



radio frequency identification

Radio Frequency Identification Tagging: Applications for the Construction Industry

Construction Industry Institute
Implementation Resource 151-2



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Radio Frequency Identification Tagging: Applications for the Construction Industry

*Prepared by the
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Radio Frequency Tagging Research Team*

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Introduction

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This implementation guide provides construction industry owners and contractors with practical information related to implementing radio frequency identification (RFID) technology. It includes a list of commonly asked questions and answers regarding the technology, lessons learned from pilot tests conducted, and a flow diagram that can help owners and contractors decide what type of RFID system to implement. The guide is intended to help owners and contractors better understand RFID technology and to assist them during the implementation process.

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Implementation Procedure

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Readers should be generally familiar with the technology described in this guide and also should be fairly certain that RFID is the appropriate technology to use for a particular application. (If not, read Chapter 3 and then return here to continue.)

As the implementation flow diagram in Figure 1 shows, the first step in implementing RFID technology involves identifying the potential RFID application ([1] in Figure 1).

Since there are both read-only and read-write RFID systems, it is important to decide whether you need the capability to alter the contents on the tag after it has been initially programmed ([2] in Figure 1). If you decide that it is not necessary to change the tag contents, then consider a read-only RFID system [3]. These typically are low-end systems that provide a unique serial number. The advantages of this RFID system are its low cost and low power consumption, which make it suitable for identification of pallets, containers, and gas bottles. These systems typically operate in the 135-KHz to 2.45-GHz frequency range.

The next consideration is the amount of data to be stored on the tag [4]. Many read-only applications require smaller amounts of data storage capability (< 2 kbytes), but RFID suppliers can supply greater storage capabilities if necessary.

Another important consideration is how the data will be formatted on the tag and shared with other users ([5] in Figure 1). Two formatting approaches can be used. One involves storing all of the data on the tag, which requires a header or definition file to map data contents on the tag. The reader needs to know the format protocol to decipher the contents of the tag [6]. The second approach involves programming a unique identification code that then goes to a database for all relevant information [7].

Data security may also be an important consideration for the read-only system ([8] in Figure 1). Note that most of the low-end, read-only systems do not include cryptological functions for enhancing data security [9]. If data security is important, however, it is possible to add data encryption functions to the read-only system [10].

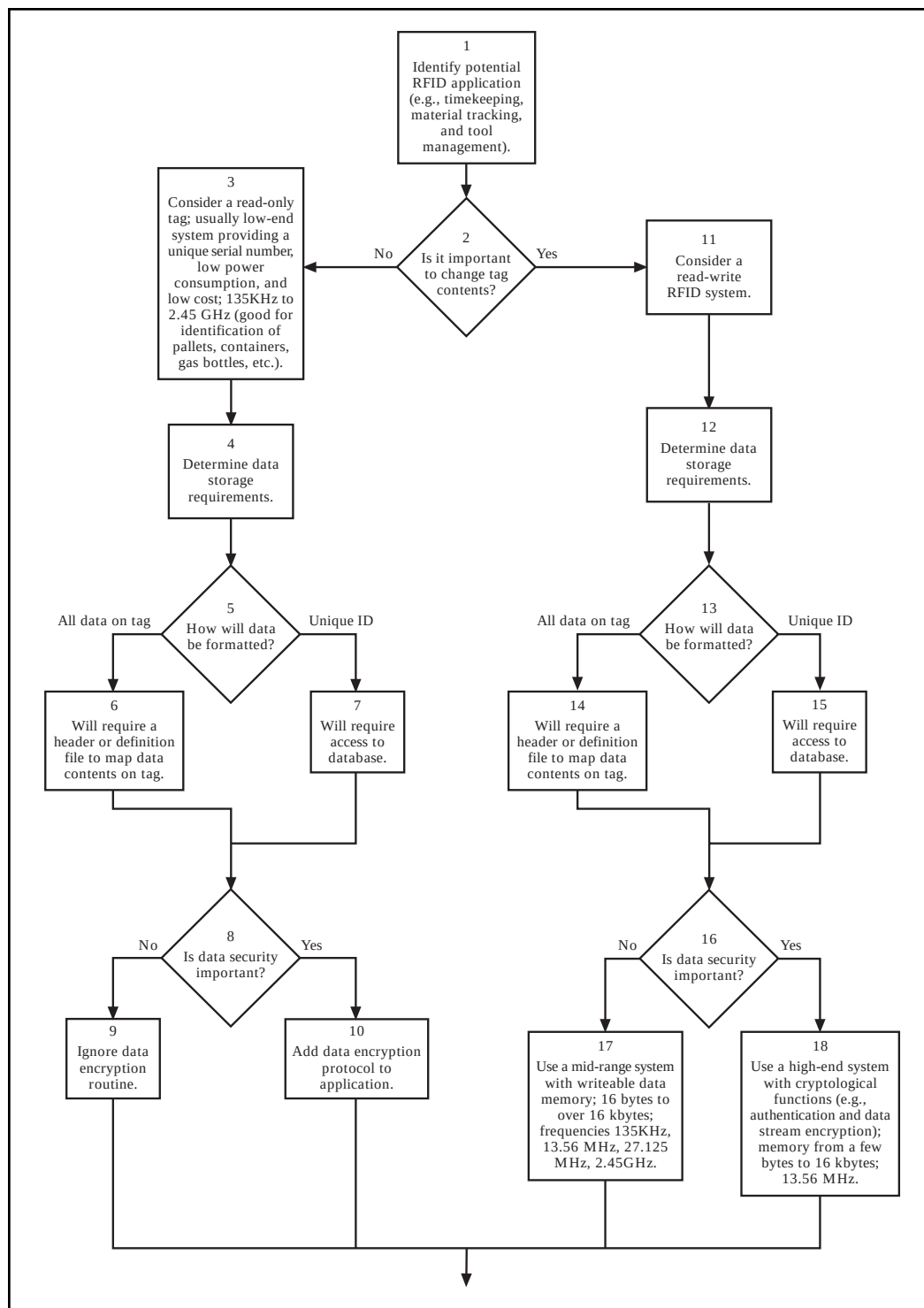


Figure 1. RFID Implementation Flow Diagram

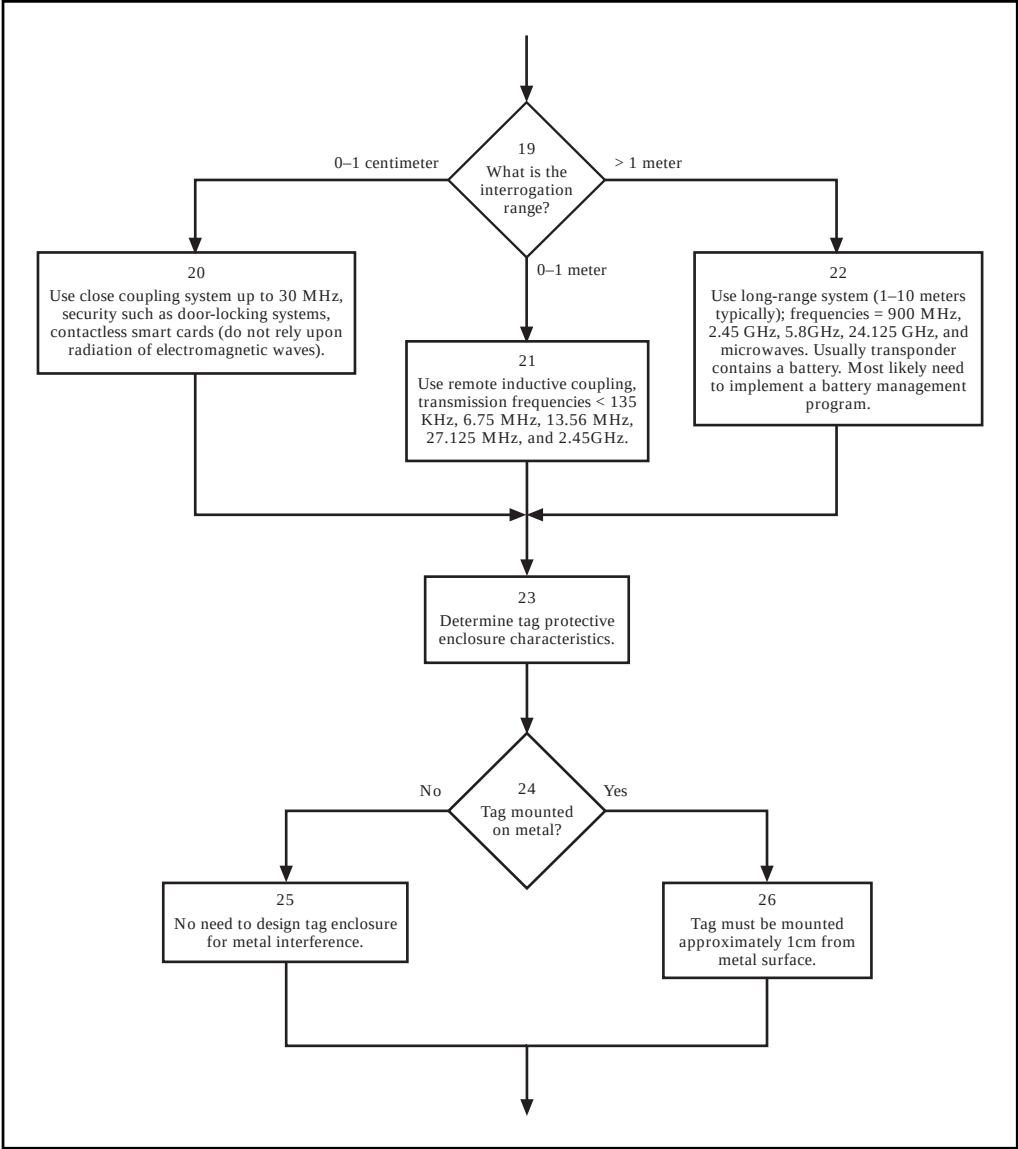


Figure 1. RFID Implementation Flow Diagram (continued)

Should altering the tag contents be required, then it is imperative to select a read-write system ([11] in Figure 1). You will need to determine the amount of data storage capability required, realizing that these tags usually hold from a few bytes of data to approximately 16 kbytes. Assuming that each byte represents a letter or a number and there are 8 bytes per character and 8 characters per word on average, then you can expect to store the equivalent of up to 2,000 words on a tag [12].

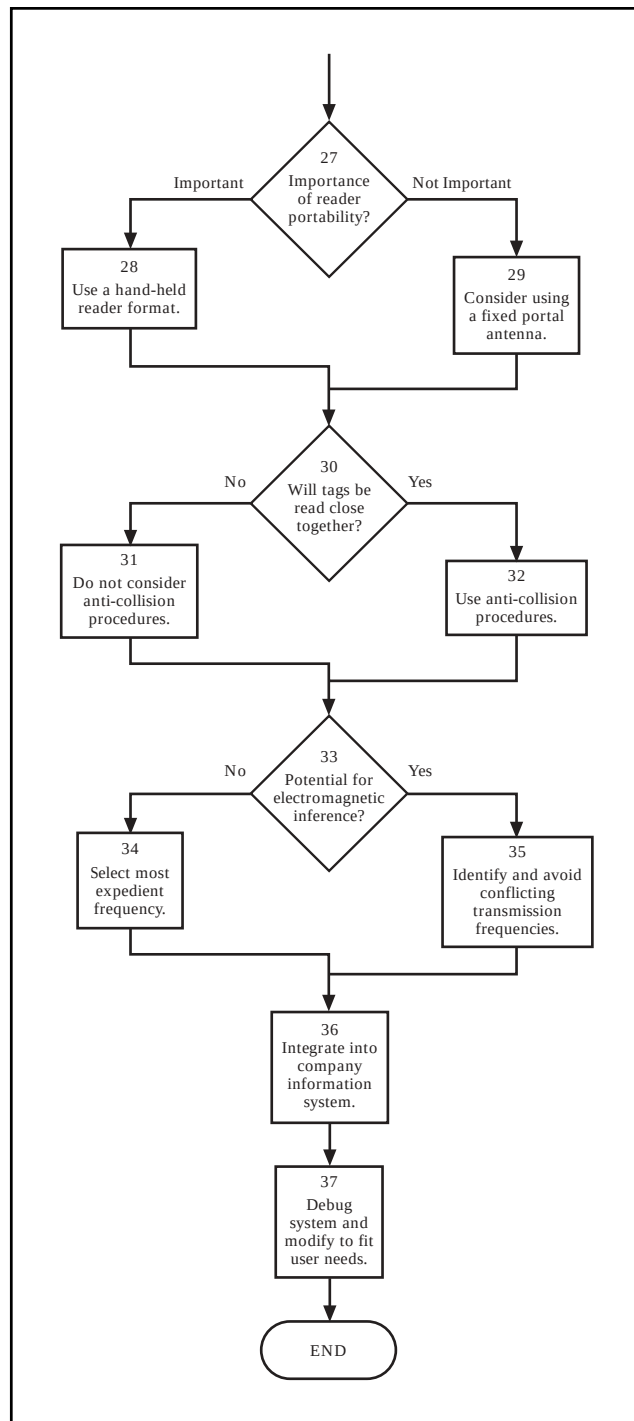


Figure 1. RFID Implementation Flow Diagram (continued)

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As with the read-only system, another important consideration is how the data will be formatted on the read-write tag and shared with other users ([13] in Figure 1). Two formatting approaches can be used. One involves storing all of the data on the tag, which requires a header or definition file to map data contents on the tag. The reader needs to know the format protocol to be able to decipher the contents of the tag [14]. The second approach involves programming each tag with a unique identification code that then goes to a database for all relevant information [15].

If data security is important for your read-write application, then you should use a high-end system with cryptological functions ([18] in Figure 1). This provides source authentication and data stream encryption. These high-end systems operate at 13.56 MHz, and as a result are more costly. If data security is not important, then a midrange system [17] is recommended. These systems can store a similar amount of data and operate at a variety of frequencies (135 KHz, 13.56 MHz, 27.125 MHz, and 2.45 GHz).

Another important consideration for both read-only and read-write systems relates to interrogation range ([19] in Figure 1). You need to decide if the range will be subcentimeter, submeter, or greater than one meter range. This determines if a close coupling, remote inductive coupling, or long-range system is required. If the range is between 0 to 1 centimeter, then a close coupling system can be used with frequencies up to 30 MHz [20]. Suitable applications for a close coupling system include door locking systems and contactless smart cards that do not rely upon the radiation of electromagnetic waves. If the interrogation range is between 0 and 1 meter, then a remote inductive coupling system is suitable [21]. Applications include contactless smart cards, material tracking, animal identification, and timekeeping. These systems are classified as passive since the tag is energized by the electromagnetic field emanating from the reader antenna. For greater interrogation ranges (> 1 meter) a long-range active system is used [22]. Active systems include a battery and therefore do not need energy from the reader. These systems are ideal for applications such as

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toll and fee collection and meter reading. With an active system, it is necessary to implement a battery management program since batteries wear out every three to 10 years, depending on usage.

Tag construction also needs to be considered ([23] in Figure 1). You need to determine the most suitable design because enclosures come in all shapes, sizes, and material types. Will the tag be mounted on metal? [24]. If so, the tag needs to be mounted approximately 1 centimeter from the metal surface to avoid interference and possibly include a metal backplane [26]. If the tag is mounted away from metal, then there is no need to consider metallic interference [25].

Reader portability is another consideration ([27] in Figure 1). If portability is not needed as in the case of employees passing through a turnstile to enter the jobsite, then a fixed antenna or portal may be appropriate [29]. If, however, as in the case of material management, it is necessary for the inventory specialist to scan tags on pieces of equipment in a laydown area, it is best to use a portable, hand-held device to scan tag data [28]. Other considerations relate to tags being spaced closely together ([30] in Figure 1). If this is the case, then anti-collision procedures should be programmed into the system [32].

Another consideration is the effect of stray electromagnetic energy from other sources on the RFID interrogation operation ([33] in Figure 1). Will other sources of electromagnetic energy affect RFID operation? This could include high power motors and antenna operating under a frequency similar to that of the RFID system. When selecting the transmitting frequency, special considerations should be made to avoid other electromagnetic interference [35]. If there is no possible source of interference, then you can select the most expedient frequency for your specific application [34].

It is important to have the RFID system compatible with the overall company information system ([36] in Figure 1). As you develop this application, you will want to work closely with your firm's information technology group. Finally, it is important to test the application and make necessary modifications [37].

3

Frequently Asked Questions

Question: What is RFID?

Answer: RFID is a technology that involves the use of tags, or transponders, that can collect and manage data in a portable, changeable database. It is a sister technology to bar codes, but RFID uses radio waves instead of light waves to scan a tag. In a sense, RFID can be viewed as a high-tech bar code with added benefits.

Question: When was RF technology developed?

Answer: In 1979 the technology was first marketed as a usable product. Since then, companies have been developing feasible applications.

Question: What are some of the current RFID applications?

Answer: Sample applications include livestock/animal control for animal identification, vehicle access for gate and parking lot control, personnel identification, tolls and fees, asset tracking (e.g., vehicles, tools, compressed gas cylinders, and other equipment), and airport baggage identification. Applications are currently being developed for groceries and postage stamps.

Question: What are its primary components?

Answer: The primary components of an RFID system comprise tags, or transponders, and a reader. The tag, or transponder, includes a small integrated circuit chip and antenna encapsulated in a protective shell. The reader contains, at a minimum, a scanner and antenna.

Question: What are some tag characteristics?

Answer: Manufactured tags range in size from that of an aspirin to approximately the size of a brick. Tags can be durable and are protected against shock, fluids, dust, chemicals, and flames. Such characteristics make it easy to select the appropriate tag for your specific application.