

# Subgroup 15S

## Performance Testing - Metal Detection Portal

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### Session Objectives:

After the session the participants will be able to do the following:

1. Plan a performance test for a metal detection portal
2. Conduct an actual performance test for contraband detection system and equipment using test objects
3. Analyze performance testing results and present findings

Two Reference Tables Attached:

1. Table of Trials and Failures giving  $P_D$  for a Designated Confidence Level – Sorted by Trials.
2. Table of Trials and Failures giving  $P_D$  for a Designated Confidence Level – Sorted by Failures.

Note: This document is used only for the metal detection performance tests. Performance testing documents and instructions for exterior and interior sensors, delay, and response forces will be provided to appropriate subgroups.

Participants will use questions and evaluation checklists/tables as a guide and for documentation of test results from the exercise.

### Estimated Time:

Approximate time required for classroom planning exercise: 60 minutes

Approximate time required for field testing: 60 minutes

### Exercises:

1. Develop a test plan for performance testing a metal detector
2. Conduct performance test based on test plan and record results
3. Answer questions based on the test results and observations
4. Present Test Data and Findings

## Exercise 1: Develop a Test Plan for Performance Testing a Metal Detector

### Equipment List:

- Portal metal detector
- One set of keys
- Stainless steel hand gun simulator like the Transportation Security Administration (formerly Federal Aviation Administration (FAA)) operational test piece (OTP)
- Ten magnetic stripe cards
- Set of actual guns (deactivated) provided by the course instructor

### Introduction:

Prior to conducting the performance testing exercise you will visit an actual test field where you will see several physical protection equipment demonstrations (e.g., exterior sensors, interior sensors, video/camera assessment, delay breaching, etc.). Your group will then go to a test station where you will gain hands on experience in conducting a performance test. You must complete Exercise 1 in your subgroup room before going to the performance test field, Exercise 2 will be conducted in the test field, and Exercise 3 will be presented at the hotel.

### Developing a Test Plan

In this exercise you need to determine the performance of a particular physical protection element (a metal detector) in order to decide if it will be acceptable in a proposed design. You have access to a test location in which the element of interest is already properly installed and the parameters have been set to optimal levels by previous preliminary testing. Your subgroup instructor and a subject mater expert are available to provide guidance and consultation.

**Element to be tested:** \_\_\_\_\_

### Determine Test Criteria

**You must either:**

Select a goal  $P_D$  \_\_\_\_\_%, and develop a sampling plan and test strategy that will determine whether the sensor meets or fails to meet that goal  $P_D$ .

**or**

Develop a sampling plan and test strategy that fits within your resources and time constraints and determine the resultant sensor  $P_D$ .

**Confidence Level:** Select an acceptable confidence level to which to test the element and record this value below. Note: most commonly values of 90%, 95%, or even 99% are used for confidence levels. The higher the confidence level the more extensive testing required (note: keep in mind the limited time for the exercise and number of trials to be completed). Two tables are provided at the end of this document to help you select an acceptable confidence level: “Table of Trials and Failures given  $P_D$  for a Designated Confidence Level—Sorted by Trials” and “Table of Trials and Failures given  $P_D$  for a Designated Confidence Level—Sorted by Failures”

**Confidence Level:** \_\_\_\_\_%

**Adversary Tactics:** Describe the adversary tactics (modes of attack) that will be used for testing the protection element (metal detector). For example, fast or slow speed and location on the body of the test object (e.g., simulated hand gun). See Figure 1 for test locations. Note: Discuss all possible tactics, but select a few tactics to ensure you complete your testing in the allotted time.

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### Develop Sampling Plan

Discuss and determine a Sampling Plan (locations and number of trials at each location (see Figure 1); stopping points; failures tolerated). Record general description below:

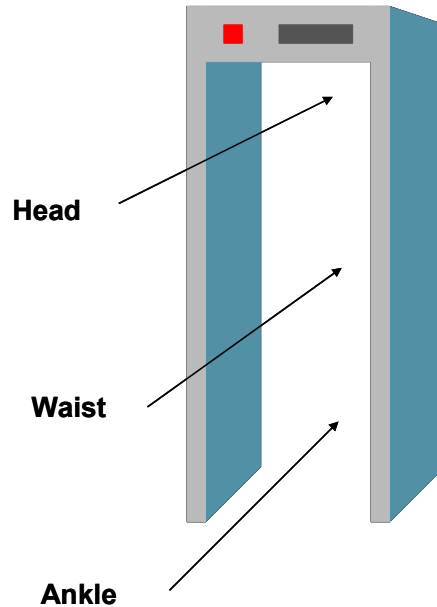


Figure 1. Test Locations for Performance Test

Test Number	Describe the test object and it will be placed on the test person (e.g., at head location, waist, ankle, or other)	Describe the speed of the tester (fast, slow, moderate, other)
Test 1		
Test 2		
Test 3		
Test 4		
Test 5		
Test 6		
Test 7		
Test 8		
Test 9		

Number of trial tests for each test = \_\_\_\_\_

Total number of trial tests to be conducted = no. of trail tests X test locations = \_\_\_\_\_

Number of failures allowed = \_\_\_\_\_ (test to be stopped when failures exceed this limit)

### Team Members Roles and Responsibilities

Define each team members' roles and responsibilities for the testing. Ensure all team members participate in the testing. Identify the project leader, note takers, testers (the project leader should make sure each team member participates as a tester), etc.

Team Member	Role/Responsibility	Comments

Exercise 1 is completed in classroom. Exercise 2 is completed in the Test field.

### Exercise 2: Conduct the Performance Test

1. After developing the test plan, determine the one or two most likely test objects (i.e., simulated handgun or other contraband items) representing the worst case threat (for guidance refer to the course content presented in the lecture for contraband detection).
2. Test participant will carry the contraband items through the metal detector according to the test plan.
3. Test the portal metal detector using the contraband items provided at each of the three locations (Figure 1):
  - Ankle
  - Waist
  - Head

If time is short, you might test only the positions you consider to be the most advantageous to the adversary.
4. Record the results of each test set performed in Table 1 (Test Results). Make extra copies of Table 1 if necessary.

Table 1: Test Results						
Test Number	Contraband Object	Test Location (head, waist, ankle, or other)	Test Speed (fast, slow, etc.)	Number of Trials	Number of Detections	Number of Failures
1						
2						
3						
4						
5						
6						
7						
8						
9						
<b>Total</b>						

Total detected alarms for all tests = \_\_\_\_\_ out of \_\_\_\_\_ tests

$P_D =$  \_\_\_\_\_

## Summary of Results

Record here the summary of the results, including the resultant  $P_D$  and if the detection element met or failed to meet the goal.

Resultant  $P_D$  = \_\_\_\_\_

*If you selected a  $P_D$  to test, then indicate if the test failed or met the performance level established.*

Goal  $P_D$  (from page 2) = \_\_\_\_\_

Test failed or met the performance level? \_\_\_\_\_

Additional Notes:

## Exercise 3: Answer the following questions based on your observations and test results:

Did the metal detector pass the test (did you successfully test it to your desired  $P_D$  and confidence levels?).

If you have time, perform some additional tests: Try carrying some common metallic items (typical pocket-carried items) through the detector to qualitatively determine the detector's immunity to nuisance alarms (use your own pocket-carried items for this test (coins, paper clips, keys, etc.)).

Which items caused nuisance alarms?

Which items did not?

Any ideas on how an adversary might defeat a metal detector?

## **Exercise 4 – Present Test Data and Findings**

As a team, put together a 5 minute presentation of your testing activities, the test data and results, your recommendations, and lessons learned. Use the following outline for your briefing:

- Purpose of test
- Describe level of performance expected (or if you determined a resultant  $P_D$ )
- Adversary tactics used
- Sampling plan (no. of trials and allowed failures)
- Summary of results
- Recommendations
- Lessons learned

### **Attachments:**

- Table of Trials and Failures giving  $P_D$  for a Designated Confidence Level – Sorted by Trials.
- Table of Trials and Failures giving  $P_D$  for a Designated Confidence Level – Sorted by Failures.



Table of Trials and Failures giving P<sub>D</sub> for a Designated Confidence Level—Sorted by Trials

P <sub>D</sub> at designated Confidence level (sorted by number of trials)						
Total Tries	Failures	Confidence Levels				
		75%	80%	85%	90%	95%
4	0	71%	67%	62%	56%	47%
4	1	46%	42%	37%	32%	25%
4	2	24%	21%	18%	14%	10%
4	3	7%	5%	4%	3%	1%
5	0	76%	73%	68%	63%	55%
5	1	55%	51%	47%	42%	34%
5	2	36%	33%	29%	25%	19%
5	3	19%	17%	14%	11%	8%
6	0	79%	76%	73%	68%	61%
6	1	61%	58%	54%	49%	42%
6	2	45%	41%	38%	33%	27%
6	3	30%	27%	24%	20%	15%
7	0	82%	79%	76%	72%	65%
7	1	66%	63%	59%	55%	48%
7	2	51%	48%	45%	40%	34%
7	3	38%	35%	32%	28%	23%
8	0	84%	82%	79%	75%	69%
8	1	70%	67%	64%	59%	53%
8	2	57%	54%	50%	46%	40%
8	3	44%	42%	38%	34%	29%
9	0	86%	84%	81%	77%	72%
9	1	73%	70%	67%	63%	57%
9	2	61%	58%	55%	51%	45%
9	3	50%	47%	44%	40%	35%
10	0	87%	85%	83%	79%	74%
10	1	75%	73%	70%	66%	61%
10	2	64%	62%	59%	55%	49%
10	3	54%	52%	49%	45%	39%
11	0	88%	86%	84%	81%	76%
11	1	77%	75%	72%	69%	64%
11	2	67%	65%	62%	58%	53%
11	3	58%	55%	53%	49%	44%
12	0	89%	87%	85%	83%	78%
12	1	79%	77%	75%	71%	66%
12	2	70%	68%	65%	61%	56%
12	3	61%	59%	56%	52%	47%
13	0	90%	88%	86%	84%	79%
13	1	81%	79%	76%	73%	68%
13	2	72%	70%	67%	64%	59%
13	3	64%	62%	59%	56%	51%
14	0	91%	89%	87%	85%	81%
14	1	82%	80%	78%	75%	70%
14	2	74%	72%	69%	66%	61%
14	3	66%	64%	62%	58%	53%
15	0	91%	90%	88%	86%	82%
15	1	83%	81%	79%	76%	72%
15	2	76%	74%	71%	68%	64%
15	3	68%	66%	64%	61%	56%
16	0	92%	90%	89%	87%	83%
16	1	84%	82%	80%	78%	74%
16	2	77%	75%	73%	70%	66%
16	3	70%	68%	66%	63%	58%
17	0	92%	91%	89%	87%	84%
17	1	85%	83%	82%	79%	75%
17	2	78%	76%	74%	72%	67%
17	3	72%	70%	68%	65%	60%
18	0	93%	91%	90%	88%	85%
18	1	86%	84%	82%	80%	76%
18	2	79%	78%	76%	73%	69%
18	3	73%	71%	69%	67%	62%
19	0	93%	92%	91%	89%	85%
19	1	86%	85%	83%	81%	77%
19	2	80%	79%	77%	74%	71%
19	3	75%	73%	71%	68%	64%
20	0	93%	92%	91%	89%	86%
20	1	87%	86%	84%	82%	78%
20	2	81%	80%	78%	76%	72%
20	3	76%	74%	72%	70%	66%
21	0	94%	93%	91%	90%	87%
21	1	88%	86%	85%	83%	79%
21	2	82%	81%	79%	77%	73%
21	3	77%	75%	73%	71%	67%
22	0	94%	93%	92%	90%	87%
22	1	88%	87%	85%	83%	80%
22	2	83%	82%	80%	78%	74%
22	3	78%	76%	75%	72%	68%
23	0	94%	93%	92%	91%	88%
23	1	89%	88%	86%	84%	81%
23	2	84%	82%	81%	78%	75%
23	3	79%	77%	76%	73%	70%
24	0	94%	94%	92%	91%	88%
24	1	89%	88%	87%	85%	82%
24	2	84%	83%	81%	79%	76%
24	3	80%	78%	76%	74%	71%
25	0	95%	94%	93%	91%	89%
25	1	90%	88%	87%	85%	82%
25	2	85%	84%	82%	80%	77%
25	3	80%	79%	77%	75%	72%
26	0	95%	94%	93%	92%	89%
26	1	90%	89%	88%	86%	83%
26	2	85%	84%	83%	81%	78%
26	3	81%	80%	78%	76%	73%
27	0	95%	94%	93%	92%	90%
27	1	90%	89%	88%	86%	84%
27	2	86%	85%	83%	81%	78%
27	3	82%	81%	79%	77%	74%
28	0	95%	94%	93%	92%	90%
28	1	91%	90%	88%	87%	84%
28	2	86%	85%	84%	82%	79%
28	3	82%	81%	80%	78%	75%
29	0	95%	95%	94%	92%	90%
29	1	91%	90%	89%	87%	85%
29	2	87%	86%	84%	83%	80%
29	3	83%	82%	80%	78%	75%
30	0	95%	95%	94%	93%	91%
30	1	91%	90%	89%	88%	85%
30	2	87%	86%	85%	83%	80%
30	3	84%	82%	81%	79%	76%
31	0	96%	95%	94%	93%	91%
31	1	92%	91%	90%	88%	86%
31	2	88%	87%	85%	84%	81%
31	3	84%	83%	82%	80%	77%
32	0	96%	95%	94%	93%	91%
32	1	92%	91%	90%	88%	86%
32	2	88%	87%	86%	84%	82%
32	3	85%	83%	82%	80%	78%
33	0	96%	95%	94%	93%	91%
33	1	92%	91%	90%	89%	86%
33	2	88%	87%	86%	85%	82%
33	3	85%	84%	83%	81%	78%
34	0	96%	95%	95%	93%	92%
34	1	92%	91%	90%	89%	87%
34	2	89%	88%	87%	85%	83%
34	3	85%	84%	83%	81%	79%
35	0	96%	96%	95%	94%	92%
35	1	92%	92%	91%	89%	87%
35	2	89%	88%	87%	86%	83%
35	3	86%	85%	84%	82%	79%
36	0	96%	96%	95%	94%	92%
36	1	93%	92%	91%	90%	88%
36	2	89%	88%	87%	86%	84%
36	3	86%	85%	84%	82%	80%
37	0	96%	96%	95%	94%	92%
37	1	93%	92%	91%	90%	88%
37	2	90%	89%	88%	86%	84%
37	3	87%	86%	84%	83%	80%

Table of Trials and Failures giving  $P_D$  for a Designated Confidence Level—Sorted by Trials

$P_D$  at designated Confidence level (sorted by number of trials)

Total Tries	Failures	Confidence Levels				
		75%	80%	85%	90%	95%
38	0	96%	96%	95%	94%	92%
38	1	93%	92%	91%	90%	88%
38	2	90%	89%	88%	87%	84%
38	3	87%	86%	85%	83%	81%
39	0	97%	96%	95%	94%	93%
39	1	93%	93%	92%	90%	88%
39	2	90%	89%	88%	87%	85%
39	3	87%	86%	85%	84%	81%
40	0	97%	96%	95%	94%	93%
40	1	93%	93%	92%	91%	89%
40	2	90%	90%	89%	87%	85%
40	3	88%	87%	86%	84%	82%
41	0	97%	96%	95%	95%	93%
41	1	94%	93%	92%	91%	89%
41	2	91%	90%	89%	88%	85%
41	3	88%	87%	86%	84%	82%
42	0	97%	96%	96%	95%	93%
42	1	94%	93%	92%	91%	89%
42	2	91%	90%	89%	88%	86%
42	3	88%	87%	86%	85%	83%
43	0	97%	96%	96%	95%	93%
43	1	94%	93%	92%	91%	89%
43	2	91%	90%	89%	88%	86%
43	3	88%	88%	87%	85%	83%
44	0	97%	96%	96%	95%	93%
44	1	94%	93%	93%	91%	90%
44	2	91%	91%	90%	88%	86%
44	3	89%	88%	87%	85%	83%
45	0	97%	96%	96%	95%	94%
45	1	94%	93%	93%	92%	90%
45	2	91%	91%	90%	89%	87%
45	3	89%	88%	87%	86%	84%
46	0	97%	97%	96%	95%	94%
46	1	94%	94%	93%	92%	90%
46	2	92%	91%	90%	89%	87%
46	3	89%	88%	87%	86%	84%
47	0	97%	97%	96%	95%	94%
47	1	94%	94%	93%	92%	90%
47	2	92%	91%	90%	89%	87%
47	3	89%	89%	88%	86%	84%
48	0	97%	97%	96%	95%	94%
48	1	94%	94%	93%	92%	90%
48	2	92%	91%	90%	89%	87%
48	3	90%	89%	88%	87%	85%
49	0	97%	97%	96%	95%	94%
49	1	95%	94%	93%	92%	91%
49	2	92%	91%	91%	90%	88%
49	3	90%	89%	88%	87%	85%
50	0	97%	97%	96%	96%	94%
50	1	95%	94%	93%	92%	91%
50	2	92%	92%	91%	90%	88%
50	3	90%	89%	88%	87%	85%
51	0	97%	97%	96%	96%	94%
51	1	95%	94%	94%	93%	91%
51	2	92%	92%	91%	90%	88%
51	3	90%	89%	89%	87%	86%
52	0	97%	97%	96%	96%	94%
52	1	95%	94%	94%	93%	91%
52	2	93%	92%	91%	90%	88%
52	3	90%	90%	89%	88%	86%
53	0	97%	97%	96%	96%	95%
53	1	95%	94%	94%	93%	91%
53	2	93%	92%	91%	90%	89%
53	3	91%	90%	89%	88%	86%
54	0	97%	97%	97%	96%	95%
54	1	95%	95%	94%	93%	92%
54	2	93%	92%	91%	90%	89%
54	3	91%	90%	89%	88%	86%

Total Tries	Failures	Confidence Levels				
		75%	80%	85%	90%	95%
55	0	98%	97%	97%	96%	95%
55	1	95%	95%	94%	93%	92%
55	2	93%	92%	92%	91%	89%
55	3	91%	90%	89%	88%	87%
56	0	98%	97%	97%	96%	95%
56	1	95%	95%	94%	93%	92%
56	2	93%	93%	92%	91%	89%
56	3	91%	90%	90%	88%	87%
57	0	98%	97%	97%	96%	95%
57	1	95%	95%	94%	93%	92%
57	2	93%	93%	92%	91%	89%
57	3	91%	91%	90%	89%	87%
58	0	98%	97%	97%	96%	95%
58	1	95%	95%	94%	93%	92%
58	2	93%	93%	92%	91%	90%
58	3	91%	91%	90%	89%	87%
59	0	98%	97%	97%	96%	95%
59	1	96%	95%	94%	94%	92%
59	2	93%	93%	92%	91%	90%
59	3	91%	91%	90%	89%	87%
60	0	98%	97%	97%	96%	95%
60	1	96%	95%	95%	94%	92%
60	2	94%	93%	92%	91%	90%
60	3	92%	91%	90%	89%	88%
61	0	98%	97%	97%	96%	95%
61	1	96%	95%	95%	94%	92%
61	2	94%	93%	92%	92%	90%
61	3	92%	91%	90%	89%	88%
62	0	98%	97%	97%	96%	95%
62	1	96%	95%	95%	94%	93%
62	2	94%	93%	93%	92%	90%
62	3	92%	91%	91%	90%	88%
63	0	98%	97%	97%	96%	95%
63	1	96%	95%	95%	94%	93%
63	2	94%	93%	93%	92%	90%
63	3	92%	91%	91%	90%	88%
64	0	98%	98%	97%	96%	95%
64	1	96%	95%	95%	94%	93%
64	2	94%	93%	93%	92%	91%
64	3	92%	92%	91%	90%	88%
65	0	98%	98%	97%	97%	96%
65	1	96%	95%	95%	94%	93%
65	2	94%	94%	93%	92%	91%
65	3	92%	92%	91%	90%	89%
66	0	98%	98%	97%	97%	96%
66	1	96%	96%	95%	94%	93%
66	2	94%	94%	93%	92%	91%
66	3	92%	92%	91%	90%	89%
67	0	98%	98%	97%	97%	96%
67	1	96%	96%	95%	94%	93%
67	2	94%	94%	93%	92%	91%
67	3	92%	92%	91%	90%	89%
68	0	98%	98%	97%	97%	96%
68	1	96%	96%	95%	94%	93%
68	2	94%	94%	93%	92%	91%
68	3	93%	92%	91%	90%	89%
69	0	98%	98%	97%	97%	96%
69	1	96%	96%	95%	94%	93%
69	2	94%	94%	93%	92%	91%
69	3	93%	92%	91%	91%	89%
70	0	98%	98%	97%	97%	96%
70	1	96%	96%	95%	95%	93%
70	2	94%	94%	93%	93%	91%
70	3	93%	92%	92%	91%	89%
71	0	98%	98%	97%	97%	96%
71	1	96%	96%	95%	95%	93%
71	2	95%	94%	93%	93%	91%
71	3	93%	92%	92%	91%	89%

Table of Trials and Failures giving P<sub>D</sub> for a Designated Confidence Level—Sorted by Trials

Total Tries	Failures	Confidence Levels				
		75%	80%	85%	90%	95%
72	0	98%	98%	97%	97%	96%
72	1	96%	96%	95%	95%	94%
72	2	95%	94%	94%	93%	92%
72	3	93%	92%	92%	91%	90%
73	0	98%	98%	97%	97%	96%
73	1	96%	96%	95%	95%	94%
73	2	95%	94%	94%	93%	92%
73	3	93%	93%	92%	91%	90%
74	0	98%	98%	97%	97%	96%
74	1	96%	96%	96%	95%	94%
74	2	95%	94%	94%	93%	92%
74	3	93%	93%	92%	91%	90%
75	0	98%	98%	98%	97%	96%
75	1	96%	96%	96%	95%	94%
75	2	95%	94%	94%	93%	92%
75	3	93%	93%	92%	91%	90%
76	0	98%	98%	98%	97%	96%
76	1	96%	96%	96%	95%	94%
76	2	95%	94%	94%	93%	92%
76	3	93%	93%	92%	91%	90%
77	0	98%	98%	98%	97%	96%
77	1	97%	96%	96%	95%	94%
77	2	95%	95%	94%	93%	92%
77	3	93%	93%	92%	92%	90%
78	0	98%	98%	98%	97%	96%
78	1	97%	96%	96%	95%	94%
78	2	95%	95%	94%	93%	92%
78	3	94%	93%	92%	92%	90%
79	0	98%	98%	98%	97%	96%
79	1	97%	96%	96%	95%	94%
79	2	95%	95%	94%	93%	92%
79	3	94%	93%	93%	92%	90%
80	0	98%	98%	98%	97%	96%
80	1	97%	96%	96%	95%	94%
80	2	95%	95%	94%	93%	92%
80	3	94%	93%	93%	92%	91%
81	0	98%	98%	98%	97%	96%
81	1	97%	96%	96%	95%	94%
81	2	95%	95%	94%	94%	92%
81	3	94%	93%	93%	92%	91%
82	0	98%	98%	98%	97%	96%
82	1	97%	96%	96%	95%	94%
82	2	95%	95%	94%	94%	93%
82	3	94%	93%	93%	92%	91%
83	0	98%	98%	98%	97%	96%
83	1	97%	96%	96%	95%	94%
83	2	95%	95%	94%	94%	93%
83	3	94%	93%	93%	92%	91%
84	0	98%	98%	98%	97%	96%
84	1	97%	96%	96%	95%	94%
84	2	95%	95%	94%	94%	93%
84	3	94%	94%	93%	92%	91%
85	0	98%	98%	98%	97%	97%
85	1	97%	97%	96%	96%	95%
85	2	95%	95%	95%	94%	93%
85	3	94%	94%	93%	92%	91%
86	0	98%	98%	98%	97%	97%
86	1	97%	97%	96%	96%	95%
86	2	95%	95%	95%	94%	93%
86	3	94%	94%	93%	92%	91%
87	0	98%	98%	98%	97%	97%
87	1	97%	97%	96%	96%	95%
87	2	96%	95%	95%	94%	93%
87	3	94%	94%	93%	92%	91%
88	0	98%	98%	98%	97%	97%
88	1	97%	97%	96%	96%	95%
88	2	96%	95%	95%	94%	93%
88	3	94%	94%	93%	93%	91%

Total Tries	Failures	Confidence Levels				
		75%	80%	85%	90%	95%
89	0	98%	98%	98%	97%	97%
89	1	97%	97%	96%	96%	95%
89	2	96%	95%	95%	94%	93%
89	3	94%	94%	93%	93%	92%
90	0	98%	98%	98%	97%	97%
90	1	97%	97%	96%	96%	95%
90	2	96%	95%	95%	94%	93%
90	3	94%	94%	93%	93%	92%
91	0	98%	98%	98%	98%	97%
91	1	97%	97%	96%	96%	95%
91	2	96%	95%	95%	94%	93%
91	3	94%	94%	93%	93%	92%
92	0	99%	98%	98%	98%	97%
92	1	97%	97%	96%	96%	95%
92	2	96%	95%	95%	94%	93%
92	3	95%	94%	94%	93%	92%
93	0	99%	98%	98%	98%	97%
93	1	97%	97%	96%	96%	95%
93	2	96%	95%	95%	94%	93%
93	3	95%	94%	94%	93%	92%
94	0	99%	98%	98%	98%	97%
94	1	97%	97%	96%	96%	95%
94	2	96%	96%	95%	94%	93%
94	3	95%	94%	94%	93%	92%
95	0	99%	98%	98%	98%	97%
95	1	97%	97%	96%	96%	95%
95	2	96%	96%	95%	95%	94%
95	3	95%	94%	94%	93%	92%
96	0	99%	98%	98%	98%	97%
96	1	97%	97%	97%	96%	95%
96	2	96%	96%	95%	95%	94%
96	3	95%	94%	94%	93%	92%
97	0	99%	98%	98%	98%	97%
97	1	97%	97%	97%	96%	95%
97	2	96%	96%	95%	95%	94%
97	3	95%	94%	94%	93%	92%
98	0	99%	98%	98%	98%	97%
98	1	97%	97%	97%	96%	95%
98	2	96%	96%	95%	95%	94%
98	3	95%	94%	94%	93%	92%
99	0	99%	98%	98%	98%	97%
99	1	97%	97%	97%	96%	95%
99	2	96%	96%	95%	95%	94%
99	3	95%	95%	94%	93%	92%
100	0	99%	98%	98%	98%	97%
100	1	97%	97%	97%	96%	95%
100	2	96%	96%	95%	95%	94%
100	3	95%	95%	94%	93%	92%

Define Physical Protection System Requirements

Table of Trials and Failures giving  $P_D$  for a Designated Confidence Level—Sorted by Failures

Failures	Total Trials	Confidence Levels				
		75%	80%	85%	90%	95%
0	4	71%	67%	62%	56%	47%
0	5	76%	73%	68%	63%	55%
0	6	79%	76%	73%	68%	61%
0	7	82%	79%	76%	72%	65%
0	8	84%	82%	79%	75%	69%
0	9	86%	84%	81%	77%	72%
0	10	87%	85%	83%	79%	74%
0	11	88%	86%	84%	81%	76%
0	12	89%	87%	85%	83%	78%
0	13	90%	88%	86%	84%	79%
0	14	91%	89%	87%	85%	81%
0	15	91%	90%	88%	86%	82%
0	16	92%	90%	89%	87%	83%
0	17	92%	91%	89%	87%	84%
0	18	93%	91%	90%	88%	85%
0	19	93%	92%	91%	89%	85%
0	20	93%	92%	91%	89%	86%
0	21	94%	93%	91%	90%	87%
0	22	94%	93%	92%	90%	87%
0	23	94%	93%	92%	91%	88%
0	24	94%	94%	92%	91%	88%
0	25	95%	94%	93%	91%	89%
0	26	95%	94%	93%	92%	89%
0	27	95%	94%	93%	92%	90%
0	28	95%	94%	93%	92%	90%
0	29	95%	95%	94%	92%	90%
0	30	95%	95%	94%	93%	91%
0	31	96%	95%	94%	93%	91%
0	32	96%	95%	94%	93%	91%
0	33	96%	95%	94%	93%	91%
0	34	96%	95%	95%	93%	92%
0	35	96%	96%	95%	94%	92%
0	36	96%	96%	95%	94%	92%
0	37	96%	96%	95%	94%	92%
0	38	96%	96%	95%	94%	92%
0	39	97%	96%	95%	94%	93%
0	40	97%	96%	95%	94%	93%
0	41	97%	96%	95%	95%	93%
0	42	97%	96%	96%	95%	93%
0	43	97%	96%	96%	95%	93%
0	44	97%	96%	96%	95%	93%
0	45	97%	96%	96%	95%	94%
0	46	97%	97%	96%	95%	94%
0	47	97%	97%	96%	95%	94%
0	48	97%	97%	96%	95%	94%
0	49	97%	97%	96%	95%	94%
0	50	97%	97%	96%	96%	94%
0	51	97%	97%	96%	96%	94%
0	52	97%	97%	96%	96%	94%
0	53	97%	97%	96%	96%	95%
0	54	97%	97%	97%	96%	95%
0	55	98%	97%	97%	96%	95%
0	56	98%	97%	97%	96%	95%
0	57	98%	97%	97%	96%	95%
0	58	98%	97%	97%	96%	95%
0	59	98%	97%	97%	96%	95%
0	60	98%	97%	97%	96%	95%
0	61	98%	97%	97%	96%	95%
0	62	98%	97%	97%	96%	95%
0	63	98%	97%	97%	96%	95%
0	64	98%	98%	97%	96%	95%
0	65	98%	98%	97%	97%	96%
0	66	98%	98%	97%	97%	96%
0	67	98%	98%	97%	97%	96%
0	68	98%	98%	97%	97%	96%
0	69	98%	98%	97%	97%	96%
0	70	98%	98%	97%	97%	96%
0	71	98%	98%	97%	97%	96%

Failures	Total Trials	Confidence Levels				
		75%	80%	85%	90%	95%
0	72	98%	98%	97%	97%	96%
0	73	98%	98%	97%	97%	96%
0	74	98%	98%	97%	97%	96%
0	75	98%	98%	98%	97%	96%
0	76	98%	98%	98%	97%	96%
0	77	98%	98%	98%	97%	96%
0	78	98%	98%	98%	97%	96%
0	79	98%	98%	98%	97%	96%
0	80	98%	98%	98%	97%	96%
0	81	98%	98%	98%	97%	96%
0	82	98%	98%	98%	97%	96%
0	83	98%	98%	98%	97%	96%
0	84	98%	98%	98%	97%	96%
0	85	98%	98%	98%	97%	97%
0	86	98%	98%	98%	97%	97%
0	87	98%	98%	98%	97%	97%
0	88	98%	98%	98%	97%	97%
0	89	98%	98%	98%	97%	97%
0	90	98%	98%	98%	97%	97%
0	91	98%	98%	98%	98%	97%
0	92	99%	98%	98%	98%	97%
0	93	99%	98%	98%	98%	97%
0	94	99%	98%	98%	98%	97%
0	95	99%	98%	98%	98%	97%
0	96	99%	98%	98%	98%	97%
0	97	99%	98%	98%	98%	97%
0	98	99%	98%	98%	98%	97%
0	99	99%	98%	98%	98%	97%
0	100	99%	98%	98%	98%	97%
1	4	46%	42%	37%	32%	25%
1	5	55%	51%	47%	42%	34%
1	6	61%	58%	54%	49%	42%
1	7	66%	63%	59%	55%	48%
1	8	70%	67%	64%	59%	53%
1	9	73%	70%	67%	63%	57%
1	10	75%	73%	70%	66%	61%
1	11	77%	75%	72%	69%	64%
1	12	79%	77%	75%	71%	66%
1	13	81%	79%	76%	73%	68%
1	14	82%	80%	78%	75%	70%
1	15	83%	81%	79%	76%	72%
1	16	84%	82%	80%	78%	74%
1	17	85%	83%	82%	79%	75%
1	18	86%	84%	82%	80%	76%
1	19	86%	85%	83%	81%	77%
1	20	87%	86%	84%	82%	78%
1	21	88%	86%	85%	83%	79%
1	22	88%	87%	85%	83%	80%
1	23	89%	88%	86%	84%	81%
1	24	89%	88%	87%	85%	82%
1	25	90%	88%	87%	85%	82%
1	26	90%	89%	88%	86%	83%
1	27	90%	89%	88%	86%	84%
1	28	91%	90%	88%	87%	84%
1	29	91%	90%	89%	87%	85%
1	30	91%	90%	89%	88%	85%
1	31	92%	91%	90%	88%	86%
1	32	92%	91%	90%	88%	86%
1	33	92%	91%	90%	89%	86%
1	34	92%	91%	90%	89%	87%
1	35	92%	92%	91%	89%	87%
1	36	93%	92%	91%	90%	88%
1	37	93%	92%	91%	90%	88%
1	38	93%	92%	91%	90%	88%
1	39	93%	93%	92%	90%	88%
1	40	93%	93%	92%	91%	89%
1	41	94%	93%	92%	91%	89%
1	42	94%	93%	92%	91%	89%

Table of Trials and Failures giving P<sub>D</sub> for a Designated Confidence Level—Sorted by Failures

Failures	Total Tries	Confidence Levels				
		75%	80%	85%	90%	95%
1	43	94%	93%	92%	91%	89%
1	44	94%	93%	93%	91%	90%
1	45	94%	93%	93%	92%	90%
1	46	94%	94%	93%	92%	90%
1	47	94%	94%	93%	92%	90%
1	48	94%	94%	93%	92%	90%
1	49	95%	94%	93%	92%	91%
1	50	95%	94%	93%	92%	91%
1	51	95%	94%	94%	93%	91%
1	52	95%	94%	94%	93%	91%
1	53	95%	94%	94%	93%	91%
1	54	95%	95%	94%	93%	92%
1	55	95%	95%	94%	93%	92%
1	56	95%	95%	94%	93%	92%
1	57	95%	95%	94%	93%	92%
1	58	95%	95%	94%	93%	92%
1	59	96%	95%	94%	94%	92%
1	60	96%	95%	95%	94%	92%
1	61	96%	95%	95%	94%	92%
1	62	96%	95%	95%	94%	93%
1	63	96%	95%	95%	94%	93%
1	64	96%	95%	95%	94%	93%
1	65	96%	95%	95%	94%	93%
1	66	96%	96%	95%	94%	93%
1	67	96%	96%	95%	94%	93%
1	68	96%	96%	95%	94%	93%
1	69	96%	96%	95%	94%	93%
1	70	96%	96%	95%	95%	93%
1	71	96%	96%	95%	95%	93%
1	72	96%	96%	95%	95%	94%
1	73	96%	96%	95%	95%	94%
1	74	96%	96%	96%	95%	94%
1	75	96%	96%	96%	95%	94%
1	76	96%	96%	96%	95%	94%
1	77	97%	96%	96%	95%	94%
1	78	97%	96%	96%	95%	94%
1	79	97%	96%	96%	95%	94%
1	80	97%	96%	96%	95%	94%
1	81	97%	96%	96%	95%	94%
1	82	97%	96%	96%	95%	94%
1	83	97%	96%	96%	95%	94%
1	84	97%	96%	96%	95%	94%
1	85	97%	97%	96%	96%	95%
1	86	97%	97%	96%	96%	95%
1	87	97%	97%	96%	96%	95%
1	88	97%	97%	96%	96%	95%
1	89	97%	97%	96%	96%	95%
1	90	97%	97%	96%	96%	95%
1	91	97%	97%	96%	96%	95%
1	92	97%	97%	96%	96%	95%
1	93	97%	97%	96%	96%	95%
1	94	97%	97%	96%	96%	95%
1	95	97%	97%	96%	96%	95%
1	96	97%	97%	97%	96%	95%
1	97	97%	97%	97%	96%	95%
1	98	97%	97%	97%	96%	95%
1	99	97%	97%	97%	96%	95%
1	100	97%	97%	97%	96%	95%
2	4	24%	21%	18%	14%	10%
2	5	36%	33%	29%	25%	19%
2	6	45%	41%	38%	33%	27%
2	7	51%	48%	45%	40%	34%
2	8	57%	54%	50%	46%	40%
2	9	61%	58%	55%	51%	45%
2	10	64%	62%	59%	55%	49%
2	11	67%	65%	62%	58%	53%
2	12	70%	68%	65%	61%	56%
2	13	72%	70%	67%	64%	59%

Failures	Total Tries	Confidence Levels				
		75%	80%	85%	90%	95%
2	14	74%	72%	69%	66%	61%
2	15	76%	74%	71%	68%	64%
2	16	77%	75%	73%	70%	66%
2	17	78%	76%	74%	72%	67%
2	18	79%	78%	76%	73%	69%
2	19	80%	79%	77%	74%	71%
2	20	81%	80%	78%	76%	72%
2	21	82%	81%	79%	77%	73%
2	22	83%	82%	80%	78%	74%
2	23	84%	82%	81%	78%	75%
2	24	84%	83%	81%	79%	76%
2	25	85%	84%	82%	80%	77%
2	26	85%	84%	83%	81%	78%
2	27	86%	85%	83%	81%	78%
2	28	86%	85%	84%	82%	79%
2	29	87%	86%	84%	83%	80%
2	30	87%	86%	85%	83%	80%
2	31	88%	87%	85%	84%	81%
2	32	88%	87%	86%	84%	82%
2	33	88%	87%	86%	85%	82%
2	34	89%	88%	87%	85%	83%
2	35	89%	88%	87%	86%	83%
2	36	89%	88%	87%	86%	84%
2	37	90%	89%	88%	86%	84%
2	38	90%	89%	88%	87%	84%
2	39	90%	89%	88%	87%	85%
2	40	90%	90%	89%	87%	85%
2	41	91%	90%	89%	88%	85%
2	42	91%	90%	89%	88%	86%
2	43	91%	90%	89%	88%	86%
2	44	91%	91%	90%	88%	86%
2	45	91%	91%	90%	89%	87%
2	46	92%	91%	90%	89%	87%
2	47	92%	91%	90%	89%	87%
2	48	92%	91%	90%	89%	87%
2	49	92%	91%	91%	90%	88%
2	50	92%	92%	91%	90%	88%
2	51	92%	92%	91%	90%	88%
2	52	93%	92%	91%	90%	88%
2	53	93%	92%	91%	90%	89%
2	54	93%	92%	91%	90%	89%
2	55	93%	92%	92%	91%	89%
2	56	93%	93%	92%	91%	89%
2	57	93%	93%	92%	91%	89%
2	58	93%	93%	92%	91%	90%
2	59	93%	93%	92%	91%	90%
2	60	94%	93%	92%	91%	90%
2	61	94%	93%	92%	92%	90%
2	62	94%	93%	93%	92%	90%
2	63	94%	93%	93%	92%	90%
2	64	94%	93%	93%	92%	91%
2	65	94%	94%	93%	92%	91%
2	66	94%	94%	93%	92%	91%
2	67	94%	94%	93%	92%	91%
2	68	94%	94%	93%	92%	91%
2	69	94%	94%	93%	92%	91%
2	70	94%	94%	93%	93%	91%
2	71	95%	94%	93%	93%	91%
2	72	95%	94%	94%	93%	92%
2	73	95%	94%	94%	93%	92%
2	74	95%	94%	94%	93%	92%
2	75	95%	94%	94%	93%	92%
2	76	95%	94%	94%	93%	92%
2	77	95%	95%	94%	93%	92%
2	78	95%	95%	94%	93%	92%
2	79	95%	95%	94%	93%	92%
2	80	95%	95%	94%	93%	92%
2	81	95%	95%	94%	94%	92%

Define Physical Protection System Requirements

Failures	Total Tries	Confidence Levels				
		75%	80%	85%	90%	95%
2	82	95%	95%	94%	94%	93%
2	83	95%	95%	94%	94%	93%
2	84	95%	95%	94%	94%	93%
2	85	95%	95%	95%	94%	93%
2	86	95%	95%	95%	94%	93%
2	87	96%	95%	95%	94%	93%
2	88	96%	95%	95%	94%	93%
2	89	96%	95%	95%	94%	93%
2	90	96%	95%	95%	94%	93%
2	91	96%	95%	95%	94%	93%
2	92	96%	95%	95%	94%	93%
2	93	96%	95%	95%	94%	93%
2	94	96%	96%	95%	94%	93%
2	95	96%	96%	95%	95%	94%
2	96	96%	96%	95%	95%	94%
2	97	96%	96%	95%	95%	94%
2	98	96%	96%	95%	95%	94%
2	99	96%	96%	95%	95%	94%
2	100	96%	96%	95%	95%	94%
3	4	7%	5%	4%	3%	1%
3	5	19%	17%	14%	11%	8%
3	6	30%	27%	24%	20%	15%
3	7	38%	35%	32%	28%	23%
3	8	44%	42%	38%	34%	29%
3	9	50%	47%	44%	40%	35%
3	10	54%	52%	49%	45%	39%
3	11	58%	55%	53%	49%	44%
3	12	61%	59%	56%	52%	47%
3	13	64%	62%	59%	56%	51%
3	14	66%	64%	62%	58%	53%
3	15	68%	66%	64%	61%	56%
3	16	70%	68%	66%	63%	58%
3	17	72%	70%	68%	65%	60%
3	18	73%	71%	69%	67%	62%
3	19	75%	73%	71%	68%	64%
3	20	76%	74%	72%	70%	66%
3	21	77%	75%	73%	71%	67%
3	22	78%	76%	75%	72%	68%
3	23	79%	77%	76%	73%	70%
3	24	80%	78%	76%	74%	71%
3	25	80%	79%	77%	75%	72%
3	26	81%	80%	78%	76%	73%
3	27	82%	81%	79%	77%	74%
3	28	82%	81%	80%	78%	75%
3	29	83%	82%	80%	78%	75%
3	30	84%	82%	81%	79%	76%
3	31	84%	83%	82%	80%	77%
3	32	85%	83%	82%	80%	78%
3	33	85%	84%	83%	81%	78%
3	34	85%	84%	83%	81%	79%
3	35	86%	85%	84%	82%	79%
3	36	86%	85%	84%	82%	80%
3	37	87%	86%	84%	83%	80%
3	38	87%	86%	85%	83%	81%
3	39	87%	86%	85%	84%	81%
3	40	88%	87%	86%	84%	82%
3	41	88%	87%	86%	84%	82%
3	42	88%	87%	86%	85%	83%
3	43	88%	88%	87%	85%	83%
3	44	89%	88%	87%	85%	83%
3	45	89%	88%	87%	86%	84%
3	46	89%	88%	87%	86%	84%
3	47	89%	89%	88%	86%	84%
3	48	90%	89%	88%	87%	85%
3	49	90%	89%	88%	87%	85%
3	50	90%	89%	88%	87%	85%
3	51	90%	89%	89%	87%	86%
3	52	90%	90%	89%	88%	86%

Failures	Total Tries	Confidence Levels				
		75%	80%	85%	90%	95%
3	53	91%	90%	89%	88%	86%
3	54	91%	90%	89%	88%	86%
3	55	91%	90%	89%	88%	87%
3	56	91%	90%	90%	88%	87%
3	57	91%	91%	90%	89%	87%
3	58	91%	91%	90%	89%	87%
3	59	91%	91%	90%	89%	87%
3	60	92%	91%	90%	89%	88%
3	61	92%	91%	90%	89%	88%
3	62	92%	91%	91%	90%	88%
3	63	92%	91%	91%	90%	88%
3	64	92%	92%	91%	90%	88%
3	65	92%	92%	91%	90%	89%
3	66	92%	92%	91%	90%	89%
3	67	92%	92%	91%	90%	89%
3	68	93%	92%	91%	90%	89%
3	69	93%	92%	91%	91%	89%
3	70	93%	92%	92%	91%	89%
3	71	93%	92%	92%	91%	89%
3	72	93%	92%	92%	91%	90%
3	73	93%	93%	92%	91%	90%
3	74	93%	93%	92%	91%	90%
3	75	93%	93%	92%	91%	90%
3	76	93%	93%	92%	91%	90%
3	77	93%	93%	92%	92%	90%
3	78	94%	93%	92%	92%	90%
3	79	94%	93%	93%	92%	90%
3	80	94%	93%	93%	92%	91%
3	81	94%	93%	93%	92%	91%
3	82	94%	93%	93%	92%	91%
3	83	94%	93%	93%	92%	91%
3	84	94%	94%	93%	92%	91%
3	85	94%	94%	93%	92%	91%
3	86	94%	94%	93%	92%	91%
3	87	94%	94%	93%	92%	91%
3	88	94%	94%	93%	93%	91%
3	89	94%	94%	93%	93%	92%
3	90	94%	94%	93%	93%	92%
3	91	94%	94%	93%	93%	92%
3	92	95%	94%	94%	93%	92%
3	93	95%	94%	94%	93%	92%
3	94	95%	94%	94%	93%	92%
3	95	95%	94%	94%	93%	92%
3	96	95%	94%	94%	93%	92%
3	97	95%	94%	94%	93%	92%
3	98	95%	94%	94%	93%	92%
3	99	95%	95%	94%	93%	92%
3	100	95%	95%	94%	93%	92%