LACKLAND AIR FORCE BASE CHUTE ASSESSMENT

DATA COLLECTION AND ANALYSIS

REPORT DL024T1

Anthony Carminati

Jeff F. Gao

John B. Jennings

Alan R. Metelko

James C. Tran

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14. ABSTRACT

LMI was tasked to conduct a baseline assessment of the Lackland Air Force Base (AFB) Phase II dress uniform issue process for male trainees. The purpose of this baselining effort was to provide the DLA Customer Driven Uniform Manufacturing II (CDUM II) Project a basis for measuring the impact of new technologies and opportunities that could improve Lackland AFB?s Phase II dress uniform issue, inventory management, and size prediction processes.

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CDUM; clothing and textiles; RFID; first-issue process; first issue; recruit clothing; chute RFID antennae

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Lackland Air Force Base Chute Assessment: Data Collection and Analysis

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Executive Summary

The Defense Logistics Agency's (DLA's) Customer Driven Uniform Manufacturing (CDUM) program sponsors research and development projects related to clothing and textiles. A recent CDUM project applied radio frequency identification (RFID) technology to the storage and distribution of airman battle uniforms (ABUs) and other recruit clothing at Lackland Air Force Base's Clothing Initial Issue Point (CIIP). The CIIP manages the issuing of initial ABUs, an activity referred to as "first issue," and uses RFID technology to facilitate its first-issue activities and associated inventory management.

At Lackland, personnel attach item-level RFID tags to most first-issue apparel items and use a chute RFID reader (chute) to track and control the distribution of those items. As part of our ongoing support of the CDUM program, an LMI team visited the CIIP to measure chute effectiveness in a controlled environment and during first-issue operations.

We tested the chute in two ways. First, after identifying the chute characteristics that could cause variations in the chute performance, we tested those characteristics in a controlled environment. Then, we tested the chute during a CIIP first issue to observe and measure actual chute performance.

During a 2-day period, we tested two chute design parameters and three process-related parameters. Our findings from those tests are summarized below:

◆ Antenna position and orientation, antenna strength, pack order, and item dampness produced statistically significant results that could explain some of the variation in chute read effectiveness.

◆ Different antenna power settings and different antenna position and orientation settings produced slightly better results during our study than the default settings at Lackland Air Force Base for these two parameters.

Our observations of chute read performance during trainee first-issue process yielded the following results:

- ◆ The chute misread 181 item-level RFID tags out of 29,656, indicating it was effective more than 99 percent of the time.

- ◆ The chute correctly flagged 264 non-chute read errors (i.e., errors associated with issue, tagging, databases, or damaged tags).

Based on what we found during our chute testing, we recommend DLA perform additional testing to optimize chute read performance. As our independent chute testing suggests, the chute reader made fewer read errors when we angled the overhead sensors at 45 degrees and maintained the side sensors in their default positions. Because this adjustment can be made in 30 minutes or less, using a screw driver and duct tape, it may warrant additional evaluation.

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Chapter 1
Introduction

The Defense Logistics Agency (DLA) Customer-Driven Uniform Manufacturing (CDUM) program sponsors research and development projects related to the production, assembly, storage, distribution, and disposal of military clothing and textiles. A CDUM project at Lackland Air Force Base (AFB) has demonstrated the application of radio frequency identification (RFID) technology to the storage and distribution of first-issue recruit clothing.

Lackland AFB is the sole location for U. S. Air Force enlisted basic military training (BMT) for the active duty Air Force, Air Force Reserve, and Air National Guard. Shortly after BMT begins, trainees receive their initial airman battle uniforms (ABUs) and other initial clothing in an activity referred to as first issue. Lackland AFB's Clothing Initial Issue Point (CIIP) employs RFID technology to facilitate the distribution of first-issue apparel and to strengthen inventory management associated with its first-issue activities. Some items are received with RFID tags; other first-issue apparel items require Lackland AFB personnel to affix item-level RFID tags to and use a chute RFID reader (chute) to track and control the distribution of those items. As trainees pass through the chute, the RFID antennae scan the RFID-tagged items, and the underlying database software updates the CDUM server with the first-issue inventory transactions.

As part of LMI's continuing support of the CDUM program, we traveled to Lackland AFB to assess chute effectiveness in a controlled environment and during first-issue operations.

ASSESSMENT APPROACH

To assess the chute in a controlled environment, we designed and conducted a set of tests to determine which design- and process-related characteristics affected chute performance and effectiveness.

To measure chute accuracy and determine the causes of chute-read errors, we observed the Lackland AFB chute during first issue. We recorded the results as trainees passed through the chute, isolated item-level RFID tag errors, and helped to identify the causes of the errors. Using this approach, we were able to generate an overall measure of chute effectiveness.

ORGANIZATION OF THIS REPORT

Three chapters follow this introduction:

◆ Chapter 2 discusses our testing of the chute in a controlled environment. During those tests, we examined five design- and process-related parameters.

◆ Chapter 3 describes our observations and analysis of chute performance during the first issue. We gathered data over a 6-day period, processing chute-read errors in an effort to measure chute effectiveness.

◆ Chapter 4 presents our findings and conclusions.

Chapter 2
Chute Testing

TESTING PARAMETERS

Over a 2-day period, we tested the chute to determine whether specific design- or process-related characteristics affect the chute's effectiveness. The chute design characteristics we tested were antenna strength and antenna position and orientation.

The antenna strength of the chute deployed at Lackland AFB ranges from a low of 0 to a high of 100, with a default strength setting of 90. We tested whether adjusting the antenna strength affected chute accuracy. In a separate test of chute design characteristics, we adjusted the orientation of the two upper antennae and the height of the side-mounted antennae to ascertain whether these adjustments affected chute performance.

We also tested the following process-related characteristics:

- ◆ Duffle bag pack order

- ◆ Dampness of duffle bag contents

- ◆ Trainee height.

APPROACH

We began by packing 9 duffle bags with 28 first-issue male apparel items, ensuring each item had a functioning item-level RFID tag. We tested the five characteristics using a two-tiered process. We prepared either the chute or the duffle bag, depending of the characteristic we were testing. We then had team members don the duffle bags and walk through the chute. These individuals also carried a sack containing an ABU coat, trousers, and caps. We included those items so we could simulate trainees walking through the chute while wearing these items, as they do during first issue. We recorded the results of each outcome, noting whether the chute reader registered a read error. Between each pass through the chute, we re-oriented the items in the duffle bag to simulate random packing.

In the next several sections, we describe the testing of these design- and process-related characteristics in greater detail.

Testing RFID Antennae Position and Orientation

The chute has four antennae, two mounted overhead and one mounted on each side panel. Figure 2-1 illustrates the chute with its antennae exposed.

Figure 2-1. Chute with Antennae Exposed

Standard positioning for the antennae is as follows:

◆ Overhead antennae are mounted flush against the top of the chute.

◆ Side antennae are mounted, one per side, facing each other, with the left-side antenna mounted at a height of 37 inches and the right-side antenna at a height of 43 inches.

We repositioned the antennae to test how positioning affected chute performance. During the testing of antennae position and orientation, we raised or lowered the right-side antenna and maintained the overhead antennae flush against the top of the chute, or changed the orientation (angle) of the overhead antennae. Table 2-1 shows the results of our antennae repositioning.

Table 2-1. Results: Antenna Orientation and Position Testing

Antennae orientation and position	Chute-read accuracy (%)	Number of RFID tags[a]	Number of errors
Overhead 45°, left side 37", right side 43"	99.95	2,100	1
Overhead 45°, left side 37", right side 62"	99.64	1,960	7
Overhead flat, left side 37", right side 43"[b]	99.76	2,100	5
Overhead flat, left side 37", right side 62"	99.71	2,100	6

[a] The number of RFID tags is a count of the number of trials multiplied by 28 RFID item tags per bag.

[b] This is the default antennae position.

We tested the chute 295 times, using the 4 antennae configurations described in Table 2-1. The chute made 1 read error in 75 trials when we angled the overhead antennae at 45 degrees and maintained the side antennae in their default positions. We then raised the height of the right-side antenna from 43 inches to 62 inches, the chute's accuracy decreased by 0.31 percent, registering 7 errors in 70 passes through the chute. When the overhead antennae were mounted flush against the top of the chute and the left- and right-side antennae were mounted at 37 and 43 inches, respectively, the chute was 99.76 percent effective, experiencing 5 errors in 75 trials. Finally, when we raised the height of the right antenna and left the overhead antennae flush, the chute registered 6 errors in 75 trials, or was 99.71 percent effective.

When we tested for statistical significance at the 95 percent confidence level, we found that these results are statistically significant: antenna positioning has an effect on chute performance.

Testing Antenna Strength

We tested antenna strength to understand its potential for causing chute read errors. When the antenna settings are set too low, the chute may misread item-level RFID tags; and when set too high, the antennae may read item-level RFID tags that are not packed in the trainee's duffle bag. In investigating how antennae strength affected chute performance, we tested the chute RFID reader 295 times, adjusting the antennae strength settings. Table 2-2 shows the results of those trials.

Table 2-2. Results: Antenna Strength Testing

Antennae strength (possible range: 0–100)	Chute-read accuracy (%)	Number of RFID tags	Number of errors
Setting top and side antennae at 75	99.52	2,100	10
Setting top and side antennae at 90[a]	99.76	2,100	5
Setting top antenna at 75, sides at 90	99.95	1,960	1
Setting top antenna at 90, sides at 75	99.86	2,100	3

[a] Default strength setting.

When we lowered the antennae strength settings to 75, the chute-read rate was 99.52 percent, making 10 errors in 75 trials. When we set the top and side antennae to 90, the chute was about 99.76 percent effective, making 5 errors in 75 trials. Setting the top antennae at 75 and the side antennae to 90 improved the read rate to 99.95 percent, reducing the number of errors to 1 in 70 trials. Reversing the settings to 90 and 75 decreased the read rate to 99.86 percent and increased the number of errors to 3.

When we tested for statistical significance at the 95 percent confidence level, we found that these test results are statistically significant: antennae strength could account for the variation in chute performance.

Testing Duffle Bag Pack Order

We tested duffle bag pack order because the various fabrics and packaging materials used for first-issue apparel items require different types of item-level RFID tags. For example, the item-level RFID tags used for tee shirts and briefs (lighter items) are printed on adhesive labels and affixed to the plastic bag used to package them. The heavier ABU items require sturdier item-level RFID tags because they are constructed from tightly woven, heavier fabrics and are not packaged in plastic. Ordinarily, during first issue, trainees pack the lighter items at the bottoms of their duffle bags and load the heavier items on top. Table 2-3 shows the results from testing whether pack order affected chute performance.

Table 2-3. Results: Pack Order Testing

Pack order	Chute-read accuracy (%)	Number of RFID tags	Number of errors
Normal[a]	99.82	2,800	5
Reverse	99.89	2,660	3
Random	99.61	2,800	11

[a] This is the default pack order; lighter items are packed first.

We tested the chute RFID reader 295 times, with two adjustments in the packing order. When we used the normal pack order with lighter items at the bottom of the duffle bag, the chute was 99.82 percent successful, registering 5 errors out of 100 passes through the chute. When we reversed the pack order, packing the heavier items first and laying the lighter items on top, the chute's accuracy improved to almost 99.89 percent, with 3 errors in 95 trials. Finally, packing the first-issue items in a random pack order generated 11 chute read errors in 100 trials for a read rate of 99.61 percent.

When we tested for statistical significance at the 95 percent confidence level, we found that these results are statistically significant: pack order may account for the variation in chute performance.

Testing Wet Items

We tested the possible effect wet clothing could have on chute performance by running a series of trials with a wet towel packed among the duffle bags contents. Table 2-4 shows the results of 295 tests.

Table 2-4. Results: Testing Wet Item in Duffle Bag

Position of wet item	Chute-read accuracy (%)	Number of RFID tags	Number of errors
Bottom	99.57	2,800	12
Middle	99.85	2,660	4
No wet clothing in duffle bag	99.89	2,800	3

When we packed the wet towel at the bottom of the duffle bag, the chute was 99.57 percent successful, registering 12 errors in 100 passes through the chute. Next, we packed the wet towel in the middle of the duffle bag and passed the bag through the chute 95 times, generating 4 errors in 95 trials. Finally, we tested the chute 100 times without including a wet towel. This test achieved a read rate of 99.89 percent, registering only 3 errors.

When we tested for statistical significance at the 95 percent confidence level, we found that these results are statistically significant: packing wet clothing at the bottom of a trainee's duffle bag has an effect on chute RFID reader performance.

Testing Trainee Height

We tested trainee height to determine if it affected chute performance. Our proxy for a short trainee was 5 feet 6 inches tall, and our surrogate for a tall trainee was 5 feet 10 inches tall. Table 2-5 shows the results from our 295 trials.

Table 2-5. Results: Trainee Height Testing

Trainee height	Chute-read accuracy (%)	Number of RFID tags	Number of errors
Short trainee (66 inches)	99.68	4,060	13
Tall trainee (70 inches)	99.86	4,200	6

The shorter trainee generated 13 chute errors during 145 passes through the chute for a read rate of 99.68 percent, while the taller trainees walked through the chute 150 times and generated 6 errors, for a read rate of 99.86 percent. These results are not statistically significant: trainee height does not affect chute RFID reader performance.

Chapter 3
Trainee First-Issue Testing

TRAINEE FIRST-ISSUE PROCESS

The U.S. Air Force refers to aggregations of trainees as flights, with a typical flight consisting of 45 to 55 trainees. Shortly after arriving for their basic training at Lackland AFB, the flights receive their first-issue apparel. Flights arrive Wednesday through Friday, with male flights arriving separately from female flights. During the 6-day assessment period, 18 male flights and 6 female flights arrived; the average number of trainees per flight was 45. To alleviate congestion at the CIIP, Lackland AFB staggers the arrival of flights throughout the day.

First-Issue Apparel

At the Lackland AFB CIIP, most first-issue apparel items are tagged with item-level RFID tags. Aside from the drawer briefs, which are issued only to male trainees, male and female trainees receive the same number of RFID-tagged items. Table 3-1 lists the first-issue apparel items provided to trainees during first issue.

Table 3-1. First-Issue Apparel Items

Apparel item	Number issued	RFID-tagged items	
		Male trainee	Female trainee
Duffel bag	1	n/a[a]	n/a[a]
Towel bath, not RFID tagged	2	0	0
Socks green, not RFID tagged	2 packs of 3	0	0
Socks athletes, not RFID tagged	2 packs of 3	0	0
Sock liner black, not RFID tagged	2 packs of 3	0	0
Belt, rigger's	1	1	1
Drawers, briefs	2 packs of 3	2	0
T-shirt, athletes sand	2 packs of 2	2	2
T-shirt, athletes	4	4	4
Gloves, leather black	1	1	1
Jacket, physical fitness	1	1	1
Pants, physical fitness	1	1	1
Trunks, general purpose	4	4	4

Table 3-1. First-Issue Apparel Items

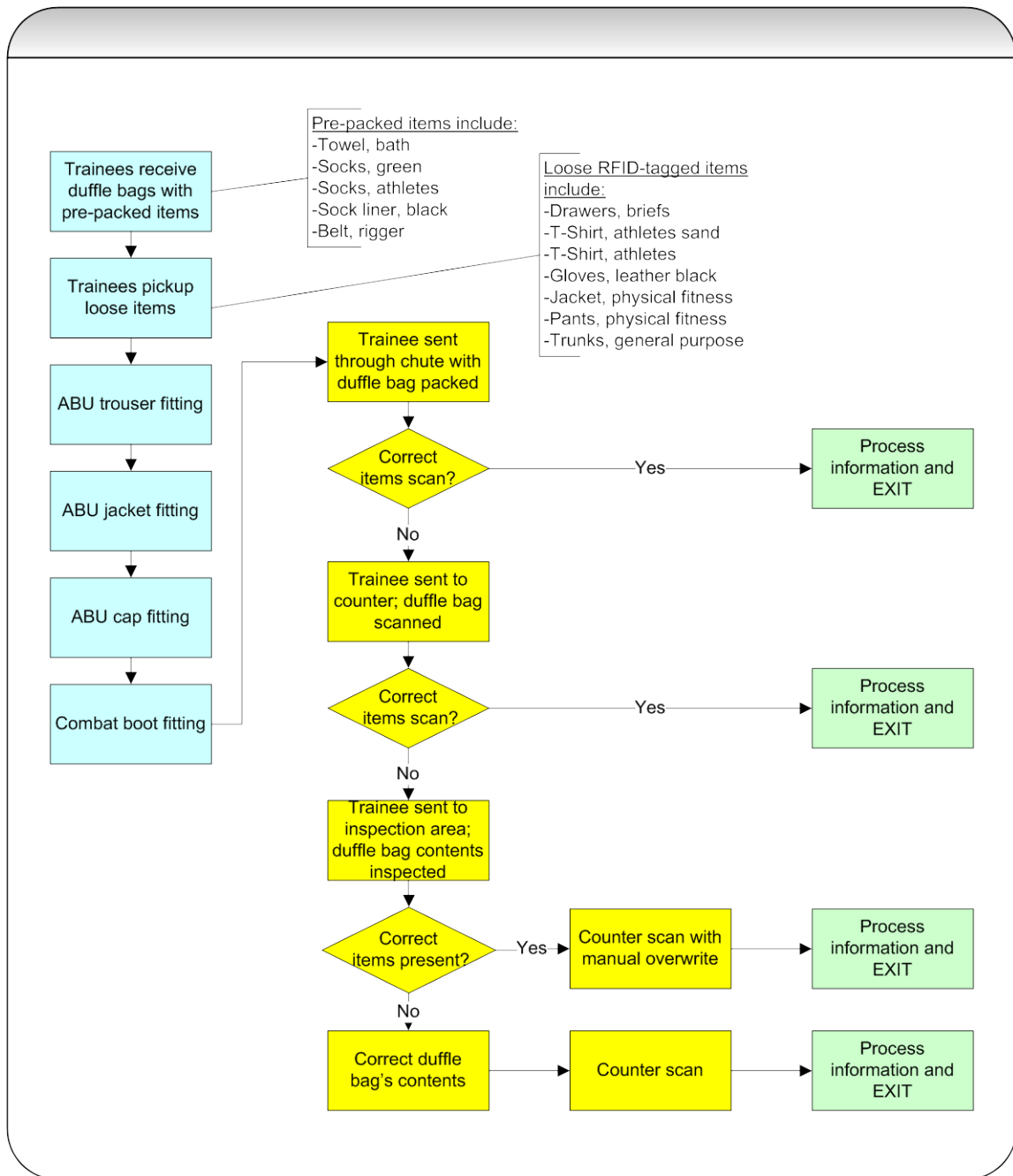| Apparel item	Number issued	RFID-tagged items	
		Male trainee	Female trainee
Cap, ABU	2	2	2
Trousers, ABU	4	4	4
Jacket, ABU	4	4	4
Boots, combat	2	2	2
Total RFID item-level tags per bag	n/a	28	26

[a] Although duffle bags have item-level RFID tags, the tags are not recorded by the computer program.

First-Issue Apparel Distribution

After a flight arrives at the CIIP, the trainees receive and pack their duffle bags with the first-issue apparel items. Each trainee is then fitted with an ABU and passes through the chute. If the chute does not register an error, the trainee departs the CIIP. If the chute registers and error, the trainee goes through an error-reconciliation process and then departs. Figure 3-1 depicts this process.

First issue begins with each trainee receiving a duffle bag packed with bath towels, three types of socks, and belt. The trainees then pack their duffle bags with RFID-tagged t-shirts, underwear, athletic gear, gloves, and trunks. Next, the trainees move to dressing areas where they are fitted with RFID-tagged recruit items, including trousers, jackets, caps, and combat boots. With their fully packed duffle bags, trainees line up single file and pass through the chute.

Figure 3-1. Trainee First-Issue Process Used during Chute Assessment

Pre-packed items include:
-Towel, bath
-Socks, green
-Socks, athletes
-Sock liner, black
-Belt, rigger

Loose RFID-tagged items include:
-Drawers, briefs
-T-Shirt, athletes sand
-T-Shirt, athletes
-Gloves, leather black
-Jacket, physical fitness
-Pants, physical fitness
-Trunks, general purpose

Trainees receive duffle bags with pre-packed items

Trainees pickup loose items

ABU trouser fitting

ABU jacket fitting

ABU cap fitting

Combat boot fitting

Trainee sent through chute with duffle bag packed

Correct items scan? — Yes → Process information and EXIT

No

Trainee sent to counter; duffle bag scanned

Correct items scan? — Yes → Process information and EXIT

No

Trainee sent to inspection area; duffle bag contents inspected

Correct items present? — Yes → Counter scan with manual overwrite → Process information and EXIT

No

Correct duffle bag's contents → Counter scan → Process information and EXIT

Note: To accommodate data collection during the chute assessment, we stationed personnel at the chute, counter, and inspection area to record errors and participate in the error-resolution process.

LACKLAND AFB CHUTE

The chute has four antennae, one mounted on either side at waist height, and two mounted overhead. As a trainee walks through the chute, the chute scans the RFID-tagged items in the trainee's duffle bag to verify the trainee has been issued the correct items. If the chute successfully reads all tags, the CDUM server is updated with that information and the trainee departs. If the chute records any errors,[1] the trainee goes through the error-resolution process. Figure 3-2 shows the chute RFID reader, with a trainee passing through the chute.

Figure 3-2. First-Issue Chute
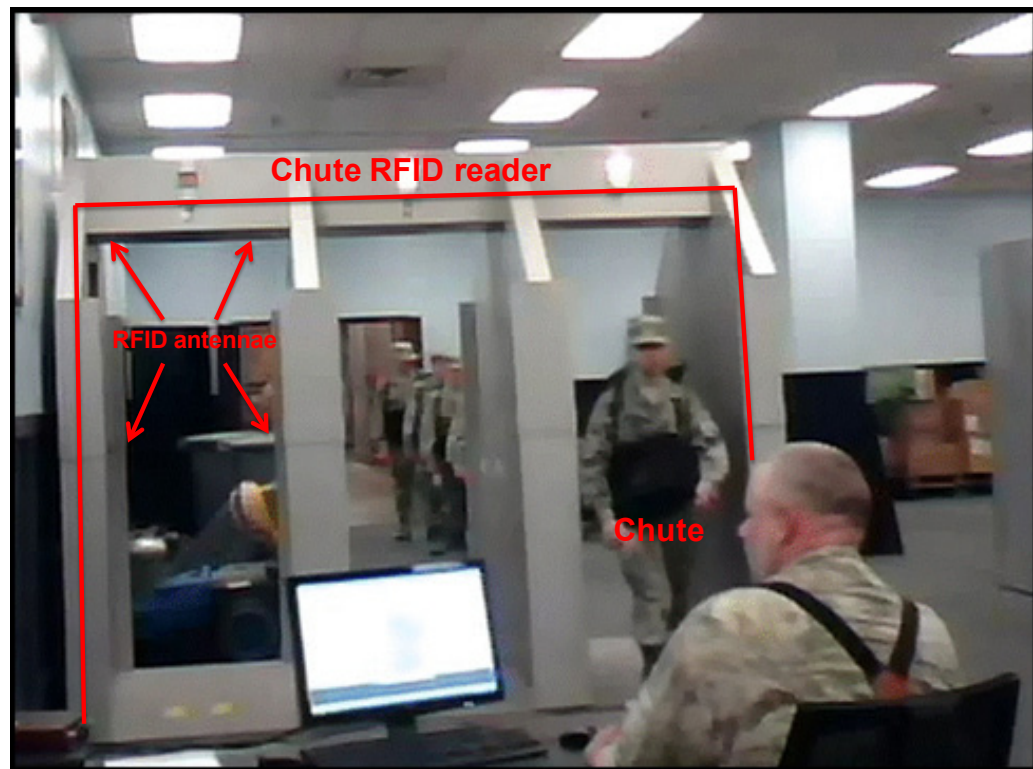
During the chute RFID reader assessment, we stationed one of our analysts at the desk, to direct trainee flow and record the outcome of each trainee's passage through the chute.

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[1] Since each bag contains either 26 or 28 RFID-tagged items, an individual bag can trigger up to 26 or 28 errors. During our testing, a duffle bag occasionally triggered two errors, and, on several occasions, a bag registered three or four errors.

Chute Error-Resolution Process

The error-resolution process[2] begins at a counter equipped with two antennae mounted underneath the counter. The trainee hoists the duffle bag onto the counter and an attendant scans its contents to determine whether an item-level RFID tag really triggered an error. If the counter antenna does not flag an error, the attendant updates the CDUM server and the trainee departs the facility. If the counter registers an error, the trainee goes to the inspection area to resolve the problem.

At the inspection area, the trainee unloads the duffle bag and attendants inspect its contents. If all the issued items are present, the trainee returns to the counter, where the counter attendant updates the CDUM server manually, and the trainee departs. If there is an error, the inspection area attendant resolves it, the trainee returns to the counter, and the CDUM server is updated manually.

We positioned analysts at both the counter reader and inspection area, and stationed another analyst to direct the flow and capture RFID read errors and error-resolution data.

Chute-Assessment Error Categories

Before conducting the chute assessment, we categorized possible chute read errors, basing our categories on a sample of chute errors that we had gathered previously. We divided the chute errors into two broad categories: non-chute read errors and chute read errors. The non-chute read errors occurred when the chute RFID reader correctly flagged an error. Table 3-2 lists the types of non-chute read errors.

Table 3-2. Non-Chute Read Errors

Error type	Examples
Tagging error	Extra RFID item-level tag in duffle bag
	Untagged apparel item in duffle bag
	RFID item-level tag agrees with RFID item-level tag print, but not with physical item specification
Issue error	Trainee issued incorrect number of apparel items or incorrect size apparel items
	Boot RFID item-level tag missing from duffle bag
Database error	RFID item-level tag linked to wrong or no national stock number
Damaged tag error	RFID item-level tag is unreadable

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[2] To gather sufficient data for our analyses, we employed an error-resolution process that was more time consuming and intrusive than what is followed by the CIIP.

We noted two possible chute-read errors: the chute antennae missed a properly functioning RFID item-level tag packed in a trainee's duffle bag, or the chute antennae read an item-level RFID tag that was not packed in the duffle bag. We concluded that, when the chute reads an RFID item-level tag that is not in the trainee's duffle bag, it is reading a tag in the immediate vicinity of the chute.

CHUTE DATA COLLECTION RESULTS

During the data collection period, 24 flights of trainees, 18 male and 6 female, passed through the chute. The 24 flights resulted in 1,072 packed duffle bags passing through the chute, 892 male and 180 female.[3] Table 3-3 shows the results of this activity.

Table 3-3. Chute Data Collection Results

	Male	Female	Total
Bags passing through chute	892	180	1,072
RFID item-level tags	24,976	4,680	29,656
RFID item-level tags read by chute without errors	24,617	4,594	29,211
Total RFID item-level tags read by chute with non-chute read errors:	206	58	264
Issue errors	85	21	106
Tagging errors	64	22	86
Database errors	43	5	48
Damaged tags	14	10	24
Chute read errors	153	28	181

The chute successfully read 98.5 percent[4] of all item-level RFID tags that passed through it. When we considered the cause of the errors (non-chute errors [264] versus chute errors [181]), we concluded the chute-read error category was more important. A high number of chute-read errors would lead us to conclude the chute was ineffective.

The chute recorded 264 item-level RFID tags with non-chute read errors, 206 for the males and 58 for the females. The most common non-chute read error was an issue error. We found 106 item-level issue errors, 85 associated with male apparel and 21 associated with female apparel. Tagging errors were also common; a total

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[3] We tracked male and female flights separately because male trainees receive two more RFID-tagged items than female trainees, and we wanted to determine whether this difference affected the chute-error rate.

[4] The calculation is 29,211 tags read without error divided by 29,656 total tags read.

of 86 items were incorrectly tagged (male apparel items had 64 errors and female apparel items had 22 errors).

The other error category, chute read errors, captures instances where the chute makes a mistake. The chute flagged 181 tags with these errors, 153 attached to male apparel and 28 to female apparel. This result is quite important because it suggests that the chute is approximately 99 percent effective.[5] We excluded non-chute read errors from this calculation because, by definition, non-chute read errors are not based on chute performance—the fact that the chute identified them indicates the chute was working properly.

Table 3-4 arrays the chute data by first-issue apparel item. Belts faired exceedingly well, achieving slightly less than a 100-percent chute-read accuracy, registering only one error. Other apparel items recorded more errors. The general purpose trunks and t-shirts, which are packaged in plastic, generated the most chute-misread errors: 38 and 43, respectively.

Table 3-4. Chute-Read Rate by First-Issue Apparel Item

Tagged items	Number of tags per bag	Number of tags read	Number of chute read errors	Chute read accuracy (%)
Belt riggers	1	1,072	1	99.91
Coat, ABU	4	4,288	11	99.74
Drawers, briefs	2 (0 if female)	1,784	5	99.72
Boots, combat	2	2,144	6	99.72
T-shirt, athletes sand	2	2,144	9	99.58
Cap, ABU	2	2,144	11	99.49
Trousers, ABU	4	4,288	24	99.44
Pants, physical fitness	1	1,072	6	99.44
Trunks, general purpose	4	4,288	38	99.11
T-shirt, athletes	4	4,288	43	99.00
Gloves, leather black	1	1,072	13	98.88
Jacket, physical fitness	1	1,072	15	98.60
Total	28 (26 if female)	29,656	181	99.39

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[5] The calculation is 29,656 total tags less 181 chute-read errors divided by 29,656 total tags.

Chapter 4
Findings and Recommendation

We tested the chute RFID reader at Lackland AFB in two ways. After isolating parameters that could cause variations in the chute-read rate, we tested the chute in a controlled environment. Then, we tested the chute in a "live" setting to capture and resolve chute errors in real time and to measure chute effectiveness.

FINDINGS

During a 2-day period, we tested two chute design parameters and three process-related parameters. Our findings from those tests are summarized below:

- ◆ Antenna position and orientation, antenna strength, pack order, and item dampness produced statistically significant results that could explain some of the variation in chute effectiveness.

- ◆ Different antenna power settings and different antenna position and orientation settings produced better results than the default settings at Lackland AFB for these two parameters.

Our observations of chute performance during trainee first issue yielded the following results:

- ◆ The chute misread 181 item-level RFID tags out of 29,656, indicating it was effective more than 99 percent of the time.

- ◆ The chute correctly flagged 264 non-chute read errors.

RECOMMENDATION

Based on what we found during chute testing, we recommend DLA consider *additional testing to optimize chute performance*. During our independent chute testing, the chute reader made fewer read errors when we angled the overhead antennae at 45 degrees and maintained the side antennae in their default positions. Because this adjustment can be made in 30 minutes or less, using a screw driver and duct tape, it may warrant additional evaluation.

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13. SUPPLEMENTARY NOTES

14. ABSTRACT
DLA's Customer-Driven Uniform Manufacturing program applied radio frequency identification (RFID) technology to the storage and distribution of Air Force recruit clothing at Lackland AFB's initial clothing issue point, where item-level RFID tags are attached to most first-issue apparel. A chute RFID reader is used to track and control the distribution of items.LMI tested the chute to identify item characteristics that could cause variations in the chute's performance. After identifying the chute characteristics that could cause variations in the chute performance, we tested those characteristics in a controlled environment. We then tested the chute during the CIIP first-issue process to observe and measure actual chute performance.

15. SUBJECT TERMS
CDUM; clothing and textiles; RFID; first-issue process; first issue; recruit clothing; chute RFID antennae

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