

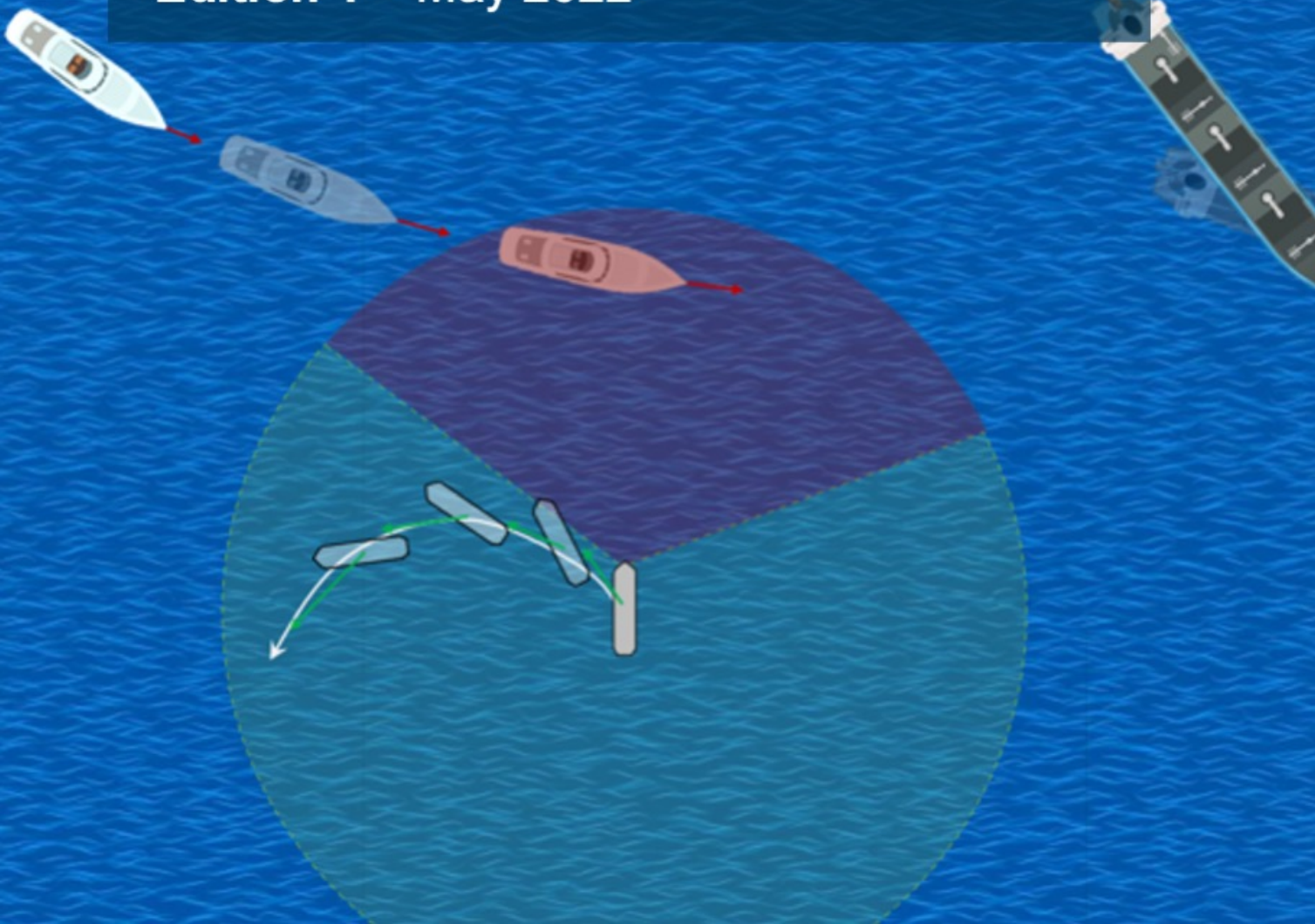


**TRUSTED
AUTONOMOUS
SYSTEMS**

COLREGS Operator Guidance Framework

Translation and application of COLREGs for autonomous
and remotely operated vessels

Edition 1 – May 2022



ANNEX A COLREGS GUIDANCE FRAMEWORK

A1 Framework Use

The framework translates the stated and unstated capabilities described, and the terminology used, in the Rules of COLREGs into a vocabulary and format that is suitable for consideration of autonomous and remotely operated vessels. It is intended to be an enabling framework to:

- Help vessel designers understand what capabilities COLREGs requires vessels to have.
- Help operators understand what capabilities COLREGs requires and how mission planning can mitigate or remove the need for solving some of the more complex elements of COLREGs.
- Help regulators apply a consistent methodology for assessing the capability of a vessel with regards to COLREGs.

A2 Autonomous Surface Vessels (ASVs)

Information provided in the framework can be used by designers and operators to assess the capability of their vessel with regards to COLREGs and the mission types that they are considering. Designers and operators are free to choose whether a specific capability will be provided onboard, remotely through human oversight, or a combination of both.

Where capabilities cannot feasibly be achieved or by preference, then the framework proposes mission constraints which can be implemented to mitigate or eliminate scenario specific risk risks.

A3 Autonomous and Remotely Operated Marine Equipment

Autonomous and Remotely Operated Marine Equipment is a category of vessel that due to its size or form cannot feasibly respond to the Rules of COLREGs. COLREGs does consider this scenario and offers two vessel status exceptions which protect unable vessels from having to give-way, “vessels not under command” and “vessels restricted in their ability to manoeuvre”. This category is aimed at small, slow-moving vessels that are likely to be operating in littoral waters and which pose a low risk to other water users.

A4 Evidence Types Key

EVIDENCE		
Design Checklist	Simulation	Trial
		

Design checklist

This symbol denotes Rules where it is proposed that an element of design appraisal could support a claim of compliance. The functional capabilities and the equipment and systems required to deliver them can be recorded and assessed as meeting the needs of that Rule. It is intended to publish a proforma checklist to assist stakeholders in making consistent judgements.

Simulation and land testing

Simulation is proposed as the primary evidence format used to observe and evaluate the situational awareness and subsequent logical decision making used to control the vessel. It is a readily available, system agnostic, and scalable method of observing system behaviour.

Sea trials

Sea trials are live trials that validate the vessels' ability to action the decisions made to avoid collision as required. The consistent, accurate, correct, and predictable actioning of the appropriate Rule items by the vessel would constitute a successful sea trial. Successful demonstration of these items provides confidence to operators and the broader maritime community that the vessel will act in a COLREGs compliant manner.

A5 COLREGs Guidance Framework

This framework supports a practical and appropriate level of compliance for autonomous vessels. The framework is best viewed as a standalone document with the accompanying key and printed at an A3 size. The COLREGs Guidance Framework is shown on the following page and is also downloadable online.

COLREGS		
Part	Rule	Essence
Part A: General	1 – Application	Definitions of when COLREGS is applicable in national and international waters.
	2 – Responsibility	Compliance with COLREGS is the responsibility of the vessel operator.
	3 – General definitions	Definitions of terms used within COLREGS. Primarily vessel types and situations.
Part B: Steering and sailing rules (Section 1)	4 – Application	Rules in Part B Section 1 apply in any condition of visibility.
	5 – Look-out	Vessels shall always maintain a look-out by sight, hearing and all available and effective means for the circumstances.
	6 – Safe speed	Safe speed shall be an ongoing consideration with due regard to the state of visibility, traffic density, manoeuvrability, weather and water depth. Vessels with radar shall additionally consider radar capability, range scale, interference, the possibility of undetectable hazards.
	7 – Risk of collision	Risk of collision with other vessels shall be an ongoing consideration through systematic observations with due regard to scanty information, unexpected other vessel behaviours or inaction by other give-way vessels.
	8 – Action to avoid collision	Actions taken to avoid a collision shall be effective and confirmed effective until clear. The most effective action is dependent on the situation and shall be proportional to the risk e.g. a minor course change or full-stop.
	9 – Narrow channels	The limitations of other vessels proceeding in a narrow channel, and constraints on situational awareness shall be considered.
Part B: Steering and sailing rules (Section 2)	10 – Traffic separation schemes	Rules and considerations specific to proceeding within or crossing traffic separation schemes.
	11 – Application	Rules in Part B Section 2 apply to vessels in sight of one another.
	12 – Sailing Vessels	Where two sailing vessels are on opposite tacks the vessel on port tack shall keep clear. Where they are on the same tack the windward vessel shall keep clear.
Part B: Steering and sailing rules (Section 3)	13 – Overtaking	Rules and considerations specific to an overtaking situation. The overtaking vessel shall keep clear.
	14 – Head-on situation	Where two power-driven vessels are approaching in a head-on situation, both vessels shall alter course to starboard and pass on the port side.
	15 – Crossing situation	Where two power-driven vessels are crossing, the vessel which has the other on its starboard side shall keep clear, and where feasible cross behind the other vessel.
	16 – Action by give-way vessel	Give way vessels shall take early and substantive action.
	17 – Action by stand-on vessel	Stand-on vessels shall maintain course so as not to confuse the situation, unless the give-way vessel fails to act, in which case action should be taken by the stand-on vessel in order to avoid collision.
	18 – Responsibilities between vessels	A hierarchy of vessel types which determines which vessel type generally has right of way, unless an exception is provided under Rules 9, 10 and 13.
Part C: Lights and shapes	19 – Conduct of vessels in restricted visibility	Extra care is to be taken in poor visibility, considering that not all other vessels have radar and not all hazards are detectable by radar. Sound signals become more important.
	20 – Application	Light specifications to be complied with at night and in restricted visibility, shape specification to be complied with during the day. Lights and shapes shall comply with the specification in Annex I.
	21 – Definitions	Definition of navigation light types used within Part C.
	22 – Visibility of lights	Defines minimum range for visibility of specific lights, determined by vessel length. Annex I Section 8 applies.
	23 – Power-driven vessels underway	Light and shape specifications for power-driven vessels that are not anchored or aground.
	24 – Towing and pushing	Light and shape specifications for power-driven vessels engaged in towing or pushing, or vessels being towed.
	25 – Sailing vessels underway and vessels under oars	Light and shape specifications for sailing vessels and vessels under oars.
	26 – Fishing vessels	Light and shape specifications for fishing vessels engaged in fishing or trawling. Additional signals for fishing vessels, fishing in close proximity to one another are specified in Annex II.
	27 – Vessels not under command or restricted in their ability to manoeuvre	Light and shape specifications for vessels constrained by their ability to manoeuvre due to being not under command or engaged in mine clearance, towing, dredging, underwater or diving operations.
	28 – Vessels constrained by their draught	Additional light for power-driven vessels constrained by their draught, applied in addition to Rule 23.
Part D: Sound and light signals	29 – Pilot vessels	Light and shape specifications to indicate that the vessel is engaged on pilotage duty.
	30 – Anchored vessels and vessels aground	Light and shape specifications for vessels at anchor or aground.
	31 – Seaplanes	Where impracticable to comply, seaplanes or WIG craft should exhibit lights and shapes as closely as possible to the Rules of Part C.
	32 – Definitions	Definition of type and length of sound signals. Sound signalling appliances are to comply with the specifications in Annex III.
	33 – Equipment for sound signals	Type of sound equipment to be provisioned for vessels less than or greater than 12m in length. Sound signalling appliances are to comply with the specifications in Annex III.
Part E: Exemptions	34 – Manoeuvring and warning signals	Description of sound and light signals used to indicate intent or presence.
	35 – Sound signals in restricted visibility	Description of sound signals for vessels not in sight of one another, dependent on vessel type and navigational activity.
	36 – Signals to attract attention	Use of sound or light signals not otherwise defined in COLREGS to attract attention, and a requirement that they should be such that they cannot be mistaken with sound and light signals otherwise defined in COLREGS.
37 – Distress signals	Distress signals are defined in Annex IV.	
38 – Exemptions	N/A	

Applicability	Context	Functional Capabilities (law Rule Essence) (Can be on-board autonomous capability or provided by continuous or occasional human overseer dependent on risk)			Supplementary mission constraints (to enable a mission in lieu of functional capabilities)	Proposed Evidence of functional capability (Simulation not required for human overseer)		
		Sense & Perceive	Decide	Act				
At all times	All times		• Presence and characteristics of other vessels, see Rule 5	• Vessel type allocation		Autonomous Marine Equipment (i.e. size & speed limitations)		
			• Presence and characteristics of other vessels by imaging camera • Light signals produced by other vessels • Sound signals produced by other vessels • Presence and characteristics of other vessels by radar • Presence and characteristics of other vessels by AIS • Course and course change of spotted vessels over time	• Deconflict sensor information • Type of vessel law Rule 3 • Type of encounter • Risk of collision - Apply Rule 7				
			• Range of imaging camera visibility in current environmental conditions • Wave height • Wind speed and direction • Water depth • Number, range and bearing of spotted vessels • Course and course change of spotted vessels over time • Proximity of navigational hazards	• Likelihood of undetectable hazards • Likelihood of sensor interference • Traffic density • If shallow water hazard exists • Stopping distance • Turning ability • Maximum safe speed	• Limit speed to safe speed			
			• Presence and characteristics of other vessels, see Rule 5 • Proximity of navigational hazards	• Safe passing distance • If expected vessel paths will cross at less than safe passing distance				
			• Presence and characteristics of other vessels, see Rule 5	• Risk of collision exists, see Rule 7 • Stand-on or give way vessel determined law Part B • Safe passing distance (if give way vessel) • If stand-on vessel	When giving way: • Early and obvious course/speed changes • Bearing change favoured over speed change • Pass at least safe passing distance • Monitor effectiveness of the action until the other vessel is passed When standing-on: • Apply Rule 17			
		Narrow channels	• Narrow channel or fairway locations • Presence and characteristics of other vessels, see Rule 5 • Sound signals made by other vessels • Light signals made by other vessels	• Other vessels which can only operate safely within the narrow channel or fairway • If own vessel can only operate safely within the narrow channel or fairway • Risk of collision exists law Rule 7 • Give way vessel if <20m, sailing vessel, crossing narrow channel or fairway • If sound or light signals are law Rule 34(d)	• Proceed on the starboard outer limit of the narrow channel or fairway • If give way vessel apply Rule 8 • Do not anchor in a narrow channel or fairway • Respond with sound signals law Rule 34 (a) and optionally light signals law Rule 34 (b)	⚠️ Avoid narrow channels of fairways and/or avoid overtaking in narrow channels or fairways.		
		Traffic separation schemes	• Traffic separation scheme locations • Traffic lanes and flow direction • Presence and characteristics of other vessels, see Rule 5 • Sound signals made by other vessels • Light signals made by other vessels	• Other vessels following a traffic separation scheme lane	• Proceed in the appropriate lane • Keep clear of a separation line or zone • Generally join and leave at the ends • Do not anchor in a traffic separation scheme	⚠️ Avoid using or approaching traffic separation schemes. ⚠️ Avoid joining or leaving traffic separation schemes anywhere but the ends. ⚠️ Avoid inshore traffic zones. 🚫 Do not cross a traffic separation scheme.		
		Sailing vessels	• Presence and characteristics of other vessels, see Rule 5 • Other sailing vessels law Rule 3(c) • Wind over port or starboard side	• Tack of other sailing vessel • Certainty of tack of other vessel allocation • Windward or leeward vessel law Rule 12(b) • Give way or stand-on vessel law Rule 12(a)	• Apply Rule 8	⚠️ If a sailing vessel avoid other sailing vessels.		
		Vessels in sight of one another	Vessels in sight of one another		• Presence and characteristics of other vessels, see Rule 5 • Risk of collision, see Rule 7	• Overtaking vessel law Rule 13(b) - Encounter type • Certainty of overtaking vessel allocation	• Apply Rule 8 • Line of determination - Encounter Type	
					• Presence and characteristics of other vessels, see Rule 5 • Risk of collision, see Rule 7	• Head-on situation law Rule 14(a) & (b) - Encounter type • Certainty of overtaking vessel allocation	• Alter course to starboard • Pass at safe passing distance	Autonomous Marine Equipment (i.e. size & speed limitations)
	• Presence and characteristics of other vessels, see Rule 5 • Risk of collision, see Rule 7			• Stand-on or give way vessel law Rule 15	• Apply Rule 8			
	• Presence and characteristics of other vessels, see Rule 5 • Risk of collision, see Rule 7			• If give way vessel fails to respond in time for the safe passing distance to be achieved • If collision becomes inevitable	Outside of safe passing distance: • Hold course • Between safe passing distance and collision distance: • Safe speed reduction law Rule 6 - Within collision distance: • Substantive course change			
	• Presence and characteristics of other vessels, see Rule 5			• Type of vessel law Rule 3 • Give way or stand-on vessel law Rule 18	• Apply Rule 8	Autonomous Marine Equipment (i.e. size & speed limitations)		
At night or in poor visibility	At night or in poor visibility	Towing or pushing						
		Sailing or rowing						
		Fishing vessel						
		Autonomous Marine Equipment				🚫 No operations at night-time or in poor visibility conditions		
		Constrained by draught						
		Pilot vessel						
		Anchored or aground						
Restricted visibility	Restricted visibility	Seaplane						
			• Inputs from Rules which recommend sound and light signals	• Produce sound or light signals law Rules and COLREGS Annexes		Autonomous Marine Equipment (i.e. size & speed limitations)		
					⚠️ Unless being made law specific Rules, lights and sound signals shall not be able to be confused with signals defined in COLREGS. Specifically no revolving or strobe lights. ⚠️ Autonomous and remotely operated vessels should not signal distress law COLREGS. They may signal "distress" in another way which cannot be confused with signals associated with harm to or loss of life.			

CONCEPTS

CONCEPT 1:
Vessel type allocation



CONCEPT 2:
Encounter type



CONCEPT 3:
Safe passing distance



CONCEPT 4:
Safe speed



EVIDENCE

Design Checklist



Simulation



Trial

