COURSEBOOK

DAMEN SERVICES

Customer
Date 1-11-2017
Version 0.1

DAMEN

COURSEBOOK

Ship's name:	
Yard number:	
IMO number:	
File name:	P.book

Rev.	Date / Prepared by	Date / Checked by	Description
0.1	18 oct. 2017 Vincent Friperson		First draft.

INTRODUCTION

This coursebook is part of a DAMEN Services training course and may only be used as such. It is published as support- and reference book for the training as well as basic operating guideline. The instructions in this document are not meant to replace the official user documentation of the concerning supplier. DAMEN Services Training cannot be held responsible for any part of this information. For detailed information refer to the technical drawings and supplier manuals.

DAMEN Shipyards Gorinchem
Industrieterrein Avelingen West 20
4202 MS GORINCHEM

P.O. Box 1
4200 AA GORINCHEM

The Netherlands

www.damen.com

SAFETY DIRECTIONS

The below mentioned warnings can be found in this manual. The pictogram indicates the severity of the warning:

Note:

Used to highlight suggestions which will result in enhanced installation, reliability, or operation.

Caution:

Hazards or unsafe practices which can result in minor personal injury or product or property damage.

Warning:

Hazards or unsafe practices which can result in severe personal injury or death.

Danger:

Immediate hazards which can result in severe personal injury or death.

All equipment and systems are designed and constructed with a maximum level of security and availability in accordance with statutory requirements. In order to establish this basis for quality and safety, operation and maintenance must be carried out in accordance with safety rules, regulations and instructions as issued by the equipment manufacturer.

GENERAL REMARKS

Systems and Equipment NOT Supplied by DAMEN

This coursebook only describes systems and equipment supplied by DAMEN and DAMEN-OEM suppliers. Equipment installed by clients / end-users of the vessel are not part of the training or training-documentation.

Illustrations

All images used are for illustrative purposes only. Although care has been taken to make this coursebook as specific as possible, some images may differ from the actual situation on your vessel.

Training levels

We determine 3 levels of training. The desired target group can follow one or more modules that can be trained as separate modules but also can be trained sequential. This book is intended to be used as supportive material for level A - Operator Level “basic operator”.

A. Operator level training:

Introduction to system (components, functional overview and basic operation).

B. Maintenance level training:

Maintenance & Adjustments (advanced operation, troubleshooting & calibrations).

C. Service level training:

Advanced (replacements, troubleshooting & diagnosing)

Note:

What is needed for the Level A - Operator level training?

- Coursebooks x number of participants
- Laptop + presentation "Praxis Course PresentationDATE"
- Location: G:\Services\09 - Training\06 Suppliers\Praxis\Praxis Basic Course
- Screen / projector
- 1x blanc paper size A1 / A0
- Component cards (see attachment for print-version)
- Markers / highlighters in different colours.

1 AUTOMATIC IDENTIFICATION SYSTEM AIS

1.1 CROSS REFERENCE

DAMEN System Code	
Drawings	
OEM documentation	

1.2 FUNCTION

An AIS-equipped system on board a ship presents the bearing and distance of nearby vessels in a radar-like display format.

Figure 1: AIS-unit

The Automatic Identification System (AIS) is an automatic tracking system used on ships and by vessel traffic services (VTS) for identifying and locating vessels by electronically exchanging data with other nearby ships, AIS base stations, and satellites.

Information provided by AIS equipment, such as unique identification, position, course, and speed, can be displayed on a screen or an ECDIS.

The International Maritime Organization's International Convention for the Safety of Life at Sea (SOLAS) requires AIS to be fitted aboard international voyaging ships with gross tonnage (GT) of 300 or more, and all passenger ships regardless of size.

AIS uses the globally allocated Marine Band Channels 87 & 88.

FM Modulation is not used.

AIS uses the High Side of the duplex from two VHF radio channels (87B) and (88B)

Channel A 161.975 MHz (87B)

Channel B 162.025 MHz (88B)

The simplex channels 87A and 88A use a lower frequency so they are not even affected by this allocation and can still be used as designated for the maritime mobile frequency plan.

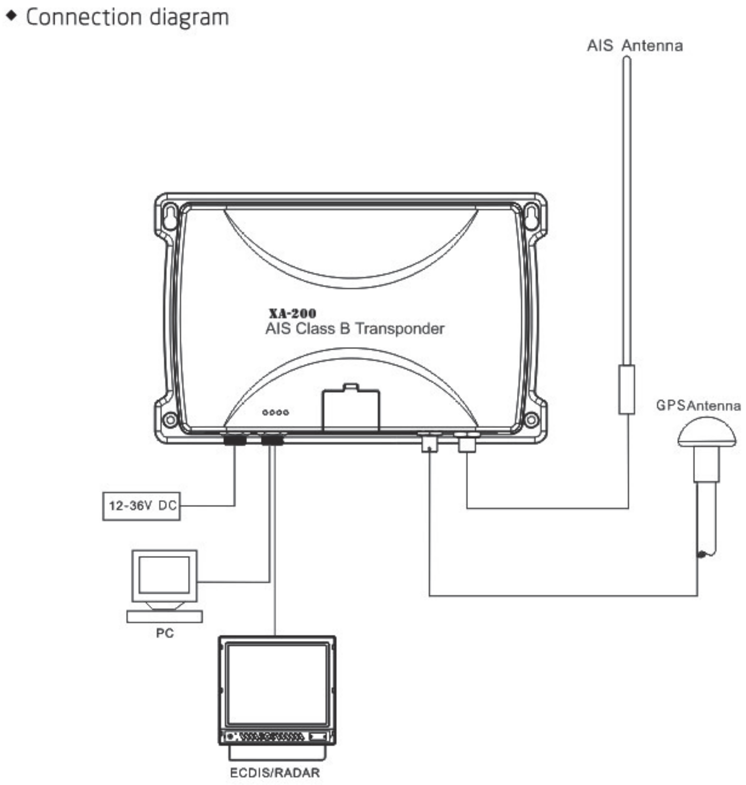


Figure 2: Connection Diagram

An AIS transceiver sends the following data every 2 to 10 seconds depending on a vessel's speed while underway, and every 3 minutes while a vessel is at anchor:

-The vessel's Maritime Mobile Service Identity (MMSI) - a unique nine digit identification number.

-Navigation status - "at anchor", "under way using engine(s)", "not under command", etc.

-Rate of turn - right or left, from 0 to 720 degrees per minute

- Speed over ground - 0.1-knot (0.19 km/h) resolution from 0 to 102 knots (189 km/h)

- Positional accuracy:

- Longitude - to 0.0001 minutes

- Latitude - to 0.0001 minutes

-Course over ground - relative to true north to 0.1°

-True heading - 0 to 359 degrees (for example from a gyro compass)

-True bearing at own position. 0 to 359 degrees

- UTC Seconds - The second's field of the UTC time when these data were generated. A complete timestamp is not present.

In addition, the following data are broadcast every 6 minutes:

- IMO ship identification number - a seven digit number that remains unchanged upon transfer of the ship's registration to another country

- Radio call sign - international radio call sign, up to seven characters, assigned to the vessel by its country of registry

- Name - 20 characters to represent the name of the vessel

- Type of ship/cargo

- Dimensions of ship - to nearest meter

- Location of positioning system's (e.g., GPS) antenna on board the vessel - in meters aft of bow and meters port or starboard

- Type of positioning system - such as GPS, DGPS or LORAN-C.

- Draught of ship - 0.1 meter to 25.5 meters

- Destination - max. 20 characters

- ETA (estimated time of arrival) at destination - UTC month/date hour: minute

- optional : high precision time request, a vessel can request other vessels provide a high precision UTC time and date stamp.

1.3 ATIS AUTOMATIC TRANSMITTER IDENTIFICATION SYSTEM

Figure 3: ATIS

The Automatic Transmitter Identification System (ATIS) is a marine VHF radio system used and mandated on navigable inland waterways in Europe for identifying the ship or vessel that made a radio transmission.

The identity of the vessel is sent digitally immediately after the ship's radio operator has finished talking and releases their transceiver's push-to-talk button.

This contrasts to the Automatic identification system (AIS) used globally on ships that transmit continuously. A short post-transmission message is sent by the radio with the vessel identity and is in the form of an encoded call sign or Maritime Mobile Service Identity, starting with number 9 and the three country-specific maritime identification digits.

ATIS use on the Trans-European Inland Waterway network and connecting waterways is mandated by the Regional Arrangement Concerning the Radiotelephone Service on Inland Waterways (RAINWAT, Regional Arrangement Concerning the Radiotelephone Service on Inland Waterways signatory countries) agreements, which also prohibit the use of Digital Selective Calling (DSC) where ATIS is required, except in some near-coastal areas, or in sea-like areas of The Netherlands.

The database of ATIS vessel identities is maintained by the Belgian Institute for Postal service and Tele communication.

The ATIS signaling protocol is based on that used for Digital Selective Calling (DSC); with the ATIS transmissions having the format specifier field set to a value of 121. While DSC transmissions take place exclusively on Channel 70, the ATIS digital signal is transmitted on the same VHF channel as the voice transmission: it lasts for 285 milliseconds after the PTT button has been released, using frequency modulation frequency-shift keying (FSK) between the frequencies of 1,300 Hz and 2,100 Hz at 1,200 baud.

The core part of the message is transmitted using 10-bit codes; each code being formed of a 7-bit symbol followed by a 3-bit count of the number of zeros in that symbol.

The 10 numbers from the ATIS code are part of the call name. A call name of a Dutch inlands vessel or jacht exist out two letters and four numbers.

They always start with the letter P. The serie starts from PDxxxx until PIxxxx. The number code always start with the number 9, next of the maritieme identification numbers off the Netherlands are (243 / 244 of 245).

Next the second letter. So the letter A is 01 and the letter Z is 26.

The ATIS code for a ship with the call name PI4019 sound as follows.

9 244 09 4019	Call name ship PI4019 = ATIS code 9244094019	
	9	always
	244	Netherlands
	09	The ninth letter of the alphabet = I
	4019	Numbers from the call name

In the table below are the countries that have a regional agreement to use the ATIS system and the codes of identification.

244	P	Netherlands
205	O	Belgium
227	F	France
205/523	L	Luxembourg
211/218	D	Germany
269	H	Switzerland
201	AE	Austria

2 VHF

2.1 CROSS REFERENCE

DAMEN System Code	440
Drawings	
OEM documentation	

2.2 VHF

Figure 4: Alfred J. Gross

Alfred J. Gross (February 22, 1918 - December 21, 2000), a.k.a. Irving J. Gross was a pioneer in mobile wireless communication.

He created and patented many communications devices, specifically in relation to an early version of the walkie-talkie, Citizens' Band radio, the telephone pager and the cordless telephone.

Marine VHF radio refers to the radio frequency range between 156.0 and 174 MHz, inclusive. The VHF signifies the very high frequency of the range. In the official language of the International Telecommunication Union the band is called the VHF maritime mobile band.

Marine VHF radio equipment is installed on all large ships and most seagoing small craft. It is also used, with slightly different regulation, on rivers and lakes.

It is used for a wide variety of purposes, including summoning rescue services and communicating with harbours, locks, bridges and marinas.

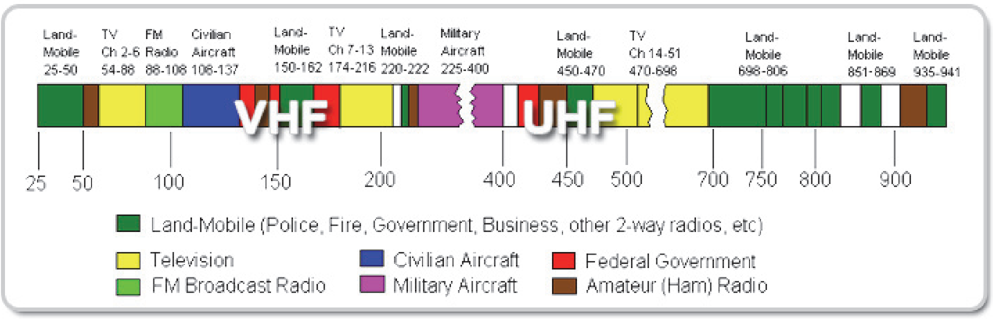


Figure 5: Frequencies

Marine VHF mostly uses simplex transmission, where communication can only take place in one direction at a time. A transmit button on the set or microphone determines whether it is operating as a transmitter or a receiver.

Frequency range: 30MHz - 300MHz

Wavelength range 1 - 10M

Figure 6: VHF-DSC unit

Marine VHF radio refers to the radio frequency range between 156.0 and 174 MHz, inclusive. The "VHF" signifies the very high frequency of the range.

Channel 6 and 8: nautical traffic between ships at sea (intership).

Channel 10: Inland shipping with limited power 0,5 to maximum 1 watt.

Channel 13: Nautical traffic, for ships at sea, only for coordination of ship movements and safe navigation (in areas where the captain thinks it is necessary, a permanent listening guard needs to be present on this channel)

Channel 16: Processing of emergency- , urgent and safety traffic. (156,8MHz)

Channel 15 and 17: Onboard (intraship) communications.

Channel 67: On scène communications (messages on site a calamity.)

Channel 70: DSC-alarms and other DSC-calls. In mariphones without DSC this channel must be blocked. (156,525 MHz)

Channel 72: Social traffic, salvage- and towing.

Channel 73: Communication in relation to environmental pollution.

Channel 77: Social traffic.

Channel 87B and 88B: Automatic Identification System A&B

AIS uses the high side of the duplex from two VHF radio "channels" 87B and 88B.

Class A: Mandated for all vessels 300 GT and above engaged on international voyages as well as all passenger ships

Class B: Provides limited functionality and intended for non SOLAS vessels. Primarily used for vessels such as pleasure crafts

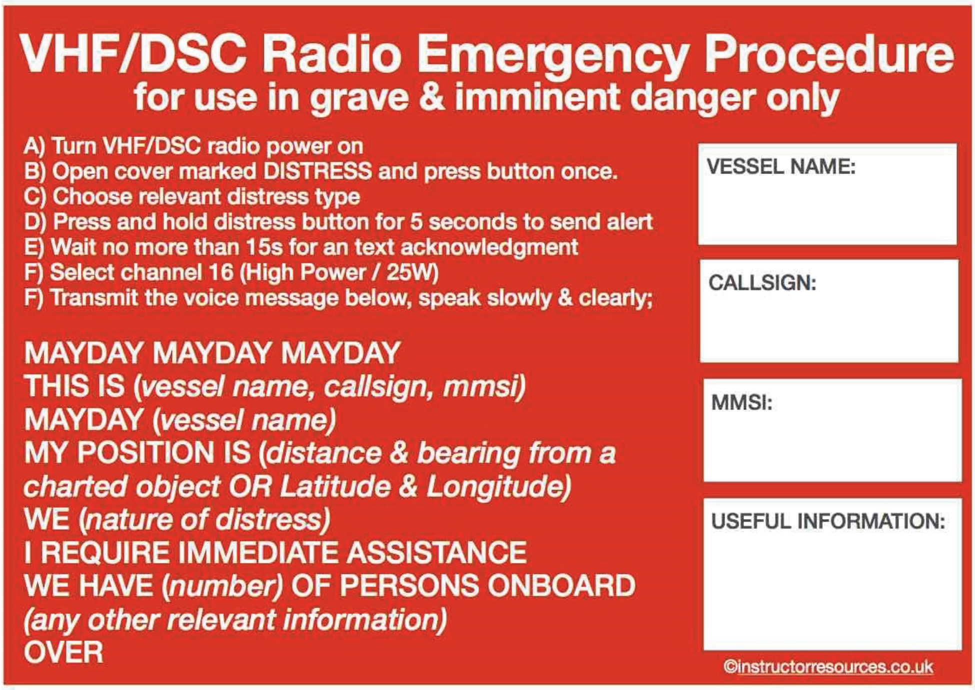


Figure 7: VHF Procedure

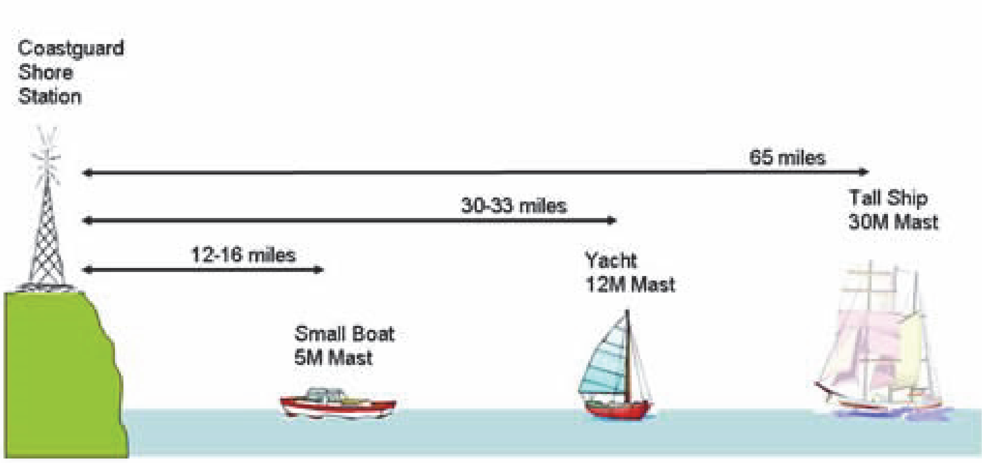


Figure 8: VHF Propagation

3 MF - HF (SSB)

3.1 CROSS REFERENCE

DAMEN System Code	440
Drawings	
OEM documentation	

3.2 MEDIUM FREQUENCY / HIGH FREQUENCY (SINGLE SIDE BAND)

Figure 9: MF/HF unit

Radio transmitters work by mixing a radio frequency (RF) signal of a specific frequency, the carrier wave, with the signal to be broadcast. The result is a set of frequencies with a strong peak signal at the carrier frequency, and smaller signals from the carrier frequency plus the maximum frequency of the signal, and the carrier frequency minus the maximum frequency of the signal. That is, the resulting signal has a spectrum with twice the bandwidth of the original input signal. In conventional AM radio, this signal is then sent to the radio frequency amplifier, and then to the broadcast antenna. Due to the nature of the amplification process, the quality of the resulting signal can be defined by the difference between the maximum and minimum signal energy. Normally the maximum signal energy will be the carrier itself, perhaps twice as powerful as the mixed signals.

SSB takes advantage of the fact that the entire original signal is encoded in either one of these sidebands.

It is not necessary to broadcast the entire mixed signal, a suitable receiver can extract the entire signal from either the upper or lower sideband.

This means that the amplifier can be used much more efficiently. A transmitter can choose to send only the upper or lower sideband, the portion of the signal above or below the carrier.

By doing so, the amplifier only has to work effectively on one half the bandwidth, which is generally easier to arrange. More importantly, with the carrier suppressed before it reaches the amplifier, it can amplify the signal itself to higher energy, it is not wasting energy amplifying a signal, the carrier, that can (and will) be re-created by the receiver anyway.

As a result, SSB transmissions use the available amplifier energy more efficiently, providing longer-range transmission with little or no additional cost.

Receivers normally select one of the two sidebands to amplify anyway, so implementing SSB in the receiver is simply a matter of allowing it to choose which sideband to amplify on reception, rather than simply choosing one or the other in the design stage.

3.3 HISTORY

The first U.S. patent for SSB modulation was applied for on December 1, 1915 by John Renshaw Carson.

The U.S. Navy experimented with SSB over its radio circuits before World War I. SSB first entered commercial service on January 7, 1927 on the longwave transatlantic public radiotelephone circuit between New York and London.

The high power SSB transmitters were located at Rocky Point, New York and Rugby, England.

The receivers were in very quiet locations in Houlton, Maine and Cupar Scotland.

SSB was also used over long distance telephone lines, as part of a technique known as frequency-division multiplexing (FDM). FDM was pioneered by telephone companies in the 1930s.

This enabled many voice channels to be sent down a single physical circuit, for example in L-carrier.

SSB allowed channels to be spaced (usually) just 4,000 Hz apart, while offering a speech bandwidth of nominally 300-3,400 Hz.

Amateur radio operators began serious experimentation with SSB after World War II.

The Strategic Air Command established SSB as the radio standard for its aircraft in 1957.

It has become a de facto standard for long-distance voice radio transmissions since then.

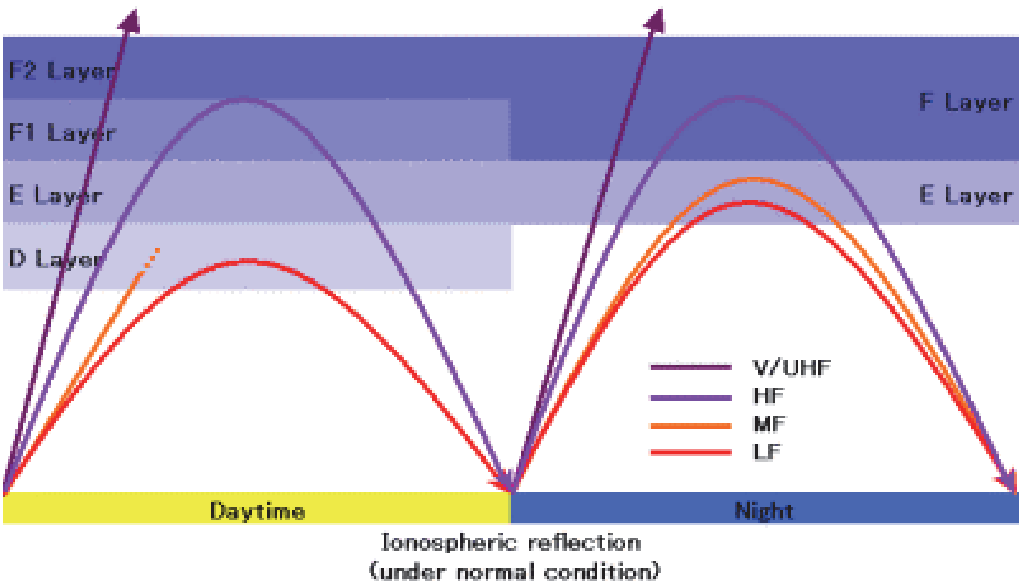


Figure 10: Signal Propagation

At shortwave frequencies, distant propagation is much more common. Shortwaves travel via ground wave (short distance) and sky wave. However, parts of our atmosphere-particularly, the part about 25 to 250 miles overhead called the ionosphere-can bounce signals back to Earth (technically, the radio signals are refracted or bent; see image to the left). What makes the ionosphere special is that the air pressure is low enough that ions can travel for a long time without colliding into other atoms and turning neutral.

The ionosphere is divided into different layers and each layer has its own characteristic. The bottom layer is the D layer and tends to absorb radio signals, especially those at lower frequencies. However, the D layer also vanishes at night, which is part of why lower shortwave bands are usually dead during the day and active at night.

Above the D layer is the E layer. It also is a daytime-only layer, and at low frequencies it can absorb radio waves (although not nearly as much as the D layer). The E layer isn't very important for shortwave frequencies, but for the TV (and FM radio) bands, it can provide E skip (see below).

3.4 MF/HF COMPONENTS.

Send / recieve antenna appr. 12 mtr

DSC recieve antenna appr. 4 mtr

Power supply

Processor

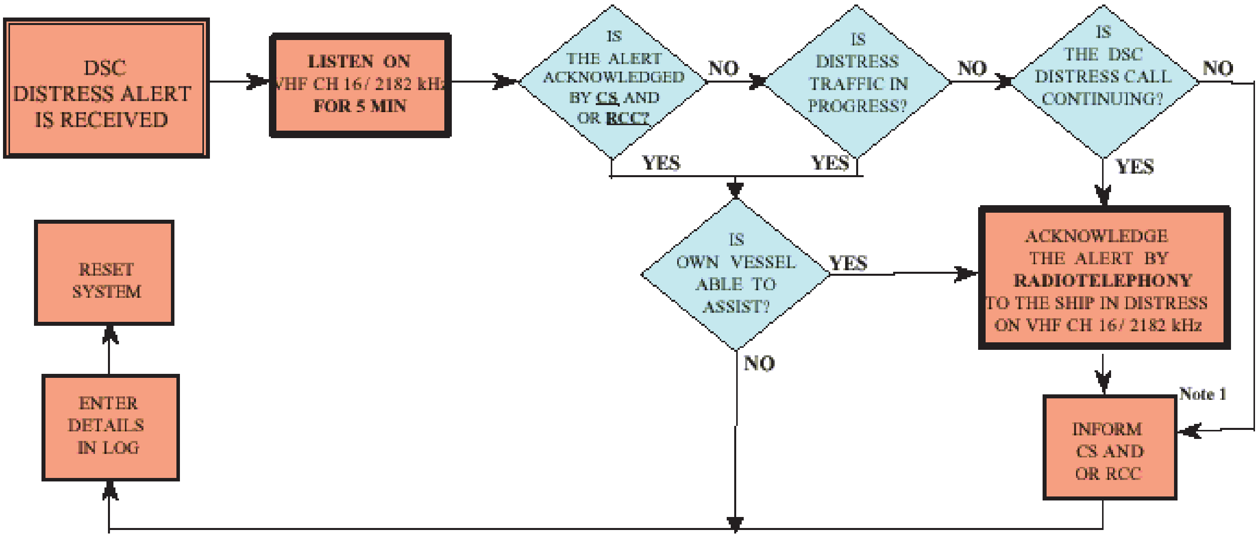
Medium frequency (MF) is the ITU designation for radio frequencies (RF) in the range of 300 kHz to 3 MHz Part of this band is the medium wave (MW) AM broadcast band. The MF band is also known as the hectometer band or hectometer wave as the wavelengths range from ten to one hectometer (1,000 to 100 m). Frequencies immediately below MF are denoted low frequency (LF)

High frequency (HF) is the ITU designation for the range of radio frequency electromagnetic waves (radio waves) between 3 and 30 MHz It is also known as the decameter band or decameter wave as its wavelengths range from one to ten decameters (ten to one hundred meters). Frequencies immediately below HF are denoted medium frequency (MF)

In radio communications, **single-sideband modulation (SSB) or single-sideband suppressed-carrier modulation (SSB-SC)** is a refinement of amplitude modulation which uses transmitter power and bandwidth more efficiently. Amplitude modulation produces an output signal that has twice the bandwidth of the original baseband signal. Single-sideband modulation avoids this bandwidth doubling, and the power wasted on a carrier, at the cost of increased device complexity and more difficult tuning at the receiver.

SSB signal is notified as J3E.

ACTIONS BY SHIPS UPON RECEPTION OF **VHF / MF** DSC DISTRESS ALERT



REMARKS:

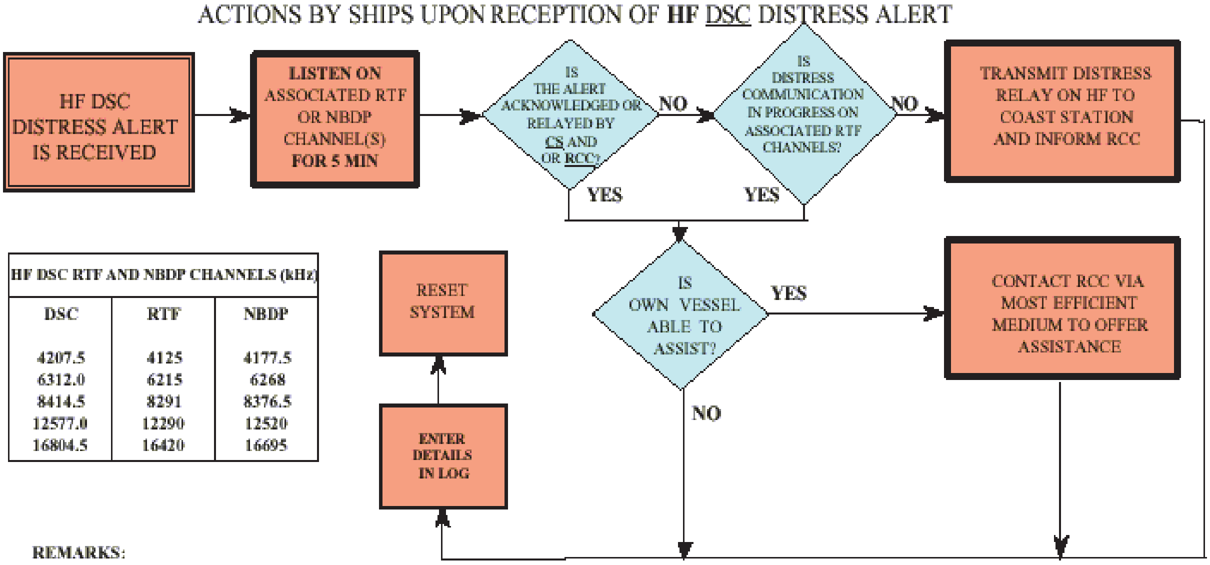
Note 1 : Appropriate or relevant RCC and/or Coast Station shall be informed accordingly. If further DSC alerts are received from the same source and the ship in distress is beyond doubt in the vicinity, a DSC acknowledgement may, after consultation with an RCC or Coast Station, be sent to terminate the call.

Note 2 : In no case is a ship permitted to transmit a DSC distress relay call on receipt of a DSC distress alert on either VHF channel 70 or MF channel 2187.5 kHz.

CS = Coast Station RCC = Rescue Co-ordination Center

Figure 11: VHF/MF DSC Distress Alert

ACTIONS BY SHIPS UPON RECEPTION OF **HF** DSC DISTRESS ALERT



HF DSC RTF AND NBDP CHANNELS (kHz)

DSC	RTF	NBDP
4207.5	4125	4177.5
6312.0	6215	6268
8414.5	8291	8376.5
12577.0	12290	12520
16804.5	16420	16695

REMARKS:

NOTE 1 : If it is clear the ship or persons in distress are not in the vicinity and/or other crafts are better placed to assist, superflous communications which could interfere with search and rescue activities are to be avoided. Details should be recorded in the appropriate logbook.

NOTE 2 : The ship should establish communications with the station controlling the distress as directed and render such assistance as required and appropriate.

NOTE 3 : Distress relay calls should be initiated manually.

CS = Coast Station RCC = Rescue Co-ordination Center

Figure 12: HF DSC Distress Alert

Band	R/T Frequency	DSC Frequency	Day Time Range	Night Time range
MF	2182 kHz	2187.5 kHz	150 nm	500 nm
HF4	4125 kHz	4207.5 kHz	300 nm	1000 nm
HF6	6215 kHz	6312 kHz	600 nm	1500 nm
HF8	8291 kHz	8414.5 kHz	1000 nm	2000 nm
HF12	12290 kHz	12577 kHz	2500 nm	
HF16	16420 kHz	16804.5 kHz		
VHF	156.800 MHz (Ch16)	156.5252 MHz (Ch. 70)	30 nm	30 nm

4 X AND S BAND RADAR

4.1 CROSS REFERENCE

DAMEN System Code	440
Drawings	
OEM documentation	

4.2 HISTORY

Figure 13: Radar equipment

The history of radar started with experiments by Heinrich Hertz in the late 19th century that showed that radio waves were reflected by metallic objects.

This possibility was suggested in James Clerk Maxwell's seminal work on electromagnetism.

However, it was not until the early 20th century that systems able to use these principles were becoming widely available, and it was German inventor Christian Hülsmeyer who first used them to build a simple ship detection device intended to help avoid collisions in fog (Reichspatent Nr. 165546).

Numerous similar systems, which provided directional information to objects over short ranges, were developed over the next two decades.

The development of systems able to produce short pulses of radio energy was the key advance that allowed modern radar systems to come into existence. By timing the pulses on an oscilloscope, the range could be determined and the direction of the antenna revealed the angular location of the targets. The two, combined, produced a "fix", locating the target relative to the antenna. In the 1934-1939 period, eight nations developed independently, and in great secrecy, systems of this type: the United Kingdom, Germany, the United States, the USSR, Japan, the Netherlands, France, and Italy. In addition, Britain shared their information with the United States and four Commonwealth countries: Australia, Canada, New Zealand, and South Africa, and these countries also developed their own radar systems. During the war, Hungary was added to this list. The term RADAR was coined in 1939 by the United States Signal Corps as it worked on these systems for the Navy.

Progress during the war was rapid and of great importance, probably one of the decisive factors for the victory of the Allies. A key development was the magnetron in the UK, which allowed the creation of relatively small systems with sub-meter resolution. By the end of hostilities, Britain, Germany, the United States, the USSR, and Japan had a wide diversity of land- and sea-based radars as well as small airborne systems. After the war, radar use was widened to numerous fields including: civil aviation, marine navigation, radar guns for police, meteorology and even medicine. Key developments in the post-war period include the travelling wave tube as a way to produce large quantities of coherent microwaves, the development of signal delay systems that led to phased array radars, and ever-increasing frequencies that allow higher resolutions. Increases in signal processing capability due to the introduction of solid state computers has also had a large impact on radar use.

4.3 DIFFERENCE BETWEEN X AND S BAND

X - Band radar

Frequency range: 8 - 12 GHz

Wavelength range: 2,5 - 3,75cm(3cm radar)

(SHF)

S - Band radar

Frequency range: 2 - 4 GHz

Wavelength range: 7,5 - 15cm(10cm radar)

(UHF -SHF)

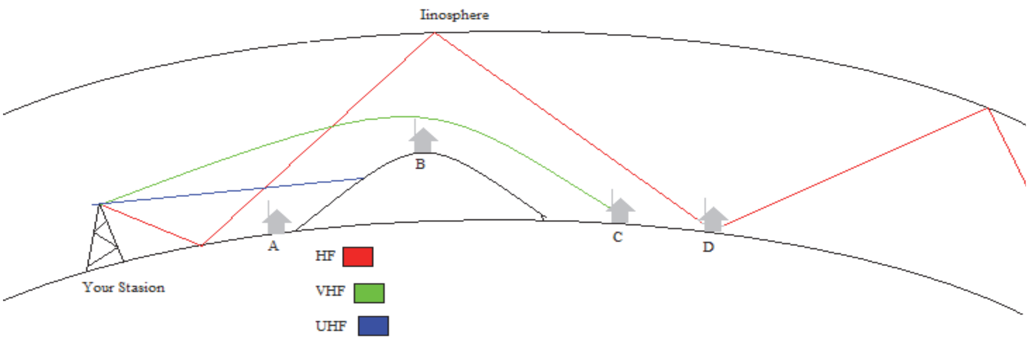


Figure 14: Radar Propagation

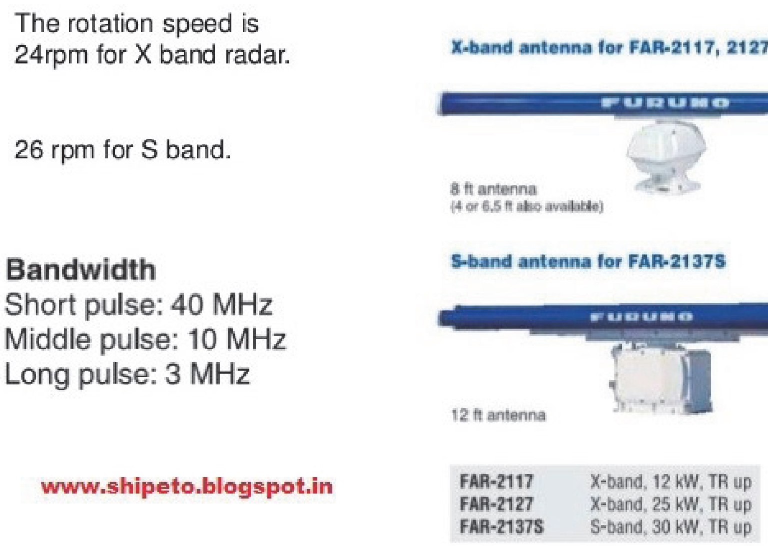


Figure 15: S-band / X-band

Simply put, they differ in frequency. The majority of marine radars operate on X-band.

X-band is widely used because of the ability to utilize smaller antennas that fit on most boats and to provide better target resolution.

S-band radars are often used for specialized applications, such as seeing through heavy weather or precipitation and for long-range bird detection. S-band antennas are larger. The smallest Furuno S-band antenna is 9 feet long and can be as long as 12 feet.

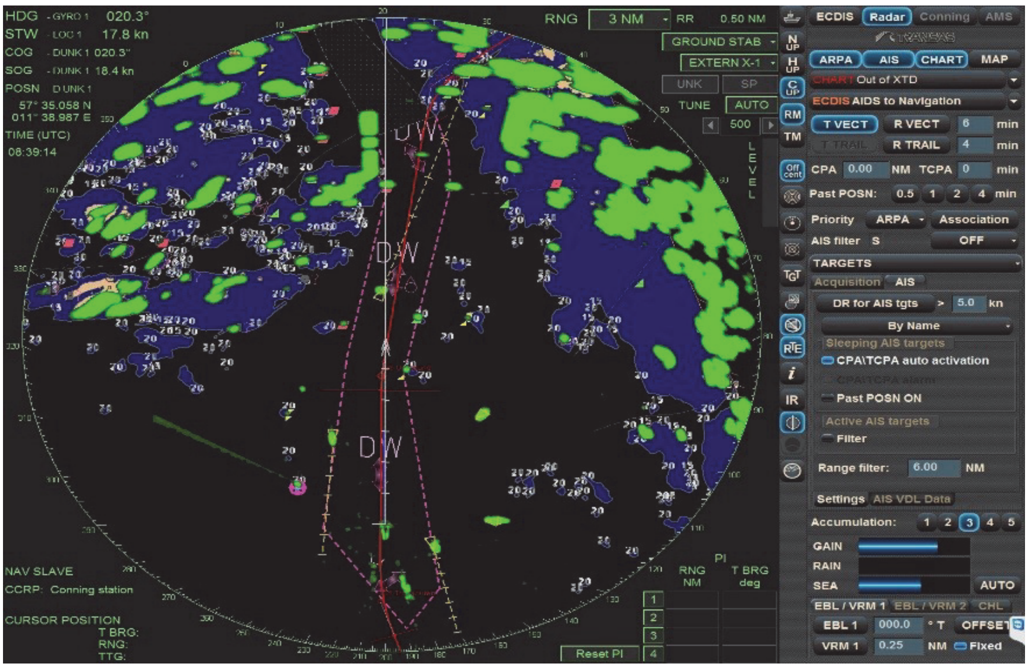


Figure 16: Radar Screen

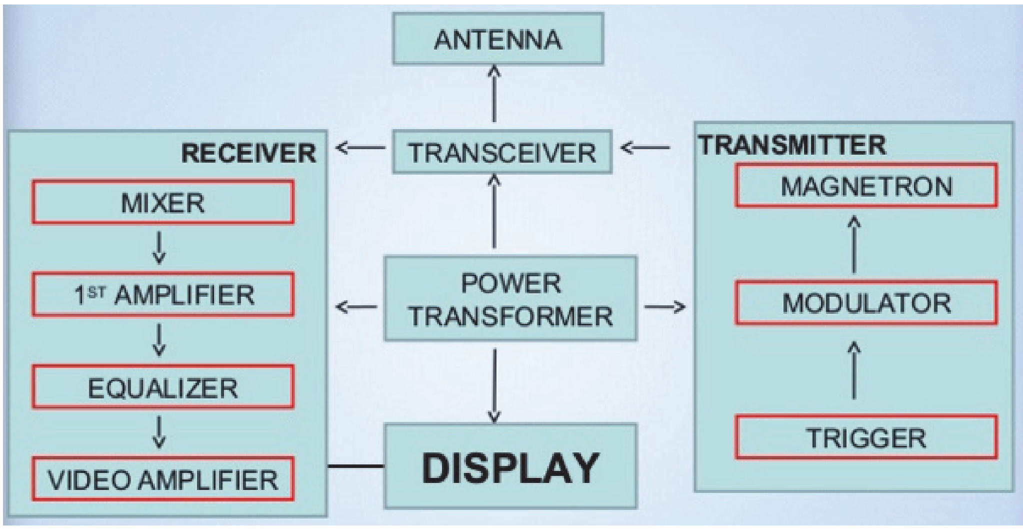


Figure 17: Block diagram

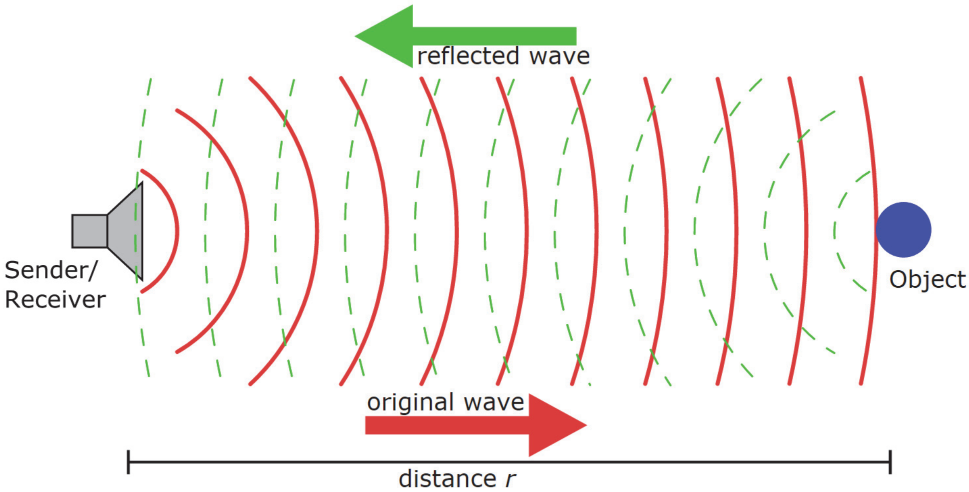


Figure 18: Send diagram

5 SHIPS LIGHTING

5.1 CROSS REFERENCE

DAMEN System Code	440
Drawings	
OEM documentation	

5.2 HISTORY

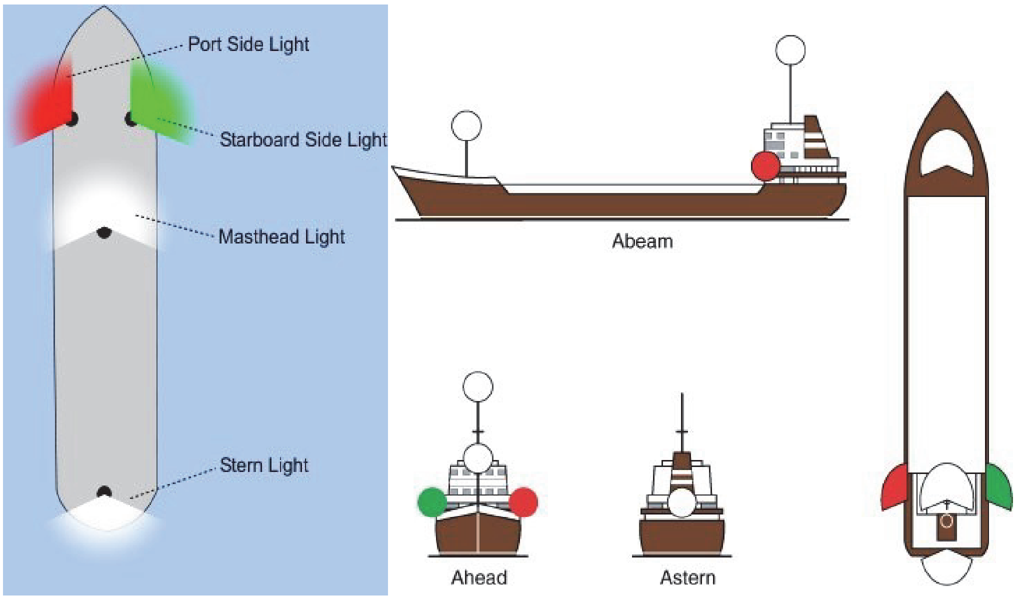


Figure 19: Overview

In 1838 the United States passed an act requiring steamboats running between sunset and sunrise to carry one or more signal lights; color, visibility and location were not specified. In 1848 the United Kingdom passed regulations that required steam vessels to display red and green sidelights as well as a white masthead light. In 1849 the U.S. Congress extended the light requirements to sailing vessels. In 1889 the United States convened the first International Maritime Conference to consider regulations for preventing collisions. The resulting Washington Conference Rules were adopted by the U.S in 1890 and became effective internationally in 1897. Within these rules was the requirement for steamships to carry a second mast head light. The international 1948 Safety of Life at Sea Conference recommended a mandatory second masthead light solely for power driven vessels over 150 feet in length and a fixed stern light for almost all vessels. The regulations have changed little since then.

The International Regulations for Preventing Collisions at Sea established in 1972 stipulates the requirements for the navigation lights required on a vessel.

5.3 BASIC LIGHTING

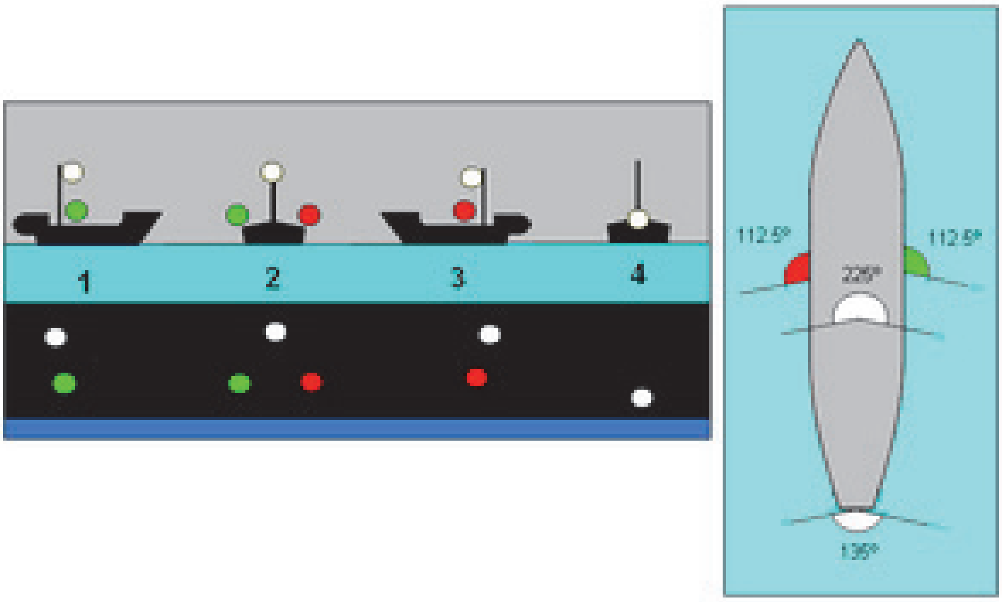


Figure 20: Basic Lighting configuration

2 = vessel facing directly towards observer;

4 = vessel facing away from the observer.

To avoid collisions, vessels mount navigation lights that permit other vessels to determine the type and relative angle of a vessel, and thus decide if there is a danger of collision. In general sailing vessels are required to carry a green light that shines from dead ahead to 2 points (22½°) abaft the beam on the starboard side (the right side from the perspective of someone on board facing forward), a red light from dead ahead to two points abaft the beam on the port side (left side) and a white light that shines from astern to two points abaft the beam on both sides.

Power driven vessels, in addition to these lights, must carry either one or two (depending on length) white masthead lights that shine from ahead to two points abaft the beam on both sides. If two masthead lights are carried then the aft one must be higher than the forward one.

Hovercraft at all times and some boats operating in crowded areas may also carry a yellow flashing beacon for added visibility during day or night.

6 ANEMOMETER

6.1 CROSS REFERENCE

DAMEN System Code	440
Drawings	
OEM documentation	

6.2 ANEMOMETER

Figure 21: Anemometer

An anemometer is a device used for measuring the speed of wind, and is also a common weather station instrument.

The term is derived from the Greek word anemos, which means wind, and is used to describe any wind speed measurement instrument used in meteorology.

The first known description of an anemometer was given by Leon Battista Alberti in 1450.

The anemometer has changed little since its development in the 15th century. Leon Battista Alberti (1404-1472) is said to have invented the first mechanical anemometer around 1450. In following centuries, numerous others, including Robert Hooke (1635-1703), developed their own versions, with some being mistakenly credited as the inventor. In 1846, John Thomas Romney Robinson (1792-1882) improved upon the design by using four hemispherical cups and mechanical wheels. In 1926, Canadian meteorologist John Patterson (January 3, 1872 - February 22, 1956) developed a three-cup anemometer, which was improved by Brevoort and Joiner in 1935. In 1991, Derek Weston added the ability to measure wind direction. In 1994, Andrews Pflitsch developed the sonic anemometer.

A typical Anemometer (see figure 22) will look something like a small and compact hand-held device. Some have different fans, which will act as the sensor and some operates using cups. The simplest version is the Cup Anemometer (see figure 23.), which is simply operated by three or four cups as a sensor. The cups spin horizontally and the sensor picks up the amount of spins on a set time period to give an accurate reading on the wind speed.

Figure 22: Handheld anemometer

Figure 23: Cup anemometer

Another version called Vane Anemometers (see figure 24) operate in a similar way.However, instead of operating horizontally like the cup anemometer, this technique is very similar to a windmill. The propeller spins on a vertical direction meaning it has to be facing the direction where the wind is coming from. The reading is similar to the cup anemometer, the device is electrically operated and the propeller spins are recorded and translated into wind speed. This technique is also widely used for recreational purposes, as this technique is fairly simple and comes at a low-cost .

Figure 24: Vane anemometer

Lastly, a more advanced method is using a anemometer with a hot-wire sensor (see figure 25). These meters usually come with higher price tag and the technology is more advanced. The Hot-Wire Anemometers use wires which send electrical currents to create heat, the wires are connected to a piece of metal (Tungsten (Wolfram) is commonly used), which is very sensitive to different temperatures. So the metal will increase or decrease in temperature depending on the amount of air flow. The device will instantly calculate the wind speed based on the temperature of the metal connected to the hot-wires. For professional and industrial use, Hot-Wire Anemometers are highly recommended, not only do they provide accurate readings, but often have enough memory to store readings and data for further analysis.

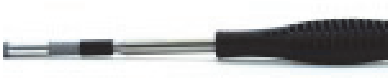


Figure 25: Hot wire Anemometer

6.3 CALCULATE WINDSPEED

Follow the steps below to calculate m/s to km/h.

$$1\ m/sec = \frac{\frac{1}{1000}}{\frac{1}{3600}}\ km/hr = \frac{3600}{1000}\ km/hr = \frac{18}{5}\ km/hr$$

$$1\ m/sec = \frac{18}{5}\ km/hr$$

$$2\ m/sec = 2 * \frac{18}{5}\ km/hr$$

$$3\ m/sec = 3 * \frac{18}{5}\ km/hr$$

$$20\ m/sec = 20 * \frac{18}{5}\ km/hr = \frac{360}{5}\ km/hr = 72\ km/hr$$

7 AUTOPILOT

7.1 CROSS REFERENCE

DAMEN System Code	440
Drawings	
OEM documentation	

7.2 AUTOPILOT

Figure 26: Simrad Autopilot operator panel

Autopilots are equipment used on ships and boats to maintain a chosen course without constant human action. It is also known by several other terms, such as self steering gear and autohelm (technically a Raymarine trademark, but often used generically). Several forms of self-steering gear exist, divided into two categories: electronic and mechanical.

Electronic self-steering is controlled by electronics operating according to one or more input sensors, invariably at least a magnetic compass and sometimes wind direction or GPS position versus a chosen waypoint. The electronics module calculates the required steering movement and a drive mechanism (usually electrical, though possibly hydraulic in larger systems) causes the rudder to move accordingly.

The main goal of a mechanical self-steering gear is to keep a sailboat on a given course towards the apparent wind and to free the helmsman from the steering job. An advantageous side effect is that the sails are kept in optimal angle towards the apparent wind, and deliver optimal propulsion force by that. Even in sailboats running under engine the self steering gear can be used to keep the boat on the correct heading into the wind to easily set or change sails.

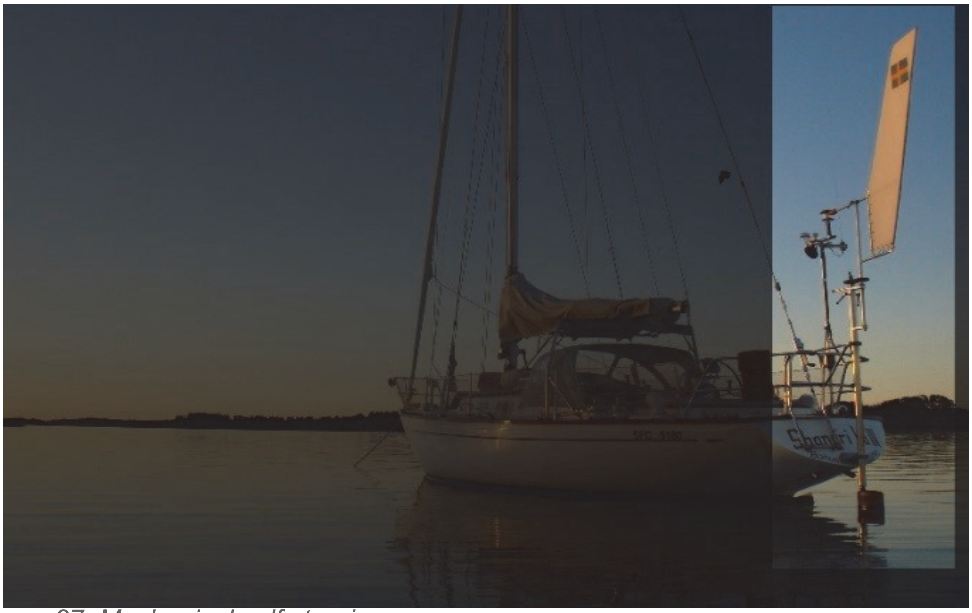


Figure 27: Mechanical self steering gear

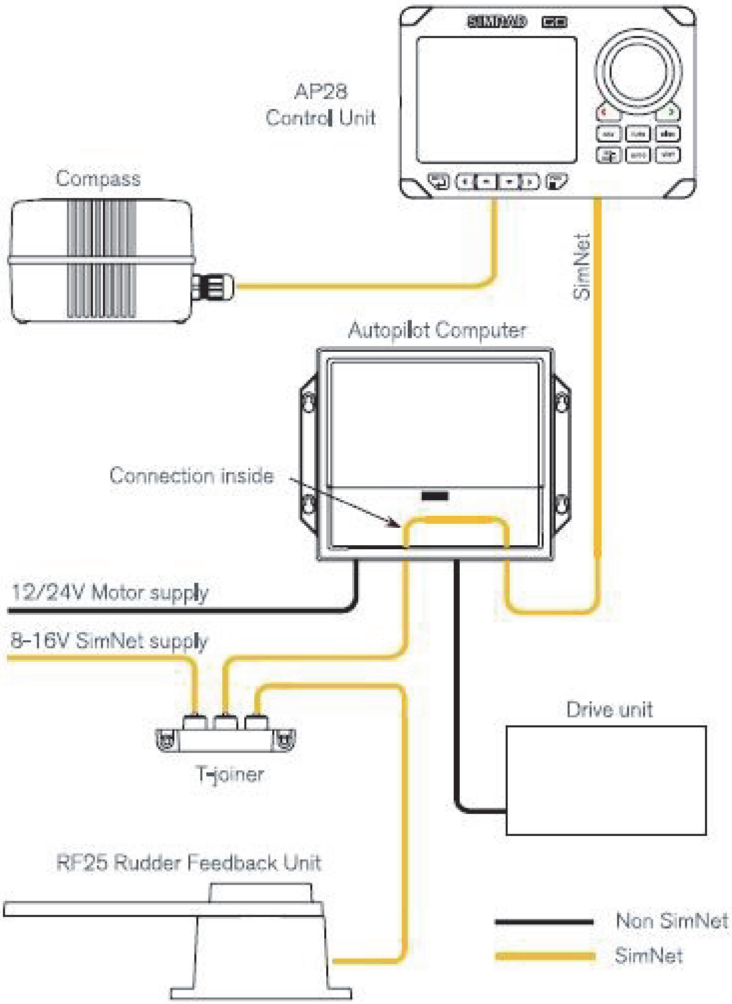


Figure 28: Electronic self-steering

8 DOPPLER LOG

8.1 CROSS REFERENCE

DAMEN System Code	440
Drawings	
OEM documentation	

8.2 DOPPLER SPEED LOG

Figure 29: Picture

A Doppler speed log measures ship's speed by utilizing the principle of the Doppler effect, which defines that a signal emitted from a moving object is heard with its frequency shifted at stationary locations and the degree of the frequency shift is proportional to the speed of the moving object.

The Doppler effect (or the Doppler shift) is the change in frequency or wavelength of a wave for an observer who is moving relative to the wave source. It is named after the Austrian physicist Christian Doppler, who described the phenomenon in 1842.

8.3 SPEED OVER WATER

What is speed over water? How is it having influence in collision avoidness in vessels navigation?

Imagine you are on a boat in a river and the current is going in opposite direction you are steaming 10 knots and the current is also rates the same i.e. 10 knots, but… in opposite direction.

Your engine speed is showing 10 knots.

Now I ask you… how much speed you are actually doing? The answer is zero knots. Your boat is not moving at all but whereas speed is 10 knots. The rate of current and engine speed is cancelling each other out. This is your speed over GROUND 10 knots but the actual speed over WATER is zero.

Now take another example and change the direction of the current towards yours. Current will now help in moving your boat. The speed over Ground will remain 10 knots but in reality you will be doing 20 knots.

In both these cases imagine another ship on a collision course or observing through Radar in what speed you will be approaching her? In both cases it will be SPEED OVER WATER.

And that's why COLREGS are made taking Speed over Water in account and you need to follow the same.

Colregs are made on the basis of visual navigation when risk of collision exist b/w two vessels. when we use Radar as an aid for navigation and use it for collision avoidance, it should be SEA STABILISED. Meaning Speed over WATER should be taken into account because it gives you actual Aspect of the vessels involved.

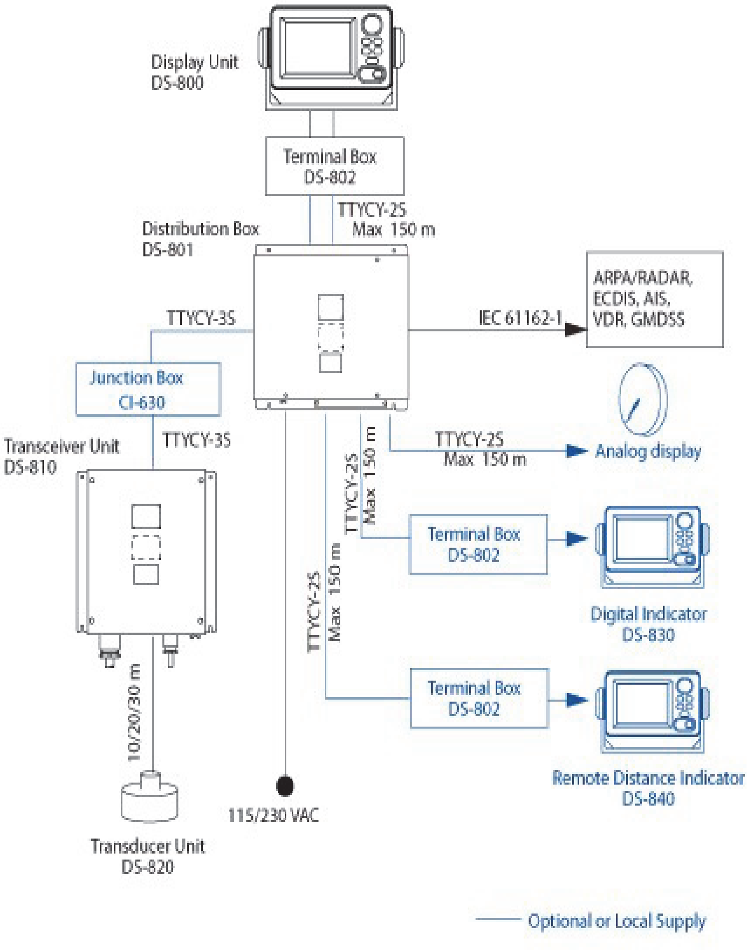


Figure 30: Doppler log diagram

9 ECDIS

9.1 CROSS REFERENCE

DAMEN System Code	440
Drawings	
OEM documentation	

9.2 ELECTRONIC CHART DISPLAY AND INFORMATION SYSTEM

Figure 31: ECDIS-console

An Electronic Chart Display and Information System (ECDIS) is a computer-based navigation system that complies with IMO regulations and can be used as an alternative to paper navigation charts. Integrating a variety of real-time information, it is an automated decision aid capable of continuously determining a vessel's position in relation to land, charted objects, navigation aids and unseen hazards.

An ECDIS includes electronic navigational charts (ENC) and integrates position information from the Global Positioning System (GPS) and other navigational sensors, such as radar, fathometer and automatic identification systems (AIS). It may also display additional navigation-related information, such as sailing directions.

ECDIS is defined in the IMO ECDIS Performance Standards (IMO Resolution A.817(19)) as follows:

Electronic Chart Display and Information System (ECDIS) means a navigation information system which, with adequate back up arrangements, can be accepted as complying with the up-to-date chart required by regulation V/19 & V/27 of the 1974 SOLAS Convention, by displaying selected information from navigation sensors to assist the mariner in route planning and route monitoring, and by displaying additional navigation-related information if required.

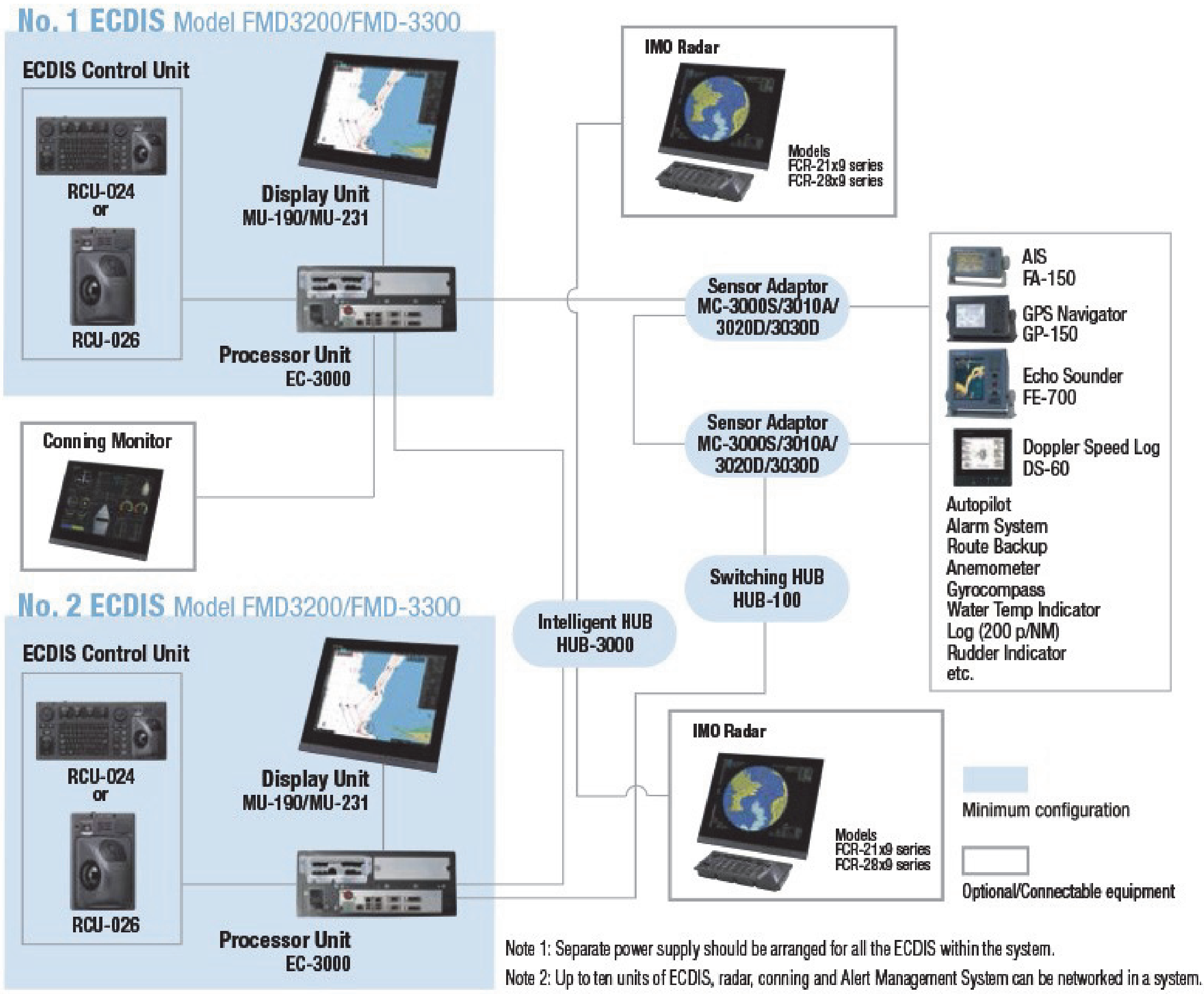


Figure 32: ECDIS diagram

10 ECHOSOUNDER

10.1 CROSS REFERENCE

DAMEN System Code	440
Drawings	
OEM documentation	

10.2 DEPTH MEASUREMENT

Figure 33: Echosounder unit

Echo sounding is a type of sonar used to determine the depth of water by transmitting sound pulses into water.

The time interval between emission and return of a pulse is recorded, which is used to determine the depth of water along with the speed of sound in water at the time.

This information is then typically used for navigation purposes or in order to obtain depths for charting purposes.

Echo sounding can also refer to hydroacoustic "echo sounders" defined as active sound in water (sonar) used to study fish.

Hydroacoustic assessments have traditionally employed mobile surveys from boats to evaluate fish biomass and spatial distributions. Conversely, fixed-location techniques use stationary transducers to monitor passing fish.

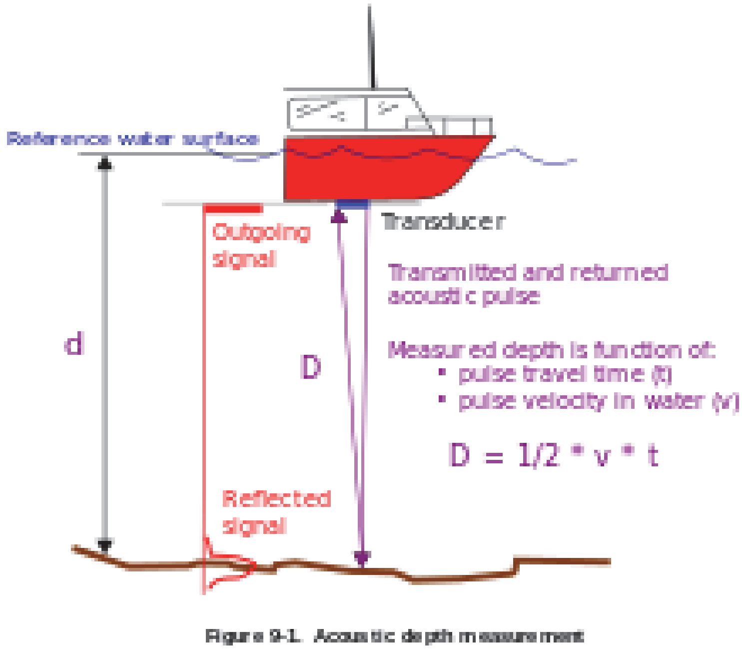


Figure 34: Principles of Echosounding

10.3 THE BASIC PRINCIPLE OF ECHO SOUNDING.

Distance is measured by multiplying half the time from the signal's outgoing pulse to its return by the speed of sound in the water, which is approximately 1.5 kilometers per second [T÷2×(4700 feet per second or 1.5 kilometers per second)] For precise applications of echosounding, such as hydrography, the speed of sound must also be measured typically by deploying a sound velocity probe into the water.

Echo sounding is effectively a special purpose application of sonar used to locate the bottom. Since a traditional pre-SI unit of water depth was the fathom, an instrument used for determining water depth is sometimes called a fathometer. The first practical fathometer was invented by Herbert Grove Dorsey and patented in 1928.

A fathom is a unit of length in the imperial and the U.S. customary systems equal to 6 feet (1.8288 meters), used especially for measuring the depth of water.

1 feet = 0,3048cm

Figure 35: Herbert Grove Dorsey whit fathometer

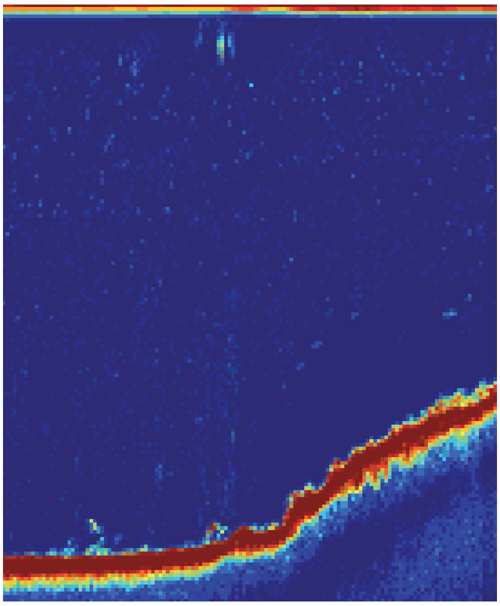
10.4 CHOOSING FREQUENCIES

The frequency of the sound wave is chosen based on how far the wave has to travel. Lower frequency waves can travel farther in a medium, such as water, because the motion of these waves is closer to a straight line. They travel through the water at a more perpendicular angle, allowing them to penetrate the medium better and not attenuate, or lose intensity, as quickly as those at higher frequencies.

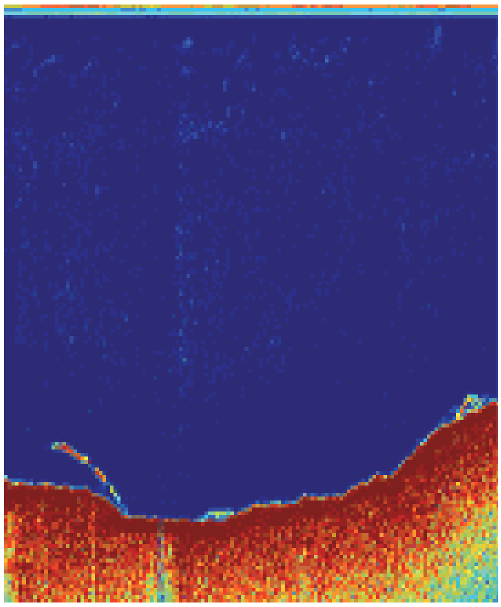
Higher frequency waves, because they approach the surface of the object at more of an angle, are more likely to bounce off of the object instead of passing through it, allowing for better resolution images. More returned sound waves mean better pictures. Therefore, for high resolution pictures, a high frequency sound wave is desirable; but if the seafloor is so deep that the high frequencies cannot reach, then lower frequency waves may be the better choice. If the wave attenuates before it reaches an object, no echo is returned to create an image.

Most used

The accuracy with which your fishfinder detects bottom and other objects is also determined by the frequency selected for the depth you are viewing. Raymarine depth transducers can be tuned to two different frequencies: 200 kHz (high) or 50kHz (low).



200 kHz Echo Sounder Display in 50' (15m) of water



50 kHz Echo Sounder Display in 50' (15m) of water

200 kHz (high)

200 kHz works best in water under 200 feet/60 meters and when you need to get an accurate reading while moving at faster speeds. High frequencies give you greater detail to detect very small objects but over a smaller portion of water. High frequencies typically show less noise and fewer undesired echoes while showing better target definition.

50 kHz (low)

For deep water, 50 kHz is preferred. This is because water absorbs sound waves at a slower rate for low frequencies and the signal can travel farther before becoming too weak to use. The beam angle is wider at low frequencies, meaning the outgoing pulse is spread out more and is better suited for viewing a larger area under the boat. However, this also means less target definition and separation and increased susceptibility to noise. Although low frequencies can see deeper, they may not give you a clear picture of the bottom.

Mud, soft sand, and plant life on the bottom absorb and scatter sound waves, resulting in a thicker bottom image. Rock, coral and hard sand reflect the signal easily and produce a thinner bottom display. This is easier to see using the 50 kHz setting, where the bottom returns are wider.

A rule of thumb would be to use the 200 kHz setting for a detailed view to about 200 feet and then switch to 50 kHz when you want to look deeper. Better yet, display both views side-by-side on a split screen for both perspectives.

11 GPS-DGPS

11.1 CROSS REFERENCE

DAMEN System Code	440
Drawings	
OEM documentation	

11.2 GLOBAL POSITIONING SYSTEM

Figure 36: GPS-logo

The GPS concept is based on time and the known position of specialized satellites. The satellites carry very stable atomic clocks that are synchronized to each other and to ground clocks. Any drift from true time maintained on the ground is corrected daily. Likewise, the satellite locations are known with great precision. GPS receivers have clocks as well; however, they are not synchronized with true time, and are less stable. GPS satellites continuously transmit their current time and position.

A GPS receiver monitors multiple satellites and solves equations to determine the exact position of the receiver and its deviation from true time. At a minimum, four satellites must be in view of the receiver for it to compute four unknown quantities (three position coordinates and clock deviation from satellite time).

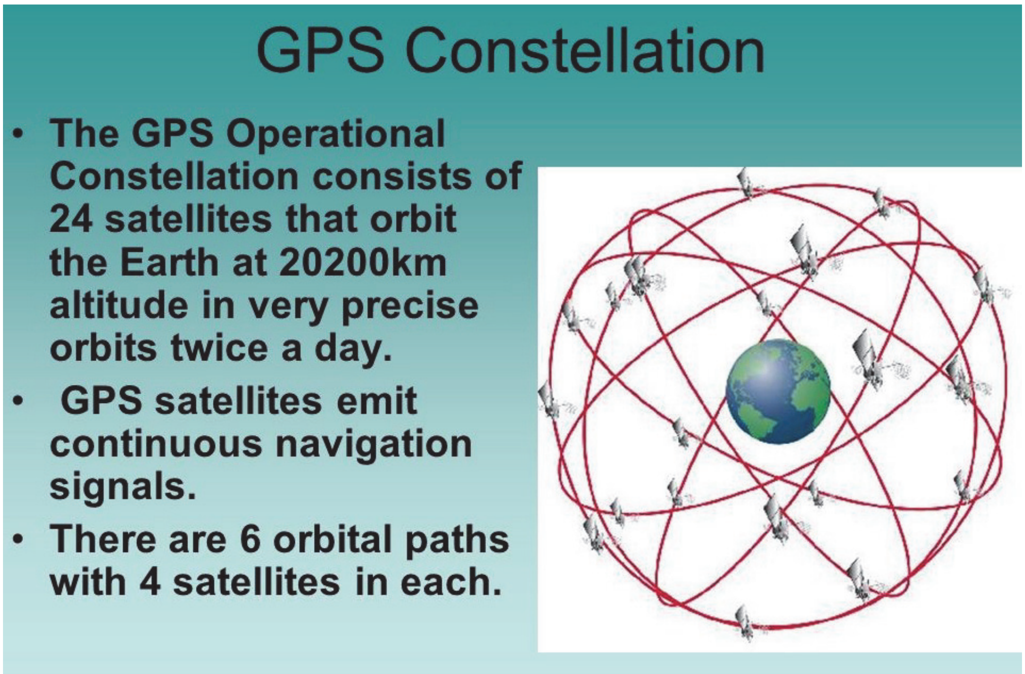


Figure 37: GPS Constellation

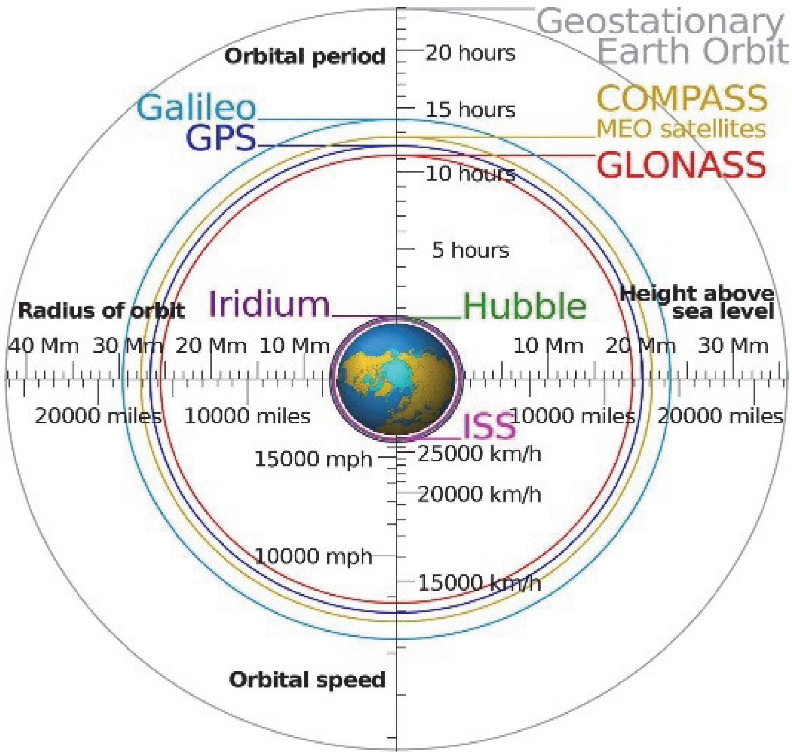


Figure 38: Satellite diagram

The Global Positioning System (GPS) is a constellation of about 24 artificial satellites. The GPS satellites are uniformly distributed in a total of six orbits such that there are four satellites per orbit. This number of satellites and spatial distribution of orbits insures that at least eight satellites can be simultaneously seen at any time from almost anywhere on Earth.

The GPS satellites circle the Earth at an altitude of about 20,000 km (13,000 miles) and complete two full orbits every day. The GPS satellites are not in a geostationary orbit, but rise and set two times per day. Each satellite broadcasts radio waves towards Earth that contain information regarding its position and time. We can receive this information by using special receivers, called GPS receivers, which can detect and decode this information.

By combining signals transmitted by several satellites and received simultaneously, a GPS receiver can calculate its position on the Earth (i.e., its latitude and longitude) with an accuracy of approximately 10 m. There are more sophisticated receivers that can be used to determine position with an accuracy of a few millimeters.

11.3 DIFFERENTIAL GLOBAL POSITIONING SYSTEM (DGPS)

Differential Global Positioning System (DGPS) is an enhancement to Global Positioning System that provides improved location accuracy, from the 15-meter nominal GPS accuracy to about 10 cm in case of the best implementations. DGPS uses a network of fixed, ground-based reference stations to broadcast the difference between the positions indicated by the GPS satellite systems and the known fixed positions. These stations broadcast the difference between the measured satellite pseudo ranges and actual (internally computed) pseudo ranges, and receiver stations may correct their pseudo ranges by the same amount. The digital correction signal is typically broadcast locally over ground-based transmitters of shorter range.

	GPS	GLONASS	Galileo
Total number of satellites	Min. 24 + 3	24	27 + 3
Satellites per orbit	4	8	10
Number of orbits	6	3	3
Distance between orbiits	60°	120”	120”
Time to complete one orbit	11 hrs 59 min	11 hrs 15 min	14 hrs 22 min
Height	20200 km	19100 km	23616 km
Max. geographical width	55°	60°	60°
Inclination angle	55°	64°8’	56°
Frequencies	L1: 1575,42 MHz L2: 1227,60 MHz L5: 1176,45 MHz (modernising)	Satellite-dependent 1246-1257 MHz 1602-1616 MHz	3 frequencies
Modulation	CDMA	FDMA CDMA (modernising)	CDMA
Coordinate-system	WGS84	PZ90.02	GTRF
Reference-time	GPS-time = TAI -19 sec.	UTC + 3 hr.	TAI

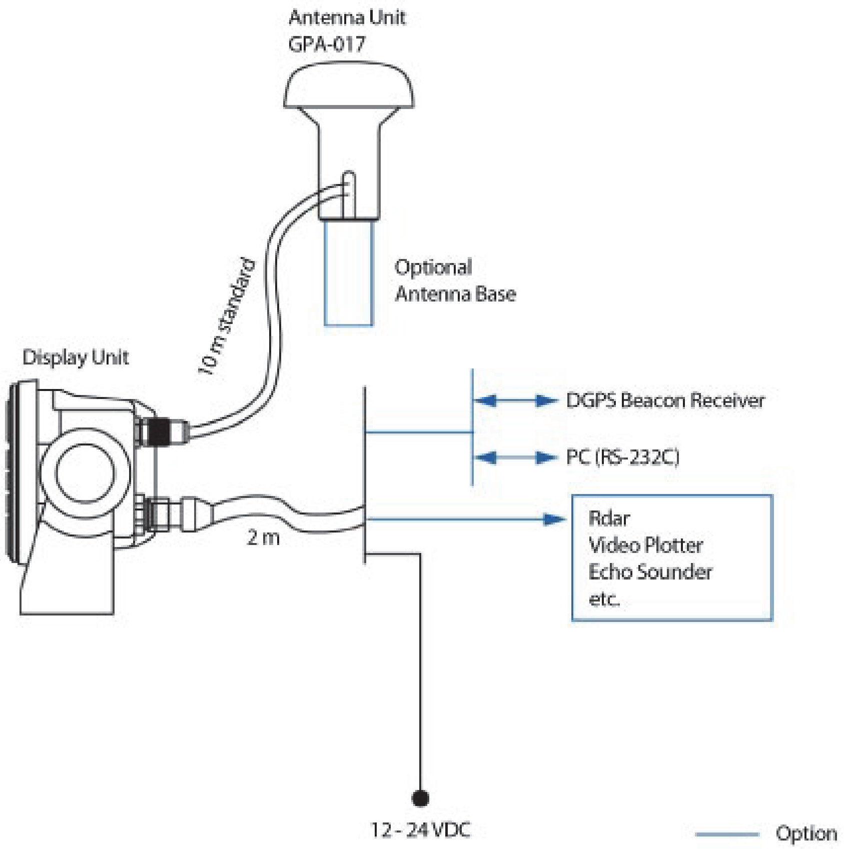


Figure 39: GPS-diagram

12 MAGNETIC AND GYRO COMPASS

12.1 CROSS REFERENCE

DAMEN System Code	440
Drawings	
OEM documentation	

12.2 GYROCOMPASS

Figure 40: Gyrocompass

A gyrocompass is a type of non-magnetic compass which is based on a fast-spinning disc and rotation of the Earth (or another planetary body if used elsewhere in the universe) to automatically find geographical direction. Although one important component of a gyrocompass is a gyroscope, these are not the same devices; a gyrocompass is built to use the effect of gyroscopic precession, which is a distinctive aspect of the general gyroscopic effect. Gyrocompasses are widely used for navigation on ships, because they have two significant advantages over magnetic compasses:

- they find true north as determined by Earth's rotation, which is different from, and navigationally more useful than, magnetic north, and

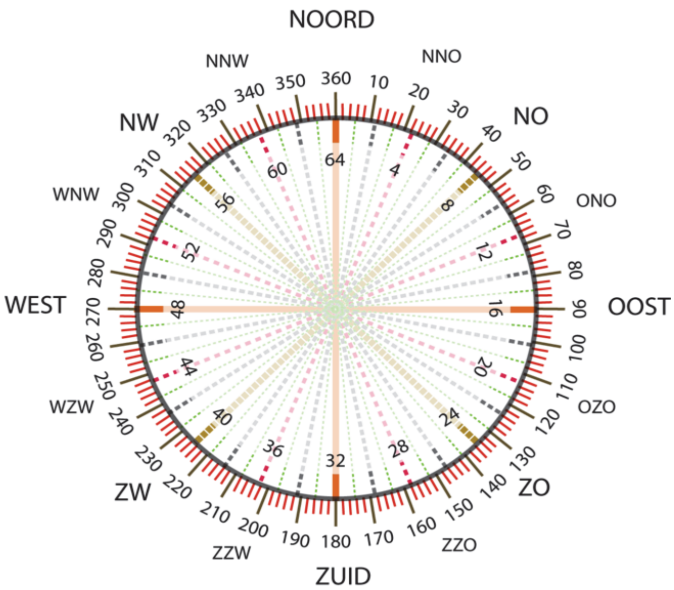
- they are unaffected by ferromagnetic materials, such as ship's steel hull, which change the magnetic field.

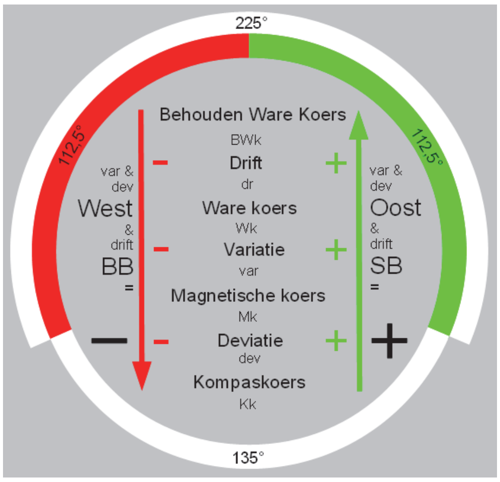
12.3 MAGNETIC COMPASS

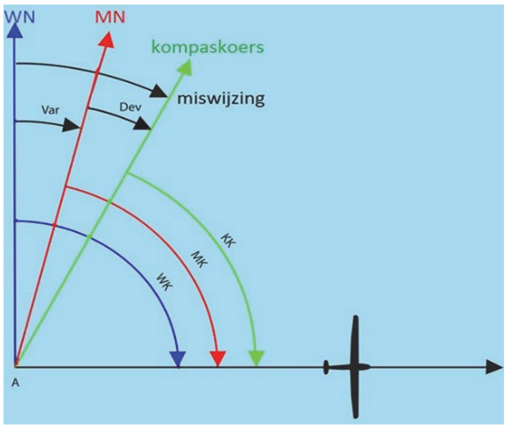
Figure 41: Magnetic compass

A Magnetic compass is an instrument used for navigation and orientation that shows direction relative to the geographic "cardinal directions", or "points". Usually, a diagram called a compass rose shows the directions north, south, east, and west on the compass face as abbreviated initials. When the compass is used, the rose can be aligned with the corresponding geographic directions, so, for example, the "N" mark on the rose really points to the north. Frequently, in addition to the rose or sometimes instead of it, angle markings in degrees are shown on the compass. North corresponds to zero degrees, and the angles increase clockwise, so east is 90 degrees, south is 180, and west is 270. These numbers allow the compass to show azimuths or bearings, which are commonly stated in this notation.

The magnetic compass was first invented as a device for divination (from Latin divinare "to foresee, to be inspired by a god) as early as the Chinese Han Dynasty (since about 206 BC), and later adopted for navigation by the Song Dynasty Chinese during the 11th century. The first usage of a compass recorded in Western Europe and the Islamic world occurred around the early 13th century.







Mismatch - formula

Mismatch

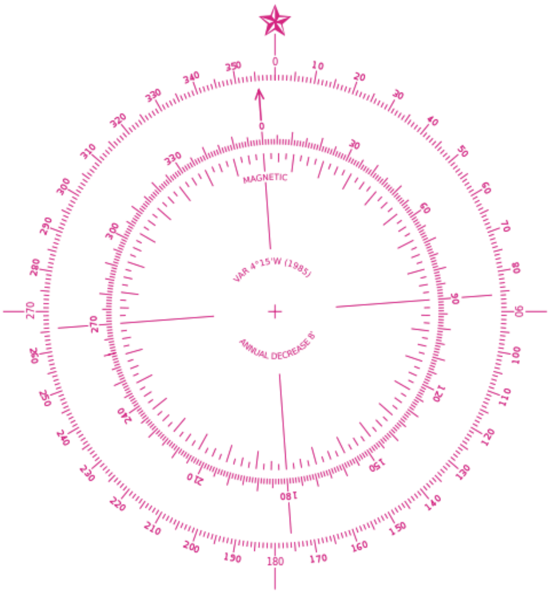
(KK + dev = MK + var = WK + drift = BWK + str = GrK)

263° + -6° = 257° + -3° = 254° + -6° = 248° + 12° = 260°

Compass course+deviation=magnetic course+variation=true course+wind=BWK+current=GrK

Variation can be found on any sea chart.

Wind and current needs to be collected from ship navigation equipment.



12.4 STEERING TABLE (DEVIATION)

Steering table is made (ship specific) to be able to make corrections from compass course to true course or the other way around.

Compass course	Deviation	Compass course	Deviation
0°	-4	202,5°	+2
22½°	-2	225°	0
45°	0	247,5°	-2
67½°	+2	270°	-4
90°	+4	292,5°	-5
112½°	+5	315°	-6
135°	+6	337,5°	-5
157½°	+5	360°	-4

13 INMARSAT

13.1 CROSS REFERENCE

DAMEN System Code	440
Drawings	
OEM documentation	

13.2 INTERNATIONAL MARITIME SATELLITE ORGANIZATION

Figure 42: INMARSAT components

Origin

The present company originates from the International Maritime Satellite Organization (INMARSAT), a non-profit intergovernmental organization established in 1979 at the behest of the International Maritime Organization (IMO)-the United Nations' maritime body-and pursuant to the Convention on the International Maritime Satellite Organization, signed by 28 countries in 1976. The organization was created to establish and operate a satellite communications network for the maritime community. In coordination with the International Civil Aviation Organization in the 1980s, the convention governing INMARSAT was amended to include improvements to aeronautical communications, notably for public safety. The member states owned varying shares of the operational business. The main offices were originally located in the Euston Tower, Euston Road, London.

In the mid-1990s, many member states were unwilling to invest in improvements to INMARSAT's network, especially owing to the competitive nature of the satellite communications industry, while many recognized the need to maintain the organization's older systems and the need for an intergovernmental organization to oversee public safety aspects of satellite communication networks.

In 1998, an agreement was reached to modify INMARSAT's mission as an intergovernmental organization and separate and privatize the organization's operational business, with public safety obligations attached to the sale.

In April 1999, INMARSAT was succeeded by the International Mobile Satellite Organization (IMSO) as an intergovernmental regulatory body for satellite communications, while INMARSAT's operational unit was separated and became the UK-based company Inmarsat Ltd.

The IMSO and Inmarsat Ltd. signed an agreement imposing public safety obligations on the new company.

Inmarsat was the first international satellite organization that was privatized.

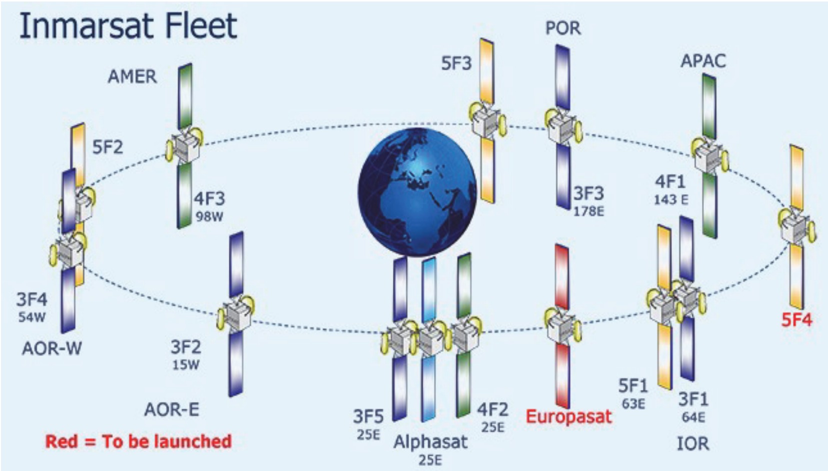


Figure 43: INMARSAT Fleet

In 2005, Apax Partners and Permira bought shares in the company. The company was also first listed on the London Stock Exchange in that year. In March 2008, it was disclosed that U.S. hedge fund Harbinger Capital owned 28% of the company.

In 2009, Inmarsat completed the acquisition of satellite communications provider Stratos Global Corporation (Stratos) and acquired a 19-percent stake in SkyWave Mobile Communications Inc., a provider of Inmarsat D+/IsatM2M network services which in turn purchased the GlobalWave business from TransCore.

Inmarsat won the 2010 MacRobert Award for its Broadband Global Area Network (BGAN) service.

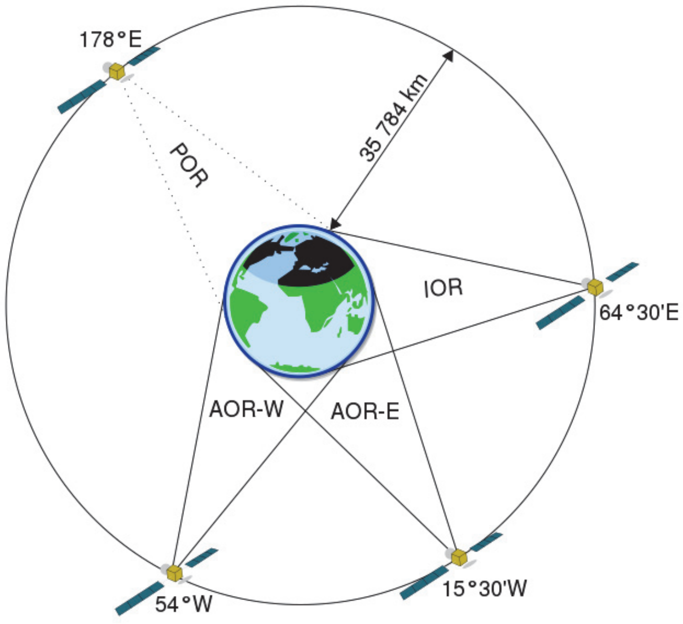


Figure 44: INMARSAT Orbit

871 Atlantic Ocean Region - East (AOR-E)

872 Pacific Ocean Region (POR)

873 Indian Ocean Region (IOR)

874 Atlantic Ocean Region - West (AOR-W)

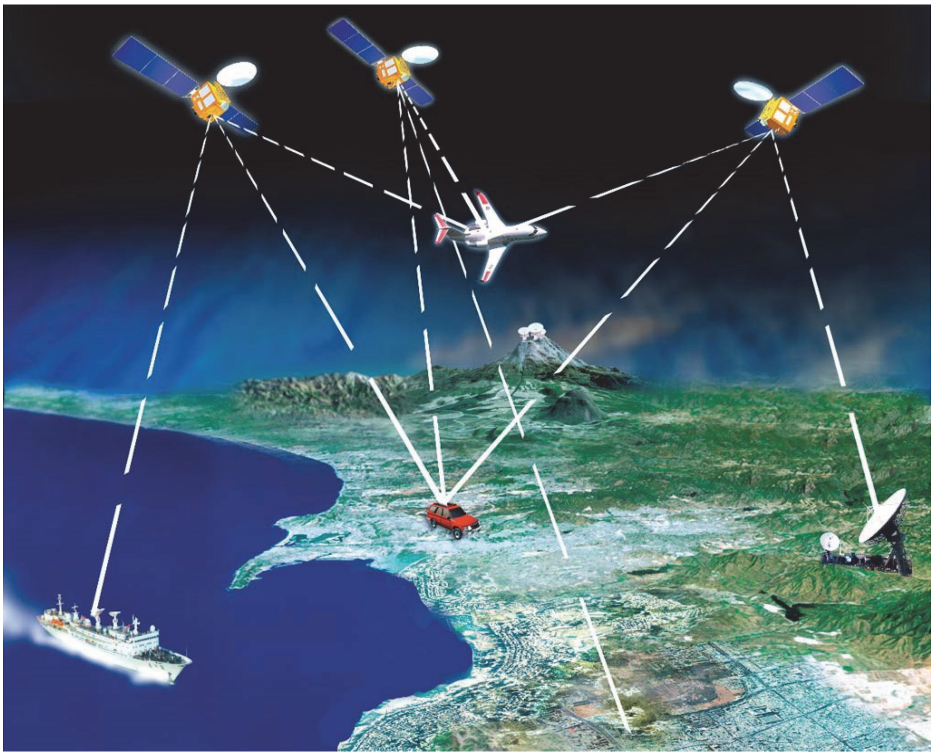
Inmarsat-B: provides voice services, telex services, medium speed fax/data services at 9.6 kbit/s and high speed data services at 56, 64 or 128 kbit/s. There is also a leased mode for Inmarsat-B available on the spare Inmarsat satellites. Service was closed early January 2017.

Inmarsat-C: effectively this is a satellite telex terminal with store-and-forward, polling etc. capabilities. Certain models of Inmarsat-C terminals are also approved for usage in the GMDSS system, equipped with GPS.

Inmarsat-M: provides voice services at 4.8 kbit/s and medium speed fax/data services at 2.4 kbit/s. It paved the way towards Inmarsat-Mini-M. Service has been closed.

Mini-M: provides voice services at 4.8 kbit/s and medium speed fax/data services at 2.4 kbit/s. One 2.4kbit/s channel takes up 4.8kbit/s on the satellite. Service was closed early January 2017

Fleet: actually a family of networks that includes the Inmarsat-Fleet77, Inmarsat-Fleet55 and Inmarsat-Fleet33 members (The numbers 77, 55 and 33 come from the diameter of the antenna in centimeters). Much like GAN, it provides a selection of low speed services like voice at 4.8 kbit/s, fax/data at 2.4 kbit/s, medium speed services like fax/data at 9.6 kbit/s, ISDN like services at 64 kbit/s (called Mobile ISDN) and shared-channel IP packet-switched data services at 64 kbit/s (called Mobile Packet Data Service or MPDS - see below). However, not all these services are available with all members of the family. The latest service to be supported is Mobile ISDN at 128 kbit/s on Inmarsat-Fleet77 terminals.



13.3 WHAT IS A SATELLITE?

A satellite is a moon, planet or machine that orbits a planet or star. For example, Earth is a satellite because it orbits the sun. Likewise, the moon is a satellite because it orbits Earth. Usually, the word "satellite" refers to a machine that is launched into space and moves around Earth or another body in space.

Earth and the moon are examples of natural satellites. Thousands of artificial, or man-made, satellites orbit Earth. Some take pictures of the planet that help meteorologists predict weather and track hurricanes. Some take pictures of other planets, the sun, black holes, dark matter or faraway galaxies. These pictures help scientists better understand the solar system and universe.

Still other satellites are used mainly for communications, such as beaming TV signals and phone calls around the world. A group of more than 20 satellites make up the Global Positioning System, or GPS. If you have a GPS receiver, these satellites can help figure out your exact location.

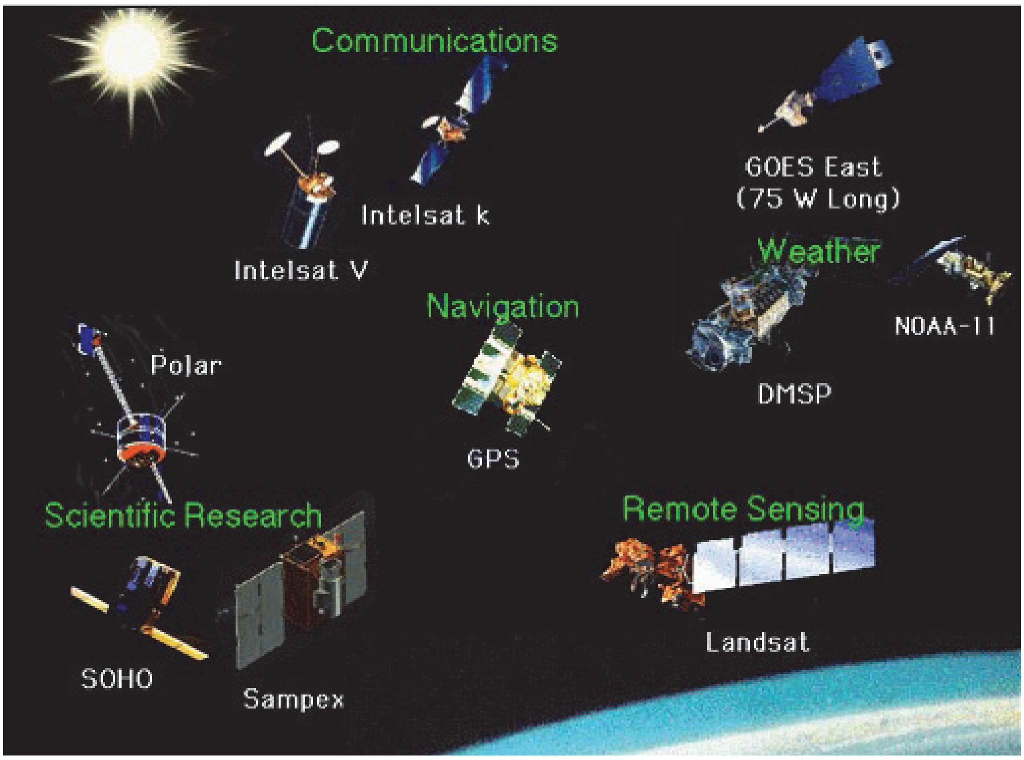


Figure 45: Types of satellites

Why Are Satellites Important?

The bird's-eye view that satellites have allows them to see large areas of Earth at one time. This ability means satellites can collect more data, more quickly, than instruments on the ground.

Satellites also can see into space better than telescopes at Earth's surface. That's because satellites fly above the clouds, dust and molecules in the atmosphere that can block the view from ground level.

Before satellites, TV signals didn't go very far. TV signals only travel in straight lines. So they would quickly trail off into space instead of following Earth's curve. Sometimes mountains or tall buildings would block them. Phone calls to faraway places were also a problem. Setting up telephone wires over long distances or underwater is difficult and costs a lot.

With satellites, TV signals and phone calls are sent upward to a satellite. Then, almost instantly, the satellite can send them back down to different locations on Earth.

What Are the Parts of a Satellite?

Satellites come in many shapes and sizes. But most have at least two parts in common - an antenna and a power source.

The antenna sends and receives information, often to and from Earth. The power source can be a solar panel or battery.

Solar panels make power by turning sunlight into electricity.

Many NASA satellites carry cameras and scientific sensors.

Sometimes these instruments point toward Earth to gather information about its land, air and water.

Other times they face toward space to collect data from the solar system and universe.

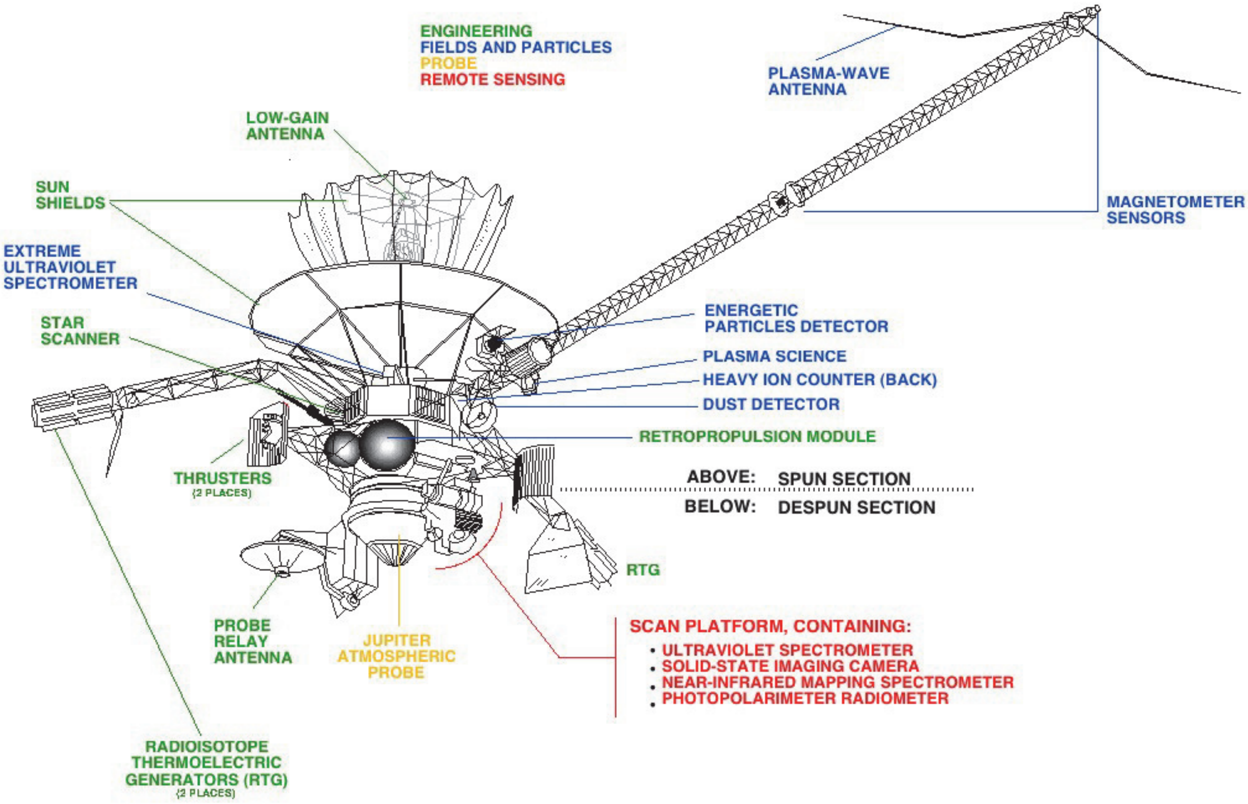


Figure 46: Satellite parts

How Do Satellites Orbit Earth?

Most satellites are launched into space on rockets. A satellite orbits Earth when its speed is balanced by the pull of Earth's gravity. Without this balance, the satellite would fly in a straight line off into space or fall back to Earth. Satellites orbit Earth at different heights, different speeds and along different paths. The two most common types of orbit are "geostationary" (jee-oh-STAY-shun-air-ee) and "polar."

A geostationary satellite travels from west to east over the equator. It moves in the same direction and at the same rate Earth is spinning. From Earth, a geostationary satellite looks like it is standing still since it is always above the same location.

Polar-orbiting satellites travel in a north-south direction from pole to pole. As Earth spins underneath, these satellites can scan the entire globe, one strip at a time.

Why Don't Satellites Crash Into Each Other?

Actually, they can. NASA and other U.S. and international organizations keep track of satellites in space.

Collisions are rare because when a satellite is launched, it is placed into an orbit designed to avoid other satellites.

But orbits can change over time. And the chances of a crash increase as more and more satellites are launched into space.

What Was the First Satellite in Space?

Sputnik 1 was the first satellite in space, the Soviet Union launched it in 1957.

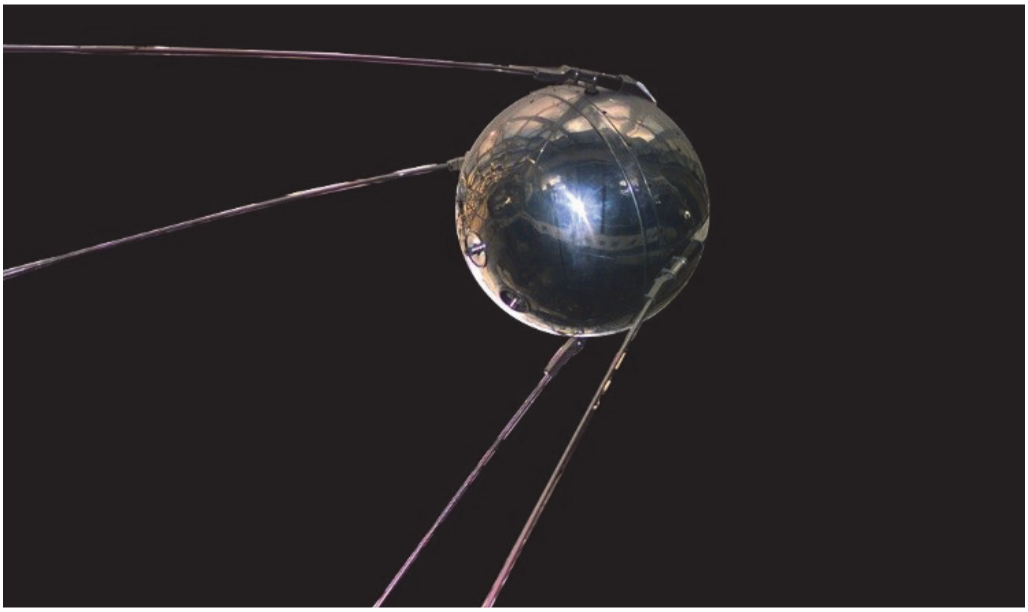


Figure 47: Sputnik1

What Is the History of NASA Satellites?

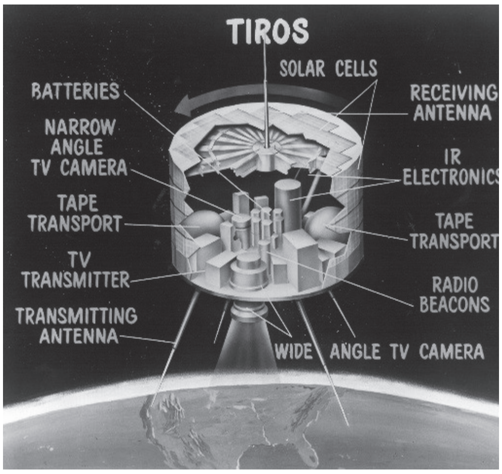
NASA has launched dozens of satellites into space, starting with the Explorer 1 satellite in 1958.

Explorer 1 was America's first man-made satellite.

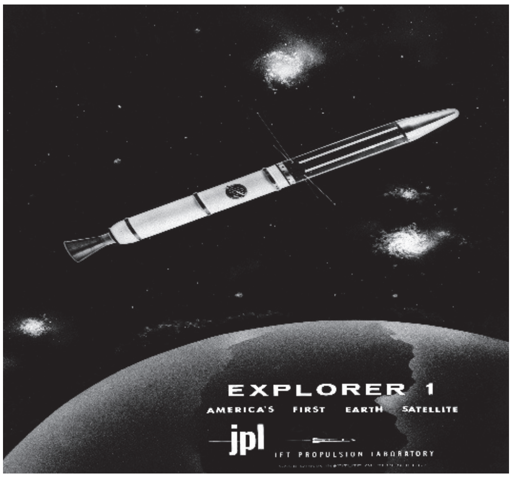
The main instrument aboard was a sensor that measured high-energy particles in space called cosmic rays.

The first satellite picture of Earth came from NASA's Explorer 6 in 1959. TIROS-1 followed in 1960 with the first TV picture of Earth from space. These pictures did not show much detail.

But they did show the potential satellites had to change how people view Earth and space.



TIROS



Explorer

The life span

The life span of satellites depends largely on their size , or to be precise , it depends on how much liquid fuel they carry aboard , the liquid fuel is used to operate small rocket engines, the rocket engines are very important for the satellite (there are three types of forces acting on the satellite in space causing the satellite to deviate from its course) , the ground station on earth uses these small rockets to perform maneuvers necessary to keep the satellite in the same position in the sky (usually they perform two maneuvers every two weeks, north-south maneuver & east-west maneuver) so we can direct our antenna's here at earth (parabolic reflectors or dish) to this specific point in space & receive the broadcasted TV & radio channels & also to send telecommands from the ground station on earth to control the satellite , otherwise we need a special type of antenna's (half a billion US$ each) to track & locate the satellite , the largest satellites out there are the communication satellites (tv,radio,telephony) & they use the geostationary orbit (about 36,000 km above sea level & above the equator) & i should note that the satellite orbit around the earth depends on the speed of the satellite , once the satellite is delivered to its orbit by the rocket it was carried on, the satellite will take that orbit speed, comm. sat. also have the longest life span (it's a round 20yrs these days), before the satellite runs out of fuel , the ground station performs one last maneuver to send the satellite to a place called (the satellite graveyard) , it's an orbit around the earth used to retire old useless satellites & they become junk on space , a growing problem, this is when in it come to satellites using the geostationary orbit , for satellites using lower orbits they may be put on re-entry course so they burn before they reach the earth.

Disposal

Like every other machine, satellites do not last forever. Whether their job is to observe weather, measure greenhouse gases in the atmosphere, or point away from Earth to study the stars, eventually all satellites grow old, wear out, and die, just like old washing machines and vacuum cleaners

So what happens when a trusty satellite's time has come? These days there are two choices, depending on how high the satellite is. For the closer satellites, engineers will use its last bit of fuel to slow it down. That way, it will fall out of orbit and burn up in the atmosphere.

The second choice is to send the satellite even farther away from Earth. It can take a lot of fuel for a satellite to slow down enough to fall back into the atmosphere. That is especially true if a satellite is in a very high orbit. For many of these high satellites, it takes less fuel to blast it further into space than to send it back to Earth.

14 NAVTEX

14.1 CROSS REFERENCE

DAMEN System Code	440
Drawings	
OEM documentation	

14.2 NAVIGATIONAL TELEX

Figure 48: NAVTEX unit

Navtex (Navigational Telex) is an international automated medium frequency direct-printing service for delivery of navigational and meteorological warnings and forecasts, as well as urgent maritime safety information to ships.

Navtex was developed to provide a low-cost, simple, and automated means of receiving this information aboard ships at sea within approximately 370 km (200 nautical miles) off shore.

Navtex broadcasts are primarily made on the medium frequencies of 518 kHz and 490 kHz. The international navtex frequency is 518 kHz, and these broadcasts should always be in English.

National transmission of navtex uses 490 kHz specifically for broadcasts in local languages. It is not used in the U.S.

Navtex Marine Safety Information (MSI) national transmissions also take place on HF at 4209.5 kHz using FEC mode.

FEC mode = Forward error correction mode

Navtex is a component of the International Maritime Organization/International Hydrographic Organization Worldwide Navigation Warning Service (WWNWS). Navtex is also a major element of the Global Maritime Distress Safety System (GMDSS). International Convention for the Safety of Life at Sea (SOLAS) mandated certain classes of vessels must carry Navtex, beginning August 1, 1993.

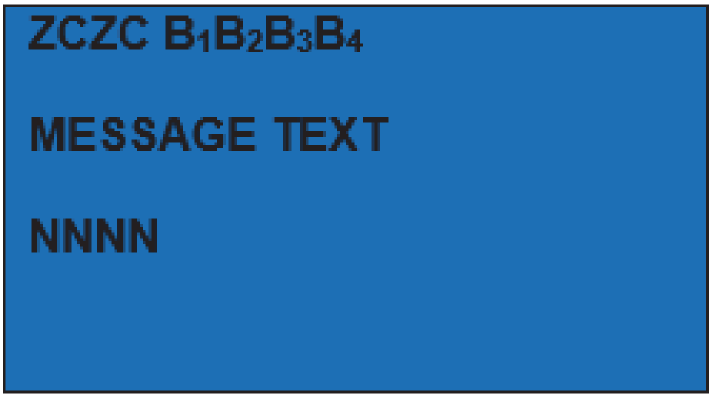


Figure 49: NAVTEX message transmission format

In the NAVTEX message transmission format:

- ZCZC indicates the start of the message.

- The B1 character is a letter (A-Z) identifying the transmitter coverage area - NAVTEX CRS identifier.

- The B2 character is a letter (A-Z) for each message type. This character is referred to as the subject indicator (explained in the following table).

- B3 and B4 constitute a two digit serial number for each message. Starting with 01, the sequence ends with serial number 99. This number is used by receivers to avoid printing messages previously received. The serial number 00 is reserved for messages of the highest priority, these are distress relay messages, and are always printed.

- MESSAGE TEXT begins with the NAVTEX CRS transmitter name and time of transmission.

- NNNN indicates the end of the message.

Note: the ERROR RATE, an indication of the radio signal reception property can also be added to the NAVTEX message. Usually it is added as text in the line before ZCZC indicator, for example (ERROR RATE = 3 %). It is usually not added if the error rate is 0%. Error rate of 0% means that there has been no error in the received message, with the signal strength being good. Otherwise error rate = number of erroneous characters (displayed/printed as "*") / total number of characters received * 100.

B_2 Subject Indicator	Subject
A	Navigational warnings (cannot be rejected by the receiver)
B	Meteorological warnings (cannot be rejected by the receiver)
C	Ice reports

B2 Subject Indicator	Subject
D	SAR (Search And Rescue) information and pirate attack warnings (cannot be rejected by the receiver)
E	Meteorological forecasts
F	Pilot service messages
G	AIS (Automatic Identification System)
H	LORAN (LOng RAnge Navigation system) messages
I	Available if required
J	SATNAV (Satellite Navigation Systems, for example United States Global Positioning System (GPS); USSR GLONASS system; Future (2008) EU GALILEO system) messages
K	Other electronic Navaid messages (messages concerning radio navigation services)
L	Navigational warnings - additional to letter Subject indicator A (should not be rejected by the receiver)
V	Special Services - allocation by the NAVTEX panel
W	Special Services - allocation by the NAVTEX panel
X	Special Services - allocation by the NAVTEX panel
Y	Special Services - allocation by the NAVTEX panel
Z	no message on hand

Table of international B2 Subject indicators

In some countries there are some variations to international B2 Subject indicators.

In the United Kingdom use:

L for Subfacts, Gunfacts and Oil Rig movements warnings (should not be rejected by the receiver) and

V for Amplifying Navigational warnings initially announced in letter A.

In the USA the following are also used:

V for Notice to Fishermen.

W for Environmental warnings.

ZCZC OA20 (ERROR RATE = 1 %)

WZ 1593
SCOTLAND, WEST COAST. SUMMER ISLES. The NORTH CARDINAL LIGHTBUOY AND THE WEST CARDINAL LIGHT*UOY WITH RACON DELTA MARKING DANGEROUS WRECK
58-01.2 NORTH 005-27.1 WEST HAVE BEEN PERMANENTLY WITHDRAWN
CANCEL WZ 1562
(OA07).

NNNN

Figure 50: NAVTEX Message example

The above NAVTEX message example was sent by Portpatrick CRS (OA20) as navigational warning (OA20) with message number 20 (OA20). The message has an error rate of 1%, that is, the word LIGHTBUOY in the message "*" was printed instead of the letter B.

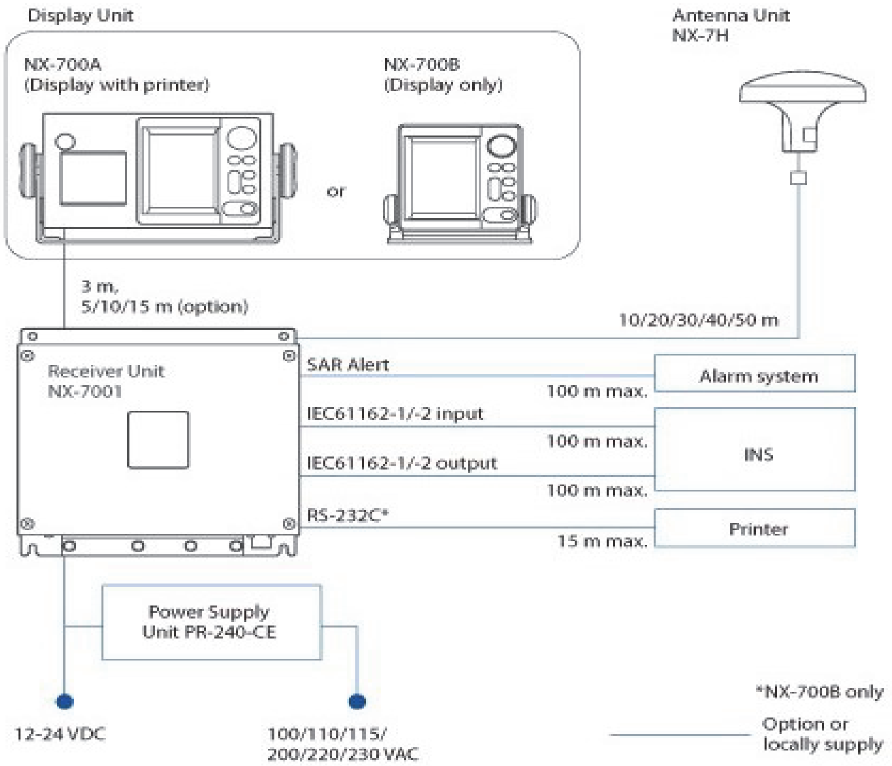


Figure 51: NAVTEX diagram

15 GMDSS

15.1 CROSS REFERENCE

DAMEN System Code	440
Drawings	
OEM documentation	

15.2 GLOBAL MARITIME DISTRESS AND SAFETY SYSTEM

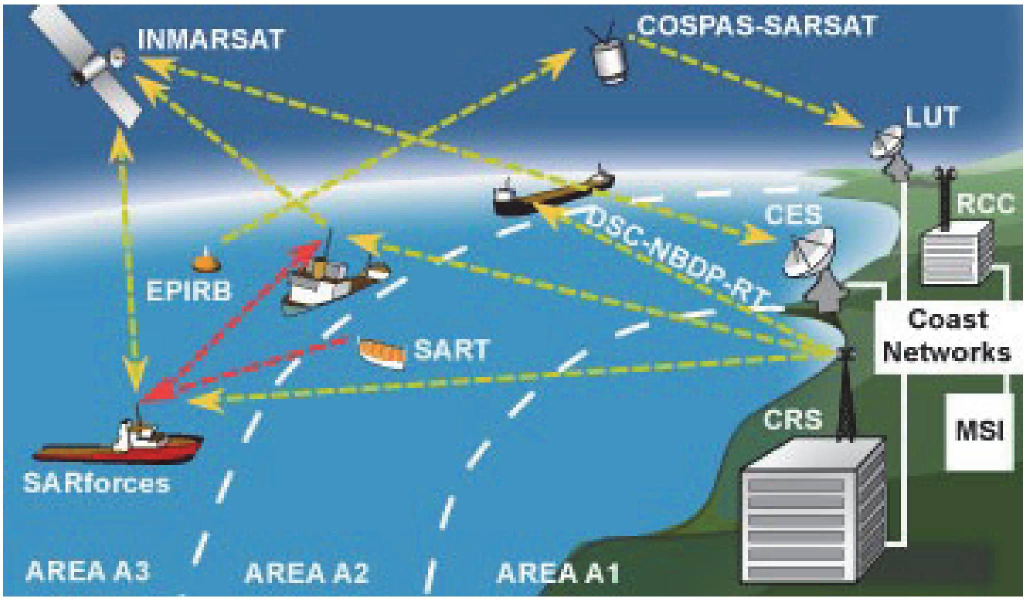


Figure 52: GMDSS network layout

History

The full implementation of the GMDSS on 1 February 1999 was an important date in maritime history, coming almost exactly 100 years after the first use of wireless technology to aid a ship in distress.

Italian engineer Guglielmo Marconi invented radio in 1895 and the first use of wireless in communicating the need for assistance came on 3 March of 1899 when a freighter rammed the East Goodwin Lightship which was anchored ten miles offshore from Deal in the Straits of Dover off the south east coast of England. A distress call was transmitted by wireless to a shore station at South Foreland and help was dispatched.

It was soon clear how valuable wireless would be in saving lives at sea. But wireless had its limitations, notably in terms of the distance that could be covered.

In the 1960s, IMO recognized that satellites would play an important role in search and rescue operations at sea and in 1976 the Organization established the International Maritime Satellite Organization, which later changed its name to the International Mobile Satellite Organization (Inmarsat) to provide emergency maritime communications. In 1988, IMO's Member States adopted the basic requirements of the global maritime distress and safety system or GMDSS as part of SOLAS, and the system was phased in from 1992 onwards.

Today, the GMDSS is an integrated communications system which should ensure that no ship in distress can disappear without trace, and that more lives can be saved at sea. Under the GMDSS requirements, all ships are required to be equipped with satellite emergency position-indicating radio beacons (EPIRBs) and NAVTEX receivers, to automatically receive shipping safety information.

The GMDSS communications system under SOLAS complements the International Convention on Maritime Search and Rescue (SAR), 1979, which was adopted to develop a Global SAR plan, so that no matter where an incident occurs, the rescue of persons in distress will be coordinated by a SAR organization and, where necessary, by co-ordination between neighboring SAR countries.

With the completion of the SAR plans and the full implementation of the GMDSS, seafarers and ships' passengers should feel safer and more secure at sea.

Figure 53: GMDSS equipment

GMDSS sea areas

GMDSS sea areas serve two purposes: to describe areas where GMDSS services are available, and to define what radio equipment GMDSS ships must carry (carriage requirements). Prior to the GMDSS, the number and type of radio safety equipment ships had to carry depended upon its tonnage. With GMDSS, the number and type of radio safety equipment ships have to carry depends upon the GMDSS areas in which they travel. GMDSS sea areas are classified in four areas: A1, A2, A3 and A4.

In addition to equipment listed below, all GMDSS-regulated ships must carry a satellite EPIRB, a NAVTEX receiver (if they travel in any areas served by NAVTEX), an Inmarsat-C SafetyNET receiver (if they travel in any areas not served by NAVTEX), a DSC-equipped VHF radiotelephone, two (if between 300 and less than 500 GRT) or three VHF handhelds (if 500 GRT or more), and two 9 GHz search and rescue radar transponders (SART).

The nine fundamentals.

- transmitting ship-to-shore distress alerts (by at least two separate and independent methods);

- receiving shore-to-ship distress alerts;
- transmitting and receiving ship-to-ship distress alerts;
- transmitting and receiving search and rescue coordinating communications;
- transmitting and receiving on-scene communications;
- transmitting and receiving signals for locating;
- transmitting and receiving maritime safety information;
- transmitting and receiving general communications; and
- transmitting and receiving bridge-to-bridge communications.

- Sea Area A1: the area within the radiotelephone coverage of at least one VHF coast station in which continuous DSC (Digital Selective Calling) alerting is available;
- Sea Area A2: the area, excluding Sea Area A1, within the radiotelephone coverage of at least one MF coast station in which continuous DSC (Digital Selective Calling) alerting is available;
- Sea Area A3: the area, excluding Sea Areas A1 and A2, within the coverage of an Inmarsat geostationary satellite in which continuous alerting is available; and
- Sea Area A4: an area outside sea areas A1, A2 and A3.

16 BNWAS

16.1 CROSS REFERENCE

DAMEN System Code	440
Drawings	
OEM documentation	

16.2 BRIDGE NAVIGATIONAL WATCH ALARM SYSTEM

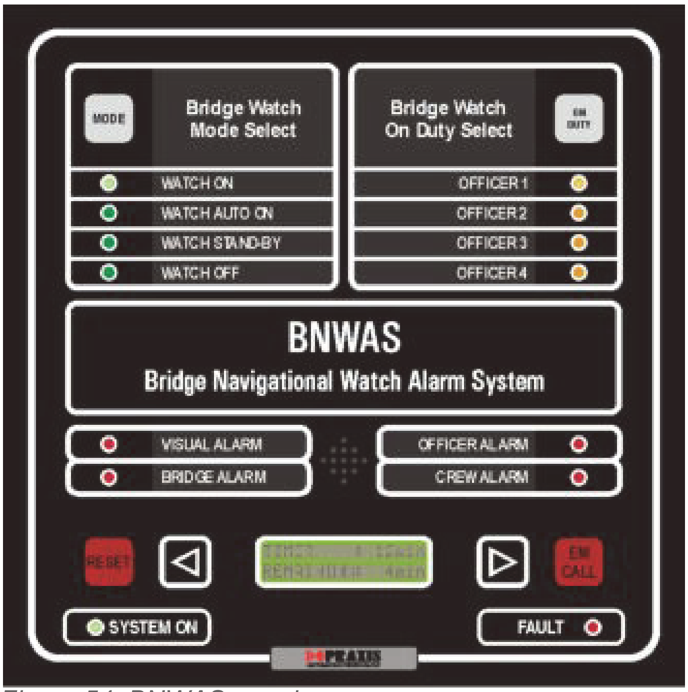


Figure 54: BNWAS panel

A **Bridge Navigational Watch Alarm System**, abbreviated BNWAS, is an automatic system which sounds an alarm if the watch officer on the bridge of a ship falls asleep, becomes otherwise incapacitated, or is absent for too long a time. The BNWAS is automatically engaged when the ship's autopilot is activated.

The minimum requirement for a BNWAS under International Maritime Organization standards is to have a dormant stage and three alarm stages, except that on a non-passenger vessel, the second stage may be omitted.

Stage 1: When the autopilot is engaged, the bridge officer is required to signal his presence to the BNWAS system every 3 to 12 minutes in response to a flashing light, either by moving an arm in front of a motion sensor, pressing a confirmation button, or directly applying pressure to the BNWAS center.

Stage 2: When a confirmation signal fails to occur within 15 seconds in Stage 1, an alarm will sound on the bridge, and if there is still no confirmation signal after a further 15 seconds, in the captain's and the first officer's cabins. One of them must then go to the bridge and cancel the alarm.

Stage 3: If neither the captain nor the first officer cancels the alarm within a specified time period (between 90 seconds and 3 minutes depending on the size of the vessel), an alarm will sound in locations where other personnel are usually available.

In addition an emergency call function may be provided, by which bridge personnel can activate a Stage 2 or Stage 3 alarm to call for help.

IMO requirements under the SOLAS resulting from an amendment of June 5, 2009, come into force on the following dates for ships classified by size:

July 2011: new vessels in excess of 150 tonnes

July 2011: all passenger vessels

July 2012: all vessels in excess of 3,000 tonnes

July 2013: all vessels between 500 and 3,000 tonnes

July 2014: all vessels between 150 and 500 tonnes

Specific nations have added further regulations. For example, vessels of the Norwegian coastal fishery are required to activate a speed sensor connected to the vessel's motor or GPS.

Wired and wireless versions are available.

17 EPIRB

17.1 CROSS REFERENCE

DAMEN System Code	440
Drawings	
OEM documentation	

17.2 EMERGENCY POSITIONING INDICATION AND RADIO BEACON

Figure 55: EPIRB units

EPIRBs are tracking transmitters which aid in the detection and location of boats, aircraft, and people in distress. A PLB (personal locator beacon) is particular type of EPIRB that is typically smaller, has a shorter battery life and unlike a proper EPIRB is registered to a person rather than a vessel. The terms ELB (emergency locator beacon) and ELT (emergency locator transmitter) are used interchangeably with EPIRB only when used on aircraft. Strictly, they are radio beacons many of which interface with worldwide offered service of Cospas-Sarsat, the international satellite system for search and rescue (SAR). Transmitters broadcasting on 406 MHz are recognized. When manually activated, or automatically activated upon immersion or impact, such beacons send out a distress signal. The signals are monitored worldwide and the location of the distress is detected by non-geostationary satellites using the Doppler effect for trilateration, and in more recent EPIRBs also by GPS.

COSPAS-SARSAT
User Segment

Activation:

- Manual
- Automatic (Hydrostatic/G-Switch)
- Signal:
- 406 MHz (Digital)
- 121.5 MHz (Analog) Homing
- Applications:
- Maritime - Emergency Position-Indicating Radio Beacon (EPIRB)
- Aviation - Emergency Locator Transmitter (ELT)
- Personal/Land - Personal Locator Beacon (PLB)
- Security – Ship Security Alerting System (SSAS)
- * Most U.S. general aviation ELTs are still 121.5 MHz which are no longer monitored by Cospas-Sarsat

Figure 56: COSPAS-SARSAT User Segment

A transmission usually gets processed as follows:

1: The transmitter is activated, either automatically in a crash or after sinking, or manually by survivors of an emergency situation.

2: At least one satellite picks up the beacon's transmission.

3: The satellites transfer the beacon's signal to their respective ground control stations.

4: The ground stations process the signals and forward the data, including approximate location, to a national authority.

5: The national authority forwards the data to a rescue authority

6: The rescue authority uses its own receiving equipment afterwards to locate the beacon and commence its own rescue or recovery operations.

Once the satellite data is received, it takes less than a minute to forward it to any signatory nation.

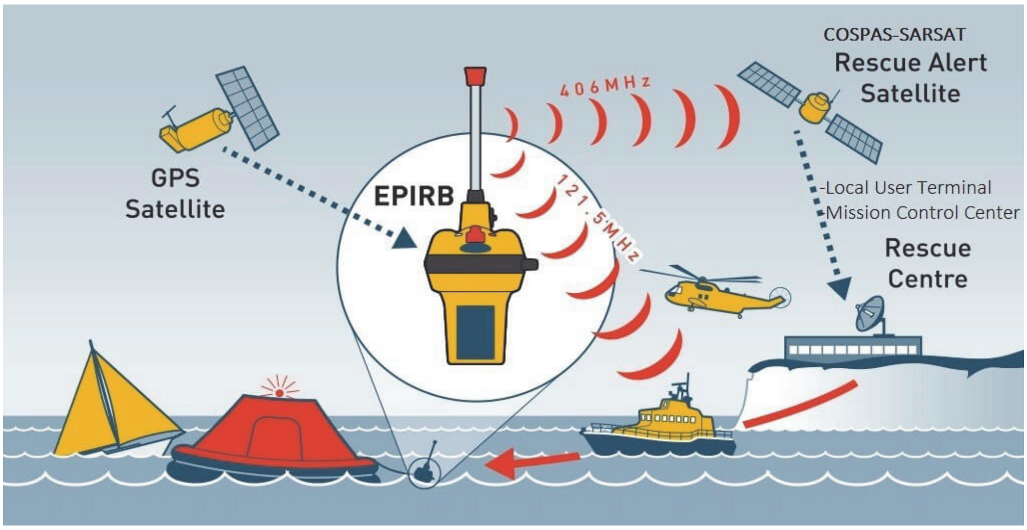


Figure 57: EPIRB Diagram

Because of a large number of false alerts, and the inability to uniquely identify such beacons because of their old, analogue technology, the Cospas-Sarsat system beginning in 2009 stopped receiving alerts from beacons operating at 121.5 MHz and 243.0 MHz, and now only receives and processes alerts from modern, digital 406-MHz beacons. Many ELTs include both a 406-MHz transmitter for satellite detection and a 121.5 MHz transmitter that can be received by local search crews using direction-finding equipment.

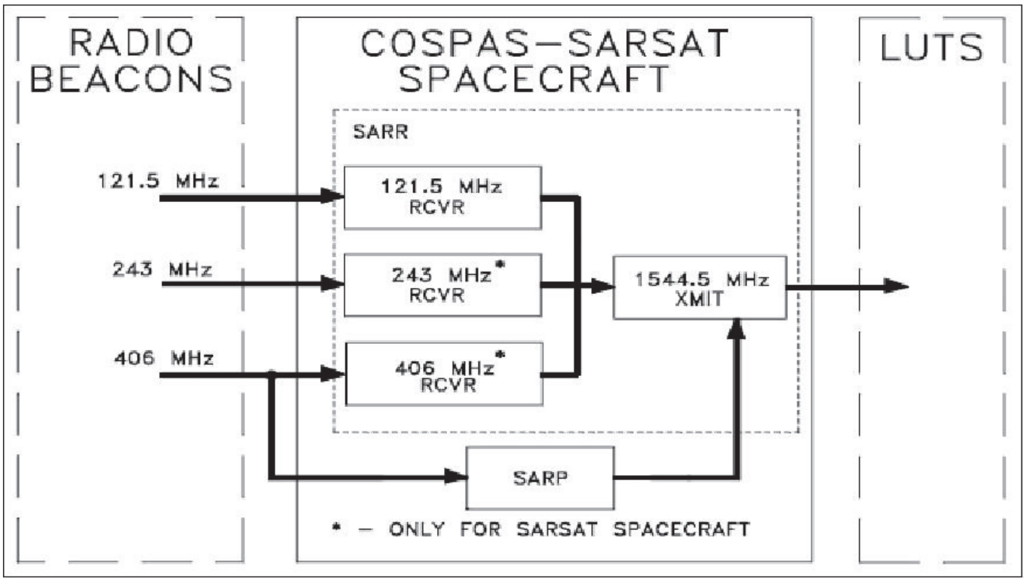


Figure 58: COSPAS Frequencies

The design of distress beacons as a whole has evolved significantly since 1982. The newest 406-MHz beacons incorporate GPS receivers. Such beacons transmit in their distress message highly accurate position reports. The distress alert and location are forwarded almost instantly to SAR agencies via Cospas-Sarsat satellites. This provides a second method for Cospas-Sarsat to know the location of the distress, in addition to the calculations independently done by Cospas-Sarsat LUTs to determine the location. This two-tiered reliability and global coverage of the system has inspired the current motto of SAR agencies: "Taking the 'Search' out of Search and Rescue." Technical specifications for the next generation of beacon technology are now being finalized, which will further increase reliability, precision and vital data sent to SAR agencies.

COSPAS is an acronym for the Russian words "Cosmicheskaya Sistema Poiska Avariynyh Sudov", which translates to "Space System for the Search of Vessels in Distress". SARSAT is an acronym for Search And Rescue Satellite-Aided Tracking.

18 ALDIS LIGHT

18.1 CROSS REFERENCE

DAMEN System Code	440
Drawings	
OEM documentation	

18.2 HAND SIGNAL LIGHT

Figure 59: Signal lamp with storage bag

A signal lamp (sometimes called an Aldis lamp, after Arthur Cyril Webb Aldis who invented a widely used design, or a Morse lamp) is a visual signaling device for optical communication, typically using Morse code.

Modern signal lamps are focused lamps which can produce a pulse of light. In large versions, this pulse is achieved by opening and closing shutters mounted in front of the lamp, either via a manually operated pressure switch or, in later versions, automatically.

With hand held lamps, a concave mirror is tilted by a trigger to focus the light into pulses. The lamps were usually equipped with some form of optical sight, and were most commonly used on naval vessels and in airport control towers (using color signals for stop or clearance).

18.3 THE SEMAPHORE ALPHABET

This alphabet was used for signaling, this was used mostly as a communication means in the maritime industry. In pirate movies it is still used.

Through the upcoming of the radio equipment, the use for semaphore signaling is reduced until a minimum.

This way of signaling is still used in the navy and in merchant navy is used just in case of emergency.

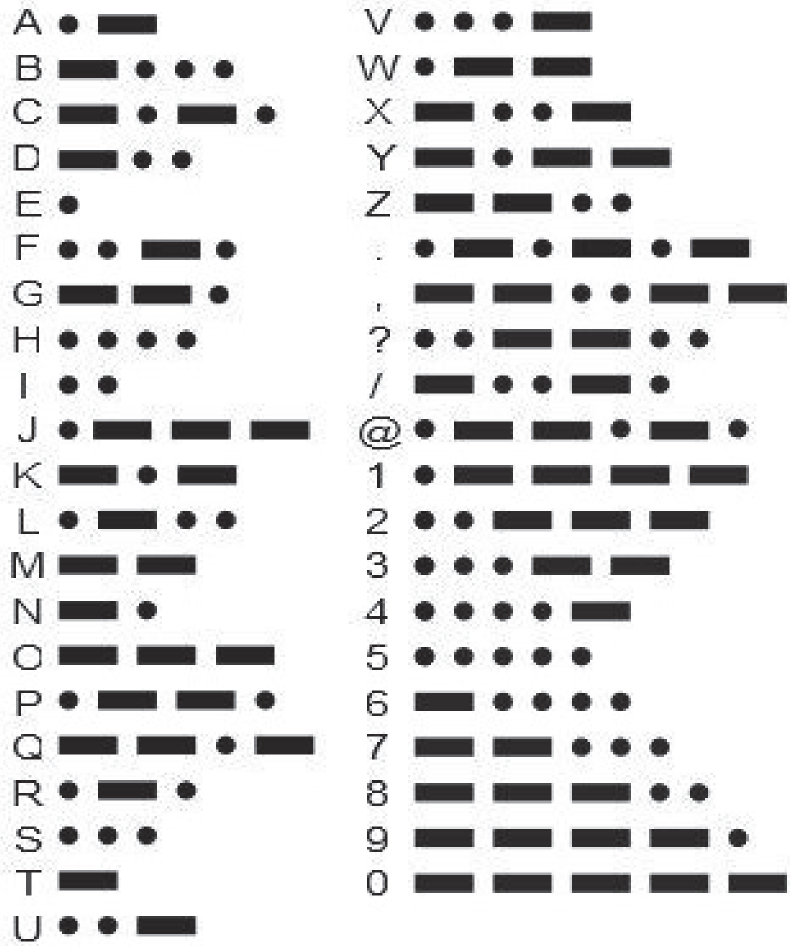


Figure 60: International Morse Code

- 1 dash = 3 dots
- The space between parts of the same letter = 1 dot
- The space between letters = 3 dots
- The space between words = 7 dots

Subject: Daylight signaling lamp - Important PSC Issue!

Case: It has been noticed, during our visits onboard vessels of 150 gross tonnage and upwards, constructed after the 1st of July 2002, that the fitted ALDIS lamp is not fully in compliance with the SOLAS requirements, Chapter V, regulation 19.

Analysis

In connection to the above, and in order to assist our clients to prevent complications during third parties visits, we would like to remind that according to SOLAS Reg.19, Chapter V, §1.1 & §2.2:

1.1 Ships constructed on or after 1 July 2002 shall be fitted with navigational systems and equipment which will fulfill the requirements prescribed in paragraphs 2.1 to 2.9

2.2 All ships of 150 gross tonnage and upwards and passenger ships irrespective of size shall, in addition to the requirements of paragraph 2.1, be fitted with:

.2 a daylight signaling lamp, or other means, to communicate by light during day and night using an energy source of electrical power not solely dependent upon the ship's power supply.

Furthermore according to recommendations enclosed in the Resolution MSC. 95(72) adopted on May 2000, §7.3:

7.3.1 Daylight signaling lamps should be solely dependent upon the ship's main or emergency sources of electrical energy.

7.3.2 Daylight signaling lamps should be provided with a portable battery with a complete weight of no more than 7, 5 kg

7.3.3 The portable battery should have sufficient capacity to operate the daylight signaling lamp for a period of not less than 2h.

Clients are encouraged to clarify whether the daylight signaling lamp on board their fleet is in compliance with the aforementioned recommendations and for further clarification should contact their Classification Society. In addition, it should be noted that the ALDIS lamp is part of the vessel's Record of Equipment for the ship Safety Equipment.

19 SART

19.1 CROSS REFERENCE

DAMEN System Code	440
Drawings	
OEM documentation	

19.2 SEARCH AND RESCUE TRANSPONDER

Figure 61: SART

A search and rescue transponder (SART) is a self-contained, waterproof transponder intended for emergency use at sea.

These devices may be either a radar-SART, or a GPS-based AIS-SART (automatic identification system SART).

The radar-SART is used to locate a survival craft or distressed vessel by creating a series of dots on a rescuing ship's radar display. A SART will only respond to a 9 GHz X-band (3 cm wavelength) radar.

It will not be seen on S-band (10 cm) or other radar. Shipboard Global Maritime Distress Safety System (GMDSS) include one or more search and rescue locating devices.

From Left to Right; the radar detection of a SART, arcs when close to SART, concentric circles when SART is radar visible.

Figure 62: Radar detection of a SART

The radar-SART may be triggered by any X-band radar within a range of approximately 8 nautical miles (15 kilometers). Each radar pulse received causes the SART to transmit a response which is swept repetitively across the complete radar frequency band. When interrogated, it first sweeps rapidly (0.4 microsecond) through the band before beginning a relatively slow sweep (7.5 microseconds) through the band back to the starting frequency. This process is repeated for a total of twelve complete cycles. At some point in each sweep, the radar-SART frequency will match that of the interrogating radar and be within the pass band of the radar receiver. If the radar-SART is within range, the frequency match during each of the 12 slow sweeps will produce a response on the radar display, thus a line of 12 dots equally spaced by about 0.64 nautical mile (1.2 km) will be shown.

When the range to the radar-SART is reduced to about 1 nautical mile (2 km), the radar display may show also the 12 responses generated during the fast sweeps. These additional dot responses, which also are equally spaced by 0.64 nautical mile (1.2 km), will be interspersed with the original line of 12 dots. They will appear stronger and larger the closer the interrogating radar gets, slowly becoming arcs at first until the SART is within 1NM, the arcs will become full circles indicating the active SART is in the general area.

SARTs are typically cylindrical, about the size of a person's forearm, and brightly coloured.

SART's are triggered by 9GHz radars from different sources

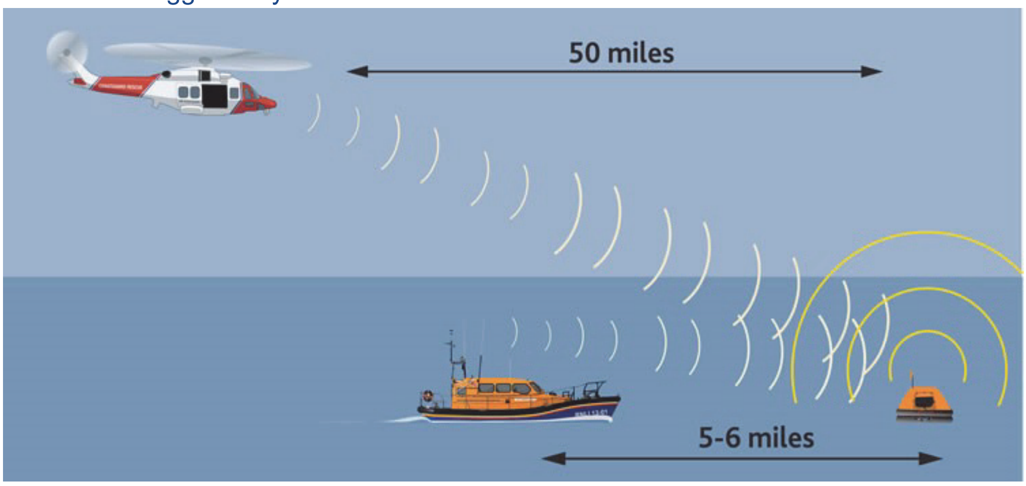


Figure 63: SART visibility

20 SHIPS BELL

20.1 CROSS REFERENCE

DAMEN System Code	440
Drawings	
OEM documentation	

20.2 SHIP'S BELL

Figure 64: Bell

Regulation according COLREGs 1972: Convention on the International Regulation for preventing collisions at sea, 1972:

- When is a ships bell needed on board. (Rule 33 COLREGs) (BVA)
- A vessel of 12 meters or more in length shall be provided with a whistle, a vessel of 20 meters or more in length
- Shall be provided with a bell in addition to a whistle, and a vessel of 100 meters or more in length shall, in addition, be
- Provided with a gong, the tone and sound of which cannot be confused with that of the bell. The whistle, bell and gong
- Shall comply with the specification in Annex III to these regulations. The bell or gong or both may be replaced by other
- Equipment having the same respective sound characteristics, provided that manual sounding of the required signals
- Shall always be possible.

Ships bell can be used for diverse things.

- Watch signals 8 times 30 minutes end of watch.
- Signaling during anchoring.
- Ship's bells are also used for safety in foggy conditions, their most important modern use.

- On naval vessels, bells additionally are rung as "boat gongs" for officers and dignitaries coming aboard or leaving the ship, in a number equivalent to the number of sidebuoys to which the visitor is entitled.
- At midnight on New Year's Eve, 16 bells would be struck - eight bells for the old year and eight bells for the new.
- When a sailor has died he or she can be honoured with the sounding of eight bells; meaning "end of the watch". The term "eight bells" can also be used in an obituary, as a nautical euphemism for finished.

Name of the ship

The ship's name is traditionally engraved or cast onto the surface of the bell, often with the year the ship was launched, as well.

Occasionally (especially on more modern ships) the bell will also carry the name of the shipyard that built the ship.

If a ship's name is changed, maritime tradition is that the original bell carrying the original name will remain with the vessel.

A ship's bell is a prized possession when a ship is broken up and often provides the only positive means of identification in the case of a shipwreck.

Number of bells	Bell patern	Watch						
		Middle	Morning	Fore noon	After noon	Dog		First
						First	Last	
One bell	1	0:30	4:30	8:30	12:30	16:30	18:30	20:30
Two bells	2	1:00	5:00	9:00	13:00	17:00	19:00	21:00
Three bells	2 1	1:30	5:30	9:30	13:30	17:30	19:30	21:30
Four bells	2 2	2:00	6:00	10:00	14:00	18:00		22:00
Five bells	2 2 1	2:30	6:30	10:30	14:30		18:30	22:30
Six bells	2 2 2	3:00	7:00	11:00	15:00		19:00	23:00
Seven bells	2 2 2 1	3:30	7:30	11:30	15:30		19:30	23:30
Eight bells	2 2 2 2	4:00	8:00	12:00	16:00		20:00	0:00

Classical system

Most of the crew of a ship would be divided into two to four groups, called watches. Each watch would take its turn with the essential activities of manning the helm, navigating, trimming sails, and keeping a lookout.

The hours between 16:00 and 20:00 are so arranged because that watch (the "dog watch") was divided in two.

The odd number of watches aimed to give each man a different watch each day; it also allowed the entire crew of a vessel to eat an evening meal, the normal time being at 17:00 with first dog watchmen eating at 18:00.

21 PYRO TECHNICS

21.1 CROSS REFERENCE

DAMEN System Code	440
Drawings	
OEM documentation	

21.2 PYRO TECHNICS

Figure 65: Overview

Pyrotechnics is the science of using materials capable of undergoing self-contained and self-sustained exothermic chemical reactions for the production of heat, light, gas, smoke and/or sound. Its etymology stems from the Greek words pyro ("fire") and tekhnikos ("made by art"). Pyrotechnics include not only the manufacture of fireworks but items such as safety matches, oxygen candles, explosive bolts and fasteners, components of the automotive airbag and gas pressure blasting in mining, quarrying and demolition.

Figure 66: Red hand flare

Unique, compact, telescopic handle allows easy extension for safe operation and saves space in stowage. Red hand-held, short range distress signal. Used to pinpoint location by day or night. Burns for 60 seconds at 15,000 candela. Features a unique telescopic handle making it very compact and space saving when stowed in a life raft. Easily extended and pull wire operated.

Typically 6 hand flares are required to be fitted in SOLAS/ commercial life rafts and life boats.

Figure 67: White hand flare

Designed for use as a collision warning signal or for illuminating small areas where an intense white light is required. Features a unique telescopic handle. For use in day and night short range collision warning situations and for illuminating small areas. Fully extend handle, remove white end cap, pull toggle sharply away from body. Hold above head, outboard and downwind. Store on board in our Mini or Large Polybottles

Figure 68: Lifesmoke

Compact, flat-top day-time orange smoke distress signal providing effective position marking or indication of wind direction during rescue operations.

The Lifesmoke pot is a compact, flat top, day time distress signal designed to be easy and safe to handle. It provides effective position marking during rescue operations and can be used to indicate wind direction, producing dense orange smoke for a minimum of 3 minutes.

Safe to use on oil or petrol covered water. Conforming to SOLAS 74/88 as amended . Two signals are required to be carried in SOLAS liferafts and lifeboats. Two are supplied in RORC and Offshore leisure kits.

Figure 69: Red Parachute Rocket

Para Red Rocket conforms to SOLAS 74/88. A long range distress signal.

The Para Red Rocket conforms to SOLAS 74/88 as amended. Designed to withstand exceptional environmental exposure and to perform reliably even after immersion in water, the pull wire ignitor and improved grip provides easy handling. Ejecting a red flare on a parachute at 300m (1000ft), burning for 40 seconds at 30,000 candela.

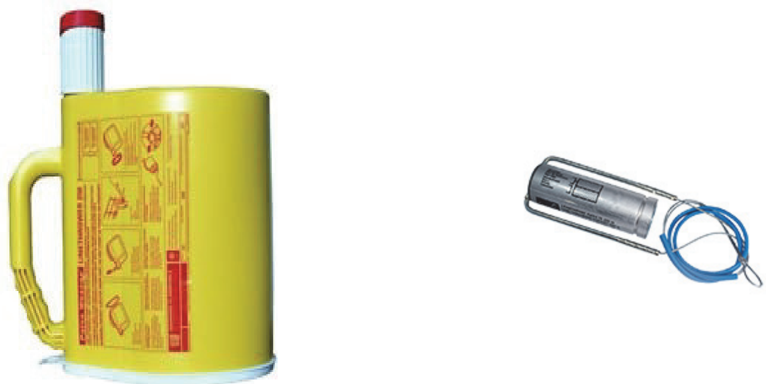


Figure 70: Line thrower and insert

Self-contained line throwing appliance. Plastic launcher with 250m of 4mm dia. line. Needs to be fitted with 50080 rocket prior to use. Typically 4 units required to be carried on SOLAS vessels. Replace container along with every third set of rockets i.e. after 9 years. Non-hazardous for transport without rocket fitted. With 50080 rocket fitted, the appliance is used to pass a line 250m to another ship or ship to shore or to aid a swimmer in distress. Instructions are printed on the side of the container

Figure 71: MOB smoke + Light

The Man-overboard Compact Lifebuoy Marker is normally mounted on a ship's bridge wing attached to a 4 kg lifebuoy. It is automatically or manually deployed to mark the position of a person in the water by day or night. Featuring a self-activated LED lighting system which exceeds SOLAS requirements for 2 candela light output and 2 hours duration, plus providing 15 minutes of dense orange smoke. Ships are required to fit at least two markers

Figure 72: Flare container

12 Litre Polybottle - water resistant storage bottle for flares

Ideally flares should be kept in a dry accessible position preferably in a custom built polybottle.

WIDTH 100 mm

HEIGHT 300 mm

WEIGHT 1.4 kg

Figure 73: Signal pistol

The signal pistol is pre-used and re-conditioned. It is classified as a firearm and can only be purchased through authorised channels on presentation of a valid firearms licence. Handling and transport must be carried out in accordance with the local firearms regulations and the terms of the licence.

22 LIFE SAVING EQUIPMENT

22.1 CROSS REFERENCE

DAMEN System Code	440
Drawings	
OEM documentation	

22.2 LIFE SAVING EQUIPMENT

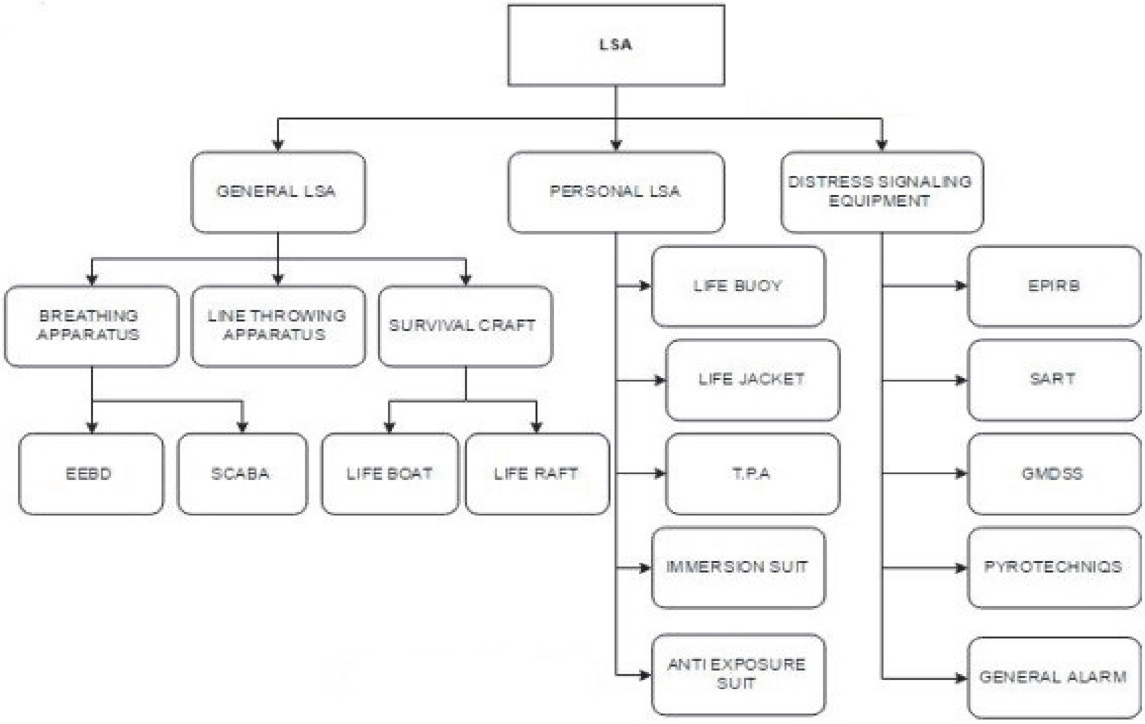


Figure 74: Life Saving Equipment

The International Convention for the Safety of Life at Sea (SOLAS) is an international maritime treaty which requires Signatory flag states to ensure that ships flagged by them comply with minimum safety standards in construction, equipment and operation. The current version of the SOLAS Convention is the 1974 version, known as SOLAS 1974, which came into force on 25 May 1980. As of March 2016, SOLAS 1974 has 162 contracting States, which flag about 99% of merchant ships around the world in terms of gross tonnage.

The SOLAS Convention in its successive forms is generally regarded as the most important of all international treaties concerning the safety of merchant ships.

22.3 HISTORY

The first life saving organisation, the Royal National Institution for the Preservation of Life from Shipwreck, was established in England in 1824 by Sir William Hillary. While living on the Isle of Man in 1808, he became aware of the treacherous nature of the Irish Sea, with many ships being wrecked around the Manx coast. He soon drew up plans for a national lifeboat service manned by trained crews, but received little response from the Admiralty.

However, on appealing to the more philanthropic members of London society, the plans were adopted and, with the help of two Members of Parliament (Thomas Wilson and George Hibbert), the National Institution for the Preservation of Life from Shipwreck was founded in 1824.

One of the Institution's first rescues was of the packet St George, which had foundered on Conister Rock at the entrance to Douglas Harbour. Sir Hillary took part in the successful operation and everyone was ultimately rescued. Thirty years later the Institution's title was changed to the Royal National Lifeboat Institution and the first of the new lifeboats to be built was stationed at Douglas in recognition of Hillary's work.

The first version of SOLAS was passed in 1914 in response to the sinking of the RMS Titanic. It prescribed numbers of lifeboats and other emergency equipment along with safety procedures, including continuous radio watches. The 1914 treaty never entered into force due to the outbreak of the First World War.

Further versions were adopted in 1929 and 1948.

23 BATTERIES

23.1 CROSS REFERENCE

DAMEN System Code	440
Drawings	
OEM documentation	

23.2 BATTERY

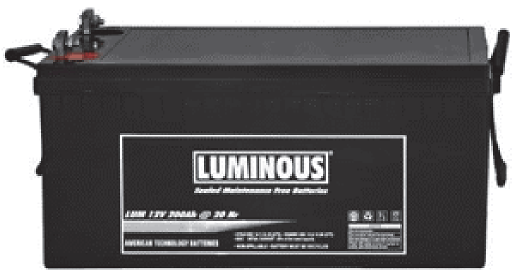


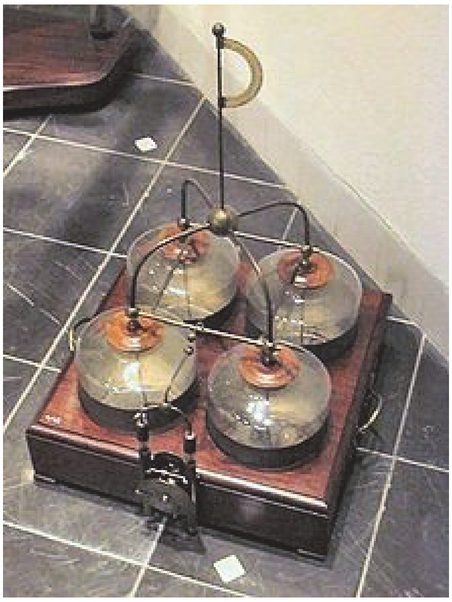
Figure 75: battery

An electric battery is a device consisting of one or more electrochemical cells with external connections provided to power electrical devices such as flashlights, smartphones, and electric cars. When a battery is supplying electric power, its positive terminal is the cathode and its negative terminal is the anode.

Figure 76: Electric symbol

The terminal marked negative is the source of electrons that when connected to an external circuit will flow and deliver energy to an external device. When a battery is connected to an external circuit, electrolytes are able to move as ions within, allowing the chemical reactions to be completed at the separate terminals and so deliver energy to the external circuit. It is the movement of those ions within the battery which allows current to flow out of the battery to perform work.

Historically the term battery specifically referred to a device composed of multiple cells, however the usage has evolved additionally to include devices composed of a single cell



A battery of linked glass capacitors

A voltaic pile, the first chemical battery

In 1749 Benjamin Franklin, the U.S. polymath and founding father, first used the term battery to describe a set of linked capacitors he used for his experiments with electricity. These capacitors were panels of glass coated with metal on each surface. These capacitors were charged with a static generator and discharged by touching metal to their electrode. Linking them together in a battery gave a stronger discharge. Originally having the generic meaning of a group of two or more similar objects functioning together, as in an artillery battery, the term came to be used for voltaic piles and similar devices in which many electrochemical cells were connected together in the manner of Franklin's capacitors. Today even a single electrochemical cell, e.g. a dry cell, is commonly called a battery

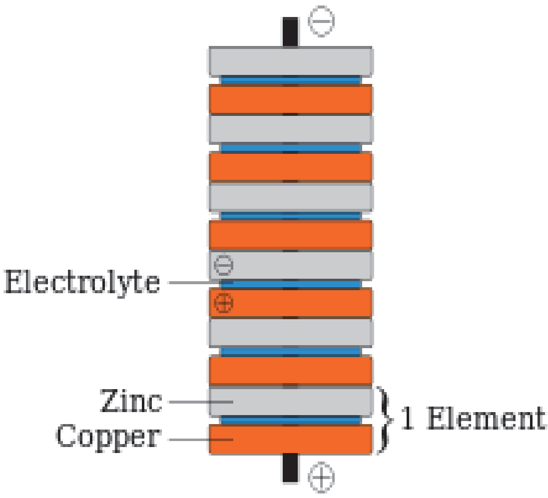


Figure 77: Construction of a battery

Another problem with Volta's batteries was short battery life (an hour's worth at best), which was caused by two phenomena. The first was that the current produced electrolyzed the electrolyte solution, resulting in a film of hydrogen bubbles forming on the copper, which steadily increased the internal resistance of the battery (this effect, called polarization, is counteracted in modern cells by additional measures). The other was a phenomenon called local action, wherein minute short-circuits would form around impurities in the zinc, causing the zinc to degrade. The latter problem was solved in 1835 by William Sturgeon, who found that amalgamated zinc, whose surface had been treated with some mercury, didn't suffer from local action.

Despite its flaws, Volta's batteries provided a steadier current than Leyden jars, and made possible many new experiments and discoveries, such as the first electrolysis of water by Anthony Carlisle and William Nicholson.

Types of batteries:

Primary cells or non-rechargeable batteries	**Secondary cells or rechargeable batteries**	**Batteries by application**
• Alkaline battery (zinc manganese oxide, carbon)	• Aluminium-ion battery	• Automotive battery
• Aluminium-air battery	• Flow battery - Vanadium redox battery - Zinc-bromine battery - Zinc-cerium battery	• Backup battery
• Atomic battery - Betavoltaics - Optoelectric nuclear battery - Nuclear micro-battery	• Lead-acid battery - Deep cycle battery - VRLA battery - AGM battery - Gel battery	• Battery (vacuum tube)
• Bunsen cell	• Glass battery	• Battery pack
• Chromic acid cell (Poggendorff Cell)	• Lithium air battery	• Battery room
• Dark cell	• Lithium-ion battery - Lithium ion lithium cobalt oxide battery (ICR) - Lithium ion manganese oxide battery (IMR) - Lithium ion polymer battery - Lithium iron phosphate battery - Lithium-sulfur battery - Lithium-titanate battery - Thin film lithium-ion battery	• Biobattery
• Daniell cell	• Magnesium-ion battery	• Button cell

Primary cells or non-rechargeable batteries	Secondary cells or rechargeable batteries	Batteries by application
• Dry cell	• Molten salt battery	• CMOS battery
• Earth battery	• Nickel-cadmium battery - Nickel-cadmium battery vented cell type	• Common battery
• Frog battery	• Nickel hydrogen battery	• Commodity cell
• Galvanic cell	• Nickel-iron battery	• Electric vehicle battery
• Grove cell	• Nickel metal hydride battery	• Flow battery
• Leclanché cell	• Low self-discharge NiMH battery	• Inverter battery
• Lemon/potato battery	• Nickel-zinc battery	• Lantern battery
• Lithium battery	• Organic radical battery	• Nanobatteries - Nanowire battery
• Lithium air battery	• Polymer-based battery	• Local battery
• Magnesium battery	• Polysulfide bromide battery	• Polapulse battery
• Mercury battery	• Potassium-ion battery	• Photoflash battery
• Molten salt battery	• Rechargeable alkaline battery	• Reserve battery
• Nickel oxyhydroxide battery	• Rechargeable fuel battery	• Smart battery system
• Oxyride battery	• Silicon air battery	• Watch battery
• Organic radical battery	• Silver-zinc battery	• Water-activated battery
• Paper battery	• Silver calcium battery	• Wet cell
• Pulvermacher's chain	• Sodium-ion battery	• Zamboni pile
• Silver-oxide battery	• Sodium-sulfur battery	• Zinc-carbon battery (manganese oxide)
• Solid-state battery	• Sugar battery	
• Voltaic pile - Penny battery - Trough battery	• Super iron battery	
• Water-activated battery	• UltraBattery	
• Weston cell	• Zinc ion battery	
• Zinc-air battery		
• Zinc-carbon battery		
• Zinc chloride battery		

Advantages and limitations of lead acid batteries.	
Advantages	• Inexpensive and simple to manufacture; low cost per watt-hour • Low self-discharge; lowest among rechargeable batteries • High specific power, capable of high discharge currents • Good low and high temperature performance
Limitations	• Low specific energy; poor weight-to-energy ratio • Slow charge; fully saturated charge takes 14-16 hours • Must be stored in charged condition to prevent sulfation • Limited cycle life; repeated deep-cycling reduces battery life • Flooded version requires watering • Transportation restrictions on the flooded type • Not environmentally friendly

Advantages and limitations of gel batteries.	
Advantages	• Maintenance free; can be mounted sideways; low self-discharge • Long lasting due to its ability to transfer heat to the outside • Performance stays high until the end of life, then drops rapidly • Produces water by combining oxygen and hydrogen • Safe operation and forgiving if abused; less dry-out than AGM • High cycle count, tolerante to abuse and heat • Large variety of battery sizes available
Limitations	• Higher manufacturing cost than AGM but cheaper than flooded • Sensitive to overcharging (gel is more tolerant than AGM) • Moderate specific energy and load current • Subject to release gases. Ventilation needed • Must be stored in charged condition (less critical than flooded)

Advantages and limitations of Nickel cadmium (NiCd) batteries.	
Advantages	• Rugged, high cycle count with proper maintenance • Only battery that can be ultra-fast charged with little stress • Good load performance; forgiving if abused • Long shelf life; can be stored in a discharged state, needs priming before use • Simple storage and transportation; not subject to regulatory control • Good low-temperature performance • Economically priced; NiCd is the lowest in terms of cost per cycle • Available in a wide range of sizes and performance options
Limitations	• Relatively low specific energy compared with newer systems • Memory effect; needs periodic full discharges and can be rejuvenated • Cadmium is a toxic metal. Cannot be disposed of in landfills • High self-discharge; needs recharging after storage • Low cell voltage of 1.20V requires many cells to achieve high voltage

Advantages and limitations of Li-ion batteries.	
Advantages	• High specific energy and high load capabilities with Power Cells • Long cycle and extend shelf-life; maintenance-free • High capacity, low internal resistance, good coulombic efficiency • Simple charge algorithm and reasonably short charge times • Low self-discharge (less than half that of NiCd and NiMH)
Limitations	• Requires protection circuit to prevent thermal runaway if stressed • Degrades at high temperature and when stored at high voltage • No rapid charge possible at freezing temperatures (<0°C, <32°F) • Transportation regulations required when shipping in larger quantities

Chemistry	Lithium Cobalt Oxide	Lithium Manganese Oxide	Lithium Nickel Manganese	Lithium Iron Phosphate	Lithium Nickel Cobalt Aluminum Oxide	Lithium Titanate
Short form	Li-cobalt	Li-manganese	NMC	Li-phosphate	Li-aluminum	Li-titanate
Abbreviation	LiCoC2 (LCO)	LiMn2O4 (LMO)	LiNiMnCoO2 (NMC)	LiFePo4 (LFP)	LiNiCoAlO2 (NCA)	
Nominal voltage	3.60V	3.70V (3.80V)	3.60V (3.70V)	3.20, 3.30V	3.60V	2.40V
Full charge	4.20V	4.20V	4.20V	3.65V	4.20V	2.85V
Full discharge	3.00V	3.00V	3.00V	2.50V	3.00V	1.80V
Minimal voltage	2.50V	2.50V	2.50V	2.00V	2.50V	1.50V (est)
Specific Energy	150-200 Wh/kg	100-150 Wh/kg	150-220 Wh/kg	90-120Wh/kg	200-260 Wh/kg	70-80Wh/kg

Chemistry	Lithium Cobalt Oxide	Lithium Manganese Oxide	Lithium Nickel Manganese	Lithium Iron Phosphate	Lithium Nickel Cobalt Aluminum Oxide	Lithium Titanate

24 FUEL

24.1 CROSS REFERENCE

DAMEN System Code	440
Drawings	
OEM documentation	

24.2 MARINE DIESEL OIL

Marine Diesel Oil (MDO) is a type of fuel oil and is a blend of gasoil and heavy fuel oil, with less gasoil than intermediate fuel oil used in the maritime field.

Marine Diesel Oil is also called "Distillate Marine Diesel". MDO is widely used by medium speed and medium/high speed marine diesel engines. It is also used in the larger slow speed and medium speed propulsion engine which normally burn residual fuel.

Those fuels resulting from a catalytic cracking/visbreaking refinery. Marine diesel oil has been condemned for its nimiety of sulfur, so many countries and organizations established regulations and laws on MDO use. Due to its lower price compared to more refined fuel, MDO is favored particularly by shipping industry.

ISO 8217 of the International Standards Organization (ISO) is the primary standard of MDO.

Marine fuels range in viscosity from less than one centistoke (see viscosity) (cSt) to about 700 cSt at 50°C (122°F). (1 cSt = 1 mm2/s.) And higher viscosity grades are preheated during use to bring their viscosity into the range suitable for fuel injection (8 to 27 cSt). But MDO does not need to be preheated before using.

According to Chevron, MDO has a sulfur limit varies from 1 to 4.5 percent by mass for different grades and Sulfur Emission Control Areas (SECAs).

Unlike gasoline and liquefied petroleum gas engines, diesel engines do not use high-voltage spark ignition (spark plugs).

An engine running on diesel compresses the air inside the cylinder to high pressures and temperatures (compression ratios from 14:1 to 18:1 are common in current diesel engines); the engine generally injects the diesel fuel directly into the cylinder, starting a few degrees before top dead center (TDC) and continuing during the combustion event.

The high temperatures inside the cylinder cause the diesel fuel to react with the oxygen in the mix (burn or oxidize), heating and expanding the burning mixture to convert the thermal/pressure difference into mechanical work, i.e., to move the piston.

NOx

Diesel engines as with other forms of combustion, produce the mono-nitrogen oxides NO and NO2, collectively known as NOx. NOx reacts with ammonia, moisture, and other compounds to form nitric acid vapor and related particles. Modern diesel engines (Euro

6 & EPA stds) use urea injection to turn NOx into N2 and water. The urea reacts with nitrogen oxides to form water and nitrogen.

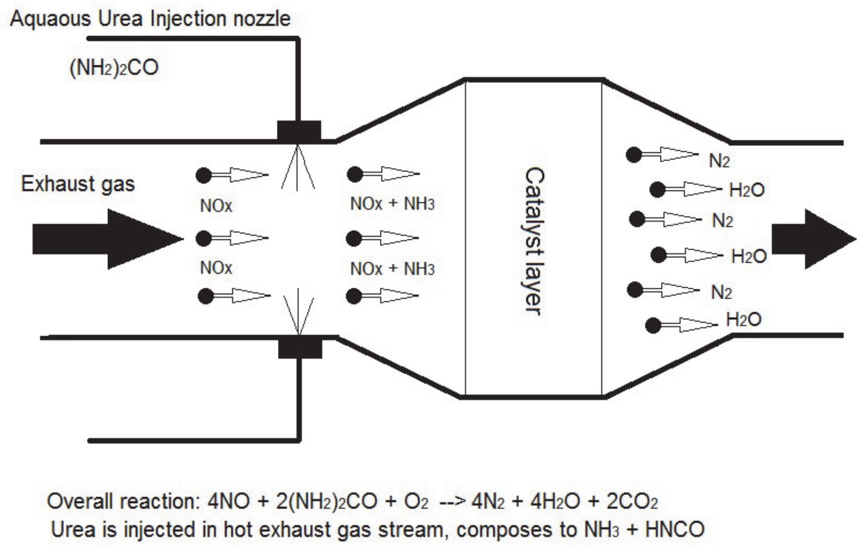


Figure 78: NOx reduction

Environment hazards of sulfur

High levels of sulfur in diesel are harmful for the environment because they prevent the use of catalytic diesel particulate filters to control diesel particulate emissions, as well as more advanced technologies, such as nitrogen oxide (NOx) absorbers (still under development), to reduce emissions. Moreover, sulfur in the fuel is oxidized during combustion, producing sulfur dioxide and sulfur trioxide, that in presence of water rapidly convert to sulfuric acid, one of the chemical processes that results in acid rain. However, the process for lowering sulfur also reduces the lubricity of the fuel, meaning that additives must be put into the fuel to help lubricate engines. Biodiesel and biodiesel/petrodiesel blends, with their higher lubricity levels, are increasingly being utilized as an alternative. The U.S. annual consumption of diesel fuel in 2006 was about 190 billion liters (42 billion imperial gallons or 50 billion US gallons).

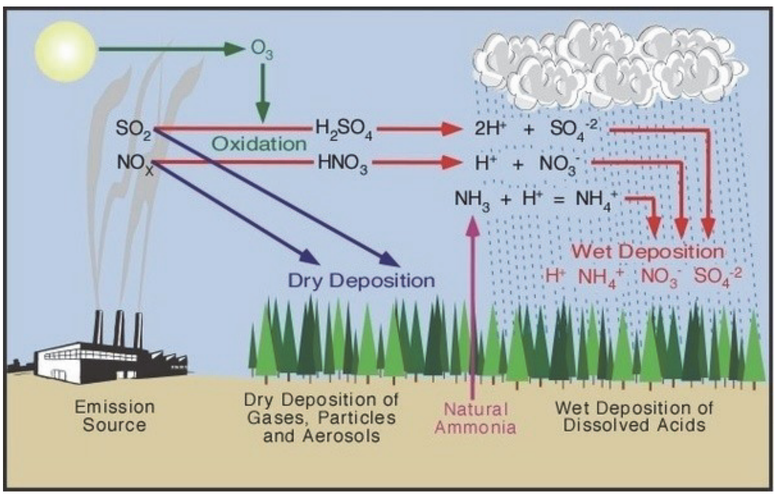


Figure 79: Emissions deposition

Algae, microbes, and water contamination

There has been much discussion and misunderstanding of algae in diesel fuel. Algae need light to live and grow. As there is no sunlight in a closed fuel tank, no algae can survive, but some microbes can survive and feed on the diesel fuel.

These microbes form a colony that lives at the interface of fuel and water. They grow quite fast in warmer temperatures. They can even grow in cold weather when fuel tank heaters are installed. Parts of the colony can break off and clog the fuel lines and fuel filters.

Water in fuel can damage a fuel injection pump; some diesel fuel filters also trap water. Water contamination in diesel fuel can lead to freezing while in the fuel tank. The freezing water that saturates the fuel will sometimes clog the fuel injector pump. Once the water inside the fuel tank has started to freeze, gelling is more likely to occur. When the fuel is gelled it is not effective until the temperature is raised and the fuel returns to a liquid state.

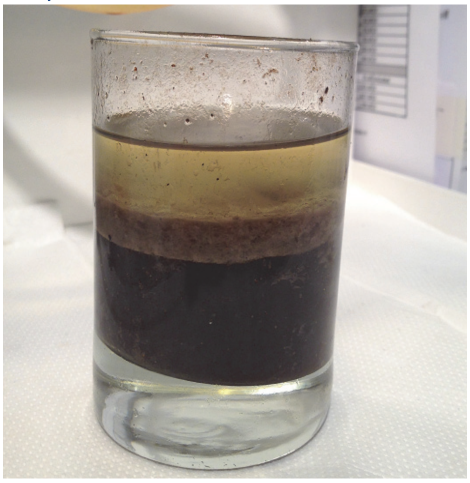


Figure 80: Contaminated diesel

Diesel fuel is organic, so it provides an ideal environment for microscopic fungi, yeast and bacteria to feed and grow.

There are hundreds of different yeasts, fungi and bacteria around and fuel will absorb them from the air.

A combination of any can lead to the microbial infection that is commonly known as diesel bug. So the bug is a combination of fungi, yeast and bacteria.

Diesel Bug multiplies quickly.

Doubling in size every twenty minutes a single cell weighing just one millionth of a gram can grow into a biomass of 10 kilograms in just 12 hours.

It doesn't take long at all for a thick biomass of diesel bug to become centimeters thick.

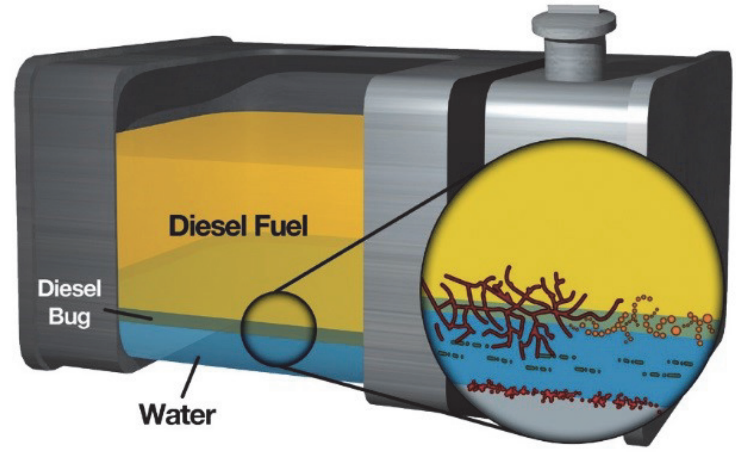


Figure 81: Contaminated diesel in tank

Perfect Environment for Diesel Bug

Your diesel fuel tank provides the perfect environment for diesel bug to thrive. Your fuel tanks provide water in which it lives and breeds, carbon in the fuel on which it feeds and oxygen and Sulphur for respiration together with trace elements for growth.

These pesky invaders don't just clog up your filters and put you at risk from a fuel related breakdown, they can form bio-films on steel surfaces that are corrosive. Look for the tell-tale pits and crevices on your tank and if there's a smell of rotten-eggs then you know you have a serious diesel bug problem.

Why Biocides Won't Solve the Diesel Bug Problem.

So the answer you would think is simple, dose the tank with a biocide, well that might kill the current diesel bug infestation, but what about when you next fill up?

The bugs themselves can hide, lying dormant in the minute crevices of the metal, rubber and polyurethane coatings of fuel tanks and systems.

Then as soon as water is introduced again (i.e. next time you take on fuel) the diesel bug infestation can take hold once more.

So, while dosing with biocide is an option you may find it both time consuming and expensive as you have to treat each new intake of fuel separately.

Prevention is better than Cure.

The best way to ensure your diesel stays free from diesel bug is to remove the habitat diesel bugs thrives in- the water.

Water is present in all fuel and by removing water from your diesel you remove their home and breeding ground.

Without water, diesel bug has nowhere to live.

Separar filters

Fuel - water separator

Figure 82: Fuel treatment

The Cure

Depending on how bad the diesel bug infestation is, it may be that a simple shot of broad spectrum biocide will do the job, initially; however, as diesel bug is becoming more problematic due to low Sulphur and more water finding its way into fuel, you might want to consider a system for removing the water from fuel permanently.

If you think you have a serious infestation of diesel bug then you need to drain and clean your tank and fuel systems before refueling.

Once again as water is present in all fuel and a biocide cannot remove water you should seriously consider implementing a system to remove the water from your fuel as part of an overall maintenance strategy.

25 THE WEATHER

25.1 CROSS REFERENCE

DAMEN System Code	440
Drawings	
OEM documentation	

25.2 HOW IS THE WEATHER TODAY?

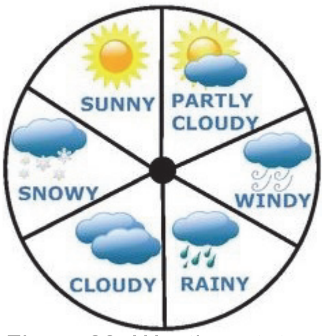


Figure 83: Weather-states

Weather is the state of the atmosphere, to the degree that it is hot or cold, wet or dry, calm or stormy, clear or cloudy. Most weather phenomena occur in the lowest level of the atmosphere, the troposphere, just below the stratosphere. Weather refers to day-to-day temperature and precipitation activity, whereas climate is the term for the averaging of atmospheric conditions over longer periods of time. When used without qualification, weather is generally understood to mean the weather of Earth.

Weather is driven by air pressure, temperature and moisture differences between one place and another. These differences can occur due to the sun's angle at any particular spot, which varies with latitude. The strong temperature contrast between polar and tropical air gives rise to the largest scale atmospheric circulations: the Hadley Cell, the Ferrell Cell, the Polar Cell, and the jet stream. Weather systems in the mid-latitudes, such as extratropical cyclones, are caused by instabilities of the jet stream flow. Because the Earth's axis is tilted relative to its orbital plane, sunlight is incident at different angles at different times of the year. On Earth's surface, temperatures usually range ±40 °C (?40 °F to 100 °F) annually. Over thousands of years, changes in Earth's orbit can affect the amount and distribution of solar energy received by the Earth, thus influencing long-term climate and global climate change.

Surface temperature differences in turn cause pressure differences. Higher altitudes are cooler than lower altitudes as most atmospheric heating is due to contact with the Earth's surface while radiative losses to space are mostly constant. Weather forecasting is the application of science and technology to predict the state of the atmosphere for a future time and a given location. The Earth's weather system is a chaotic system; as a result, small changes to one part of the system can grow to have large effects on the system as a whole. Human attempts to control the weather have occurred throughout history, and there is evidence that human activities such as agriculture and industry have modified weather patterns.

Studying how the weather works on other planets has been helpful in understanding how weather works on Earth. A famous landmark in the Solar System, Jupiter's Great Red Spot, is an anticyclonic storm known to have existed for at least 300 years.

However, weather is not limited to planetary bodies. A star's corona is constantly being lost to space, creating what is essentially a very thin atmosphere throughout the Solar System. The movement of mass ejected from the Sun is known as the solar wind.

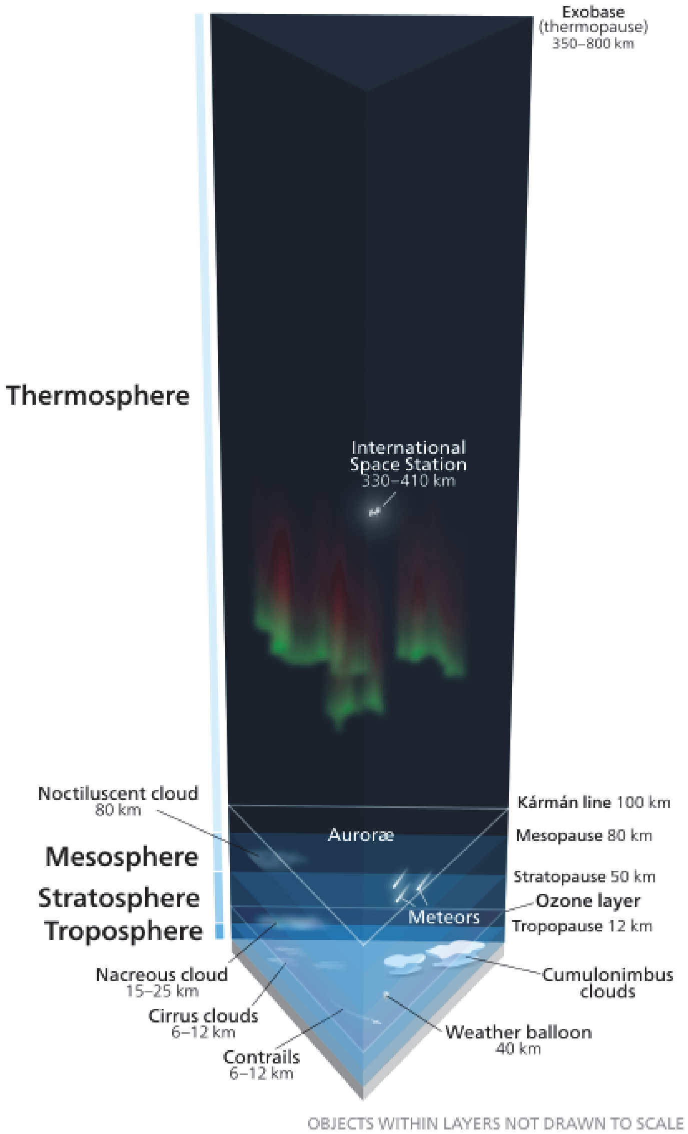


Figure 84: Layers

Where does space starts

The American space agent NASA use a border of 80 kilometer above earth's surface. By the standard of NASA could eight pilots from the experimental X-15 rocket planes from the 60,s call theme self's also astronaut. This title will not be recognized by all space agents.

Australian layers have changed by law the space border to 100 kilometer. Maybe in the near future the border will change again, some space Engineers are choosing for a 120 kilometer border above earth's surface because they believe that this is the point where the returning space ship the frictional heat of earth's atmospheric parts are detectable.

Maybe the winning definition can set the border even higher on 160 kilometers above earth's surface, because they found traces of gasses that we humans breathe in and out.

Exosphere: 700 to 10,000 km (440 to 6,200 miles) The exosphere contains most of the satellites orbiting Earth.

Thermosphere: 80 to 700 km (50 to 440 miles) The International Space Station orbits in this layer.

Mesosphere: 50 to 80 km (31 to 50 miles) sounding rockets and rocket-powered aircraft.

Stratosphere: 12 to 50 km (7 to 31 miles) jet-powered aircraft, Ozon layer.

Troposphere: 0 to 12 km (0 to 7 miles) propeller-driven aircraft.

The ozone layer or ozone shield is a region of Earth's stratosphere that absorbs most of the Sun's ultraviolet (UV) radiation. It contains high concentrations of ozone (O3) in relation to other parts of the atmosphere, although still small in relation to other gases in the stratosphere. The ozone layer contains less than 10 parts per million of ozone, while the average ozone concentration in Earth's atmosphere as a whole is about 0.3 parts per million. The ozone layer is mainly found in the lower portion of the stratosphere, from approximately 20 to 30 kilometers (12 to 19 mi) above Earth, although its thickness varies seasonally and geographically.

Ultra violet. (Electromagnetic radiation)

Although the concentration of the ozone in the ozone layer is very small, it is vitally important to life because it absorbs biologically harmful ultraviolet (UV) radiation coming from the sun. Extremely short or vacuum UV (10-100 nm) is screened out by nitrogen. UV radiation capable of penetrating nitrogen is divided into three categories, based on its wavelength; these are referred to as UV-A (400-315 nm), UV-B (315-280 nm), and UV-C (280-100 nm).

UV-C,

Which is very harmful to all living things, is entirely screened out by a combination of dioxygen (< 200 nm) and ozone (> about 200 nm) by around 35 kilometers (115,000 ft.) altitude. UV-B radiation can be harmful to the skin and is the main cause of sunburn; excessive exposure can also cause cataracts, immune system suppression, and genetic damage, resulting in problems such as skin cancer. The ozone layer (which absorbs from about 200 nm to 310 nm with a maximal absorption at about 250 nm) is very effective at screening out UV-B; for radiation with a wavelength of 290 nm, the intensity at the top of the atmosphere is 350 million times stronger than at the Earth's surface. Nevertheless, some UV-B, particularly at its longest wavelengths, reaches the surface, and is important for the skin's production of vitamin D.

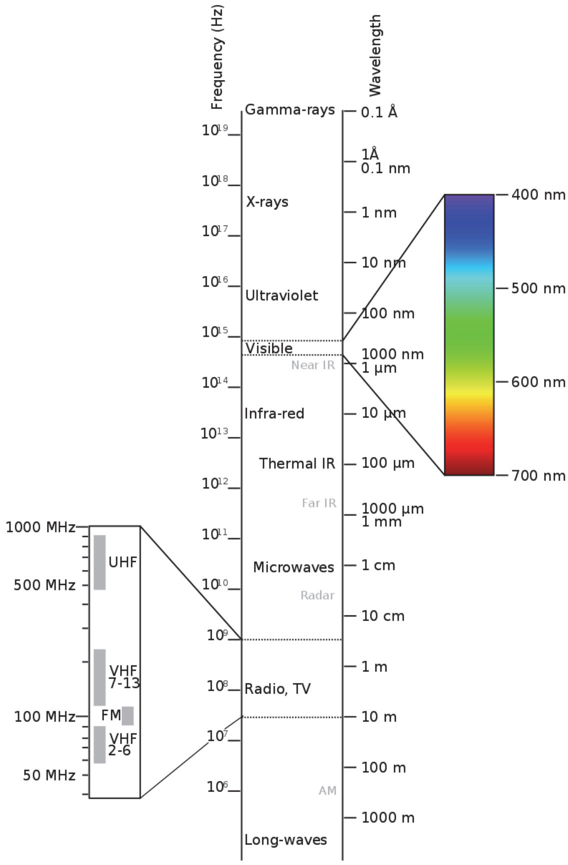


Figure 85: Electromagnetic spectrum frequencies

Ozone

Is transparent to most UV-A, so most of this longer-wavelength UV radiation reaches the surface, and it constitutes most of the UV reaching the Earth. This type of UV radiation is significantly less harmful to DNA, although it may still potentially cause physical damage, premature aging of the skin, indirect genetic damage, and skin cancer.

UV A (320-420 nm)

Uv A form 98,7% of al Uv A radiation on our earth's surface. The ozon layer has no influence on this Uv A radiation.

Causes skin ageing.

Most of the Uv A radiation will penetrated through glass and clothes, causing decoloring of fabric or paint.

Causes melanooms, the deadliest form of skin cancer.

UV B (280-320 nm)

UV B form 1,3% of al UV B radiation on our earth's surface.

The ozon layer has a big influence on this Uv B radiation.

Change oxygen to ozon and slowly repair the ozon layer.

Causes skin to turn brown and skin burn.

Will not penetrate regular glass (filtered up to 300 nm), it will penetrate kwartsglas (In pure form made from silica glass can be made and named kwartsglas).

Causes al sorts of skin cancer.

270-300 nm are the best radiation waves for forming vitamin D.

UV C (100-280 nm)

This deathly Uv C radiation is fully blocked by our atmosphere.

Change oxygen to ozon and slowly repair the ozon layer.

Is very destructive for skin cells. Will cause damage in a very short time.

25.3 THE TEN BASIC CLOUDS

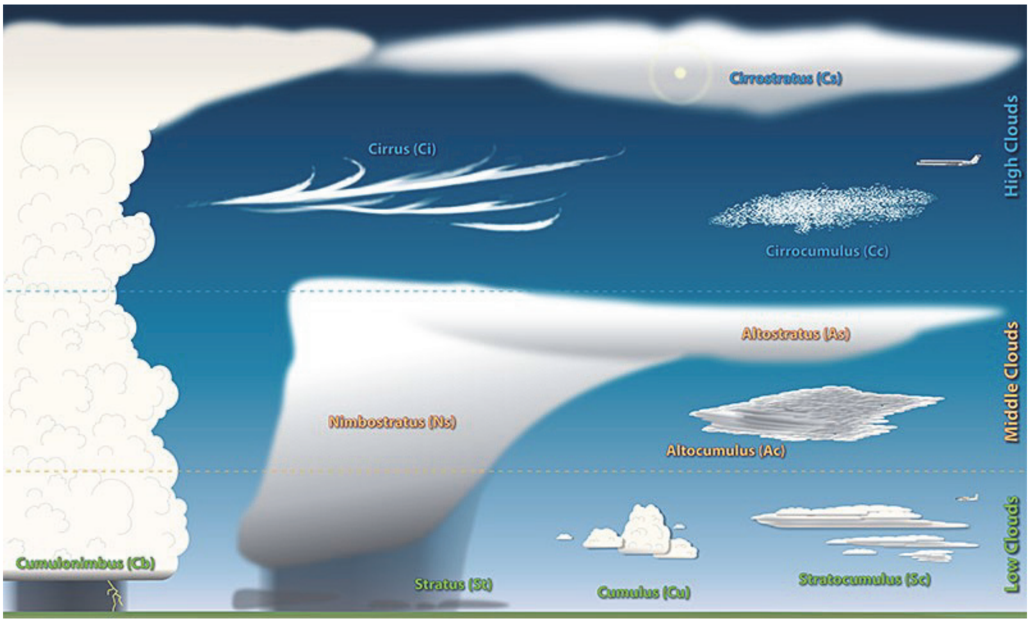


Figure 86: All clouds

High clouds - Cirrus

Detached clouds in the form of white, delicate filaments, mostly white patches or narrow bands. They may have a fibrous (hair-like) and/or silky sheen appearance.

Cirrus clouds are always composed of ice crystals, and their transparent character depends upon the degree of separation of the crystals.

As a rule when these clouds cross the sun's disk they hardly diminish its brightness. Before sunrise and after sunset, cirrus is often colored bright yellow or red. These clouds are lit up long before other clouds and fade out much later.

High clouds - Cirrostratus

Transparent, whitish veil clouds with a fibrous (hair-like) or smooth appearance. A sheet of cirrostratus which is very extensive, nearly always ends by covering the whole sky.

A milky veil of fog (or thin Stratus) is distinguished from a veil of Cirrostratus of a similar appearance by the halo phenomena which the sun or the moon nearly always produces in a layer of cirrostratus.

High clouds - Cirrocumulus

Thin, white patch, sheet, or layered of clouds without shading. They are composed of very small elements in the form of more or less regularly arranged grains or ripples.

In general Cirrocumulus represents a degraded state of cirrus and cirrostratus both of which may change into it and is an uncommon cloud. There will be a connection with cirrus or cirrostratus and will show some characteristics of ice crystal clouds.

Medium High Clouds - Altostratus

Gray or bluish cloud sheets or layers of striated or fibrous clouds that totally or partially covers the sky. They are thin enough to regularly reveal the sun as if seen through ground glass.

Altostratus clouds do not produce a halo phenomenon nor are the shadows of objects on the ground visible.

Sometime virga is seen hanging from Altostratus, and at times may even reach the ground causing very light precipitation.

Medium High Clouds - Altocumulus

White and/or gray patch, sheet or layered clouds, generally composed of laminae (plates), rounded masses or rolls. They may be partly fibrous or diffuse.

When the edge or a thin semitransparent patch of altocumulus passes in front of the sun or moon a corona appears. This colored ring has red on the outside and blue inside and occurs within a few degrees of the sun or moon.

The most common mid cloud, more than one layer of Altocumulus often appears at different levels at the same time. Many times Altocumulus will appear with other cloud types.

Medium High Clouds - Nimbostratus

The continuous rain cloud. Resulting from thickening Altostratus, This is a dark gray cloud layer diffused by falling rain or snow. It is thick enough throughout to blot out the sun. The cloud base lowers into the low level of clouds as precipitation continues.

Also, low, ragged clouds frequently occur beneath this cloud which sometimes merges with its base.

Low clouds - Cumulus (vertical cloud)

Detached, generally dense clouds and with sharp outlines that develop vertically in the form of rising mounds, domes or towers with bulging upper parts often resembling a cauliflower.

The sunlit parts of these clouds are mostly brilliant white while their bases are relatively dark and horizontal.

Over land cumulus develops on days of clear skies, and is due diurnal convection; it appears in the morning, grows, and then more or less dissolves again toward evening.

Low clouds -Stratus

A generally gray cloud layer with a uniform base which may, if thick enough, produce drizzle, ice prisms, or snow grains. When the sun is visible through this cloud, its outline is clearly discernible.

Often when a layer of Stratus breaks up and dissipates blue sky is seen.

Low clouds - Cumulonimbus (vertical cloud)

The thunderstorm cloud, this is a heavy and dense cloud in the form of a mountain or huge tower. The upper portion is usually smoothed, fibrous or striated and nearly always flattened in the shape of an anvil or vast plume.

Under the base of this cloud which is often very dark, there are often low ragged clouds that may or may not merge with the base. They produce precipitation, which sometimes is in the form of virga.

Cumulonimbus clouds also produce hail and tornadoes.

Low clouds - Stratocumulus

Gray or whitish patch, sheet, or layered clouds which almost always have dark tessellations (honeycomb appearance), rounded masses or rolls. Except for virga they are non-fibrous and may or may not be merged.

They also have regularly arranged small elements with an apparent width of more than five degrees (three fingers - at arm's length).

25.4 CLOUD TYPES

While clouds appear in infinite shapes and sizes they fall into some basic forms. From his Essay of the Modifications of Clouds (1803) Luke Howard divided clouds into three basic categories; cirrus, cumulus and stratus.

Figure 87: Cirro-form clouds

The Latin word 'cirro' means curl of hair. Composed of ice crystals, cirro-form clouds are whitish and hair-like.

There are the high, wipsy clouds to first appear in advance of a low pressure area such as a mid-latitude storm system or a tropical system such as a hurricane.

Figure 88: Cumulo-form

Generally detached clouds, they look like white fluffy cotton balls.

They show vertical motion or thermal uplift of air taking place in the atmosphere. They are usually dense in appearance with sharp outlines.

The base of cumulus clouds are generally flat and occurs at the altitude where the moisture in rising air condenses.

Figure 89: Strato-form

From the Latin word for 'layer' these clouds are usually broad and fairly wide spread appearing like a blanket.

They result from non-convective rising air and tend to occur along and to the north of warm fronts.

The edges of strato-form clouds are diffuse.

Figure 90: Nimbo-form

Howard designated a special rainy cloud category which combined the three forms Cumulo + Cirro + Stratus. He called this cloud, 'Nimbus', the Latin word for rain.

The vast majority of precipitation occurs from nimbo-form clouds and therefore these clouds have the greatest vertical height

Why does a rain cloud looks dark

The colour of any object depends on its ability to reflect selected wavelengths of light. Consequently, if the object does not reflect any colour, it appears black.

The tiny droplets of water in rain clouds scatter the white light of the sun. Red is scattered first, and violet the last.

This happens at such a high altitude that no rays of the sun reach the bottom of the cloud.

Thus, we do not see the rays of the sun, and this results in a dark effect. As normal clouds have no water, the light is not scattered and thus look white.

26 WIND, WAVES AND TIDES

26.1 CROSS REFERENCE

DAMEN System Code	440
Drawings	
OEM documentation	

26.2 WIND & WAVES

Figure 91: Waves

Wind

Wind is the flow of gases on a large scale. On the surface of the Earth, wind consists of the bulk movement of air.

In outer space, solar wind is the movement of gases or charged particles from the Sun through space, while planetary wind is the outgassing of light chemical elements from a planet's atmosphere into space.

Winds are commonly classified by their spatial scale, their speed, the types of forces that cause them, the regions in which they occur, and their effect.

Wind is caused by differences in the atmospheric pressure.

When a difference in atmospheric pressure exists, air moves from the higher to the lower pressure area, resulting in winds of various speeds. On a rotating planet, air will also be deflected by the Coriolis effect, except exactly on the equator.

Globally, the two major driving factors of large-scale wind patterns (the atmospheric circulation) are the differential heating between the equator and the poles (difference in absorption of solar energy leading to buoyancy forces) and the rotation of the planet.

Outside the tropics and aloft from frictional effects of the surface, the large-scale winds tend to approach geostrophic balance. Near the Earth's surface, friction causes the wind to be slower than it would be otherwise.

Surface friction also causes winds to blow more inward into low-pressure areas.

Waves

A wave is a disturbance that transfers energy through matter or empty space.

Sound waves move through the air, earthquakes send powerful waves through solid earth, spacecraft radio waves travel across millions of miles through the vacuum of empty space, and ocean waves move through water.

All of these types of waves are able to transfer energy over great distances.

The size of a wave and the distance it travels depends on the amount of energy that the wave carries.

The most familiar waves occur on the ocean's surface. It is upon these waves that surfers play and boogie boarders ride. These waves are mostly created by the wind. There are three factors wind that determine the size of the wave: 1) the speed of the wind, 2) the distance over which the wind has blown, and 3) the length of time that the wind has blown. The greater each of these factors, the bigger the wave.

Waves can be measured by their amplitude, a distance measured vertically from the crest (the top of the wave) to the trough (the bottom of the wave). They can also be measured by their wavelength, which is the horizontal distance between crests. When wind blows across the water surface, energy is transferred to the water. The transfer of that energy may create tiny ripples that disappear when the wind dies down, or it may create larger waves that continue until they reach the shore. Most waves reach the shore.

Waves are measured by their amplitude and by their wavelength.

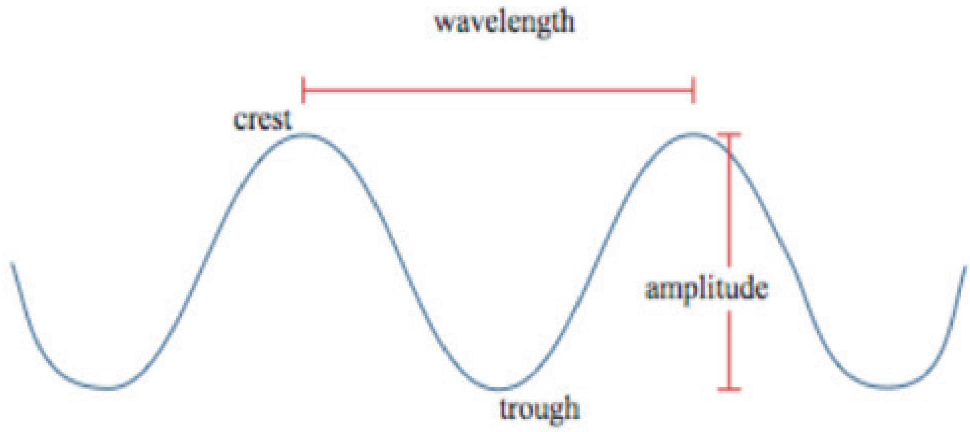


Figure 92: Waves

An undersea earthquake caused the Boxing Day Tsunami in 2004 which devastated Indonesia, Sri Lanka, India, Thailand, and Myanmar.

In this photo, waves up to 30 meters (100 ft.) high. It was one of the deadliest natural disasters in recorded history.

Indonesia was the hardest-hit country, followed by Sri Lanka, India and Thailand.

Scientists sometimes describe waves by measuring the speed of a wave.

A wave's speed is determined by measuring the time it takes for one wavelength to pass by.

Interestingly, particles in the ocean are not significantly moved by waves; although they are bobbled around by the waves, the particles tend to stay where they are.

Waves can also form when a rapid shift in ocean water is caused by underwater earthquakes, landslides, or meteors that hit the ocean. These waves, called tsunami, can travel at speeds of 800 kilometers per hour (500 miles per hour).

Tsunami have small, often unnoticeable wave heights in the deep ocean. However as a tsunami approaches the continental shelf, wave height increases.

The wave speed is also slowed by friction with the shallower ocean floor, which causes the wavelength to decrease, creating a much taller wave.

Many people caught in a tsunami have no warning of its approach. Tsunami warning systems are important for protecting for coastal areas and low-lying countries.

Waves break when they get close to the shore.

That is due to the wave's interaction with the sea floor. When the wave hits the shore, the energy at the bottom of the wave is transferred to the ocean floor, which slows down the bottom of the wave.

The energy at the top of the wave, in the crest, continues at the same speed, however. Since the top of this wave is going faster than the bottom, the crest falls over and crashes down.

Tides

Wind is the primary force that causes ocean surface waves, but it does not cause the tides. Tides are the daily changes in the level of the ocean water at any given place. The main factors that causes tides are the gravitational pull of the Moon and the Sun.

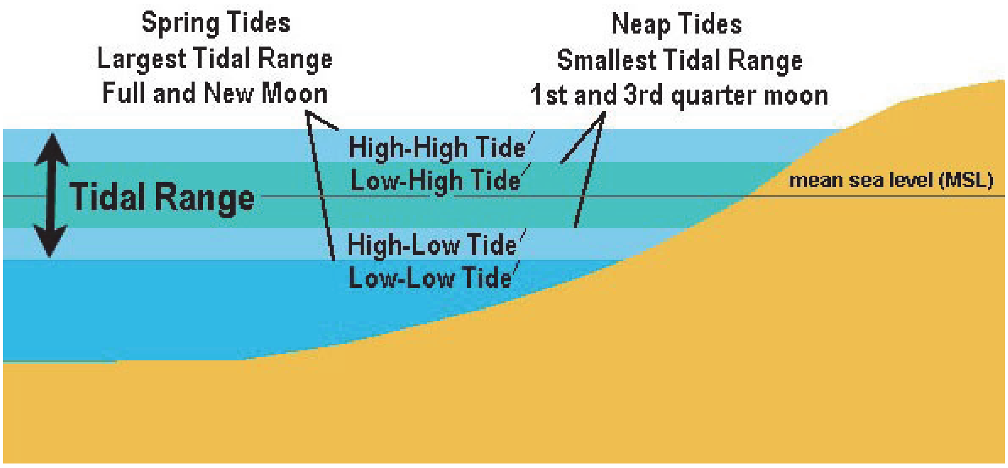


Figure 93: Tidal range

How does the Moon affect the oceans? Since the Moon is a relatively large object in space that is very close to the Earth, its gravity actually pulls Earth's water towards it.

Wherever the moon is, as it orbits the Earth, there is a high tide 'bulge' that stays lined up with the Moon. The side of the Earth that is furthest from the Moon also has a high tide 'bulge'.

This is because the Earth is closer to the moon than the water on its far side. The Moon's gravity pulls more on the planet than the water on the opposite side.

These two water bulges on opposite sides of the Earth aligned with the Moon are the high tides. Since ocean water is pulled higher in the areas of the two high tides, there is less water in between the two high tides. These areas are the low tides.

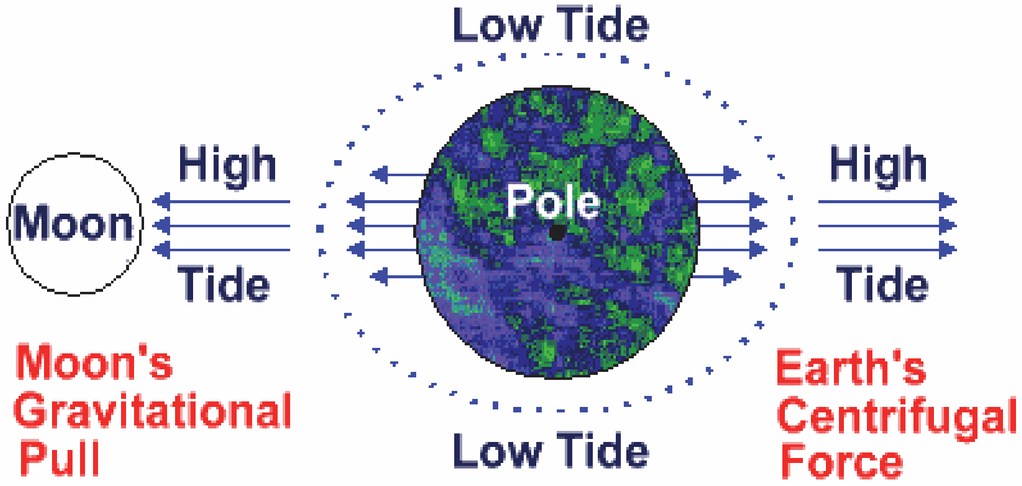


Figure 94: Tides

The tidal range is the difference between the ocean level at high tide and the ocean at low tide.

Some places have a greater tidal range than others. High tides occur about twice a day, about every 12 hours and 24 minutes.

The Moon's gravity is mostly responsible for our tides, but the Sun also plays a role.

The Sun is much larger than our Moon. It has a mass about 27,500,000 times greater than the Moon. A very large object like the Sun would produce tremendous tides if it were as near to Earth as the Moon.

However it is so far from the Earth that its effect on the tides is only about half as strong as the Moon's.

When both the Sun and Moon are aligned, the effect of each is added together, producing higher than normal tides called spring tides.

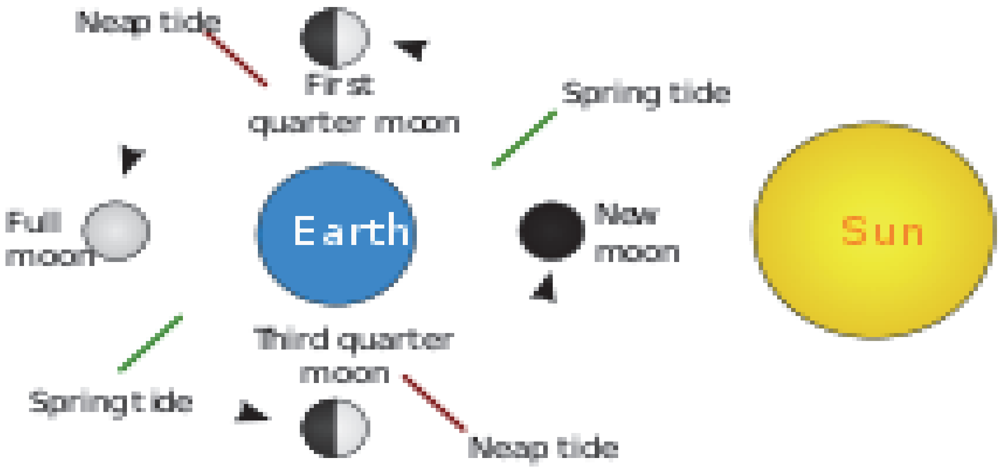


Figure 95: Why spring tide?

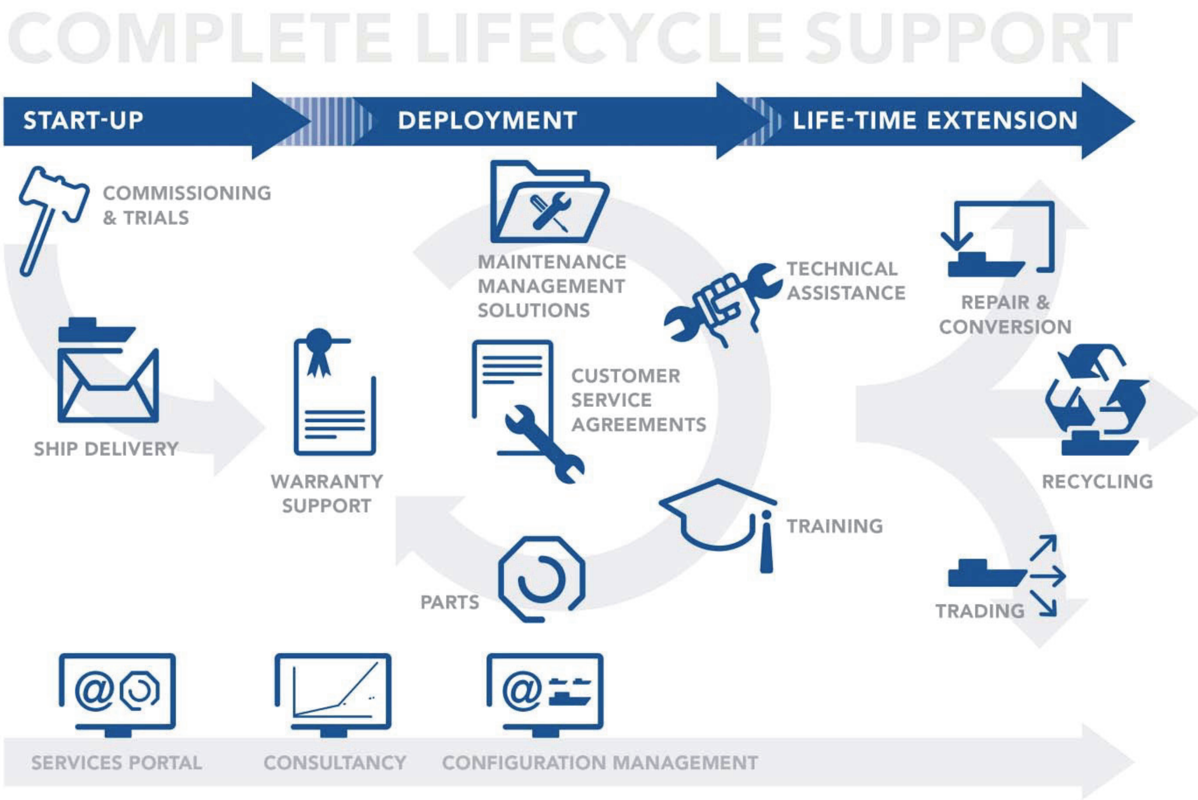
Spring tides are tides with the greatest tidal range.

Despite their name, spring tides don't just occur in the spring; they occur throughout the year whenever the Moon is in a new-moon or full-moon phase, or about every 14 days.

Neap tides are tides that have the smallest tidal range, and occur when the Earth, the Moon, and the Sun form a 90° angle.

They occur exactly halfway between the spring tides, when the Moon is at first or last quarter.

This happens because the Moon's high tide occurs in the same place as the Sun's low tide and the Moon's low tide is added to by the Sun's high tide.



DAMEN SERVICES - MARITIME SERVICE PROVIDER

DAMEN

DAMEN SERVICES

Industrieterrein Avelingen West 20
4202 MS Gorinchem

P.O. Box 1
4200 AA Gorinchem
The Netherlands

phone +31 (0)183 63 99 11
fax +31 (0)183 63 21 89

services@damen.com
www.damen.com