has a good knowledge of the principles of RFID systems, common terms and their meaning, and the many factors which can influence how well such a system performs for a particular application. Its emphasis was not on testing the examinees knowledge of how to design and deploy an RFID system, but rather on the basics of RFID, what the components of such as system, what role they each play and generally how they are applied in various applications.

The Professional Level moves forward to where candidates are expected to have a good understanding of the more technical aspects of RFID and knowledge of how to deploy such systems.

When the RFID Professional Institute certifies that a candidate has demonstrated a specific level of professional knowledge about RFID it must be sure that it can stand behind that statement and that it has taken all reasonable steps to verify the candidate's knowledge.

The exam is simply the mechanism by which we verify that you, the candidate, have the knowledge that we have set out in the curriculum for the Certificate that we issue. It is also the mechanism by which you, the candidate, demonstrate to us that you have that knowledge.

3 Exam Media, Format & Pass Level

3.1 Media

The exam is usually taken online in two possible settings:

3.1.1 Event

Exams are periodically held at key RFID events such as RFID Journal LIVE! Exams are also hosted on behalf of the RFID Professional Institute by other similar organisations such as the New Zealand Pathfinder Group (http://www.rfid-pathfinder.org.nz/).

In this setting there may be a group of candidates taking the exam at the same time in the same room. The exam is still taken online but is proctored by RFID Professional Institute staff.

3.1.2 Individual

It was previously possible for individuals to take RFID Professional Institute exams online but the company providing that service ceased operations.

We are looking at alternative ways to reinstate this option and will advise on our website www.rfidpros.org when this is available again.

3.2 Format

3.2.1 Questions

- The exam consists of 9 sections each of which tests the candidate's knowledge of one of the subject areas set out in this guide.
- Each question will be a "multiple choice" type question
- For most questions, but not all, you will be guided as to how many correct answers are expected
- You may answer the questions in any order that you choose

3.2.2 Time

- You may start the exam period at any time after the proctor has told you to start. Once you start the exam the clock is counting down your exam period
- The exam period is 90 minutes
- At the end of the exam period no further input should be made to any question
- You may complete the exam in less than the allotted exam period but once you have handed in your paper you may not restart the exam even if the exam period has not yet expired

3.3 Exam Pass Level

The normal grade need for passing the RFID Professional Institute Associate Level exam is 70% of the weighted answers.

However, this score is a provisional score and must not be relied upon as an indication that you have definitely passed or failed the exam.

Note also that this does not mean that if you answered 70% of the questions correctly then you have passed. The questions in this exam are weighted and do not contribute equally to your score.

As with all academic and professional exams, there are occasions when the scores or a group of candidates indicate that a further normalization of the scores and associated pass level is required.

Candidates will normally be advised of their formal score and pass or fail within 28 days of taking the exam. Communication will be by email from the RFID Professional Institute President advising each candidate of their status.

Candidates who have passed the exam will also receive a Pass Certificate from the RFID Professional Institute signed by the President and Chairman of the Institute. *This certificate is the only formal confirmation that candidate has passed the exam.*

If you have any exam related questions then email exam@rfidpros.org for assistance.

4 Examination Scope

The scope of examination for Professional level is the following:

- **RFID Technology - Deep Dive** – Focus on performance characteristics of various forms of RFID, selection of RFID components (tags, readers, antennas), reader management, integrating RFID into other environments and security.
- **Standards & Regulations** – understanding of RFID related standards and regulations in North America and the European Union (because most regulations in other jurisdictions are based upon these), Health & Safety.
- **Protocols & Middleware** – UHF, HF, NFC, Active, Passive, BLE, ZigBee, Rubee, middleware functions.
- **Physics behind RFID**– Frequencies, reflection, refraction, diffraction, absorption, coupling types, link budgets, antenna types
- **Complete System** – gates, portals, tunnels, printers, sensors/GPS, types of readers, mountings, peripherals.
- **RFID Evaluation and Selection** – Benchmarking readers & tags, identifying correct technology for application.
- **Deployment** – Site survey, RFID installation, locating & positioning, deployment platforms, network integration
- **Troubleshooting & Maintenance of RFID Systems** – problem identification, tag batteries, handheld batteries, chargers.
- **Data: Flow, Management & Issues** – Data encoding systems, barcode compatibility, integration with other platforms.

The breadth and depth of knowledge that candidates are expected to know for each of these subject areas is explained in more detail below.

5 RFID Technology - Deep Dive

5.1 Scope

This section focuses on the performance characteristics of various forms of RFID and how to select RFID tags, readers, antennas suitable to meet the user requirements.

It also covers how to set up, configure and manage readers and how to integrate a RFID system into other process and systems environments.

Lastly it covers security in the context of RFID equipment, tags and data exchange.

5.2 Knowledge Tested

- RFID Integration Components
    - Readers, tags, antennas, multiplexors, middleware
- Operational Security
    - Reader control
    - Tag access
    - Data transfers
- Integration to interfacing technologies
    - GPS
    - Sensors
- Reader Management
    - Configuration
    - Testing
    - Read modes
    - Power sources
- Selecting RFID Tags and Readers, Antennas
    - Reader characteristics – protocols supported, environmental survival (heat, liquids, dust, explosive atmosphere)
    - Tag types – including environmental survival (heat, chemical, abrasion)
    - Antenna types and function parameters (induction, propagation, polarization, duplex, gain, radiation pattern, impedance, EIRP, ERP)
- Performance characteristics
    - Read distance

- Data transfer speed
- Environmental adverse impact (e.g. water)
- Protocol overhead

5.3 Knowledge Not Tested

Candidates are not expected to know:

- How vendor specific middleware functions
- GPS or sensor internal functionality
- Reader management protocols in detail
- Vendor specific reader control protocol extensions
- Vendor specific tag characteristics

5.4 Sample Questions

6 Standards & Regulations

6.1 Scope

This section covers RFID related standards and regulations.

6.1.1 Regulations

For regulations it focuses on those in North America and Europe because in general the regulations in the rest of the world are based upon them.

- Type approval, including responsibility for in country compliance with radio regulations
- Licensing for radio devices
- Use of RFID radio devices such as readers, tags and antennas
- Transmitting parameters such as frequency, dwell time, FHSS, antenna radiated power
- Health & Safety regulations for use of RFID equipment

6.1.2 Standards

For standards it focuses on global standards related to RFID tag data, data encoding and data identification.

Note that standards for Air Interface Protocols are covered in the next section.

6.2 Knowledge Tested

Candidates are expected to understand:

- Type approval, including responsibility for in country compliance with radio regulations
- Licensing for radio devices
- Use of RFID radio devices such as readers, tags and antennas
- Transmitting parameters such as frequency, dwell time, FHSS, antenna radiated power
- Health & Safety regulations for use of RFID equipment
- Reader management - LLRP
- Tag Data – ISO, GS1/EPC
- Tag data encoding – ISO, GS1/EPC
- Tag data identifiers – ISO DI, GS1 AI
- Tag data business extraction - ALE

6.3 Knowledge Not Tested

Candidates are not expected to know:

- Specific regulations operating parameter values other than frequencies & power limits
- Specific content of Health & Safety of any regulations
- Which countries have adopted regulations from other countries
- Translation between data formats – Decimal, HEX, binary
- Specific tag data identifier values

6.4 Sample Questions

7 Protocols & Middleware

7.1 Scope

Protocols & Middleware – UHF, HF, NFC, Active, Passive, BLE, ZigBee, Rubee, middleware functions

7.1.1 Protocols

Protocols stipulate how something should be done in a standard way. At this level you are expected to understand the basics of how specific protocols work as listed below.

7.1.2 Middleware

Middleware acts as a broker between RFID hardware and business applications to retrieve data and present it in a filtered intelligent format.

You are expected to understand middleware principles and the value it provides within the overall RFID environment.

7.2 Knowledge Tested

Candidates are expected to understand the protocols for:

- UHF - Class 1 Gen2 V2, ISO/IEC 18000-63
- HF
    - Proximity – ISO 14443 A/B
    - Vicinity
        - ISO 15693
        - ISO/IEC 18000-3M1
- NFC
    - Tag types
    - Security
    - Connectivity
- Active
    - Tag Transmission
    - Activation Frequencies
    - ISO/IEC 18000-7
- BLE – beacons
- ZigBee and Rubee
- Middleware

- Event management
- Setting business rules
- Available standards for extracting data (such as ALE)

7.3 Knowledge Not Tested

Candidates are not expected to know:

- Specific vendor extensions to protocols
- Functionality of any specific middleware

7.4 Sample Questions

8 Physics behind RFID

8.1 Scope

Physics behind RFID– Frequencies, reflection, refraction, diffraction, absorption, coupling types, link budgets, antenna types

This section covers the physics behind the operation of RFID broken into three distinct subject area

- Communications between components
- Environmental factors that impact that communications
- Antenna types, design and functionality in more depth

8.2 Knowledge Tested

Candidates are expected to know:

- RF Frequencies, Communication & Protocols (UHF, HF, NFC, Active)
- Reflection/Refraction/Diffraction/Absorption
- Inductive Vs Capacitive Coupling
- Link Budgets
- Antenna
    - Types
        - Linear
        - Circular
        - Other
    - Design
    - Functionality

8.3 Knowledge Not Tested

Candidates are not expected to know:

- Specific formulae for any of the above – with the exception of rate of energy dissipation
- Details of any specific vendor's equipment

8.4 Sample Questions

9 Complete System

9.1 Scope

Complete System – gates, portals, tunnels, printers, sensors/GPS, types of readers, mountings, peripherals

An RFID system in its simplest form is composed of a reader, at least one antenna and an application to send the read data to for processing.

But in practice there are many variations on the type and quantity of components that can be integrated into an RFID system. This section covers what those components are, when they should be used and how they fit together.

9.2 Knowledge Tested

Candidates are expected to know:

- Gates, Portals & Tunnels
- Printers
- Sensors & GPS
- Types of readers and mountings
- Peripherals
- How the components fit together to form an overall system

9.3 Knowledge Not Tested

Candidates are not expected to know:

- Specification of any components
- Vendor specific details of any component

9.4 Sample Questions

10 RFID Evaluation and Selection

10.1 Scope

The Associate Level curriculum covered the basic of selecting RFID technology for a particular purpose and application.

At Professional Level the scope moves on to not just selecting RFID technology based upon applicability but to then benchmark components within that selection to insure that the optimum fit for purpose has been selected.

10.2 Knowledge Tested

Candidates are expected to know:

- Identifying correct technology for application
- Benchmarking readers & tags

10.3 Knowledge Not Tested

Candidates are not expected to know:

- Specification of testing equipment
- Details of the design of any test equipment

10.4 Sample Questions

11 Deployment

11.1 Scope

While RFID technology is a well proven technology it is also one that can be greatly impacted by how it is deployed and the environment that it is deployed into. Lack of understanding of the essentials of deployment can lead to serious issues and a perception that it is RFID technology itself that does not work well so it is essential that you do understand this subject.

The scope of this section is all aspects of implementing RFID except middleware, which is covered elsewhere in this curriculum.

11.2 Knowledge Tested

Candidates are expected to know:

- Site Survey
- Installing & Configuring
    - Gates & Portals
    - Tunnels
    - Vehicle Mount (Forklift, Pickup, Trucks)
- Antenna Installation
- Locating & Positioning
    - RTLS
    - Zonal
    - Hot Spots
    - Beaconing
- Deployment Platforms
    - On-premise
    - Cloud
- Network Integration

11.3 Knowledge Not Tested

Candidates are not expected to know:

- Vendor specific component specifications or operation

11.4 Sample Questions

12 Troubleshooting & Maintenance of RFID Systems

12.1 Scope

A RFID system has many components which must seamlessly work together. When things go wrong it can be difficult to track down the root cause to a specific component so a well disciplined approach to troubleshooting is required.

A disciplined approach to troubleshooting is not on its own sufficient – you must also have an understanding of the symptoms that can occur when specific components within the RFID system fail intermittently or completely.

12.2 Knowledge Tested

Candidates are expected to know:

- RFID system problem identification
- Tag batteries
- Handheld batteries & chargers

12.3 Knowledge Not Tested

Candidates are not expected to know:

- Specific problem solving methodology (e.g. Kepner Trego, PDCA, RPR)
- Vendor specific batteries or chargers

12.4 Sample Questions

13 Data: Flow, Management & Issues

13.1 Scope

Data encoding systems, barcode compatibility, integration with other platforms

RFID systems are deployed for one reason, and only one reason – to collect data about what something was, where it was and when it was there. This data on its own is useless – it must be sent somewhere where it can be processed and become useful.

This section covers how something can be identified, how that data flows to where it will be processed, how to manage that flow and what to do if there are issues in doing so.

Since one issue that could arise is that a tag can no longer be read, you are also expected to know the basics of the most common backup mechanism – barcodes.

13.2 Knowledge Tested

Candidates are expected to understand:

- Tag data identifier systems
    - UID
    - GS1/EPC
- Data identifiers, formats & translation
    - Data Identifier (DI's)
    - Application Identifiers (AI's)
    - Text
- Barcode Compatibility
    - 1D
    - 2D
- Integration with other platforms such as Oracle, SAP

13.3 Knowledge Not Tested

Candidates are not expected to know:

- Specific organisations data identifier formats
- Standard Data Identifiers values
- Specific barcode standards or formats
- Specifics of Other Platforms beyond the principles of integrating with them

13.4 Sample Questions

14 Preparing for Your Exam

14.1 Planning for Success

You are likely to pass the exam if you have the following:

- Passed the RFID Professional Institute Associate Level exam
- Studied the subject areas set out in this curriculum
- Are familiar with RFID terms and applications, the different types of RFID systems, common terms related to RFID and the components that make up an RFID system.
- Have spent at least 2 years installing, using and managing RFID systems
- A basic understanding of the physics of the various forms of RFID
- A good understanding of data formats and encoding
- A good knowledge of the international standards related to RFID equipment and its use

14.2 Some Steps to Take Before Taking the Exam

14.2.1 Study

Study the subject areas outlined in this exam guide. Remember that the exam is not focused on a specific form of RFID and you will be tested on different aspects of all types of RFID systems, including passive LF, HF and UHF RFID, active systems and hybrid systems.

If you are an experienced RFID professional then you may feel that it's not necessary for you to review the curriculum subject areas. But we advise you against this approach because:

- You may be tested on an aspect of RFID that you have not become familiar with in your career so far
- RFID technology and applications are constantly changing
- The curriculum provides a structured check list to make sure you have covered everything that you may be tested on

14.2.2 Where to Get Information on RFID

There are a number of primers on RFID on the Web to help you get started, including:

- https://en.wikipedia.org/wiki/Radio-frequency_identification
- http://www.rfidjournal.com/get-started
- http://cottonsrevolutions.org/applications/blog/Technology/2011-12-05/RFID-Primer

Many of the RFID protocols used in industry are covered by the ISO -18000 series standards, formally called the "Parameters for Air Interface Communications." You can find an explanation of these standards at:

- http://www.hightechaid.com/standards/18000.htm

14.2.3 Glossary of RFID Terms

A number of Web sites have glossaries of RFID terms, including:

- RFID Journal: http://www.rfidjournal.com/glossary/
- AIM, the Association for Automatic Identification & Mobility: http://www.aimglobal.org/?page=rf_glossary

14.2.4 Case Studies

- The AIM site has a number of case studies, which can be found at: http://www.aimglobal.org/?rfid_casestudies.
- RFID Journal has free case studies, which can be found at: http://www.rfidjournal.com/free-case-studies

14.2.5 News and other information

There are several websites that offer news about RFID deployments, products, standards development and other issues. Among these are:

- RFID Journal: http://www.rfidjournal.com/
- RFID Solutions Online: http://www.rfidsolutionsonline.com/
- RFID Ready: http://www.rfid-ready.com/

14.2.6 Get Trained

The RFID Professional Institute maintains a list of companies that provide RFID training. The list can be viewed at

- http://rfidpros.org/rfid-certifications/training/

The RFID Professional Institute offers this list of organizations providing RFID training, either online or instructor led. Some training offerings may be aimed specifically at preparing students for an RPI certification examination; others may not. The Institute does not claim that the list is all inclusive. Likewise, the inclusion of an organization on the list should not in any way be construed as a recommendation by the Institute, or guarantee that a student taking the organization's training will pass an RPI certification examination.

