Second Test Report

October 2007
DENSO WAVE INCORPORATED

Title	**RFID Read Test for Container Management**
Date	Wednesday, October 17, 2007
Location	Head office of DENSO CORPORATION

1. Experiment Purpose

Checks the reality of container management using RFID.

2. Conclusion

When reading containers pasted with UHF tags, this experiment verified as follows:

(1) When the number of containers is 10, 100% of reading is enabled by moving at about 8km/h.

(2) When container size is about 10 times bigger, 100% of reading (ten containers) is enabled even if at about 12km/h.

3. Experiment Equipments

(1) Container

Sanko Sanbox #5A-2 (322 x 198 x 100 mm)

(2) Tag

Alien ALL-9440-02 (98 x 11 mm)

(3) Reader/Writer

DENSO WAVE UR-400 (Software: Console 802_3)

* Send antenna: UR-A410 (linearly polarized wave)
* Receive antenna: UR-A400 (circularly polarized wave)

Container

Tag

Reader/Writer

4. Experiment Method

(1) Tag Pasting Position

- Pastes a tag on the container's longitudinal side (The tag direction coincides with the antenna polarized wave plane)
- Tags are parallel to antenna

(2) Container Stack Method

(1) When the number of containers is changed:

- One hundred:
  3 x 3 x 11 tiers + 1
- Fifty:
  3 x 3 x 5 tiers + 5
- Twenty-five:
  3 x 3 x 2 tiers + 7
- Ten:
  3 x 3 x 1 tiers + 1

(one hundred)

(fifty)

(twenty-five)

(ten)

(2) When the number of containers is not changed:

When one hundred of containers are stacked (3 x 3 x 11 tiers + 1) and the number (tag density) of pasted tags is changed:

(This test simulates various size of containers)

- 100 tags
- 50 tags
- 25 tags
- 10 tags

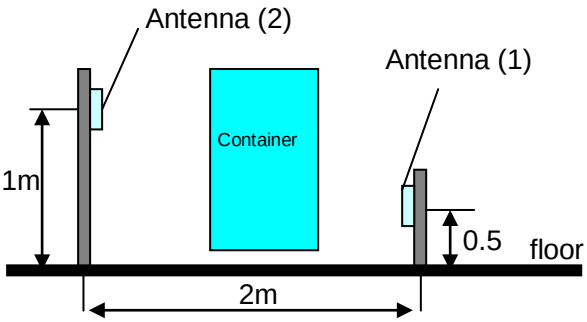
100 tags

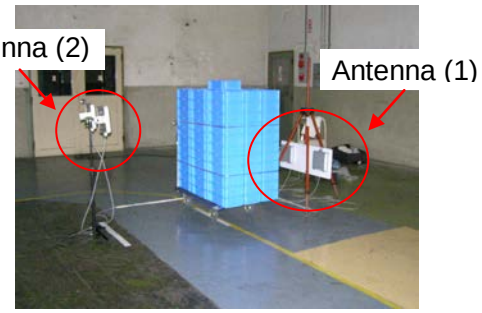
50 tags

25 tags

10 tags

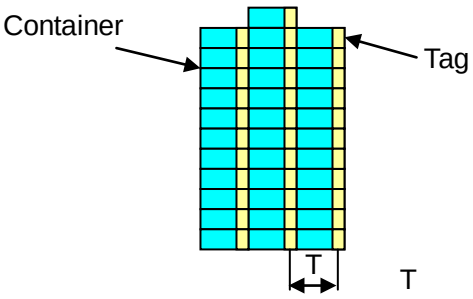
(3) Antenna Layout





(4) Tag Direction

- Same direction (100 tags)



Distance between tags: T = 198 mm

4. Results

No	Conditions		Read number/total											
	Container stack method	Moving rate / Number of tags	About 2km/h			About 4km/h			About 8km/h			About 12km/h		
			1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd
1	Number of containers is changed	100	**100**	**100**	**100**	97	97	**100**	71	58	69	40	60	60
2		50	**50**	**50**	**50**	48	49	48	42	39	47	38	31	39
3		25	**25**	**25**	**25**	24	23	23	24	24	23	21	22	17
4		10	**10**	**10**	**10**	**10**	**10**	**10**	**10**	**10**	**10**	**10**	7	7
5	Tag density is changed	100	**100**	**100**	**100**	97	97	**100**	71	58	69	40	60	60
6		50	**50**	**50**	**50**	**50**	**50**	**50**	44	42	48	33	30	38
7		25	**25**	**25**	**25**	**25**	**25**	**25**	**25**	24	24	21	20	22
8		10	**10**	**10**	**10**	**10**	**10**	**10**	**10**	**10**	**10**	**10**	**10**	**10**

* Colored data in bold designates reading rate=100%

* The moving rate is estimated based on the walking speed (4km/h)

5. Consideration

We verified that 100% of reading at about 8km/h is enabled by reducing the number of containers to ten.

Also, when big container is used, we verified that influence among tags is reduced because the tag density goes down, and the reading rate of tags is improved.