

# Standards and Regulations

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**Project Sponsor -- National Robotics Engineering Center**

# Agenda

- The International Regulations for Preventing Collisions at Sea 1972 (Colregs), also known as the "**Rules of the road**".
- IMO A.342: Recommendation on performance standards for automatic pilots.

# **SECTION A of PRESENTATION**

The International Regulations for Preventing Collisions at Sea 1972 (Colregs), also known as the "Rules of the road".

# Summary of the rules

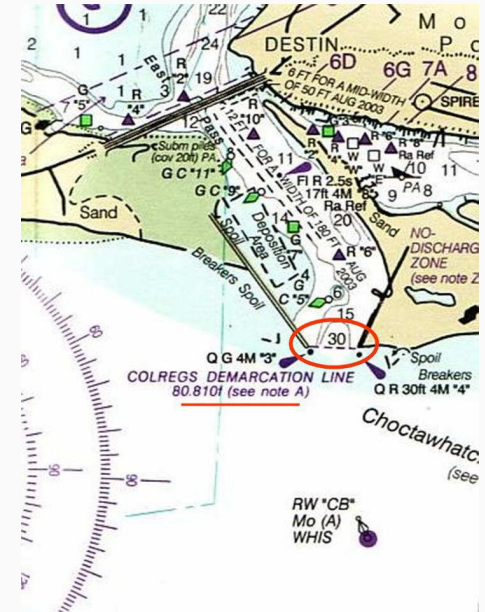
There are 38 rules which are grouped in 5 parts.

- PART A -- General
  - Rule 1-3
- PART B -- Steering and Sailing
  - Rule 4-19
- PART C -- Lights and Shapes (*not covered in the presentation*)
  - Rule 20-31
- PART D -- Sounds and Light Signals
  - Rule 32-37
- PART E -- Exemptions
  - Rule 38

# Rule 1 -- Application

The rules apply to 2 categories --

- a. International rules (COLREGS) apply:
  - i. to all vessels upon the high seas and all waters connected to the high seas and navigable by seagoing vessels.
- b. US Inland rules apply:
  - i. on the Great lakes, Western Rivers, waterways, and waters inside the Demarcation Line
  - ii. Local rules should conform as close as possible to COLREGS



## Rule 2 -- Responsibility



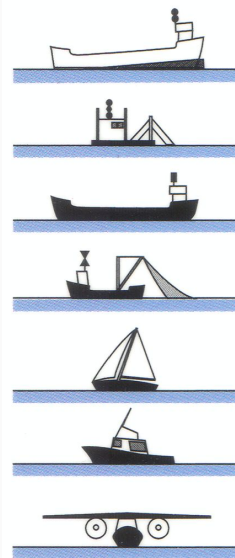
# Rule 2 -- Responsibility

- Everyone having to do with the vessel operations is responsible for:
  - Rule Compliance
  - Using **CAUTION**
  - Good sense
  - Good Seamanship
  - Immediate Danger Avoidance



# Rule 3 -- General Definitions

1. **Not under command** -- Vessel unable to maneuver due to some exceptional circumstances.
2. **Restricted in ability to maneuver** -- Vessel which, due to her nature of her work, cannot maneuver easily.
3. **Constrained by Drought** -- severely restricted in ability to deviate from the course she is following.
4. **Engaged in Fishing** -- Vessels engaged in shipping.
5. **Sailing** -- Propelled by sail alone.
6. **Power-Driven** -- any watercraft usable to transport on water -- including seaplane.
7. **Seaplane** -- aircraft which can maneuver on water.



Not Under Command

Restricted in Ability to Maneuver

Constrained by Draft (COLREGs only)

Engaged in Fishing

Sailing (not motorsailing)

Power-Driven

Seaplane

**Stand-On  
Vessel**



THE HIERARCHY

**Give-Way  
Vessel**



# Part B -- Steering & Sailing

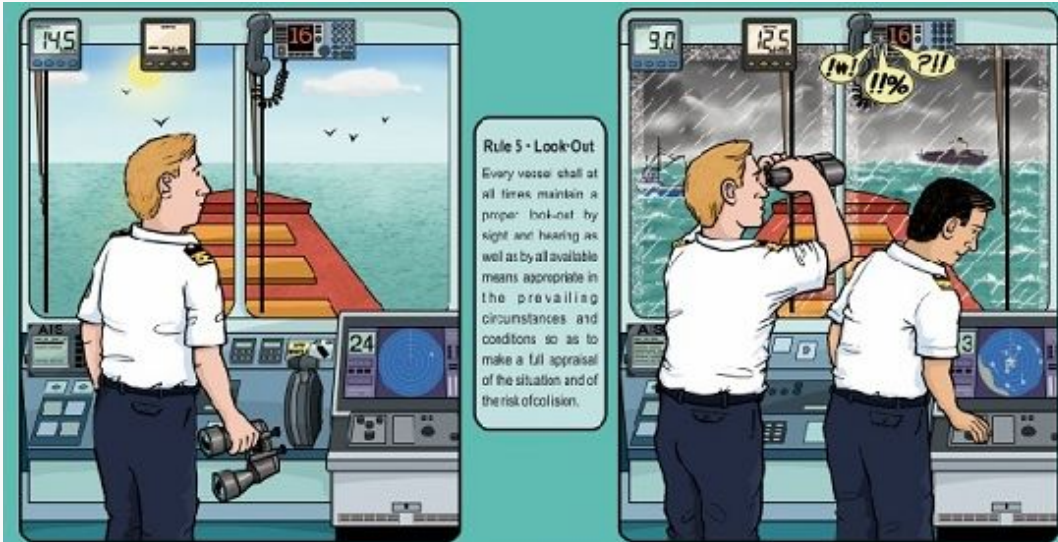
- SECTION I
  - Rules 4 - 10
- SECTION II
  - Rules 11 - 18
- SECTION III
  - Rule 19 applies to vessels (not in sight of one another) in or near restricted visibility.

# Rule 4

Rule 4 just says that --

**Rules 5 - 10 apply in any condition of  
visibility (in sight or restricted visibility)**

# Rule 5 -- Lookout



Keep a good look-out by sight and hearing using all available means including radar, AIS and VHF

# Rule 6 -- Safe Speed

Requires every vessel proceed at a safe speed to avoid collisions under existing conditions and circumstances --

1. Visibility and Weather
2. Background Lights
3. Traffic
4. Maneuverability
5. Current
6. Navigation Hazards
7. Limitations



# Rule 7 -- Risk of Collision

- Vessels must use all available means to determine the risk of a collision, including the use of radar (if available).
- If the distance of any vessel is reducing and her compass bearing is not changing much, then a risk of collision shall be deemed to exist.



# Rule 8 – Action to Avoid Collision

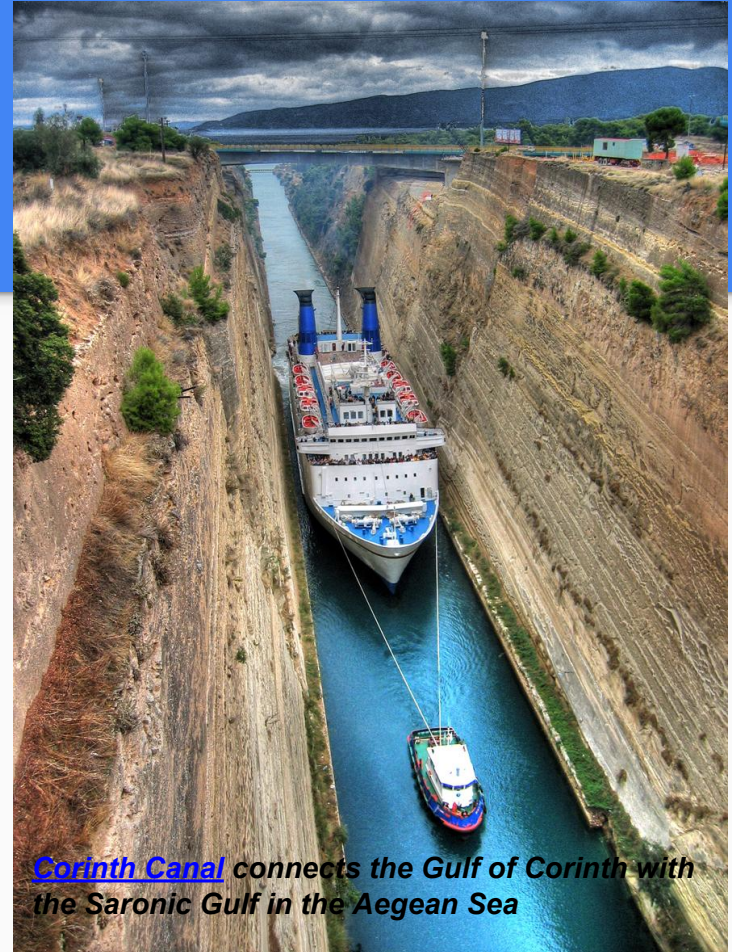
- Any action taken must:
  - Comply with these rules
  - Be obvious to the other vessel
  - Occur in a timely manner so that 2 vessels pass well clear of each other





# Rule 9 – Narrow Channels

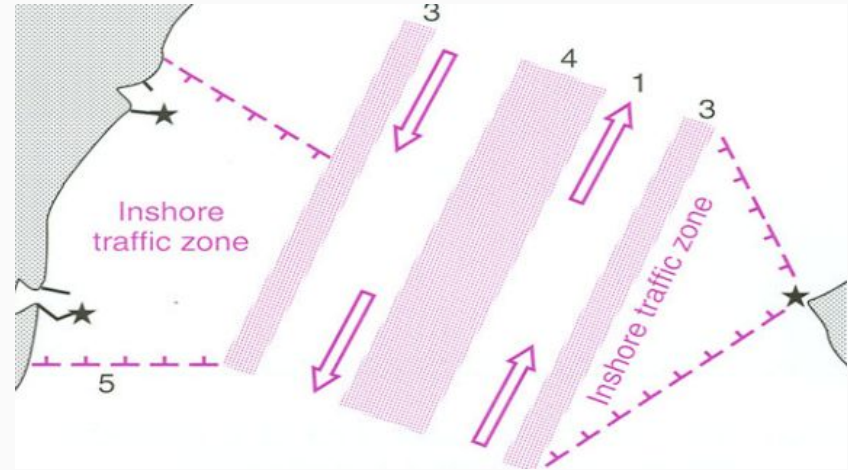
- Problem -- Limited room to maneuver
- In narrow channel:
  - Stay on the starboard side
  - Do not cross if interfering with a confined vessel
  - Do not anchor in a channel
- “...vessel less than 20m ...shall not impede passage of vessel which can safely navigate only within a narrow channel or fairway.”



[Corinth Canal](#) connects the Gulf of Corinth with the Saronic Gulf in the Aegean Sea

# Rule 10 -- Traffic Separation Schemes

- Lane schemes developed by the IMO to regulate busy waterways
- Ships must cross traffic lanes as close to 90 degs. as possible.
- A vessel shall not use an inshore traffic zone when she can safely use an appropriate traffic lane.





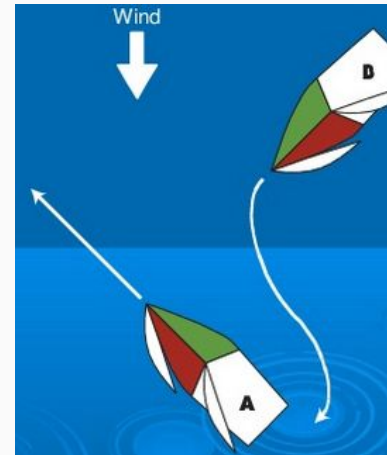
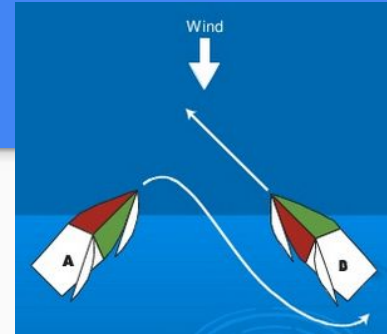
# Rule 11

Rule 11 just says that --

**Rules 12 - 18 apply to vessels in sight of one another.**

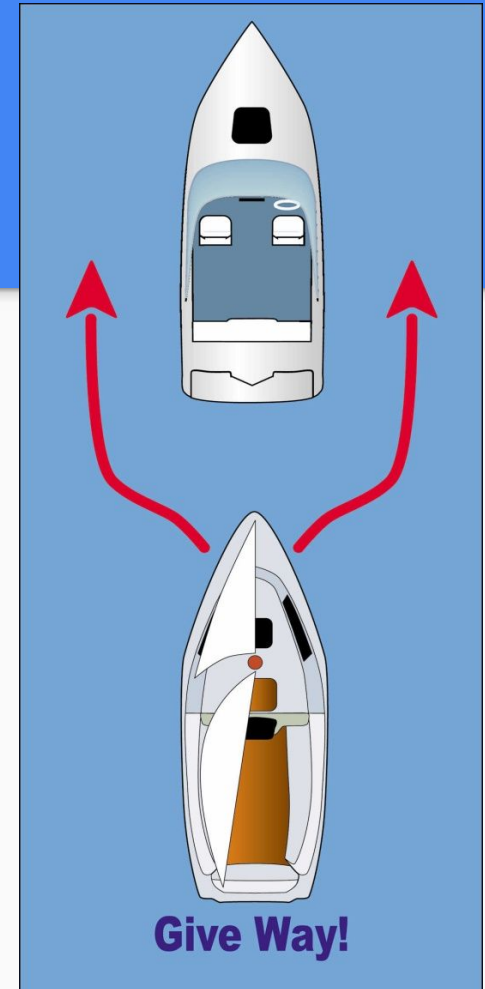
# Rule 12 -- Sailing Vessels

- When each has the wind on a different side, the vessel which has the wind to port must give way.
- When both have the wind on the same side, the vessel which is windward must give way to the vessel which is downwind.
- If a vessel with the wind on the port side, is unsure of the other vessel, they must give way.



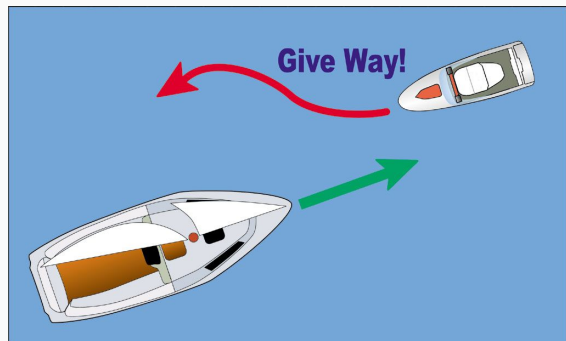
# Rule 13 -- Overtaking

- This rule overrides all other give-way rules
- The overtaking vessel must stay out of the way of the vessel being overtaken.
- Can pass on either side, but keep well clear; they may not see you.
- If you are being overtaken, hold your course and speed until the vessel is clear

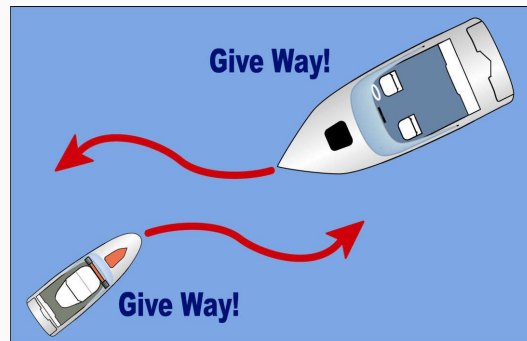


# Rule 14 -- Head-on Situations

- Both vessels must alter course to starboard.
- Anytime you have to turn in an emergency, turn starboard.



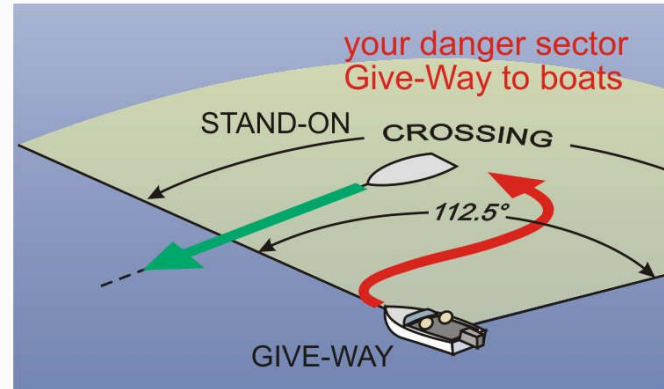
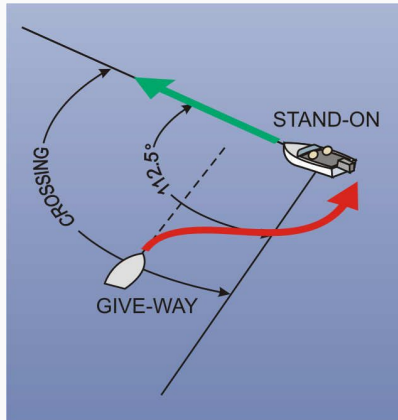
Meeting - Power Vs Sail



Meeting - Power Vs Power

# Rule 15 -- Crossing Situations

- If other vessel is starboard side, you must give way.
- If other vessel is port side, you have the right of way.

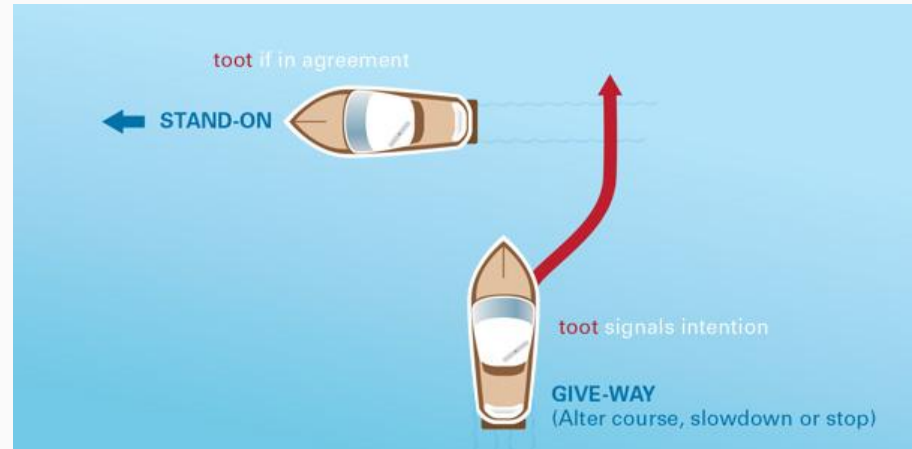


# Rule 16 -- The Give-way Vessel

**Q.** *What is a Give-way vessel?*

**Ans.** Vessel obligated to keep out of way of other.

***The give-way vessel must take early and substantial action to keep well clear.***

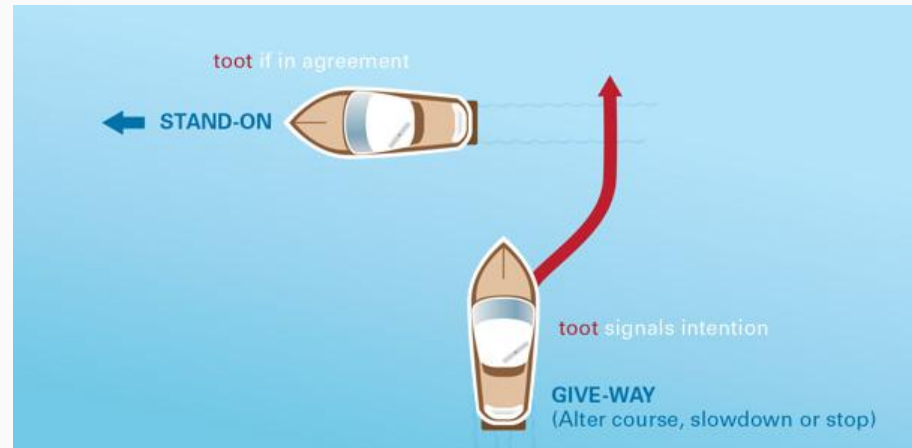


# Rule 17 -- The Stand-on Vessel

**Q.** What is a Stand-on vessel?

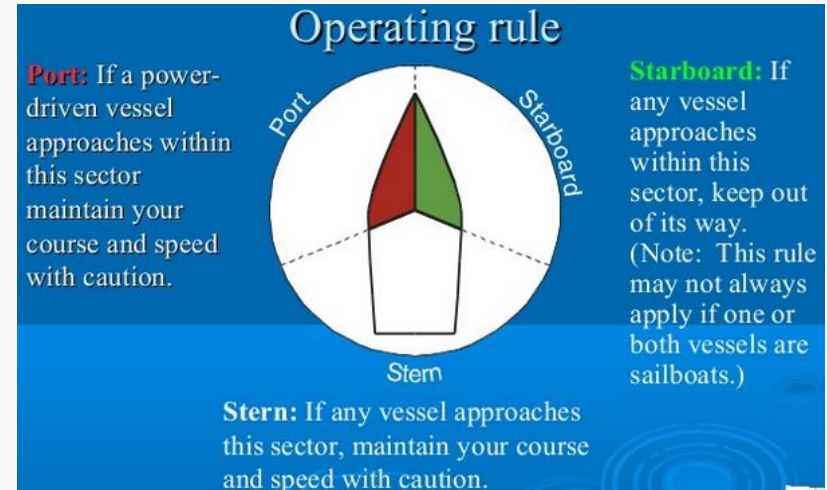
**Ans.** Vessel obligated to maintain course & speed.

*The stand-on vessel shall maintain her course and speed, but she may take action to avoid collision if it becomes clear that the give-way vessel is not taking appropriate action.*



# Rule 18 -- Responsibilities between Vessels

- Except in special situations (traffic schemes, overtaking), refer to the “pecking” order.
- Power vessels should stay away from fishing and sailing vessels, as well as vessels hampered by tasks.



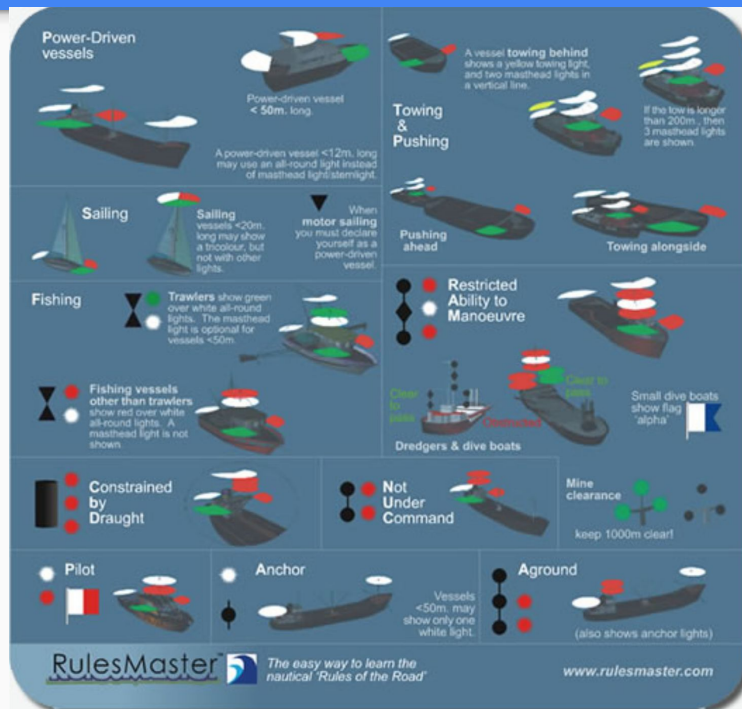


# Rule 19 -- Conduct of Vessel in Restricted Visibility

- All ships shall proceed at a safe speed.
- Remember the lookout rules.
- Sound fog signals. Slow down if fog signal of another vessel is heard.



# Part C -- Lights and Shapes













# Part D -- Sound and Light Signals

These cover rule 32 to 37. In nutshell, these signals define --

- What signals to use when the vessel --
  - is about to perform a maneuver.
  - is in restricted visibility.
  - needs attention.

*Signals can be short(1 second) or long(4-6 seconds).*

## STANDARD MARINE DISTRESS SIGNALS

MARINE RADIO	CODE FLAGS	SOUND SIGNALS
<b>DISTRESS CALL</b> USE: 2182 kHz (MF) OR CHANNEL 16, 156.8 MHz (VHF)	 N over C  <b>BALL</b> over or under <b>SQUARE</b> 	Continuous foghorn, bell or whistle. 1 - minute intervals: gun or any explosive 
<b>CALLING PROCEDURES</b> MAYDAY Immediate danger for persons or ship MAYDAY MAYDAY PAN-PAN Urgent message concerning safety of a person or ship PAN-PAN PAN-PAN PAN-PAN	<b>DISTRESS CLOTH</b> 	<b>FLARES</b> TYPE A: Parachute rocket TYPE B: Multi-star rocket TYPE C: Hand-held TYPE D: Buoyant or hand-held orange smoke 
<b>RADIOTELEGRAPH</b> • (S.O.S.) 500 kHz	<b>ARM SIGNAL</b>  Do not use this signal near helicopters (different meaning).	<b>DYE MARKER</b> 
<b>EMERGENCY POSITION INDICATING RADIOBEACON (EPIRB)</b> • USE ALARM SIGNAL 	<b>FLASHLIGHT</b> 	

## Part E -- Exemptions

Vessels may be exempt from portions of the regulations if they were built before or within the first few years after the standards were developed.

# **SECTION B of PRESENTATION**

**IMO A.342: Recommendation on performance standards for automatic pilots.**

# Recommendation on performance standards for automatic pilots

## **General Introduction:**

These are performance standards for marine autopilot equipments.

## **Applicable market:**

Automatic pilot equipment aboard a seagoing vessel, Unmanned Surface Vessel (USV)

# Content of the Standard

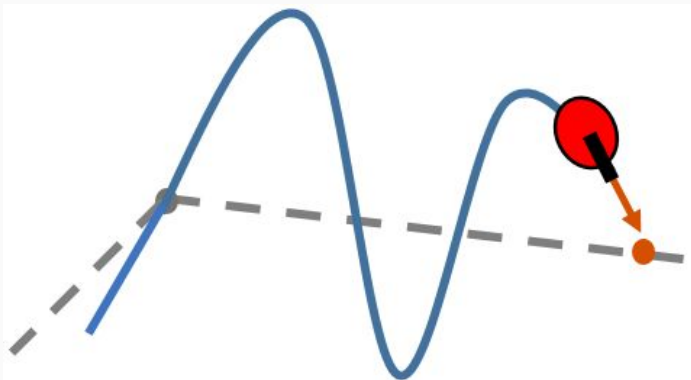
1. General
2. Changing over from manual steering and vice versa
3. Alarm signalling facilities
4. Controls
5. Rudder angle limitation

# 1. General

1.1 Keep minimum operation of the steering gear for a preset course

1.2 Adaptability to different steering characteristics of the vessels.

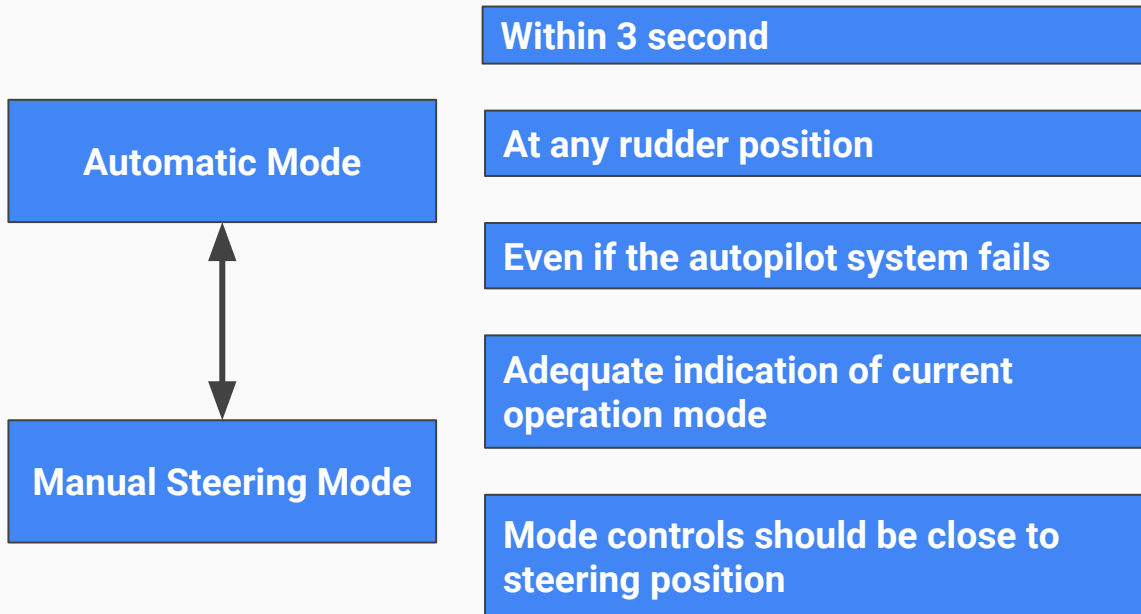
Reliable operation under environmental and normal operational condition.



- Our system computes the optimized path and sends waypoints to the low level controller.
- The low level controller uses pure pursuit path tracking algorithm and PID controller to make the boat follow the waypoints.



## 2. Changing over from automatic to manual steering and vice versa



### ***Our boat has:***

- Indicator of operation mode
- Mode button near the steering wheel
- Fast response when changing the control mode

### 3. Alarm signalling facilities

- A course monitor should be provided with audible alarm signal after a course deviation of a preset amount.
- The information for the course monitor should be provided from an independent source.

The **Safety Driver** is monitoring the boat path and will take manual control once the boat is off the planned path.



In this pic, Tushar is monitoring the path and will take manual control once the boat is off the planned path.

### 3. Alarm signalling facilities

- Audible and visual alarm for failure or reduction of power supply.
- The alarm signalling facilities should be fitted near the steering position.

- Our boat has visual power indicator for failure of power supply.
- The visual power indicator is near the steering position.



## 4. Controls

- Should be minimized as far as possible.
- Should be provided with adequate controls for operational use to adjust effects due to weather and steering performance.
- Ensure altering course to starboard by turning the course setting control clockwise.
- Except for the course setting control, the actuation of any other control should not affect the course of the vessel.

## 5. Rudder angle limitation

In auto mode, we should:

- 1. Limit the maximum rudder angle**
- 2. Indicate when the limitation has been reached**

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In our system, we have tuned the motion primitives and increased the cost for moving sideways and backwards, so the path we planned won't take sharp angles.

Thank you!

Questions?

