Input paper: [[1]](#footnote-1) ENG6-10.35

Input paper for the following Committee(s): check as appropriate Purpose of paper:

**□** ARM **X** ENG **□** PAP **X** Input

**□** ENAV **□** VTS **□** Information

Agenda item [[2]](#footnote-2) 10

Technical Domain / Task Number 2 …………………………………

Author(s) / Submitter(s) MOBILIS SA

Discussion on buoys on-site test procedure

# Summary

This report is meant to open the discussion on the redaction of a new guideline regarding buoys on-site tests.

Indeed, Ministry of Oceans and Fisheries Korea have issued and diffused a document called "Latest report of the plastic buoy testing" dated 9 Sep 2016. Portions of this document have been diffused as "Sea Test Results of Plastic Buoys (Polyethylene, Polyurea foam, Steel)" to all members of IALA in an Input Paper (N° 10.37) to IALA-ENG5 Committee. This document states, among other things, that “JET7000 was easily affected by the ship wave so it can be dangerous when the operator is onboard”. This affirmation is not backed up by any figures, video or data and is in contradiction with our customers feedbacks.

The document "Sea Test Results of Plastic Buoys (Polyethylene, Polyurea foam, Steel)" presents a certain number of methodological shortcomings that conduct to misunderstandings. That is why the present document has been submitted to open the discussion on the redaction of a clear procedure for buoys on-site tests.

## Purpose of the document

The purpose of this document is to:

* Give some comments on document ENG5-10.37 Report-Sea Test Result of plastic buoys-2.pdf and highlights the short comings in this report and its conclusions;
* Open the discussion to establish a guideline regarding buoys on-site test.

## Related documents

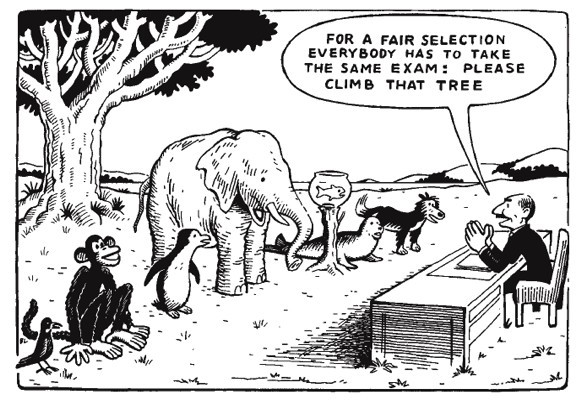
* ENG5-10.37 Report-Sea Test Result of plastic buoys-2.pdf

# Background

Ministry of Oceans and Fisheries Korea have issued and diffused a document called "Latest report of the plastic buoy testing" dated 9 Sep 2016. Portions of this document have been diffused as "Sea Test Results of Plastic Buoys (Polyethylene, Polyurea foam, Steel)" to all members of IALA in an Input Paper (N° 10.37) to IALA-ENG5 Committee. The document comes apparently from Dr. Ju-Seop Han / KAAN (Korea Association of Aids to Navigation).

The following general remarks can be made regarding this document:

* The "Test" is described as jointly co-operated by PYEONGTAEK Regional Office of Oceans and Fisheries with KAAN;
* KANN are the conceiver and builder of one of the models included in the test;
* In facts the test method and conditions seems to have been established solely by KAAN;
* A test procedure, if formalized, is not presented or reported in the published documents;
* The sensors used and their position on the buoys are not precisely described;
* No criterion or comparison base is defined or in use in the test;
* Conditions of mooring site, depth, waves, winds & currents are not reported;
* Description of mooring lines are not reported;
* Location and means of mooring attachment points for each compared model are not specified;
* The types of the compared buoys are completely different;
* For models of similar material, buoyancies and displacements vary from 1 to 1.5, ballast ratios vary from 1 to 3.5. This important point for a "comparison" is not documented nor mentioned;
* These differences affect greatly the dynamic behaviour of the different buoys, fact that is not explained. Indeed, the buoy stability and comportment is under the influence of the buoy shape, the ballast weights applied and the mooring line used.



1. Comparative Test procedure

About dynamic behaviour and analysis:

* Trim and Heel angles collection and reports methods are not documented or explained;
* Analysis of angles raw data and extractions of results seems to be irrelevant with typical analysis of buoys dynamic behaviour;
* The data to allow the buoys behaviour comparison are not presented;
* The first time check-up of the test is described as having taken place on 17 june 2016 with 2 people from Pyeongtaek Port Authority and "3 people from KAAN";
* Other competitors representative have not been invited to attend;
* Conditions and results of the test have not been disclosed and even communicated to, at least, one of the competitors;
* The weather and sea conditions for conclusions in "operating in berthing" are not reported;
* Pictures or Video of "operating in berthing" are not supplied;
* Some of the test conclusions are stated in absence of any criterion and therefore seem to be entirely subjective;
* Such tests are usually based on respecting a minimal equity and fairness between suppliers and on fully sharing between all the suppliers the information's and results about the tests. This is not the case;
* The document is not fully translated in English (for example figures titles and axis legend) and, as a consequence it is not possible for an external reader to fully understand it;
* The buoy supplied by KAAN for the test does not comply with IALA Maritime Buoyage System requirements for region B starboard lateral mark (cylindrical topmark instead of conical) nor with IALA Recommendation E-108 on color.
* The mooring line used by KAAN does not comply with IALA recommendations (IALA Guideline No. 1066), the length of the mooring line being too short for the site depth and the site conditions. This directly impairs the buoy performances as they are linked to the buoy own shape but also to its mooring line. Indeed, the following site conditions were reported by Office of Oceans and Fisheries during the selection phase of the buoy:

1. Site conditions provided by Incheon Port authority

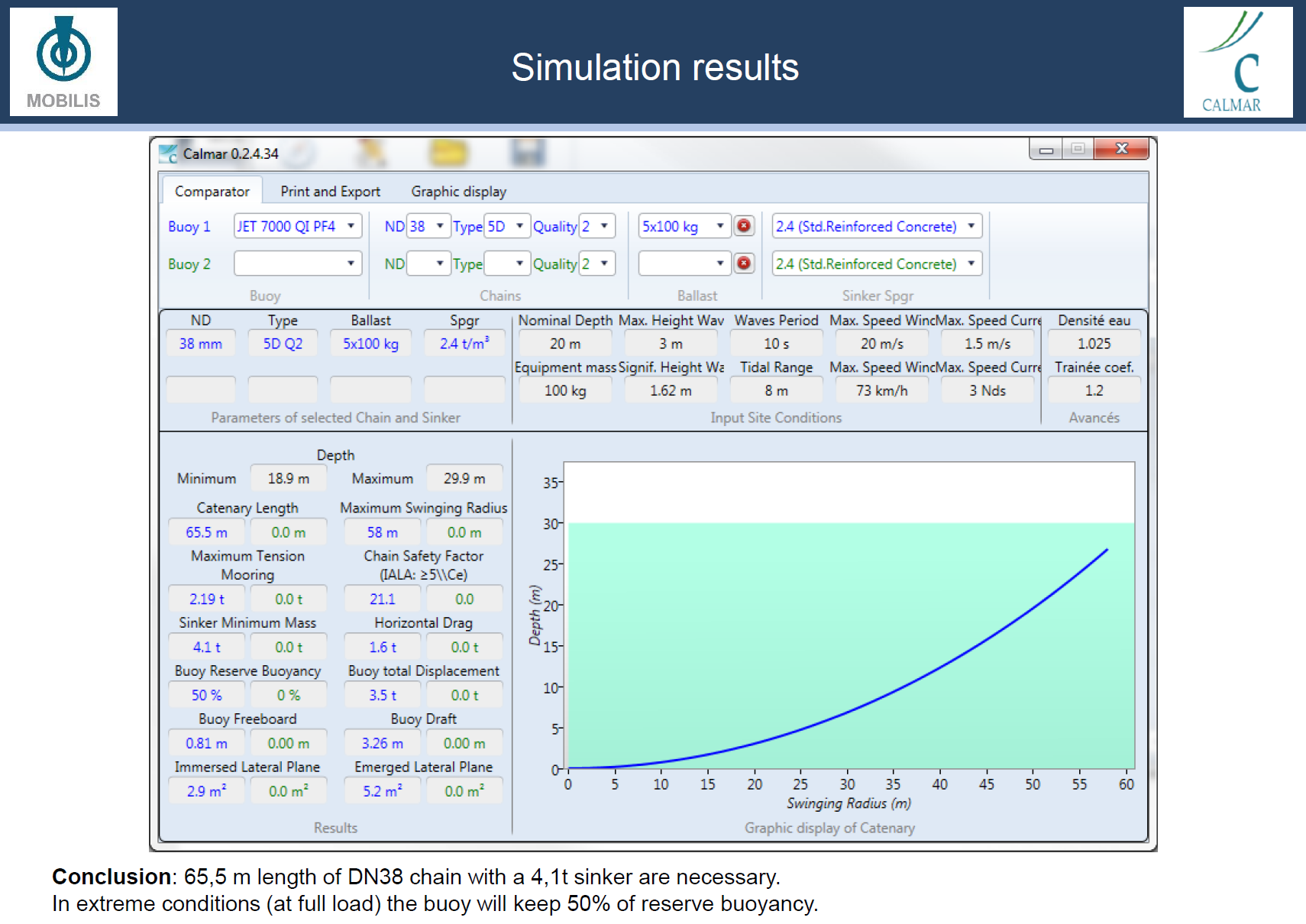
|  |  |  |
| --- | --- | --- |
| 1). Depth | 2). Current | 3). Maximum Wave Height: 3.0m |
| - HHWL: 20.4m | - Flood current: 3.0kn | 4). Maximum Wind Speed: 20.3m/sec |
| - MSL: 13.424m | - Ebb current: 2.7kn | 5). Seabed: MS |
| - LLWL: 8.77m |  |  |

MOBILIS recommendation can be seen in Figure 2 (extract of the technical offer made when the JET 7000 was ordered). A mooring line in chain ND38mm and 65m long was advised, based on calculations done with CALMAR (Mooring Line Calculation Software developed by IALA). However, these recommendations were not followed. Upon MOBILIS request and only after the test has been already presented to IALA committee, KAAN agreed to disclose the mooring line used for their test:

1. Mooring system used for the test

|  |  |
| --- | --- |
| **1). Chain** | **3). Shackle** |
| - Type: DN38 | - Type: DN38 |
| **- Length: 25m** | - Quantity: 1 |
| **2). Sinker** | **4). Swivel** |
| - Material: Concrete | - Type: DN38 |
| - Quantity: 2 | - Quantity: 7 |
| - Weight: 4T |  |

As can be seen above, the mooring used by KAAN for the test was 25m long (for a maximal depth of 20m) i.e. 40m shorter than the mooring line advised by MOBILIS. In these conditions, the results obtained are not reliable as a too short mooring line impairs greatly the buoy dynamic comportment.



1. Mooring line recommendations made by MOBILIS before the test

# Discussion to establish a new guideline regarding buoys on-site test

The previously described document establishes a starting point to discuss the method to follow when conducting comparisons of buoys performances. A number of shortcomings were observed in the document issued by KAAN and the next sections will attempt to complete it and open the discussion on the best practice to follow to do on-site tests.

## Description of test conditions and buoys performances expectations

### Buoys performances: Criterions

Beforehand the performances tested should be clearly defined. This is a major requirement to have equivalent buoys examined during the on-site test. Following is a proposal for a non-exhaustive list of the criteria applicable that should be correlated with operational sea states:

* Conspicuity of the mark, in given sea states:
* Focal plane
* Visible surface
* Color RAL
* Topmark and light
* Inclination angles in different site conditions
* Dynamic behavior
* ***Reference to relevant guidelines (ex. IALA Guideline No. 1065, IALA Recommendation E-108…)***
* Safety:
* Buoy behavior with maintenance workers on board for given sea states
* Damaged stability : amount of sustainable damage to maintain flotation, stability and survival of floating Aid to Navigation
* Ergonomics for maintenance (handrail…)
* ***Reference to relevant guidelines (ex. IALA Guideline No. 1066…)***
* Behavior
* Prediction by calculation
* On-site measurements i.e. periods, amplitudes, accelerations…
* Sensors used (mechanical principle, output…)
* Buoy loading capacity (Behavior for different load configurations)
* ***Reference to relevant guidelines (ex. IALA Guideline No. 1099…)***

### Buoys performances: Technical solutions

The performances described in the previous sections can be attained by working on the following items:

* Floats:
* Free board (should be adapted to the working boat for maintenance operation)
* Buoyancy reserve
* Color change during buoy lifetime complies with latest IALA requirements
* Fooling level
* Buoy required maintenance (operation duration and mean time between 2 inspections)
* ***Reference to relevant guidelines (ex. IALA Guideline No. 1099 …)***
* Structure:
* Cathodic protection
* Connection wear
* Lifting point wear
* Corrosion
* ***Reference to relevant guidelines (ex. NORSOK M501…)***
* Mooring line
* Corrosion
* Mooring point wear
* ***Reference to relevant guidelines (ex. IALA Guideline No. 1066…)***
* Day mark
* Focal plane
* Visible surface
* Topmark and light
* ***Reference to relevant guidelines (ex. IALA MBS…)***

All these criteria shall be, when applicable, linked to the adequate IALA guideline or recommendations, duly dated.

### Site conditions

Maximal site conditions should be used to select the buoy tested and its mooring system. The following parameters should be considered:

* Test location
* Nominal water depth
* Tide range
* Cyclonic / Storm surge (if applicable)
* Maximum wave height
* Wave period (corresponding to the maximum wave height)
* Maximum wind speed
* Maximum current speed

They should be correlated with the expected performance levels described in the previous section to select the buoy tested. The selection can either be done by the test instigator (using CALMAR for example) with validation of the buoy supplier or directly by the buoy supplier himself.

### Buoy characteristics

From the site conditions transmitted, an adapted buoy will be selected for the test. In the test report, main characteristics of the buoys tested shall be compiled:

* Total volume ;
* Buoy mass (equipped) ;
* Ballast masses ;
* Vertical Center of gravity of the equipped buoy ;
* Metacentric height (GM) ;
* Focal plane ;
* Buoy diameter ;
* Buoy draught ;
* Materials (floats, structure and mast).

Along with the buoy own characteristics, the mooring line used shall be described:

* Chain length ;
* Chain type ;
* Chain quality ;
* Chain properties (MBL, linear mass …) ;
* Position of mooring point on buoy ;
* Minimum characteristics of anchorage system.

The mooring line can either be recommended by the supplier or calculated based on IALA recommendations (IALA Guideline No. 1066; CALMAR software available on IALA website). Method of selection of the mooring line shall be documented.

### Test conditions

The buoy location during the test should be documented. The different buoys tested should be placed in the same area to be submitted to the same environmental conditions.

The sensors characteristics and positions on the buoys should be precisely documented.

Calendar and descriptions of installation operation and inspections should be communicated beforehand to involved competitors

## Hydrostatic tests

Before the buoys installations on site, an hydrostatic test can be run in a sheltered area. This test can be conducted following the procedure described in the attached video from the CETMEF (Centre d'Etudes Techniques Maritimes Et Fluviales = State Institute for Maritime and Waterways Studies) (a2012m10-vidéo Buoy inclining test demonstration-avec voix off 01.mp4) or any equivalent method.

See also IALA Guideline No. 1099 (Hydrostatic design of buoys - Edition 1 - May 2013).

This test will give general insights on important hydrostatic parameters:

* Vertical Center of gravity
* Reserve of buoyancy
* Metacentric height (GM)
* Buoy roll period

## On-site test

The following information shall be documented in the test results:

* Buoy location during the test
* Sensors installed (function, characteristics, position on the buoy…)
* Environmental conditions encountered

During intermediate inspection, competitors’ representatives should be invited to attend in order to ensure impartiality of the conclusions drawn.

Raw data shall be available for other IALA members’ consultation.

## Report

Report of the tests shall be written in English to ensure general accessibility of the test results. The different points described in the previous section shall be included in the report, i.e.:

1/ General description of the tested buoys

* Performances tested
* Design parameters (site conditions and buoy general specifications)
* Selected buoy characteristics
* Mooring line installed (and method of selection)
* Sensors used for the tests, position of implantation on the buoys and output data

2/ Results of the hydrostatic test (documented with photos and/or videos)

* Center of gravity
* Reserve of buoyancy
* Metacentric height
* Buoy roll period

3/ Results of the On-site test (documented with photos, videos and/or raw data)

* Parameters tested
* Conditions encountered during the test
* Output (Processed data with description of method + raw data available)
* Report of inspection (with photos and / or videos of maintenance operations) signed by witnesses/attendants
* Fulfillment of design parameters

# References

1. IALA Maritime Buoyage System (MBS)
2. IALA Guideline No. 1099 (Hydrostatic design of buoys - Edition 1 - May 2013)
3. IALA Guideline No. 1066 (The Design of Floating Aid to Navigation Moorings – Ed.1.1-June 2010)
4. IALA Guideline No. 1065 (Aids to Navigation Signal Light Beam Vertical Divergence - Edition 2 - December 2013)
5. IALA Recommendation E-108 (The Surface Colours used as Visual Signals on Aids to Navigation - Edition 3 - May 2013)
6. NORSOK M501 (Coatings System Guide - Published 22/12/2014 version 7)
7. a2012m10-vidéo Buoy inclining test demonstration-avec voix off 01.mp4 – Video from the CETMEF presenting the procedure for Practical Measurements of hydrostatic characteristics

# Action requested of the Committee

The Committee is requested to:

1. Establish an assessment worksheet for on-site tests
2. Discuss on critical parameters to consider for buoy selection
3. Discuss on performance ranges concerning stability parameters such as roll period, max roll angle, accelerations…

1. Input document number, to be assigned by the Committee Secretary [↑](#footnote-ref-1)
2. Leave open if uncertain [↑](#footnote-ref-2)