

## IMO Manoeuvring trials

Manoeuvrability is essential for safe navigation and operation of all ships. Requirements and regulations as to the manoeuvre capacity have been issued by International Maritime Organization (IMO) and adopted by the national regulatory authorities. Assessment of manoeuvring capacity starts with a prediction in the design stage and it can be measured with a ship model. But the manoeuvrability always has to be confirmed with full scale tests in order to comply with the IMO requirements.

### Services:

- Verification of manoeuvring criteria
- Manoeuvring booklet
- Pilot card
- Wheelhouse poster
- Research of manoeuvring characteristics in off-design conditions
- Comparison of performance before and after modifications

### Background

MARIN offers a unique full scale consulting and monitoring service, and has gained considerable experience in a broad field of ship types over the years (e.g. cruise ships, container ships, bulk carriers, navy vessels, working vessels, etc.).

### Onboard verification

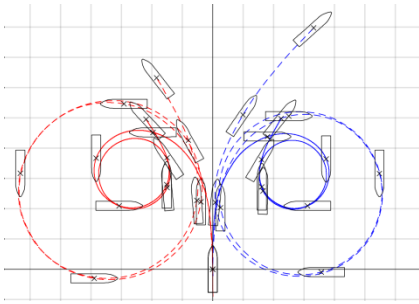
Since final assessment of manoeuvring capacity has to be conducted with sea trials, the MARIN Performance at Sea group operates an advanced sea trial measurement system. This system combines accurate sensor techniques with modern data acquisition software which enables onboard processing and presentation of the full scale trial results directly after the trials.

### Measurement system

For high quality data and rapid analysis of the results, a dedicated measurement system is installed onboard to record the following parameters continuously and synchronously:

- Position, Speed, Heading and Course over ground (D-PGS)
- Rate of turn (motion sensor)
- Roll angle (motion sensor)
- Rudder angle / thruster angle / pod angle
- RPM, torque and power on propeller shaft(s)
- Relative wind speed and direction





### Related products:

- Sea trial acceptance tests
- Speed/power trials
- Propeller cavitation observations
- Noise & vibration measurements
- MARIN consultancy

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All signals are synchronized and logged in one data acquisition computer. During the trials the data acquisition computer gives real-time graphics of all main parameters during the trial (sailed track, heading, rudder angle, rate of turn, shaft power, etc.).

## Results

Results of the trials are used to provide the manoeuvring characteristics in compliance with IMO or other reference criteria. The deliverables comprise a detailed report, pilot card and/or wheelhouse poster.

### M/V SHIPNAME

### Manoeuvring Information

Cell sign: NIRAM

IMO no: 1234567

#### Main dimensions

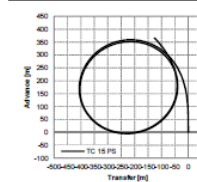
|                              |          |
|------------------------------|----------|
| Length overall               | 114.00 m |
| Length between pp.           | 103.50 m |
| Breadth extreme              | 19.70 m  |
| Summer freeboard draught     | 4.00 m   |
| Displacement at SP (50-100‰) | 3767 MT  |
| Deadweight (50-100‰)         | 694 MT   |
| Gross tonnage                | ~4012 -  |
| Net tonnage                  | ~1204 -  |

#### Draught at which the manoeuvring data was obtained

|               |         |
|---------------|---------|
| Draught on PP | 3.63 m  |
| Draught on AP | 3.61 m  |
| Displacement  | 3231 MT |

#### Turning Circle Port

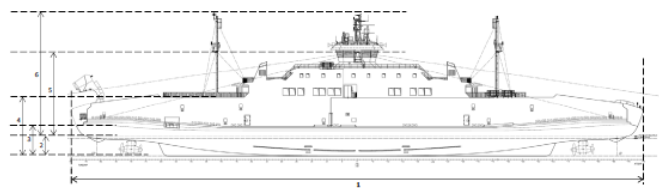
|                   |            |
|-------------------|------------|
| Trial Date        | 144 kn     |
| Initial speed     | 144 kn     |
| Steering angle    | 10 degrees |
| Tactical diameter | 401 m      |
| Advance           | 251 m      |
| Transfer          | 124 m      |
| Drift angle       | 34 degrees |



#### Disclaimer

The response of M/V SHIPNAME may be different from that listed below in conditions other than during the sea trials. The characteristics of the turning circles and zig-zag manoeuvres are valid for steering with the aft thruster only.

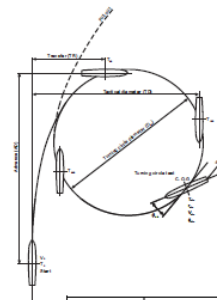
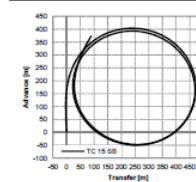
Manoeuvring information provided by



| No | Description              | Value    | No | Description                                    | Value   |
|----|--------------------------|----------|----|--|---------|
| 1  | Length overall           | 114.00 m | 4  | Depth to passenger deck                        | 11.05 m |
| 2  | Summer freeboard draught | 4.00 m   | 5  | Cybernet above waterline (at SP draught)       | 17.1 m  |
| 3  | Depth to main deck       | 6.00 m   | 6  | Maximum height above waterline (at SP draught) | 23.5 m  |

#### Turning Circle Starboard

|                   |            |
|-------------------|------------|
| Trial Date        | 142 kn     |
| Initial speed     | 142 kn     |
| Steering angle    | 13 degrees |
| Tactical diameter | 470 m      |
| Advance           | 360 m      |
| Transfer          | 204 m      |
| Drift angle       | 13 degrees |



#### Propulsion / steering particulars

|                        |                               |
|------------------------|-------------------------------|
| Installed power        | 2 x 3510 kW                   |
| Propeller type         | Steerplan SP 42 CDF           |
| Max rpm propeller      | 2042 rpm                      |
| Max steering angle     | 100 degrees                   |
| Time head over stern   | 100 to 300 7.5 seconds        |
| Stg)                   |                               |
| Position direction     | From propeller (right-handed) |
| Propeller forward      | Aft propeller (left-handed)   |
| thruster               |                               |
| Position direction     | From propeller (right-handed) |
| Propeller aft thruster | Aft propeller (left-handed)   |

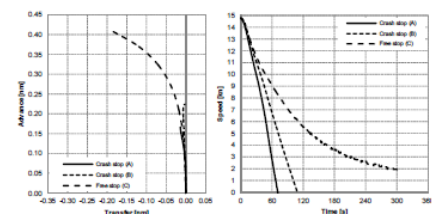
#### Anchor chain

|                 |                         |
|-----------------|-------------------------|
| Type            | Steel rope (S-2016-NIR) |
| Length          | 440.5 m                 |
| Performer chain | 6.5 m                   |

| Lever setting fwd and aft | E-motor speed | Propeller speed | Power per thruster | Ship speed |
|---------------------------|---------------|-----------------|--------------------|------------|
| 1                         | 500 rpm       | 85 rpm          | 190 kW             | 6.5 kn     |
| 2                         | 720 rpm       | 123 rpm         | 370 kW             | 9.4 kn     |
| 3                         | 960 rpm       | 146 rpm         | 570 kW             | 11.2 kn    |
| 4                         | 960 rpm       | 160 rpm         | 765 kW             | 12.6 kn    |
| 5                         | 1050 rpm      | 179 rpm         | 1020 kW            | 13.8 kn    |
| 6                         | 1130 rpm      | 192 rpm         | 1250 kW            | 14.8 kn    |
| 7                         | 1190 rpm      | 203 rpm         | 1420 kW            | 15.6 kn    |
| 8                         | 1200 rpm      | 204 rpm         | 1515 kW            | 15.7 kn    |
| 9                         | 1200 rpm      | 204 rpm         | 1615 kW            | 15.7 kn    |
| 10                        | 1200 rpm      | 204 rpm         | 1615 kW            | 15.7 kn    |

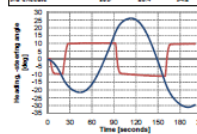
#### Crash stop / Free stop

| Trial Date    | A: Crash stop by turning both thrusters | B: Crash stop by turning one thruster 180 degrees | C: Free stop by pulling the lever to zero |
|---------------|---|---|---|
| Initial speed | 14.0 kn                                 | 14.7 kn   | 14.9 kn                                   |
| Time reach    | 0.040 sec                               | 0.028 sec   | 0.020 sec                                 |
| Advance       | 0.040 m                                 | 0.028 m   | 0.042 m                                   |
| Transfer      | 0.028 m                                 | 0.005 m   | 0.005 m                                   |
| Stopping time | 1.12 min:sec                            | 1.47 min:sec                                      | 5.20 min:sec                              |



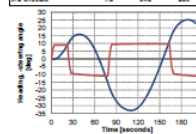
#### Zig-zag 10/10 port, 13.9 knots

| Trial Date  | Steering angle [deg] | Overhoot angle [deg] | Overshoot time [sec] |
|-------------|----------------------|----------------------|----------------------|
| 1st execute | 9.7                  | 123                  | 20.8                 |
| 2nd execute | 10.1                 | 129                  | 24.7                 |
| 3rd execute | 10.5                 | 204                  | 34.2                 |



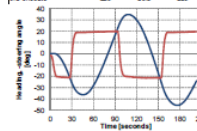
#### Zig-zag 10/10 starboard, 13.9 knots

| Trial Date  | Steering angle [deg] | Overhoot angle [deg] | Overshoot time [sec] |
|-------------|----------------------|----------------------|----------------------|
| 1st execute | -9.9                 | 6.9                  | 36.5                 |
| 2nd execute | -10.4                | 10.8                 | 32.3                 |
| 3rd execute | -9.8                 | 14.0                 | 26.5                 |



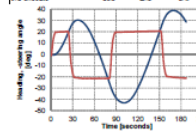
#### Zig-zag 20/20 port, 13.8 knots

| Trial Date  | Steering angle [deg] | Overhoot angle [deg] | Overshoot time [sec] |
|-------------|----------------------|----------------------|----------------------|
| 1st execute | 20.9                 | 114                  | 13.0                 |
| 2nd execute | 19.5                 | 123                  | 14.9                 |
| 3rd execute | 23.3                 | 200                  | 22.5                 |



#### Zig-zag 20/20 port, 14.1 knots

| Trial Date  | Steering angle [deg] | Overhoot angle [deg] | Overshoot time [sec] |
|-------------|----------------------|----------------------|----------------------|
| 1st execute | -19.0                | 13.7                 | 15.7                 |
| 2nd execute | -21.4                | 17.5                 | 20.2                 |
| 3rd execute | -20.1                | 15.0                 | 17.5                 |



Example of a wheelhouse poster