Radio Frequency Identification - RFID - Technical Specialist  
Competency Requirements

The **Radio Frequency Identification** Technical Specialist will have a working fundamental knowledge of electronics communication principles. This basic criterion can be found in the Associate CET (CETa) and other RF Communications area [http://www.eta-i.org/communications.html](http://www.eta-i.org/communications.html) certification programs. The following **RFID** competencies are a listing of the knowledge and abilities necessary to perform configuration and maintenance of RFID hardware and software including NFC (Near Field Communications) as an RFID Technical Specialist.

### 1.0 Introduction to Radio Frequency Identification (RFID) Fundamentals

1. Explain basic electrical theory and uses including:
   1.1 Ohms law
   1.2 Watts law
   1.3 Kirchhoff's law

2. Describe basic DC circuit concepts of series and parallel

3. Describe basic AC circuit concepts of RLC (resistive, inductive and capacitive) circuit

4. Describe basic semiconductors circuitry including:
   4.1 diodes
   4.2 transistors
   4.3 amplifiers
   4.4 oscillators

5. Explain electrical and network infrastructure site analysis

6. Identify symbols used in electronic circuitry and blueprints

7. Define RFID (Radio Frequency Identification) including:
   7.1 origin, history and early RFID uses:
      7.1.1 tag
      7.1.2 reader
   7.2 the EPC (Electronic Product Code)
   7.3 current RFID market awareness

8. Describe Near Field Communications (NFC) in relation to RFID

9. Describe how RFID technology is different than magnetic secure transmission (MST)

### 2.0 RF Safety

2.1 Describe Radio Frequency (RF) safety protocols per industry standards

   2.1.1 Explain the FCC OET65 Bulletin
   2.1.2 Explain the IEEE/ANSI C-95 standard

2.2 Describe general safety guidelines:

   2.2.1 List the National Electrical Codes (NEC®) as they apply to RFID technology
   2.2.2 List Occupational Safety and Health Administration (OSHA) requirements for working with RFID technology
   2.2.3 List personal protection equipment (PPE) used in RFID work
   2.2.4 RFID power applications including:
      2.2.4.1 AC power
      2.2.4.2 Battery systems
      2.2.4.3 Lock Out / Tag Out procedures
   2.2.5 Describe safety measures used with tower and elevated surfaces
   2.2.6 Describe grounding and surge/lightning protection safety measures

2.3 Explain how to protect components from Electrostatic Discharge (ESD)

### 3.0 RF Fundamentals Applied in RFID

3.1 Explain basic RF fundamental operating principles and terminology

3.2 Describe basic RF spectrum and propagation

3.3 Explain basic principles of radio communication

3.4 Explain RF modulation and demodulation to include:
   3.4.1 Transmitter modulation
3.4.2 Receiver demodulation
3.4.3 Receiver bandwidth must match the transmitter modulation scheme

3.5 Describe RFID or NFC digital modulation methods including:
3.5.1 ASK (amplitude-shift keying)
3.5.2 FSK (frequency-shift keying)
3.5.3 PSK (phase-shift keying)
3.5.4 PJM (phase jitter modulation)

3.6 Describe a site survey requirements:
3.6.1 RF
3.6.2 Physical

3.7 Describe RFID coverage area

3.8 Explain RFID Antenna:
3.8.1 characteristics including:
   3.8.1.1 Tag Antennas
   3.8.1.2 Reader Antennas
3.8.2 wave propagation
3.8.3 field performance

4.0 Communication Methods and Protocol in RFID
4.1 Describe coupling including:
   4.1.1 inductive
   4.1.2 electromagnetic backscatter
   4.1.3 close loop or capacitive
4.2 Define collisions (contentions) including:
   4.2.1 Tag collisions
   4.2.2 Reader collisions
4.3 Describe anti-collision tree protocols:
   4.3.1 Tree-base
   4.3.2 Query tree
   4.3.3 Binary tree
4.4 Describe the TCP/IP (transmission control protocol/internet protocol) fundamentals:
   4.4.1 wired
   4.4.2 wireless
   4.4.3 cybersecurity / https secure socket layer
4.5 Define tag authentication
   4.5.1 Describe RFID tag forgery security countermeasures
      4.5.1.1 Define “skimming” and “cloning”
      4.5.1.1.1 Explain “replay” signal security vulnerabilities
      4.5.1.2 Describe tag/card “anti-cloning”
   4.5.2 Describe “denial of service” (DoS) prevention including virus protection
   4.5.2.1 Describe Distributed Denial of Service (DDoS)

5.0 Tag Characteristics
5.1 Describe passive tags including:
   5.1.1 BAPS (battery assisted passive tags)
   5.1.2 advantages and disadvantages of using passive tags
   5.1.3 NFC (near field communications tags)
5.2 Describe active tags including:
   5.2.1 “Read / Write” tags
   5.2.2 advantages and disadvantages of using active tags
5.3 Describe active/passive tags/readers including:
   5.3.1 AVI (automated vehicle id) systems with or without transponders
5.4 Explain how tags are designed
5.5 Explain signal strengths pertaining to communication range including:
   5.5.1 reader to tag requirements
   5.5.2 tag to reader available strengths
5.6 Describe a Smart Label
5.7 Explain Tag Implementation
6.0 Fundamentals of Interrogator Communications

6.1 Describe how readers (interrogators) function in an RFID system
6.2 Define the Interrogation Zone
6.3 Explain the parameters of a Dense Interrogators Environment including:
   6.3.1 Deployment Environments
6.4 Explain Interrogator international power regulations
6.5 Explain how a host computer is connected to tag reader
   6.5.1 Describe common specific wired and wireless network interfaces
6.6 Explain how a Device Driver works
6.7 Explain the role Middleware and Edgeware has in RFID architecture including:
   6.7.1 software on the reader
   6.7.2 middleware used between reader and computer
6.8 Explain ONS (object naming service) and the role it plays in an enterprise RFID System
6.9 Describe basic programming techniques including:
   6.9.1 Basic C structure
   6.9.2 XML namespace

7.0 RFID System Design Selection and Installation

7.1 Describe which Frequency selection is used including:
   7.1.1 LF
   7.1.2 HF
   7.1.3 UHF
7.2 Explain the applications of selection and installation/configurations including:
   7.2.1 Tag types
   7.2.2 Reader/Interrogator types
   7.2.3 Antenna types
   7.2.4 power distribution including:
      7.2.4.1 power supply
      7.2.4.2 cable/wiring considerations
   7.2.5 RFID peripherals
   7.2.6 NFC tag uses instead of RFID tags

8.0 RFID Standards and Regulations

8.1 Define the EPC (Electronics Product Code)
8.2 Describe how EPCglobal Network and GS1 incorporate sharing information including:
   8.2.1 ONS
   8.2.2 EPC Discovery services
   8.2.3 EPC Information services
   8.2.4 EPC Security services
8.3 Describe common ISO Standards as it related to RFID including:
   8.3.1 18000 series (air interface frequency standards)
   8.3.2 11784 (tag data structure)
   8.3.3 11785 (air interface protocol – a.i.p.)
   8.3.4 14443 (proximity systems definitions for a.i.p.tags – payment systems)
   8.3.5 15693 (vicinity cards)
   8.3.6 18046 (tag and interrogator performance test methods)
   8.3.7 refer to the many other RFID related standards
8.4 Define the GEN 1 and GEN 2 RFID standards differences
8.5 Define the Class 0,1,2,3,4,5 tags
8.5 Define SSCC (Serial Shipping Container Code)
8.6 Define EDI (electronic data interchange) Transaction including:
   8.6.1 ASN (Advanced Shipping Notice)
8.7 Describe how the PCI DSS (Payment Card Industry Data Security Standard) is designed to
   keep information secure
   8.7.1 Explain how tokenization is different than encryption (E2EE)
9.0 Additional Instrumentation Used with RFID Systems
   15.1 Describe how to use a real time spectrum analyzer
   15.2 Describe how to use an oscilloscope
   15.3 Describe how to use voltage/ohm meters
   15.4 Describe how to use field strength meters

10.0 Troubleshooting an RFID System
   14.1 Explain procedures used in Tag Data Management
   14.2 Explain how to assess Readability and Reliability issues
   14.3 Describe procedures to resolve Environmental Tag damage
   14.4 Define SLRRP (Simple Lightweight RFID Reader Protocol)
   14.5 Describe procedures used in RFID security/privacy applications

End of RFID Technician Specialist Competencies Listing

Find an ETA® Test Site  http://www.eta-i.org/testing.html
Additional Suggested Study Materials and Resources:

- **RFID Field Guide**: Bhuptani/Moradpour; ISBN 978-131853553; Sun Microsystems-Prentice Hall; 2005
- **NFC for Dummies**: Sabella; ISBN 978- 1119182924; For Dummies; 2016
- **NFC for Dummies**: Sweeney II; ISBN 978- 0764579103; For Dummies; 2005
- **See more Texts listed at the end of the CETa, GCT1, & GCT2 competency listings...**

Webpages, (find more in your search engines):
- [https://rfid4u.com/](https://rfid4u.com/)
- [https://www.electronicproducts.com/fundamentals](https://www.electronicproducts.com/fundamentals)

**RFID - Certification Program Subject Matter Advisory Board:**

<table>
<thead>
<tr>
<th>Name</th>
<th>Email</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ira M. Wiesenfeld, P.E., CETst</td>
<td><a href="mailto:iwiesenfel@aol.com">iwiesenfel@aol.com</a></td>
</tr>
<tr>
<td>Ed Kirkpatrick, PVI, CSS</td>
<td><a href="mailto:ekipatrick@eta-i.org">ekipatrick@eta-i.org</a></td>
</tr>
<tr>
<td>Andre Smalling, CET</td>
<td><a href="mailto:gent2001@hotmail.com">gent2001@hotmail.com</a></td>
</tr>
<tr>
<td>Herman Lozano</td>
<td></td>
</tr>
<tr>
<td>Richard W. Booth, FOT</td>
<td><a href="mailto:richard.w.booth@gmail.com">richard.w.booth@gmail.com</a></td>
</tr>
<tr>
<td>Alvin S. Kohr</td>
<td></td>
</tr>
<tr>
<td>John J, Zielinski, CETma</td>
<td><a href="mailto:johnzielinski0@gmail.com">johnzielinski0@gmail.com</a></td>
</tr>
<tr>
<td>Dr. Ron Millione, CETma</td>
<td><a href="mailto:ronmilione@yahoo.com">ronmilione@yahoo.com</a></td>
</tr>
<tr>
<td>Michael Goshen</td>
<td></td>
</tr>
</tbody>
</table>

ETA certification programs are accredited through ICAC, complying with the ISO/IEC 17024 standard.

**ICAC**

International Certification Accreditation Council

Accredited to the ISO 17024:2012 standard for certification programs