Safe Nav Watch

WITHERBYS
Since 1740

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This publication has been prepared to deal with the subject of Safe Nav Watch. This should not, however, be taken to mean that this publication deals comprehensively with all of the issues that will need to be addressed or even, where a particular issue is addressed, that this publication sets out the only definitive view for all situations.

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INTRODUCTION

This publication provides guidance on safe bridge watchkeeping and highlights potential issues and pitfalls. It is based on advice and guidance from experienced mariners, reinforced by best practice.

Safe navigation is now more important than ever, as:

- Every mistake is a potential human and environmental catastrophe
- Masters and officers can be faced with fines, if incompetence is proved, as well as potential imprisonment
- incidents can result in reputational damage and financial loss for companies
- every mistake is scrutinised by a global media audience and even small errors are now shown in videos online.

Navigation is still an art despite the fact that it is increasingly dominated by technology, as:

- Watchkeeping in the digital age presents the same challenges but in different forms
- technology does not diminish the importance of watchkeeping and maintaining a proper lookout
- the principles of navigation have not changed, especially monitoring the position of the ship safely along a prepared route
- the four stages of passage planning are just as critical, whether using ECDIS or paper charts.

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CHAPTER 1

Bridge Equipment (Carriage Requirements)

Equipment Defined by SOLAS

- Internal Communications (Phone)
- Compass: Magnetic Compass
- Compass: Gyro Compass
- Bridge Navigational Watch Alarm System (BNWAS)
- Daylight Signalling Lamp
- Electronic Chart Display and Information System (ECDIS)
- Automatic Identification Systems (AIS)
- Voyage Data Recorder (VDR) and Simplified VDR (S-VDR)
- Transmitting Heading Device (THD)
- Electric Inclinometer
- Ship Security Alert System (SSAS)
- Rate of Turn Indicator
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- Sound Reception System
- Search and Rescue Transponder (SART)

- Echo Sounder
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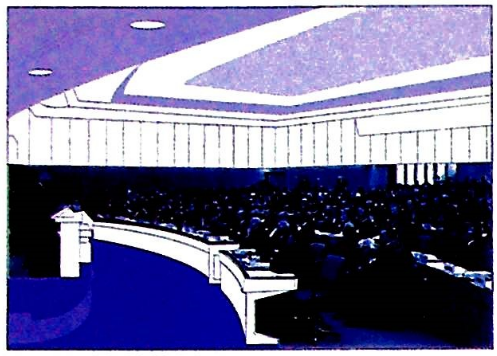
- Long-range Identification and Tracking of Ships (LRIT)
- Emergency Position Indicating Radio Beacon (EPIRB)
- Night Vision Equipment
- Anemometer

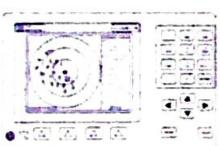
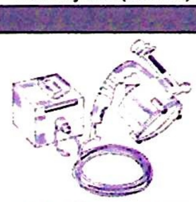
1.1 Bridge Equipment – Performance Standards



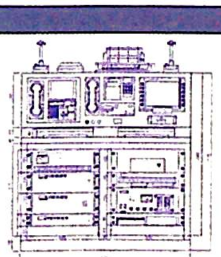
IMO Resolutions are the finalised documents adopted by the IMO. They generally result from an agreement on a recommendation or amendment. The prefix 'A' to a resolution indicates that it was passed by the assembly, while 'MSC' denotes Maritime Safety Committee. It should be noted that Resolution A.886(21) resolved that the functions of adopting and amending performance standards for radio and navigational equipment should be performed by the Maritime Safety Committee rather than the Assembly.

As an example, MSC.364(92) refers to MSC Resolution No. 364, which was adopted during the 92nd session of the Committee. Resolutions are listed by number, from the earliest resolution (lowest number).

An IMO Circular is a written statement of IMO policy and is used to provide information, guidance, rules and background information on legislative or procedural matters. The prefix 'SN' to a circular relates to the 'Safety of Navigation' and 'COMSAR' to 'Radiocommunications and Search and Rescue'. The following table provides a list of typical bridge equipment and their accompanying performance standards and relevant references.

Equipment	Details	Relevant Performance Standards			Relevant References				
		IMO Resolution	Adopted/ In Force Date	Valid for Equipment Fitted	SOLAS	Assembly	MSC	Circular	UK MSN*
 Automatic Identification System (AIS)		MSC.74(69)	12 May 1998	On or after 01 January 2000	Ch V Reg 19(2.4)	A.956(23)	MSC.347(91)	COMSAR.1/ Circ.46	MGN 465
		A.694(17)	06 November 1991			A.917(22)	MSC.246(83)	MSC.1/ Circ.1473	MGN 324
							MSC.224(82)	MSC.1/ Circ.1252	MGN 321
							MSC.191(79)	SN.1/Circ.322	MSN 1795
							MSC.140(76)	SN.1/Circ.290	
							MSC.43(64)	SN.1/Circ.289	
								SN.1/Circ.227. Corr.2	
								SN.1/Circ.247	
								SN.1/Circ.244/ Rev.1	
								SN.1/Circ.236	
								SN.1/Circ.217	
Automatic Tracking Aid (ATA)		MSC.64(67)	04 December 1996	On or after 01 January 1999	Ch V Reg 19(2 5.5)				
		A.694(17)	06 November 1991						
 Bridge Navigational Watch Alarm System (BNWAS)		MSC.128(75)	20 May 2002	On or after 01 July 2003	Ch V Reg 19(2.2.3)	A.1021(26)	MSC.350(92)	MSC.1/ Circ.1474	MIN 488
		A.694(17)	06 November 1991				MSC.282(86)	MSC.1/ Circ.982	
 Daylight Signalling Lamp		MSC.95(72)	22 May 2000	On or after 01 July 2002	Ch V Reg 19(2.2.2)	A.813(19)			
		A.694(17)	06 November 1991						

**Denotes relevant UK Merchant Shipping Notice number (MSN, MGN or MIN)*

Equipment	Details	Relevant Performance Standards: IMO Resolution	Relevant Performance Standards: Adopted/ In Force Date	Relevant Performance Standards: Valid for Equipment Fitted	Relevant References: SOLAS	Relevant References: Assembly	Relevant References: MSC	Relevant References: Circular	Relevant References: UK MSN*
 Echo Sounder		MSC.74(69)	12 May 1998	On or after 01 January 2001	Ch V Reg 19(2.3.1)	A.1021(26)			
		A.694(17)	06 November 1991						
		A.224(VII)	12 October 1971	Before 01 January 2001					
 Electronic Chart Display and Information System (ECDIS)		MSC.232(82)	05 December 2006	On or after 01 January 2009	Ch V Reg 19(2.1.4)	A.1021(26)	MSC.224(82)	MSC 1/ Circ.1503/ Rev.1	MGN 360
		MSC.86(70)	08 December 1998	On or after 01 January 2000			MSC.191(79)	MSC.1/ Circ.1391	MGN 285
		MSC.64(67)	04 December 1996	On or after 01 January 1999				MSC.1/ Circ.982	
		A.817(19)	23 November 1995	Before 01 January 1999				SN.1/Circ.312	
		A.694(17)	06 November 1991					SN.1/Circ.276	
		A.281(VIII)	20 November 1973					SN.1/Circ.266/ Rev.1	
								SN.1/Circ.243/ Rev.1	
								SN.1/Circ.207/ Rev.1	
Electronic Inclinometer		MSC.363(92)	14 June 2013	On or after 01 July 2015	N/A	A.1021(26)	MSC.191(79)	MSC.1/ Circ.1228	
		A.694(17)	06 November 1991					MSC.1/ Circ.982	
Electronic Plotting Aid (EPA)		MSC.64(67)	04 December 1996	On or after 01 January 1999	Ch V Reg 19(2.3.3)	A.823(19)			
		A.694(17)	06 November 1991						
Electronic Position Fixing System	Worldwide Radio Navigation System	A.1046(27)	30 November 2011		N/A	A.577(14)			
		A.694(17)	06 November 1991			A.281(VIII)			
						A.156(ES. IV)			
	Decca Navigator	A.816(19)	23 November 1995		Ch V Reg 19(2.1.6)	A.1046(27)			
		A.694(17)	06 November 1991						
	Loran-C and Chayka	A.818(19)	23 November 1995		Ch V Reg 19(2.1.6)	A.1046(27)			
		A.694(17)	06 November 1991						
	Differential Omega	A.694(17)	06 November 1991		Ch V Reg 19(2.1.6)				
		A.479(XII)	19 November 1981						
		A.425(XI)	15 November 1979						
		A.281(VIII)	20 November 1973						
 Global Maritime Distress and Safety System (GMDSS)	General				Ch IV	A.1051(27)	MSC.199(80)	COMSAR/ Circ.35	MGN 304
						A.1046(27)		COMSAR/ Circ.34	MGN 294
						A.1001(25)		COMSAR/ Circ.32	MGN 375
						A.958(23)		COMSAR/ Circ.28	MSN 1810
						A.953(23)		COMSAR/ Circ.21	
						A.915(22)			

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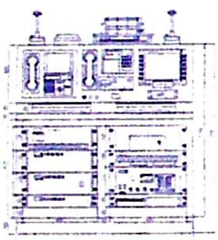
Equipment	Details	Relevant Performance Standards			Relevant References				
		IMO Resolution	Adopted/ In Force Date	Valid for Equipment Fitted	SOLAS	Assembly	MSC	Circular	UK MSN*
 Global Maritime Distress and Safety System (GMDSS) (cont)						A.887(21)		COMSAR/ Circ.19	
						A.860(20)		COMSAR/ Circ.16	
						A.814(19)		MSC.1/ Circ.1415	
						A.801(19)		MSC.1/ Circ.1078	
						A.769(18)		MSC.1/ Circ.957	
						A.707(17)		MSC.1/ Circ.861	
						A.706(17)a			
						A.705(17)a			
						A.703(17)			
						A.616(15)			
						A.614(15)			
						A.607(15)			
						A.606(15)			
						A.420(XI)			
	Emergency Position Indicating Radio Beacon (EPIRB): Satellite 406 MHz	MSC.120(74)	31 May 2001		Ch IV Reg 7.1.6	A.887(21)		MSC.1/ Circ.882	
		MSC.56(66)	03 June 1996			A.696(17)			
		A.810(19)	23 November 1995	On or after 23 November 1996		A.660(16)			
		A.763(18)	04 November 1993	Before 23 November 1996		A.568(14)			
		A.662(16)	19 October 1989						
	Emergency Position Indicating Radio Beacon (EPIRB): Satellite Inmarsat 1.6 GHz	A.812(19)	23 November 1995	On or after 23 November 1996	Ch IV Reg 7 1.6	A.660(16)			
		A.661(16)	19 October 1989	Before 23 November 1996		A.812(19)			
		A.662(16)	19 October 1989						
	Emergency Position Indicating Radio Beacon (EPIRB): VHF	A.805(19)	23 November 1995	On or after 23 November 1996	Ch IV Reg 8.3	A.806(19)			
		A.612(15)	19 November 1987	Before 23 November 1996					
	Enhanced Group Call Equipment (EGC)	MSC.306(87)	17 May 2010	On or after 01 July 2012	Ch IV Reg 7 1.5	A.701(17)			
		A.664(16)	19 October 1989	Before 01 July 2012					
	 NBDP and NAVTEX	MSC.148(77)	03 June 2003	If installed on or after 01 July 2005	Ch IV Reg 7.1.4	A.617(15)	MSC.199(80)	MSC.1/ Circ.1403	
		A.700(17)	06 November 1991						
		A.699(17)	06 November 1991						
		A.694(17)	06 November 1991						
		A.525(13)	17 November 1983	Before 01 July 2005					
	 Shipborne Radio-communication Equipment	MSC.130(75)	21 May 2002		Ch IV Regs 7 to 11	A.1001(25)	MSC.131(75)		MGN 324
		MSC.80(70)	08 December 1998			A.954(23)	MSC.129(75)		MGN 305
		MSC.68(68)	06 June 1997	01 January 2000		A.918(22)			
		A.811(19)	23 November 1995			A.813(19)			
		A.808(19)	23 November 1995	If installed on or after 23 November 1996		A.706(17)			
		A.807(19)	23 November 1995	If installed on or after 23 November 1996		A.702(17)			

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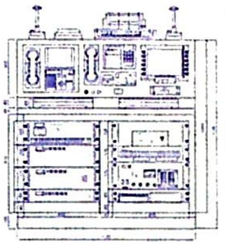
Equipment	Details	Relevant Performance Standards			Relevant References				
		IMO Resolution	Adopted/ In Force Date	Valid for Equipment Fitted	SOLAS	Assembly	MSC	Circular	UK MSN*
 Global Maritime Distress and Safety System (GMDSS) (cont)		A.806(19)	23 November 1995	If installed on or after 23 November 1996		A.571(14)			
		A.804(19)	23 November 1995	If installed on or after 23 November 1996		A.570(14)			
		A.803(19)	23 November 1995	If installed on or after 23 November 1996		A.397(X)			
		A.698(17)	06 November 1991	If installed before 23 November 1996					
		A.694(17)	06 November 1991						
		A.663(16)	19 October 1989	If installed before 23 November 1996					
		A.613(15)	19 November 1987	If installed before 23 November 1996					
		A.610(15)	19 November 1987	If installed before 23 November 1996					
		A.609(15)	19 November 1987	If installed before 23 November 1996					
		A.524(13)	17 November 1983						
		A.421(XI)	15 November 1979						
		A.385(X)	14 November 1977						
		A.383(X)	14 November 1977						
		A.334(IX)	12 November 1975						
 Global Navigation Satellite System (GNSS)	Accuracy Standards for Navigation	A.1046(27)	30 November 2011		N/A				
		A.694(17)	06 November 1991						
		A.529(13)	17 November 1983						
	Global Positioning System (GPS)	MSC.112(73)	01 December 2000	On or after 01 July 2003	Ch V Reg 19(2.1.6)	A.1046(27)			
		A.819(19)	23 November 1995	Before 01 July 2003					
		A.694(17)	06 November 1991						
	Global Navigation Satellite System (GLONASS)	MSC.113(73)	01 December 2000	On or after 01 July 2003	Ch V Reg 19(2.1.6)	A.1046(27)			
		MSC.53(66)	30 May 1996	Before 01 July 2003					
		A.694(17)	06 November 1991						
	Differential GPS & GLONASS (DGPS/ DGLONASS)	MSC.114(73)	01 December 2000	On or after 01 July 2003	Ch V Reg 19(2.1.6)				
		MSC.64(67)	04 December 1996	On or after 01 January 1999					
		A.694(17)	06 November 1991						
	Combined GPS/ GLONASS	MSC.115(73)	01 December 2000	On or after 01 July 2003	Ch V Reg 19(2.1.6)	A.1046(27)			
		MSC.74(69)	12 May 1998	Before 01 July 2003					
		A.694(17)	06 November 1991						
	Galileo	MSC.233(82)	05 December 2006	On or after 01 January 2009	Ch V Reg 19(2.1.6)	A.1046(27)			
		A.694(17)	06 November 1991						
Gyro Bearing Repeater		A.694(17)	06 November 1991		Ch V Reg 19(2.5.3)				
		A.424(XI)	15 November 1979						

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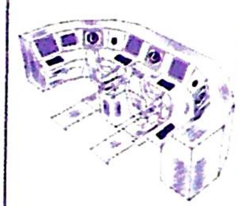
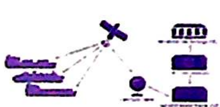
		IMO Resolution	Adopted/ In Force Date	Valid for Equipment Fitted	SOLAS	Assembly	MSC	Circular	UK MSN*
 Gyro Compass		A.694(17)	06 November 1991		Ch V Reg 19(2.5.1)				
		A.424(XI)	15 November 1979						
		A.280(VIII)	20 November 1973						
Gyro Compass Heading Repeater		A.694(17)	06 November 1991		Ch V Reg 19(2.5.2)				
		A.424(XI)	15 November 1979						
Gyro Compass (HSC)		A.821(19)	23 November 1995		Ch V Reg 19(2.5)		MSC.36(63)		
		A.694(17)	06 November 1991						
 Heading/Track Control System	Automatic Steering Aids (Automatic Pilots)	MSC.64(67)	04 December 1996	On or after 01 January 1999	Ch V Reg 19(2.8.2)				
		A.694(17)	06 November 1991						
		A.342(IX)	01 November 1975	Before 01 January 1999					
		A.281(VIII)	20 November 1973						
	Heading Control Systems	MSC.64(67)	04 December 1996	On or after 01 January 1999	Ch V Reg 19(2.8.2)				
	Track Control Systems (TCS)	MSC.74(69)	12 May 1998	On or after 01 January 2000	Ch V Reg 19(2.8.2)	A.1021(26)			
		MSC.64(67)	04 December 1996	On or after 01 January 1999					
		A.694(17)	06 November 1991						
	Automatic Pilots for HSC	A.822(19)	23 November 1995		Ch V Reg 19(2.8.2)		MSC 36(63)		
		A.694(17)	06 November 1991						
		A.342(IX)	01 November 1975						
 Integrated Bridge Systems	Integrated Bridge System (IBS)	MSC.64(67)	04 December 1996	On or after 01 January 1999	Ch V Reg 19(2.6)	A.1021(26)			
		A.694(17)	06 November 1991						
	Integrated Navigation System (INS)	MSC.252(83)	08 October 2007	On or after 01 January 2011	Ch V Reg 19(2.6)	A.1046(27)		MSC.1/ Circ.982	
		MSC.86(70)	08 December 1998	On or after 01 January 2000 but before 01 January 2011		A.1021(26)			
		A.694(17)	06 November 1991						
 Long-Range Identification and Tracking of Ships (LRIT)		MSC.330(90)	25 May 2012		Ch V Reg 19-1	A.813(19)	MSC.361(92)	MSC.1/ Circ.1377/ Rev.11	MGN 441
		MSC.263(84)	16 May 2008				MSC.322(89)	MSC.1/ Circ.1308	
		A.694(17)	06 November 1991				MSC 298(87)	MSC.1/ Circ.1307	
							MSC.297(87)	MSC.1/ Circ.1299	
							MSC.276(85)	MSC.1/ Circ.1298	
							MSC 275(85)	MSC.1/ Circ.1295	
							MSC.264(84)	MSC.1/ Circ.1259/ Rev.7	

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Equipment	Details	Relevant Performance Standards			Relevant References				
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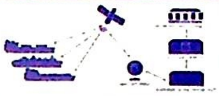
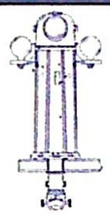
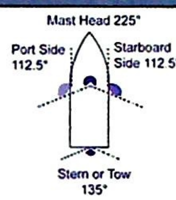
 Long-Range Identification and Tracking of Ships (LRIT) (cont)							MSC 242(83)		
							MSC 211(81)		
							MSC 202(81)		
 Magnetic Compass		A.694(17)	06 November 1991		Ch V Reg 19(2.1.1)				
		A.382(X)	14 November 1977						
 Navigation Lights		MSC.253(83)	08 October 2007	On or after 01 January 2009	IRPCS				MGN 393
		A.694(17)	06 November 1991						
Night Vision Equipment		MSC.94(72)	22 May 2000	On or after 01 July 2002	A19		MSC.36(63)		
		A.694(17)	06 November 1991						
Pelorus					Ch V Reg 19(2.1.2)				
 Radar 9 GHz, 3 GHz	Radar Equipment	MSC.192(79)	06 December 2004	On or after 01 July 2008	Ch V Reg 19(2.3.2) 19(2.7.1)	A.614(15)	MSC.191(79)		
		MSC.64(67)	04 December 1996	On or after 01 January 1999		A.278(VIII)			
		A.694(17)	06 November 1991						
		A.477(XII)	19 November 1981	Between 01 September 1984 and 31 December 1998					
	Radar Equipment (HSC)	MSC.192(79)	06 December 2004	On or after 01 July 2008	Ch V Reg 19(2.3.2) 19(2.7.1)				
		A.820(19)	23 November 1995	Before 01 July 2008					
		A.694(17)	06 November 1991						
	Automatic Radar Plotting Aid (ARPA)	MSC.192(79)	06 December 2004	On or after 01 July 2008	Ch V Reg 19(2.3.2) 19(2.7.1)	A.1021(26)		SN.1/Circ.243/ Rev.1	
		A.823(19)	23 November 1995	On or after 01 January 1997					
		A.694(17)	06 November 1991						
		A.422(XI)	15 November 1979	Before 01 January 1997					
Radar Beacons and Transponders		A.694(17)	06 November 1991		Ch IV Reg 1.3	A.823(19)	MSC.247(83)		
		A.615(15)	19 November 1987			A.802(19)	MSC.192(79)		
						A.530(13)	MSC.64(67)		
						A.477(XII)			
						A.222(VII)			

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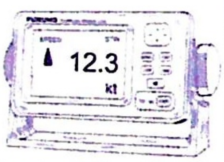
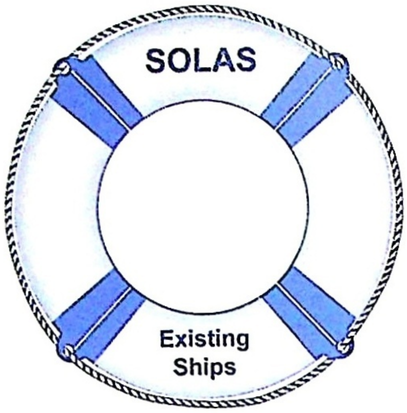
Equipment	Details	Relevant Performance Standards: IMO Resolution	Adopted/ In Force Date	Valid for Equipment Fitted	Relevant References: SOLAS	Assembly	MSC	Circular	UK MSN*
Radar Reflector		MSC.164(78)	17 May 2004	On or after 01 July 2005	Ch V Reg 19(2.1.7)				
		A.694(17)	06 November 1991						
		A.384(X)	14 November 1977	Before 01 July 2005					
		A.277(VIII)	20 November 1973						
Rate of Turn Indicator		A.694(17)	06 November 1991		Ch V Reg 19(2.9.1)	A.281(VIII)			
		A.526(13)	17 November 1973	On or after 01 September 1984					
Rudder/Propeller/Pitch Indicators					Ch V Reg 19(2.5.4)				
Search and Rescue Transponder (SART)		MSC.247(83)	08 October 2007	On or after 01 January 2010	Ch III Reg 6	A.530(13)			
		A.802(19)	23 November 1995			A.477(XII)			
		A.694(17)	06 November 1991						
Sound Reception System		MSC.86(70)	08 December 1998	On or after 01 January 2000	Ch V Reg 19(2.1.8)				
		A.694(17)	06 November 1991						
 Speed and Distance Measuring Equipment (SDME)		MSC.334(90)	22 May 2012	On ships constructed on or after 01 July 2014	Ch V Reg 19(2.3.4) 19(2.9.2)				
		MSC.96(72)	22 May 2000	On ships constructed on or after 01 July 2014					
		A.824(19)	23 November 1995	On or after 01 January 1997					
		A.694(17)	06 November 1991						
		A.478(XII)	19 November 1981	Before 01 January 1997					
Transmitting Heading Device (THD)		MSC.166(78)	20 May 2004		Ch V Reg 19(2.3.5)				
		MSC.116(73)	01 December 2000	On or after 01 July 2002					
		MSC.86(70)	08 December 1998	Before 01 July 2002					
		A.694(17)	06 November 1991						
Transmitting Magnetic Heading Device (TMHD)		MSC.166(78)	20 May 2004		Ch V Reg 19(2.3.5)	A.813(19)			
		MSC.116(73)	01 December 2000	On or after 01 July 2002		A.382(X)			
		MSC.86(70)	08 December 1998	Before 01 July 2002					
		A.694(17)	06 November 1991						
 Voyage Data Recorder (VDR) and Simplified VDR (SVDR)		MSC.333(90)	22 May 2012	On or after 01 July 2014	Annex 20	A.1021(26)	MSC.224(82)	MSC/Circ.982	MGN 272
		MSC.214(81)	12 May 2006	Before 01 July 2014			MSC.99(73)		
		MSC.163(78)	17 May 2004						
		MSC.109(73)	06 December 2000						
		A.861(20)	27 November 1997	On or after 27 November 1997					
		A.694(17)	06 November 1991						

**Denotes relevant UK Merchant Shipping Notice number (MSN, MGN or MIN)*

1.2 SOLAS Equipment List for Existing Ships

The following table lists bridge equipment that should be fitted to Existing Ships (equipment for ships built before 1st July 2002) as mandated by SOLAS Chapter V.

Note that existing ships may continue to meet the requirements of SOLAS V/74.



Equipment	SOLAS V Regulation	Fitting Mandated									
		All Ships	All Passenger Ships	Less than 150 GT	150 GT and over	300 GT and over	500 GT and over	1,600 GT and over	3,000 GT and over	10,000 GT and over	100,000 GT and over
Adequate up-to-date charts and nautical publications	V/74 20	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
AIS (see note 6)	19.2.4.2 19.2.4.3		Yes6			Yes6	Yes6	Yes6	Yes6	Yes6	Yes6
ARPA	V/74 12(j)									Yes	Yes
Bridge Navigational Watch Alarm System (BNWAS) (see note 7)	19.1.2.4		Yes7		Yes7	Yes7	Yes7	Yes7	Yes7	Yes7	Yes7
Compass reading to emergency steering	V/74 12(f)						Yes1	Yes1	Yes1	Yes1	Yes1
Daylight signalling lamp	V/74 11				INT	INT	INT	INT	INT	INT	INT
Echo sounder	V/74 12(k)						INT	INT	INT	INT	INT
GMDSS radio installations (see note 8)	V-Part C		INT8			Yes8	Yes8	Yes8	Yes8	Yes8	Yes8
GNSS or terrestrial position finding system	19.1.2.2	Yes5	Yes5	Yes5	Yes5	Yes5	Yes5	Yes5	Yes5	Yes5	Yes5
Gyro compass	V/74 12(d)						Yes	Yes	Yes	Yes	Yes
Gyro repeater(s)	V/74 12(d)							Yes	Yes	Yes	Yes
Long Range Identification and Tracking of Ships (LRIT) (see note 9)	19-1		INT9			INT9	INT9	INT9	INT9	INT9	INT9
Radar (9 GHz)	V/74 12(g)		INT			INT	Yes	Yes	Yes	Yes	Yes
Radar plotting facilities	V/74 12(i)		INT			INT	INT	Yes	Yes2	Yes2	Yes2
Rate of turn indicator	V/74 12(n)										Yes
RDF (may be exempted if position finding system fitted)	V/74 12(p)							Yes4	Yes4	Yes4	Yes4
Rudder, propeller and pitch indicators	V/74 12(m)						Yes	Yes	Yes	Yes	Yes
Second radar	V/74 12(h)									Yes	Yes
Ship Security Alert System (SSAS) (see note 10)	XI-2/6						INT10	INT10	INT10	INT10	INT10
Speed and distance measuring device	V/74 12(l)						INT	INT	INT	Yes3	Yes3
Standard magnetic compass	V/74 12(b)				Yes	Yes	Yes	Yes	Yes	Yes	Yes
Steering compass and means of taking bearings	V/74 12(c)			Yes							
Telephone to emergency steering	V/74 12(f)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
VDR and S-VDR (see note 11)	20.1 & 20.3		INT11						INT11	INT11	INT11

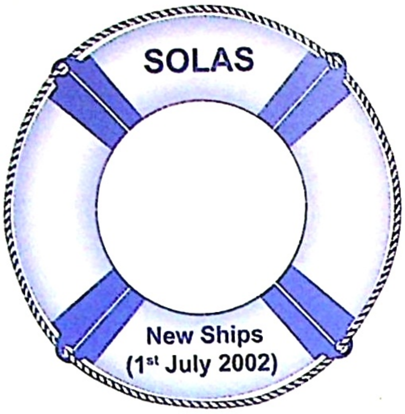
Notes:

YES = On all voyages
INT = On international voyages

1. Ships constructed on/after 01 February 1992
2. At least as effective as a reflection plotter
3. Speed and distance through water
4. Until first survey after 01 July 2002
5. By first survey after 01 July 2002
6. Fitting of AIS applies to·
   - All ships of 300 GT and upwards on international voyages or calling at a port of an EU Member State
   - All passenger ships, including high speed craft, irrespective of size or of 300 GT and upwards if engaged in domestic trade
7. Ships constructed before 01 July 2002 shall be fitted with BNWAS as follows:
   - Passenger ships irrespective of size, not later than the first survey after 01 January 2016
   - Cargo ships of 3,000 GT and upwards, not later than the first survey after 01 January 2016
   - Cargo ships of 500 GT and upwards but less than 3,000 GT, not later than the first survey after 01 January 2017
   - Cargo ships of 150 GT and upwards but less than 500 GT, not later than the first survey after 01 January 2018
   - A BNWAS installed prior to 01 July 2011 may subsequently be exempted from full compliance with the standards adopted by the organisation, at the discretion of the Administration
8. GMDSS should be fitted to the following vessels:
   - All cargo ships of 300 GT and over, and all passenger ships on international voyages
   - All ships should carry radio equipment appropriate to the sea area or areas through which they will pass
9. The fitting of LRIT shall apply to the following types of ships engaged on international voyages:
   - Passenger ships, including high speed passenger craft
   - Cargo ships, including high speed craft, of 300 GT and upward
   - Mobile offshore drilling units
   - This applies to:
     - Ships constructed before 31 December 2008 and certified for operations:
       - In sea areas A1 and A2, as defined in regulations IV/2.1.12 and IV/2.1.13 or
       - In sea areas A1, A2 and A3, as defined in regulations IV/2.1.12, IV/2.1.13 and IV/2.1.14, not later than the first survey of the radio installation after 31 December 2008
     - Ships constructed before 31 December 2008 and certified for operations in sea areas A1, A2, A3 and A4, as defined in regulations IV/2.1.12, IV/2.1.13, IV/2.1.14, not later than the first survey of the radio installation after 01 July 2009
     - Ships, irrespective of the date of construction, fitted with an AIS and operated exclusively within sea area A1, shall not be required to comply with the provisions of this regulation
10. All the following types of ships engaged on international voyages shall be provided with an SSAS:
    - Passenger ships, including high speed passenger craft, cargo ships, including high speed craft, of 500 GT and upwards
    - Mobile offshore drilling units
    - European Commission Regulation 725/2004 extends the scope of compliance to include:
      - Domestic 'Class A' passenger ships (domestic ships that travel more than 20 miles from a place of refuge)
      - Domestic ships required to comply by an EU member state's risk assessment (eg for the UK this covers ships certified to carry more than 250 passengers and tankers)
      - Port facilities serving any of the types of ships detailed above
11. To assist in casualty investigations, the following ships, when engaged on International voyages, shall be fitted with a VDR:
    - Ro-ro passenger ships constructed before 01 July 2002
    - Passenger ships other than ro-ro passenger ships constructed before 01 July 2002
    - Cargo ships, when engaged on international voyages, shall be fitted with a VDR which may be a simplified VDR (S-VDR) as follows:
      - Cargo ships of 20,000 GT and upwards constructed before 01 July 2002
      - Cargo ships of 3,000 GT and upwards but less than 20,000 GT constructed before 01 July 2002
    - Administrations may exempt ships, other than ro-ro passenger ships, constructed before 01 July 2002 from being fitted with a VDR where it can be demonstrated that interfacing a VDR with the existing equipment on the ship is unreasonable and impracticable
    - EU Council Directive 2002/59/EC (Vessel Traffic Monitoring Directive) requires all ships calling at a port of a Member State to be fitted with a VDR. This includes ships on UK domestic voyages. Ships operating only in coastal waters that are classified for domestic passenger ships as EC classes B, C or D may be exempted.

1.3 SOLAS Equipment List for New Ships

The following table lists bridge equipment that should be fitted to New Ships (equipment for ships built on or after 1st July 2002) as mandated by SOLAS Chapter V.



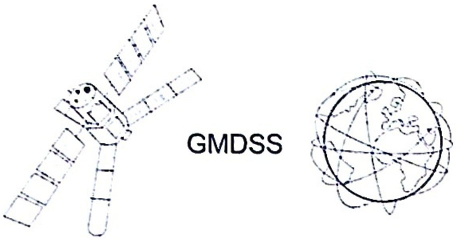
Equipment	SOLAS V Regulation	Fitting Mandated						
		All Ships[2]	150 GT and over & all Passenger Ships	300 GT and over & all Passenger Ships	500 GT and over[3]	3,000 GT and over	10,000 GT and over	50,000 GT and over
Automatic Identification System (AIS) (see note 1)	19.2.4		Yes[1]	Yes[1]	Yes[1]	Yes[1]	Yes[1]	Yes[1]
Automatic Radar Plotting Aid (ARPA)	19.2.8.1						Yes	Yes
Automatic Tracking Aid (ATA)	19.2.5.5				Yes	Yes	Yes	Yes
Backup if ECDIS fitted	19.2.1.5	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Bridge Navigational Watch Alarm System (BNWAS) (see note 4)	19.2.2.3	Yes[4]	Yes[4]	Yes[4]	Yes[4]	Yes[4]	Yes[4]	Yes[4]
Daylight signalling lamp	19.2.2.2		Yes	Yes	Yes	Yes	Yes	Yes
Echo sounder	19.2.3.1			Yes	Yes	Yes	Yes	Yes
Electronic Plotting Aid (EPA)	19.2.3.3			Yes	Yes	Yes	Yes	Yes
GMDSS radio installations (see note 5)	V-Part C	Yes[5]	Yes[5]	Yes[5]	Yes[5]	Yes[5]	Yes[5]	Yes[5]
GNSS receiver or terrestrial position finding equipment	19.2.1.6	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Gyro compass	19.2.5.1				Yes	Yes	Yes	Yes
Gyro repeater at emergency steering position	19.2.5.2				Yes	Yes	Yes	Yes
Gyro repeater for bearings over 360° of horizon	19.2.5.3				Yes	Yes	Yes	Yes
Heading or Track Control System (TCS)	19.2.8.2						Yes	Yes
Indicators for rudder angle, propeller, thrust, pitch and revolutions	19.2.5.4				Yes	Yes	Yes	Yes
Long Range Identification and Tracking of Ships (LRIT) (see note 6)	19-1	INT[6]	INT[6]	INT[6]	INT[6]	INT[6]	INT[6]	INT[6]
Means of correcting headings/ bearings to true	19.2.1.3	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Means to transmit heading information to Radar, EPA and AIS	19.2.3.5			Yes	Yes	Yes	Yes	Yes
Nautical charts or ECDIS	19.2.1.4	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Pelorus	19.2.1.2	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Radar (9 GHz)	19.2.3.2			Yes	Yes	Yes	Yes	Yes
Radar 3 GHz (or where Administration considers appropriate a second 9 GHz radar)	19.2.7.1					Yes	Yes	Yes
Radar reflector	19.2.1.7	Yes						
Rate of turn indicator	19.2.9.1							Yes
SDME (over ground in forward and athwartships direction)	19.2.9.2							Yes
Second ATA	19.2.7.2					Yes	Yes	Yes
Ship Security Alert System (SSAS) (see note 7)	XI-2/6				Yes[7]	Yes[7]	Yes[7]	Yes[7]
Sound reception system (if bridge totally enclosed)	19.2.1.8	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Spare magnetic compass	19.2.2.1		Yes	Yes	Yes	Yes	Yes	Yes
Speed and distance measuring equipment (SDME) (through the water)	19.2.3.4			Yes	Yes	Yes	Yes	Yes
Standard magnetic compass	19.2.1.1	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Telephone to emergency steering position (where fitted)	19.2.1.9	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Voyage Data Recorder (VDR) and Simplified VDR (S-VDR) (see note 8)	20		Yes[8]	Yes[8]		Yes[8]	Yes[8]	Yes[8]

Notes:

1. Fitting of AIS applies to:
   - All ships of 300 GT and upwards on international voyages or calling at a port of an EU Member State
   - All passenger ships, including high speed craft, irrespective of size or of 300 GT and upwards if engaged in domestic trade
2. UK pleasure vessels under 150 GT are exempt from requirements of V/19 EXCEPT 19.2.1.7 (radar reflector, where practicable)
3. On all ships of 500 GT and over failure of one piece of equipment should not reduce the ship's ability to meet requirements of 2.1.1, 2.1.2 and 2.1.4
4. Ships constructed on or after 01 July 2002 shall be fitted with BNWAS as follows:
   - All ships of 150 GT and upwards and passenger ships irrespective of size
   - Cargo ships of 150 GT and upwards and passenger ships irrespective of size constructed on or after 01 July 2011
   - Passenger ships irrespective of size constructed before 01 July 2011, not later than the first survey after 01 July 2012
   - Cargo ships of 3,000 GT and upwards constructed before 01 July 2011, not later than the first survey after 01 July 2012
   - Cargo ships of 500 GT and upwards but less than 3,000 GT constructed before 01 July 2011, not later than the first survey after 01 July 2013
   - Cargo ships of 150 GT and upwards but less than 500 GT constructed before 01 July 2011, not later than the first survey after 01 July 2014
   - A BNWAS installed prior to 01 July 2011 may subsequently be exempted from full compliance with the standards adopted by the organisation, at the discretion of the Administration
5. Ships constructed on or after 01 July 2002 shall be fitted with GMDSS as follows:
   - All cargo ships of 300 GT and over, and all passenger ships on international voyages
   - All ships should carry radio equipment appropriate to the sea area or areas through which they will pass
6. The fitting of LRIT shall apply to the following types of ships engaged on international voyages:
   - Passenger ships, including high speed passenger craft
   - Cargo ships, including high speed craft, of 300 GT and upward
   - Mobile offshore drilling units
   - This applies to:
     - Ships constructed before 31 December 2008 and certified for operations:
       - In sea areas A1 and A2, as defined in regulations IV/2.1.12 and IV/2.1.13 or
       - In sea areas A1, A2 and A3, as defined in regulations IV/2.1.12, IV/2.1.13 and IV/2.1.14, not later than the first survey of the radio installation after 31 December 2008
     - Ships constructed before 31 December 2008 and certified for operations in sea areas A1, A2, A3 and A4, as defined in regulations IV/2.1.12, IV/2.1.13, IV/2.1.14, not later than the first survey of the radio installation after 01 July 2009
     - Ships, irrespective of the date of construction, fitted with an AIS and operated exclusively within sea area A1, shall not be required to comply with the provisions of this regulation
7. All the following types of ships engaged on international voyages shall be provided with an SSAS:
   - Passenger ships, including high speed passenger craft, cargo ships, including high speed craft, of 500 GT and upwards
   - Mobile offshore drilling units
   - European Commission Regulation 725/2004 extends the scope of compliance to include:
     - Domestic 'Class A' passenger ships (domestic ships that travel more than 20 miles from a place of refuge)
     - Domestic ships required to comply by an EU member state's risk assessment (eg for the UK this covers ships certified to carry more than 250 passengers and tankers)
     - Port facilities serving any of the types of ships detailed above
8. To assist in casualty investigations, the following ships, when engaged on international voyages shall be fitted with a VDR:
   - Passenger ships constructed on or after 01 July 2002
   - Ships other than passenger ships of 3,000 gross tonnage and upwards constructed on or after 01 July 2002
   - EU Council Directive 2002/59/EC (Vessel Traffic Monitoring Directive) requires all ships calling at a port of a Member State to be fitted with a VDR. This includes ships on UK domestic voyages. Ships operating only in coastal waters that are classified for domestic passenger ships as EC classes B, C or D may be exempted.

1.4 GMDSS Equipment

The following table lists GMDSS equipment that should be fitted in accordance with SOLAS Chapter IV.



GMDSS Equipment	Sea Area A1	Sea Area A2	Sea Area A3 (Inmarsat-C)	Sea Area A3 (HF)	Sea Area A4
VHF with DSC	Yes	Yes	Yes	Yes	Yes
DSC watch receiver (VHF channel 70)	Yes	Yes	Yes	Yes	Yes
NAVTEX receiver (518 kHz)	Yes	Yes	Yes	Yes	Yes
EPIRB (float-free satellite)	Yes	Yes	Yes	Yes	Yes
SART	Yes[1]	Yes[1]	Yes[1]	Yes[1]	Yes[1]
VHF transceivers (hand held)	Yes[2]	Yes[2]	Yes[2]	Yes[2]	Yes[2]
EGC receiver	Yes[3]	Yes[3]		Yes	Yes
MF telephony with MF DSC		Yes	Yes		
DSC watch receiver MF (2187.5 kHz)		Yes	Yes		
Duplicated VHF with DSC			Yes	Yes	Yes
Duplicated Inmarsat SES			Yes	Yes	
Approved SES with EGC receiver			Yes		
MF/HF telephony with DSC and NBDP				Yes	Yes
DSC watch receiver MF/HF				Yes	Yes
Duplicated MF/HF telephony with DSC and NBDP					Yes
Additionally for Passenger Ships					
Distress Panel (SOLAS IV/6.4, 6.6)	Yes	Yes	Yes	Yes	Yes
Automatic updating of position to all relevant radiocommunication equipment (SOLAS IV/6.5)	Yes[4]	Yes[4]	Yes[4]	Yes[4]	Yes[4]
Two-way on scene radiocommunication on 121.5 and 123.1 MHz (aeronautical) from the navigating bridge (SOLAS IV/7.2)	Yes	Yes	Yes	Yes	Yes

Notes:

1. Cargo ships between 300 and 500 GT, 1 set and cargo ships of 500 GT and upwards and passenger ships, 2 sets
2. Cargo ships between 300 and 500 GT, 2 sets and cargo ships of 500 GT and upwards and passenger ships, 3 sets
3. Outside NAVTEX coverage area
4. Also applies to cargo ships (SOLAS IV/18)

Sea Area A1

An area within the radiotelephone coverage of at least one VHF coast station in which continuous digital selective calling VHF DSC Ch 70 alerting and radiotelephony services are available. Such an area could extend typically 30 to 40 nm from the Coast Station.

Sea Area A2

An area, excluding Sea Area A1, within the radiotelephone coverage of at least one MF coast station in which continuous DSC (2187.5 kHz) alerting and radiotelephony services are available. For planning purposes, this area typically extends to up to 180 nm offshore but would exclude any A1 designated areas.

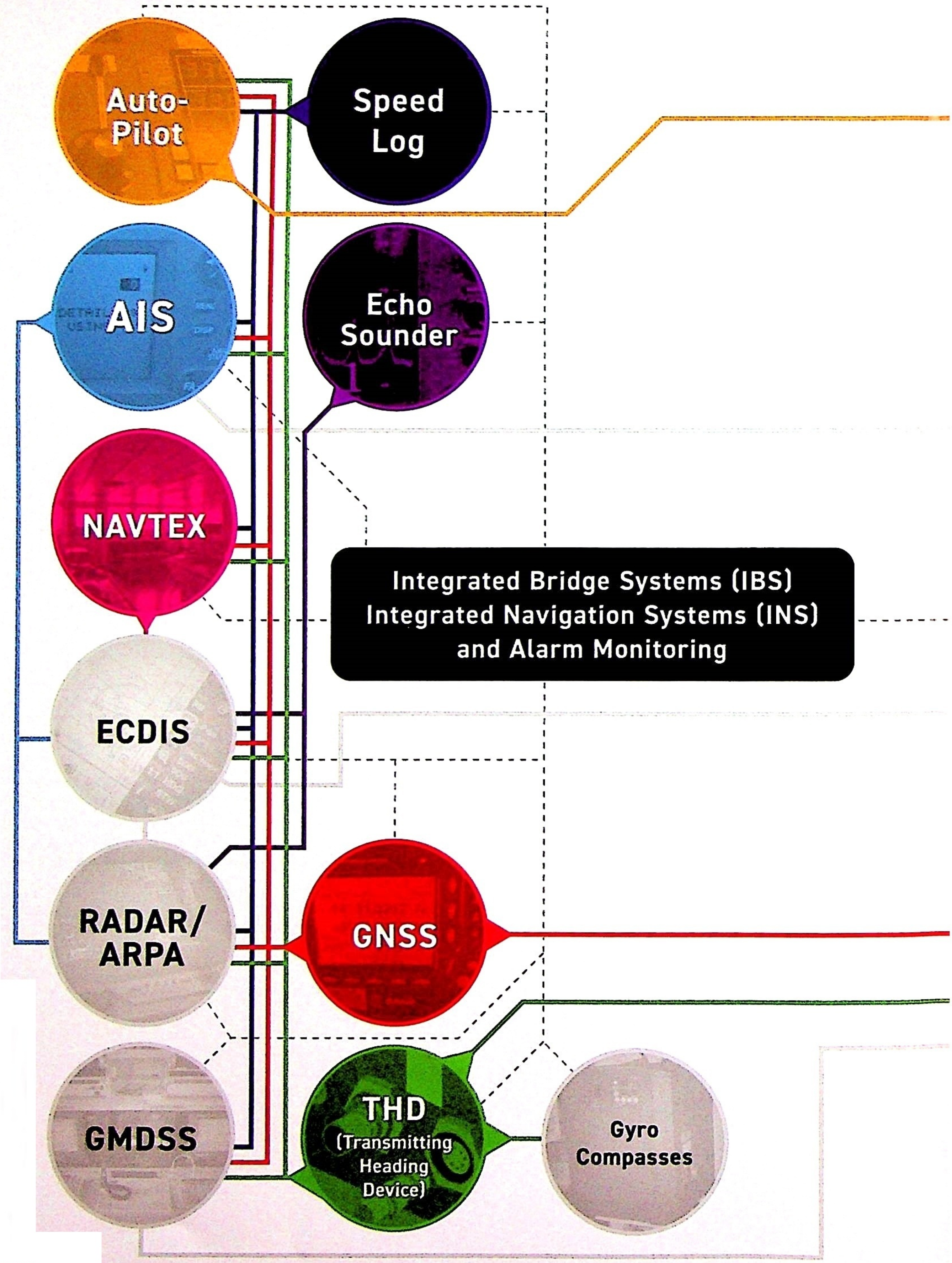
Sea Area A3

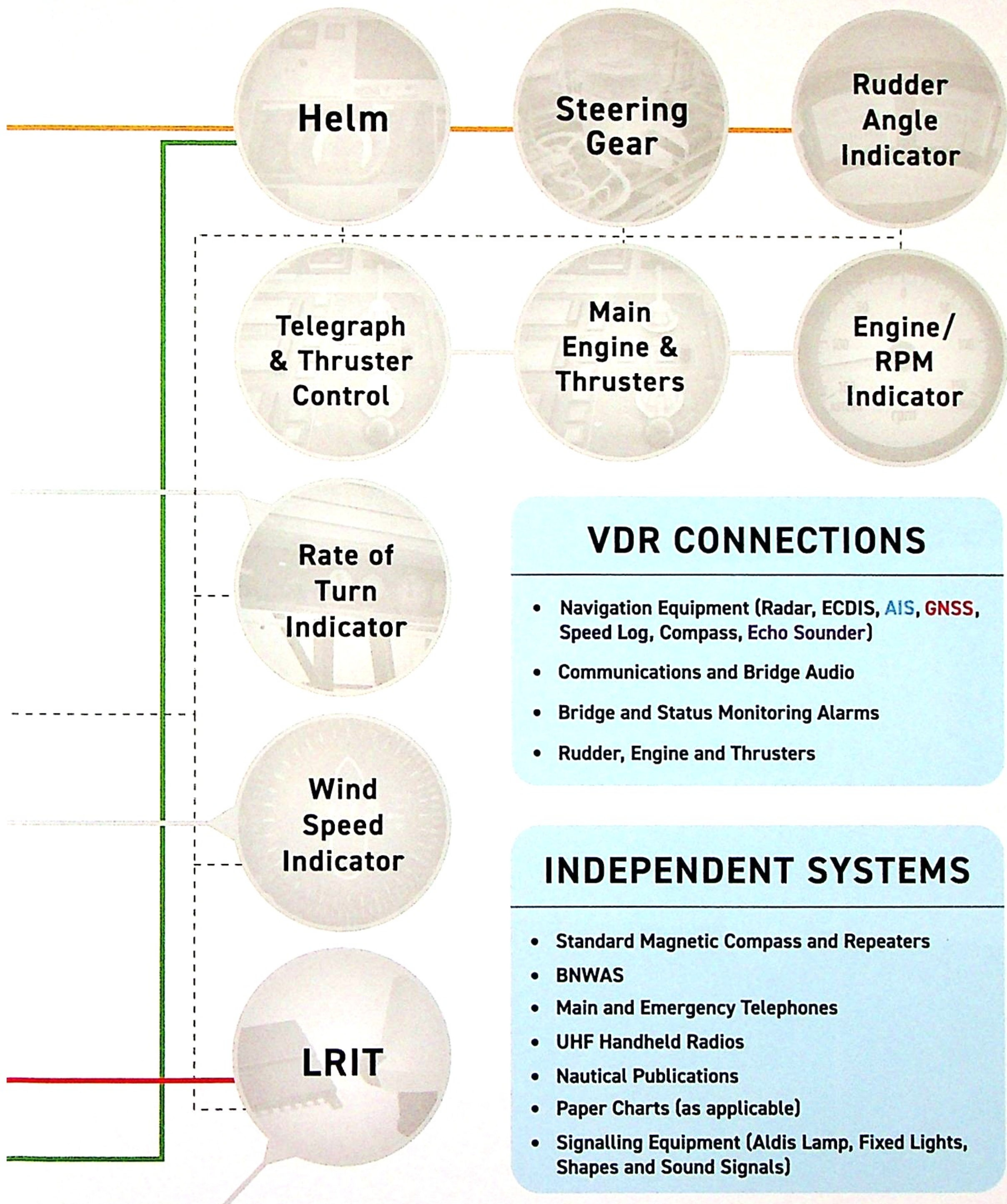
An area, excluding sea areas A1 and A2, within the coverage of an Inmarsat geostationary satellite. This area lies between about latitude 76 degrees north and south, but excludes A1 and/or A2 designated areas. Inmarsat guarantees their system will work between 70 south and 70 north (though it will often work to 76 degrees south or north).

Sea Area A4

An area outside Sea Areas A1, A2 and A3 is called Sea Area A4. This is essentially the polar regions, north and south of about 76 degrees of latitude, excluding any A1, A2 and A3 areas.

BRIDGE EQUIPMENT CONNECTIONS





VDR CONNECTIONS

- Navigation Equipment (Radar, ECDIS, AIS, GNSS, Speed Log, Compass, Echo Sounder)
- Communications and Bridge Audio
- Bridge and Status Monitoring Alarms
- Rudder, Engine and Thrusters

INDEPENDENT SYSTEMS

- Standard Magnetic Compass and Repeaters
- BNWAS
- Main and Emergency Telephones
- UHF Handheld Radios
- Nautical Publications
- Paper Charts (as applicable)
- Signalling Equipment (Aldis Lamp, Fixed Lights, Shapes and Sound Signals)

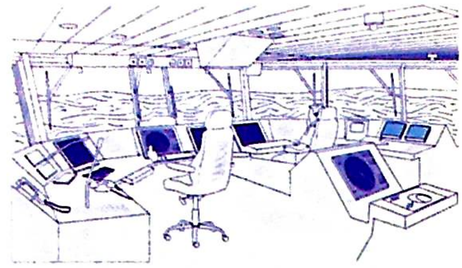
Key:

: Autopilot connection	: Echo Sounder connection	: THD connection
: Speed Log connection	: NAVTEX connection	- - - - : IBS and INS connection
: AIS connection	: GNSS connection	: Singular connection

CHAPTER 2

Bridge Equipment (Overview and Usage)

Bridge Equipment (Overview and Usage)



The computers and electronic equipment fitted on a navigational bridge must be configured correctly and within safe parameters.

All electronic equipment must be monitored to ensure that it does not exceed the prescribed safety parameters and that it continues to perform correctly.

Most ships are fitted with high-tech equipment, but many officers lack the skills to use the equipment effectively. This can lead the ship into danger.

While bridge equipment carriage requirements are mandatory, the OOW should still consider the following observations:

- The OOW can only accomplish their duties safely if they use effectively all of the navigation aids available to them. While the characteristics and operational performance of these aids are determined by the IMO and individual flag States, the OOW should be completely familiar with the capabilities and accuracy of the equipment on the bridge of the ship on which they are working. Being able to verify equipment performance and the quality of the information available will assist with decision making. Particular attention should be given to the accuracy and reliability of the particular equipment fitted on board, rather than the generic capabilities expected of the system
- performance standards are constantly being updated and refined to improve the operational reliability of equipment and to reflect technological progress, improvements in design and experience gained. This means that the equipment installed on a ship may not always be designed to the latest specifications and so accuracy and performance may differ from expectation. This is especially true where officers move from a newer ship to an older ship
- on joining the ship, and ideally before taking the first watch of the trip, the OOW should familiarise themself with the layout of the bridge. If time is available, the outgoing OOW should, as part of their handover, explain the specifics of individual equipment (including any faults) to the incoming OOW. The OOW should ensure that they have a basic understanding of the control of each item of equipment before the watch, specifically the use of the radar, ECDIS, helm controls, as well as the readouts for GPS, gyro and other essential repeaters. As the OOW settles in and time becomes available, they should develop an advanced understanding of each item of equipment, so that confidence in the information provided is increased, through experience and use
- the OOW should read the relevant equipment manuals, as this will allow them to establish operating limits, question the performance of the equipment where differences exist and know more instinctively whether equipment is functioning correctly. It is important that the OOW allocates sufficient time to read the manufacturers' instructions for testing and maintenance of each item of equipment. Not only will this allow the full capabilities of the system to be utilised, but greater understanding will facilitate better fault finding and enhance decision making in the event of any failure. **(The OOW should at all times consider the immediate actions in the event of the failure of each specific item of equipment, so that they can respond quickly and professionally in such an event)**
- some of the installed bridge equipment might seem outdated, outmoded and unnecessary. However, it should be assumed it is there for a reason, which is normally as redundancy in case of primary equipment failure. A prudent OOW will invest time in understanding how to use such equipment as it may one day tip the balance between safety and disaster
- knowing equipment intimately will allow management of expectations and, ultimately, prevent the belief that bridge equipment is all encompassing and foolproof.

The OOW should also observe the following points when checking equipment and discovering any defects:

- To ensure adequate performance, readouts and display information from electronic equipment should always be compared and verified against information from different independent sources
- checks of electronic equipment should verify that the equipment is functioning correctly and that it is successfully communicating with any bridge system to which it is connected
- all equipment defects should be reported for repair immediately. Where available, the OOW should select the appropriate backup system, test it, start using it immediately and inform the Master
- when reporting defects to the Master, a proactive approach is best, ie not just reporting what is defective and what is being done about it, but also where the information that was being provided is now coming from and its level of accuracy.

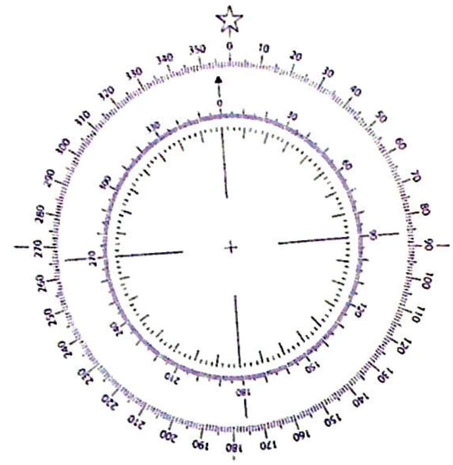
Anticipation of equipment failure is a good discipline to practise at all times. An OOW should be ready to respond to equipment failure by continually planning what should be done if failure did occur on the next stage of the passage.

2.1 Ship's Compasses

SOLAS Chapter V, Regulation 19 – Carriage Requirements for Shipborne Navigational Systems and Equipment

All ships, irrespective of size, are required to be fitted with:

- **A properly adjusted standard magnetic compass, or other means, independent of any power supply, to determine the ship's heading and display the reading at the main steering position**
- **a steering magnetic compass, except when the standard compass provides heading information at the steering position**
- **a spare magnetic compass, interchangeable with the standard compass, except if a steering compass or gyro compass is fitted (applies to ships of >150 GT and all passenger ships).**

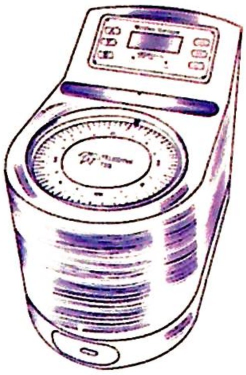


A compass remains the principal item of equipment for the safe navigation of a ship, despite the advancements in technology. Each seagoing ship is still required to carry a magnetic compass to provide backup against failure of the mechanical (gyro) or the electronic (satellite/fibre-optic) compass. The OOW must, therefore, ensure correct functioning of the primary compass, which may be gyro or satellite, but must also ensure that a magnetic compass is available at all times for use as a cross-check. While the use of the magnetic compass has diminished in the 21st century, it remains the principal directional instrument should all electronic aids fail on the bridge.

The OOW should:

- Ensure that a compass error is obtained at least once every watch and recorded. A comparison should be made with the compass deviation card and any notable differences addressed
- compare all compasses after each alteration of course, particularly if the ship had been on its previous course for a long period. Where appropriate, the compass error should be checked after a large alteration of course
- be aware of local magnetic anomalies in certain parts of the world; frequent checks on compass deviation should be carried out when in such locations
- ensure that compass viewing surfaces are clean and visible and that the gimbals are free at all times. Repeaters should be clean and free to use. If the ship is fitted with bridge wing repeaters, the bearing diopters should be kept in good condition, with the line of bearing observable. If the repeaters are removable, they may be kept inside during rough or wet weather, but should be returned for use as and when needed for collision avoidance/navigation.

2.1.1 Gyro Compass



SOLAS Chapter V, Regulation 19 – Carriage Requirements for Shipborne Navigational Systems and Equipment

All ships >500 GT shall have:

- **A gyro compass, or other means, to determine and display their heading by shipborne non-magnetic means, being clearly readable by the helmsman at the main steering position. These means shall also transmit heading information for input to other navigational equipment**
- **a gyro compass heading repeater, or other means, to supply heading information visually at the emergency steering position if provided**
- **a gyro compass bearing repeater, or other means, to take bearings, over an arc of the horizon of 360°, using the gyro compass or other means.**

A gyro compass is an electromechanical device that positions itself on True North. On the majority of ships, the gyro compass is connected to the autopilot and is also used as a transmitting heading device (THD) for other bridge equipment such as radar, ECDIS and the repeaters located at various positions around the bridge.

As the gyro compass is an item of critical equipment, any failure or error will affect the accuracy of equipment that receives heading information from it.

- Almost all gyro compasses have an automatic latitude and speed input, but some old models may require manual adjustment of latitude and speed corrections
- gyro error checks should be carried out on a regular basis using all available means
- the gyro can be easily checked for error while leaving and entering port by using visual transits. While on passage, every opportunity should be taken to check the gyro, including taking an amplitude of the sun at sunset and sunrise
- the OOW must know what to do if the gyro fails, as this may happen in a busy shipping environment or during pilotage when there isn't time to consult a check-off card. Ordinarily, this may involve switching to the backup gyro compass but, where this is unavailable or not fitted, it will involve transfer to a magnetic compass and all the additional corrections that this requires
- when setting courses on an autopilot, adjustments should be made for any gyro error
- gyro repeaters should be compared regularly. This should be done for bridge wing as well as other remote repeaters, such as in the steering flat
- a gyro compass will be affected by even a short duration power failure and, therefore, its accuracy cannot be relied upon until it has settled and a gyro error has been obtained
- while gyro and compass errors are required to be calculated during each navigational watch or after every large course alteration, compasses can be easily monitored by comparing them with each other.

The following information about equipment performance, settings and checks should be noted by the OOW:

- The gyro compass should always be properly settled and the heading compared with the alignment of the berth before sailing
- the maximum difference between the master gyro compass and the gyro repeaters should not exceed +/- 0.5°

- where the gyro compass or any repeaters are not correctly aligned, the Master should ensure that a realignment is carried out before the ship sails
- routine duties with respect to the maintenance and operation of the gyro compass include:
  - daily checks:
    - » check power supply (including UPS)
    - » check for any alarm illumination and test the alarm sound using the test button
    - » check for any abnormal sound, vibration or overheating created in the master gyro compass main body. Observe the performance of the gyro compass and make adjustment if necessary
    - » check for signs of liquid leaking in the gyro compass main body
    - » check the repeater with the master gyro compass to verify that the transmission system is functioning properly.

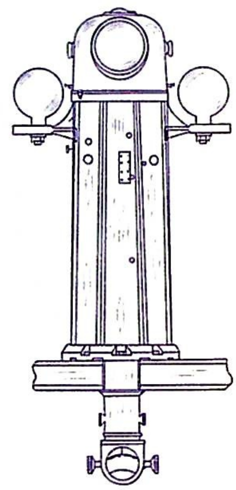
The gyro compass is a key navigational aid with inputs to most items of bridge equipment and is used directly for conning, ship handling and navigation. While the accuracy of the gyro compass is something that the OOW relies on all the time, they often may not realise its importance until a large error or failure occurs.

Most modern gyro compasses are sealed units that allow for little maintenance by the bridge team. However, the OOW should be aware of the location of the master gyro units (often in a room aft of the wheelhouse) and how to verify their accuracy. The gyro compass should be serviced periodically and this provides an opportunity to further understand the system.

2.1.2 Magnetic Compass

IMO Performance Standards given in Magnetic Compasses – Resolution A.382(X) and Transmitting Magnetic Heading Devices – Resolution MSC.86(70), Annex 2.

- **A magnetic compass must be adjusted by a qualified person (such as the Master or a compass adjuster) when:**
  - **It is first installed**
  - **Abnormal deviations are observed**
  - **The ship undergoes structural changes such as during a dry dock or major refit**
  - **New electronic/electrical equipment is installed near the compass**
  - **After loading/discharging steel cargoes**
  - **2 years after the last service.**
- **OOWs are not qualified and therefore not authorised to carry out compass adjustments. However, their role is significant in observing the compass error and deviation and notifying the Master of any observed anomalies.**



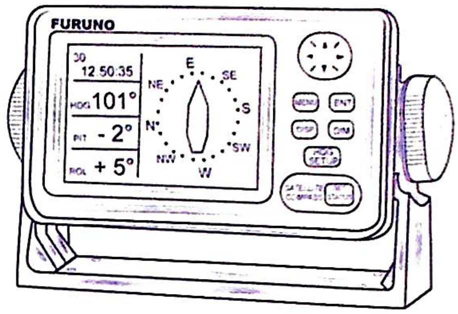
For all magnetic compasses:

- Compass error should be checked regularly, such as after every major alteration of course and/ or once every watch. This error must always be compared with the error recorded in the compass error book. Calculated deviation must be compared with the values in the deviation card. Any anomalies must be reported immediately to the Master, who may need to call upon a compass adjuster for large changes in deviation

- the OOW must ensure that comparison of gyro and magnetic compasses is made on a regular basis to identify any anomalies
- any bubbles observed in the compass bowl should be reported to the Master and removed immediately
- the 'true vector' function of ARPA should be operated with caution when the heading input is derived from a transmitting magnetic compass (TMC). ARPA prediction is reliant on steady state tracking, where course and speed remain steady. In a seaway, a transmitting magnetic compass may not produce a sufficiently steady heading, resulting in unreliable vectors.

In the event of gyro failure where only one gyro is fitted, the magnetic compass is the backup as it is independent and does not require any means of power.

2.1.3 Satellite Compass



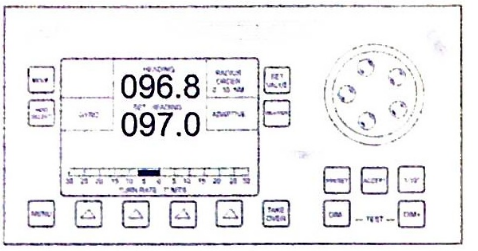
Satellite compasses are typically found on offshore vessels and are approved as THD devices under IMO MSC.116(73). Satellite compasses consist of two or three GNSS sensors, fitted within the satellite compass antennae, that calculate the vector relative to north, ie the ship's heading.

- The device works with GNSS satellites so accuracy depends upon availability and a clear viewing line between satellites and the compass antenna
- like GNSS, a satellite compass also requires time to acquire satellites and present course information. OOWs must, therefore, check the status of satellite acquisition and their DOP values prior to using the information provided by the satellite compass. The OOW should switch on the satellite compass some time before it is required to be used for navigation to ensure it is ready
- in addition to heading, the satellite compass also provides information such as COG, SOG, RoT and trip distance
- cautions regarding chart datum, such as WGS 84, that is used for GNSS also apply to satellite compasses
- a satellite compass, particularly if it is a THD, is required to have an inbuilt battery for power supply in addition to external power supply. Battery life usually depends upon usage but, in most equipment, the system gives a warning when the battery is unable to provide the required voltage. The battery must be replaced by a qualified technician at the earliest opportunity.

2.2 Autopilot (Heading/TCS)

SOLAS Chapter V, Regulation 24 – Use of Heading and/or Track Control Systems

1. **In high traffic areas, restricted visibility or areas that are navigationally challenging, it must be possible to engage hand steering immediately.**
2. **In the above circumstances, the OOW shall have a qualified helmsman available at all times.**
3. **The changeover from automatic to hand steering and vice versa shall be made by, or under the supervision of, the OOW.**
4. **Hand steering shall be tested after prolonged use of heading and/or track control systems and before entering areas where navigation requires close attention.**



The ship's heading can be controlled either by heading control or a track control system (TCS) when in open sea conditions. In many cases, the proven performance of the equipment may influence how the OOW chooses to use the equipment.

In heading control, the ship's heading is governed by the autopilot. In track control, equipment such as ECDIS (or GNSS) provides instructions to the autopilot that are set out in the passage plan.

In pilotage waters, heavy weather, restricted visibility or in emergencies, it is recommended that the OOW switches from automatic to hand steering. SOLAS Ch V, Reg 24 requires that the helmsman must be able to change from automatic to hand steering within 30 seconds.

While a track control system is effective in adopting the most efficient course based on the inputs it receives, such systems do require a thorough understanding of how the equipment is designed and intended to operate. This, together with experience from the other officers on board, will help in the understanding of its full capabilities and restrictions:

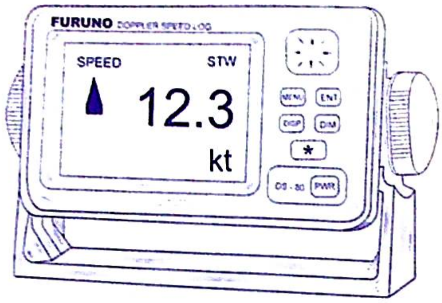
- If there is any XTE when 'track control' is activated, it will immediately seek to correct the error by applying a large angle of helm
- be aware of acknowledging course changes, depending on the type of system fitted
- a TCS maintains a stricter adherence to the set course than conventional autopilot systems
- in TCS, the OOW does not need to apply or make allowances for set and leeway as the TCS will apply these changes based on the data it receives from ECDIS (or GNSS)
- any error in the GNSS will automatically be acted upon by the TCS (the OOW needs to be particularly alert to occurrences when GNSS switches to 'DR Mode')
- in strong winds, high-sided vessels operating in 'track control' may have difficulty in maintaining and/or altering course.

The OOW needs to understand the following with regard to the use of autopilot/TCS:

- **[ ] Changeover from automatic to hand steering**
- **[ ] Use of steering override control such as NFU**
- **[ ] Adjustments of autopilot adaptive controls**
- **[ ] Procedure to change over to 'emergency steering'**
- **[ ] Occasions when more than one steering motor needs to be running**
- **[ ] The importance of ensuring compass and rudder repeaters are synchronised**
- **[ ] The need to respond correctly to any alarms (ie never just acknowledge the alarm to silence it)**
- **[ ] That such systems can be inefficient at low speeds**
- **[ ] Ship manoeuvring characteristics (in particular, rate of turn and turning circle)**
- **[ ] Effective use in heavy weather**
- **[ ] Alarm parameters in use at any time.**

2.3 Ship's Log (Speed Log)

The bridge team must be aware of the 'accuracy limits' of the speed log, particularly when navigating in areas where UKC is reduced as the log outputs may not reflect the actual speed values. For example, in shallow waters, where the speed of the ship may be reduced quickly, there may be a small time lag.



The ship's log, or speed log, has two key functions: determination of the ship's speed and recording the distance travelled. If the speed log transmits information to other equipment, such as radar or ECDIS, the type of speed (speed over the ground or speed through the water) should be known to the OOW.

Speed through the water (STW), ie ship's log speed, is used for collision avoidance.

Speed over the ground (SOG), ie from the GNSS feed, is used for navigation, day's run and fuel figures.

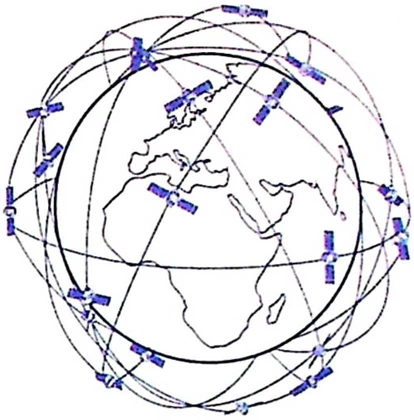
As a minimum, the log will provide information on the lateral motion of the bow and stern in knots. An arrow indicates the direction of movement. As the log speed is supplied to other equipment, the OOW should monitor it at sea, comparing it to other instruments available as well as general navigational expectations. Additionally, before departure and on first movement of the ship, the OOW can verify the change of difference in speed from all fast to underway.

Different types of log include:

- The acoustic dual axis log. This is based on the Doppler effect. High frequency acoustic energy is transmitted below the hull and signals are returned, amplified and then converted into speed
- the electromagnetic log. This type of log produces an alternating current through a transducer, creating an electromagnetic field in the water. As the ship moves through the water, a voltage is measured that is proportional to the speed. It is then amplified and processed digitally.

The OOW should have a general awareness of the location of the transducers on the hull of the ship. This information is usually available in the accompanying documents. Alternatively, when in dry dock, the OOW should visually inspect the hull to aid understanding of the transducer locations.

2.4 GNSS



All ships, regardless of their length of voyage, area of operation, nature of trade and size, are required under SOLAS Ch V, Reg 19 to be fitted with a GNSS receiver.

Shipboard GNSS receivers typically receive signals from the USA GPS system and, in many cases, from GLONASS. It is important that the OOW understands the signal inputs that any onboard GNSS equipment can receive.

The following five GNSS are currently operational:

GNSS SYSTEMS

GLOBAL COVERAGE

USA's GPS:

- Current position accuracy **5 metres.**

Russian GLONASS:

- Current position accuracy **5–6 metres**, likely to be improved to **1.4 metres** by 2020.

European Galileo:

- Current position accuracy **1 metre.**

(As of May 2019, the system has 26 of 30 satellites in orbit, with 21 satellites listed as usable, 3 not usable and 2 satellites undergoing testing. A fully operational system consisting of 30 satellites, 24 operational and 6 active spares, will be available in 2020. The complete Galileo constellation will consist of satellites spread evenly around three orbital planes inclined at an angle of 56° to the equator. Each satellite will take about 14 hours to orbit the Earth. One satellite in each plane will be a spare, on standby should any operational satellite fail. From most locations, 6–8 satellites will always be visible, allowing positions and timing to be determined very accurately to within a few cm. Interoperability with the US system of GPS satellites will only increase the reliability of Galileo services.)
Source: www.gsc-europa.eu

REGIONAL COVERAGE

Chinese BeiDou:

- Stated position accuracy **10 metres.**

Indian NAVIC:

- Stated position accuracy **10 metres.**

(The Indian Regional Navigation Satellite System (IRNSS) has the operational name of NAVIC ('sailor' or 'navigator' in Sanskrit, Hindi and many other Indian languages; NAVIC also stands for NAVigation with Indian Constellation). The NAVIC system will consist of a constellation of 3 satellites in geostationary orbit (GEO), 4 satellites in geosynchronous orbit (GSO), approximately 36,000 km (22,000 mi) altitude above earth surface, and 2 satellites on the ground as standby, in addition to ground stations. The constellation of 7 NAVIC satellites were all in orbit in April 2016.)

Note: Not all GNSS provide global coverage at present.

While each system has its own accuracy standards, the common factors that need to be considered by the OOW include:

- The position shown on the GNSS receiver is the position of its antenna, which may be some distance away from the bow of a ship, particularly on larger ships such as VLCCs. This may cause serious navigational issues, particularly when transiting confined waters
- the quality of the fix should be monitored, such as by checking the DOP (Dilution of Precision) values according to the GNSS receiver manufacturer's instructions. A low accuracy fix (ie high DOP value) should be rejected and alternative means of position fixing used. There are several DOP types, but the most important to the mariner is the HDOP (horizontal) because it indicates the accuracy in N/S and E/W satellite geometry
- during instances of a loss of signal, the GNSS receiver typically switches to DR mode. This is usually indicated by the letters 'DR' being shown on screen and/or a change in the signal strength traffic lights, combined with an audible alarm. Unless this is recognised by the OOW, this will give a false impression of the accuracy of the position displayed
- opportunities to compare positions obtained from GNSS with other means of position fixing
- whether using paper or electronic charts, datum used by the GNSS receiver must be compared with the chart and correction settings applied as appropriate
- the datum settings in different equipment, such as ECDIS/electronic charts, GNSS, satellite compass, etc, must be the same to avoid differences in the position indicated
- when using Differential GPS (DGPS) receivers, the OOW must be aware of the integrity of the DGPS signal, which will be indicated by symbols on the display screen
- although the integral GPS receiver within the GMDSS may be seen as a redundancy to other GPS receivers, on some GMDSS equipment the position is only displayed to the nearest whole minute.

2.5 ARPA/Radar

SOLAS Chapter V requires:

All ships of 300 GT and above to be fitted with a 9 GHz radar, whereas a 3 GHz radar is required to be fitted on all ships of 3,000 GT and above except when exempted by their flag State.

Marine radars use a magnetron and rotating antenna to transmit a narrow beam of microwaves around the ship out across the horizon. Targets are detected when the microwaves are reflected back, amplified and converted for display.

Radar is a valuable tool for the safety of navigation and collision avoidance. In conditions of both clear and restricted visibility, it provides:

- A means to continuously monitor the ship's position in coastal areas along the planned track, even when other methods of position fixing such as GNSS or visual methods are not available
- the means to locate other traffic and objects around own ship.

When combined with ARPA, the functionality radar can offer is enhanced even further. However, the OOW must understand the following when using such equipment:

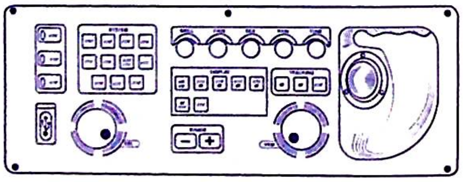
- Difference in capabilities and limitations of X and S band marine radars:
  1) X band or 3 cm (9.2 to 9.5 GHz) for high definition, good sensitivity and tracking performance.
  2) S band or 10 cm (2.9 to 3.1 GHz) to ensure that target detection and tracking capabilities are maintained in varying and adverse conditions of restricted visibility, rain and sea clutter.
- effect of the height of the radar scanner on range of detection, impact of sea/rain clutter and how to mitigate any negative effects on target detectability
- the possibility that certain targets may not be detected adequately by radar. The ability of radar to detect a target will depend on:
  - target characteristics (size, material, shape, aspect and texture)
  - the weather and sea state
  - optimum adjustment of the radar controls
- impact of weather and sea state on radar detection:
  - anti-rain clutter, which reduces the overall gain of the entire picture such that unwanted rain clutter is suppressed
  - anti-sea clutter, which reduces the amplification of received signals for all echoes up to about 3 miles from the centre of the radar display

  While anti-sea clutter works from the centre of the screen outwards, anti-rain clutter works across the screen. Both controls may be manual or auto
- performance monitoring should be carried out at regular intervals and in accordance with the manufacturer's recommendations
  (Note: Performance monitoring powers the magnetron to full power and should not be over used)
- the need to adhere to the manufacturer's recommended start-up procedure for the radar and initial set-up
- the duration a radar takes (maximum 4 minutes) to reach 'standby' and then 'operational' state from switching on
- impact of losing the gyro compass or speed input
- emergency power arrangement/UPS supply to the radars and how it operates and is tested
- impact of overlay of ECDIS and AIS information on the radar screen and the OOW's confidence to use radar, ARPA, AIS and ECDIS information on the same display

- what clear weather practice checks must be conducted
- on ships with multiple radar scanners in separate locations (eg main mast, bow, stern), the ability to change between them may result in differences in the shadow/blind sectors of each location. On such ships, the incoming OOW must be informed during watch handover of any changes from the primary radar antenna
- navigational capabilities when using radar, such as parallel indexing. These techniques should be used whenever possible, noting that measurement of range by radar is more accurate than measurement of bearing
- range scale in use and the importance of long range scanning
- false echoes may appear on the screen either when no real target exists or the echoes are displayed in the wrong position. False echoes include:
  - indirect echoes (obstructions in the path of the radar beam)
  - multiple echoes (multiple reflections between surfaces, usually when passing a large target at close range)
  - side lobe echoes (weaker beams appear in an arc on either side of the true echo)
  - radar interference (from other radar transmissions)
  - second trace echoes (where an echo is received from a target after the following pulse was transmitted)
  - ghost echoes (generated from a reaction with electro-magnetic fields, for example a ship approaching overhead power cables)
- the value in radar image overlay outputs to ECDIS
- ARPA maps should be used with extreme caution and must be checked to confirm that all areas, particularly TSSs, correspond to the current charted TSS
- data presented on ARPA is historical, ie ARPA provides information about what a target was doing at the time of last observation and not what it is currently doing. This is particularly noticeable in congested waters where alterations of course by other ships can occur frequently and visually sighting/confirming the aspect of another ship is critical before any alteration of course and/or speed of own vessel
- the OOW should prioritise the targets. This should be based on the existence of risk of collision and the rate of approach/TCPA and CPA.

Always remember that radar does not show on the screen everything you can see visually. This is because some objects may give poor echoes and other objects may return no echo at all. A proper visual lookout must be maintained along with interrogation of the radar.

Automatic Radar Plotting Aid (ARPA)



ARPA provides facilities for manual or automatic acquisition of at least 40 radar targets and 200 AIS targets (on ships of >10,000 GT), along with the ability to conduct trial manoeuvres. It provides course, speed, CPA, TCPA, range and bearing on any tracked target.

Further considerations when using ARPA include:

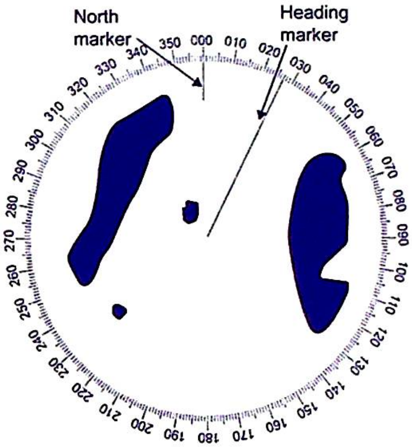
- Error in information provided to the ARPA will lead to errors in the ARPA results. This could lead to serious consequences for navigation as well as for collision avoidance
- the importance of knowing the differences in relative motion and true motion displays for collision avoidance and navigation respectively

- the duration an ARPA requires to complete a plot and present basic information about another target
- the impact on target information of any alteration of own or target speed and the resulting delay in obtaining accurate updated information
- guard zones and automatic target acquisition.

2.5.1 Stabilised and Unstabilised Radar Modes of Display

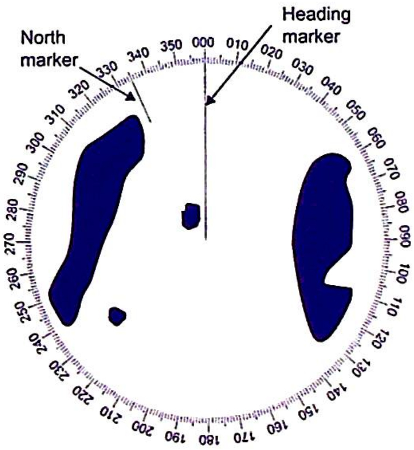
The radar picture may be presented to the OOW in a number of different modes that will affect the location of targets around own ship. To understand the radar display mode, the OOW must comprehend the difference between stabilised and unstabilised radar displays.

In a stabilised (or north-up) presentation, the radar must be supplied with true heading information. In this mode, the ship's heading marker is aligned to the true heading of the ship at any particular instance. This means that, where a ship is steering a course of 027°T, the heading marker will be aligned to 027°T on the azimuth scale, ie 000° on the azimuth scale will always show true north.



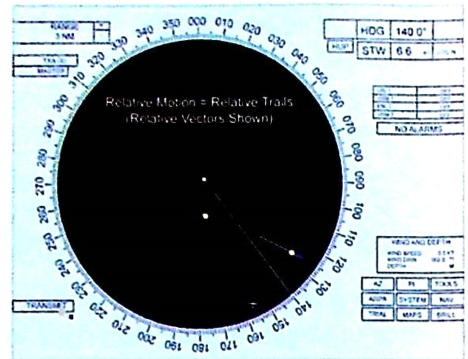
Radar display showing the heading marker as 027°T

In an unstabilised (or head-up) display, the radar is not using any heading information. The heading marker is aligned to the fore/aft line of the ship and shown at 000° on the azimuth scale.



Radar display showing the heading marker as 000°

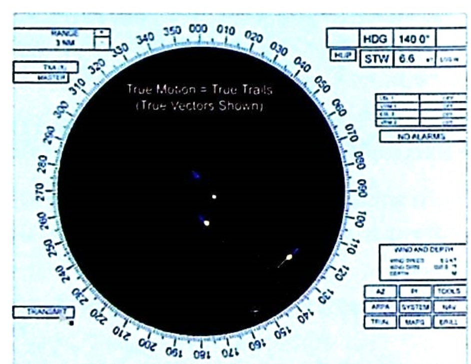
2.5.1.1 Relative Motion (RM) Display



In RM, the display moves around own ship. In this mode of display:

- The centre of the radar screen represents own ship's position
- stationary targets (eg POIs, Nav Marks, etc) will move at a speed equal to the speed of own ship (over the ground) and in a direction reciprocal to the direction of own ship (over the ground). This effect is utilised in parallel indexing techniques
- a moving target's motion (ie another ship) on an RM display is the resultant vector movement of own ship and the target's motion
- an RM presentation can be stabilised or unstabilised
- an unstabilised relative motion display is known as head-up (HU) display in which the heading marker is placed on the 000° graduated mark of the azimuth scale
  - all the radar bearings taken with EBL are relative, which means that the own ship's true heading needs to be applied before these can be plotted on a navigational chart
  - the advantage of head-up mode of display is that the picture on the radar screen resembles the true presentation of the ship's surroundings
- a stabilised relative motion display can be divided into the following types:
  - north-up stabilised mode
  - course-up stabilised mode.

2.5.1.2 True Motion (TM) Display

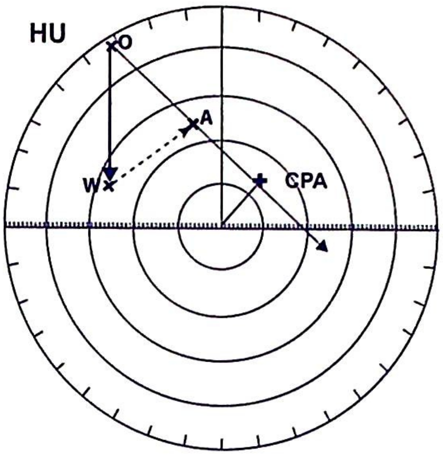


In TM, own ship moves through the display. In this mode of display:

- Unlike RM, own ship's position is not at the centre of the radar display but, instead, moves in a direction and speed equal to that of the ship. During its movement, the ship's position progresses to the edge of the radar display and then resets
- all moving targets appear to be moving through the water
- all stationary targets are shown as stationary
- the display can be divided into two types according to the course and speed input:
  - true motion sea stabilised
  - true motion ground stabilised.

2.5.1.3 Modes of Display in ARPA

The basic modes of display used in ARPA are the same as those used for radar. However, the ARPA calculates the target information by resolving the WOA triangle (same as that used in manual plotting) and presenting the operator with target data. It is, therefore, important to know the difference between the information available from each mode, shown in the table below:



Head Up
O = Original target
A = Actual target
O – W = Way (speed) of your ship

CPA = Closest point of approach
O – A = Direction of relative motion
Target speed = W – A
Target true relative course = W – A
Target true course = WA + Your course

Data/Information	Mode of Display		
	Relative Motion	True Motion Sea Stabilised	True Motion Ground Stabilised
Target's CPA/TCPA	Available instantly as soon as OA vector established	In true motion, the ARPA determines the true vector, based on which it can then calculate the relative vector. Therefore, CPA/TCPA is not available instantly and requires calculation time.	
Target's course, speed and aspect	Own course and speed input required for resolving the WOA triangle	Directly available from the true vector	Ground course, speed of target available directly
Input of own ship's data	Not required for calculation of CPA/TCPA	Required as own ship's position moves across radar screen at the course and speed input to ARPA	
Input of tidal information for set and rate of current	Not required for calculation of CPA/TCPA	Not required as the set and rate affects all targets at the same rate in the immediate vicinity of observing ship	Required to check the effect of current, otherwise the information obtained is the same as TM sea stabilised
Use of mode of display	Suitable for navigation and collision avoidance	Best for collision avoidance. Better than TM ground stabilised as CPA/TCPA can be readily obtained	Best for navigation, particularly if parallel index lines are provided
Limitations when used for collision avoidance	Target course and speed not instantly available, so extra time required to complete the plot	CPA/TCPA not instantly available, so extra time required to complete the plot to obtain both	Not suitable for collision avoidance as all courses and speeds calculated are ground referenced
Limitations when used for navigation	Issues caused by the movement of target echoes across the radar screen	Own ship moves on the radar display, so no issues due to echo movement on radar screen	Best for navigation if input of set and rate of tide is accurate or 'echo' referencing used to determine current

2.5.2 Use of Radar for Collision Avoidance (Restricted Visibility)

Radar can be used for collision avoidance in clear or restricted visibility. However, the difference is that, in clear visibility, watchkeeping officers are able to see the aspect of other ships, while in restricted visibility they have to wait until the movement of a target has been determined by either manual or automatic plotting (through the use of ARPA). As radar is the only means to decide on the action needed to be taken in restricted visibility, the relevant part of Rule 19 of the COLREGS is reproduced here:

When taking action to avoid collision in restricted visibility, the following should be kept in mind:

1) *COLREGS Part B – Steering and Sailing Rules – Section I – Conduct of vessels in any condition of visibility* applies to ships in any condition of visibility, ie in clear visibility as well as in restricted visibility, so the OOW needs to consider:
   - Rule 5 – Look-out
   - Rule 6 – Safe speed
   - Rule 7 – Risk of collision
   - Rule 8 – Action to avoid collision
   - Rule 9 – Narrow channels
   - Rule 10 – Traffic separation schemes.
2) The rules in *Section II – Conduct of vessels in sight of one another* do not apply in restricted visibility, so it can be said that, in restricted visibility, there is no stand-on ship and therefore every ship is a give-way ship. Therefore, any action taken to avoid collision should be in accordance with Rule 19:

Rule 19 – Conduct of vessels in restricted visibility

(a) *This Rule applies to vessels not in sight of one another when navigating in or near an area of restricted visibility.*

(b) *Every vessel shall proceed at a safe speed adapted to the prevailing circumstances and conditions of restricted visibility. A power-driven vessel shall have her engines ready for immediate manoeuvre.*

(c) *Every vessel shall have due regard to the prevailing circumstances and conditions of restricted visibility when complying with the Rules of section I of this part.*

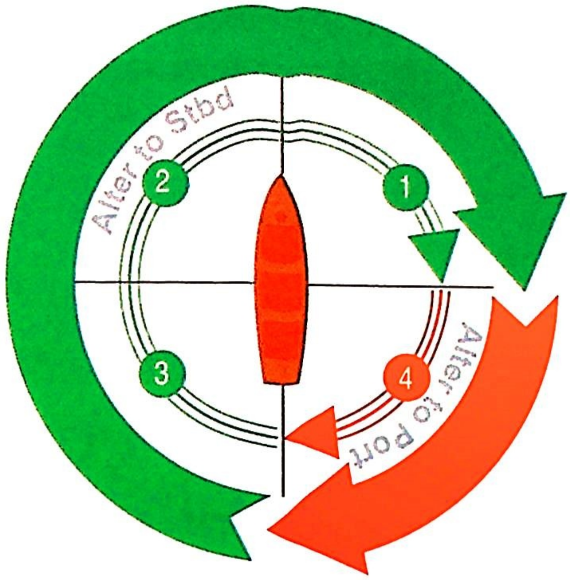
(d) *A vessel which detects by radar alone the presence of another vessel shall determine if a close-quarters situation is developing and/or risk of collision exists. If so, she shall take avoiding action in ample time, provided that when such action consists of an alteration of course, so far as possible the following shall be avoided:*

(i) *an alteration of course to port for a vessel forward of the beam, other than for a vessel being overtaken;*

(ii) *an alteration of course towards a vessel abeam or abaft the beam.*

(e) *Except where it has been determined that a risk of collision does not exist, every vessel which hears apparently forward of her beam the fog signal of another vessel, or which cannot avoid a close-quarters situation with another vessel forward of her beam, shall reduce her speed to the minimum at which she can be kept on her course. She shall if necessary take all her way off and in any event navigate with extreme caution until danger of collision is over.*

3) Paragraph (d) of Rule 19 is related to radar detection. The actions required (when altering course to avoid collision rather than reducing speed) can be summarised as follows:
   - Own ship, shown in the middle of the following figure, has to avoid alteration of course to port for ships forward of the beam, for all target ship directions of approach in quadrants **1** and **2.** It means that own ship would have to alter course to starboard to avoid a collision
   - own ship also has to avoid any alteration of course towards a ship abeam or abaft the beam, which will be the case for target ship directions of approach in quadrant **3.** It means that own ship must alter course to starboard for ships approaching in quadrant **3.** However, in quadrant **4,** this is the only area where own ship has to alter course to port to comply with Rule 19.

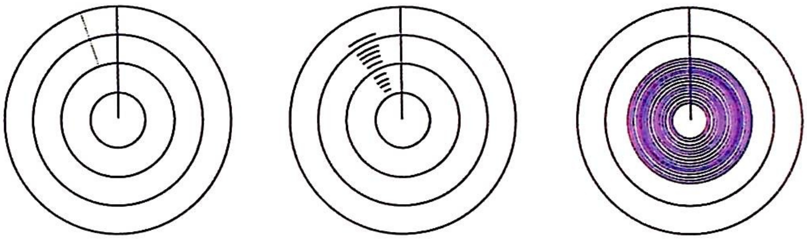


It is important to understand that not every plotting device is an 'ARPA'. A distinction between various devices available is provided below for reference:

- Radar
- ARPA (Automatic Radar Plotting Aid)
- EPA (Electronic Plotting Aid).

2.5.3 Use of Radar with Other Electronic Equipment

2.5.3.1 Radar and SART



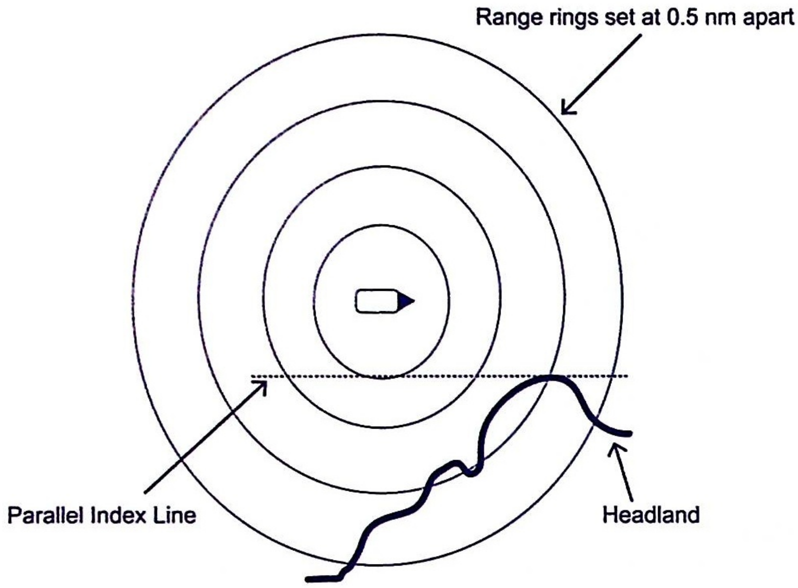
i) SART at 8 nm ii) SART within 3 nm iii) SART within 0.3 nm

A search and rescue transponder (SART) responds when interrogated by X band (3 cm) radar for ranges of up to 8 miles (the SART detection range depends upon its height above the sea level). When radar waves strike a SART, it transmits 12 complete cycles of pulses as a response to radar waves on the same frequency as that of the transmitting radar, showing a line of 12 dots at a distance of about 0.64 miles between each dot. However, when the range decreases, because of side lobes of the radar beam, these dots may change to an arc, or even concentric circles, around the centre of the radar display (shown above).

To measure the range and bearing of the position of SART, the first dot closest to the ship's position (or the centre of the radar display) should be the point of consideration. When detecting a SART with radar, the following precautions should be taken:

- When searching for a SART, the radar should be switched on to 6 or 12 miles range scale as the echo displayed may extend for about 9.5 miles beyond the SART position
- the anti-sea clutter control should be kept to minimum while the anti-rain clutter control should be used as normal. If the first dot is not clearly distinguishable from the radar display, a distance of 9.5 miles from the furthest echo (dot) of the SART signal can give an indication of the origin of the SART signal, ie the position of the SART.

2.5.4 Parallel Indexing



The vessel is in the centre of the range rings. The parallel index line is set at 0.5 nm away from the vessel.

Providing you keep the index line on the headland, you will maintain the most direct course, staying the set distance (in this case 0.5 nm) from the headland.

Parallel indexing is a useful technique for monitoring the ship's progress, but requires careful planning and execution by the OOW. When following the approved passage plan, the OOWs should set parallel index line(s) and monitor the movement of their echo on the radar screen.

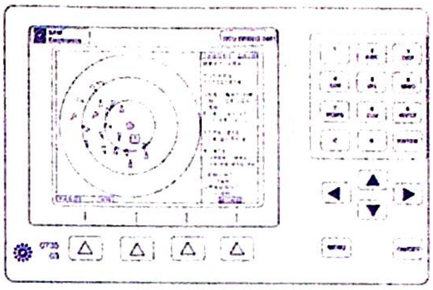
A minimum of four independent parallel index lines must be provided on any radar/ARPA.

The following steps can be used to set up parallel index lines correctly:

1) From the navigational chart, select a radar conspicuous object.
2) On the navigational chart, draw a line parallel to the charted course/track that passes along the edge of the selected object. The line drawn is known as the parallel index line.
3) Measure the perpendicular distance between the charted course and the parallel index line. This distance represents the range at which the target should pass from the selected object and is known as the Cross Index Range (CIR).
4) Prior to seeing the selected object's echo on the radar screen, switch on the index line.
5) Place the index line on the radar display at a range equal to the CIR and rotate it so that it becomes parallel to the ship's charted track (course made good).
6) As the ship progresses along its charted track, as long as it stays on track, the object's echo should move on the index line in a direction reciprocal to the direction in which the ship moves. However, if the ship starts to drift to any side, the echo will move to one side.

The OOW should make frequent use of parallel index lines in coastal navigation. Time is not an excuse as, if determined beforehand, it should take less than a minute for at least one line to be applied to the radar. Safety reports have shown that a number of groundings might have been avoided if the OOW had used even a single parallel index line.

2.6 Automatic Identification System (AIS)



Even though AIS provides information including course, speed, CPA and TCPA of other targets, this information is ONLY for those targets that are fitted with AIS and have it operational.

Therefore, targets that do not have an operational AIS will not be 'seen' by other ships. For this reason, AIS should NOT be used solely for collision avoidance.

Other shipboard equipment that can be connected to AIS to display target station information includes:

- Ship's log
- Gyro/magnetic compass
- ECDIS
- Radar
- Rate of turn indicator
- DSC receiver
- VDR
- Inmarsat or other long range communication equipment.

The AIS equipment provides the following information:

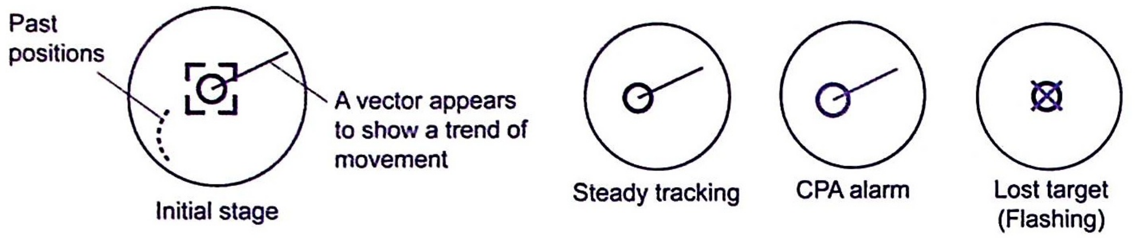
- Target station's identity and position in one display
- range, bearing and name of ship in one display
- information about all stations that are detected (or are within AIS range), as selected by the user
- in graphical format, the position, course and speed over the ground, heading and position of targets in relation to own ship. Various symbols are used by different manufacturers to show differences in targets, such as those used on ARPA.

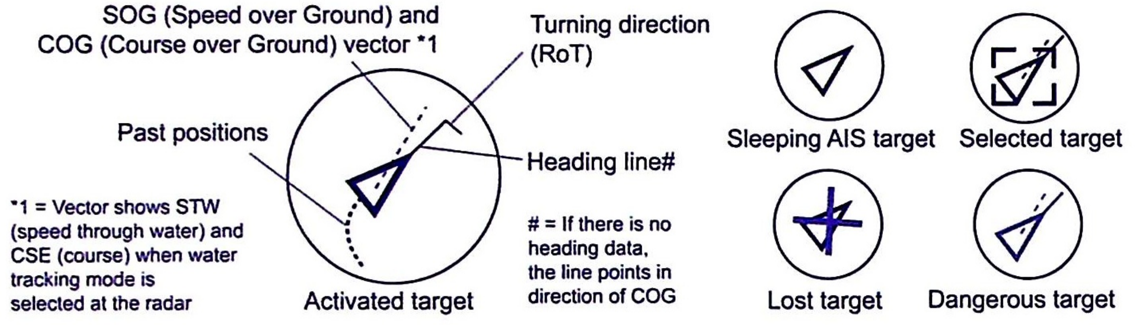
The OOW is required to update/enter the following information as required:

- Ship's draught
- number of persons on board
- nature of cargo or ballast voyage
- destination and ETA
- correct navigational status (eg at anchor, NUC, moored, towing astern, etc).

AIS uses five types of symbols on either the AIS graphical display or on attached ARPA or ECDIS. The OOW must be familiar with the differences in these symbols and their meaning:

- Sleeping target, for which no action to avoid collision is required
- activated target, for which action to avoid collision may be required
- selected target, for which the user needs more information on manual selection of the target from the AIS equipment
- dangerous target, which is in breach of the CPA and TCPA limits that have been preset by the user
- lost target, for which the AIS signal has been lost.





AIS is a valuable aid on the navigational bridge. However, it requires certain factors to be considered during its use while remaining alert to its limitations:

- Failure to update AIS information upon entering and leaving harbour may cause confusion, particularly where target information states the ship is moored when it is actually underway
- where ports have multiple routes of entry, exit and pilot stations, the destination and ETA fields should be updated, where possible, to make it clear to other ships which route is being taken
- some ships, such as warships, leisure craft and fishing vessels, may not be fitted with AIS
- AIS fitted on ships as part of the equipment carriage requirements may be switched off due to various circumstances and at the discretion of the Master. OOWs must remain alert to the possibility that some targets may go undetected, even if fitted with AIS
- a wrong input of course, speed, rate of turn, etc has the same consequences as incorrect information being used for a target in a manual radar plot. OOWs should frequently compare own ship's data displayed in AIS with the actual instrument from which it is being relayed
- AIS uses ground speed/course from GNSS, which cannot be used for collision avoidance
- incorrect offset data for the antenna location can provide a positional error that results in target separation on an ARPA display, even at a close range
- AIS static, dynamic and voyage related information should be carefully checked at regular intervals. This is particularly important where units have been shut down for any period of time, noting that some data may be changed only on the authority of the Master
- OOWs should regularly test the information transmitted by their own ship. This can be done by contacting another station to see what data they have received from the ship.

AIS information can be displayed on a radar display, which provides the following benefits:

- As the AIS is based on radio waves that can travel longer distances than radar waves, the targets that will normally be hidden behind a coastline may be detected by AIS and shown on a radar display
- if using AIS information overlaid on the radar display, the AIS identity of echoes will be displayed on the radar screen
- the AIS information includes rate of turn (optional) data that can help improve assessment of target track during collision avoidance manoeuvres or navigational alterations of course
- AIS information does not suffer from sea or rain clutter, so it provides improved detection ability over radar

- AIS tracking is not subject to target swap, so will not result in track loss of targets
- AIS information does not suffer from target loss due to the speed of the target (ie HSCs), so targets are continuously tracked and can be displayed on the radar display.

When using AIS information, targets as far away as 40 miles can be detected with accuracy and displayed on the radar screen. This allows the OOW to predict target motion and also to see their intentions for the future. It can, therefore, be said that AIS overlay radar provides better possibility of traffic monitoring and reduces the risk of collision. However, use of AIS on a radar display has certain limitations:

- AIS information itself may not be accurate
- the position of a target echo on a radar display may be different from that provided by AIS for the same target.

2.7 ECDIS/Paper Charts

SOLAS Chapter V requires all ships to have nautical charts and publications to plan and display the ship's route for the intended voyage and to plot and monitor positions throughout the voyage. An electronic chart display and information system (ECDIS) is also accepted as meeting the chart carriage requirements.

Ships are required to carry adequate and up-to-date navigational charts for their entire passage. The carriage of charting information is acceptable in paper or electronic format, with electronic acceptable only if used with an approved ECDIS and a suitable means of backup.

With the advent of ECDIS as a primary means of navigation, the use of paper charts has declined. However, the principles used for 'chartwork', from chart selection to planning a passage and then execution and monitoring of that plan, remain the same for both paper and electronic charts.

When using any type of chart datum, the OOW must be familiar with the following:

- When using electronic charts, it is important to understand the difference between the two types currently available:
  - electronic navigational charts (ENCs)
  - raster navigational charts (RNCs)
    (If using raster charts, the OOW must also use a portfolio of paper charts)
- the data sources input to the ECDIS, which include but are not limited to:
  - ship's position, provided by the GNSS receiver (and any errors therein)
  - ship's draught input by the OOW
  - UKC, provided by the echo sounder
  - radar and AIS information overlay
  - heading information
  - autopilot. If connected to ECDIS, this can give commands to steer the ship according to the passage plan, known as auto-tracking system
- selection of the correct layers of the ENC. Be aware that, on small scale, symbols may obscure other hazards located beneath them. Note that the size of the symbol on an ECDIS does not change with the scale of display
- correct use of the ECDIS safety settings. If the safety settings and alerts on an ECDIS are configured correctly, the navigator will gain an early indication of upcoming dangers, hazards and areas of concern. It should be further noted that:
  - the value for the safety depth should be calculated during the planning phase and entered in the ECDIS by the navigator. The ECDIS will use this safety depth to generate the safety contour on each ENC
  - it is recommended practice that the passage plan incorporates a planned safety depth, based on the planned draught and required UKC, appropriate for each leg of the passage plan. These planned values may change and having a UKC plan allows the safety depth setting to be reviewed proactively at any stage of the voyage
  - prior to departure, the planned safety depth value must be checked to ensure it is still appropriate as it may be affected by delays in sailing, tidal restrictions or other factors such as a change in draught. Where the safety depth value has changed, the route must be checked again prior to sailing.

The calculation for safety depth is as follows:

Safety depth = draught + under keel clearance (UKC) (including squat and a safety margin) – height of tide (HoT)

Safety Contours

The OOW should be aware that contours available for use will vary with each ENC. However, in many cases, the desired safety contour value may not be available within the ENC in use. This is particularly noticeable where safety depths are given to one decimal place, and where the system automatically selects the next deepest contour available (eg the contour for a safety depth of 7.7 m may not be available, nor the 8 m or 9 m contours, in which case the next deepest contour will be used, which would be the 10 m contour if available).

The displayed safety contour may change during a voyage for the following reasons:

- If the safety contour selected by the navigator is not available in the ENC, the ECDIS will select the next deepest contour and trigger an alert
- when the ship moves onto a new ENC and the safety contour previously in use is no longer available, the ECDIS will select the next deepest contour and trigger an alert.

It is useful to note that the soundings equal to or less than the safety depth selected are displayed in bold type when the display of spot sounding depths is turned on, making them slightly more conspicuous than deeper soundings. This is important because the safety depth value is intended as an aid when no appropriate safety contour is available in the ENC. Where the safety contour defaults to a value deeper than that specified by the navigator, it may not represent the limit of navigable water. In such cases, the navigator may be forced to navigate in these waters and the limit of navigable water will be represented by the spot sounding depths in bold type. This decision should be thoroughly risk assessed and discussed with the Master. This will particularly affect ships navigating in restricted sea areas.

If the ship must cross the safety contour to continue along the planned route, the following factors should be considered:

- Confirm that isolated dangers are displayed in shallow waters
- turn on the display of spot sounding depths
- check that suitably scaled ENCs are available
- assess CATZOC quality.

To mitigate the risks of navigating within the safety contour, the OOW should apply the following techniques:

- Define no-go areas through the use of mariner added objects
- monitor the echo sounder
- use additional bridge manning (ie request support from the Master)
- increase frequency of position cross-checking
- clearly mark in the passage plan whenever the ship will cross the safety contour.

2.8 Echo Sounder

The IMO performance standards for echo sounders, specifically the 'allowed' inaccuracy in depth measurements, are given below:

Under normal propagation conditions at a speed of sound waves of 1500 m/s, the error in measured depths should not exceed the greater of the values shown below:

- ***+/- 0.5 m on the 20 m range scale and +/- 5 m on the 200 m range scale; or***
- ***+/- 2.5% of the indicated depth.***

The echo sounder transmits sound waves into the water and uses the time interval between transmission and the return of the pulse to determine the depth of the water.

The echo sounder is the only item of equipment on the navigational bridge providing the distance from the ship's keel to the seabed. Consequently, this device must always be used in shallow water areas, particularly when making landfall after a long sea passage.

The maximum depth to which echo sounders operate is approximately 200 m. Beyond this depth, their use is limited.

When in shallow waters, the OOW must consider the following factors in the use of an echo sounder:

- The echo sounder should always be switched on unless it is an older paper unit, which should be switched on and marked on the paper in good time prior to making landfall and when navigating in shallow or coastal waters. Newer recorders will usually have a digital recording system that may need to be saved or exported at the end of the voyage. This might be saved directly onto a computer or exported on USB etc
- depth/UKC alarms must be set on the echo sounder as per the passage plan and should be changed as required on various legs of the passage
  - when depths measured with the echo sounder are used, they should always be reduced to soundings by applying the height of tide and ship's draught as shown in the formula:

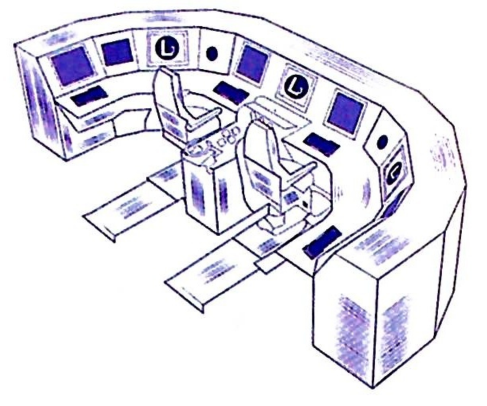
Charted Depth + Height of Tide (Predicted) = Ship's Draught + UKC

- if the alarm is set to alarm for a preset depth, it is important to ensure that this depth is not the minimum depth (ie allow a margin for error and safety) and that the alarm is not muted
- when comparing the depth of water indicated by the echo sounder with that shown on the chart, an allowance should be made for the height of tide and ship's draught, including any changes in draught due to squat
- the OOW should be aware of the echo sounder transducer location and which transducer has been selected: forward, midships or aft. The transducer location should be switched according to the directional movement of the ship
- always compare the depth readings on the actual echo sounder with those shown on any repeaters or on the ECDIS display to ensure accuracy of the readings shown
- echo sounder readings can provide a good means to obtain a position line, check a fix or check the estimated position
- the OOW must familiarise himself with the control settings on the echo sounder as they may vary between manufacturers. Inappropriate adjustments to the control settings may lead to incorrect depth read-out due to errors in the data obtained

- when an echo sounder is used to verify position in circumstances such as restricted visibility or lack of any radar conspicuous targets in the absence of GNSS, the OOW must consider 'echo sounder errors' such as:
  - sound wave speed of propagation through the water due to change in salinity or temperature of the water. This can introduce errors of up to 5% in the depth readings shown. In any such situation, an extra safety margin must be allowed to ensure adequate UKC
  - false echoes such as double or multiple echoes due to reflection of sound waves from the ship's hull showing a second layer of seabed. This error can be removed by changing the depth scale in use.

The OOW should never discount the importance of the echo sounder for safe navigation. In almost all voyages, the closest land is that directly beneath the ship and the echo sounder can alert the OOW to a changing and potentially dangerous reduction in UKC.

2.9 Integrated Bridge Systems



Most ships have a centralised location that provides integrated information from various sources, such as ECDIS, radar, GNSS and other equipment. There are two types of integrated system:

- **Integrated Bridge Systems (IBS)**
  IBS combines the information from different sources into a single conning screen or workstation. The IBS provides no further analysis of that data
- **Integrated Navigation Systems (INS)**
  INS analyses the incoming data for presentation to the bridge team and this decision support enhances situational awareness.

An INS has additional functionality (compared to an IBS) and this is divided into three categories:

- INS (A) – a system that provides the minimum functions of an INS
- INS (B) – in addition to providing the functions for INS (A), this system also provides decision support information
- INS (C) – in addition to providing the functions for INS (B), this system also provides automatic control functions for heading, track or speed of the ship.

The OOW must have a full understanding of the system's limitations and capabilities as well as the actions required in the event of the failure of any component of an integrated system.

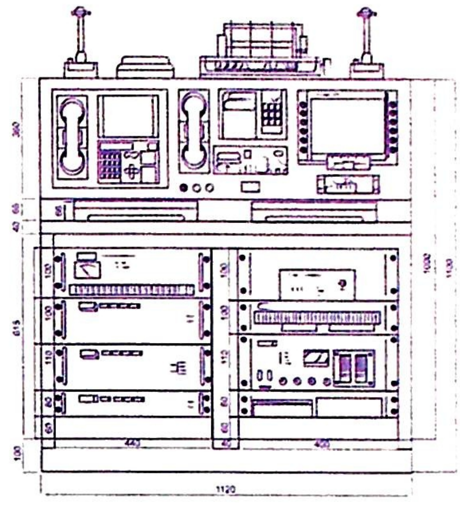
2.9.1 Engine/Cargo/Ballast Management Systems

Some bridges have additional integrated systems. This is particularly true where the bridge also functions as the cargo control room or where an engine control system is on the bridge. For the latter, an engineering OOW may also be on the bridge, as well as the deck OOW. Where this is the case, clearly defined roles in the SMS are essential and officers should be careful not to distract each other while fulfilling their own roles.

On ships where cargo and ballast systems are also controlled from the bridge, it is most important not to let these systems interfere with safe navigation. For example, if a cargo alarm sounds at sea (eg inert gas, tank over pressurisation, cargo temperature, etc), the OOW should send a qualified individual to investigate and report back. They should not let the cargo system interfere with keeping a proper lookout. If cargo and ballast operations are interfering with the keeping of a lookout, the Master should be informed and additional bridge resources put in place.

There may also be an integrated system for engine and fuel management systems. These provide accurate data on speed and fuel consumption to be compared with the ETA. The OOW can then adjust the speed for fuel efficiency purposes, according to the company procedure and the Master's Standing Orders. However, if the speed is adjusted for efficiency purposes, the OOW must be aware of the potential implications for collision avoidance and the need to maintain speed in certain situations. They should never become distracted by these monitoring and management systems.

2.10 Communications Equipment



GMDSS

Only holders of a GMDSS certificate should operate the equipment, although cadets can practise provided the GMDSS certificate holder is present. The following are useful observations with regard to GMDSS:

- The OOW must be aware of the need to inform the Master of the content of navigational and meteorological warnings and weather forecasts
- ensure that the position available to the GMDSS system is checked frequently to ensure it is correct. This is critical given that this position will be provided in distress situations
- ensure that the user knows when to receive MMSI for a given area and subject; many MMSI broadcasts are scheduled at a particular time. For example, all navigational warnings and meteorological forecasts are scheduled broadcasts, while meteorological warning and distress alerts and certain urgent navigational warnings are unscheduled
- it is the responsibility of the OOW to ensure that the equipment is set up correctly and the appropriate messages from the appropriate areas are being received. Details of the coverage areas and message categories that have been excluded by the operator from reception and/or display should be readily available
- know how to cancel a false distress alert, whether by VHF, MF, HF or Inmarsat-C. If for any reason an EPIRB is activated accidentally, the ship should contact the nearest coast station or an appropriate coast earth station or RCC and cancel the distress alert.

Procedures learnt during training for GMDSS certification may become outdated quite rapidly, highlighting the need for all ranks, including the Master, to practise on new equipment.

GMDSS Log Entries

Tests and checks of GMDSS must be carried out regularly, with records kept in the GMDSS logbook. The GMDSS radio log must include summaries of all urgency and distress traffic, with times and positions. The position of the ship should be recorded at least once each day, including the time. The Master should inspect and sign each daily entry.

GMDSS Checks

VHF Radio Installation

D W

- VHF.DSC internal
- Check position supplied is correct
- External VHF or MF test call

MF/HF Radio Installation

D W

- Check position supplied is correct
- External VHF or MF test call

Recognised Mobile Satellite Service*

D W

- Check position supplied is correct
- Internal test system

Survival Craft Portable VHF Radio

W M

- Check present and batteries charged
- Test on working frequency, not channel 16

Reserve Power Supply

D W M Y

- Battery on/off load voltage check (note voltage reading to monitor trend)
- Check reserve power supply (where not a battery, such as generator)
- Check security and condition of all batteries part of GMDSS installation. Check connections and battery
- Battery capacity test

Key: D : Daily W : Weekly M : Monthly Y : Yearly * : Iridium/Inmarsat

NAVTEX

D

- Check position supplied is correct
- NAVTEX correctly set up and working

EPIRB/ SART

M

- Internal/system test
- Inspect mountings and unit for any signs of damage

Antennas/ Connection

M

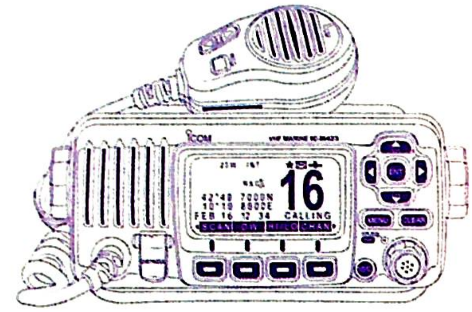
- Check condition of antennae systems and connections

Printers

D

- Check adequate paper/ink/ cartridge supply

2.10.1 VHF



SOLAS Chapter IV – Radiocommunications, Regulation 7 requires that:

1 Every ship shall be provided with:

.1 a VHF radio installation capable of transmitting and receiving:

.1.1 DSC on VHF channel 70. It shall be possible to initiate the transmission of distress alerts on channel 70 from the position from which the ship is normally navigated; and

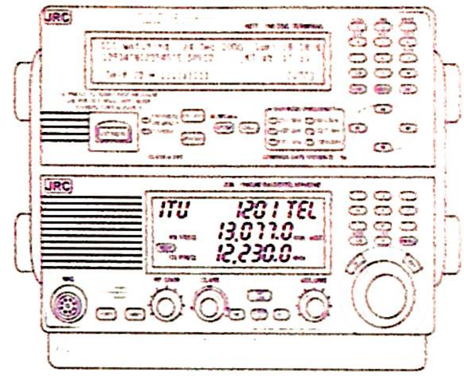
.1.2 radiotelephony on VHF channel 6, channel 13 and channel 16

.2 a radio installation capable of maintaining a continuous DSC watch on VHF channel 70 which may be separate from, or combined with, that required by subparagraph 1.1

Items that the OOW must consider with regard to VHF include:

- The communication equipment (such as VHF) in the wheelhouse should be checked and the channel(s) being monitored noted
- during bridge watch handover, a standard check should be to discuss any ongoing/expected communications in the next watch or any relevant history and the VHF channels being monitored
- a continuous listening watch should be maintained on appropriate VHF channels for the pilot station, harbour authority and distress channels. If the number of VHFs is less than the number of channels required to be monitored, dual watch function of VHF transceivers can be used
- think about what to say before using the VHF and use written notes where possible
- if mindless chatter is encountered on the VHF, especially on channel 16, do not turn off the VHF volume as this creates the risk of not hearing valid transmissions. In such circumstances, reduce the volume to the minimum audible level. Resist the urge to broadcast a response to such chatter as this may escalate the intensity of their illegal broadcasts
- portable GMDSS VHF radios should only be used in emergencies. These radios are supplied with disposable batteries so, if used routinely, they may not work properly in an emergency.

2.10.2 MF/HF



SOLAS Chapter IV – Radiocommunications, Regulations 9, 10 and 11 require that a ship engaged in voyages in sea areas A2, A3 or A4 shall be fitted with:

An MF radio installation capable of transmitting and receiving, for distress and safety purposes, on the frequencies: 2,187.5 kHz using DSC, and 2,182 kHz using radiotelephony.

This installation must be able to maintain a continuous DSC watch.

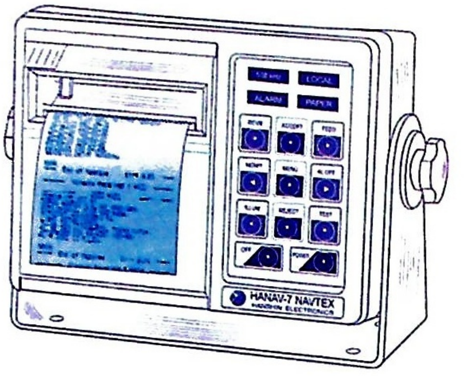
SOLAS also requires that ships in sea areas A2, A3 and A4 be fitted with an HF radio, except where compliance is met through another installation (for example, the use of a geostationary satellite service in sea area A2). Therefore, whether an MF and HF radio installation is on board will depend on the sea area in which the ship will be sailing.

HF frequencies are as follows:

BAND	DSC FREQUENCY	RT FREQUENCY
HF 4 MHz	4,207.5 kHz	4,125.0 kHz
HF 6 MHz	6,312 0 kHz	6,215.0 kHz
HF 8 MHz	8,414.5 kHz	8,291.0 kHz
HF 12 MHz	12,577.0 kHz	12,290.0 kHz
HF 16 MHz	16,804.5 kHz	16,420.0 kHz

- The MF/HF installation should be confirmed as operable during the weekly check
- an external MF or HF DSC test call should be carried out once per month. However, it is often difficult to obtain a satisfactory test call, particularly as the ship is dependent on another station to respond to the test and the MF/HF range may be affected at times. The OOW should:
  - use the ALRS to identify a coast station that is maintaining a listening watch on MF or HF, as not all coast stations monitor these frequencies
  - perform the test at night and/or in good weather, where propagation is likely to be best and signals are not subject to as much interference
  - wait until the vessel is within range of a coast station in a country with greater infrastructure resources and where MF/HF tests are often responded to. For example, a vessel on a voyage from the UK to Chile would be better testing the MF externally when off the coast of Europe or South America, rather than off West Africa where the number of MF/HF listening coast stations is small
- the OOW should be familiar with the actions to be taken on receipt of an MF or HF distress call. Additionally, the OOW must only relay a long-distance frequency message, such as an MF mayday, where the coast station has not responded. This is to prevent unnecessary message relays across a large area
- the OOW should be aware that the MF/HF transmitter is very powerful and, due to the way in which waves are propagated, the transmitter will not be able to contact a station at close range. For example, the MF would be expected to work at a few hundred nautical miles from land and the HF at a few thousand nautical miles. Therefore, attempting to contact a coast station from a ship that is only 1 nautical mile away will not yield a response.

2.10.3 NAVTEX



NAVTEX is derived from the words navigation and telex.

While older NAVTEX sets were provided with a built-in printer, modern sets are an integral part of GMDSS and messages are displayed on screen or passed through to the ECDIS.

NAVTEX messages or warnings that are passed through to an ECDIS may, on certain sets, have the capability to automatically apply the corrections as a layer to the ECS.

Typically, these messages or warnings can be viewed by the OOW by placing the mouse cursor over the symbol to read the text.

Whether using a printed method or a screen method, a record should be made in the GMDSS log, by the OOW, that the NAVTEX has been checked.

If fitted, a connection to the GNSS receiver may prove useful in automatic selection of stations. The OOW will, however, need to set this functionality to their requirements.

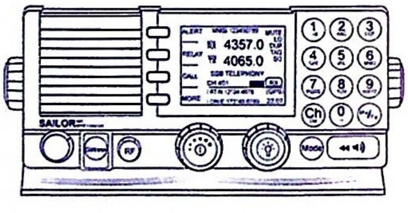
NAVTEX will store at least 200 messages of 500 characters in length, even after the equipment has been switched off. The identities of these messages are stored for a period of at least 72 hours, after which they may be overwritten by a new message.

If a character is not received accurately, the receiver prints an asterisk (*) to identify the erroneous character. Receipt of numerous erroneous characters indicates you may be leaving the range of the transmitting station.

If still within the effective coverage area for the NAVTEX station, the OOW should visually inspect the connections to the antenna and carry out equipment tests, as per the manufacturer's instructions, to check for any loose connections or damage.

The antenna must be inspected regularly and cleaned to remove any accumulated dust or salt particles.

2.10.4 Digital Selective Calling (DSC)



The OOW should pay particular attention to the use of DSC, bearing in mind the following:

- DSC can be a valuable tool to establish communication with another station. Once communication is established, a working channel/frequency can be used for further communications
- OOWs can only transmit messages accurately if they understand how a particular DSC receiver operates
- appropriate DSC, ie VHF, MF or HF, should be used, depending on the distance away of the other station
- when using MF or HF DSCs, OOWs must ensure selection of the appropriate frequency (2187.5, 4207.5, 6312.0, 8414.5, 12577.0 or 16804.5 kHz) for the desired message. The transmission should then be followed on appropriate voice frequency (2182, 4125, 6215, 8291, 12290 or 16420 kHz)
- DSC equipment is normally connected to the GNSS receiver to automatically update time and position. It is important to ensure that the position in the DSC is updated manually when a GNSS receiver fails, develops faults or is not connected to the DSC transceiver
- DSC equipment is designed to continue the transmission of a distress message until it is acknowledged by another station.

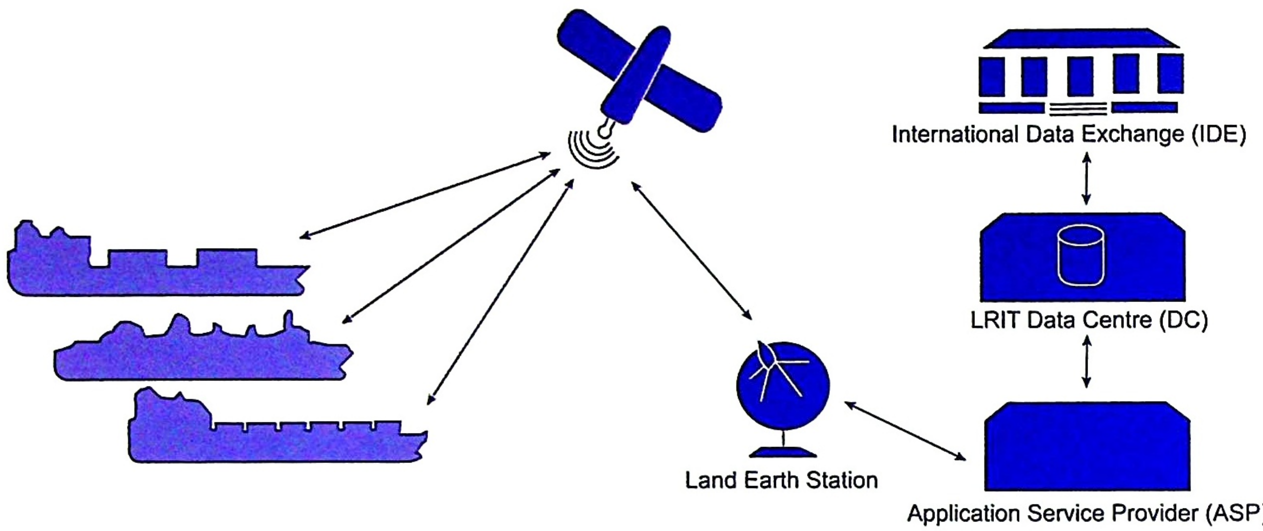
2.10.5 False Alerts

The primary reason for transmission of a false alert from shipboard equipment is lack of practice or training with the equipment, which may differ to that used during training for GMDSS certification.

When a false alert is transmitted, the OOW is recommended to take the actions listed in the following table:

Equipment	Actions – Inform the Master immediately and before taking any of the following actions
VHF DSC	If the false alert is observed on transmission: ▪ Switch off the equipment immediately and then switch it back on (to stop the message continuously transmitting) ▪ switch VHF to channel 16 ▪ make an all stations broadcast as per the example below: All Stations, All Stations, All Stations This is Ship's Name/Call Sign, MMSI Number, Position (in Lat, Long) Cancel my distress alert of Date, Time UTC. Over. If a false alert is observed some time after it has been transmitted and it is believed to have been the result of a fault in the equipment: ▪ When the 'Transmit Distress' is pressed, the equipment will continue to repeat the transmission until an acknowledgement is received. It will therefore be prudent to turn off the 'faulty' DSC and use a different VHF set to transmit the message given above ▪ the faulty DSC should not be used again until repaired.
MF DSC	Follow the same procedure as for VHF DSC except that, instead of using channel 16, the voice communication will take place on 2182 kHz.
HF DSC	Follow the same procedure as for VHF DSC except that the voice communication will take place on all frequencies in the 4, 6, 8, 12 and 16 MHz frequency bands.
Inmarsat	Do not turn off the equipment, but instead transmit a message to RCC notifying them with a 'distress priority' message using the same CES (Coast Earth Station) through which the false alert was transmitted. The message should include the following information: Ship's Name/Call Sign, MMSI Number, Position (in Lat, Long) Cancel my Inmarsat distress alert of Date, Time UTC. By turning off the equipment, the false alert cancellation message transmission will be delayed until the equipment is ready to transmit again after acquiring the satellites.
EPIRB	Do not turn off the equipment, but instead inform the Master and then contact the nearest CES or RCC. Upon receiving advice from them, turn off the EPIRB. This is to ensure that the authorities identify the correct EPIRB from which the distress alert is being transmitted.
SART	Turn off the equipment immediately and transmit a DSC Safety Alert on VHF channel 70 to all stations, followed by a voice message on VHF channel 16 as given below: All Stations, All Stations, All Stations This is Ship's Name/Call Sign, MMSI Number, Position (in Lat, Long) SART signal transmitted in position (Lat, Long) is a false alert transmitted at Date, Time UTC. Over.

2.10.6 LRIT (Long Range Identification and Tracking)

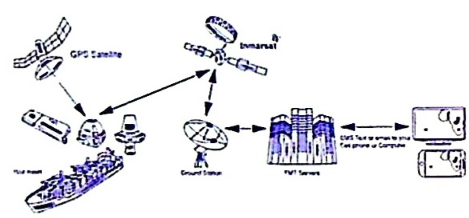


The purpose of LRIT is to enable flag States to obtain ship identity and position information for security purposes. In the EU, for example, EMSA receives all LRIT data on behalf of its member States at the Maritime Support Services Operations Centre (MSS Centre).

It is a requirement under SOLAS that LRIT is switched on.

The OOW should be aware, and make bridge personnel aware, that the Master is required to inform the Administration, without undue delay, if the LRIT equipment is switched off and to state the reason why. In addition, an entry must be made in the record of navigational activities and incidents, which is maintained in accordance with SOLAS Ch V, Reg 28, indicating the dates and times between which the equipment was switched off or the distribution of LRIT information ceased.

2.10.7 Ship Security Alert System (SSAS)



SSAS is a shipboard alerting system designed to inform shore-based facilities/authorities of a threat of a terrorist or piracy attack by raising an alarm. The objective of an SSAS is to increase the safety of ship, crew and passengers without making anyone on board ship aware of an alarm being activated.

SOLAS Chapter XI-2, Regulation 6 requires ships to be provided with a Ship Security Alert System (SSAS) as follows:

- **Passenger ships and high-speed passenger craft**
- **bulk carriers, tankers, gas carriers and cargo high-speed craft of 500 gross tonnage and upwards**
- **other cargo ships of 500 gross tonnage and upwards.**

Note: The location of alert activation buttons must remain confidential in the same way as details of the Ship Security Plan.

The SSAS may be a standalone system that operates independently of the existing GMDSS equipment or it may be provided as an additional control unit to the existing system.

The ship's administration (flag State) approves the security alert system suitable for its operational area, so the requirements are given in the 'security plan' drawn up according to the ISPS Code.

2.11 Internal Communications

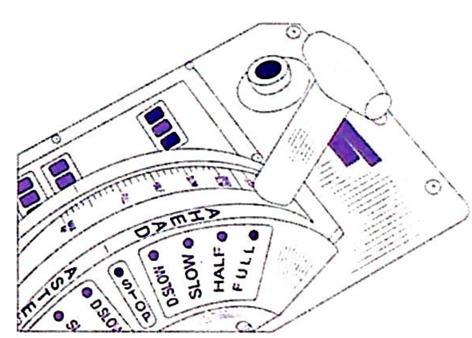
Ships are required to be fitted with means of communication between the following locations:

- Bridge and machinery control position
- bridge and steering compartment
- two-way means of communication between bridge and emergency control stations, muster and embarkation stations and strategic positions on board
- steering position and the standard compass
- if fitted with MES (Marine Evacuation Systems), an additional two-way communication system between the bridge and the location of the MES.

Ships must also have:

- A general emergency alarm system to summon crew and passengers to the muster stations
- a public address (PA) system to supplement the general emergency alarm system, with PA substations in the following locations:
  - bridge wings
  - forecastle deck
  - aft mooring station
  - midship mooring station
  - steering gear room
  - engine control room
  - cargo control room
  - crew/passenger cabins (speaker only)
  - ship's offices and lounges (speaker only).

2.11.1 Telegraph



The ship's navigation bridge is fitted with a main telegraph and an emergency telegraph.

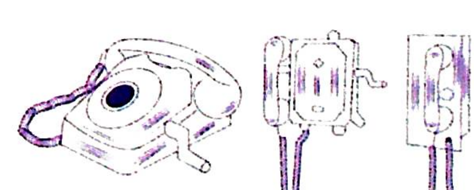
The main telegraph controls engine speed directly from the bridge while the emergency telegraph provides a visual indication of the orders required to be acted upon by the engineers in the engine control room, and their responses.

These are replicated on both the bridge and in the engine control room. Some telegraphs have backup functionality. The backup system will usually have reduced functionality to the main control, so any difference must be known and drills carried out for training and familiarisation purposes.

The bridge watchkeepers must monitor the process of:

- Order
- acknowledgement
- action to verify order by looking at the engine RPM indicator on the bridge.

2.11.2 Internal Voice Communications



Ships have on board:

- Main telephone system utilising an exchange
- sound-powered telephones as a backup system

It is common on ships to fit independent and direct telephone lines or other means of communication between the machinery space and the navigation bridge, or between the navigation bridge and the:

- engine control room
- steering gear room
- Master's cabin
- chief engineer's cabin

- talk-back system

  The talk-back system usually supplements the PA system. In a talk-back system, users talk to each other through microphones provided at both locations. PTT (press to talk) buttons may be fitted to transmit when pressed and, therefore, must be released to hear transmission from the other end. The rules used for fixed or portable VHF radios will apply to any communication over the talk-back system

- public address (PA) system

  This is used to make simultaneous announcements to all areas of a ship

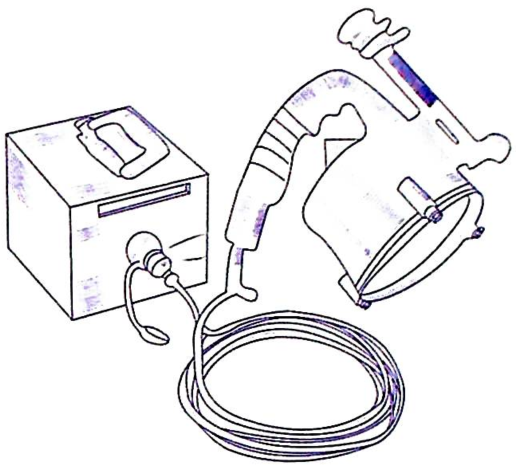
- UHF portable radio

  Ships will be supplied with VHF/UHF portable radios for communication between various locations within the ship. All sets must be kept charged at all times, with tests carried out with another user prior to being required for any operation, such as mooring stations. When using radios, the language used in SMCP should be followed to avoid misunderstanding.

2.12 Signal and Navigation Lights

The two types of signal light used on board are a daylight signalling lamp (commonly known as an Aldis lamp) and an all-round white light used for transmission of Morse code signals or light signals, as required under the COLREGS.

Aldis Lamp



SOLAS requires that all ships of over 150 GT, when engaged on international voyages, should have an efficient daylight signalling lamp with a power supply from the ship's mains and a backup power supply.

An Aldis lamp is used to attract the attention of other ships in accordance with the COLREGS. It may also be used for the transmission of coded messages through Morse code. It is valuable when all other means of communicating with another ship prove ineffective. Consequently, OOWs must be familiar with its use, ensure availability of spare bulbs and test the equipment and its backup power supply regularly.

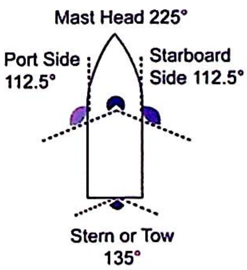
It is useful to practise with the equipment in fair weather and when safe to do so, particularly if the ship is carrying deck cadets.

Manoeuvring Light

The COLREGS require ships to be fitted with an all-round white light as a manoeuvring light in the same fore and aft vertical plane as the masthead light or lights. This light can also be used for transmission of Morse signals and, for this, its operation can be separated from the sound signalling apparatus.

OOWs must ensure that this light is tested during bridge control tests and also regularly when sound signals are used. Spare bulbs must be carried on board to fit as and when required.

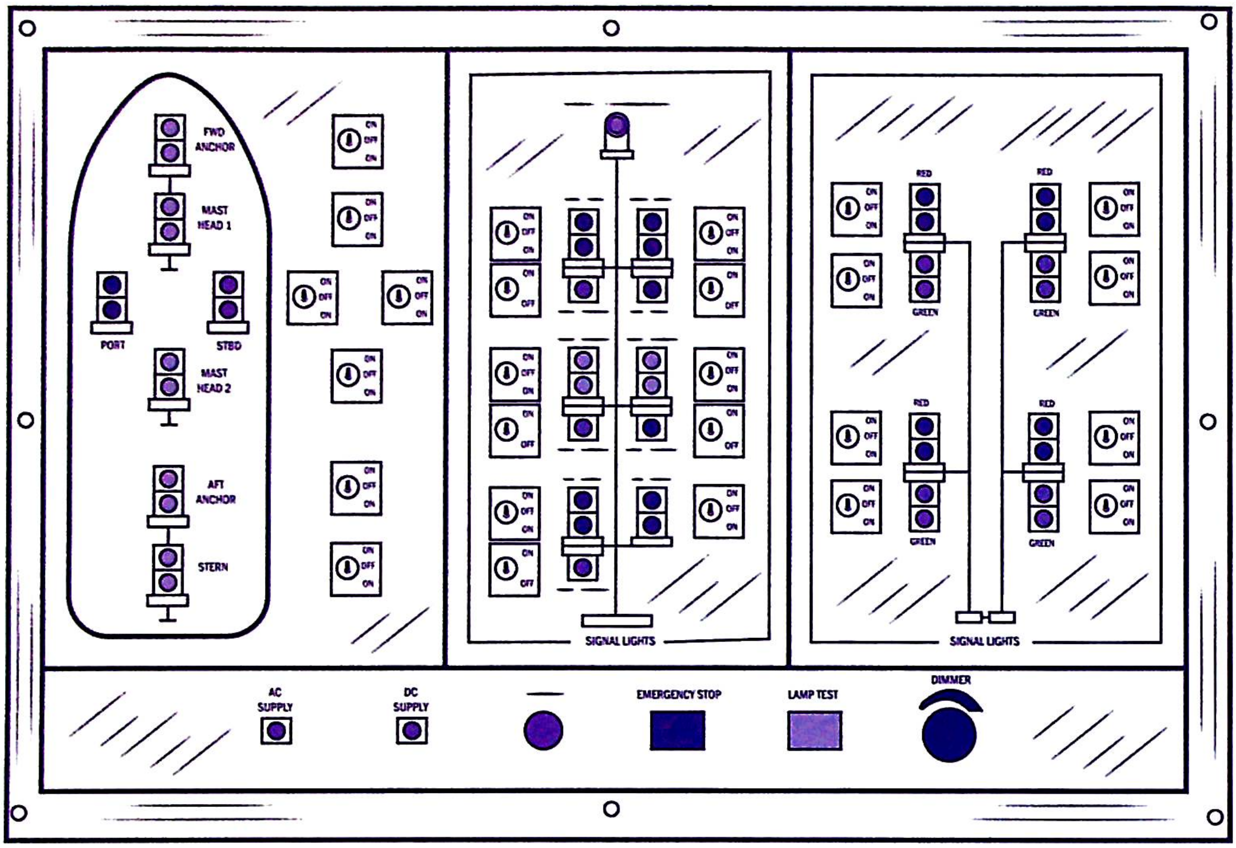
Navigation Lights



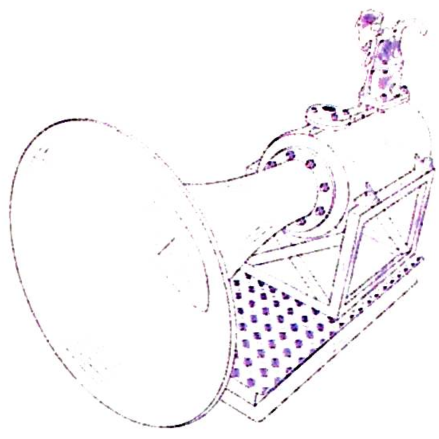
The COLREGS require a ship's navigation lights to be kept switched on from sunset to sunrise. However, these lights are usually switched on at departure from berth and then switched off when the ship's navigation status changes, such as when going from underway to anchor or when alongside in a harbour.

It is important to remember that changes in the navigational status of the ship require a change in the display of navigation lights.

In the event of failure of a navigation light, it is prudent to check the fuse before creating a permit to work to go aloft and check the bulb. Spare bulbs should be carried so that any fused lights can be replaced when required.



2.13 Sound Signalling Equipment



Ships are fitted with two types of sound signalling equipment:

- Emergency alarm system
- whistle, bell, gong or fog horn.

The emergency alarm system is used to warn personnel on board about emergencies requiring them to proceed to the muster stations. The whistle, bell, gong or fog horn are all used, under the COLREGS, for manoeuvring and warning signals.

Annex III of the COLREGS requires all ships to be fitted with sound signalling equipment. Its use must, therefore, always comply with those requirements.

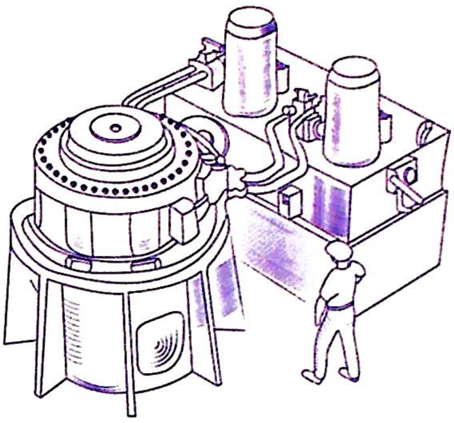
All ships, irrespective of size, must be fitted with a sound reception system, or other means, to enable the OOW to hear sound signals from other ships and determine their direction when the ship's bridge is totally enclosed. On most ships, keeping a bridge wing door open will meet this requirement.

2.14 Miscellaneous Items

There are several miscellaneous items on a bridge that are essential for the OOW. These include:

- Torch/flashlight. These are essential for night watches when illumination is required for filling out logs or checking equipment not fitted with a dimmed light. The bridge torches should be checked periodically, with a supply of spare batteries and bulbs available on the bridge. The OOW should also consider getting their own torch or pen light that can be carried in their pocket as this is useful when the bridge torch is not stowed in its normal location. A self-made red or black lens may be useful if the beam is too bright
- binoculars. There should always be a plentiful supply of binoculars around the bridge. They should be kept clean and replaced if not working correctly. The most common marine binoculars are 7 x 50, meaning 7 powers with an objective lens of 50 mm diameter. Larger sizes are not recommended as they are more unsteady when focusing and the light-gathering ability of a bigger lens limits their night-time use
- notepad, pen/pencil. While it may be obvious that such materials are kept on the bridge, there is value in the OOW having their own writing instrument and pocket notepad. For example, this is apparent when a sudden need occurs to write down something important during an unplanned VHF call, but the bridge notepad is on the other side of the wheelhouse!
- bridge toolbox. A set of essential bridge tools should be available. This might include spanners, an adjustable wrench, screwdrivers, tape, etc. These can be particularly useful for small maintenance tasks and also for opening equipment cases etc. However, any use of the bridge tools should not interfere with the navigational watch and repairs to equipment should be carried out at a safe and suitable time
- bridge publications. While the suite of publications on the bridge will vary by flag State, ship type and company, the OOW should be familiar with the resources available. The OOW should, as time allows, consult publications for general reading and to maintain theoretical knowledge. Navigation publications and their consultation is an essential component of creating a proper passage plan. The use of sailing directions and other professional resources should never be neglected by the OOW. The officer in charge of the bridge publications (usually the 2/O) should ensure that new editions are added to the bridge bookshelf and that updates are applied to official products (eg updates from the UKHO to official publications/notice to mariners).

2.15 Steering Gear

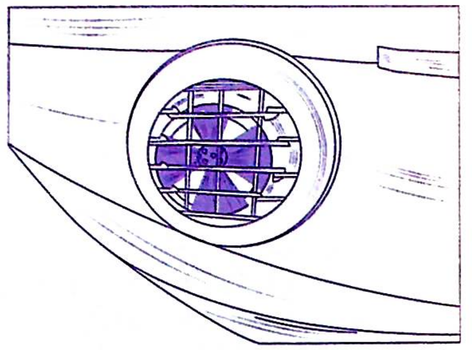


The ship will be fitted with steering gear that can be controlled directly from the bridge. An emergency means of operation will also be available, both on the bridge and locally in the steering gear compartment.

A large number of accidents result from failure of ships' steering gear. While the full range of potential issues relating to steering gear failure is beyond the scope of this section, guidance to avoid or reduce the impact of any failure is given here.

- Engineer OOWs must ensure that all required checks on the steering gear are carried out thoroughly and as per the ship's procedures or equipment manufacturers' instructions. They may use a checklist such as the '*Steering Gear Test Routines*' checklist card, which will assist in ensuring all of the required areas are fully covered
- checking oil levels and functionality of components will be part of the ship's engineers' regime and they will maintain the required records. However, appropriate regular communications between the deck and engineering officers will ensure any significant or relevant information is exchanged regularly
- OOWs must familiarise themselves with the emergency equipment, emergency procedures and the means of communication between the bridge and steering room. In addition, all personnel tasked to assist with emergency steering must be familiar with the procedure
- practice during drills builds the necessary confidence and familiarity with the equipment to ensure that personnel will be able to operate it in a professional manner in the event of an emergency.

2.16 Bow/Stern Thrusters



Thrusters, if used correctly, can add to the ease of manoeuvring a ship, particularly during berthing, turning around and when anchoring. Thrusters can counter the effect of canting during a turn or, more generally, the effects of transverse thrust. In confined spaces, thruster systems can help the ship turn, in effect, on its axis as it pivots around to a new course.

They can be used independently of the main propulsion system, in conjunction with it or, if fitted as azipods, as the main propulsion. The thruster system provides thrust in longitudinal and lateral directions, the extent of which depends on the system fitted. Thruster systems may be fitted at the bow and/or stern of conventional ships. They also form an integral part of ships fitted with a dynamic positioning (DP) system.

There are many types of thruster, such as conventional propeller and rudder, azimuth thruster, azipod thruster, tunnel thruster, Voith Schneider Propulsion (VSP), Gill jet, water jet, etc. Two of the most utilised are tunnel thrusters and azimuth thrusters.

Tunnel Thruster

A tunnel thruster is fitted inside an athwartship tunnel at the end of a ship, forward and/or aft, to apply thrust in a sway direction. Tunnel thrusters may be compromised in rough seas as the tunnel may be out of the water due to heavy pitching. The location of the tunnel from the centre of rotation (COR) affects the moment of that thruster. The farther it is located from the COR, the more effective it is. The proximity of two tunnel thrusters will affect their combined efficiency due to thruster-to-thruster interaction. Tunnel thrusters tend to become less effective with headway above 3 knots due to fore and aft movement of water affecting athwartship thrust.

Azimuth Thruster

Azimuth thrusters are large powerful thrusters capable of rotating 360°, which eliminates the need for a conventional rudder. They are powerful enough to provide main propulsion. The propellers may be designed as fixed-pitch or variable-pitch propellers, with a nozzle to provide directional thrust. Azimuth thrusters can apply thrust in positive as well as negative direction by changing pitch. Some azimuth thrusters can be retracted to avoid grounding damage.

Azimuth thrusters can be fixed installed, retractable, swing-up or underwater mountable. Underwater mountable thrusters are used as DP propulsion for very large ships. Azimuth thrusters may be configured by the operator in various modes, depending on the operational and environmental conditions. They are usually a component of a DP system. The controller calculates the total force and moment to keep the ship in the position and heading that has been set by the operator for a given environmental condition.

Operation

Before arrival or departure, the Master or OOW should confirm that adequate power is available for use of the thrusters. When the system is operational, a brief test should be carried out to confirm they are functioning correctly. This allows for time to rectify any failure of the thrusters before they are required.

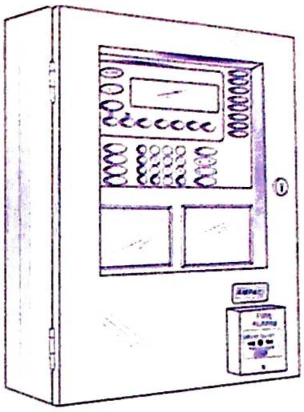
The Master should ensure that senior OOWs and the chief officer have the opportunity (when available) to practise using the thruster controls, for example during anchoring while waiting for a berth.

When using the thrusters, it is important to be aware that there may be a sluggish response time between activating the control and the thrust being generated. Therefore, when using the controls, it is better to use only a little power initially and then gradually increase as required. This prevents a large rate of turn suddenly developing.

Failure of a thruster may have serious consequences, such as drive-off resulting in collision. Often, thruster failure requires the operator's intervention and his response will depend on the reaction time available based on the warning given by a thruster failure alarm. Failure of an alarm should also be considered, as this has happened in numerous cases.

2.17 Internal Monitoring Systems

2.17.1 Fire/Smoke Detection Panel



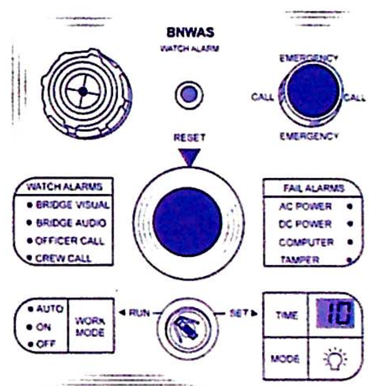
Various types of control or detection panels for fire and smoke may be fitted on the bridge of a ship. These panels provide continuous monitoring for the protected spaces. A smoke detection panel will usually consist of smoke sensing units, where air drawn from protected spaces is analysed by smoke detectors and an alarm is triggered when smoke is detected. Many ships only have a repeater panel on the bridge while, in some ships, the whole sensing unit may be located on the bridge. When smoke is detected in any cargo space, the OOW must ensure that the ship's procedures are followed immediately. When any such incident occurs at sea, the OOW's primary responsibility remains to ensure the safety of navigation, ie they should not leave the bridge until properly relieved by the Master or another OOW, as described in the ship's muster list.

A fire detection panel may also be fitted on the bridge. The procedural requirements for both smoke and fire detection and the subsequent actions are the same, but the speed at which an emergency resulting from smoke or fire will spread is different. As a consequence, the OOW must know fully the systems and the actions to take, including the requirement to discharge their primary navigational duty and attend to the alarms. Fire or smoke alarms should not be muted unless the subsequent actions have been determined on the basis of ship's procedures.

Whenever a smoke or fire alarm is raised, the OOW must assess whether it is a true or false alarm. Each alarm must be approached on the basis of it being a real event and it should never be assumed that it is a false alarm until it has been properly investigated.

An important aspect of emergency alarm procedures is the relief of OOW, lookout and helmsman. While they may have specific duties detailed on the muster list, they cannot leave the bridge until they are properly relieved.

2.17.2 Deadman Alarm/BNWAS



Under SOLAS Ch V, Reg 19, ships are required to be fitted with a Bridge Navigational Watch Alarm System (BNWAS or 'deadman alarm'). The OOW has to respond to the alarm sounded by the BNWAS at pre-set intervals. If he fails to respond to a BNWAS alarm, the Master or another OOW will be notified to attend the bridge and investigate immediately. This will assist if, for example, an OOW suddenly becomes incapacitated due to illness or is unable to silence the alarm due to other unforeseen circumstances, such as pirate attack.

The BNWAS is required to be operational when the ship is underway.

The OOW must be aware of the timings at which the BNWAS alarms must be reset to ensure the alarm does not go to the second or subsequent stages, generating an alert to the Master or another OOW. The durations are:

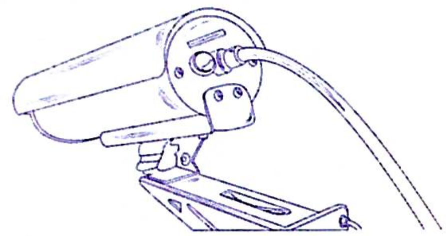
- First alarm: BNWAS is designed to remain silent for a duration of 3–12 minutes. This period is known as the dormant period and is set by the Master. Security codes/passwords etc for configuration of the system must only be known by the Master. At the end of the specified period, a visual alarm will activate and this must be reset by the OOW. However, an OOW may reset the function that triggers the alarms prior to the alarm being activated
- Second alarm: If the first alarm is not reset, an audible alarm will sound 15 seconds after the visual alarm
- Third alarm: If the second alarm is not attended to, a remote audible alarm in the Master's or other OOW's cabin will sound at an interval of 15 seconds after the second alarm

- Fourth alarm: If the third alarm is not attended to, 90 seconds later a remote audible alarm is activated to alert other personnel capable of taking over the safety of navigation from the bridge. In ships other than passenger ships, the third and fourth alarms may be combined to transmit one alert in all locations. Larger ships may be allowed to increase the gap between the third and fourth alarms to a maximum of 3 minutes to allow sufficient time for personnel to arrive on the bridge.

In addition, the BNWAS is required to normally operate from the ship's main power supply, but a backup of at least 6 hours must be provided by an emergency power supply such as batteries. The BNWAS transmitter will be fitted with a reset switch and additional controls can be provided at remote locations within the bridge. This may be through other equipment, such as an integrated bridge system.

Some ships may be fitted with a passive infra-red (PIR) resetting functionality, which will trigger an alarm if the system does not detect any movement on the bridge. If used, this system will have been approved by a Classification Society.

2.17.3 CCTV



CCTV (closed circuit television) is fitted on most ships' bridges, particularly on passenger, RoRo and offshore ships, as well as any other types of ship that need to remotely monitor areas of the ship. The primary objectives of CCTV are:

- To provide continuous monitoring without the need to send personnel to check any anomalies
- to reduce time between detection of an anomaly and the action taken to resolve it
- to facilitate security surveillance at all times.

Additional benefits include:

- Acting as a deterrent against security breaches
- recording of all information captured by the cameras
- any intrusions or breaches can be used to trigger alarms to warn the OOW. For example, CCTV cameras can be used in port or at sea to set up a security perimeter around the ship, where any intrusion will raise an alarm on board
- can be used for fire or smoke detection, where an analysis of the picture provides an indication of smoke or fire
- at sea, enhances lookout for piracy craft or other security threats
- onboard access can be controlled by the use of an access control system through CCTV camera imaging and face recognition technology
- cameras can be located in remote machinery or other spaces such as the main engine room, steering room, etc for monitoring purposes
- it can assist reconstruction of events for incident/accident investigations.

2.17.4 Voyage Data Recorder (VDR)

SOLAS Chapter V, Regulation 20 requires all passenger ships and other ships of 3,000 GT or more to be fitted with a VDR.

As a minimum, the VDR records the following shipboard information in real time for at least the last 12 hours:

- **Video – radar images**
- **Audio – communications on the bridge.**

A VDR may record other bridge equipment such as ECDIS, echo sounder and engines.

All ships are required to maintain onboard records in a manner that will enable the sequence of events immediately before an accident to be reconstructed.

The components of a shipboard VDR are:

- Main electronics unit that can either be downloaded onto a USB stick or connected to a personal computer (PC) to download data. The downloaded information can be viewed on board ship or ashore. This operation should, however, only be carried out by the Master or another person authorised by them
- bridge area microphones and interfaces with other instruments
- battery backed power supply
- a USB stick that can be retrieved by the Master in case the ship has to be abandoned
- memory capsule – a float-free device, normally activated by hydrostatic release unit (HRU).

CHAPTER 3

Prerequisites for Watchkeepers

3.1 Fitness for Duty

Deck officers should ensure they are fit for duty and able to carry out their watch effectively. This is primarily achieved through adequate management of hours of rest. While long periods of sleep are difficult during multiple port calls or in rough weather, the watch system should ensure, with only a few authorised exceptions, that minimum hours of rest are given.

The ILO Convention on Seafarers' Hours of Work and the Manning of Ships (ILO 180) was carried forward unchanged into the Maritime Labour Convention, 2006 (MLC). The Manila amendments to STCW Regulation VIII/1 and Code A-VIII/1 came into force on 1st January 2012, setting out the minimum hours of rest. These state the limits on hours of work or rest shall be as follows:

'(a) maximum hours of work shall not exceed:
  - *(i) 14 hours in any 24-hour period; and*
  - *(ii) 72 hours in any seven-day period;*

or

(b) minimum hours of rest shall not be less than:
  - *(i) ten hours in any 24-hour period; and*
  - *(ii) 77 hours in any seven-day period.*

Hours of rest may be divided into no more than two periods, one of which shall be at least six hours in length, and the interval between consecutive periods of rest shall not exceed 14 hours.

Musters, fire-fighting and lifeboat drills, and drills prescribed by national laws and regulations and by international instruments, shall be conducted in a manner that minimizes the disturbance of rest periods and does not induce fatigue.

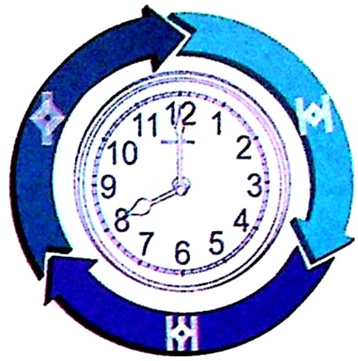
When a seafarer is on call, such as when a machinery space is unattended, the seafarer shall have an adequate compensatory rest period if the normal period of rest is disturbed by call-outs to work.'

The Master has a statutory duty to ensure that hours of rest are being given. However, officers should ensure they adequately and truthfully record their daily hours of rest under the approved record system on board. They should discuss any concerns or exceptions with the Master. It should also be noted that:

- The watch system is only effective if the efficiency of watchkeeping personnel is not impaired by fatigue
- it is the overall responsibility of the Master and the responsibility of every watchkeeping officer and rating to ensure that they are sufficiently rested prior to taking over a navigational watch. While commercial considerations may be in the mind of the Master, he must under no circumstances let these interfere with his requirements to provide adequate hours of rest to all seafarers
- it is the responsibility of the owner or operator in conjunction with the Master to ensure that the vessel is manned with a sufficient number of personnel so that a safe navigational watch can be maintained at all times by appropriately qualified and rested personnel in all foreseeable circumstances
- in approved exceptions, where the hours of rest cannot be met, there should be established procedures and contingencies in place to ensure that the ship is brought to, or remains in, a place of safety until a safe navigational watch can be established. In some circumstances, this may require a delay to a ship's departure or a period of anchoring
- officers should be careful to gain adequate rest by avoiding entertainment that may impact on working ability.

Alcohol consumption is prohibited during watchkeeping, with mandatory limits of alcohol being 0.05% for blood and 0.25 mg per 100 ml for breath (STCW Regulation VIII/1 – Fitness for Duty). It is an offence for a seafarer to be impaired by alcohol or drugs while on duty. During a handover, the outgoing OOW should ensure his relief appears fit for duty and is not observed as drunk or intoxicated.

3.2 Watch Arrangements



The following considerations are important regarding watch arrangements:

- It is the duty of the Master of every ship to ensure that watchkeeping arrangements are adequate for maintaining a safe navigational watch at all times, taking into account the experience of the watchkeeping team
- the composition of a navigational watch should comprise one (or more) qualified officers supported by appropriately qualified ratings. The actual number of officers and ratings on watch at a particular time will depend on the prevailing circumstances and conditions and the following factors should be among those taken into account:
  - traffic
  - weather conditions and visibility
  - fatigue
  - proximity of navigational hazards
  - use and operational condition of navigational equipment
  - whether hand steering is required
  - any unusual demands on the navigational watch that may arise as a result of special operational circumstances
- if support is needed by the OOW, for any reason, additional manpower should be called for
- in circumstances where a single watchkeeper is considered permissible, support personnel should be readily available (this is generally by handheld radio).

3.3 Master's Standing Orders

The Master's Standing Orders are important to an OOW as they contain the ship specific guidelines for navigation and ship operations. They set out how the Master wishes his ship to be run. Therefore, they should be read carefully and any content that is not understood should be clarified before signing.

- The Master's Standing Orders must be clear on the chain of command, how decisions and instructions are given and responded to on the bridge and how bridge team members can bring any concerns to the attention of the Master
- when reading Master's Standing Orders and other documents, ask yourself whether they are realistic. This comes with experience, but many procedures and processes may be simply incorporated without thought or may not be tailored to meet the requirements of a specific ship
- the OOW should seek clarification on any item in the Master's Standing Orders that is not understood
- take time to read the Master's Standing Orders and do not be rushed into signing them. Signing the Standing Orders means that they have been read and understood
- the Master's Standing Orders and Night Orders must be available for reference and consultation at all times by the OOW.

3.3.1 ISM Code and Company Procedures

The OOW should have a good knowledge of the Safety Management System (SMS) as required by the ISM Code. The OOW should utilise quieter periods to ensure they are up to date with the SMS as well as company procedures in general.

There should be open dialogue on board the ship on matters relating to the SMS and all personnel should have the opportunity to provide feedback and suggestions for improvement.

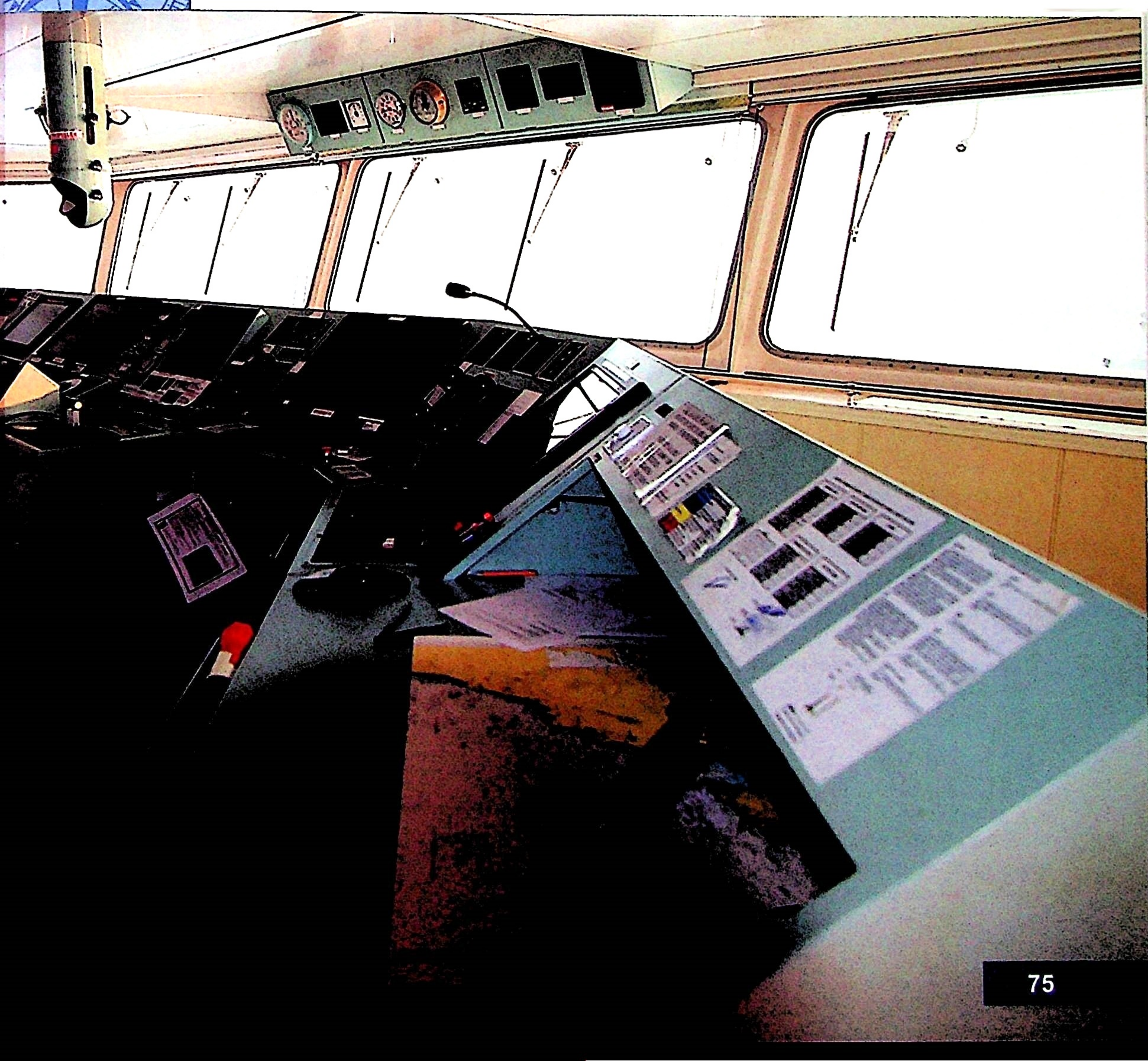
3.4 Proceeding to Sea

The OOW on the bridge for departure will usually be expected to help prepare the bridge for sailing. The following considerations may apply:

- Bridge equipment should be tested well in advance of sailing so that any defects can be rectified without delaying the sailing time
- prepare all bridge checklists and the Master/Pilot card in good time
- it is good practice to check the NAVTEX and other means of receiving navigational warnings in good time prior to sailing, to ensure sufficient time for messages to be actioned
- the latest weather forecast should be available
- confirm the departure condition and update bridge equipment with any relevant data (eg draughts, GM, displacement, cargo figures including UN Nos)
- ECDIS safety settings should be reviewed and re-assessed
- cross-check GNSS sources and compare gyros
- the geographical situation in the vicinity of the ship should be closely observed before sailing. If any observations conflict with the planned departure as briefed, they may affect the plan and need to be communicated to the Master
- prepare any flags that are required
- the OOW may be closely involved in the process to start the main machinery prior to sailing. Before this is done, have someone check the propeller is clear
- conduct a test of the steering gear (as required)
- if the ship is sailing with engines in bridge control, take bridge control and test the engines, bridge telegraphs and indicators. Highlight any alarms to the engine control room. Do these tests early to minimise the impact of any faults or issues that may arise
- prior to testing the engines and bow thruster, ensure that the gangway is lifted clear and the mooring stations are monitored. The use of a small amount of power for a very short period of time should be sufficient. The selection of a fixed transit ashore can assist in monitoring any fore and aft movement
- when satisfied that all equipment and machinery is in good working order, review the relevant checklist to make sure that nothing has been forgotten before reporting to the Master that the bridge is ready in all respects to sail.

CHAPTER 4

Bridge Practices – At All Times



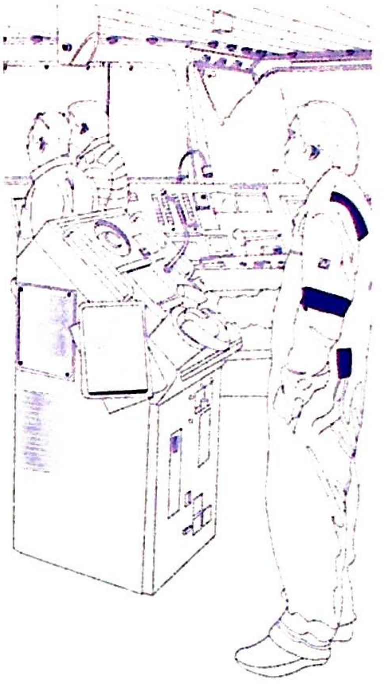
4.1 Bridge Familiarisation

The items to be covered during bridge familiarisation should be documented as part of the SMS and as a minimum should include the operation of all bridge equipment (including the location of power supplies, breakers and backup power arrangements).

In particular, the use, location and settings (where appropriate) of the following equipment and documentation should be covered:

- Engine controls
- alarm and alert panels
- navigation lights and deck lights
- operation of bridge recording equipment
- bow and/or stern thruster controls
- steering gear – changeover procedure between all modes, including emergency steering procedure
- operation of GNSS
- location of significant aerials and antennaes
- location and condition of binoculars, flags, sextant and bridge tools
- location of signalling equipment, including Aldis lamp
- location and operation of meteorological equipment
- the location of voyage charts and nautical publications
- ECDIS type-specific familiarisation training
- user/operator manuals for all bridge equipment
- operation of bridge computer and relevant software
- location and operation of GMDSS
- bridge lighting and dimmer switches.

4.2 Nav Watch Rating



To get the best from the nav watch rating, the OOW must ensure that the rating is fully acquainted with the bridge layout, procedures and equipment relevant to their duties. To assist in this process, a checklist may be useful to ensure all tasks and equipment relating to the role are considered.

Other factors to consider are:

- The helmsman and the lookout are two separate and distinct roles. A helmsman should not be expected or encouraged to perform lookout duties at the same time that he is steering the ship
- the lookout must be briefed about expectations for reporting lights, sounds and signals
- there should be a good flow of information between the OOW and the rating. Closed-loop communication (positive feedback) should be used
- there should be a challenge and response environment on the bridge to enable the rating to ask the OOW to clarify any concerns
- while undertaking bridge nav watch duties, the rating must not be allocated any other task. This is to ensure they can give their full attention to the assigned role
- when the nav watch rating is performing the duties of helmsman:
  - changeover from autopilot to manual steering, or vice versa, must only be carried out under the OOW's supervision
  - any helm orders given must be acknowledged and repeated
  - OOWs must make the helmsman comfortable about asking for a repetition of an order if it is not understood
  - they should report if loss of steering occurs or difficulty is experienced in maintaining a course or heading
  - they should report if the rudder indicator or any other bridge instrument related to steering fails
- when the OOW gives instructions to the helmsman, they should consider that:
  - small alterations of course can be given as compass course values, but larger alterations should be given by helm order
  - when an order to adjust course or helm is given, the OOW must listen to the order being repeated by the helmsman to ensure correct understanding has been achieved
  - the OOW must continue to monitor the helmsman's actions and the ship's response to ensure the orders are being carried out as requested and that the ship responds as required. This should involve checking the rudder angle indicator, rate of turn indicator and also the ship's swing
  - when ordering a new course to the helmsman, the course figures should be read out clearly and a direction of the indication given (for example, with an arm raised in the direction of the alteration).

Considerations when Mentoring and Training a Nav Watch Rating

Building a Relationship

The more informed and knowledgeable the lookout, the better their contribution to the safe navigation of the ship. Try to develop a relationship of mutual respect. Do not be dismissive of reported sightings, even if it has already been seen or it appears obvious, as the next time the lookout may be apprehensive about reporting. Build confidence not barriers. Always reinforce the point that whenever they see something they should report it.

Expectations

Explain what is to be reported and how it is to be reported, eg ensure the rating understands how to report in points or using 'clockface' notation. Do not make presumptions about their level of knowledge or experience.

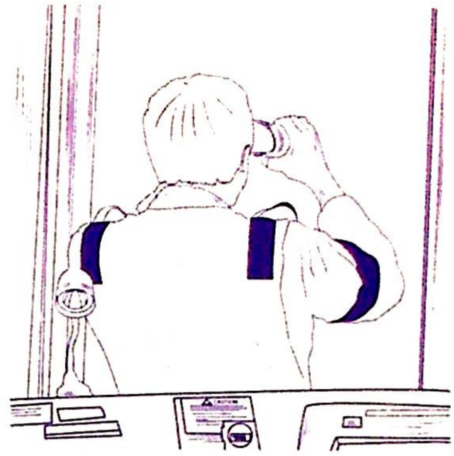
Maintaining the Relationship

Keep the rating updated, involved and interested and, whenever time permits, help to build their understanding of bridge equipment, navigation lights and the importance of their role. This will improve their confidence and self-esteem.

For example, explaining the current navigational situation will help to develop situational awareness, reinforcing the importance of the role and what they must report. Leaving a watchman standing on a bridge wing alone for hours will not improve information flow and is unlikely to help them to maintain their concentration.

4.3 Maintaining a Proper Lookout

General



Rule 5 of the COLREGS regarding lookout states:
"Every vessel shall at all times maintain a proper look-out by sight and hearing as well as by all available means appropriate in the prevailing circumstances and conditions so as to make a full appraisal of the situation and or the risk of collision."

The need to maintain a proper lookout is the most important of all the COLREGS, as without the keeping of a proper lookout no other steering and sailing rule can be applied. A proper lookout is also essential in monitoring for any signs of distress or pollution at sea.

The following considerations apply:

- A proper lookout consists of:
  - sight – a continuous visual scan all around the vessel
  - hearing – listening for sound signals and radio messages
  - all available means – including radar, ECDIS, ARPA, AIS, NAVTEX and any other equipment fitted on the ship
- constantly assess the range of visibility. Ensure that this information is continuously updated and passed on to the next watch. Radar ranges can be used to assist in determining visibility
- the OOW must not focus their attention solely on radar and ECDIS displays. Electronic equipment will not detect or provide complete situational awareness of the area around the ship. The OOW must resist the temptation to only 'look in' on the bridge equipment, becoming fascinated with one target on the display. 'Looking out' visually fills in the gaps that electronic equipment may not detect and provides greater situational awareness
- always have a good quality pair of sunglasses with ultraviolet (UV) filters. These should not conflict with the multi-layered windows used on most ships and should not result in a restriction of vision
- ensure the bridge windows are kept clean
- ensure that any external sound reception devices (if fitted) are functioning correctly
- mobile phones and other personal electronic devices should not be used on the navigational bridge.

Visual Lookout at Night

- The bridge team should allow a sufficient period for their eyes to adapt to the light conditions at night (it can take up to 40 minutes for the human eye to adjust at night)
- the OOW should ensure that background lights are dimmed appropriately to avoid light contamination
- when trying to focus on an object at night, it may help to look a few degrees away from the focal point as detail can sometimes be picked up from peripheral vision
- no member of the bridge team should wear photochromic lenses (light sensitive) for lookout duties at night, as these significantly reduce light transmission when compared to ordinary coated and uncoated lenses
- all bridge equipment and other displays should be appropriately dimmed to preserve night vision and reduce glare and reflection/back scatter on the bridge windows. The night palette or equivalent function on bridge navigation equipment should be selected.

Sole Lookout

- In certain circumstances, the Master may consider that the OOW can be the sole lookout. Even in perfect daylight conditions, the risks should be fully assessed to ensure a proper lookout is maintained at all times. If at any point the OOW feels uncomfortable about being the sole lookout, they must immediately call for their duty rating
- conditions can change rapidly and, therefore, the OOW must be able to call his lookout immediately if required. The duty rating must be either on standby or working within the vicinity of the bridge and be immediately contactable
- for reasons of safety, ships must not operate with the OOW acting as the sole lookout during periods of darkness or restricted visibility.

Over 58% of all the collisions and groundings investigated by the UK MAIB in a 5-year period were attributed to single-handed bridge watchkeeping.

Other Comments Regarding Lookout

- Before visiting the toilet during the watch, the OOW should consider whether it is safe to do so
- monitor own ship throughout the course of the watch, looking out for dangers to the ship, anything out of place or a hazard to personnel. If something dangerous is seen, stop the activity and inform relevant personnel so that it can be rectified. Do not assume that dangers have been spotted by other personnel, no matter how obvious or trivial they may be
- when involved in SAR or transiting piracy areas, additional lookouts (non-bridge watchkeepers) should be posted at various heights and locations around the ship
- a navigational lookout commonly observes the horizon and four points either side of the bow. However, the lookout should observe a 360 degree view around the ship
- the lookout should pay attention to rapid changes in the weather conditions, such as from a line squall or waterspout
- keeping a lookout also extends to environmental considerations, including pollution.

4.4 OOW Watch Handovers

4.4.1 General

The relieving officer, including ratings, should arrive in sufficient time to take over the watch. This is particularly important for night watches so that watchkeepers can adjust their vision to the prevailing light conditions and to read through any Master's orders or instructions.

The period when taking over the watch is one of the most critical for safe navigation. The OOW must be properly prepared, informed and situationally aware.

Situational awareness is a key principle of being a watchkeeper. An incoming OOW must have sufficient time to orientate themselves to their surroundings. This requires the ability to relate observations to the information derived from navigational equipment.

A proper lookout must be maintained during the handover period and the OOWs should only spend as much time as is necessary at one item of equipment or at one place, such as when filling out the handover list at the chart table.

A review of accident reports indicates that a high percentage of collisions and groundings occur in the 20–30 minutes before and after the handover of the navigational watch, especially during hours of darkness.

4.4.2 Considerations when Handing Over and Taking the Watch

- If the incoming OOW is a newly joined officer, the Master and outgoing officer should ensure they are familiar with the layout and operation of all bridge equipment, even if they appear confident
- confirm the ship's position in advance of handover and look ahead on the chart to ensure the ship remains on a safe track during handover discussions
- if relieving personnel appear unfit for the watch, the Master should be informed and the handover deferred
- a prepared checklist should be used to provide a detailed overview of the navigation, traffic situation, weather/tide and ship operations and any other items of relevance, such as:
  - defects
  - the speed, course steered and course made good, along with effects of the wind and tidal stream
  - gyro and compass errors
  - autopilot and track control settings
  - conspicuous points of land or other navigation marks that are being used for position fixing. Prominent marks that are to be used next should also be clearly identified
  - the current configuration of navigation and bridge equipment
- if own ship is executing a collision avoidance or navigational manoeuvre, defer the handover until the situation has been resolved
- both watchkeepers should confirm the ship's position
- review any relevant navigation warnings that have been received and double-check them against the route
- highlight any nearby dangers or hazards to navigation
- if any calls or other ship specific actions need to be undertaken during the watch, ensure they are written down clearly
- the relieving OOW should be aware of activities that are ongoing or planned to take place on deck under a permit to work
- where the OOW is the sole lookout, test communication with standby personnel

- confirm that the relieving officer has positively stated that they are happy with the situation and take over the watch. The outgoing OOW must confirm that he has handed over the watch to the relieving officer
- the officer relieved should complete and sign the bridge logbook
- if applicable, on leaving the bridge undertake fire and safety rounds of accommodation and other critical areas.

The key mindset in taking over the watch is the need to double-check and confirm everything.
Failure to do so risks continuing any error that may have occurred during the previous watch, such as misidentification of navigation marks.

4.5 Keeping a Safe Navigational Watch

STCW Chapter VIII/2 – Principles to be observed in keeping a navigational watch, paragraph 12 states that *'the OOW is the Master's representative and is primarily responsible at all times for the safe navigation of the ship and for complying with the International Regulations for Preventing Collisions at Sea'*.

General Advice

- Becoming a watchkeeper can be a daunting prospect. Remember that the Master and your fellow officers are there for support
- be confident in your own ability to carry out your duties and always place safety at the forefront of all decision making
- the OOW should never be afraid to call the Master. If a situation arises where there is any doubt as to whether or not to call the Master, then he should be called
- the OOW should be familiar with the passage plan and aware of the degree of flexibility on each leg to allow for collision avoidance and deviations from the planned track
- an OOW should be familiar with the ship's speed settings, turning circles, stopping distances and handling characteristics, while appreciating that other ships may have different manoeuvring capabilities
- there are two elements to bridge watchkeeping; the con and keeping the watch. The separation between these roles can be compared to when the pilot is on board, as he will take the con but not the watch.
  - when the Master is on the bridge, the OOW continues to be responsible for the safe navigation of the ship, regardless of whether or not the Master has formally taken the con
  - when the Master takes the con, he should clearly state that he has taken the con and the OOW should acknowledge that the Master has the con
  - whenever the Master has the con, the OOW retains the watch and remains responsible for the safe navigation of the vessel and the provision of relevant information to the Master, until such time as the con is handed back
- every action taken on the navigational bridge will always have an associated risk. The mindset to reducing risk is to make all decisions following an assessment
- when resolving situations on the navigational bridge, do not restrict to a single solution. Decisions should be flexible and able to respond to change. Each time an action is taken, aim to have an alternative solution that can be implemented immediately if the need arises
- where possible, timely notice of intended variations of engine speed should be given to the duty engineer. However, the ship's engines are at the disposal of the OOW and there should be no hesitation in using them in case of need
- personal electronic devices should not be brought onto the bridge
- if the watch coincides with any planned events, such as arrival in port, anchoring or onboard operations, make sure that there is clarity about what is required in advance, such as completion of checklists, preparation of pilot cards and the issue of notices to engine room or deck crew.

Communication

- Be concise
- communication becomes more difficult when different nationalities are involved. English may not be the primary, or even secondary, language and the OOW may have to take this into account (it is estimated that as many as 90% of crews are not native English speakers but use English as their working language. It is also estimated that over 60% of the world's fleet is manned and operated with multinational crews using mixed languages)
- issue orders slowly and clearly and ensure they are repeated back to confirm they are understood. Verify that the task is being carried out as expected or has been completed correctly
- not everyone will understand an accent or dialect:
  - it is important to note tone and body language when communicating as this can affect the listener's response
  - an encouraging tone helps give bridge team members the confidence to share their thoughts and concerns
- the ship will have a working language. However, during periods of increased concentration, crew members will often revert to their native language and may not be aware that they are doing so.

Checks and Monitoring of the Bridge Equipment

The bridge equipment should be continually monitored and adjusted as necessary throughout the navigational watch and not just when tested prior to departure.

Alarm and safety settings should be as per the Master's Standing Orders, the passage plan and the SMS.

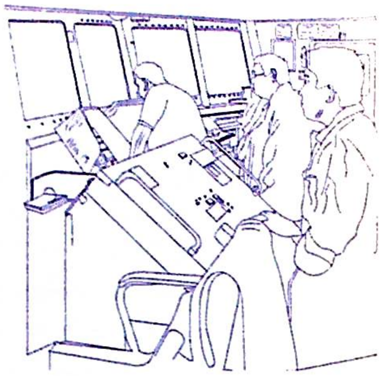
Whenever any equipment is tested, an entry should be made in the relevant logbook. Any defects, reduction in performance or any other findings should be recorded and reported to the Master.

Checks should be conducted on all equipment on the navigational bridge when in use, including but not limited to:

- ECDIS – it is essential that the safety settings are in compliance with the Master's Standing Orders, the SMS and the passage plan. The reliability and accuracy of information supplied to the ECDIS by other equipment should be confirmed.
  Remember – while ECDIS will always give a position, it may not be accurate
- hand steering should be tested in accordance with the SMS procedures and manufacturer's guidelines
- autopilot – the changeover between manual and auto should always be supervised by the OOW. Whenever autopilot is engaged, the OOW should monitor the autopilot until he is satisfied with its performance and this should include a test to ensure that it responds correctly to any new order
- radar – in addition to checking the radar's performance monitor (tuning), the heading marker alignment should be checked using a ship or charted object that is right ahead.
  The radar should be adjusted to match the environmental conditions including gain, sea clutter and rain clutter.
  The current radar mode should be confirmed, including Head Up, North Up, TM/RM and whether trails are displayed as True or Relative.
  If operating more than one radar, it is good practice to have each radar on a different range scale with one radar ground stabilised for navigational purposes and one sea stabilised for collision avoidance
- ARPA – checks are the same as for radar, although particular attention should be given to vector length and CPA/TCPA settings/alarms.
  The reliability and accuracy of information supplied to the ARPA by other equipment should be confirmed
- compasses – compass error should be calculated once every watch and, if the circumstances allow, after every major alteration of course.
  The gyro compass should be compared frequently with the magnetic compass

- echo sounder – with digital echo sounder displays, established practice is to leave them running continuously and activate the paper readout as required
- VDR – ensure that it is running without any alarms
- GNSS – positions derived from GNSS should be cross-checked.
  Check the status indicators to ensure the unit is functioning correctly and, importantly, that the GNSS is not operating in DR Mode.
  The value of HDOP (horizontal dilution of precision) should be checked frequently
- navigation lights – the status of lights should be checked every watch
- barometer/barograph – monitor the trend during your watch
- main engines – status of the engines, monitoring of alarms and UMS (unmanned machinery space) status. When operating in UMS:
  - if the duty engineer has to enter the engine room to respond to an alarm, once he has responded to the alarm he should contact the bridge to advise how long he is expected to be and confirm when he has left the engine room
  - the duty engineer should notify the bridge before entering the engine room to conduct his safety round and again upon leaving
- GMDSS console – monitor as required. However, from a navigational perspective, ensure that the NAVTEX receiver is monitoring the correct station ID for the region that the ship is in
- AIS – ensure the settings remain appropriate for the voyage.

4.6 Conning



Altering Course and Manoeuvres

The following considerations apply:

- When carrying out large alterations of course, the helmsman should be present on the bridge and manual steering should be engaged
- it should be established on the bridge how helm orders are to be given, eg course to steer or angle of rudder. Closed-loop communications should be used
- the rate of turn indicator is a useful tool when carrying out any alteration of course. Monitoring of the rate of turn indicator provides an indication of when to ease back on the wheel or if the autopilot is not responding sufficiently
- where appropriate, when altering course, the use of calculated wheel over bearings or radar index lines can help ensure that the planned alteration is executed accurately
- when altering course, always check that your quarters are clear of any overtaking ships both visually and by radar in all conditions of visibility
- it is imperative that the OOW knows how the track control software on their ship responds to course changes at waypoints. The difference between track mode and heading mode should be understood, as well as the correct use of their settings
- at wheel over, sufficient rudder initially will ensure the ship starts swinging in the correct direction. The wheel can be eased once sufficient swing has been started
- the OOW should request the Master's assistance in situations involving shallow water or where manoeuvring occurs in strong tidal streams, winds, etc
- where the helmsman has been instructed to steady on a visual navigational mark, it is critical that they use the correct mark and that their actions are carefully supervised
- all orders for alterations should be monitored to ensure they are correct. Never presume an order has been correctly followed but verify that the action has been sufficient.

4.7 OOW/Master Relationship

The relationship between the OOW and the Master should be one of mutual support. Building confidence and understanding between the OOW and the Master is important. The OOW must feel able to raise any concerns with the Master.

The following considerations apply when establishing a good OOW/Master relationship:

- Before taking any action, always take the time to explain your intentions to the rest of the bridge team (be this Master, pilot or OOW)
- never assume that the Master has a complete picture of what is going on and take time to brief him regularly
- it is important for the Master to assume the role of mentor. The OOW should be allowed the opportunity to develop their confidence by suggesting action to resolve a situation, with the Master providing guidance and confirming the decision as appropriate
- when the Master and OOW are on the bridge, it is recommended that the Master briefs the OOW on his planned actions to help develop and build an engaged bridge team. This is an opportunity for mentoring the OOW
- the Master should never underestimate the value and benefit in providing the OOW the opportunity to carry out basic ship handling manoeuvres in a controlled environment
- the Master's Standing Orders should be based on the Master's professional experience and be realistic. They should document the Master's expectations of his officers
- the Master's Night Orders are an important communication tool for the OOW when the Master is resting. The OOW should always seek clarification if he has any doubt with the Master's Night Orders
- the Master must be careful not to intimidate the OOW when he is on the bridge. The OOW should expect his presence and use it as an opportunity to build a positive working relationship
- the presence of remote display screens for ECDIS and/or radar in the Master's cabin does not relieve the OOW of his responsibility to call the Master when required, but neither does it allow the Master to make a decision without fully assessing the situation using all available means. The use of such equipment does not indicate a lack of trust from the Master to the OOW
- the Master's course of action in most cases will be appropriate. However, the OOW should never be afraid to seek clarification on any action that the Master is taking. It may be that the Master holds information that the OOW does not, or vice versa.

It is essential to observe the following when calling the Master:

- The Master should be called immediately if the OOW has any concern. The Master has experience that can help prevent an incident and he needs time to assess the situation
- before calling the Master, consider what relevant information he needs
- the Master will want to know concisely and precisely what the problem is. This is where the OOW can best prepare for informing the Master
- the Master would rather be called unnecessarily than be called too late or not at all.

4.7.1 Circumstances in which the OOW should Call the Master

> **The two key considerations for the OOW calling the Master are:**
>
> **1) Do I need to call the Master?**
>
> **2) When do I need to call the Master?**
>
> **In each circumstance, the Master should be called in plenty of time so that he can fully assess the situation before he is required to act.**

The Master is responsible for the safety of the ship on behalf of the owner and, in turn, the OOW is responsible to the Master.

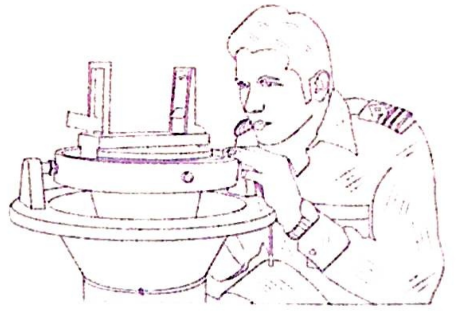
Therefore, the OOW must ensure that the Master is informed of any developments that may affect the safety of the vessel.

Situations where the Master should be called to the bridge by the OOW are specified in STCW Chapter VIII/Part 3-40. They include, but are not limited to, the following:

- *'If restricted visibility is encountered or expected*
- *if the traffic conditions or the movements of other ships are causing concern*
- *if difficulty is experienced in maintaining course*
- *on failure to sight land, or a navigation mark or to obtain soundings by the expected time*
- *if, unexpectedly, land or a navigation mark is sighted or a change in soundings occurs*
- *on breakdown of the engines, propulsion machinery remote control, steering gear or any essential navigational equipment, alarm or indicator*
- *if the radio equipment malfunctions*
- *in heavy weather, if in any doubt about the possibility of weather damage*
- *if the ship meets any hazard to navigation, such as ice or a derelict and*
- *in any other emergency or if in any doubt.'*

4.8 Collision Avoidance

4.8.1 Collision Avoidance – General



The OOW must have a comprehensive understanding of the COLREGS.

The fundamental principles of collision avoidance are to:

- **Detect and identify targets as early as possible**
  using all available bridge equipment, including visually and by radar, as part of a proper and effective lookout (Rule 5 – Look-out). If this is not conducted, doubt can still remain, available thinking time will be reduced and the risk of making a poor decision will be increased.
- **determine whether risk of collision exists**
  ARPA, AIS and ECDIS provide information that can assist the OOW in maintaining situational awareness.

  Whether or not risk of collision actually exists (Rule 7 – Risk of collision) depends on visual observations and radar/ARPA information.

  Be aware that the situation, as viewed by the OOW on different types and sizes of ship, may vary considerably when assessing the risk of collision and determining the time and distance in which to take avoiding action.

  The OOW should always remember that one of the most effective methods of determining a likely risk of collision is to take a series of compass bearings. In the limited circumstances where compass bearings and radar targets cannot easily be obtained, standing still while monitoring the other ship in relation to a fixed point such as the bridge window edge is sufficient to provide a basis of whether or not the bearing of the approaching ship is steady. If the ship moves either side of your first observation, the bearing is changing. If the ship remains at the bridge window edge, it is steady. However, this method is by no means definitive and visual bearings/ARPA should always be attempted in the first instance. If in doubt, the OOW should call the Master.

  It should be noted that acquiring targets on ARPA will be recorded on the VDR.
- **where risk of collision exists, determine your responsibility and take proper and effective action**
  First, determine whether any of the ships have privileges under the rules (eg fishing, sailing, NUC, RAM, CBD).

  Then determine which rules also apply (eg Rule 10 – Traffic separation schemes, Rule 13 – Overtaking).

  Next, confirm your responsibility (Rule 16 – Action by give-way vessel, Rule 17 – Action by stand-on vessel) and carry out the action required to avoid collision (Rule 8 – Action to avoid collision).

  Any alteration of course and/or speed should be large enough to be readily apparent to any other ship observing visually or by radar/ARPA.

  Where sea room exists, an alteration of course is the preferred option, as it is the most apparent to other ships. However, a change in speed can be just as effective as the engines remain at the OOW's disposal and may be used when required.

  Where the OOW is in any doubt as to another ship's intentions, the Master should be called and at least 5 short and rapid blasts made on the ship's whistle under Rule 34(d). This signal may be supplemented by a light signal of at least 5 short and rapid flashes.

  However, still be prepared to take avoiding action as the other ship may not respond to the signal within the time/distance that is reasonable or appropriate.
- **monitor the other ship until she is finally passed and clear**
  Any action should result in passing at a safe distance. Do not be tempted to relax and assume the other ship will pass clear. Keep monitoring the situation carefully, using all available means, while being aware of any equipment limitations.

4.8.2 Collision Avoidance – Use of Radar/ARPA

To be an accurate aid to collision avoidance, radar/ARPA must be closely monitored at all times on a range scale appropriate to the prevailing circumstances and conditions. However, even with proper use of radar/ARPA, maintaining a visual lookout should never be neglected.

The value of data/information obtained depends on the skills of the operator, who requires a knowledge of the types, X band (3 cm) or S band (10 cm), the various settings and the different presentation that these settings display.

Sea stabilised mode should be used for collision avoidance, while ground stabilised mode is preferred for navigation.

After an alteration of course and/or speed, while the ARPA is settling and recalculating, the AIS collision avoidance data can give an early indication of the effect of that alteration.

Once a target has been acquired, the ARPA will take a period of time to establish a steady and accurate plot. The OOW must be aware that, if there is a change in the course and/or speed of either ship, the ARPA will take time to recalculate the plot.

Reliance on ARPA Guard Zones is an example of lazy watchkeeping and is not a substitute for keeping a proper lookout.

For collision avoidance, it may be useful for trails and vectors to be in different modes. The use of relative trails and true vectors is a common display configuration for collision avoidance.

Trails display history, while vectors display predicted track. Using an EBL is a quick and convenient tool to determine whether risk of collision is developing when combined with either relative trails or relative vectors.

A quick switch to true vectors while still in sea stabilised mode can supplement relative vector information with the ship's aspect. Frequently changing between vectors and ranges can be a useful aid.

Scanning ahead by increasing the radar range scale provides early detection of targets, which is a good discipline in any sea area.

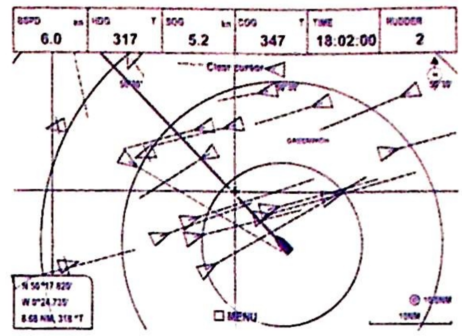
Know where the radar blind spots are and check them regularly by visual and/or other means.

Although an offset radar display is useful in improving the ability to look ahead, own ship should not be offset so far back that it cannot easily detect ships that may be overtaking.

The trial manoeuvre function is a useful tool that can be used in assessing multi-ship situations. It is especially useful for new watchkeepers to provide reassurance and build confidence as to their intended actions.

Whenever possible, always cross-check radar/ARPA information with other means.

4.8.3 Collision Avoidance – Use of AIS



AIS provides a valuable contribution to situational awareness. However, do not rely solely on AIS information as there is no certainty about the accuracy of the transmitting station.

Once a ship has been detected, AIS can assist in target tracking as its actions can also be monitored. Changes in heading and speed are immediately apparent and many of the problems common to tracking targets on radar, such as clutter, target swap and target loss following a manoeuvre, do not affect AIS.

AIS can assist with positively identifying ships by name, especially with an understanding of ships in the vicinity such as when there are multiple overtaking ships in restricted waters.

AIS names are useful in both congested waters and when multiple ships are reporting to VTS/VTIS, as it provides an indication of the intentions of other ships. This includes traffic routeing.

AIS can provide details of the destination of other ships, but this information should be used with caution (for example, the destination field may not have been updated).

Always bear in mind that information provided by AIS may not be giving a complete or correct picture of shipping traffic in the vicinity. The OOW should always be aware that small craft, and naval ships in particular, may not be fitted with AIS.

It should be noted that AIS will often be able to detect targets that are in the shadow area of a radar or a blind spot behind a headland or other obstruction. Where AIS is available as a radar overlay, it should be displayed to assist with detecting targets in clutter, eg rain showers.

In areas where a large number of AIS stations are transmitting, particularly in areas where yachts and small craft are encountered, the system can quickly become overloaded. In the event of system overload, it should be noted that distant targets will tend to drop out to give preference to targets close by.

AIS can help with identification for radio communications and monitoring.

The ability to transmit AIS messages between ships should not be used for collision avoidance.

4.8.4 Collision Avoidance – Use of VHF

If the OOW feels the need to call another ship by VHF to resolve a situation, then in many situations the point where the Master should be called to assist has already passed.

Similarly, if called by another ship wishing to resolve a situation that, for whatever reason, the OOW is not comfortable with, then the Master should be called.

Great care should be taken in the use of VHF, as it can cause both a loss of situational awareness and reduce the time available to assess a situation and take action to avoid collision.

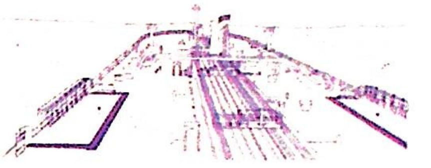
Where risk of collision exists, VHF should not be used to agree deviation from the COLREGS as, even when agreeing an action, it can still be confused or misinterpreted. For example, use of VHF is especially dangerous for fine head-on situations, where both ships may agree to make a small alteration in violation of the COLREGS but only one ship alters as intended. Confusion then occurs.

Use of the VHF should be clear, positive and in accordance with the COLREGS. VHF is recorded on the VDR and also by many coastal States (VTS/VTIS).

4.8.5 Altering Course and Manoeuvres

- Where autopilot is engaged, it should be possible to change over from automatic to manual steering at any position of the rudder and this should be effected by one manual control within 3 seconds
- when altering course, the use of a calculated wheel over bearing or of radar indices, where appropriate, can help ensure that the alteration is conducted accurately, resulting in the ship wheeling over on track on the new course
- when altering course, always check that your quarters are clear of any overtaking ships, both visually and by radar, in all conditions of visibility
- when in track control, the OOW is normally warned prior to course alterations, typically 5 minutes and 1 minute in advance. Some systems will automatically follow the track with or without confirmation of the course change from the OOW, while in others the ship will remain on the current course and not alter. It is imperative that the OOW knows how the track control software on their ship responds to course changes at waypoints
- at wheel over, the use of plenty of rudder initially will ensure the ship starts swinging in the right direction. Doing so will prevent a ship hanging in the original direction, particularly in shallow water where the effect of the rudders may be much less than expected or when turning out of wind. The wheel can be eased once sufficient swing has been started
- when approaching an anchorage, it is usually better to give the helmsman the course to steer as early as possible to leave more time for observation of marks, ships, etc
- where the helmsman has been instructed to steady on a navigational mark, it is critical that they use the correct mark and that their actions are carefully supervised.

4.9 Navigation in Restricted Visibility



In or near an area of restricted visibility, the OOW should:

- Call the Master and lookout(s)
- reassess the safe speed of the ship
- inform the engine room and confirm engines are ready for immediate manoeuvre
- complete the restricted visibility checklist
- adhere to the Master's Standing Orders and any supplementary orders
- maintain a proper lookout (by sight and hearing as well as by all available means)
- ensure that navigation lights are on and that sound signalling has commenced
- confirm compliance with the COLREGS.

Considerations in Restricted Visibility

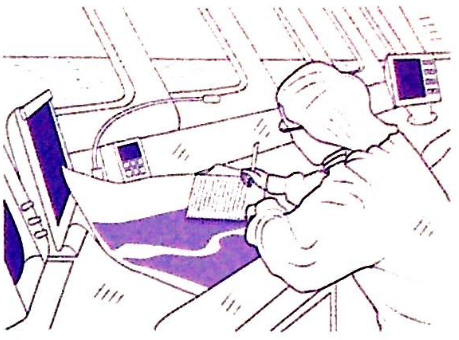
- A primary consideration in restricted visibility is to proceed at a safe speed, taking into account the range of visibility, traffic including fishing vessels or other small craft such as sailing yachts, and the proximity of navigational hazards
- as the nature of the visibility changes the OOW should reassess safe speed
- proceeding at a safe speed may involve a reduction in speed, where the objective is to provide more time to assess the situation. For example:

Distance of Target Detection (nm)	Reaction Times 20 kts Closing Speed	Reaction Times 10 kts Closing Speed
4	12 min	24 min
3	9 min	18 min
2	6 min	12 min
1	3 min	6 min
0.5	1 min 30 sec	3 min
0.25	45 sec	1 min 30 sec
0.125	22 sec	45 sec

- the use of other navigation aids (eg AIS) assists the conduct of ships in restricted visibility, but does not reduce the need to comply fully with the COLREGS
- radar must be adjusted to ensure sufficient detection of other ships (eg reduce the range)
- the bridge should increase their attention on listening for sound signals. Ensure that the sound reception system is on/tested or bridge wing doors are open
- in practice, the range at which a whistle may be heard is extremely variable and depends on the weather conditions. Under conditions of strong wind or high ambient noise, the range may be much reduced
- the OOW should ensure they have commended sound signalling in accordance with the COLREGS and Master's orders
- while the visibility permits, take visual fixes of conspicuous objects and approaching ships before the visibility reduces
- the radar can be used to assess the visibility. For example, on one radar, where possible, adjust the VRM to match the range of visibility and update as the visibility changes
- if navigation in restricted visibility is likely to be for a prolonged period, inform the engine room so they can make the necessary arrangements. Update them regularly on the situation
- restricted visibility may come in the form of poor weather and fog but, depending on location, may have other causes. For example, sandstorms are common in the Middle East, while in areas such as Indonesia and Malaysia visibility may be affected by smog due to forest fires, ash clouds, etc

- It is essential that the OOW is aware of his obligations under Rule 19(e):
  "Except where it has been determined that a risk of collision does not exist, every vessel which hears apparently forward of her beam the fog signal of another vessel, or which cannot avoid a close-quarters situation with another vessel forward of her beam, shall reduce her speed to the minimum at which she can be kept on her course. She shall if necessary take all her way off and in any event navigate with extreme caution until danger of collision is over"
- if it is decided to slow down or stop, hand steering should be engaged. Be aware that manoeuvrability may be lost when slowing down, making it more difficult to avoid oncoming ships. The use of thrusters, if fitted, should be considered.

4.10 Logbooks



The OOW should maintain all logbooks and record books to a high standard. This is important as it highlights accountability for the watch and acts as an official record in the event of an incident.

Many of these records are updated each watch, although some records may be only entered weekly or by exception. Record keeping requirements are usually similar for merchant ships, but official records vary by flag State. In general, logbooks and record books on the navigation bridge can include:

- The Official Logbook (OLB). The Master will normally fill this in. However, there are times when the OOW may be asked to countersign entries (such as following a weekly inspection of the ship) or write entries under authorisation from the Master. The OLB is usually supplied by the flag State of the ship
- the Deck Logbook. This is the primary logbook for the bridge and entries are made by each OOW for every watch, both at sea and in port. Along with records of positions and significant navigation information, the Master may also place his Night Orders in this book. The OOW should fill out information using any standardised columns/rows and sign after each watch is completed. Deck Logbooks are usually supplied by the company (these are either their own specially designed book or they may be printed from a third party source)
- the Bridge Defect Book. This is a maintenance logbook for recording defects, repairs and activities relating to navigation equipment. Separate entries are made for each item of equipment and it should be available for inspection. Once an item of navigation equipment is repaired, the relevant entry should be closed out and signed by the OOW responsible
- the Bridge Movement Logbook (sometimes known as the 'Bell Book'). This is a logbook for entering ship movements (bridge and engine commands). It is now less commonly used as the information is adequately captured on data loggers
- the Compass Error Logbook. A compass error should be taken at least once per watch and entered into the logbook. This should be compared with the compass card and previous compass errors to monitor for changes and large observations
- the GMDSS Logbook. As required under flag State radio regulations, all records of equipment tests and transmissions should be entered, together with a record of broadcasts, stations, times, dates and positions. It is maintained each day and as appropriate.

Some logbooks may be located on the bridge or in the cargo control room/engine room/ship's office/hospital, depending on the ship:

- The Garbage Record Book. There are two parts. Part I is for all ships. Part II is for ships that carry solid bulk cargoes. Entries are made of all garbage discharges, according to category
- the Ballast Water Record Book. This is required for all ships of 400 GT and above. All information necessary for compliance with the BWM Convention should be entered across two sections, one on routine ballast operations, the other on non-routine (emergency)
- the Medical Logbook. Entries should record all medical incidents and any drugs issued/the controlled drug register
- the Oil Record Book. There are two parts. Part I (Machinery Space Operations) is for every oil tanker over 150 GT and all ships over 400 GT. Part II (Cargo Operations) is for all oil tankers over 150 GT.

It is good practice to update record books as often as possible. The OOW should make use of quieter periods on the watch to fill out the log and should avoid leaving it until the end of the watch to record everything. This is especially true for busier watches, where entries should be maintained as they occur to prevent anything being missed. However, the OOW should never fill out the log before the event has happened, eg the last line of the watch section should be completed and signed after the handover.

The OOW should always read the accompanying instructions before filling out a logbook for the first time. A ship particulars page may need to be completed for some logbooks.

Errors in the logbook entries should be crossed out and initialled by the officer. Correction pens etc should never be used and under no circumstances should pages be removed from the logbook.

All logbook entries should be signed by the OOW as a true and accurate statement.

In some cases, electronic logbooks may be used. These must be in accordance with the IMO recommended format and authorised by the flag State. The OOW should be familiar with the software used to record the information and must know what to do if the electronic logbook does not work.

4.11 Fatigue

STCW Code Chapter VIII, Section A-VIII/1 – Fitness for duty requires:

2 *All persons who are assigned duty as officer in charge of a watch or as a rating forming part of a watch and those whose duties involve designated safety, prevention of pollution and security duties shall be provided with a rest period of not less than:*

.1 a minimum of 10 hours of rest in any 24-hour period; and

.2 77 hours in any 7-day period.

3 *The hours of rest may be divided into no more than two periods, one of which shall be at least 6 hours in length, and the intervals between consecutive periods of rest shall not exceed 14 hours.*

4 *The requirements for rest periods laid down in paragraphs 2 and 3 need not be maintained in the case of an emergency or in other overriding operational conditions. Musters, fire-fighting and lifeboat drills, and drills prescribed by national laws and regulations and by international instruments, shall be conducted in a manner that minimizes the disturbance of rest periods and does not induce fatigue.*

Fatigue can be defined as extreme exhaustion resulting from mental or physical exertion or from illness.

Fatigue induces lapses in judgement and, therefore, affects the ability to make competent decisions.

The following table sets out the increased accident risk and the equivalent 'alcohol effect' of staying awake for an extended period.

Hours Awake	Estimated % Blood Alcohol Equivalent	Accident Risk
17 hours	0.05% blood alcohol	Risk of accident increases x2
21 hours	0.08% blood alcohol *(UK limit for driving is 0.08 grams of alcohol in 100 ml of blood)*	Risk of accident increases x4
24 hours	0.10% blood alcohol	Risk of accident increases x10

Factors that contribute to fatigue on board ship can be grouped into the following categories:

1) **Sleep and Rest**
   - **Lack of and poor quality of sleep:** Collectively, this can be called 'sleep deprivation', which can lead to a reduced level of alertness and, therefore, increased potential for accidents
   - **insufficient rest periods or poor quality of rest:** Rest periods should be recorded, managed and used properly for good quality relaxation time. Ships typically use specialised software for managing and recording rest hours.
2) **Food (timing, frequency, content and quality)**
   - A good, nutritious and well balanced diet on board will help keep crew energy levels stable. It should take into account the needs of watchkeepers. Allowances should be made for those coming on or off watch.

3) **Psychological Impact**
   - **Boredom:** Excessive boredom can eventually lead to lack of mental rest and the onset of fatigue. Repetitive work can lead to boredom and exacerbate fatigue
   - **Homesickness:** Living away from family and friends in a restricted environment can cause loneliness, which may cause an inability to concentrate
   - **Stress** can occur from overwork, worry, illness or injury. While the human body can withstand normal stress, excessive stress can lead to a reduction in levels of alertness and create inattentiveness to the task at hand. If stress levels continue and are not resolved it can lead to anxiety and/or depression.
4) **Physical Impact**
   - Noise and vibration may cause lack of sleep or rest
   - stimulants – a regular intake of caffeine, eg coffee, tea or energy drinks, can alter the body's chemical balance. Fatigue may result if the body is not given caffeine at the expected intervals
   - jet lag can occur when ship's crew have to take long-haul flights to join their ship
   - excessive workload can lead to both mental and physical fatigue.
5) **Medical Conditions and Medication**
   - Some medications, such as antihistamines or cough and cold remedies, can contribute to fatigue. Their use should be considered in relation to the work environment and medical advice should be sought.

To avoid complications resulting from fatigue:

- Recognise fatigue, its causes and the actions required to mitigate its effects
- comply with procedures and guidance for watchkeepers and control the risks associated with fatigue
- include human fatigue as a hazard when planning any tasks, when carrying out risk assessments and when implementing control measures. Examples of specific hazards that need to be considered are early start of work, overtime, off duty callouts and failure to be relieved from watch on time due to, for example, berthing/unberthing stations and other associated work.

What can seafarers do if they feel fatigued?

- If a seafarer is too fatigued to carry out their tasks, another crew member will have to undertake them to ensure continued operations
- from an OOW's perspective, the risks associated with fatigue will apply to both themself and the lookout or helmsman. If one is fatigued, the other will have to be extra vigilant or less reliant on the other. However, the important skill is to be able to recognise fatigue and declare it to the other person. If this becomes critical, it will have to be made known to the Master.

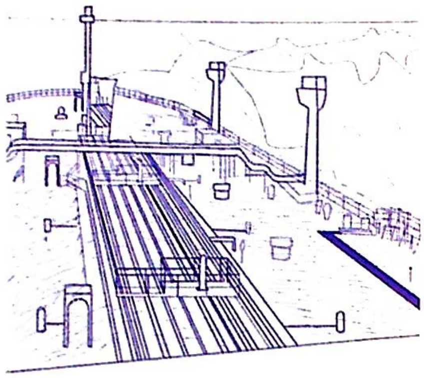
Note: When it becomes apparent to others that someone is fatigued, they will already be at a stage where their ability to perform is substantially reduced.

Other tips for watchkeepers to help manage fatigue:

- If you have insufficient time to sleep properly before your watch, sitting or lying in a darkened room for between 20–40 minutes to rest your eyes can help alleviate the lack of sleep
- having a shower before sleeping can help your body relax in preparation for sleep
- having a shower on waking will help freshen you up for your watch after a period of sleep
- if you are unable to sleep, get up from bed and sit down and read for a period and then go back to bed. This can help give your body the signal that it's now time for sleep
- maintain your cabin at a temperature that is more comfortable for sleeping
- ensure that you are properly hydrated
- use sun cream (when needed) to prevent sun burn, which can make it harder to sleep.

We are generally not good at estimating our own fatigue levels. In a working environment, such as on a ship, undertaking repetitive tasks while fatigued may cause loss of situational perspective. You need to recognise the signs of your own impaired performance and those around you and know when it is appropriate to call the Master.

4.12 Responsibilities of the OOW in Heavy Weather



The role of the OOW can be challenging when deteriorating weather conditions cause reduced visibility or a change in sea state.

In such conditions, the OOW should observe the following guidelines:

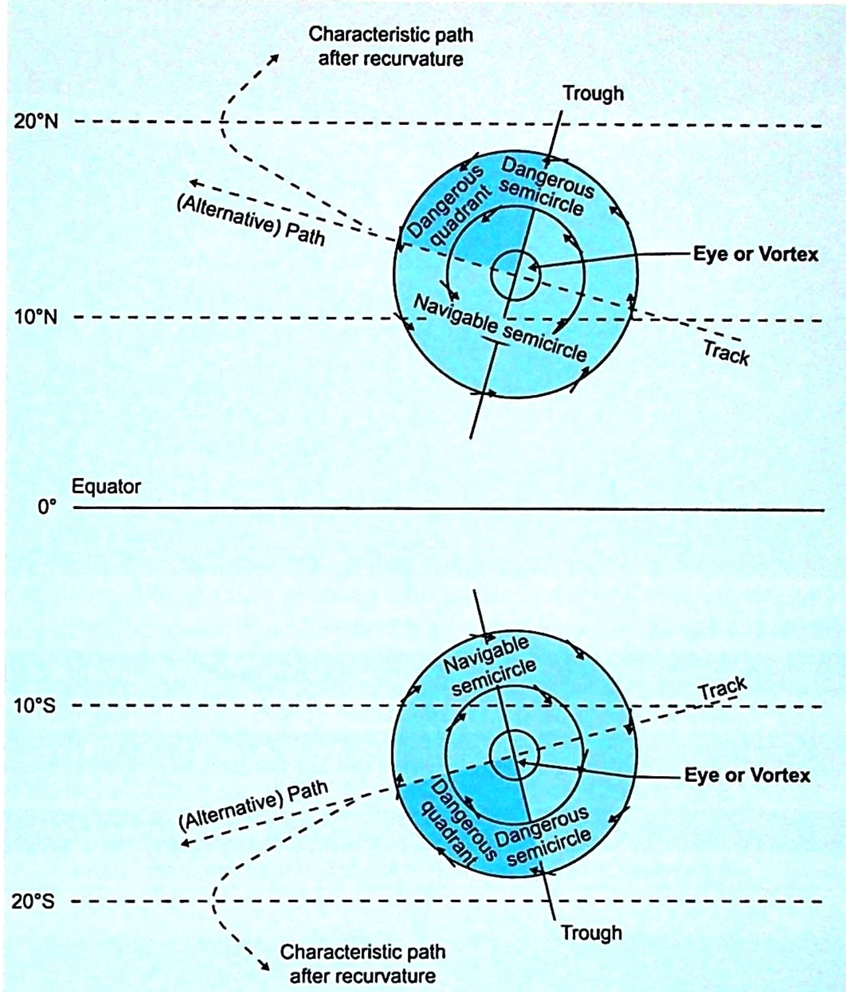
- Inform the Master and other departments
- complete the appropriate heavy weather checklist
- increase the frequency of weather observations and monitoring of trends. Obtain updated weather forecasts, but recognise that the actual weather experienced may be different to that forecasted
- monitor NAVTEX, safety area and weather warnings
- be aware of the proximity to navigational hazards and the ship's ability to maintain course, speed and position. This involves considering availability and efficiency of the engines and steering gear according to the prevailing weather conditions
- understand the availability of the engines for changes in speed of the ship during heavy weather conditions
- make adjustments to navigational equipment such as radar (sea state, clutter)
- engage hand steering if the autopilot struggles to maintain heading in deteriorating weather
- in heavy weather, with the vessel rolling and/or pitching heavily, access to the main deck should be restricted. However, where access is required to maintain the safety of the ship or prevent further damage to equipment on deck, the risks will have to be carefully assessed. Hazard mitigation measures should be considered, such as the ship's heading being adjusted to reduce the movement of the ship, lifelines being rigged or agreeing a signal such as the use of the ship's whistle to bring the attention of crew on deck to a particular hazard (eg large waves/green water on deck)
- inform the galley/engine room and crew of any large alterations of course, particularly in a sea state or crossing sea that may result in a large or significant angle of heel
- liaise closely with the watch engineers to ensure that the setting of RPM is kept within permissible limits and does not place unnecessary load fluctuations on the main engines. It is best to work together by listening to the engineers while keeping them abreast of the situation from the bridge perspective.

4.12.1 Heavy Weather – Preparation and Planning

- In addition to the weather data available on the bridge from NAVTEX, MSI and radio broadcasts, ships with internet access should make full use of independent meteorological data such as weather monitoring services or those in the public domain (such as www.ventusky.com)
- while planning the voyage, the navigating officer can assess climatological weather data and routeing charts. However, the latest weather reports should be obtained and monitored prior to and throughout the voyage. Upon receipt of a storm warning, the Master may have to determine the best course of action, which may include a deviation from the intended track
- all departments should be informed well in advance of any storm warning, so that all areas are lashed and secured and planned activities and maintenance can be brought forward, postponed or cancelled
- as early as possible, plot the position of the storm and its intended path. This can be plotted on ECDIS, paper chart or weather routeing software, as appropriate
- check the remote alarms and indicators on the bridge for watertight doors
- while all watertight doors will have been closed prior to departure, ensure that all weathertight doors and loose items inside the accommodation are secured

- consider the stability of the vessel, the reduction of free surface and the need to take on heavy weather ballast.

4.12.2 Heavy Weather – Tropical Revolving Storm (TRS)



Tropical revolving storms (TRS) are very intense depressions that develop in tropical latitudes over oceans. TRS are also known as tropical cyclones, hurricanes and typhoons, depending on their location. Once formed, they are typically 400 to 500 miles in diameter, with winds exceeding force 12.

TRS form primarily in the Intertropical Convergence Zone (ITCZ), which moves seasonally:

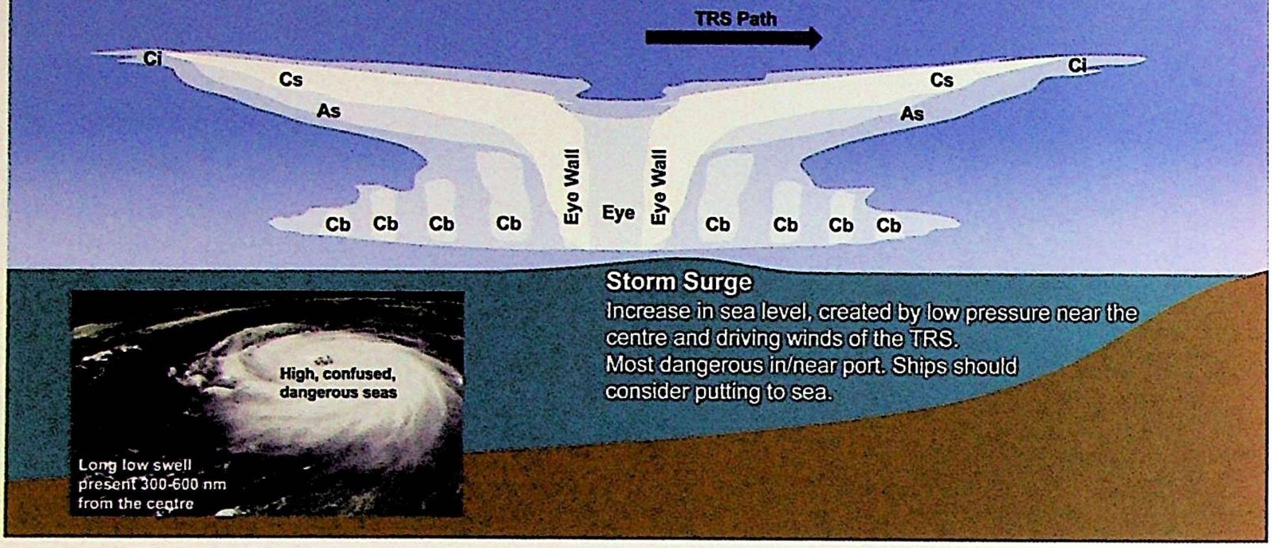
- In the northern hemisphere, the TRS season is approximately from July to October. TRS form mostly in the latitudes of 5°N to 15°N at the start and end of the season and between 10°N and 25°N in the middle of the season
- in the southern hemisphere, TRS develop mostly between 5°S and 18°S. They usually originate in the western part of the Pacific and south Indian oceans.

Once formed, storms usually decay when reaching 35°N or S. TRS are usually detected by meteorological services during their formation. They are then tracked and monitored, with meteorological information including forecasts of future movement disseminated to ships.

In latitudes where TRS may form, it is essential that the Master and OOW regularly check the weather information provided to the ship and are alert to the characteristics that indicate that a TRS is forming. This is because some TRS form without detection from ashore and shipboard equipment and observations are, therefore, key to detection.

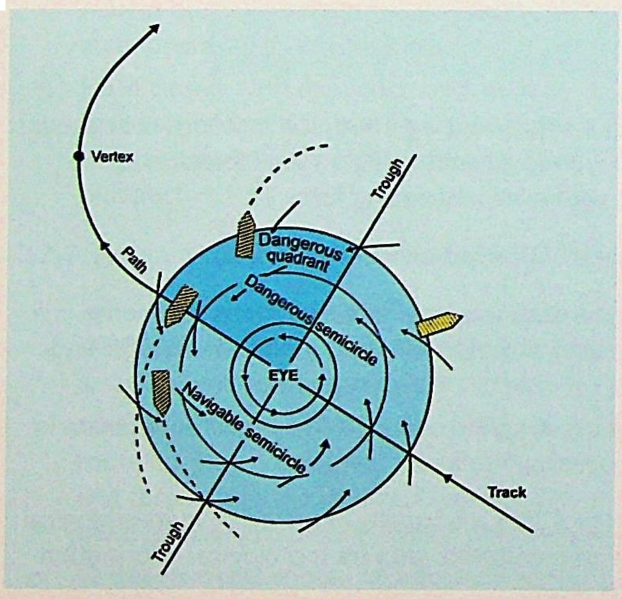
Signs of an Approaching TRS

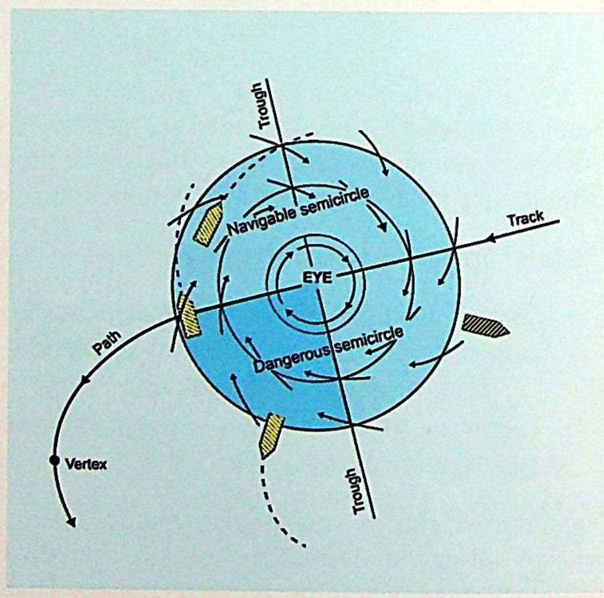
- A long low swell from the direction of the storm
- the presence of spiralling cirrus (Ci) clouds, increasing in density
- pressure drop in the tropics, dropping more than 3 mb below the daily (diurnal) average
- change in the direction and force of the trade winds
- ugly lurid (copper) sky at sunset or sunrise
- oppressive humid atmosphere
- increasing wind strength as storm approaches
- increasing rainfall; very heavy under bands of cumulonimbus (Cb) cloud.



Establishing the Ship's Location

Wind Observation	Northern Hemisphere	Southern Hemisphere
Veering	Ship located in dangerous semicircle.	Ship located in navigable semicircle.
	If pressure is falling, the ship is located in the advance quadrant.	
Backing	Ship located in navigable semicircle.	Ship located in dangerous semicircle.
	If pressure is falling, the ship is located in the advance quadrant.	
Steady	If pressure is falling, the ship is located in the path of the storm.	





Action by a Ship in a TRS

Location	Northern Hemisphere	Southern Hemisphere
Dangerous semicircle.	Put the wind on the starboard bow and alter course to starboard as the wind veers.	Put the wind on the port bow and alter course to port as the wind backs.
Navigable semicircle. In the path of the TRS.	Put the wind on the starboard quarter and alter course to port as the wind backs.	Put the wind on the port quarter and alter course to starboard as the wind veers.

It should be noted that:

- When an observer faces the wind, the eye will lie approximately 100° to 125° to their right hand side (in the northern hemisphere) when the storm is about 200 miles away
- an area of rain surrounds the eye, causing appreciable clutter on the radar. However, if the storm is visible by radar, the ship will already be experiencing high seas and gale force winds. Action to avoid the storm needs to be taken before such a situation arises
- a good speed should be made as a TRS moves relatively slowly (between 15 and 40 knots). A ship proceeding at 20 knots away from the eye of the storm may easily outstrip an approaching TRS. However, this needs to be done before the wind increases to the point that it affects the ship's movement
- if the ship is trailing the storm in the navigable semicircle, there should be sufficient time and sea room to move away from the eye
- if you are in the northern hemisphere and the wind is veering, you are likely to be in the dangerous semicircle. Proceed with maximum speed, keeping the wind at 10° to 45° on the starboard bow. The ship should turn to starboard as the wind veers. Where the wind direction is steady or backs, such that the ship is in the navigable semicircle, proceed at maximum speed while the wind is brought onto the starboard quarter. The ship should turn to port as the wind veers (northern hemisphere)
- if you are in the southern hemisphere and the wind is backing, the ship is likely to be in the dangerous semicircle and should proceed with maximum speed keeping the wind 10° to 45° on the port bow. The ship should turn to port as the wind backs. If the wind direction is steady or backs, such that the ship is in the navigable semicircle, the wind should be brought well on the port quarter and the ship should proceed with maximum speed. Turn to starboard as the wind backs (southern hemisphere)
- if the ship is in port when a TRS approaches and there is sufficient time to escape, it may be better to put out to sea than staying at the berth as, even with the best moorings, it is doubtful that the ship will be safe from the effects of the storm.

4.13 Navigation in Ice

The most important aspect of safely navigating in ice is to maintain the ship's freedom to manoeuvre. This requires skill and patience on the part of the bridge team, as well as cooperation with the rest of the ship's crew and any icebreaker escort.

Ice concentration and thickness, very low operating temperatures, high winds and the relatively unknown hydrography of some ice regions make safe manoeuvring particularly challenging. Because of the remoteness of the polar regions, many areas have little or no supporting infrastructure, such as pilotage, routeing schemes, emergency response assets, tugs and, importantly, aids to navigation (AtoN). The lack of AtoN, whether fixed, floating or virtual, and ice accretion/indistinct coastlines can make traditional navigation difficult.

Successful navigation depends on thorough planning prior to entering ice regions and the ability to successfully navigate without traditional navigational aids (including making use of GNSS and other position monitoring methods). As far as possible, every effort should be made to avoid difficult ice conditions and ensure the ship has the freedom to navigate.

Following the introduction of the Polar Code and amendments to STCW, it is a requirement that Masters and OOWs on ships operating in polar waters are trained to an approved basic and advanced standard. *(Ref A-V/4, paragraph 2 of the STCW Code).*

These standards set out subjects in which deck officers should be able to demonstrate knowledge, understanding and proficiency, including:

- Ice characteristics and areas where different types of ice can be expected
- vessel performance in ice and low air temperatures
- operating and manoeuvring a vessel in ice
- regulatory considerations (including the Polar Code)
- crew preparation, working conditions and safety
- environmental factors and pollution prevention
- voyage planning and reporting in polar waters
- limitations of equipment.

During ice navigation, OOWs who have only undertaken basic training should make use of every available opportunity to expand their knowledge and understanding, in particular by asking suitable questions, listening, observing and learning from more experienced ice navigators and senior officers. While the STCW Polar Code training standards do not apply to lower latitudes, ice may still be present (for example, in the Baltic) and the requirements for safe operations and navigation in ice still apply. The OOW should be aware of the ice area in which the ship may be operating and the considerations that apply for safe navigation.

4.13.1 Passage Planning and Routeing in Ice Regions

The passage plan should ensure adequate UKC for deviations according to the route through the ice. As a general principle, the navigator should plan routes in open water where possible and only plan for the ship to enter ice when absolutely necessary. There are specific circumstances that may require entry into the ice, such as when there is significant freezing spray. The passage plan should recognise any limitations of navigation or communication equipment on board and take into account the provision of AtoN, availability and reliability of charts, SAR capability and infrastructure (all of which may be limited) in the intended region.

A passage plan for ice will consider pack ice and iceberg limits indicated on the navigational chart and other available material (some regions will have more information than others), such as:

- Information from government or commercial sources
- forecasts for the intended location and estimated date of passage

- historic data, including previous ice information, as well as knowledge gained from local experience and/or previous visits on the route
- the Polar Operational Limit Assessment Risk Indexing System (POLARIS)
- restrictions and calculations in certain regulatory regions (such as the Northern Sea Route and the Canadian Arctic Ice Regime Shipping System).

The Polar Code states that the passage (voyage) plan must consider the potential hazards of the intended voyage. Ships operating in polar regions should ensure that each passage plan includes, as a minimum, the requirements for compliance with the voyage planning goal of the Code. Additionally, passenger ships should follow the 'Guidelines on voyage planning for passenger ships operating in remote areas' (IMO Resolution A.999(25)). Passenger ships should create contingency plans that consider emergency response in the event of limited SAR and medical facilities in remote regions.

Ice routeing services may exist in the ice region. Care should be taken with such information as it may not be fully comprehensive. Ice routeing services may be compulsory, voluntary or available from commercial providers for a fee.

When routeing in or near an ice region, the navigator should consider the following:

- The Classification of the ship according to its ice strengthening capability
- desired speed, maximum speed and charter party specified speed for the voyage
- charter party and insurance clauses/limits
- the projected weather patterns for the period of the voyage
- the endurance and bunker capacity of the ship (including sufficient fuel for emission control areas in the event of a delay), as well as sufficient fresh water and supplies
- available advice from ice pilots and advisors
- monthly routeing charts showing seasonal ice limits
- the monitoring aids available
- that progress is irregular in pack ice conditions.

When following a passage from a previous voyage, be aware that it is very likely that the ice conditions will have changed.

4.13.2 Watchkeeping Practices

When approaching a known ice region, or deciding to enter an area of ice, the Master should carry out an assessment of the current status of the voyage, with the most up-to-date imagery, data and forecasts available. The decision should be a dynamic one, taking into account all the information available including the visibility, wind, state of the vessel and the movement of the ice.

When navigating in ice covered waters, lookouts should be increased in areas known to have surface ice. In general, consideration should be given to doubling bridge manning.

Depending on the level of ice experience, and for lengthy periods of ice navigation, additional support for the bridge team may be obtained from the services of ice navigators/pilots.

The primary function of the OOW when inside an ice area is to maintain an effective lookout, both visually and by a continuous radar watch. In many cases, the bridge team will consist of two officers. This allows one officer to monitor the radar and position, while the other officer will concentrate on the ship's progress and the oncoming ice.

Ships that operate permanently in polar regions are called 'polar ships' while ships operating in ice covered areas are 'ice classed' according to Class Society Rules regarding the structural strengthening required to withstand the impact of ice. However, some of these ships will still require the services of an ice breaker.

Prior to entering an ice area, all of the bridge team, including the lookout and the helmsman, should be fully briefed as to their duties and actions, which may include:

- Illuminating the ship at night instead of keeping it dark
- optimising radar settings to maximise ice detection
- watching for the helm response, which will be very different to normal operations.

In bergy waters, there should be a dedicated lookout during daylight. It is vitally important to rotate lookouts at frequent intervals and to fully brief them as to their duties.

The Master should instruct the OOW on appropriate action to take upon encountering ice, ie when to call the Master, whether to enter or avoid and whether to reduce or maintain speed.

When navigating in pack ice, the ice edge must be located as early as possible. A ship should enter the ice at slow speed and with caution, ensuring that leads are followed. Radar and satellite imagery should be used to determine the safest course through the ice.

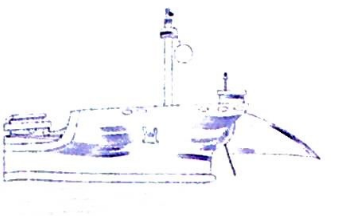
4.13.3 Considerations that Apply when Navigating in Ice

The bridge team should always follow the established procedures for ice navigation as outlined in the SMS and under the Night and Standing Orders of the Master. The following should also be considered when navigating in ice:

- The ship's movement will be restricted due to the surrounding ice. Vigilance and patience are essential
- the use of GNSS and other appropriate navigation systems is essential for safe navigation in ice regions, but to mitigate their limitations their accuracy should be cross-checked by other means, such as radar ranges/bearings and/or visual bearings/transits (if possible)
- it is sometimes difficult to use coastal features for position fixing as they may be covered by ice. Coastlines may also present a poor radar return, especially where fast ice is present. Ranges may not be reliable
- in many ice areas, AtoN may not exist. In some ice regions, physical AtoN are removed during the ice season and may be replaced by virtual AtoN or not replaced at all. The visibility and efficiency of physical AtoN may be reduced due to the weather and ice accretion
- charts used in ice regions are usually less accurate due to a lack of surveys, with poor data or historical data often being used
- monitoring of the echo sounder is an essential element of safe navigation in regions that have not been surveyed to modern hydrographic standards
- specialised ships may have forward facing sonar and/or hull stress monitoring equipment fitted that should be monitored by the OOW
- gyrocompasses may have a limiting range of latitude and the OOW should be aware of this. In higher latitudes, the accuracy of the gyrocompass should be checked
- the magnetic compass is less effective when in proximity to the magnetic poles, but it can be used with caution in lower latitude ice regions
- the use of overlays can be effective when navigating in ice. Using radar overlays and ice imagery overlays (if installed/purchased) can aid the mariner in following a safe route through the ice
- speed, distance and depth measurement equipment (SDME) may be affected by ice. For example some logs may not operate effectively due to the turbulence caused by ice and this may also impact on other equipment connecting with the speed logs
- sea ice makes a poor radar target, particularly at ranges beyond 4 miles. Radar returns are usually greatest from the ice features, particularly ridges and the edges of floes. Some ships may be fitted with specialised ice radars for this purpose
- the OOW should frequently adjust the gain controls to determine the presence of growlers and bergy bits. Adjusting the gain settings up and down regularly will also aid detection, as will monitoring trails

- identification of ice by radar in clear conditions during daylight is a good training practice that will provide more confidence in night-time radar use
- freezing spray can be particularly dangerous as it quickly results in ice accretion. Actions to reduce freezing spray include reducing speed, changing course or seeking sheltered waters
- depending on the time of year, at high latitudes there may be either long periods of daylight or long periods of darkness. During darkness, searchlights should be used to illuminate the ice and assist in safe navigation
- the Master should be notified of any significant changes in ice conditions, temperature, sea state or visibility.

4.14 Anchoring and Watchkeeping at Anchor



The main duty of an OOW when at anchor must be to maintain a lookout to ensure a safe watch is kept. Maintaining a lookout will alert the OOW to not only the movement of traffic, but also to other situations, such as the ship dragging anchor.

> **If a ship drags anchor(s), the OOW should:**
> - **Immediately raise the emergency alarm**
> - **start taking initial actions, without waiting for the Master if he is away from the bridge.**

4.14.1 Approach to an Anchorage

- Check the chart to make sure there is good holding ground and there is nothing charted that may foul the anchor upon anchoring, or in the vicinity should the anchor drag. Ships regularly foul their anchors because of a lack of planning in this regard. Any potential issues should be raised with the Master. On ECDIS, ensure that seabed hazards are visible in the display settings
- if local information is available, it is always beneficial to seek advice on ship movements and the potential anchorage location before entering congested anchorages, particularly at night
- when proceeding to an unassigned anchorage, it can never be guaranteed to be clear. It is, therefore, prudent to have a contingency plan available
- if it is necessary to anchor at a specific time, eg due to tidal constraints, constantly monitor the speed required to make the ETA
- plot the positions of anchored ships on the chart to confirm that the anchor position and the planned approach to it are clear. This can be achieved using ECDIS with RIO/AIS or with radar ranges and visual bearings
- maintain an awareness of the state of tide and the true and relative wind direction upon anchoring. If possible, anchor into (stem) the wind or tidal stream (whichever is the stronger)
- the choice of anchor and the amount of cable to be used should be decided in advance, but be prepared to vary these choices depending on the actual conditions and the forecast weather
- when determining the length of cable to pay out, take the following into account:
  - the depth of water and capability of the windlass
  - the nature of the seabed
  - expected currents, tides and forecast weather
  - the holding power of the anchor and scope of cable available
  - proximity to hazards (including other ships and underwater obstructions)
  - planned time at the anchorage
- the weight and type of the anchor and cable on the seabed is what holds the vessel at anchor. This is affected by the nature of the seabed, wind and tidal streams. The aim is to keep the pull of the cable horizontal in order for the maximum holding power of the anchor to be realised, particularly in heavy weather conditions. A change in conditions, such as increased seas, wind, current or tide, may require more cable to be paid out to keep the pull horizontal
- observe other ships anchored in the vicinity to gain an understanding of the conditions. It is usually possible to see which is the better anchor to use by observing the catenary of their cables
- the estimated 'let go' position should be specified in the passage plan
- radar PIs and a 'head range' to indicate the let go position can be used to navigate into the anchorage in restricted visibility. Regardless of visibility, they serve as a useful check that the vessel has anchored in the correct position

- when referencing the radar and ECDIS, remember that the stem to conning distance should be used when plotting the let go position.

4.14.2 Anchoring

- During the day, hoist the anchor ball and by night, turn on anchor lights and deck lights as required. The exact moment to hoist the day shape or switch on the lights is when the anchor touches the bottom. Any additional signals required by local authorities or certain operations (eg diving) should also be displayed
- upon anchoring, change the AIS status
- on letting go the anchor, fix the ship's position and cross-check using available means. Note the anchor position, ship's head, time and obtain a sounding. The sounding provides a check that sufficient cable is being used.
  Some ECDIS provide an anchoring function, which takes into account the anchor to CCRP distance
- Classification Societies will set the standards for the windlasses and chain on the ship.
  For most merchant ships, the walk-back chain speed is 1 shackle every 3 mins
- once the position of the anchor has been plotted, the safety swinging circle (SSC) using the stem-to-standard distance should be confirmed. This should use the fix and direction of the ship's head at the time of letting go. The formula for the SSC is:
  - length of cable used + ship's length + safety margin
- check that the SSC is clear of any navigational hazards
- turning the ship's past track on in ECDIS will allow the ship's swing to be displayed for the duration of the stay and any deviations will be obvious. If ECDIS facilitates an anchor alarm circle, then this should also be used. Radar can also be used to cross-check the position.

4.14.3 At Anchor

- The OOW should monitor the ship's position while at anchor, including observing the current weather conditions and the forecast. An OOW should be no less vigilant at anchor than when they are underway
- it is up to the Master to decide whether the watch is to be kept on deck or on the bridge. It is the responsibility of the OOW to ensure that all measures are taken for safety of the ship, its cargo and its crew, and this includes maintenance of a proper lookout, identification of possible dangers and frequent checking of bridge equipment
- the engine notice period should be agreed with engine personnel. Immobilising engines for repair/maintenance should be considered carefully, with permission obtained from the harbour authority
- as the ship swings, it may move position and the anchor cable will stretch. The OOW should continue to monitor the position to check the anchor is holding and ensure the ship remains inside the SSC
- use of the radar in ground stabilised mode with true vectors is a visual indicator. Setting the vector to 60 mins or more could provide an early indication of dragging
- regularly check the cable and brake or have the cable and brake checked and the findings reported. Slipping of the gypsy wheel within the anchor brake indicates excessive weight on the anchor
  Note: To aid the OOW in monitoring for early signs of the anchor cable slipping, consider attaching a cloth/rag to the cable at the gypsy during the day or a glow stick/retro-reflective tape at night
- maintain a listening watch on local frequencies as these are a source of useful information on ship movements and weather
- while at anchor, maintain a lookout for any signs of pollution, whether from own ship or others at the anchorage. If any is sighted, inform the Master and the chief engineer immediately
- in areas prone to piracy and robbery, the OOW should keep a good visual and radar lookout for small craft approaching the ship and immediately pass information on sightings to the Master and onboard security personnel (if embarked). Consideration may also be given to not anchoring and remaining offshore

- in anchorage areas that are prone to piracy attack, the anchor cable provides an easy means of access to the ship. Therefore, appropriate deck patrols should be maintained to ensure security of the ship, in accordance with the ship security plan. During such patrols, a check should be made of the anchor cable, brakes and other securing arrangements in addition to the spurling pipe covers
- in case of restricted visibility at anchor, the Master must be informed and appropriate sound signals used as stated in COLREGS Rule 35 – Sound signals in restricted visibility
- where heavy weather is forecast and the Master decides to remain at anchor, taking on heavy weather ballast is an option to reduce windage. This must take account of ship stability and UKC.

4.14.4 In Deteriorating Weather Conditions

In deteriorating weather conditions:

- Consider informing the Master
- inform the engine room and make engines ready
- obtain the latest weather forecasts
- inform the anchoring party to make ready
- on certain ship types/hull forms, consider use of steering gear and thrusters
- consider paying out additional cable
- consider taking on additional ballast
- consider the need for tugs
- consider suspending any ongoing operations (eg bunkering, tendering, etc)
- assess the proximity of other ships and navigational hazards
- watch for other ships dragging or leaving the anchorage
- weigh anchor and proceed to sea.

The OOW should monitor for indications of dragging anchor. These include:

- Weight will come on the cable significantly, leading to a long lead, and weight will come on and off the cable repeatedly
- the bow will not be able to stand against the wind
- extra vibration
- dragging anchor may be visible on radar and ECDIS as a 'dragging and yawing' action when the ship's past track is turned on
- the ECDIS anchor watch/SSC alarm function will activate
- if vectors are displayed, an increasing vector
- an increase in the SOG and change in COG from the swing, whether observed on GNSS or the Doppler log.

4.14.5 Action in the Event of Dragging Anchor

Once it has been confirmed that the ship is dragging anchor, the following actions should be taken:

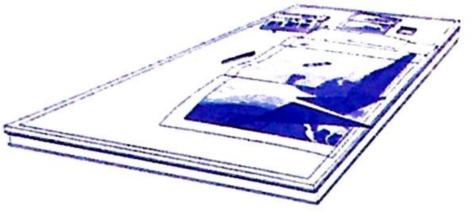
- The OOW must assess the situation, the severity of dragging and the time available
- inform the Master, anchoring party and engine room; confirm engines are ready
- as an interim measure, consider the use of thrusters
- in many cases, the ship's movement can be arrested by paying out more cable. However, this is only a valid option during the early stages of dragging, as once a ship starts to drag more power will be required to arrest the motion
- the Master should determine the best action for the ship, which may include weighing anchor and re-anchoring the ship or proceeding to sea

- in certain circumstances, a second anchor could be deployed. This can halt the ship's progress and provide additional time to consider the next action
- other ships in the vicinity should be informed where appropriate.

CHAPTER 5

Bridge Practices – Coastal Navigation

5.1 Coastal Navigation



A coastal passage can be defined as being within sight or radar range of land for a period of time. This is typically associated with increased risk, a build-up of traffic volume (combined with ocean traffic converging with coastal vessels/fishing vessels) and proximity of navigational hazards.

Coastal passages require the OOW to maintain an increased sense of alertness, vigilance and situational awareness, as the bridge manning level at this stage of the passage may only be the OOW and a lookout.

a. Coastal Navigation – General

- Prior to accepting the watch, the OOW should have complete understanding of the passage for the duration of their watch and what is likely to be encountered
- coastal navigation provides an opportunity to fix the ship's position by multiple methods. This is particularly important on first making a landfall and immediately upon taking over the watch
- if there is a discrepancy between ECDIS and the radar image overlay of a coastline, this should be investigated
- remind the lookout of your expectations of him on commencing a coastal passage leg
- when approaching a coastal area, reassess the navigational situation. For example, do you now need to increase the bridge manning levels or should you consider a reduction in speed?

b. Coastal Navigation – What the OOW needs to be aware of for the watch ahead

- The Master's requirements for the watch ahead
- manpower status, including watchkeeper, engine room and the location of the Master
- courses to steer and alterations for the watch ahead
- nearest hazards along each leg
- likely concentrations of traffic, including yachts and fishing vessels
- ECDIS safety settings and whether they remain appropriate
- use of PIs
- the presence of AtoN
- tidal streams and currents
- VTS/VTIS reporting requirements and radio channels to be monitored
- UKC and how the ship responds to shallow water effects.

c. Coastal Navigation – Under keel clearance (UKC)

- Be aware of the loss of UKC due to heeling, rolling, listing and the effects of swell and squat
- be aware of the expected minimum UKC for each leg of the coastal passage plan
- ensure appropriate alarm settings on the ECDIS and echo sounder for the watch ahead
- understand that the echo sounder alarm is an actual alarm at the current time and position, from a primary sensor
- on ships with more than one echo sounder transducer, it is prudent to select the forward transducer for coastal navigation.

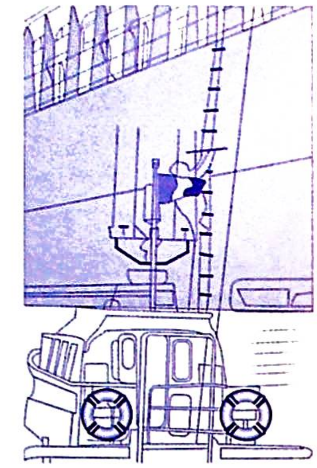
d. Coastal Navigation – Shallow water effect (squat)

- Understand how to reduce the likelihood of shallow water effect occurring during coastal stages of the voyage and recognise the possible indicators. These include, but are not limited to:
  - vibration levels increasing noticeably
  - an increase in the magnitude of the bow wave
  - the ship's wake will be larger and nearer the bow than usual
  - propeller RPM will reduce (up to 20% in open water conditions)

  - there will be a reduction in speed (up to 30% in open water conditions)
  - any rolling, pitching or heaving motions will be reduced
  - sediment can suddenly show in the water
  - an increased delay between helm orders and ship response
- to overcome squat, reduce speed. Squat varies with the square of the speed. Therefore, if you reduce your speed by 50%, the squat will be reduced to 25% of the previous level
- when speed is increased, ensure the effect on UKC is taken into account
- squat will result in an increase in the turning circle, as well as an increase in stopping distances and times.

5.2 Pilot on Board

> *"Despite the duties and obligations of a pilot, his presence on board does not relieve the officer of the watch from his duties and obligation for the safety of the vessel. He should co-operate closely with the pilot and maintain an accurate check on the vessel's position and movements. If he is in any doubt as to the pilot's actions or intentions, he should seek clarification from the pilot and if doubt still exists he should notify the master immediately and take whatever action is necessary before the master arrives."*
> ***IMO Resolution A.285(VIII)***



The OOW continues to be responsible for their watch regardless of the pilot's presence on the bridge.

Pilots possess local knowledge but they may not know the ship, its equipment or the ship's personnel. The most important aspect of navigation with a pilot on board is to avoid:

- Handing over entire control of the ship to the pilot without paying any attention to his actions
- failing to support the pilot.

a. Prior to pilot boarding

- Determine the ETA to the pilot station, updating the ETA as required. Ensure the deck crew and engine room are informed of any delays
- confirm pilot boarding arrangements
- identify the pilot vessel at the earliest opportunity, whether using AIS or their visual markings
- consider what actions to take in the event that the pilot vessel is not on station as the ship arrives
- have the pilot card laid out ready to be inspected, along with any other necessary paperwork.

b. Pilot embarkation/disembarkation

- The pilot should be escorted safely to/from the bridge. If the OOW is escorting the pilot, the Master should consider additional bridge manning
- if possible, station an OOW to supervise the pilot boarding
- exhibit RAM signals to cover the period that the pilot is boarding/disembarking and own ship is restricted in her ability to manoeuvre
- instructions received from the pilot vessel should only be complied with if it is safe to do so.

c. Pilot on board

- Master/Pilot Exchange is the exchange of information between OOWs, the Master and the pilot to include the ship's characteristics, navigation procedures and local conditions. Checklists combined with a pilot card can be extremely useful during information exchange
  (Even though some ships require pilots to sign a copy of the pilot card, on occasion a pilot may decline to sign it. Lack of signature should not be taken as an offence as the pilot will perform his duties with the same diligence with or without signature on the pilot card)
- where the passage plan does not match the pilot's intended plan, a detailed discussion is required regarding the intended route. This allows any differences between the plans to be fully understood and the passage plan to be amended as appropriate
- a pilot will use the pilot card to understand the manoeuvrability of the vessel, its capabilities, limitations and equipment. This document should be regularly updated and detail any defects or malfunctioning equipment

- the flow of information between the pilot and the bridge team should be an ongoing process that continues for the duration of the pilotage. This ensures all parties can monitor the ship's progress and will be aware of any developing situation or change in expected conditions
- if the helmsman or watchkeepers change watch, a positive report should be made to the pilot
- arrangements for disembarking the pilot should be ascertained in good time.

The OOW should update the pilot with the following information during the period of pilotage:

- **Time/distance to alterations of course/wheel over positions**
- **position fixing discrepancies**
- **vessel traffic movements, particularly small craft that may not appear on the radar**
- **the meaning of any alarms**
- **positive reporting of course and speed.**

What pilots may ask about the ship's engines and machinery plant

Main engine

- Status of the engines and thrusters
- the effectiveness of the engines when going astern (stopping distances)
  Some engine types, eg steam turbine, will only deliver about 40% of the ahead power when going astern
- number of starts available (as applicable)
  Class requires that a ship has sufficient compressed air start storage capacity for the starting air on the main engine to allow for 12 starts off the engine, ie 6 ahead and 6 astern
- time taken for the compressors to re-charge the air-start system?
- any relevant load monitoring/engine monitoring systems and RPM limiting in place, as the pilot may need to increase RPM until load is out of a certain range
- time taken to go from full ahead to full astern.

During the Master/Pilot Exchange, the Master should give the pilot a basic safety briefing and then go on to explain:

Current status

- Course and heading
- speed
- status of the engine
- personnel on the bridge, specifically who has the con.

Bridge equipment

- Ship alarms
- key bridge equipment
- location of the pilot plug
- radar/ECDIS arrangements.

Steering gear

- Rudders (type and range)
- the minimum steerage speed.

Electrical power

- Shaft generators, if being used.

Thrusters

- Number and type of thrusters and any limitations
- if fitted with a stern thruster, whether it functions when going astern.
  This is not possible on many ships.

Propulsion

- Characteristics, number and type of propellers, where appropriate
- on ships fitted with CPP, the fail-safe direction in the event of loss of hydraulic power.
  Many ships on losing hydraulic power 'fail-to-closed', but some 'fail-to-open', ie on losing hydraulic power, the blades will adopt the full pitch position.

Other items

- Availability of the anchors
- equipment and machinery defects (do not conceal defects)
- UKC considerations
- personal arrangements, such as refreshments, smoking policy, location of cabin if required, etc
- any other relevant information.

5.3 VTS/VTIS

The OOW must understand the difference between a VTS and a VTIS. A VTS (Vessel Traffic Service) can instruct a ship that is operating within its area, while a VTIS (Vessel Traffic Information Service) will only provide information and will not instruct the ship.

IALA VTS Categories

INS – Information Service

INS provides information to ships but does not participate in decision making. This is the minimum level of service provided by all official VTS.

TOS – Traffic Organisation Service

TOS can provide information and advice to ships and also issue instructions to ships within their VTS area. TOS typically issue arrival or departure slots, assign an anchorage and manage traffic movements. The purpose of a TOS VTS is to monitor and control shipping to prevent dangerous traffic situations from developing. TOS will often require reports to be made, will monitor that routes are being followed correctly and may intervene when risk of collision situations are identified.

NAS – Navigational Assistance Service

NAS can give navigational advice, participate in onboard decision making and issue instructions. NAS may be used in difficult weather or in the case of defective ships. This service is usually provided in addition to INS and/or TOS and may be imposed when ships seem to be navigating erratically. It may also be requested by a ship experiencing navigational confusion or difficulty. Instructions, if given, will be results based. For example, NAS can give own ship's position, speed and proximity to navigational hazards, but they will issue a course to make good and not a course to steer.

Types of VTS

Some VTS do not meet IMO/IALA requirements for INS/TOS/NAS and may not therefore have the same authority or competence to instruct or advise shipping. The standards of the coastal State may provide another designation for these VTS, such as Local Port Service (LPS) in the United Kingdom.

Mariners should consult ALRS in advance and determine what level of service is provided by the VTS along their passage plan.

A port/harbour VTS will provide different services to a coastal VTS. Mariners should check the level of service provided as this is also a check on the authority and competency of the VTS.

The bridge team should be aware of the level of authority that the traffic service actually has.

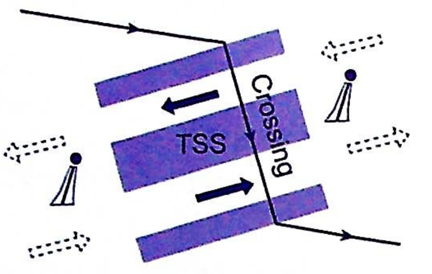
The OOW must:

- Be prepared. This includes having to hand the necessary reporting information, such as the number of persons on board, destination, last port, cargo on board, fuel and lube figures. If fuel figures are not available on the bridge via a computer, a preemptive call to the engine room to obtain them is prudent. If reporting to VTS/VTIS at night, obtaining the fuel figures earlier, when the engine room is manned, is preferable
- if a VTS/VTIS does not answer, record that fact in the log.

If you are in a VTS/VTIS reporting area and your ship develops a defect, inform the VTS/VTIS immediately.

If you identify a rogue ship, notify the VTS/VTIS.

5.4 Traffic Separation Schemes



In addition to the requirements of COLREGS Rule 10 – Traffic separation schemes, the OOW should take the following into account:

Bridge resource management particular to a TSS should be considered before entry, including:

- Bridge manning level
- availability of helmsman and additional lookouts
- availability of engines and their state of readiness
- hand steering tested before entry
- two steering gears running (if applicable).

When navigating within a TSS:

- The OOW must always remember that observation of Rule 10 does not in any way affect a ship's legal requirement and obligation to comply with ALL other applicable rules of the COLREGS
- when crossing a TSS, a ship must cross on a heading as near as practicable at right angles to the general direction of traffic flow. Therefore, when crossing a TSS, no allowance should be made for set, regardless of the resultant course made good over the ground
- appreciate that it is not a narrow channel, so you do not need to keep to the starboard side of the lane you are following but can be on the port side of the lane following the traffic flow. While this is not always possible, depending on draught constraints and the width of a TSS, it can be desirable because being on the port side of a lane allows room for responding to overtaking or crossing situations
- the practice of reversing waypoints on ECDIS passage plans should be avoided as such complacency can have disastrous consequences
- survey quality may not be any higher than in the surrounding area and should always be checked. Remember that just because you are following a TSS does not mean there is sufficient UKC for your draught; this must still be verified during passage planning preparation and then monitored on passage
- ships should give careful consideration to the adoption of constrained by draught status
- deep draught ships should anticipate that they will be overtaken by other ships and take this into account as part of the passage planning process
- be mindful of ships ahead of you as they may reduce speed
- if you are overtaking, always give consideration to slowing down until clear of the TSS, where more sea room may exist for overtaking at a safe distance
- make full use of trial manoeuvre
- be aware of the behaviour of fishing vessels. While fishing is permitted in a separation zone in any direction, fishing vessels operating in the traffic lane must comply with the COLREGS and proceed in the direction of the lane. However, in practice, some fishing vessels may not always follow the rules diligently and the OOW should keep a close watch for sudden alterations of course from fishing vessels, even when within the TSS.

Note: TSS are often associated with two-way routes and deep water routes and the OOW should be aware that there may be no separation of the traffic in these areas.

CHAPTER 6

Emergencies

6.1 General

When dealing with emergencies on the bridge, the bridge team should always refer to the ship specific emergency checklists and the latest edition of the ICS *'Bridge Procedures Guide'*. This chapter provides additional guidance on emergency response and the considerations that contribute to a successful outcome.

Checklists are the primary means of ensuring that a complete set of actions is carried out in a timely manner. In an emergency, even the best trained individuals can forget simple actions. The emergency checklist should be easily accessible, always utilised and kept up to date.

An effective bridge team response to an emergency requires cooperation between all ranks. The OOW should be prepared to assist the Master and if necessary, remind him of actions on the emergency checklist.

The following are important when considering shipboard emergency response:

- Drills and training should always be conducted as if a real emergency is occurring
- initial actions should always assume that a situation will worsen, eg sound the general alarm immediately
- drills and training should ensure that the entire crew is confident in their roles and responsibilities to deal with any emergency
- the more challenging the drills, the better prepared the crew and the more effective the response in a real emergency
- in highly stressful scenarios, the crew will revert to and rely on their core emergency training
- in the event of an emergency, start recording relevant information such as times and locations. Key facts written down are crucial in decision making, but are often lost in the early stages of an incident. Always record as much information as possible
- where possible, take time to update the crew on what is happening, as this may prevent distracting phone calls and visitors to the bridge.

6.1.1 The Value of Effective Drills

Drill scenarios should be varied to be of value. Crews should be prepared in how to respond to a variety of scenarios, so that on the sounding of the alarm and mustering, the response will be instinctive and appropriate.

All drills should be meaningful, with the crew using the lifesaving and fire-fighting systems on board, as this will build confidence that procedures, crew and equipment will work effectively in an emergency. This is especially true for the bridge team. During any drill, the Master, OOW, helmsman and others should ensure that they are familiar with their duties on the bridge depending on the type of emergency.

Drills should be conducted regularly so that skills are kept up to date. There is a requirement for both statutory and non-statutory drills and, therefore, drills should either meet or exceed the requirements of the flag State and other guidelines. Each drill should be planned to ensure that, on a rotating basis, all safety equipment is used and training is provided in its use. On the bridge, the OOW should practise use of the communication equipment, including, if given the order by the Master, issuing an emergency broadcast, eg pan-pan or mayday.

Drills and preparations should never be regarded as an obligatory task that is merely carried out to meet regulatory requirements. Whether they are emergency drills required by SOLAS or additional drills designed to improve crew competence, they should be carried out with the same level of diligence and seriousness. Whenever possible, SOLAS requires drills to be conducted as if they were an actual emergency.

The crew's experience is important in determining how quickly a drill or certain elements of a drill can be carried out. Always remember that a drill can be paused, so that any difficult elements can be explained. In practice, on merchant ships, most emergency training is provided during drills.

Training is more effective when crew know why they are doing a drill. Separating training from drills helps to build confidence ahead of the drill and allows for a drill to be more realistic.

On the bridge, a drill may present an opportunity for the Master to develop the OOW's skills and responsibilities by sharing lessons from their own emergency experience. Likewise, it is an opportunity for the OOW to ask the Master questions, particularly if the rest of the crew are simulating a drill elsewhere on the ship.

In an actual emergency, poorly trained and inexperienced crew may become incapacitated by fear. However, experience has shown that crew members who regularly train and exercise in safety drills:

- Are less frightened and less likely to panic
- respond in a controlled manner
- do exactly what they have been trained to do
- handle a situation much better than they did before the training.

Regular and varied drills, if effectively executed, will:

- Test and improve emergency plans and procedures (and inform updates to the SMS where necessary)
- reveal any weaknesses or omissions in the ship's emergency plans
- highlight any deficiencies in the emergency equipment
- reveal any gaps in resources
- improve communication
- clarify individual roles and responsibilities
- improve both individual and team performance
- improve the process of managing emergencies
- meet or exceed regulatory requirements.

It is important that drills are carried out in a safe manner. Many accidents have occurred during poorly planned drills, particularly during lifeboat drills. Before conducting a drill, the equipment to be used should be thoroughly examined to ensure that it is safe to use.

Training and drills may reveal a need for further training ashore and this should be reported to the company. Should you consider that additional training materials are required, the company should be informed.

Consideration should be given to conducting a complete walkthrough of the drill before undertaking the drill itself, particularly after a large crew change or if the drill is complicated in nature.

Drills should:

- Practise different scenarios based on existing risks and the specific cargo that is being carried
- practise different response procedures
- practise drills under varying conditions
- be as realistic as possible – this will help reduce stress in the event of an emergency situation
- be recorded in the appropriate logbook
- involve all crew, including the Master and the rest of the bridge team, not just those mustering at the fire stations
- identify weaknesses and the remedial action required
- end with a beneficial debrief that reinforces the lessons learned.

6.1.2 Responding to Emergency Alarms

When dealing with emergency alarms:

- The OOW should always remember that, when an alarm sounds, it is their responsibility to find out what is happening
- be aware that investigating and responding to alarms will cause a loss of situational awareness, so ensure that assistance on the bridge is obtained as early as possible
- never acknowledge an alarm without verification and confirmation of the cause
- except in clear cases of a false alarm, the OOW should contact the Master immediately as the initial minutes of an emergency are the most crucial. The Master will make a judgment as to the next sequence of events for the ship response
- remember that any significant delay between alarm and response can be fatal.

6.2 MOB

Emergency

MOB

Details

A man over board (MOB) is one of the more unsettling emergencies for the OOW. This is because, in many cases, the success of the immediate response is dictated by their actions in the first few minutes. This is especially true of an event witnessed by the OOW, where the bridge wing lifebuoy can be thrown over and a turn begun, with assistance from the rest of the crew following over the next few minutes.

However, a MOB is one of the easiest emergencies to prepare for. Search patterns may be dictated by the location and the weather, but the general procedure is standardised. Therefore, the OOW can prepare for a MOB event mentally by practising their actions in their head. This should include varying their position on the bridge, eg if the OOW is near the bridge wing, releasing the lifebuoy might be their first action but if they are near the console, sounding the general alarm (or MOB signal) might be done first.

6.2.1 MOB Drills

During a MOB drill:

- The bridge team should ensure they know how to deploy the bridge wing smoke/light lifebuoy
- as many crew as possible should participate, as it is a good way to introduce non-watchkeepers to actions on the bridge following a MOB
- lookouts should be instructed to keep the MOB in sight. If those assigned to look out are not watchkeepers, they should be instructed how to systematically scan the horizon with binoculars. The preferred method is to move the binoculars gradually from the horizon back to the ship, in vertical block movements so as not to miss any sections of the water.

6.3 Fire

Emergency

Fire

Details

An immediate response using a plan that suits the characteristics and location of the fire is essential in ensuring that the fire is contained and extinguished. The response actions to a fire should be reviewed periodically, together with any responses laid out in the ship's SMS.

The role of the bridge team is crucial in ensuring that the ship's response is appropriate to the situation. There should be a good flow of communications. On mustering, the fire parties should establish communication with the bridge first, before going to the reported location of the fire. As information on the nature of the fire is passed to the bridge, the Master will ensure that each fire team and other responders are tasked as appropriate, eg to rescue casualties, to boundary cool, to isolate ventilation or to extinguish the fire. The fire teams should provide feedback on the issued commands and the ongoing fire situation. This is crucial as it is unlikely that the bridge team will be able to observe the scene of the fire. As a fire develops or is controlled, this information should be passed to the Master.

It is of utmost importance for the Master to reassess the situation regularly and based on new information. He should issue new commands if the previous commands have been ineffective. For example, if a fire is escalating, perhaps there is still ventilation to the space or the boundary cooling arrangements are ineffective.

Each situation will be different and the Master's decision making should be dynamic. It can be a mistake for crew, regardless of rank, to stick to a fixed plan. This is where the OOW on the bridge, as well as the fire party team leaders, can assist the Master with feedback and suggestions. During a fire, the OOW in charge of the fire team will have a better understanding than the bridge of the risks to the fire team. He should relay this information strongly to the bridge, as this will be crucial in assisting the Master with his decision making, in particular whether or not the fire can be extinguished using the resources on the ship.

In the event of a fire, the bridge team should follow the fire checklist, but also consider the following:

- An appropriate heading should be chosen that considers the location of the fire and the direction of the wind. This can help reduce the spread of the fire and allow smoke to drift away from the fire parties on deck. The Master should also consider reducing speed to lower the wind speed if this is helping the fire to spread or where the ship's course cannot be altered
- the OOW should ensure he is familiar with his actions in the event of a fire, eg knowing the location of the fire control plan, the BA control board, the emergency fire pump 'ON' button, as well as what information and times to record in the logbook
- the OOW should ensure he has a good knowledge of the layout of the ship, especially when joining a new ship, as this will assist response in the event of a real fire
- as a fire may be a distress scenario, consider issuing a communication to all ships and also raising the 'Not Under Command' signal and updating the AIS. While this will reduce the tasks of the bridge team towards collision avoidance, the bridge team must still monitor position, course, speed and UKC. The Master may delegate the navigation tasks to the OOW, so that he can focus on the command decisions relating to the fire
- the bridge team should consider what to do if engine or bridge equipment becomes inoperable or if main power is lost. Contingency planning is useful as, for example, a fire in the engine room may mean the loss of manoeuvring power or steering.

6.3.1 Fire Drills

Fire response plans, using a variety of scenarios, should be practised regularly so that the crew are trained to cope with different situations. Having several flexible plans may be crucial to responding to a fire if it spreads or the intensity changes. For example, a drill could involve a fire in proximity to one of the fire lockers that prevents a fire party from mustering in their usual way.

After the fire drill, the person in charge should always give a debrief. This should highlight what went well in the drill, what could have gone better and what lessons can be learned overall. Feedback should be given by the crew to the person in charge and vice versa. This should highlight some of the following:

- Communications: could the fire parties communicate with the bridge team? Were there any UHF black spots, where instead the phone system should be used? Were orders clear from the bridge? Were the Master and OOW satisfied with the information passed back to them on the bridge?
- equipment: was any equipment not working correctly? Was any additional equipment required? Were spare BA bottles and other support equipment made available?
- access and response: were the fire parties able to contain and extinguish the simulated fire? Could access arrangements be improved or an alternative route used? Should fire containment procedures be changed, eg boundary cooling undertaken in a different place?

Ideally, the feedback and debrief should take place on the bridge (provided it does not interfere with navigation). The Master, chief officer and others should use the opportunity to highlight the above, as well as providing general guidance and training on effective firefighting.

6.4 SAR

Emergency

SAR

Details

A search and rescue (SAR) operation can prove a challenging task for any bridge team. It requires good communication and all ranks working together to ensure a coordinated response between the various rescue units in the operation.

IAMSAR Volume 3 is the definitive source of guidance for any SAR operations, but the following should also be considered:

- The Master and the deck officers should be familiar with their likely responsibilities in a SAR operation. Although IAMSAR Volume 3 can be consulted, it will be more efficient if initial actions and basic search patterns are familiar as the bridge is likely to be particularly busy in a SAR operation. As SAR procedures are rarely practised, all officers should periodically revisit IAMSAR Volume 3 to keep themselves apprised
- identify who is the agreed On-Scene Commander (OSC). It is important to establish clear and effective communications and provide regular feedback/updates between all rescue units in the operation. While this will vary between situations, in many cases a merchant ship is called to assist an ongoing search from the vessel with the MOB/casualties. As such, your ship may not be the one making the SAR decisions but instead told where and how to search. While the Master must ensure his own ship's safety, it is important to follow the orders of the OSC as far as practicable, especially where a casualty may only have limited survival time
- as with all emergencies, it is easy to become a casualty by rushing in to help others without proper planning. If the passage plan needs to be amended to assist a distress call, remember that the route will still need to be carefully checked, despite the urgency of the situation and especially if the vessel is coastal or offshore
- if approaching another ship in grave danger, the bridge team should determine the nature of the danger before closing the position and approaching the other ship. For example, the other ship may have run aground, in which case closing the position could put your own ship in danger
- the need to still adhere to the COLREGS
- passenger ships are required under SOLAS to have a plan on board for cooperation with the SAR services. Additional information is available in the IMO *'Guidelines for preparing plans for cooperation between search and rescue services and passenger ships'*.

6.5 Collision

Emergency

Collision

Details

Many emergencies occur outside the control of the bridge team (a fire in the engine room for example) but a collision results from the actions of the bridge team themselves. As a situation escalates to a risk of collision or close contact, the OOW should always remember two significant actions.

The first is to **call the Master** and additional bridge manning as required. While the Master may not always answer in a friendly manner, they would always prefer to be called to the bridge to assist the OOW in avoiding a collision.

The second should be to assess **what actions should be taken right now to avoid a collision.** Remember that no course of action is certain and even a bold alteration of course or a reduction in speed may be sufficient to avert a collision in a close quarters situation. The Master may take time to come to the bridge and, depending on the sea experience of the individual OOW, he will expect the OOW to have considered all possible options to avoid the collision by the time he arrives. While it does come with experience, considering what the Master is likely to do is a good thought process. The OOW should always remember that he is the Master's representative and should not hesitate to take the necessary actions to keep the ship clear of danger.

If a collision is unavoidable, there will still be a few seconds, perhaps even a minute, before contact occurs where the OOW, Master and other members of the bridge team can take action. The most important of these is to sound the general alarm BEFORE the collision occurs. This gives people time to brace, to at least alert themselves as to a danger unfolding on the ship. Sounding the general alarm a few minutes after the collision is too late. It is very easy for the bridge team to become overly focused on watching the collision evolve.

There is always something that can be done to lessen the effects of a collision. This could include a reduction in speed and the closing of watertight doors. If a ship is at anchor and a collision is about to occur with another ship, the anchored ship might be able to bring up its anchor or at the very least make use of a thruster if fitted to change the angle of contact, eg instead of hitting the ship's side amidships, the other ship collides with the forecastle.

Swift action is key to minimising the effects of a collision. The bridge team should follow the emergency checklist, but also keep in mind:

- Be prepared for an escalation of the emergency. For example, the collision may result in a fire, flooding or pollution, so the bridge team should be ready to react if information is passed to them as the situation changes
- commence sound signals. Even though you may be in VHF contact with the other ship, still commence sound signals as this indicates that you made every effort to alert the other ship and have complied with the COLREGS
- commence recording and ensure that the VDR is saved. The OOW should record critical times in the logbook, such as the time of collision and that your ship offered to assist the other ship. It is a requirement under SOLAS to render assistance to the other ship
- consider making the ships fast to each other to prevent additional damage and flooding
- the OOW should note the position and assess the nearest place of refuge, usually a nearby port, especially if the ship can proceed underway. This information can be passed to the Master who, in coordination with the coastal Authorities, may designate a place of refuge. Assistance from tugs and salvors may be required.

6.5.1 Collision Drills

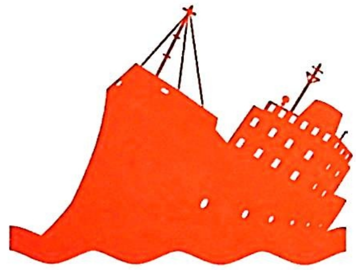
A good collision drill will train the crew in the actions to take to minimise the effects of collision damage. A collision drill should involve:

- Manoeuvring the ship to minimise the effect of a simulated collision
- simulating a reduction in speed, stopping or putting the engines astern
- sounding the general alarm signal and warning the crew by all available means
- ensuring the bridge team know how to close all the watertight doors and verify that the fire doors are closed
- ensuring the bridge team know how to communicate the collision to the company and, depending on the severity, how to make a distress call
- forming damage control parties to inspect the damage and follow the collision checklist.

The Master should consider discussing accident investigation reports with the bridge team during collision drills to develop an understanding of real life scenarios.

6.6 Groundings

Emergency



Groundings

Details

Groundings are usually noticed immediately. A shuddering of the ship occurs, with activation of multiple alarms (engine, course, bilge alarms, etc). Swift action can reduce the damage associated with grounding, eg stop engines, check the charts, carry out a damage assessment.

In some instances, the officers and the Master have been unaware for some time that the ship has grounded, even into a number of hours, and the engine has been left running. This demonstrates a failure to monitor the passage plan and the ship's alarms.

On other occasions, the wind and waves have exceeded the power capabilities of the ship, but even in these circumstances, it can be argued that the ship should have remained in port or in more sheltered waters.

Groundings may cause fires, oil spills and flooding. The Master should consider the stability of the ship and to what extent additional help is required.

The effects of the grounding will depend on the nature of the seabed, eg sand or rock. After sounding the general alarm and stopping the engines, the OOW should identify where and how the ship went aground. When the position has been accurately determined, the nature of the seabed can be interrogated from the ECDIS/read from the chart. This will help determine the likely damage to the ship in conjunction with inspections of tanks, investigation of bilge alarms and soundings around the ship.

The bridge team should as far as possible provide regular updates to the rest of the ship's crew. The Master will need to verify the integrity of the ship and, with the knowledge of the seabed and/or tide, determine whether the ship can be refloated unassisted. However, in most cases, either emergency stability software will be needed (with shore support) or specialist teams, eg salvors and surveyors, will be required to attend the ship to confirm the seaworthiness of the ship. In some circumstances, eg with a soft sandy bottom at low tide, there may be minimal damage and the ship can be refloated immediately. Grounding on a rock has far worse consequences, evidenced by the *'Costa Concordia'* incident. In this case, prompt action to evacuate non-essential personnel, such as passengers, is crucial.

6.7 Medical Emergencies

Emergency

Medical Emergencies

Details

Medical emergencies at sea present a number of challenges. For the bridge team, these relate to ensuring a coordinated response on board and with shore-based support services. This may be in the form of radio medical assistance or, on broadcast of an urgency signal, gaining help from helicopters and other ships (which may have greater medical facilities and more specialist trained staff, eg cruise ship doctors). Other challenges may involve the transfer of injured persons off the ship (requiring course alterations at a correct speed and heading to ensure an appropriate lee) and providing updates to medical authorities and the company ashore.

If a medical emergency is reported to the bridge, the OOW should as a minimum call the Master and then call additional named personnel (eg ship's medical officer and first aid team). The OOW should be aware of who they should call on their ship. For example, on many ships, the C/O or 2/O will serve as medical officer, being responsible for the hospital with a first aid team also being available (usually, the cook and/or steward), but this will vary according to the size of the crew. Larger ships and passenger ships will have a doctor and/or medical team with a nurse. The OOW should ensure that response from these teams to the location of the emergency is as quick as possible.

Depending on the severity of the incident, the OOW should consider sounding the general alarm. For example, safely rescuing an unconscious casualty in a cargo tank will require breathing apparatus and other safety precautions involving most of the ship's crew. All other work on the ship should be halted until the risk to life is averted. Alternatively, in a minor medical emergency that is not life-threatening, a call to the Master and ship's medical officer may be sufficient. While a senior OOW may be in a position to make such a judgment, for newly qualified officers, it is always better to call the Master and he will then decide on what resources to mobilise on board.

In worst-case scenarios, medical emergencies can occur during another emergency (eg multiple crew burned in a fire). Crew should be trained in how to prioritise first aid in such events.

After ensuring an appropriate response on board, it may then be necessary to obtain radio medical assistance or arrange an evacuation. Before calling the medical support services (eg the International Radio Medical Centre (CIRM), the Coastguard or another private service), the OOW should make a note of the following to help with communicating the incident:

- Ship Name/Call Sign
- position
- details of the situation, relaying the most crucial information first, including:
  - whether or not the casualty is breathing
  - whether or not the casualty is conscious
  - the nature, physical location and extent of injuries
  - any first aid or medication that has been given to the casualty
  - the location of the casualty on the ship
  - whether an evacuation is required
  - if communicating by telephone, the ship's satellite number to call back.

The exact information will vary according to the incident. For the most severe incidents, such as where a casualty is unconscious and not breathing, the main response will rely on the actions of the onboard first aid team (eg use of the resuscitation pack, defibrillator, etc). For less serious emergencies, it is best to obtain radio medical advice as early as possible. The service is available free of charge (for UK ships, see MGN 225). It is recommended to pass on as much information as possible initially, in case a situation worsens and further advice is needed. Good passage plans should include emergency contact information.

6.8 Abandonment/Evacuation

Emergency

Abandonment/Evacuation

Details

In the unlikely event of a disaster, the Master will make a decision as to when to abandon ship and when to evacuate personnel. In some incidents, for example after an explosion and in a severe fire, the Master and crew will abandon ship together. In others, for example where the ship is aground, the Master may decide to evacuate non-essential personnel and remain on the ship himself, with perhaps a few senior officers, to assist with a towage/salvage operation.

The order to abandon ship should never be taken lightly as the ship is the primary means of survival and far better suited for the crew than smaller survival craft. Abandonment should be the last resort.

In some incidents, the order to abandon ship is given in a very short space of time, eg following a capsize. In others (such as a fire in the forecastle, slowly spreading aft), greater time may be available to prepare survival craft if fire-fighting efforts fail. Consideration should be given to gathering as many additional resources as possible, including:

- Extra water and food
- blankets/additional clothing
- additional medical supplies
- the SART and EPIRB
- additional radios and batteries
- sundry items such as toilet rolls, the bridge emergency distress flares, line throwing appliances, etc (especially if the ship is deep sea).

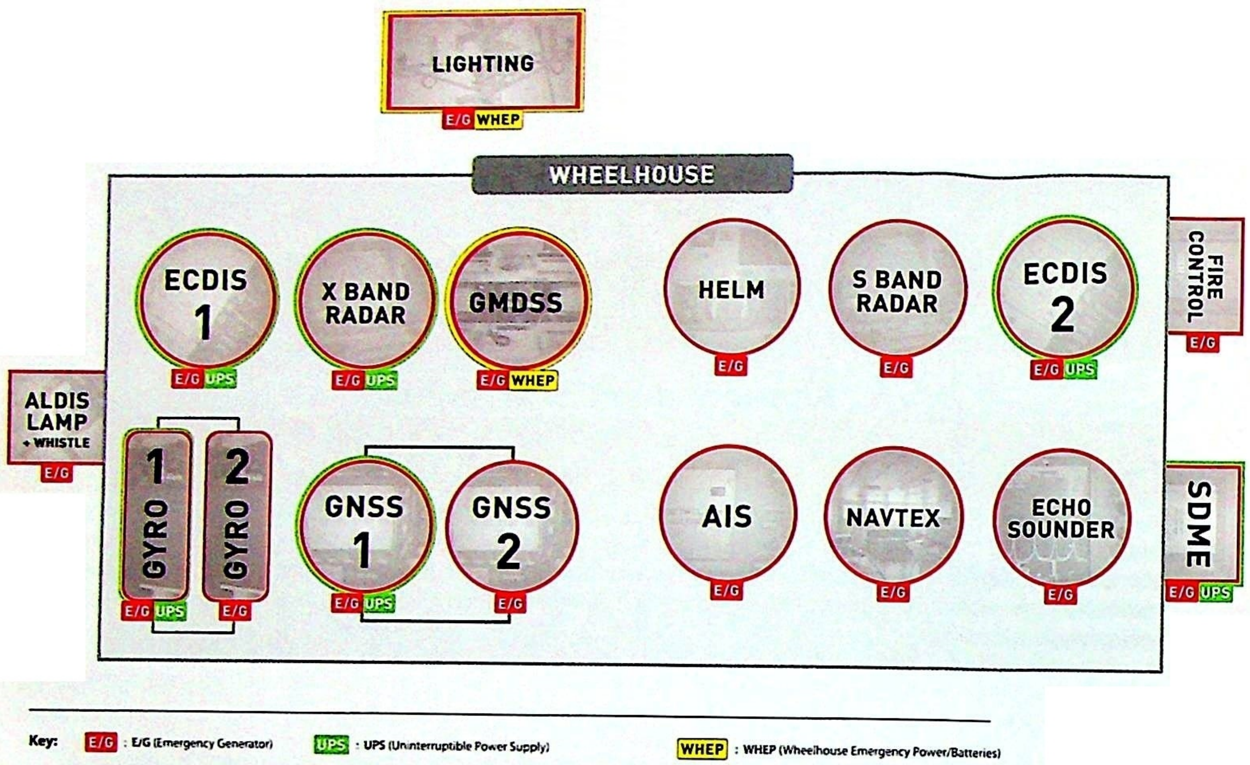
These additional supplies should be placed in the survival craft, depending on the room and time available. Ideally, the bridge team and especially the Master should give this order to a small group of crew members as far in advance as possible, especially as a situation can escalate and the order to abandon ship may follow. Remember that SOLAS survival craft only contain the minimum supplies necessary to sustain life for a week at full capacity and even a few days in them can be far less harsh if additional supplies are available. The direction for this must come from the bridge team.

When the order to abandon ship is given in cold climates, it is essential to don appropriate clothing as well as an immersion suit/lifejacket. Extra layers of clothing will reduce the possibility of hypothermia when spending prolonged periods in survival craft in cold climates. Hypothermia can also occur in mild climates, so, if time allows, all crew should always attend the muster station with extra clothing.

Importantly, many survival craft, such as liferafts, can be prepared in advance, eg deployed and the embarkation ladders lowered, ready for use. This may save valuable minutes if the emergency escalates.

During the sequence of events leading up to abandoning the ship, the OOW will be of great assistance to the Master. The Master may be occupied with numerous decisions, including the decision to abandon ship. By thinking ahead, the OOW may be able to advise the Master of the need to prepare survival craft with additional supplies and also lower liferafts/embarkation ladders in case they are required should the situation worsen.

Minimum Emergency Power and UPS Arrangements



Power/UPS Arrangements

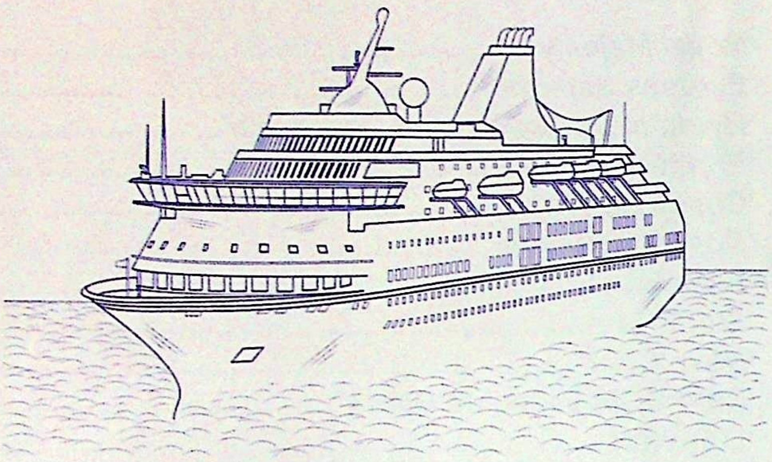
CHAPTER 7

Lessons from Navigation Incidents

This chapter identifies the main navigational safety lessons learned from a number of major shipping incidents.

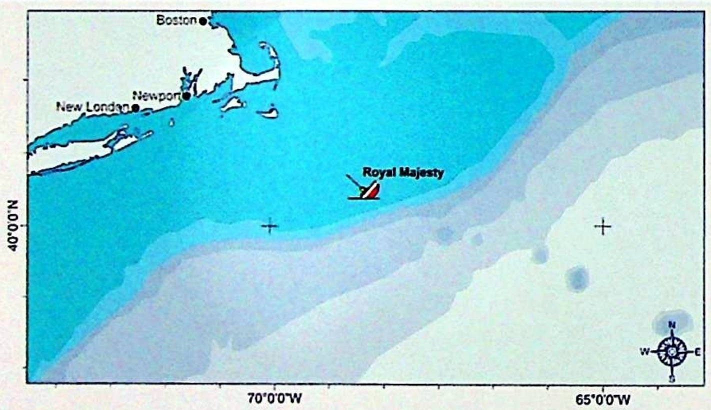
7.1 *'Royal Majesty'*

Grounding: GNSS in DR Mode



Ship Details	**Cruise ship, 32,396 GRT**
Nature of Incident	**GNSS failure/DR mode led to grounding of the ship, due to an overreliance on the accuracy of the position supplied by the GNSS.**
Date of Incident	**June 1995**

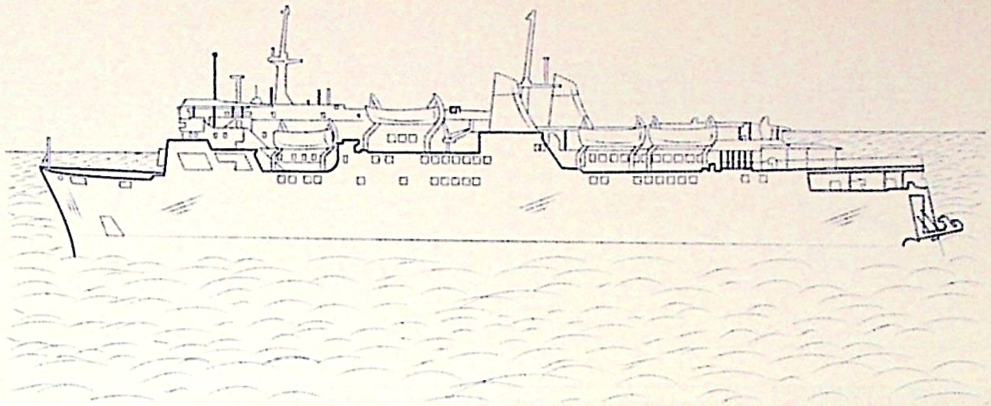
Location

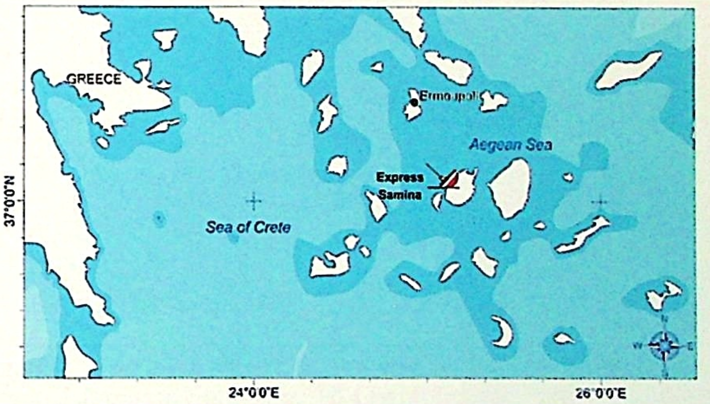


Summary of Incident	The Panamanian cruise ship *'Royal Majesty'* grounded on the Rose and Crown Shoal about 10 miles east of Nantucket Island (US) when the GNSS system switched to DR mode. The grounding occurred 17 miles from where the watch officers actually thought the vessel was.
Navigational Safety Lessons Learned	The ship grounded because the watch officers did not carefully monitor the ship's position and relied totally upon the GNSS. They had not noticed that it had switched to dead reckoning (DR) mode for a period of 34 hours due to a detached antenna lead. To prevent this type of incident occurring, it is essential to: • Regularly cross-check the position supplied from the GNSS by other means, such as with radar and visual ranges/bearings, so that the accuracy of the GNSS position is verified *(In this case, the OOW also disregarded the sighting of a fixed light, trusting the position supplied by the GNSS)* • monitor the display of the GNSS and ECDIS to confirm that positions are not from DR mode and that the fix provided is good • respond to GNSS alarms by checking the mode of the GNSS and the position given. Divergence alarms, low signal alarms, low dilution of precision alarms, etc should be investigated • regularly conduct inspections of the antennae locations to check for corrosion and damage.

7.2 'Express Samina'

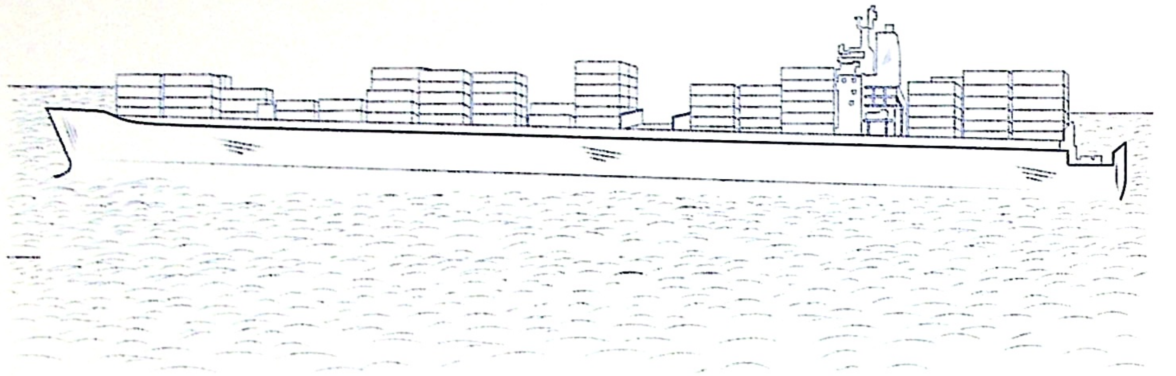
Total loss: Failure to monitor position

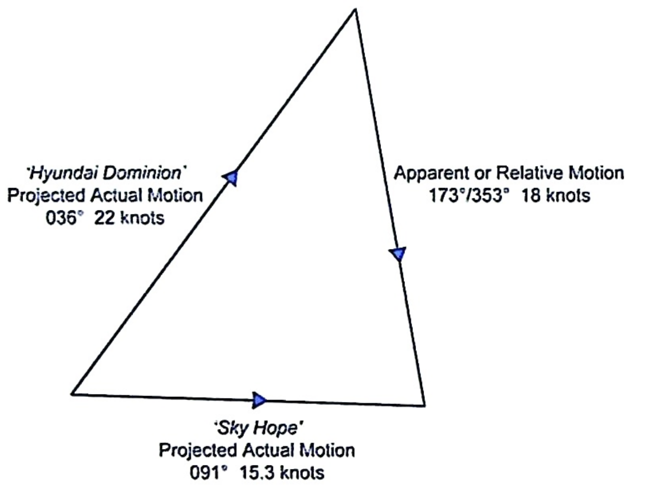


<table>
<tr><td>Ship Details</td><td>RoRo ferry, 4,455 GRT</td></tr>
<tr><td>Nature of Incident</td><td>Ship flooded and sank following contact with a reef, due to a failure to keep a proper bridge watch.</td></tr>
<tr><td>Date of Incident</td><td>September 2000</td></tr>
<tr><td>Location</td><td>
</td></tr>
<tr><td>Summary of Incident</td><td>A proper bridge watch was not maintained and the vessel was left in autopilot, with the position and course not monitored by the OOW or the Master. Only one of the ship stabilisers was active so the vessel gradually went off course, leading to the ship proceeding at speed into a reef in the Aegean Sea. Flooding caused the ship to sink and resulted in 81 deaths.</td></tr>
<tr><td>Navigational Safety Lessons Learned</td><td>To prevent this type of incident occurring, it is essential to:
• Fully maintain an active bridge watch in accordance with good seamanship and international convention. This must include active monitoring of the ship's course in relation to the planned track and monitoring of the position of the ship in proximity to nearby navigational hazards
(In this case, the bridge was effectively left unmonitored)
• ensure that the Master and the OOW are aware of their responsibilities and duties on board. This should be verified by periodic inspection and with information available in the SMS
• ensure that alarms and alerts on the bridge are configured to aid the OOW and the Master in understanding dangers to own ship
• ensure that BNWAS is active. At the time of the sinking, BNWAS was not required to be fitted, but its use is now mandatory and is crucial in alerting others on a ship if the bridge team does not respond to alerts and alarms.</td></tr>
</table>

7.3 'Hyundai Dominion' and 'Sky Hope'

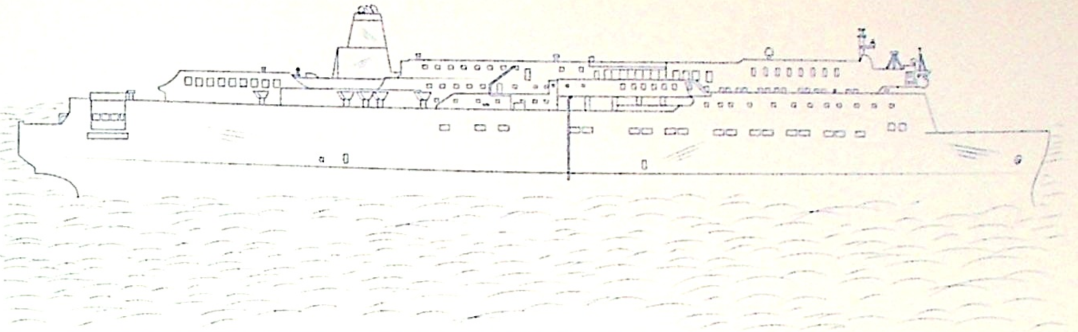
Collision: Incorrect assessment of situation

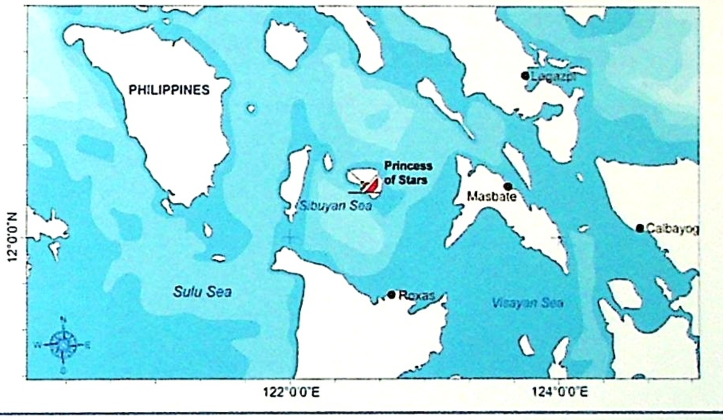


Ship Details	**Container ship, 74,373 GRT and container ship, 6,899 GRT**
Nature of Incident	**Collision due to poor application of the COLREGS by the watchkeepers.**
Date of Incident	**June 2004**
Relative Track of Both Ships	
Summary of Incident	The two container ships collided in the East China Sea in good visibility. The officer on the *'Sky Hope'* incorrectly assessed the encounter while his ship was being overtaken. The *'Hyundai Dominion'* was the overtaking vessel. The officer on the *'Hyundai Dominion'* thought he was required to stand on as he considered *'Sky Hope'* was a crossing vessel. Action by either vessel was delayed due to a VHF discussion. Very late avoiding action was taken, but it was not sufficient to avert a collision.
Navigational Safety Lessons Learned	To prevent this type of incident occurring, it is essential to: • Understand and correctly implement the COLREGS. This includes being aware of the exact requirements describing an overtaking situation ***(In this case, both watchkeepers had a misunderstanding between overtaking and crossing situations)*** • ensure that watchkeepers have received sufficient rest hours ***(In this case, both watchkeepers were fatigued, having had less than the minimum hours of rest for the previous two days)*** • take avoiding action, in accordance with the COLREGS, in ample time ***(In this case, no avoiding action was taking until a range of 0.2 nm)*** • avoid becoming confused by VHF conversations ***(In this case, a disagreement took place over whether the situation was a crossing or overtaking situation)*** • contact the Master for assistance. ***(In this case, neither OOW called his Master prior to the collision.)***

7.4 'Princess of the Stars'

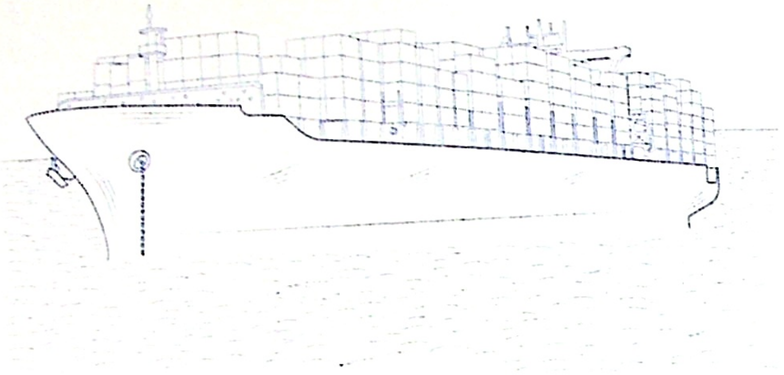
Total loss: Typhoon

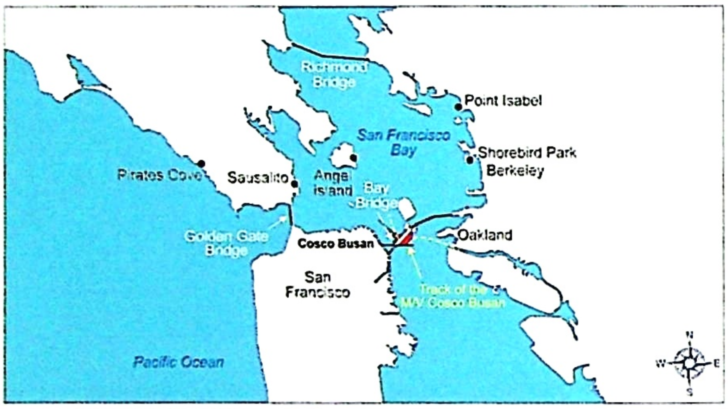


Ship Details	**Ferry, 23,824 GRT**
Nature of Incident	**Miscalculation of the severity of a typhoon led to the ship capsizing in stormy weather.**
Date of Incident	**June 2008**
Location	
Summary of Incident	While transiting off the Philippines, the ship sank in the extreme storm conditions of Typhoon Fengshen. 814 persons died, with only 56 surviving.
Navigational Safety Lessons Learned	To prevent this type of incident occurring, it is essential to: • Correctly assess the expected weather conditions and the level of risk to own ship prior to departure. *(In this case, the Master had disregarded the severity of the typhoon and set sail from Manila. The accident report stated he further miscalculated the risk of continuing the voyage, despite the worsening conditions.)*

7.5 'Cosco Busan'

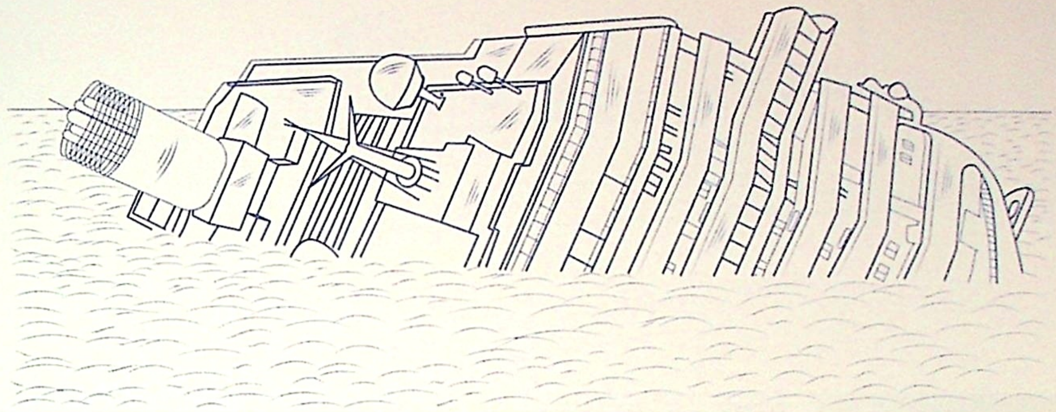
Collision with bridge: Pilot impaired (with no intervention by any of the officers on the bridge)

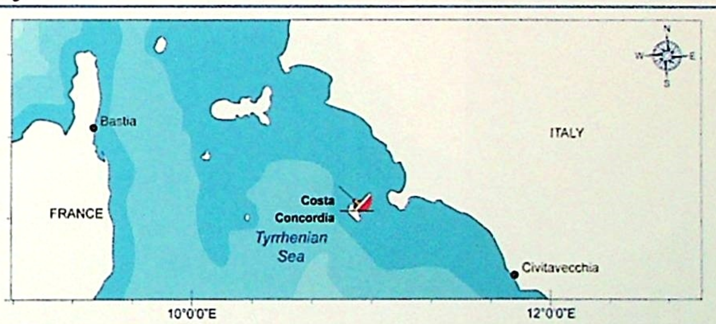


Ship Details	**Container ship, 65,131 GRT**
Nature of Incident	**A series of navigational errors resulted in the ship colliding with a bridge.**
Date of Incident	**May 2009**
Location	
Summary of Incident	The ship departed its berth in restricted visibility and, soon after, collided with the base tower of the San Francisco–Oakland Bay Bridge. The report concluded that a number of navigational errors were made. The collision resulted in damage to a 212 feet long section of the ship's hull, breaching the fuel oil tanks and spilling 200 cubic metres of oil.
Navigational Safety Lessons Learned	To prevent this type of incident occurring, it is essential to: • Monitor the actions of the pilot. In this case, the Master failed to adequately monitor the pilot and relied on assumed competence, which was compromised by medication. If in doubt, the Master or the OOW must question the pilot and, if not satisfied with his actions, be prepared to take over from the pilot to protect the safety of the ship • conduct a formal and effective Master/pilot information exchange *(In this case, there was no Master/pilot change before leaving and there was no effective communication between ship and pilot)* • practise good bridge team management to ensure all nationalities work together on the bridge and can overcome any cultural divide to question an order that raises safety concerns among the bridge team • fully monitor the course of the vessel in relation to the passage plan, using all available means to verify the vessel is on the planned track. *(In this case, the vessel had deviated onto a collision course with the bridge towers and this was not reported to the pilot.)*

7.6 'Costa Concordia'

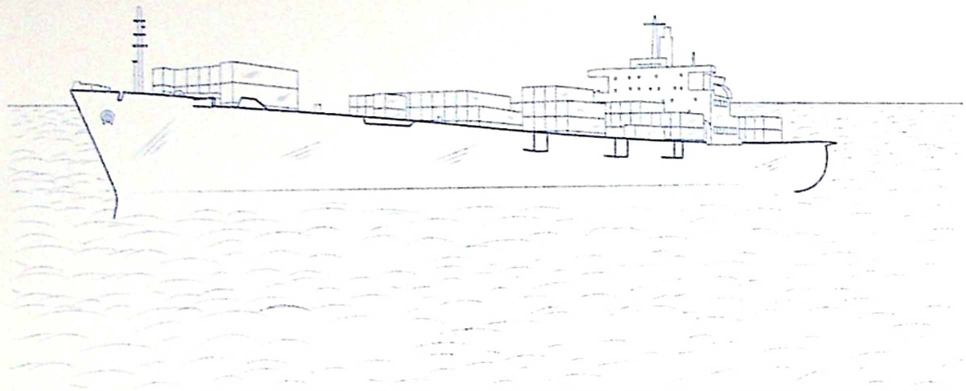
Total loss: Unsafe manoeuvre by the Master (with no intervention by any of the officers on the bridge)

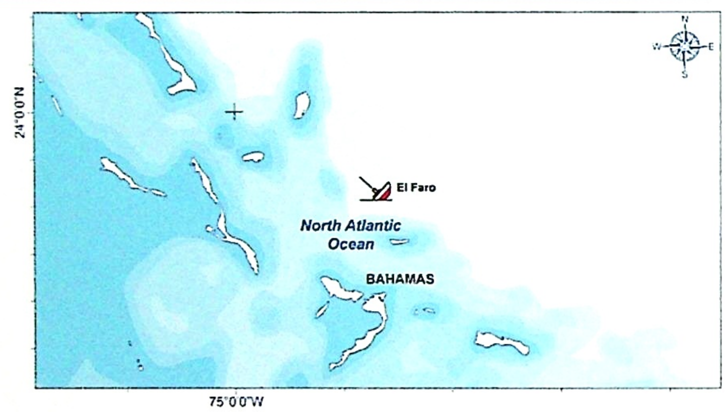


Ship Details	**Cruise ship, 114,147 GRT**
Nature of Incident	**Failure by the Master and the bridge team to monitor the UKC and disregard for the requirements of a safe passage plan led to the ship grounding on the Scole Rocks, off Giglio Island, Italy.**
Date of Incident	**January 2012**
Location	
Summary of Incident	The ship, with 4,229 persons on board, had just left Civitavecchia in Italy. The Master brought the ship too close to the coastline (deviating from the passage plan), which led to the vessel grounding on the rocks. The vessel subsequently lost propulsion, blacked out and began flooding, eventually capsizing. The order to abandon ship was delayed and the evacuation poorly conducted, leading to 32 deaths.
Navigational Safety Lessons Learned	The ship grounded primarily because of the unconventional behaviour of the Master in choosing a course through unsafe water, at close proximity to land, on an inappropriate nautical chart. The failure of the bridge team to correct this behaviour led to the grounding. To prevent this type of incident occurring, it is essential to: • Ensure that the passage plan is safe. If in close proximity to the coastline, verify there is adequate UKC • switch on and regularly monitor the echo sounder, comparing with the chart *(The ship did not have its echo sounder switched on and the UKC was, therefore, not monitored)* • maintain a safe speed in proximity to the coast/shore *(The ship was proceeding at 16 knots, less than half a nautical mile from the shore in an area with known rocks and shoals)* • use appropriate nautical charts *(The ship was using inappropriate charts, of 1/100,000 scale, when 1/50,000 scale charts were available for the voyage area)* • practise good bridge team management by ensuring all members of the bridge team monitor each other's actions. Where they believe a given order may put the ship into danger, the OOW should ask for confirmation.

7.7 'El Faro'

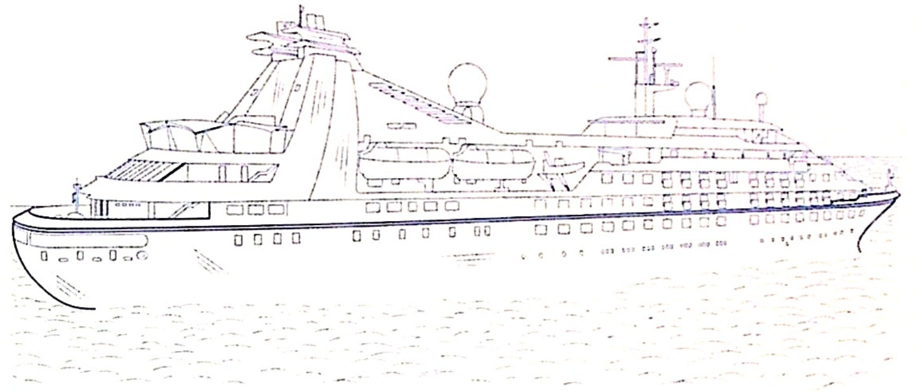
Total loss: Failure to avoid hurricane

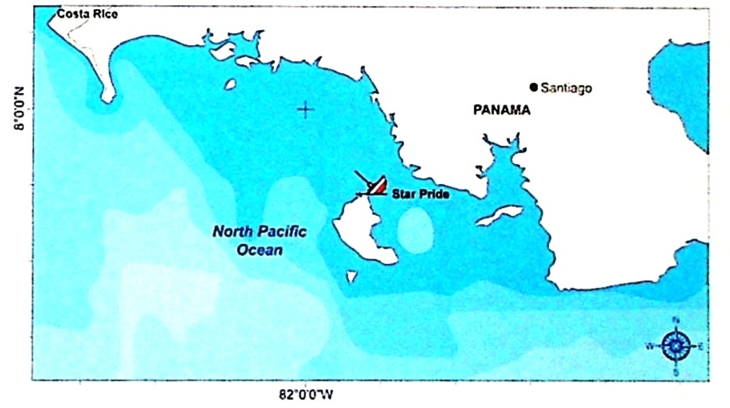


Ship Details	**RoRo general cargo ship, 31,515 GRT**
Nature of Incident	**The ship sank in heavy storms due to insufficient action by the ship to avoid a hurricane.**
Date of Incident	**October 2015**
Location	
Summary of Incident	During hurricane Joaquin, the ship sank in the Atlantic Ocean about 40 nm northeast of the Bahamas. All 33 people on board perished. It was determined that the sinking occurred because the Master took insufficient action to avoid the hurricane, the bridge team did not use the most current weather information and, following flooding, the Master made the decision too late to muster the crew.
Navigational Safety Lessons Learned	To prevent this type of incident occurring, it is essential to: • Fully monitor the weather forecast during all stages of a voyage. The OOW should regularly monitor the weather during his watch and check forecasts frequently. The Master should make regular checks when storms and bad weather are forecast and consider weather routeing where necessary • never underestimate a hurricane or tropical revolving storm. The bridge team should be aware of the actions to take in the event that the ship is caught in a hurricane and how to correctly adjust their course to proceed away from the path of the storm.

7.8 'Star Pride'

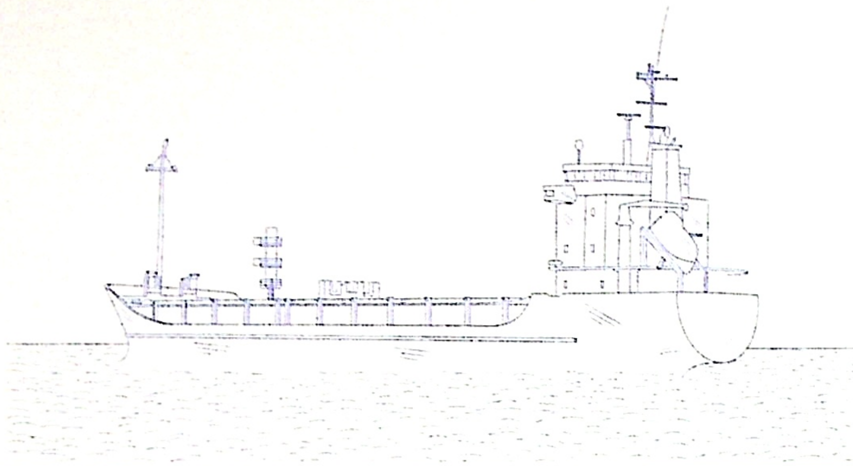
Grounding: Insufficient UKC



Ship Details	**Cruise ship, 9,975 GRT**
Nature of Incident	**The ship grounded on rocks, despite having previously transited the same area and been aware of the limited UKC.**
Date of Incident	**December 2015**
Location	
Summary of Incident	During the previous voyage, the Master had noticed bumps and shuddering. When arriving at port, a diver had inspected the hull and not found any damage. On the next voyage, the ship took a reciprocal course without amending any of the waypoints in the passage plan to avoid the same area. On this voyage, the ship grounded on rocks in the Canal de Rancheria. Structural damage and severe flooding followed and the passengers were evacuated.
Navigational Safety Lessons Learned	To prevent this type of incident occurring, it is essential to: • Create a proper passage plan, being careful to avoid reciprocal courses without conducting a full check of the entire route. In this case, the navigator and the Master failed to adjust the passage plan to take into account the circumstances of the previous voyage • ensure that the Master explains his requirements for passage planning to the navigator *(In this case, the navigator had not been properly trained for his role on board, having undertaken only his safety familiarisation training. He was not familiar with the bridge and navigation system)* • conduct a voyage briefing. *(In this case, the Master did not conduct a proper voyage briefing that took into account the intended passage of the second voyage which followed a reciprocal course to that of the first voyage.)*

7.9 'Nova Cura'

Grounding: Failure to check CATZOC



Ship Details

General cargo ship, 3,999 GRT

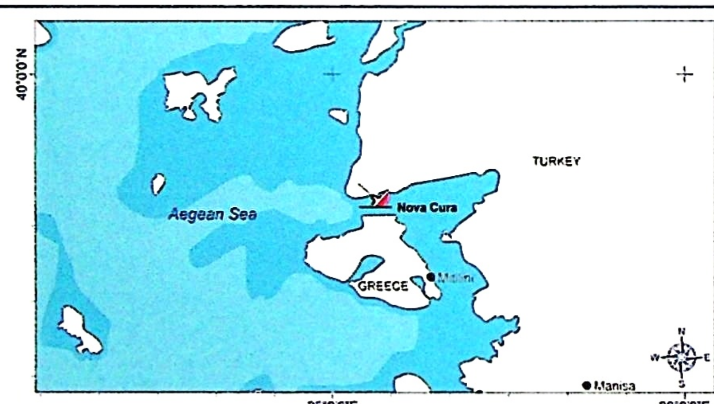
Nature of Incident

Ship grounding due to poor passage planning, ineffective use of ECDIS and inadequate CATZOC understanding on board.

Date of Incident

April 2016

Location



Summary of Incident

The ship ran aground in Mytilini Strait (to the north of Lesbos) at operating speed. At the time, the ECDIS indicated that the charted depth, at the ship's position, should be 112 m. However, the ship had run aground in shallow water at Lamnas Reef. As a result, all of the double-bottom tanks were breached and filled with water, as was the engine room and the bow thruster room. The ship was a total loss.

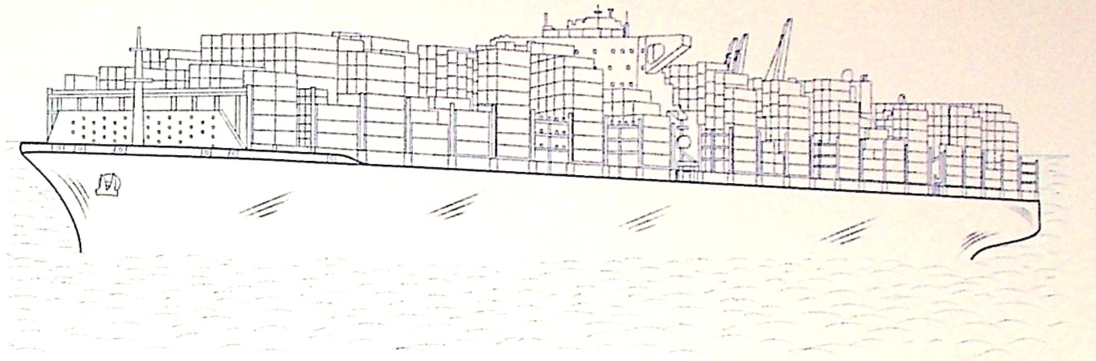
Navigational Safety Lessons Learned

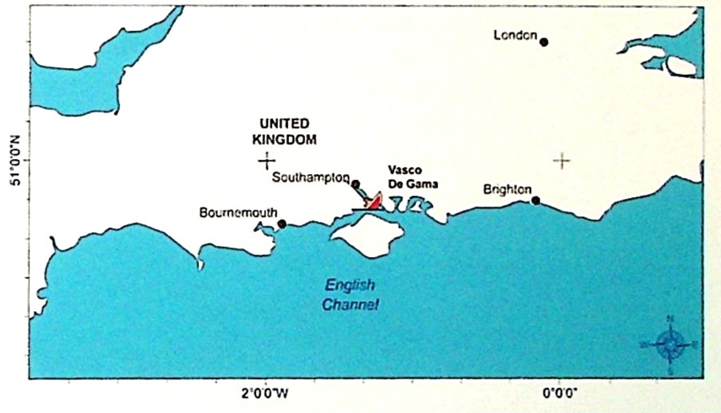
To prevent this type of incident occurring, it is essential to:

- When using ECDIS, be aware of the standards and quality of ENC data as provided within CATZOCs
  (In this case, the ENC CATZOCs of the route were not checked and ENCs of lowest quality were not identified as a risk to the safety of the courses marked. An alternate course, in deeper water, using more appropriately scaled ENCs could have been chosen at the passage planning stage)
- remind ECDIS users that they must continue to rely on traditional navigation skills, such as those required when using a paper chart for navigation, alongside modern navigation technology
- ensure that the OOW is familiar with how to consult the pick report for additional information about those areas that are relevant for safe navigation.

7.10 'CMA CGM Vasco de Gama'

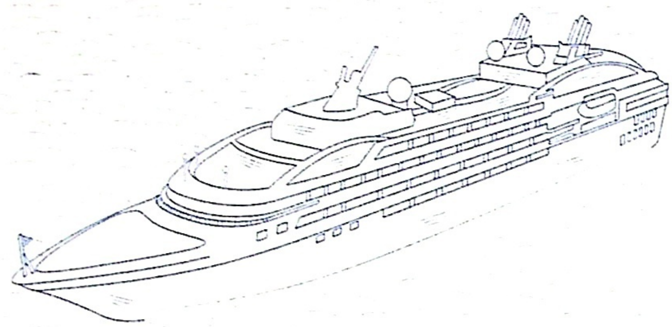
Grounding: Inappropriate passage planning and monitoring

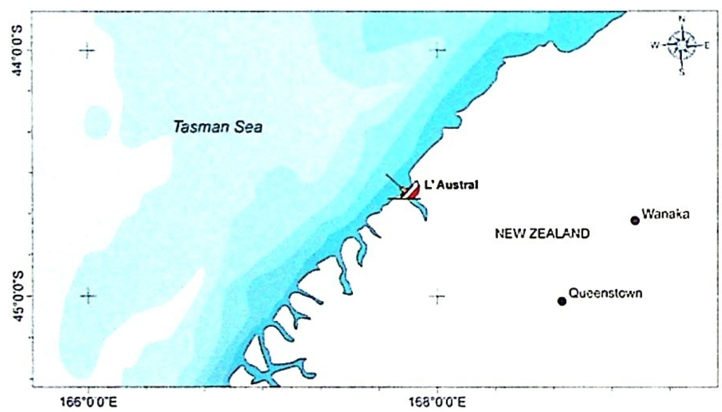


Ship Details	**Container ship, 178,228 GRT**
Nature of Incident	**Grounding due to a failure to follow a detailed passage plan and complacency among the bridge team (including the pilot).**
Date of Incident	**August 2016**
Location	
Summary of Incident	The ship grounded on the western side of the Thorn Channel while entering the port of Southampton. The vessel went aground because the ship was too far north of the intended track, for a ship of its size, when the turn was commenced.
Navigational Safety Lessons Learned	To prevent this type of incident occurring, it is essential to: • Adequately create and follow a detailed passage plan from berth to berth *(In this case, a detailed pilotage plan had not been produced for entry into Southampton)* • not be overconfident or complacent, regardless of how many times navigators may have sailed in an area *(In this case, it was apparent that the Master and the port's pilot contributed to the incident because of complacency and a degree of overconfidence)* • ask the pilot to confirm helm manoeuvres, particularly in narrow waters and when the ship's turning characteristics are limited *(In this case, the lead pilot's intended manoeuvre around Bramble Bank was not explained, although he should have explained the turn to the bridge team. Furthermore, the bridge team should have monitored the actions of the pilot and the manoeuvre)* • ensure that all members of the bridge team are aware of their duties during a pilotage operation. *(In this case, the report noted roles and responsibilities were unclear and the electronic navigation aids on board were not fully utilised.)*

7.11 *'L'Austral'*

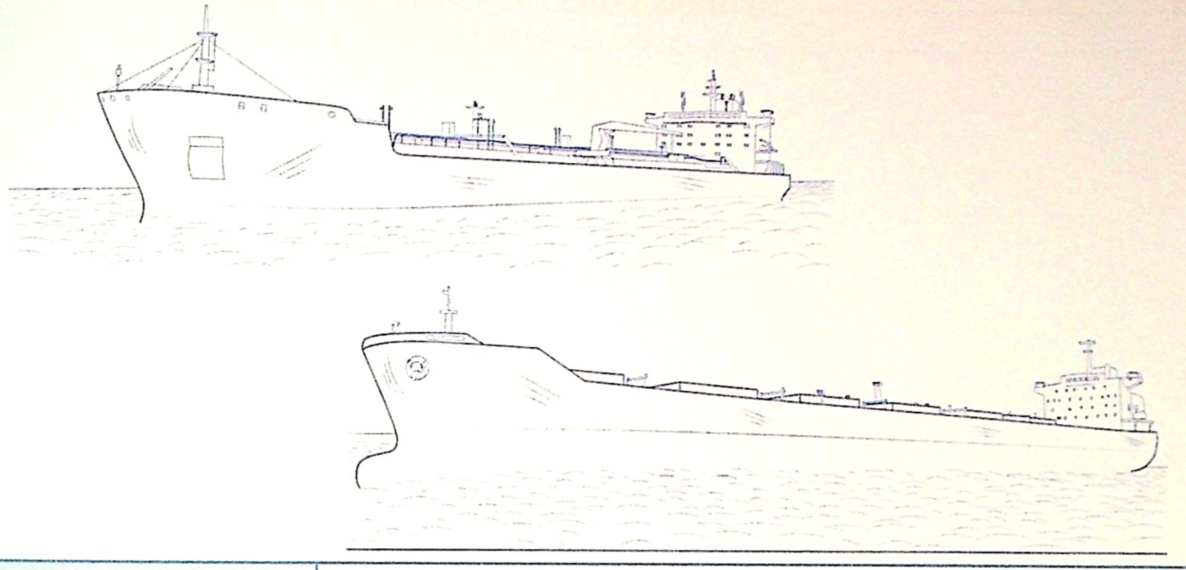
Grounding: The bridge team failed to notify the pilot of their observations



Ship Details	**Cruise ship, 10,944 GRT**
Nature of Incident	**The ship grounded when the bridge team failed to inform the pilot that the ship was standing into danger.**
Date of Incident	**February 2017**
Location	
Summary of Incident	While transiting Milford Sound, New Zealand, at night and without aids to navigation, the pilot ordered a planned alteration of course. The vessel deviated from the planned track and the pilot lost awareness of the ship's course and position. The bridge team noticed the ship off the planned track, but did not bring the information to the pilot's attention. The ship grounded, colliding with a stony bank.
Navigational Safety Lessons Learned	To prevent this type of incident occurring, it is essential to: • Fully monitor the actions of the pilot and, where necessary, question and assist the pilot to maintain safe navigation *(In this case, the standard of bridge resource management on board was poor and the bridge team were not working effectively together)* • ensure that the bridge team are fully conversant with the ship's equipment *(In this case, the investigation revealed that the ECDIS was not being used to its full potential as a tool for planning and monitoring the ship's passage and the crew were not fully conversant with its safety features)* • consider delaying pilotage operations in hours of darkness if there are insufficient aids to navigation. *(In this case, no visual aids to navigation were present and the vessel navigated using only the ECDIS. A lack of landmarks and lights caused the pilot to lose awareness and become disorientated in the darkness of Milford Sound.)*

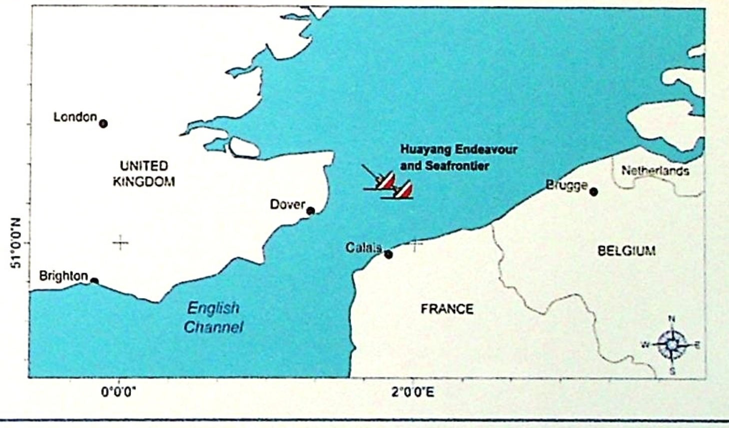
7.12 'Huayang Endeavour' and 'Seafrontier'

Collision: VHF assisted



Ship Details	Bulk carrier, 41,605 GRT and oil tanker, 30,241 GRT
Nature of Incident	**Collision between two ships in an overtaking situation, assisted by confusing VHF radio conversations between the two ships.**
Date of Incident	**July 2017**

Location



Summary of Incident

The bulk carrier *'Huayang Endeavour'* was overtaking the oil tanker *'Seafrontier'*. The collision occurred as a result of conflicting information held between the two bridge teams due to a VHF conversation, where the ship being overtaken altered course and the overtaking ship also altered, leading to a collision.

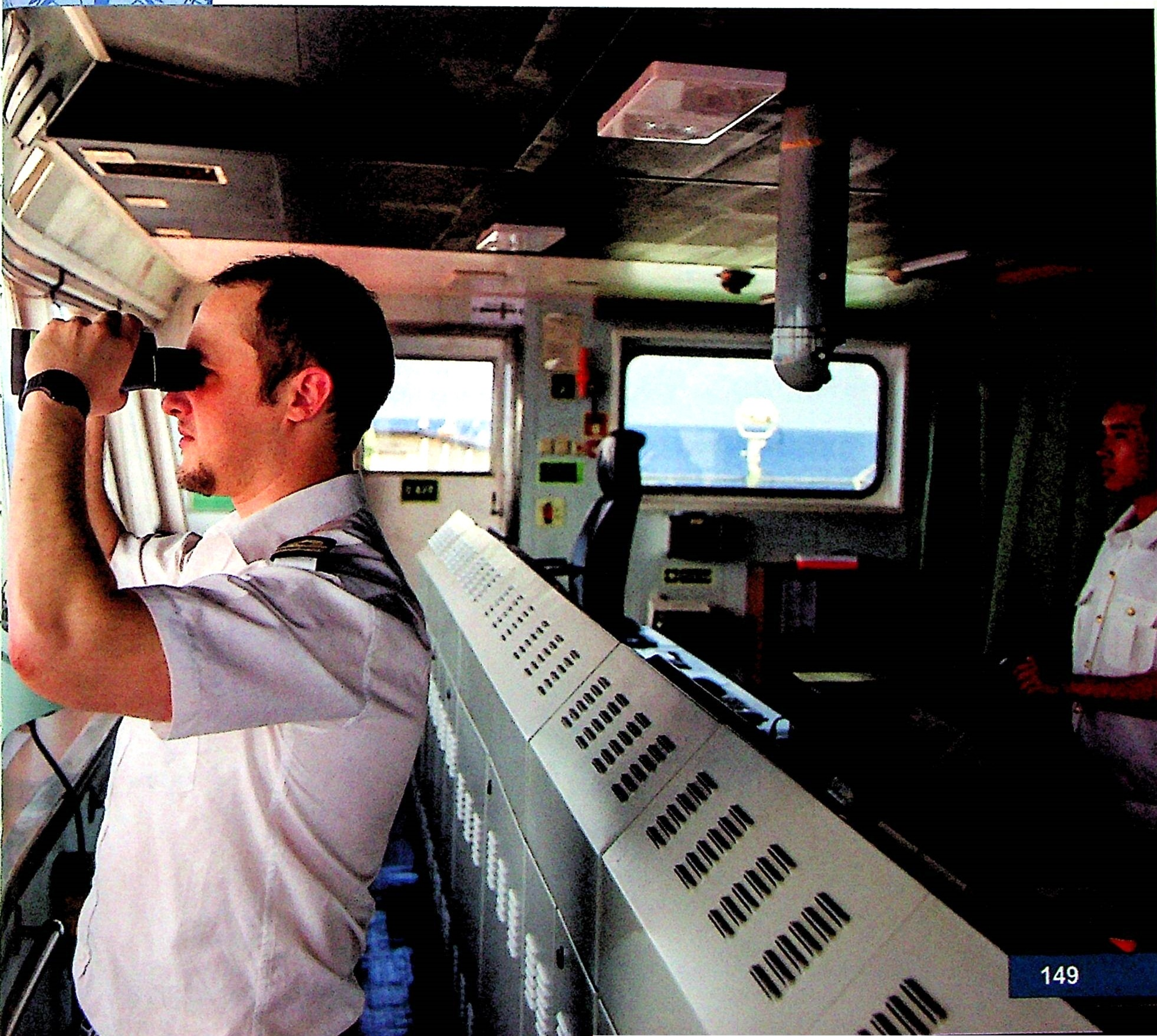
Navigational Safety Lessons Learned

To prevent this type of incident occurring, it is essential to:

- Strictly follow the COLREGS and not use VHF conversations for collision avoidance purposes
  (In this case, the VHF conversation was confusing, resulting in misunderstanding of the intentions of the other vessel. A strict application of the overtaking rules would have prevented the collision)
- ensure the bridge team have had adequate rest hours to reduce the effects of fatigue on decision making
  (In this case, fatigue was a contributing factor, as the tanker Master had been present on the bridge of his ship for 14 hours)
- make use of sound signals, particularly where these give an opportunity to avert a close quarters situation or collision by alerting another ship to own ship's intentions.

CHAPTER 8

Bridge Preparedness



8.1 Double Checking and Backup Philosophies

- Ask an appropriate person to check your passage plan
- also ask someone to check your work where necessary. Don't rely on checking your own work, as errors can go undetected
- in the same way that you would have spares for equipment, assume that things might go wrong operationally and have a backup for everything
- double check everything you can
- never accept someone else's work without checking it is correct (eg passage plans)
- in challenging traffic situations, use trial manoeuvre, but also get a second opinion
- print passage plans and waypoints so that you have a back-up in case of ECDIS failure
- if receiving weather forecasts from the internet or by email, still continue to check the NAVTEX
- update and modify risk assessments for the particular situation and do not rely on outdated risk assessments that were completed by others
- when everything appears to be going to plan, don't relax. This is the time to double check equipment, including changing ranges on the radars and ECDIS and looking ahead and changing vector display mode.

8.2 Likelihood of an Accident Occurring

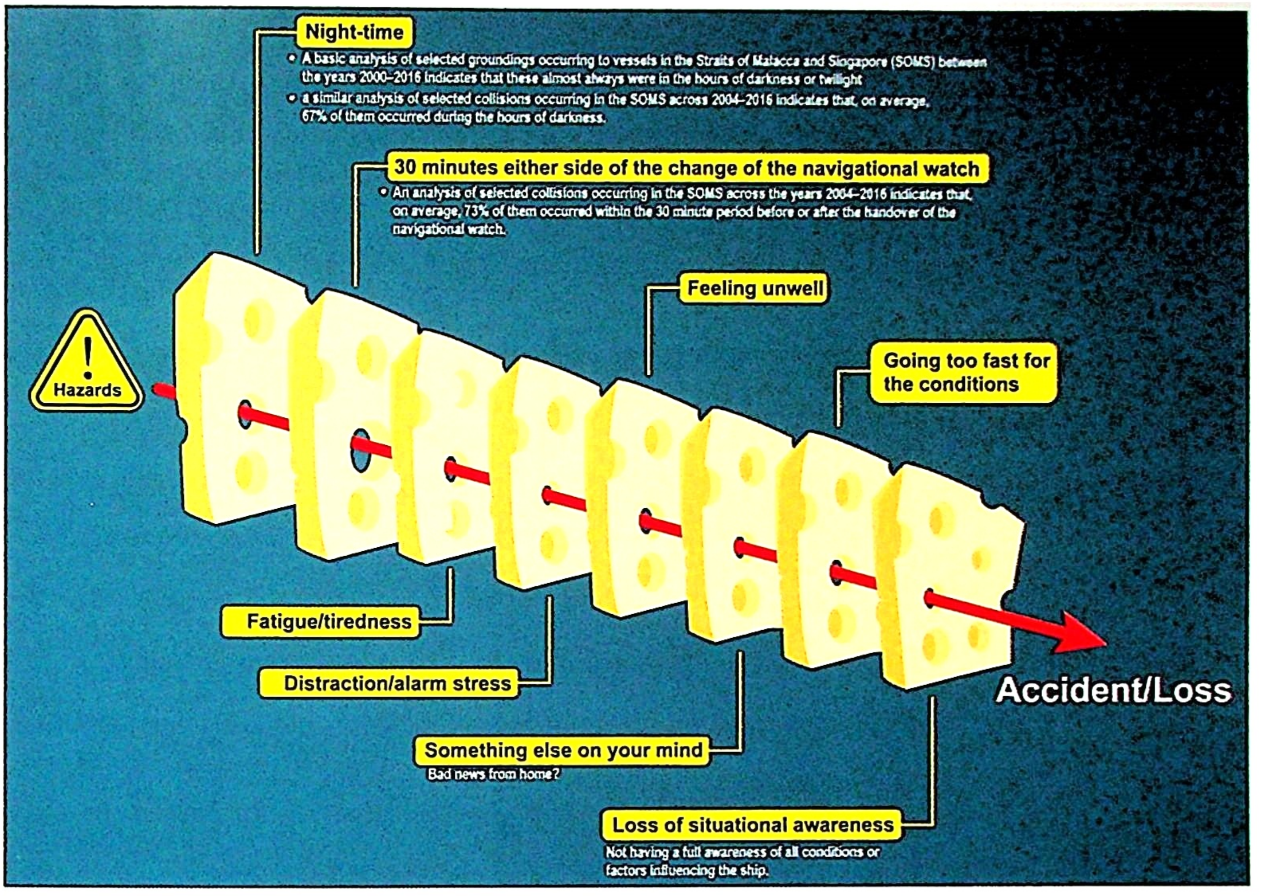


Figure 8.1: Swiss cheese model illustrating some of the key factors in navigation related incidents

As an OOW, you may have come across the Swiss cheese model, which is used to demonstrate the likelihood of an accident occurring. On the navigation bridge, exactly the same methodology can be used when assessing factors that have contributed to previous collisions or groundings.

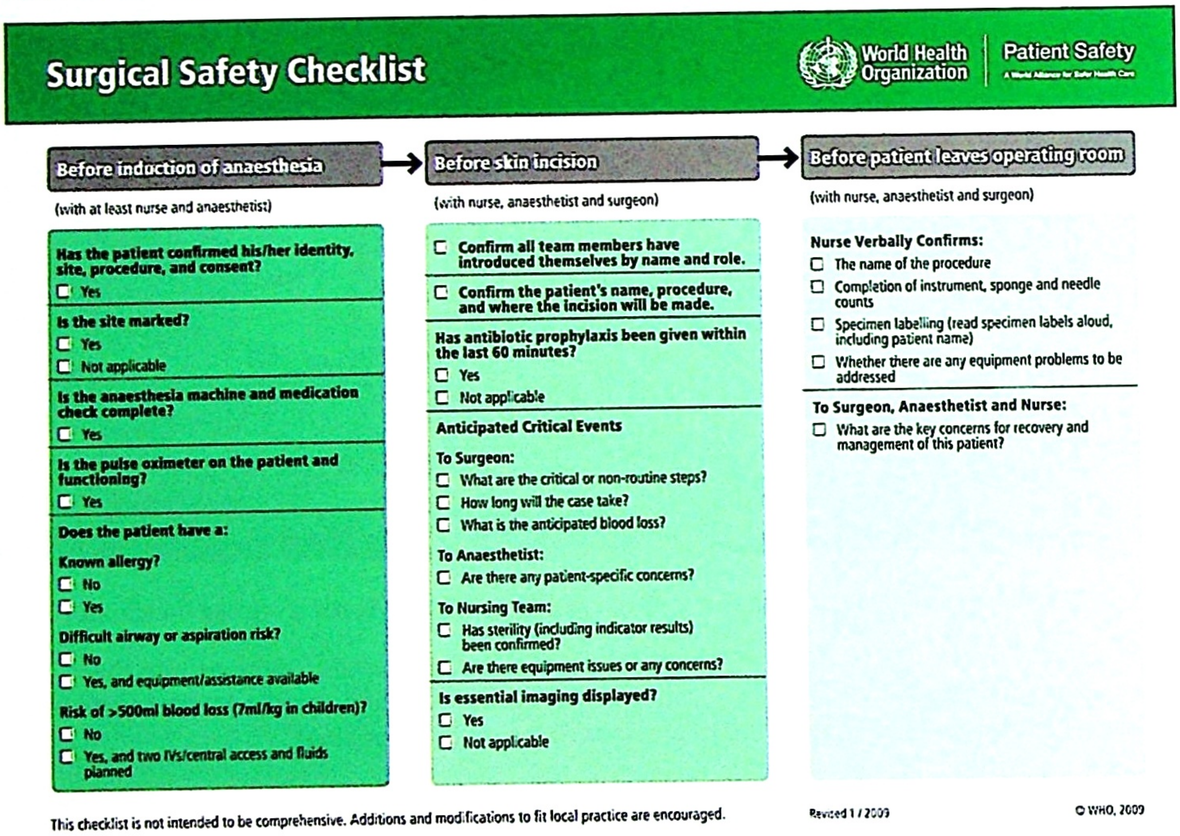
A near miss, collision or grounding is rarely, if ever, down to a single failing action, but is generally the result of a combination of contributory factors.

If you study the Swiss cheese model, you will recognise that some of the factors occur each day. For example, at least once a day you will take over the watch in night-time conditions and have a 30-minute period where you are settling in to your watch. This starts to demonstrate why you need to be continually vigilant and performing at your best each and every day. You should learn to recognise the signs of when you are potentially at most risk on the navigation bridge.

8.3 The Use of Checklists

Checklists save lives

If you were a patient at London's St Mary's Hospital in October 2008, you were 47% less likely to die, and 36% less likely to develop major post-surgical complications, than if you were a patient at that same hospital in February of the same year. This statistic was true for patients in eight hospitals around the world, spanning a geography from rural Tanzania to a world-leading medical centre in Seattle. Why? A checklist. A humble one page, nineteen item list used by operating teams in every operation, which focused on pre, during and post-operative checks (starting with *'Is this the correct patient?'*), almost halved the risk of death due to surgical complications.


Surgical Safety Checklist

World Health Organization | Patient Safety

Before induction of anaesthesia → **Before skin incision** → **Before patient leaves operating room**

Before induction of anaesthesia
(with at least nurse and anaesthetist)

Has the patient confirmed his/her identity, site, procedure, and consent?
- ☐ Yes

Is the site marked?
- ☐ Yes
- ☐ Not applicable

Is the anaesthesia machine and medication check complete?
- ☐ Yes

Is the pulse oximeter on the patient and functioning?
- ☐ Yes

Does the patient have a:

Known allergy?
- ☐ No
- ☐ Yes

Difficult airway or aspiration risk?
- ☐ No
- ☐ Yes, and equipment/assistance available

Risk of >500ml blood loss (7ml/kg in children)?
- ☐ No
- ☐ Yes, and two IVs/central access and fluids planned

Before skin incision
(with nurse, anaesthetist and surgeon)

- ☐ **Confirm all team members have introduced themselves by name and role.**
- ☐ **Confirm the patient's name, procedure, and where the incision will be made.**

Has antibiotic prophylaxis been given within the last 60 minutes?
- ☐ Yes
- ☐ Not applicable

Anticipated Critical Events

To Surgeon:
- ☐ What are the critical or non-routine steps?
- ☐ How long will the case take?
- ☐ What is the anticipated blood loss?

To Anaesthetist:
- ☐ Are there any patient-specific concerns?

To Nursing Team:
- ☐ Has sterility (including indicator results) been confirmed?
- ☐ Are there equipment issues or any concerns?

Is essential imaging displayed?
- ☐ Yes
- ☐ Not applicable

Before patient leaves operating room
(with nurse, anaesthetist and surgeon)

Nurse Verbally Confirms:
- ☐ The name of the procedure
- ☐ Completion of instrument, sponge and needle counts
- ☐ Specimen labelling (read specimen labels aloud, including patient name)
- ☐ Whether there are any equipment problems to be addressed

To Surgeon, Anaesthetist and Nurse:
- ☐ What are the key concerns for recovery and management of this patient?

This checklist is not intended to be comprehensive. Additions and modifications to fit local practice are encouraged.

Revised 1 / 2009

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The WHO Safe Surgical Checklist responsible for 47% reduction in fatalities

In January 2009, a US Airways flight struck a flock of geese, lost both engines and crash landed in the Hudson River. All 155 people on board survived and a potentially major catastrophe was averted. The pilot, Captain Sullenberger, was hailed as a national hero and the event became known as 'the miracle on the Hudson'. Its almost mythical status was cemented in a film starring Tom Hanks. However, behind 'the miracle' was a methodical and careful use of checklists and flight procedures.

Aviation checklists have been in use since the 1930s and today all airlines have checks and procedures in place that cover both the everyday (such as initial cockpit checks, taxi and take-off briefings) and the extraordinary (emergencies such as engine failure and loss of cabin pressure). The fact that these checks were in place, and were followed by flight staff, is arguably the sole reason for the successful landing. As soon as Captain Sullenberger and First Officer Jeffrey Skiles became aware of the engine failure, they knew exactly which emergency procedures and practices to fall back on. During their pre-flight checks, they had established that Captain Sullenberger had more experience flying that model of aircraft, so he took over the controls, allowing Officer Skiles to work through the engine restart checklist and ditching procedures. Sullenberger used the plane's inbuilt 'fly by wire' system to guide the plane to a safe landing, as Skiles methodically worked through readying the plane for an emergency landing. The flight attendants also followed their own emergency procedures (instructing passengers to don life vests and adopt the brace position and ensuring the emergency exit doors were opened swiftly). Once the plane had landed, Skiles carried out the evacuation checklist as Sullenberger performed a final check of the plane. One hundred and fifty five lives were saved that day thanks, in part, to the use of checklists. The pre-flight routines had bonded the crew as a team and identified their individual strengths, and the emergency procedures in place had helped ensure as safe a landing as possible.

The effectiveness of a simple checklist cannot be overstated. Checklists are often regarded as an irritation, a box ticking exercise or piece of bureaucracy that doesn't take into account daily operations or individuality. However, when constructed and used efficiently, checklists present an opportunity to deal with the unexpected, to facilitate communication and promote teamwork and, crucially, to maximise safety and success.

Constructing a Checklist

Checklists should be precise, easy to use, efficient and practical. They should:

- ☐ Focus on only the most critical and important steps of the activity
- ☐ have an obvious purpose, eg test the steering gear
- ☐ have 'pause points', ie points for stopping and reflecting on the checklist task or function, and phrases such as *'Have you considered other...?'*
- ☐ have open-ended questions, such as *'What is the gyro error in degrees?'*, rather than yes/no questions
- ☐ be divided into logical sections, eg an enclosed space entry permit is typically divided into before, during and re-entry
- ☐ be as concise as possible. Studies have shown that 5–9 items is the limit of working memory, and this range decreases in stressful situations
- ☐ use simple, precise wording and familiar terminology, eg Standard Marine Communication Phrases (SMCP)
- ☐ require critical items to be cross-checked by another person
- ☐ be tailored to the task and tested in real-life situations
- ☐ be updated and evaluated regularly.

Checklists can be divided into two types, the Read-Do checklist and the Do-Confirm checklist, and this should be taken into account during creation.

A Read-Do checklist is like a recipe or instruction manual. Items are read off the checklist, completed and checked off one by one.

A Do-Confirm checklist checks that tasks that are supposed to have been carried out have been completed. The work/processes will have been completed prior to consulting the checklist, so it works as a safeguard.

Considerations for improving the use and effectiveness of checklists in the maritime industry

- ☐ Each checklist item is allocated to a specific individual, eg a permit to work that specifies Area Authority, Permit Authority and Work Authority
- ☐ consider the use of master checklists. The master checklist should provide supporting information with the knowledge behind each checklist item, including where to go to get more information and who is responsible for actioning each item on the checklist

- ☐ ensure checklists are verified by those who will be expected to complete them. Checklists in the maritime industry are often created by someone with substantial experience, but they are typically used by someone with entry level experience
- ☐ undertake regular reviews and updates to ensure the checklist never becomes out of date. Some companies require reviews at a specified interval, such as annually
- ☐ improve awareness of ship's crew that changes to checklists can be made through the safety management system (SMS).