



CESNI (18) 41
25 April 2018
Or. en fr/de/nl/en

EUROPEAN COMMITTEE FOR
DRAWING UP STANDARDS
IN THE FIELD OF INLAND NAVIGATION

Draft standards for technical and functional requirements applicable to vessel-handling simulators and radar simulators

Communication from the Secretariat

According to Article 21(2) of Directive (EU) 2017/2397 on the recognition of professional qualifications in inland navigation the Commission is empowered to adopt delegated acts in accordance with Article 31 to supplement the Directive by laying down standards for the approval of simulators, specifying the minimum functional and technical requirements and the administrative procedures in this regard, with the objective of ensuring that the simulators used for an assessment of competences are designed in such a way as to allow for the verification of the competences as prescribed under the standards for practical examinations referred to in Article 17(3).

CESNI experts examined the annexed draft on 10 April 2018 and decided to put it on the agenda of the CESNI meeting on 8 November 2018 for adoption.

Annex

Draft standards for technical and functional requirements applicable to vessel-handling simulators and radar simulators

Technical and functional requirements for simulators in inland navigation

| | Item | Quality level of technical requirement | Test procedure | Vessel handling simulator | Radar simulator |
|-----|--|---|---|----------------------------------|------------------------|
| 1. | Inland navigational radar installation | At least one inland navigational radar installation with the same functionalities as a type approved inland navigational radar installation according to ES-TRIN has to be installed on the simulator. | It has to be verified if the installation has the same functionalities as the type approved inland navigational radar installation. | x | x |
| 2. | Communication system | The simulator shall be fitted with a communication system comprising <ul style="list-style-type: none"> – an alternative internal telephone link and – two independent inland waterway radio communication systems. | It has to be verified if the simulator is fitted with communication systems. | x | x |
| 3. | Inland ECDIS | At least one Inland ECDIS has to be installed on the simulator. | It has to be verified if the installation has the same functionalities as an Inland ECDIS. | x | |
| 3.a | Exercise area | The exercise area contains at least a representative river with side arms or canals and harbours | Visual inspection of the area | x | x |
| 4. | Sound signals | Sound signals can be given using foot pedals or buttons. | It has to be verified if foot pedals or buttons function correctly. | x | x |
| 5. | Night time navigation lights panel | Night-time navigation lights panel is installed on the simulator. | It has to be verified if night time navigation lights panel functions correctly. | x | x |

| | Item | Quality level of technical requirement | Test procedure | Vessel handling simulator | Radar simulator |
|-----|---|---|---|---------------------------|-----------------|
| 6. | Mathematical models for craft | At least three mathematical models of representative types of craft with different methods of propulsion and loading conditions including one small craft which could be a tug, one medium sized craft (e.g. 86 m length) and one large craft (e.g. 110 or 135 m length). | It has to be verified if the three mandatory models are available. | x | |
| 6.a | Mathematical models for craft | At least one mathematical model of representative type of craft (e.g. 86 m length). | It has to be verified if the mandatory model is available. | | x |
| 7. | Number of available target craft ¹ | The simulator shall include target craft of at least 5 European Conference of Ministers for Transport (CEMT) classes. | It has to be verified if the required number and variety of target craft is available. | x | x |
| 8. | Operator station | The operator shall be able to communicate on all very high frequency (VHF) channels. The operator has to be able to monitor the use of the channels. | It has to be verified if the operator can communicate on all VHF channels and if the operator can monitor the use of all channels. | x | x |
| 8.a | Various exercises | There shall be a possibility to create, store and run various exercises, which shall be manipulable while running. | Different operations shall be performed. | x | x |
| 8.b | Separable exercises | During examination of more than one applicant, the applicants' exercises shall not interfere with the examination of another applicant. | The exercise shall be replayed for each applicant. | x | x |
| 9. | Craft's bridge functions and layout | The wheelhouse section shall be designed for radar navigation by one person as set out in ES-TRIN 2017/1. | It has to be verified if the bridge layout and equipment functions correspond to the applicable technical requirements for inland waterway craft. It has to be verified if the wheelhouse is designed for one person steering operations. | x | x |

¹. A target craft is fully controlled by the simulator and may have much simpler motion behaviour as an own craft.

| Nr | Item | Quality level of technical requirement | Test procedure | Vessel handling simulator | Radar simulator |
|-----|-----------------------------------|--|--|---------------------------|-----------------|
| 10. | Steering station (bridge/cubicle) | Steering stations resemble those aboard inland craft as regards form and dimensions. | Visual inspection. | x | x |
| 11. | Operator station | <ol style="list-style-type: none"> 1. There shall be a separate room in which operator(s) and examiner(s) can be seated, where the examiner must be able to perceive the radar image of the applicant. 2. The wheelhouse and operator space must be separate from each other. They shall be as much soundproof as possible. 3. The operator must be able to operate at least two VHF channels at the same time. 4. The operator must be able to clearly identify which radio communication channel the applicant is using. | Visual inspection of the operator station and functionality check. | x | x |
| 12. | Briefing/Debriefing station | Possibility for replay at an operator or debriefing station. | Assessment activities have to be monitored. | x | x |

| Nr | Item | Quality level of technical requirement | Test procedure | Vessel handling simulator | Radar simulator |
|------------------------|--------------------|--|---|---------------------------|-----------------|
| Own craft ² | | | | | |
| 13. | Degrees of freedom | The simulator shall be able to visualize the motion in six degrees of freedom. | <p>The degrees of freedom implemented in the simulator can be evaluated by observing the visualization system or by instruments. Therefore, the following manoeuvres are carried out using small craft which usually move more distinctively and faster than bigger ones.</p> <ul style="list-style-type: none"> – If the horizon is swinging when looking forward during navigating along curves, the roll motion is implemented. – If the craft's bow raises and drops with strong longitudinal accelerations, the pitch motion is implemented. – If the echo sounder display changes when running at higher speeds at constant water depth, the heave motion is implemented. This test implies the modelling of the squat effect. | x | |
| 13.a | Degrees of freedom | The simulator shall be able to simulate the motion in three degrees of freedom. | The degrees of freedom implemented in the simulator have to be evaluated. | | x |
| 14. | Propulsion system | The simulation of all components of the propulsion system is carried out close to reality and considers all relevant influences. | The propulsion system has to be tested by acceleration and stopping manoeuvres during which the performance of the engine (in terms of reaction to throttle) and craft (in terms of maximum speed and time behavior) can be observed. | x | x |

² An own craft is an object in the simulator which is fully controlled by a human being and provides a visual representation of the scenario.

| Nr | Item | Quality level of technical requirement | Test procedure | Vessel handling simulator | Radar simulator |
|-----------|-----------------|--|---|----------------------------------|------------------------|
| 15. | Control devices | The control device behaves close to reality regarding the rudder rate of turn and considers the most important influences. | <p>To test the quality of the simulation of control devices, different investigations can be carried out. Limitations are given where it is not possible to evaluate the behaviour without protocols of state variables.</p> <ul style="list-style-type: none">– Reaction: The control device is used in forward and backward motion. It is observed if changes of the craft's direction are initiated.– Rudder rate of turn: The control device is used and the rate of turn is observed on the display. It can be measured if the rate is realistic. | x | x |

| Nr | Item | Quality level of technical requirement | Test procedure | Vessel handling simulator | Radar simulator |
|-----|-----------------------|---|---|---------------------------|-----------------|
| 16. | Shallow water effects | The effect of limited water depth on the power demand and the manoeuvring behavior is modelled correctly in terms of quality. | <p>Two types of tests are proposed which allow judging the quality regarding the consideration of the shallow water influence:</p> <p>Running straight ahead: on different water depths the achieved maximum speed is measured, standardized with the speed on deep water and plotted versus the parameter draught by water depth (T/h). The comparison with existing data from model tests gives information about the quality of the shallow water influence in the simulation.</p> <p>Turning circle: by running a craft at constant power and a rudder angle of 20° on lateral unrestricted water, the stationary values of speed, drift angle, rate of turn and turning circle diameter can be recorded on stepwise reduced water depth. Plotting this data versus T/h allows determining how drift angle, rate of turn, speed and the diameter change with the water depth.</p> | x | |

| Nr | Item | Quality level of technical requirement | Test procedure | Vessel handling simulator | Radar simulator |
|-----|----------------------|---|---|---------------------------|-----------------|
| 17. | Influence of current | At least two current measuring points on the craft exist so that the current yaw moment can be calculated. | <p>Tests are planned to check the existence of the performance characteristic and its consideration in the simulation:</p> <ul style="list-style-type: none"> – An own craft without propulsion is put into a river with existing current. It is observed whether the craft is taken by the current. Besides, it is checked whether it is accelerated up to the current speed. If the current follows the river direction, it will be checked further whether the craft slightly rotates. – A trial with the port entrance from a river with current shows, to what extent the simulator realistically calculates a yawing moment generated by the inhomogeneous current. | x | x |
| 18. | Influence of wind | The wind influence generates forces in the horizontal plane according to the actual wind speed and direction. The wind also generates yaw and roll moments. | <p>To check the quality level of the wind influence, different tests can be carried out. To be able to easily detect these effects, relatively high wind speeds are to be chosen.</p> <p>Execute the test as follows: conduct a test for both head-wind and side-wind in two different wind speeds in an area with no influence but wind. Start the wind and notice the behavior. Stop the wind and notice the behavior again. Start with a non-moving craft.</p> | x | |

| Nr | Item | Quality level of technical requirement | Test procedure | Vessel handling simulator | Radar simulator |
|-----|-------------------------|---|---|---------------------------|-----------------|
| 19. | Bank effect | The lateral force and yaw moment tend to change with distance to the bank and speed in a proper manner. | <p>For checking the bank effect in the simulator an exercise area is needed which provides an embankment or wall on one side. The following tests have to be carried out:</p> <ul style="list-style-type: none"> – The craft is running parallel along the wall. It is checked, whether the straight motion is affected and if the craft is attracted by the wall and if the bow turned away from it. – The distance to the bank or wall and the speed of the craft are varied and it is observed how the effects change. | x | |
| 20. | Craft-craft interaction | Craft are interacting with each other and realistic effects are computed. | <p>For an entire check of the craft-craft interaction an exercise with two own craft should be started on the simulator in a lateral unrestricted water. If this is not possible, the test can also be carried out using a traffic craft as the other craft. For a good assessment of the results, the craft should start in parallel courses at a relatively small lateral distance.</p> <ul style="list-style-type: none"> – For both overtaking and encountering it will be checked to which extent the own craft shows attraction and rotation. – The water depth is reduced. It will be checked, if the interaction effects increase. – The distance between the craft will be increased to find out, if the effects decrease. – The speed of the other craft will be increased. The functional relation between passing craft effect and encountering speed is checked. | x | |

| Nr | Item | Quality level of technical requirement | Test procedure | Vessel handling simulator | Radar simulator |
|-----|--------------|---|---|---------------------------|-----------------|
| 21. | Squat | Both dynamic sinkage and trim are modelled in dependency of the speed, water depth and draught. | <p>This feature is best tested in an area with lateral unrestricted water and constant water depth.</p> <ul style="list-style-type: none"> – A trial run has to show if the feature “squat” can be checked using echo sounders. – Different values for the under keel clearance at bow and stern show whether the craft trims. – With increasing speed the functional relation between squat (difference between under keel clearance during standstill and motion) and craft speed is checked. – It is tested whether the squat increases at constant speed but decreasing water depth. | x | |
| 22. | Canal effect | Consideration of the current back flow. The back flow is not linear to the craft speed. | <p>Back flow is a physical effect brought in the simulator as a resisting force executed on the craft. To test this, a craft is put in a narrow canal, the ship runs steady with constant power. The speed is then measured. The power is increased and the speed is measured. The test is repeated in open water with the same constant power (two levels) is applied. The effect that should be seen is:</p> <ul style="list-style-type: none"> – The speed in the narrow canal is less than in open waters at the same power setting. – On a larger power setting, the speed difference is bigger than on a lower power setting. | x | |

| Nr | Item | Quality level of technical requirement | Test procedure | Vessel handling simulator | Radar simulator |
|-----|-------------|---|---|---------------------------|-----------------|
| 23. | Lock effect | In a lock the craft experiences the same effects as in a canal. The lock causes an additional effect due to a displacement flow caused by the craft with a large blockage factor entering the lock (the piston effect). | <p>The test for the canal effect shows the back flow. This test does not have to be repeated. The piston effect can be demonstrated by:</p> <ul style="list-style-type: none"> – Take the craft into the lock at a relatively high speed. The craft should experience additional resistance after entering the lock (slow down). When the propulsion is stopped the reversing forces should still be available and the craft should reverse slightly. – Start in the lock, set propulsion to a fixed setting. The craft will leave the lock, experience a resisting force due to the piston effect. After leaving the lock (the craft free of the lock) the resisting force should stop, shown by a sudden increase in speed that can be noted. | x | |

| Nr | Item | Quality level of technical requirement | Test procedure | Vessel handling simulator | Radar simulator |
|------|---|---|---|---------------------------|-----------------|
| 24. | Grounding | Grounding slows the craft down, it can be heard by a sound but does not lead in all cases to the craft stopping. Grounding is notified to the operator. | <p>An exercise area with an even as well as a softly rising bottom is necessary for the check of grounding. Here, the existence of suitable depth information in the simulator itself is addressed and not the representation in the visualization system.</p> <p>When grounding on a beach it has to be tested whether the craft really stops, and if so whether it stops abruptly or it slows down.</p> <p>During grounding, the change of the horizontal plane of the craft has to be checked with the visualization system.</p> <p>Running over a flat bottom at extreme shallow water, it has to be tested whether the craft grounds due to squat while the speed is increased continuously.</p> <p>For all groundings it has to be checked, if this incident is accompanied by a sound.</p> | x | |
| 24.a | Grounding Collision craft-shore Collision craft-craft Collision craft-bridge | A grounding, a collision craft- shore, craft-craft, craft or bridge are notified in the simulation to the candidate and the operator. | Visual inspection | | x |

| Nr | Item | Quality level of technical requirement | Test procedure | Vessel handling simulator | Radar simulator |
|-----|-----------------------|---|---|---------------------------|-----------------|
| 25. | Collision craft-shore | Collisions craft-shore are notified in the simulation at least by a sound. The simulation slows the craft down. The calculation of the collision is carried out using a 2-dimensional shape of the craft. | <p>Only for exercise areas with different objects on the shore the simulation of the collision craft-shore can be tested.</p> <p>By sailing against different objects it can be found whether the simulator can detect these and react on them.</p> <p>For different objects it should be tested whether there are certain types, for which no collision reaction occurs.</p> <p>The sound for the collision can be tested with the audio system of the simulator, if available.</p> <p>The observation of the collision in the visualization system shows whether the collision occurs abruptly or if a crumble zone is simulated.</p> <p>A collision with a flat angle at low speed can show whether an elastic push is computed.</p> | x | |

| Nr | Item | Quality level of technical requirement | Test procedure | Vessel handling simulator | Radar simulator |
|-----|-----------------------|--|---|---------------------------|-----------------|
| 26. | Collision craft-craft | Collisions craft –craft are notified in the simulation at least by a sound. The simulation slows the craft down. The calculation of the collision is carried out using a 2-dimensional shape of the craft. | <p>Under the precondition that it makes no difference for the own craft whether the other craft it is colliding with is another own craft or a traffic craft, different collisions can be carried out.</p> <p>It is checked which reaction occurs on the simulator during a craft-craft collision for the own craft and whether a sound can be noticed.</p> <p>In the instructor station, it is checked with sufficient magnification, if the outlines of the craft are used for the collision detection.</p> <p>It is tested, if the collision occurs exactly at that moment, when the outlines touch each other.</p> <p>It is checked, if there is a precise detection of the collision also for various craft with different shapes.</p> | x | |

| Nr | Item | Quality level of technical requirement | Test procedure | Vessel handling simulator | Radar simulator |
|-----|------------------------|---|--|---------------------------|-----------------|
| 27. | Collision craft-bridge | Collisions craft-bridge are detected using a static height value (corresponding to a lowered wheelhouse, lowered mast). Collisions are notified in the simulation at least by a sound. The simulation slows the craft down. | <p>To examine this achievement, a bridge must exist in the exercise area and Inland Electronical Navigation Chart is used.</p> <p>It is checked whether during the passage of a bridge with not enough clearance a collision occurs and what is the outcome for the further simulation.</p> <p>It is checked whether a safe passage is possible with sufficient reduction of the water level or increase of the draught. This should also be checked in the visualization system.</p> <p>Different runs are necessary to check the collision point on the ship, if only one exists. In this case it can also be localised whether the bridge causes a collision in the centre line or in the outer boundaries.</p> | x | |

| Nr | Item | Quality level of technical requirement | Test procedure | Vessel handling simulator | Radar simulator |
|-----|--------------------|--|---|---------------------------|-----------------|
| 28. | Lifting wheelhouse | Collision height and eye point are adaptable to the position of the bridge. A continuous motion of the lifting wheelhouse is available. | <p>A precondition for testing this performance feature is the availability of a typical inland waterway craft, e.g. a craft of 110 m length.</p> <p>The basic availability of this functionality can be checked by the presence of an operating device for the change of the bridge position.</p> <p>The function can be tested on the bridge and it will be checked, whether arbitrary positions can be chosen and whether the motion is abrupt or with realistic speed.</p> <p>By positioning another own craft in the vicinity it can be tested whether this functionality is also available for other craft in the visualization system.</p> <p>It can be observed whether also navigational lights and day signs move according to the motion of the lifting wheelhouse of the second own craft in the visualization system.</p> | x | |
| 29. | Ropes | The visualization system displays the dynamics of both the craft and the rope (e.g. slack, elasticity, weight and breaking and connections to the bollard points). | <p>In an exercise area with a quay wall, mooring with a rope has to be tested.</p> <p>When using the rope, it has to be checked whether the rope connects to certain bollard points.</p> <p>The breaking of a rope has to be checked by trying to stop the craft with a rope from full speed</p> <p>The slack of a rope has to be checked by decreasing force and distance.</p> | x | |

| Nr | Item | Quality level of technical requirement | Test procedure | Vessel handling simulator | Radar simulator |
|-----|---------|---|--|---------------------------|-----------------|
| 30. | Anchors | Anchors can be set and hauled in. The water depth and the dynamics of the chain are considered. | <p>In an exercise area with restricted water depth and an own craft with one or several anchors, the anchor function can be examined. It is reasonable, if a constant current with a variable velocity is available.</p> <p>Setting and hauling in of the anchor is only possible if appropriate operating elements exist. It has also to be checked whether there are instruments indicating the chain length.</p> <p>It is checked whether the speeds differ while setting and hauling in. Besides, it has to be also found out whether a suitable sound can be heard.</p> <p>By variation of the water depth it has to be checked, if the water depth has an influence on the anchor function.</p> <p>At low current velocity, it has to be tested whether the craft is oscillating and coming to halt after anchoring.</p> <p>At continuous increase of the current, it has to be tested, if the anchor holds the craft.</p> <p>If a single anchor does not hold, it has to be checked, if the craft halts with two anchors when two anchors are used.</p> | x | |

| Nr | Item | Quality level of technical requirement | Test procedure | Vessel handling simulator | Radar simulator |
|-----|--------------------------------------|--|---|---------------------------|-----------------|
| 31. | Towing (operation between two craft) | While towing, the dynamics of both craft and the rope connection are considered. | <p>The exercise area for checking of the towing function can be an open sea area. Besides the towing or towed own craft, another craft (own craft or traffic craft) is necessary.</p> <p>The basic condition for towing can be tested by bringing out a towing line between an own craft and the other craft.</p> <p>If this is not possible, it has to be checked whether at least an alternative method for defining a force coming from a virtual tug is given.</p> <p>It is checked whether the other craft, used as towing assistance, can accelerate the towed own craft and also initiate a yaw motion by a lateral pull.</p> <p>It is checked whether the towing own craft can move the other craft by suitable manoeuvres and stop it and whether the other craft also can be brought into rotation by a lateral pull.</p> | x | |

| Nr | Item | Quality level of technical requirement | Test procedure | Vessel handling simulator | Radar simulator |
|---------------|---------------------------------------|--|---|---------------------------|-----------------|
| Traffic craft | | | | | |
| 32. | Quantity of traffic craft | A minimum of ten traffic craft shall be available. | Test has to show if the required quantity can be inserted in an exercise. | x | x |
| 33. | Control of traffic craft | The traffic craft can follow routes with change of course and speed in a realistic way. | The availability of control functions has to be checked by creating a new exercise including traffic craft. | x | x |
| 34. | Motion behaviour | Reasonably smooth motion behaviour. | The test procedure on control of traffic craft applies. | x | x |
| 35. | Influence of the wind | The traffic craft reacts to a given wind by showing a drift angle. | Wind applied to an exercise has to show a drift angle on the traffic craft changing with the speed and the direction of the wind. | x | |
| 36. | Influence of the current | The traffic craft reacts to a given current by showing a drift angle. | Current applied to an exercise has to show a drift angle on the traffic craft changing with the speed and the direction of the current. | x | x |
| 37. | Image section and size | The visualization system allows a view around the horizon (360 degrees). The horizontal field of view may be obtained by a fixed view of at least 210 degrees and additional switchable view(s) for the rest of the horizon. The vertical view allows the view down to the water and up to the sky as it would be seen from the regular steering position in the wheelhouse. | Visual inspection of the running simulator. | x | |
| 38. | Resolution by frame | The resolution reaches the resolution of the human eye. The frame rate (ideally > 50 fps, at least showing a realistic smooth picture) reveals no jerking. | Resolution has to be checked by visual inspection. | x | |
| 39. | Further detailing and display quality | The level of detail of the display system goes beyond a simplified representation. It shows a good view of the navigational area under all circumstances. | The visual model has to be checked by visual inspection. | x | |

| Nr | Item | Quality level of technical requirement | Test procedure | Vessel handling simulator | Radar simulator |
|-----|--|--|---|---------------------------|-----------------|
| 40. | Water surface | Craft induced waves depend on the craft's velocity. Water depth is considered. Wind induced waves comply with wind direction and speed. | The visual inspection has to show whether the craft induced waves change with the craft's speed and whether the wind induced waves change with wind direction and speed. | x | |
| 41. | Sun, moon, celestial bodies | Sun and moon follow a 24-hour interval. The positions do not exactly correspond to place and date of the simulation. The night sky may consist of arbitrary stars. | The visual inspection has to show whether the sun, moon and celestial bodies in day, night and twilight situations can be modified | x | |
| 42. | Weather | Stationary high cloud layers are represented. Furthermore rainfall, haze and fog can be displayed. | The visual inspection shows the required level of detail. | x | |
| 43. | Ambient noise | Engine noises are reproduced in a realistic manner. | The engine noises have to be tested in quiet weather and sea conditions by assessing the noises for all engine speeds. It has to be determined if the engine sound is audible and if volume level and sound are appropriate. | x | x |
| 44. | External noise sources (e.g. engine noises, audible warning signals and anchor). | Single sound signals are played in a realistic way, but cannot be located acoustically. | As a first step on the wheelhouse of the stationary own craft, all available sound signals are activated one after the other. It is assessed whether the sound signals are realistic regarding sound and volume levels. In a second step, the same sound signals are activated on another craft, whereas the distance to the craft is modified. It has to be examined, if the correct signal sounds and if the volume levels are played in the right way. All operable auxiliary power units (e. g. anchors) on craft's wheelhouse are activated separately. It has to be verified whether the operating status is acoustically perceivable. | x | |
| 44a | External noise (sound signals) | Sound signals from target craft shall be hearable. | During an exercise a sound signal from a target craft shall be given. | | x |

| Nr | Item | Quality level of technical requirement | Test procedure | Vessel handling simulator | Radar simulator |
|-----|-------------------------------|---|--|---------------------------|-----------------|
| 45. | Internal acoustic information | Acoustic signals from bridge devices sound realistically, but are played by speakers located on the console of the simulator. | All acoustic signals of all available wheelhouse devices are activated one after the other. It is tested whether the signals are emitted by the devices themselves or by the speakers of the simulator and how far they sound realistic. | x | |
| 46. | Listening | The operator is able to listen to all noises from the craft's wheelhouse. | Within the scope of a simulation it has to be tested whether sounds from craft's wheelhouse are transmitted clearly and understandably and if the volume level is adjustable. | x | |
| 47. | Recording | Sounds from craft's wheelhouse are recorded synchronously with the simulation. | An exercise is executed including radio communication and sounds. Replay must show a proper audible recording synchronously with the replay of the simulation. | x | |
| 48. | Radar conformity | The angular accuracy for horizontal bearing shall be in accordance with European Technical Specification (ETSI) EN 302 194. Effects related to the vertically limited opening angle are identifiable e.g. when passing bridges. | Conformity "vertical": simulation of bridge passage with consideration of: <ul style="list-style-type: none"> - the height of the antenna above the water surface at current draught, - the radiation angle in accordance with the radar lobe and the trim of the craft, - the height of the bridge between lower edge of the bridge and the water surface. | x | x |
| 49. | Resolution | The radar simulation shall create a realistic radar image. The radar simulation shall meet the requirements of ETSI EN 302 194 [1]. | Proper resolution has to be demonstrated at a distance of 1200 m: two objects with an azimuthal distance of 30 m have to be identified as two separate objects. Two objects at a distance of 1200 m in the same direction with a distance of 15 m between them have to be identified as two different objects. | x | x |

| Nr | Item | Quality level of technical requirement | Test procedure | Vessel handling simulator | Radar simulator |
|-----|--|--|---|---------------------------|-----------------|
| 50. | Shadowing caused by own or other craft | Shadowing corresponds to the trigonometric relations, but do not consider changes of the dynamic position of craft. | <p>The shadowing caused by own craft has to be tested by approaching a buoy and identifying the distance when the buoy is hidden by the craft's bow. This distance should be realistic.</p> <p>The shadowing caused by other craft has to be tested by putting two craft in the same direction. When putting a smaller craft behind a larger craft, the smaller craft should not appear on radar display.</p> | x | x |
| 51. | Sea and rain clutter | The adjustment of filters and their effect correspond to the magnitude of real approved devices. | An assessment is done by switching on and adjusting the filters. | x | x |
| 52. | False echoes | False echoes are generated. Additionally, the frequency of multiple echoes changes with the distance in a realistic manner. | In an exercise with multiple target craft, false echoes should be visible. During the test, the observer has to look for interference and multiple echoes. | x | x |
| 53. | Water depth | The bottom topography is described in detail by bathymetric contours and soundings or in any other form in a high resolution, as far as data is available. | When sailing through the area to be inspected, it has to be checked whether the echo sounder shows realistic values. | x | |
| 54. | Current | The current can be arbitrary defined by at least 2-dimensional vector fields with a high resolution adapted to the craft size and the area. | The effect of current has to be tested by letting an own craft drifting on a river. The craft shall move with the current in a realistic way. | x | x |

| Nr | Item | Quality level of technical requirement | Test procedure | Vessel handling simulator | Radar simulator |
|-----|---------------------------------------|--|---|---------------------------|-----------------|
| 55. | Tide | Tidal data is given in a coarse spatial and/or temporal resolution. | The effect of the tide on floating objects can be evaluated by simulating a preferable small floating object without any propulsion or other forces (e.g. from wind or ropes). By changing the time of day, it can be checked whether the tidal current and water level are time dependent and realistic. The water level can be directly seen at the echo sounder, and can be recorded for a full day to be compared with measured or calculated data. | x | |
| 56. | Wind | Fluctuations and wind vector fields can be defined and allow local modification. | If an anemometer is "installed" on board the instrument on the bridge should display the relative wind speed and direction. The influence of different wind fields on the craft dynamics has to be tested. | x | |
| 57. | 2D/3D models of stationary objects | 2D replacements of objects are only allowed for objects far away and are not recognized. | While a craft is moving in the whole simulation area that has to be validated, fixed objects are observed. It can be found, at which distance and in which way the level of detail is reduced and whether 2D-modells are used. | x | |
| 58. | Level of detail of stationary objects | A good level of detail can appear realistic objects, although simplifications are recognizable in shape and surface. | The training area to be assessed will be loaded and an own craft is set. It is first necessary to examine whether all navigationally important objects are identified. The scenery must at first glance appear realistic. | x | |

| Nr | Item | Quality level of technical requirement | Test procedure | Vessel handling simulator | Radar simulator |
|-----|--------------------------------------|---|--|---------------------------|-----------------|
| 59. | Day/night models of moveable objects | In the darkness, any object can be illuminated. Navigationally important light sources can emit light at predetermined characteristics. | The training area to be assessed will be loaded and an own craft is set. Simulation time is set to midnight. It has to be tested whether all navigationally important objects are illuminated in the simulation as in reality. Furthermore it has to be tested whether other objects are illuminated. If the simulator software has this feature, the instructor switches the lighting of the intended items on and off. | x | |
| 60. | 2D/3D models of moveable objects | Two-dimensional objects are only used in the background (large distance) so that they are hardly apparent. Otherwise 3D-models are taken. | The training area to be assessed is loaded and an own craft selected. The training area is navigated completely; at the same time the available moveable objects are used, observed and evaluated to determine whether they have flat surfaces turning to the observer. | x | |
| 61. | Level of detail | In case of an improved level of detail realistic objects are presented, though forms and surfaces appear in a simplified way. | An own craft runs within an arbitrarily selected operating area. Assessable moving objects are used. They should appear in a realistic way. | x | |
| 62. | Setting of lights and day signals | The lights and signal shown can be switched individually, i.e. all the lights and signals are separately stored in the database and are positioned according to the requirements of real craft and according to the applicable regulation for the craft used. | In close proximity to a traffic craft an own craft is used in any training area. As far as possible, the operator sets all kinds of day signals and traffic lights aboard the traffic craft. If the simulator allows, a second own craft is used instead of the traffic craft. On the second own craft all kinds of light and day signals are also set. At the steering station of the first own craft it will be checked which light and day signals are visible on both other craft. | x | |

| Nr | Item | Quality level of technical requirement | Test procedure | Vessel handling simulator | Radar simulator |
|-----|--|--|--|---------------------------|-----------------|
| 63. | Day/night models | Light sources can flash according to certain characteristics. | An own craft navigates within an operating area. Simulation time is set to 24:00 h. All assessable moving objects are used. As far as possible, the operator switches on all available light sources installed at the objects for a visual inspection. | x | |
| 64. | Radar reflectivity | The echo in the radar picture shall be realistic and dependent of the viewing angle. | It shall be checked, if reflecting objects show a realistic echo. | x | x |
| 65. | Echoes caused by waves and precipitation | Sea state echoes are stored for typical wave pattern also covering the range of sea state levels. Echoes by precipitation are shown in a realistic manner. | Sea state echoes have to be tested by introducing different wave heights and directions. Precipitation echoes are checked. | x | x |
| 66. | Waves | Sea state and wave direction can be adjusted; the craft moves realistically. | It has to be tested, if the motion of the craft varies according to the sea state. Wave directions and height have to be visible. | x | |
| 67. | Precipitation | All weather conditions (restriction of visibility, precipitation, but with the exception of lightning and cloud formation) are available resulting in a coherent picture. | A visual inspection, if the visibility is reduced, has to be carried out. | x | |
| 68. | Chart display | The Inland ECDIS in information mode has to meet the requirements of the most recent standard published by the European Union or the Central Commission for Navigation of the Rhine (Commission Implementing Regulation (EU) N° 909/2013 or CCNR Inland ECDIS edition 2.3 or its updated edition). | It has to be checked, if the ECDIS software is certified and Inland Electronical Navigation Chart is used. | x | |
| 69. | Measuring units | The simulator uses units for European inland waterway navigation (km, km/h). | The displayed units have to be evaluated. | x | x |

| Nr | Item | Quality level of technical requirement | Test procedure | Vessel handling simulator | Radar simulator |
|-----|----------------------------------|--|---|---------------------------|-----------------|
| 70. | Language options | Language of examination and/or English shall apply. | Language of the instruments has to be checked. | x | x |
| 71. | Quantity of exercises | There shall be a possibility to create, store and run various exercises, which shall be manipulable while running. | Different operations shall be performed. | x | x |
| 72. | Quantity of own craft | For each bridge a different own craft can be loaded. | Demonstration of separate exercises on multiple bridges (if applicable). | x | |
| 73. | Storage data | All simulation values which are necessary to replay the simulation, including video and sound of the performance of the applicant have to be stored. | A simulation run is started and the storage carried out. The simulation is reloaded and reviewed in order to determine whether all relevant data is available from the recorded simulation run. | x | x |
| 74. | Storage of displayed examination | There must be an opportunity for replay in the operator room or at a debriefing station. Radio communication shall be recordable. | The exercise shall be replayed. | x | x |
