Professionalism through Certification

The Institute for RFID Education, Research and Certification

Professional Level Examination

Examination Preparation Guide & Curriculum

Version 2-0

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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 in particular the knowledge required to successfully 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 currently testing software that would 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 70 questions covering 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

- Questions are presented randomly by the system but you may revisit questions you have previously answered or marked for review

3.2.2   Time

- You may start the exam period at any time after the proctor has told you to start. Once you are presented with the first question the clock is counting down your exam period

- The exam period is 90 minutes

- At the end of the exam period no further input to any question will be possible

- You may complete the exam in less than the allotted exam period but once you have left the exam room 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:

- **Assessing the Business Case** – Focus on capital expenditure vs operational costs, hard vs soft potential savings, impact on inventory management, value of accuracy in operations.

- **Determining the Application Requirements, Planning and System Design** – understanding of how to plan and manage an RFID project, practical steps to be taken and the role of sensors in the project.

- **Technology Evaluation and Selection** – reader and antenna form factors, selecting the applicable technology, antenna types and selection, RF regulations, benchmarking RFID equipment; security, alternatives to RFID.

- **Peripherals and Add-ons** – Gates, portals, tunnels, printers, label applicators, lights, cables

- **ROI Analysis** – estimating system and ancillary costs, estimating hard and soft financial benefits, estimating soft benefits.

- **Pilot and Assessment** – Pilot best practices, location selection, validating pilot results.

- **Data: Flow, Management & Issues** – Data encoding systems, data identifiers, application identifiers, text, barcode compatibility, data integration with other platforms (e.g. SAP)

- **Deployment** – installing hardware & equipment, shielding, object location methods, deployment platforms, network integration.

- **Troubleshooting & Maintenance of RFID Systems** – Identifying & fixing problems, tag batteries, handheld batteries, chargers.

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 Assessing the Business Case

5.1 Scope

Few RFID projects will be commissioned without a well-reasoned and accurate business case being made so the ability to do this is crucial to a successful RFID implementation.

This section focuses on the financial aspects of assessing if a proposed RFID Project will provide sufficient business benefits.

This includes understanding the types of costs involved, potential savings (hard and soft), quantification and tradeoffs. It also includes the impact of any increased accuracy in data about operations.

5.2 Knowledge Tested

- Capital expenditure vs recurring operational costs
- Hard dollar savings vs soft benefits
- Labor savings
- Reductions in theft
- The value of inventory accuracy
- The value of shipping accuracy

5.3 Knowledge Not Tested

Candidates are not expected to know:

- Specific financial assessment techniques such as Net Present Value (it is assumed that such expertise is made available to the Project Manager)
- Inventory management methods

5.4 Sample Questions

A supplier to multiple retailers wishes to deploy an RFID system to track goods from its warehouse to its store. Which of the following are likely going to be hard-dollar benefits from the system? Choose the one best answer.	A reduction the amount of workers needed to confirm the items picked at the warehouse are the items ordered by the store
	A reduction in theft of items in transit due to the ability to track what was shipped and what arrived at the store
	A reduction in charges for misshipments by its retail customers
	All of the other answers are correct

Which of the following contribute hard-dollar savings (as opposed to soft benefits) when calculating the potential return on investment of an RFID system? Choose the three best answers.	Reduction in time spent looking for tagged assets
	Reduction in chargebacks, fines or other financial penalties
	Reduction in capital expenditure due to improved asset utilization rates
	Reduction in lost or stolen items due to better tracking

6 Determining Application Requirements, Planning & System Design

6.1 Scope

No matter how good the business case for an RFID implementation, it cannot succeed without comprehensive and accurate determination of the detailed requirements to be met. So this section tests your ability to accurately gather those requirements, design for them and plan their implementation.

6.2 Knowledge Tested

Candidates are expected to understand:

- What are the basic steps in an RFID project and how do they fit into a project plan?

- What are the business needs / requirements the Project will address & how are they captured?

- What is a site survey, what does it achieve, when is it needed and who would carry it out?

- What role do sensors (RFID and other types) play in meeting the business requirements?

6.3 Knowledge Not Tested

Candidates are not expected to know:

- Specific project management methods or software

- The physics behind the equipment used in a site survey

- Detailed technical specifications of any specific sensor or RFID equipment

6.4 Sample Questions

For an application where the moisture in several thousand low-cost items in a warehouse must be monitored, which of the following is likely to be the best choice? Choose the one best answer.	Passive RFID transponders with sensors
	Active RFID transponders with sensors
	Wi-Fi tags with sensors
	Zigbee tags with sensors

When designing an RFID system for a specific application, it is important to limit the scope of the project for which of the following reasons? Choose the two best answers.	To ensure that the system can be delivered on time and within budget☐
	To ensure shareholders don't get concerned about cost and sell their stock
	To ensure the benefits of the system can be measured accurately
	To make sure the supplier of RFID tags can deliver the quantities needed

7 Technology Evaluation and Selection

7.1 Scope

There many forms of RFID and other complimentary technologies, each with their own specific characteristics, advantages and disadvantages. Selecting the wrong technology combination could prevent a successful implementation, reduce potential benefits and cause unnecessary costs to be incurred.

So this section will test your ability to evaluate and select the right RFID technology for an RFID Project, including alternate technologies where RFID is not appropriate.

It will also cover how to ensure the right level of security is implemented

7.2 Knowledge Tested

Candidates are expected to understand the protocols for:

- Benchmarking Readers and Tags
- Identifying correct RFID technology for application (active, passive or battery assisted)
- Reader form factors (fixed, mobile, handheld, etc.)
- Alternatives to RFID
    - i. Ultrasound
    - ii. Infrared
    - iii. 2D bar codes
    - iv. Dual-technology tags
- Antennas
    - i. Types
    - ii. Polarization
    - iii. Power output/gain
- RF regulations
- Security

7.3 Knowledge Not Tested

Candidates are not expected to know:

- Specifics about any vendor's tags or equipment
- Security algorithms
- Specific regulations references

7.4 Sample Questions

When seeking to track assets in near-real time, it is best to choose which of the following types of active RFID tags? Choose the one best answer..	Tags that are woken up by commands from the reader because this conserves battery life
	Tags that beacon because they broadcast their ID at set intervals, allowing the system to locate that asset each time it beacons
	Passive tags that beacon
	None of the other options is correct

RFID readers are sometimes placed within enclosures to protect them from environmental elements. If a reader enclosure has an IP67 rating, which of the following are true? Choose the two best answers.	The reader can be used safely in an environment where there is dust
	The reader will not cause an explosion in an environment with flammable gas
	The reader will not cause an explosion in an environment with flammable liquids
	The reader can be immersed in water up to 1 meter (3 feet)

8 Peripherals and Add-ons

8.1 Scope

All RFID projects will require at least a basic reader/antenna/tag combination but some projects also require additional peripherals and add-ons to maximize gains form the use of RFID.

This section will test your knowledge of such peripheral equipment, including mountings, enclosures, cables & other connected devices such as stack lamps to visually indicate status.

8.2 Knowledge Tested

Candidates are expected to know:

- Gates, portals and tunnels

- Printers/encoders, label applicators

- Sensors and GPS

- Types of readers and mountings

- Reader enclosures, protective structures

- Lights, cables and other peripherals

8.3 Knowledge Not Tested

Candidates are not expected to know:

- Specific branded designs of any peripheral equipment

- GPS technology other than ability to retrieve current location and time

8.4 Sample Questions

Sensors are sometimes used with RFID tags to monitor which of the following? Choose the one best answer.	Temperature
	Moisture
	Strain/tension
	All of the other answers are correct

Light stacks or signals are sometimes linked to RFID systems for which of the following reasons? Choose the one best answer.	To let workers know when to turn on and off readers
	To prevent collisions between forklifts carrying tagged goods
	Light stacks are never used with RFID systems
	To indicate tags were read

9 ROI Analysis

9.1 Scope

Understanding how to put together a business case is not of itself enough to ensure that a good business case is constructed. Since the business case normally consists of key financial data it is important that you can demonstrate a good understanding of how to collect and assess these data.

So this section focuses on estimating project costs and benefits, with benefits being expressed in hard financial benefits and other softer benefits.

9.2 Knowledge Tested

Candidates are expected to know:

- Estimating system and ancillary costs
- Estimating potential hard dollar savings
- Estimating soft benefits

9.3 Knowledge Not Tested

Candidates are not expected to know:

- Specific financial assessment techniques such as Net Present Value (NPV)
- Standard Costs compilation techniques

9.4 Sample Questions

An RFID project is projected to reduce the number of opened products that customers return by 35%. Which of the following costs would you expect to be reduced? Choose the two best answers	Inventory processing
	Marketing
	Credit processing
	Insurance

Which of the following are soft benefits? Choose the two best answers.	Lower shipping costs
	Less customer dissatisfaction
	Employee attendance
	Customer loyalty

10 Pilot and Assessment

10.1 Scope

Few major or large projects in life go straight form development to full implementation because the risk of doing so is unacceptably high. In most cases it makes sense to create and run a smaller scale pilot to minimize risk and adverse impact from initial teething troubles.

This section covers your knowledge of everything needed to set up and run a successful RFID pilot, including location selection.

Then it covers how to validate the results of the pilot.

10.2 Knowledge Tested

Candidates are expected to know:

- Pilot best practices
- Choosing a location
- Validating the results

10.3 Knowledge Not Tested

Candidates are not expected to know:

- Details of any specific location layout

10.4 Sample Questions

Which of the following are among the primary reasons for running an RFID pilot? Choose the two best answers.	To get customers used to the idea of being tracked
	To determine whether the system works as expected in a real-world environment
	To get employees used to the idea of being tracked
	To determine whether the system delivers the expected benefits

In assessing the results of a pilot, it is important to do which of the following? Choose the two best answers.	Validate that no other technology could do the job
	Less customer Validate that the system delivered the expected benefits
	Validate that workers' health is not adversely affected by the system
	Validate that the system performed as expected

11 Data: Flow, Management & Issues

11.1 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.

11.2 Knowledge Tested

Candidates are expected to understand:

- Data encoding systems – UID, GTIN, UPC, etc.
    i. Tag data identifiers, formats and translation
    ii. Data identifier
    iii. Application identifiers
    iv. Text
- Barcode Compatibility
    i. 1D
    ii. 2D
- Integration with other platforms such as Oracle, SAP

11.3 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

11.4 Sample Questions

Passive UHF RFID readers typical share the tag data captured in which of the following formats? Choose the one best answer.	BIN
	XML
	HTML
	TID

Which of the following is held in the Reserved memory of a passive UHF tag that uses the ISO/IEC 18000-63 Type C air interface protocol standard? Choose the one best answer.	Electronic Product Code Kill password
	Kill password
	User data
	None of the other answers are correct

12 Deployment

12.1 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.

12.2 Knowledge Tested

Candidates are expected to know:

- Installing and configuring gates/portals, tunnels and vehicle-mounted readers

- Antenna installation, shielding

- Locating tagged objects

    i.   RTLS

    ii. Zonal

    iii. Hot spots

    iv. Beaconing

- Deployment Platforms

    i.   On-premise

    ii. Cloud

- Network Integration

12.3 Knowledge Not Tested

Candidates are not expected to know:

- Vendor specific component specifications or operation

12.4 Sample Questions

If two passive UHF reader antennas face each other, you should use which of the following. Choose the best answer.	Antennas with different gain
	Antennas with different attenuation
	Antennas with opposing polarizations
	You should never install readers facing one another to avoid interference issues

Different patch antennas have different angles at which radiation is emitted. It's important to know the antenna angle because of which of the following reasons? Choose the one best answer.	The angle determines the gain of the antenna
	The angle determines the width and depth of the read field
	The angle determines the frequency of the energy emitted
	The angle is not important

13 Troubleshooting & Maintenance of RFID Systems

13.1 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.

13.2 Knowledge Tested

Candidates are expected to know:

- Identifying and fixing system problems
    - i. Multipath
    - ii. Sources of electromagnetic interference
    - iii. Null spots
    - iv. Extraneous reads
- Tag batteries
- Handheld batteries & chargers

13.3 Knowledge Not Tested

Candidates are not expected to know:

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

13.4 Sample Questions

Which of the following devices can interfere negatively with the operation of a Wi-Fi-based real-time location system? Choose the two best answers.	Microwave oven
	Television
	Fluorescent lighting
	Infrared-based remote control

Electromagnetic Interference (EMI) shielding is used for which of the following purposes? Choose the two best answers.	To create a read zone (for example, around a conveyor belt) and prevent the reader from picking up tags outside of that read zone
	To isolate tags and readers from interference from other RF devices used in the same area as the RFID system
	To improve the security of the RFID system
	To project consumer privacy

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/IEC -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.