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2.2 Placing the antenna

2.2.1 Obstructions

The antenna rotates 360° and down to -25° for the SAILOR 500 FleetBroadband and -60° for the SAILOR 250 FleetBroadband in pitch and roll, to allow for continuous pointing even in heavy sea conditions. Any obstructions within this volume can cause signal degradation.

The amount of degradation depends on the size of the obstruction and the distance from the antenna. As a rule of thumb any obstruction that subtends an angle of less than 3° at the antenna has limited effect. The table below gives a guideline for obstruction sizes, which will cause limited degradation.

<table>
<thead>
<tr>
<th>Distance of Obstruction</th>
<th>Size of Obstruction</th>
</tr>
</thead>
<tbody>
<tr>
<td>3 m</td>
<td>16 cm</td>
</tr>
<tr>
<td>5 m</td>
<td>26 cm</td>
</tr>
<tr>
<td>10 m</td>
<td>52 cm</td>
</tr>
<tr>
<td>20 m</td>
<td>104 cm</td>
</tr>
</tbody>
</table>
2.2.2 Radiation hazard

The SAILOR 500 FleetBroadband antenna radiates 22 dBW EIRP. This translates to a minimum safety distance of 1.3 m from the antenna while it is transmitting, based on a radiation level of 10 mW/cm².

The SAILOR 250 FleetBroadband antenna radiates 16.1 dBW EIRP. This translates to a minimum safety distance of 0.6 m from the antenna while it is transmitting, based on a radiation level of 10 mW/cm².

For higher radiation levels, see the table below.

<table>
<thead>
<tr>
<th>Radiation level</th>
<th>Distance</th>
<th>SAILOR 500 FleetBroadband</th>
<th>SAILOR 250 FleetBroadband</th>
</tr>
</thead>
<tbody>
<tr>
<td>100 W/m²</td>
<td>0.4 m</td>
<td>0.2 m</td>
<td></td>
</tr>
<tr>
<td>10 W/m²</td>
<td>1.3 m</td>
<td>0.6 m</td>
<td></td>
</tr>
</tbody>
</table>

MICROWAVE RADIATION
NO PERSONNEL
based on 10 W/m²

MICROWAVE RADIATION
NO PERSONNEL
based on 10 W/m²

Safety distance:
SAILOR 500:
1.3 m, 10 W/m²
SAILOR 250:
0.6 m, 10 W/m²
2.2.3 Interference

Overview

The antenna must be mounted as far away as possible from the ship’s radar and high power radio transmitters (including other Inmarsat based systems), because they may compromise the antenna performance. RF emission from radars might actually damage the antenna.

The SAILOR FleetBroadband antenna itself may also interfere with other radio systems. Especially other Inmarsat systems and GPS receivers with poor frequency discrimination are vulnerable to the radiation generated by the SAILOR FleetBroadband antennas.
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Radar

It is difficult to give exact guidelines for the minimum distance between a radar and the antenna because radar power, radiation pattern, frequency and pulse length/shape vary from radar to radar. Further, the antenna is typically placed in the near field of the radar antenna and reflections from masts, decks and other items in the vicinity of the radar are different from ship to ship.

However, it is possible to give a few guidelines:

Since a radar radiates a fan beam with a horizontal beam width of a few degrees and a vertical beam width of up to +/- 15°, the worst interference can be avoided by mounting the antenna at a different level – meaning that the antenna is installed minimum 15° above or below the radar antenna. Due to near field effects the benefit of this vertical separation could be reduced at short distances (below approximately 10 m) between radar antenna and the SAILOR FleetBroadband antenna. Therefore it is recommended to ensure as much vertical separation as possible when the SAILOR FleetBroadband antenna has to be placed close to a radar antenna.
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Radar distance

The minimum acceptable separation (d min.) between a radar and the antenna is determined by the radar wavelength/frequency and the power emitted by the radar. The tables below show some “rule of thumb” minimum separation distances as a function of radar power at X and S band. If the d min. separation listed below is applied, antenna damage is normally avoided.

“d min.” is defined as the shortest distance between the radar antenna (in any position) and the surface of the SAILOR FleetBroadband antenna.

<table>
<thead>
<tr>
<th>Radar power</th>
<th>SAILOR 500 FleetBroadband</th>
<th>SAILOR 250 FleetBroadband</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>d min. at 15° vertical separation</td>
<td>d min. at 60° vertical separation</td>
</tr>
<tr>
<td>0 – 10 kW</td>
<td>0.8 m</td>
<td>0.4 m</td>
</tr>
<tr>
<td>30 kW</td>
<td>2.4 m</td>
<td>1.2 m</td>
</tr>
<tr>
<td>50 kW</td>
<td>4.0 m</td>
<td>2.0 m</td>
</tr>
</tbody>
</table>
The separation distance for C-band (4-8 GHz) radars should generally be the same as for X-band radars.

### Interference

Even at distances greater than “d min.” in the previous section the radar might still be able to degrade the performance of the SAILOR FleetBroadband system.

The presence of one or more X-band radars within a radius up to 100 m could cause a minor degradation of the signal-to-noise ratio during high speed and data calls. The degradation will be most significant at high radar pulse repetition rates.

As long as receiving conditions are favorable, this limited degradation is without importance. However, if receiving conditions are poor – e.g. due to objects blocking the signal path, heavy rainfall or icing, low satellite elevation and violent ship movements – the small extra degradation due to the radar(s) could cause poor call quality. A voice call might become noisy and perhaps fail while a data connection might decrease in speed and performance.
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The presences of S-band radar(s) are unlikely to cause any performance degradation – as long as the minimum distances (d min.) listed in the previous section are applied.

It is strongly recommended that interference free operation is verified experimentally before the installation is finalized.

![Caution!](image) The antenna must never be installed closer to a radar than “d min.” - even if experiments show that interference free operation can be obtained at shorter distances than “d min.” in the previous section.

Other Inmarsat systems

Recommended minimum safe distance to other Inmarsat antennas is 10 m.

GPS receivers

Good quality GPS receivers will work properly very close to the antenna - typically down to one meter outside the main beam, and down to a few meters inside the main beam. However, simple GPS receivers with poor frequency discrimination could be affected at longer range (typically 10 m). It is always recommended to test the GPS performance before the installation is finalized.

Other transmitters

See Minimum distance to transmitters. on page 100 in Appendix B for minimum recommended distance to transmitters in the frequency range below 1000 MHz.

Other precautions

Do not place the antenna close to a funnel, as smoke deposits are corrosive. Furthermore, deposits on the radome can degrade performance.
2.2.4 Antenna mast design

Overview

The antenna mast must be designed to carry the weight of the antenna unit, which is approximately

- 16 kg (+ the weight of the mast flange) for the SAILOR 500 FleetBroadband antenna and
- 3.9 kg (+ 1.1 kg for the mast mount kit) for the SAILOR 250 FleetBroadband antenna.

The mast must also be able to withstand onboard vibrations and wind forces up to 108 knots on the radome, even in icing conditions.

The SAILOR 500 FleetBroadband and SAILOR 250 FleetBroadband antennas use different methods for mast mounting. The following sections describe the two methods separately.

SAILOR® 500 FleetBroadband antenna mast flange

The top of the SAILOR 500 FleetBroadband antenna mast should be fitted with a flange with holes matching the bushes in the radome.

The flange thickness must be at least 10 mm. The antenna is to be mounted on the flange by means of 4 M10 bolts. The length of the bolts must be such that they engage into the bushes of the radome with minimum 6 mm and maximum 12 mm. Drill a hole in the centre of the flange for the antenna cable and for drainage from the radome. For recommended dimensions of the flange, see Outline dimensions, SAILOR 500 flange on page 94 in Appendix B.

Important: Avoid sharp edges where the flange is in direct contact with the radome. Round all edges as much as possible to avoid damaging the surface of the radome.
SAILOR®250 FleetBroadband antenna mast mounting

**Mast mount kit:**

The top of the SAILOR 250 FleetBroadband antenna mast should be fitted with the dedicated mounting kit, see SAILOR®250 FleetBroadband mast mount kit on page 88.

Assemble the mast mount kit according to the assembly instruction included with the kit.

The mast mount kit interfaces to a 1½” pipe (OD 48.3 mm). If the supplied plastic sleeve is omitted, a maximum diameter OD of 52 mm can be used.

**Custom mast mounting:**

For a custom mast mounting, use 4 M6 bolts (A4) in the threaded bushes on the 175.4 mm diameter circle in the bottom of the antenna (see outline drawing SAILOR®250 FleetBroadband antenna on page 99). The length of the bolts must be such that they engage into the bushes of the radome with min. 6 mm and max. 12 mm. No drainage hole is necessary. Drill a hole for the cable or use an angled connector.
Mast length and diameter

The placement of the antenna must ensure a rigid structural connection to the hull or structure of the ship. Parts of the ship with heavy resonant vibrations are not suitable places for the antenna.

A small platform or short mast shall provide rigid support for the antenna fastening bolts and a rigid interface to the ship.

If it is necessary to use a tall mast, use the tables on page 19 and page 20 to obtain the maximum free length of the mast. Note that these values depend on rigid antenna-ship interfaces. The cross-sectional properties and the corresponding maximum free length give a natural frequency above 30 Hz.

It is recommended to shorten the mast length as much as possible to obtain higher frequencies. Alternatively, mount stays or wires to stabilize the mast further.

Note

The hole in the lower part of the mast is necessary for drainage and ventilation for the SAILOR 500 FleetBroadband antenna. Please refer to Condensation, SAILOR® 500 FleetBroadband on page 24.
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The tables in the next sections give some suggested design values for the free part of the mast (shown on the previous page).

**Note** The tables list the values for **steel masts**. For **aluminium masts**, the free mast length is reduced to 75% of the values for steel.

High masts or installations on ships with high vibration levels should be further stabilized by stays or wires from the mast flange. Also mount vibration isolators between the flange and the radome, as described in *Vibration, SAILOR®500 FleetBroadband* on page 25. For SAILOR 250 FleetBroadband, the vibration isolators are included in the Mast mount kit.

**Note** Stays and rigid masts can still not prevent vertical vibration if the mast is attached to a deck plate that is not rigid. Make every effort to mount the mast on a surface that is well supported by ribs. If this is not possible, provide extra deck plate propping.
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SAILOR®500 FleetBroadband antenna mast length

The below table shows the values for a SAILOR 500 FleetBroadband antenna mast without stays or wires. Note that these values are only guidelines - always consider the environment and characteristics of the ship before deciding on the mast dimensions.

<table>
<thead>
<tr>
<th>OD (mm)</th>
<th>Wall Thickness (mm)</th>
<th>Weight (kg/m)</th>
<th>Inertia ((\times 10^6 \text{ mm}^4))</th>
<th>Max. free mast length (steel), m</th>
</tr>
</thead>
<tbody>
<tr>
<td>88.9</td>
<td>4.05</td>
<td>8.47</td>
<td>0.974</td>
<td>&lt; 0.9</td>
</tr>
<tr>
<td>88.9</td>
<td>4.85</td>
<td>10.1</td>
<td>1.14</td>
<td></td>
</tr>
<tr>
<td>100</td>
<td>5</td>
<td>11.7</td>
<td>1.69</td>
<td>&lt; 1.0</td>
</tr>
<tr>
<td>101.6</td>
<td>5</td>
<td>11.9</td>
<td>1.77</td>
<td></td>
</tr>
<tr>
<td>114.3</td>
<td>4.5</td>
<td>12.1</td>
<td>2.34</td>
<td>&lt; 1.2</td>
</tr>
<tr>
<td>114.3</td>
<td>5.4</td>
<td>14.4</td>
<td>2.75</td>
<td></td>
</tr>
<tr>
<td>139.7</td>
<td>4.85</td>
<td>16.1</td>
<td>4.68</td>
<td>&lt; 1.4</td>
</tr>
<tr>
<td>139.7</td>
<td>5.4</td>
<td>17.9</td>
<td>5.14</td>
<td></td>
</tr>
<tr>
<td>165.1</td>
<td>4.85</td>
<td>19.2</td>
<td>7.85</td>
<td>&lt; 1.6</td>
</tr>
<tr>
<td>165.1</td>
<td>5.4</td>
<td>21.3</td>
<td>8.65</td>
<td></td>
</tr>
<tr>
<td>200^a</td>
<td>5</td>
<td>24</td>
<td>14.6</td>
<td>&lt; 2.0</td>
</tr>
<tr>
<td>200^a</td>
<td>10</td>
<td>46.9</td>
<td>27</td>
<td></td>
</tr>
<tr>
<td>300^a</td>
<td>7.5</td>
<td>54.1</td>
<td>73.75</td>
<td>&lt; 2.7</td>
</tr>
<tr>
<td>300^a</td>
<td>15</td>
<td>105.4</td>
<td>136.7</td>
<td></td>
</tr>
</tbody>
</table>

a. The diameter of the circle where the bolts are to be mounted on the antenna is Ø183.8. Since the mast diameter is larger, you must use a tapered end on the mast, or find other means of accessing the mounting bushes.
Chapter 2: Installing the system

SAILOR® 250 FleetBroadband antenna mast length

The below table shows the values for a SAILOR 250 FleetBroadband antenna mast without stays or wires. Note that these values are only guidelines - always consider the environment and characteristics of the ship before deciding on the mast dimensions.

The mast mount kit interfaces to a 1½” tube (OD 48.3 mm - absolute maximum OD 52 mm). Masts with larger diameters must be tapered and the upper part of the tube (approximately 50 mm) must have a diameter of 1½”.

<table>
<thead>
<tr>
<th>OD (mm)</th>
<th>Wall Thickness (mm)</th>
<th>Weight (kg/m)</th>
<th>Inertia (X10^6 mm^4)</th>
<th>Max. free mast length (steel), m</th>
</tr>
</thead>
<tbody>
<tr>
<td>48.3</td>
<td>3.25</td>
<td>3.61</td>
<td>0.117</td>
<td>&lt; 0.6</td>
</tr>
<tr>
<td>48.3</td>
<td>4.05</td>
<td>4.43</td>
<td>0.139</td>
<td></td>
</tr>
<tr>
<td>50</td>
<td>3.00</td>
<td>3.48</td>
<td>0.123</td>
<td></td>
</tr>
<tr>
<td>60.3</td>
<td>3.65</td>
<td>5.10</td>
<td>0.262</td>
<td>&lt;0.8</td>
</tr>
<tr>
<td>60.3</td>
<td>4.50</td>
<td>6.17</td>
<td>0.309</td>
<td></td>
</tr>
<tr>
<td>76.1</td>
<td>3.65</td>
<td>6.80</td>
<td>0.547</td>
<td>&lt; 1.0</td>
</tr>
<tr>
<td>76.1</td>
<td>4.50</td>
<td>7.90</td>
<td>0.651</td>
<td></td>
</tr>
<tr>
<td>88.9</td>
<td>4.05</td>
<td>8.47</td>
<td>0.974</td>
<td>&lt; 1.1</td>
</tr>
<tr>
<td>88.9</td>
<td>4.85</td>
<td>10.10</td>
<td>1.140</td>
<td></td>
</tr>
</tbody>
</table>
2.3 Installing the antenna

2.3.1 Antenna grounding

You may ground the antenna using the mounting bolts.

If the antenna cannot or should not be electrically connected directly to the mounting surface, you can use a separate grounding cable to make the connection between the antenna and the common ground to which the terminal is also connected. For example, you can connect a separate grounding cable when vibration isolators are used at the mounting bolts.

To obtain a good ground connection, the metal underneath the head of at least one bolt must be clean of insulating protective coating and a serrated washer should be used. After tightening the bolts we recommend that you seal the area suitably in order to avoid corrosion of the grounding point.

Use stainless steel bolts and washers.

For further grounding information read Appendix C Grounding and RF protection on page 109.

2.3.2 Antenna cables

Guidelines

A coaxial cable for connection between the antenna and terminal is delivered with the system. If you need a different cable, make sure that the cable meets the requirements. Preferably choose one of the cable types in Recommended antenna cables on page 22.

Select a suitable area for installation of the terminal, antenna and cradle. Where the cables are exposed to mechanical wear - on deck, through bulkheads, etc. - protect the cables with steel pipes. Otherwise, follow standard procedures for cabling in ship installations.

The maximum allowed RF-loss in the antenna cable is 20 dB at 1660 MHz. This is to ensure the performance of the system.
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Recommended antenna cables

The table below shows recommended cable types and maximum cable lengths for both SAILOR 500 FleetBroadband and SAILOR 250 FleetBroadband.

<table>
<thead>
<tr>
<th>Cable Type</th>
<th>Absolute maximum length</th>
</tr>
</thead>
<tbody>
<tr>
<td>G02232-D</td>
<td>6 m</td>
</tr>
<tr>
<td>RG223-D</td>
<td>25 m</td>
</tr>
<tr>
<td>RG214/U</td>
<td>50 m</td>
</tr>
<tr>
<td>S 07272B-05</td>
<td>95 m</td>
</tr>
</tbody>
</table>

Check in the data sheet from the cable supplier that both the RF-attenuation and the DC-resistance are kept within the maximum specified values:

- Antenna cable RF-attenuation max: 20 dB incl. connector at L-band.
- Antenna cable modem-attenuation max: 4 dB at 54 MHz, 3 dB at 36 MHz.
- Antenna cable loop DC-resistance max: $1 \Omega$.

Also ensure that the specified minimum bending radius is respected. If this is not the case, the loss in the cable will increase. Check the instruction from the cable supplier.
2.3.3 Important mounting notes

**Line of sight**

Place the antenna with free line of sight in all directions to ensure proper reception of the satellite signal. Do not place the antenna close to large objects that may block the signal.

**Water intrusion**

After having connected the antenna cable to the antenna - ensure that the connector assembly is properly protected against seawater and corrosion. As a minimum, use self-amalgamating rubber.

If possible, install the radome such that direct spray of sea water is avoided.

It is recommended not to use pneumatic tools for cleaning the radome, specially at a short distance and directly at the split between top and bottom.

Make sure the requirements to drainage are met. See *Condensation, SAILOR®500 FleetBroadband* on page 24.
Condensation, SAILOR® 500 FleetBroadband

In some cases there will be condensation inside the radome. The gasket in the bottom center of the SAILOR 500 FleetBroadband antenna is designed to lead any water away from the radome.

Make sure this draining gasket is not blocked. If the antenna is mounted on a pole, make sure the pole is hollow inside and open at the bottom, allowing water from the gasket to escape and providing ventilation for the antenna.

If the antenna is mounted on a flat surface, use 10 mm spacers (washers) at each bolt so that the gasket in the center of the antenna bottom is free and water can escape.
Vibration, SAILOR® 500 FleetBroadband

Install the antenna where vibrations are limited to a minimum. If you cannot avoid heavy vibrations, we recommend using vibration isolators between the hull/mast and the radome. E.g. use Paulstra isolators (530903 11) together with Paulstra washers. Mount the isolators as shown in the drawings below.

Always use all 4 screws when installing. It is recommended to use screws of A4 quality / stainless steel.

Note

The mounting bolts alone cannot be used for grounding the antenna when the isolators are mounted. If the antenna should be grounded, you can use a separate grounding cable. For further information, see Grounding and RF protection on page 109.
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2.3.4 Mounting the antenna

Overview

The radome can now be installed on the ship with 4 stainless steel bolts fastened to the hull or to a mast.

For information on mast mounting, see Antenna mast design on page 15.

Mounting the SAILOR®500 FleetBroadband antenna onto the hull

Make sure the antenna has line of sight to the satellites. When the antenna is mounted directly on the hull, it may be difficult to obtain line of sight, especially down to -25°, which is the maximum rotation angle (pitch and roll) for the SAILOR 500 FleetBroadband antenna.

Use M10 bolts for mounting the SAILOR 500 FleetBroadband antenna.

The bolt thread must not penetrate more than 12 mm (or 8 turns of the bolt) - and not less than 6 mm (or 4 turns of the bolt) - into the threaded part of the bushes in the radome. Fasten the bolts with 25 ±5 Nm torque.

The only electrical connector is a single N-connector in the center bottom of the radome.

Mounting the SAILOR®250 FleetBroadband antenna onto the hull

Make sure the antenna has line of sight to the satellites. When the antenna is mounted directly on the hull, it may be difficult to obtain line of sight, especially down to -60°, which is the maximum rotation angle (pitch and roll) for the SAILOR 250 FleetBroadband antenna.

Use M6 bolts for mounting the SAILOR 250 FleetBroadband antenna.

The bolt thread must not penetrate more than 12 mm (or 8 turns of the bolt) - and not less than 6 mm (or 4 turns of the bolt) - into the threaded part of the bushes in the radome. Fasten the bolts with 7-8 Nm torque.

The only electrical connector is a single TNC-connector in the bottom of the radome.