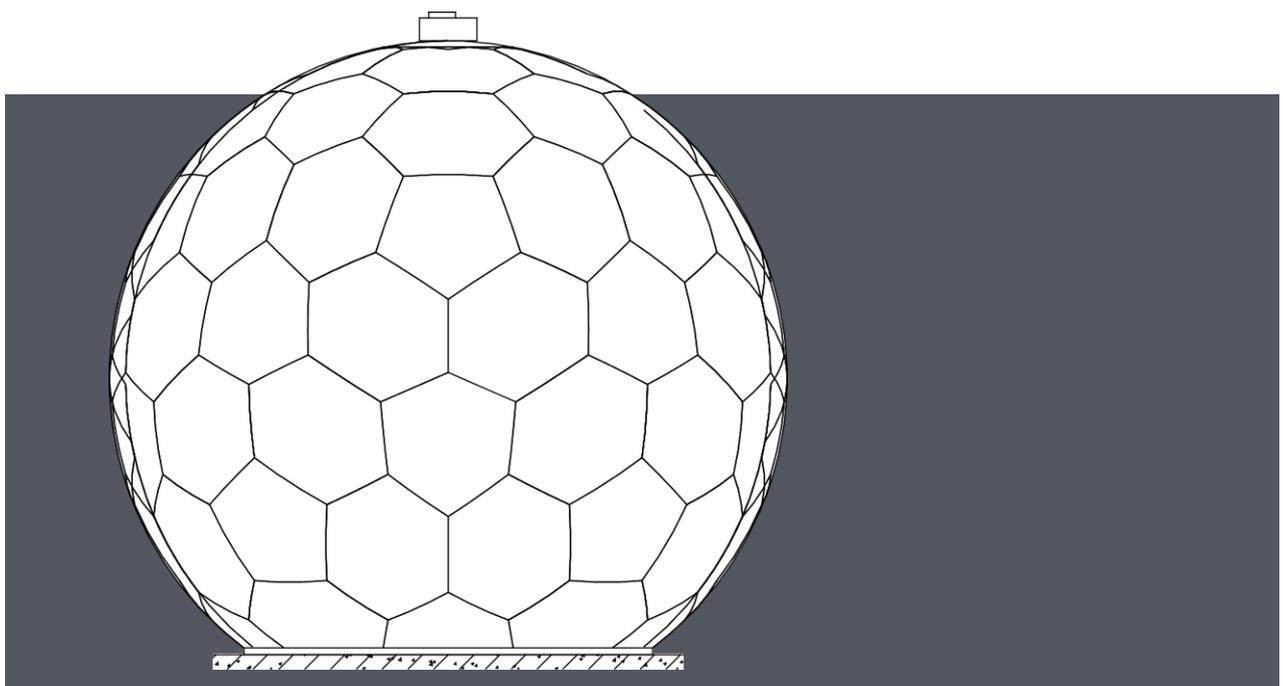


Service Manual

RAD-S-118-F1-DA10

Radome



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Gematronik Weather Radar Systems

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General

1 General

1.1 Fundamentals concerning the documentation

This documentation enables safe and efficient handling of the radar unit. The documentation is a component of the radar unit and consists of the multiple manuals. The documentation must be kept in the immediate vicinity of the radar unit where it is available to specialized personnel at all times.

Personnel must have carefully read and understood this manual prior to starting any task. The basic prerequisite for safe work is compliance with all specified safety instructions and handling instructions.

The documentation is delivered in hard copy, and on customer request can be additionally delivered on an optical data carrier together with the radar unit.

The illustrations in this documentation are provided for the purpose of basic understanding and can deviate from the actual version.

General

1.1.1 The terms radar unit and radar system

In the manuals of the documentation a distinction is made between the terms "radar unit" and "radar system".

The assemblies cited below for the terms radar unit and radar system are examples and depend on the actual scope of delivery.

Radar unit

The radar unit is comprised of all assemblies required for radar operation:

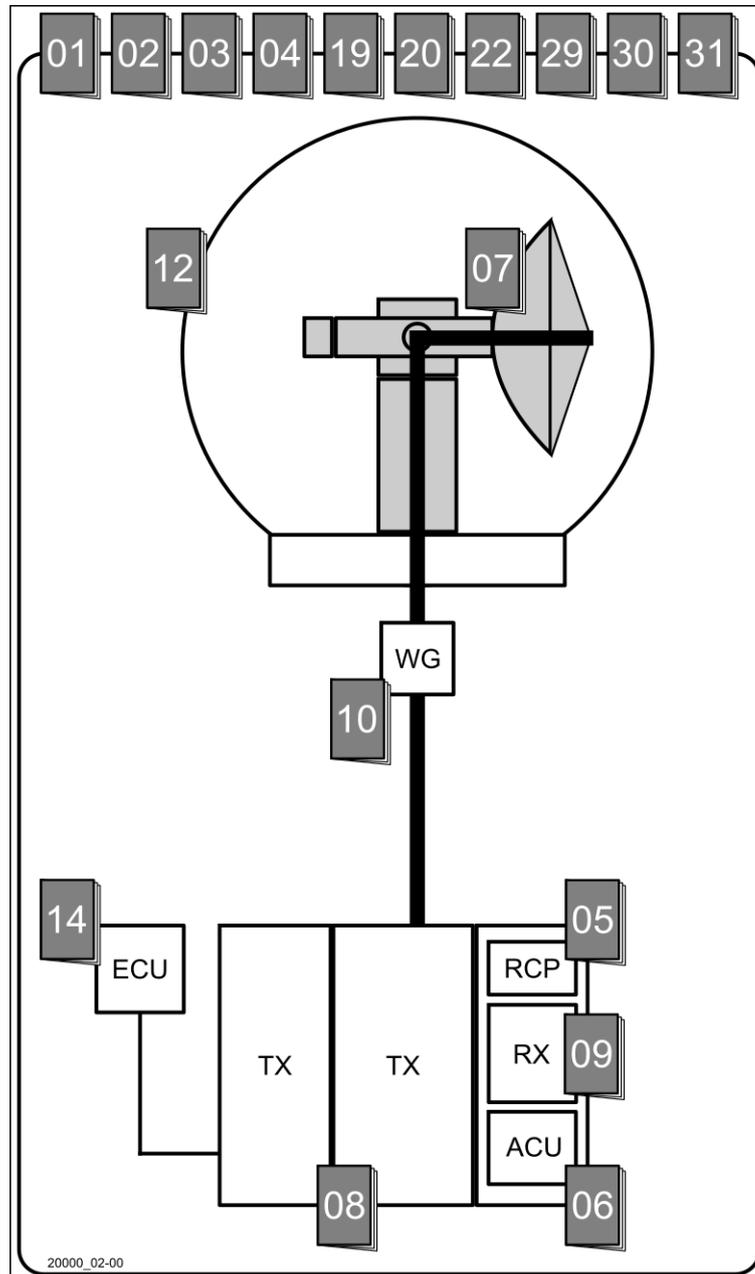
- Radar control processor
- Antenna control unit
- Antenna unit
- Transmitter
- Receiver
- RF circuit

Radar system

In addition to the radar unit, the radar system includes all the remaining assemblies:

- Infrastructure
- Tool set
- IT components
- Generator
- Main power distribution box
- UPS
- Spare parts

1.1.2 Structure of the documentation



Radar system

- 01 Operating Manual
- 02 Maintenance schedule
- 03 Service Manual - block diagram, cabling diagram
- 04 Safety Manual
- 19 Network
- 20 Maintenance software Ravis®
- 22 Data backup and data restore
- 29 Safety distances
- 30 Spare parts list
- 31 CD of the vendor manuals

Service manuals – subsystems

- 05 Radar control processor
- 06 Antenna control unit
- 07 Antenna unit
- 08 Transmitter
- 09 Receiver
- 10 RF circuit
- 12 Radome
- 14 Environment control unit

Fig. 1: Chapter allocation - radar system and subsystems

General

1.1.3 Manual types

As part of the documentation there are different types of manuals that are available for safe and efficient use of the radar unit:

- The **operating manual** (code number 01) documents the general handling of the radar unit in the various life phases.
- The **unit maintenance schedule** (code number 02) provides an overview of all maintenance tasks of the radar unit and of all subsystems. It can be used to provide templates for the documentation of the maintenance tasks. In addition, a digital **form for the unit maintenance schedule** is available on the documentation CD.
- In the **service manual** of the unit (code number 03) the system tasks are described that extend beyond the tasks in the operating manual; these are tasks that must only be executed by specialized personnel. These include tasks that affect the entire unit or that cannot be allocated to any subsystem.
- The **safety manual** (identification number 04) summarise all safety-relevant topics relating to the radar unit. Personnel working on or with the radar unit or a subsystem must have read and understood the complete safety manual.
- In addition to these manuals, the **service manuals** of the subsystems (from code number 05) also apply. These service manuals provide deep insight into the mode of operation of the subsystems and enable execution of fault correction tasks, as well as maintenance of the system. Service manuals are released for specialized personnel exclusively.
- Finally **software manuals** (from code number 20) are available for control of the unit and processing of the data.

1.1.4 Customer-provided components

There may be additional customer-provided components in supplementation to the radar unit delivered by Leonardo-Gematronik and described in this documentation. The customer-provided components are specified in detail in the contract documents.

1.2 Conventions used

1.2.1 Notes

Notes of different types and meaning appear in the manuals for this radar system. This section provides information concerning the use of these notes.

1.2.1.1 Safety instructions

Appear under the header "**Safety**" (e.g. 10.1 Safety) and apply across all sections for the subordinate sections within a main section (e.g. 10 Maintenance). These safety sections are listed in the table of contents of the manuals.

To avoid accidents and injury, comply with the safety instructions and act prudently.

1.2.1.2 Warnings

In the manuals for this radar system, warnings are indicated by a warning symbol and are graphically emphasized. Warnings are introduced by signal words that express the scope of the hazard in risk levels.

To avoid accidents and injury, comply with the warnings and act prudently.

Differentiation and design of warnings

Warnings are differentiated as follows:

Section-based

Apply for an entire action sequence and appear at the beginning of an action-based section under the subheading "Dangers".



SIGNAL WORD

This is a warning text that cites the hazard

This is a warning text that cites the consequences.

Therefore:

- This is a warning text that cites the remedy.

General

Integrated

Appear as action step within the action sequence of an action-based section.

Integrated warnings contain notes concerning safety in subsequent sections.

1. ⚠ **SIGNAL WORD**

This is a warning text that cites the hazard and the consequences.

This is a warning text that cites the remedy.

To avoid accidents and injury, comply with the warnings and act prudently.

Risk levels and associated signal words

The scope of a hazard is specified in 3 risk levels, each with signal word, as follows:

■ **Danger**

...indicates an imminent dangerous situation that results in death or serious injury if it is not avoided.

■ **WARNING**

...indicates a possible dangerous situation that can result in death or serious injury if it is not avoided.

■ **CAUTION**

...indicates a possible dangerous situation that can result in minor injury if it is not avoided.

1.2.1.3 Marking of special warnings

Various danger sources are identified on the radar system through specific warning signs to alert personnel to the respective danger.

Design of special warnings

In addition to the general warning symbol, warnings with reference to these specific dangers are cited with the specific warning symbol.



SIGNAL WORD

This is a warning text that cites the hazard



This is a warning text that cites the consequences.

Therefore:

- This is a warning text that cites the remedy.

The example additionally shows the "High Voltage" warning symbol.

For the list of the warning symbols used and their respective meaning, see:

- Section "Warnings"



*For more information see:
04 System Safety Manual*

General

1.2.1.4 Warnings of material damage

In the manuals for this radar system, warnings of material damage are indicated by the "!" character and are graphically emphasized. They are introduced by the signal word **"NOTICE"**.

To avoid material damage, strictly comply with the warnings of material damage and act prudently.

Differentiation and design of warnings of material damage

Warnings of material damage are differentiated as follows:

All-sections

Appear in the section "Safety" (e.g. 10.1 Safety) under the subheading **"Protection from material damage"** and apply through all sections for the subordinate sections within a main section (e.g. 10 Maintenance).

Section-based

Appear at the beginning of an action-based section under the subheading **"Protection from material damage"** and apply for an entire action sequence.



NOTICE

This is a material damage information text that cites the hazard

This is a material damage information text that cites consequences.

Therefore:

- This is a material damage information text that cites the remedy.

Integrated

Appear as action step within the action sequence of an action-based section.

Integrated warnings of material damage contain information concerning safe handling so that material damage is avoided.

1. ! NOTICE

This is a material damage information text that cites the hazard and the consequences.

This is a material damage information text that cites the remedy.

1.2.1.5 Tips and recommendations

Tips and recommendations for handling the system are indicated in the manuals to this radar system by the symbol "i" and are emphasized graphically.

Tips and recommendations can appear at any point in the manual.

Design of tips and recommendations



NOTE

... indicates useful tips and recommendations as well as information for efficient and trouble-free operation.

Integrated tips and recommendations

Within an action-based section they are presented as follows:

1. This is the text of an action step.
2. This is the text of an action step.



NOTE

... indicates useful tips and recommendations as well as information for efficient and trouble-free operation.

3. This is the text of an action step that refers to the preceding note.
4. This is the text of an action step.

General

1.2.2 References

In the manuals for this radar system there are different types of references. This section provides information concerning the use of these references.

1.2.2.1 Section references within a manual

In order to more quickly find helpful or necessary information, references to sections within a manual are used.

Section references can appear at any point in the manual.

Design of section references

Section references include at least the following elements:

- The word **section**
- In quotation marks ""
 - the **section number** in digits
 - the **section heading**
- The **page number** in digits

Example

The reference to this section is presented as follows:

See chapter "1.2.2.1 Section references within a manual" on page 16.

1.2.2.2 Document references to a different manual

In the manuals for this radar system, document references are indicated by the symbol with the code number of the respective manual and are graphically emphasized.

Document references can appear at any point in the manual.

Design of document references



*For further information see:
01 System Operating Manual*

Integrated document references

Within an action-based section they are presented as follows:

1. This is the text of an action step.
2. This is the text of an action step.



*For more information see:
01 System operating manual*

3. This is the text of an action step.

General

1.2.3 Frequency bands in accordance with IEEE standard 521-2002

The IEEE standard 521-2002 assigns the following letters to the frequency bands:

Frequency band designation	Frequency range
S-band	2 to 4 GHz (prevalent in the weather radar area: 2.70 to 2.90 GHz)
C-band	4 to 8 GHz (prevalent in the weather radar area: 5.60 to 5.65 GHz)
X-band	8 to 12 GHz (prevalent in the weather radar area: 9.30 to 9.50 GHz)

1.3 Manufacturer information

1.3.1 Customer service

Our customer service organization is available for information on the product, product documentation and ordering spare parts.

Our employees are always interested in new information and experiences associated with the application, which could prove valuable in improving our products, and in improving the associated product documentation.

See the section "Contact data" for contact information.

1.3.2 Contact data

Technical enquiries concerning the product are handled at Leonardo-Gematronik via the "Customer Service" organization. For prompt handling of your enquiry use the following email address:

service@selex-es-gmbh.com

All requests concerning the product documentation should be directed to our Documentation Department (preferably in English):

documentation@selex-es-gmbh.com

For additional contact data, see page 2.

1.3.3 Warranty terms

For our warranty terms, please refer to the contract documents.

The prerequisite for acknowledging a guarantee case is compliance with all maintenance tasks in accordance with the prescribed maintenance intervals.

During the guarantee period maintenance tasks must be recorded in writing. These maintenance logs must always be submitted in order for a guarantee case to be acknowledged. Maintenance that is not executed or not correctly executed can result in exclusion from the guarantee.

General

1.3.4 Limitation of liability

All information and instructions in this operating manual have been provided under due consideration of applicable guidelines, the current state of technology, as well as our many years of experience.

The manufacturer assumes no liability for damages due to:

- Failure to follow the instructions in the manual
- Non-intended use
- Deployment of untrained personnel
- Unauthorized conversions
- Technical changes
- Use of non-approved spare parts

The actual scope of delivery can vary from the explanations and graphic representations provided in this manual in the case of special versions, if supplemental order options are desired, or on the basis of the latest technical changes.

In all other respects the agreed obligations in the delivery contract, the general terms and conditions, as well as delivery conditions of the manufacturer, and the statutory regulations valid at the time the contract was concluded, apply.

1.4 Copyright

This document contains data and information proprietary to LEONARDO Germany GmbH. This data shall not be disclosed, disseminated or reproduced in whole or in part without the written authorization of LEONARDO Germany GmbH.

General

2 Safety

The safety-related information concerning the radar system is summarized in the Safety Manual.



*For further information see:
04 System Safety Manual*

Through failure to comply with:

- the Safety Manual, significant dangers occur.
- the action instructions, safety instructions and warnings in this manual significant dangers can occur.

Safety

3 Structure and function

3.1 Overview

3.1.1 Structure

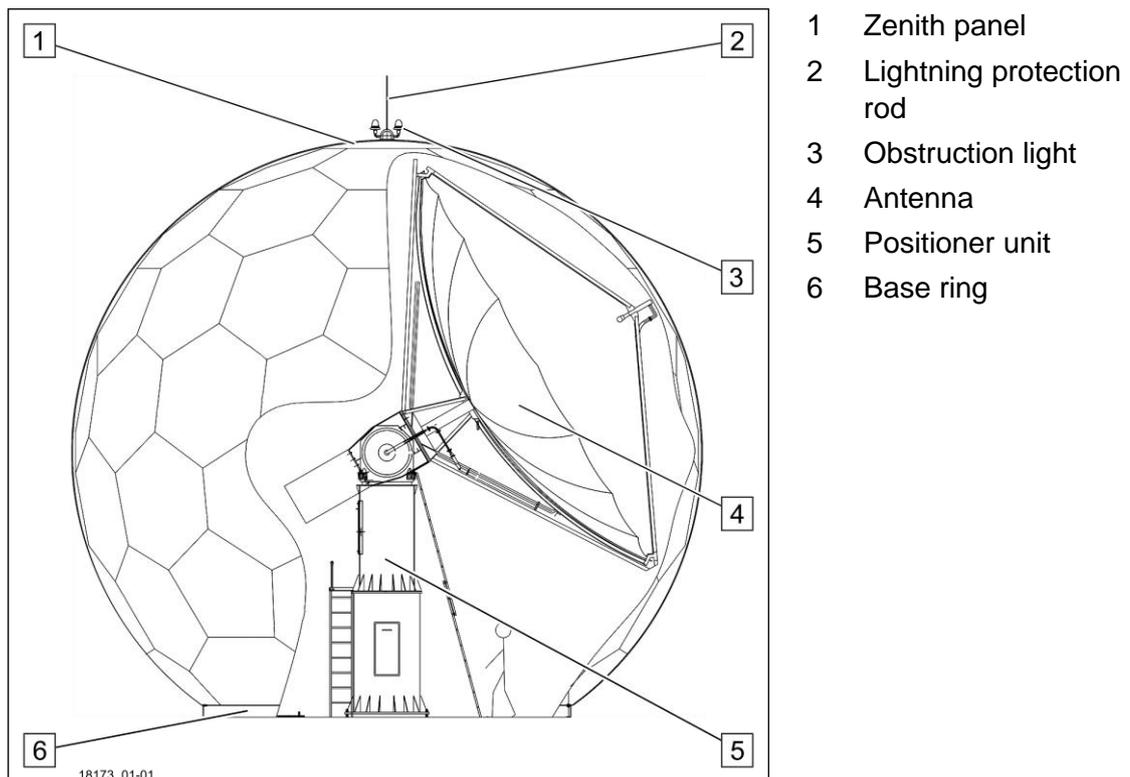


Fig. 2: Radome



NOTE!

The structure of the radome can deviate on a building-specific basis.

The radome (**Radar Dome**) protects the positioner from environmental impact. Its shape is that of a truncated ball which is mounted on a basering at its cut end.

Depending on its design and size the radome is made up of three to six segments called panels. The panels consist of a foam core which is stabilized by a coating.

The radome can be accessed through a radar access door.

Structure and function

3.1.2 Functional principle

The different components of the radome, ensure that operation of the antenna unit remains undisturbed even in unfavorable environmental influences. In this regard they take on the following tasks:

- With the base ring the radome is firmly anchored on the radome platform of the tower.
- The opposite bolted panels ensure stable and watertight shielding.
- The vent scoop on the tip of the radome ensures ventilation of the radome with the side openings. The maintenance hatch permits access to the outer radome components.
- The lightning protection consists of lightning protection rod, protects the radome from being struck by lightning.
- The aircraft warning light warns flying objects of the obstacle.

3.2 Components

3.2.1 Base ring

The base ring of the radome is divided into 10 segments, 5 small and 5 large, each covering 35° or 37° .

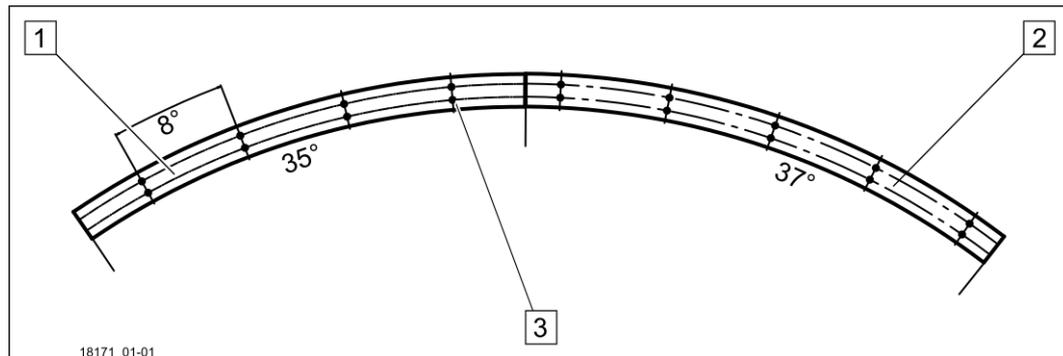


Fig. 3: Base ring segments – bottom

- | | | | |
|---|-------------------------|---|--------------------------------------|
| 1 | Small base ring segment | 3 | Bore for threaded union to the floor |
| 2 | Large base ring segment | | |

The bores on the bottom for threaded union to the floor are arranged in two rows and have a distance of 8° .

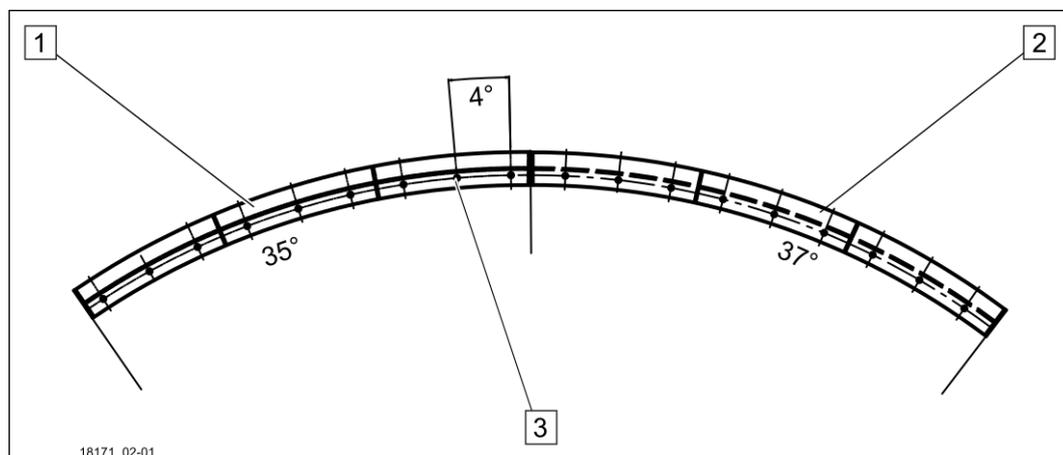
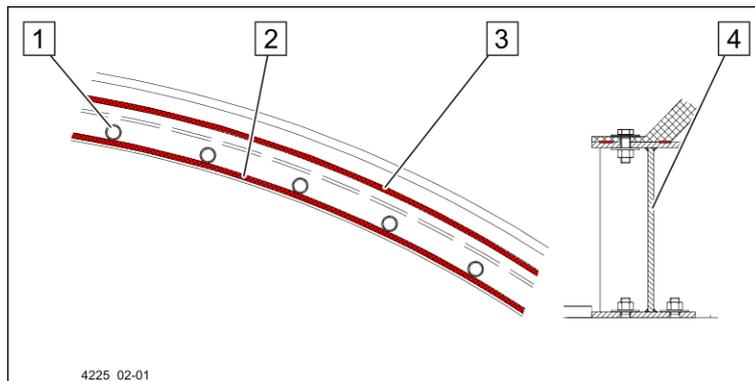


Fig. 4: Base ring segments – top side

- | | | | |
|---|-------------------------|---|---------------------------------------|
| 1 | Small base ring segment | 3 | Bore for threaded union to the panels |
| 2 | Large base ring segment | | |

The bores on the top threaded union to the panels have a distance of 4° .

Structure and function



- 1 Bore for the threaded union of panels
- 2 Gasket tape in front of the bores
- 3 Gasket tape behind the bores
- 4 Base ring

Fig. 5: Base ring – top / cross section

The radome is sealed with a gasket tape on the base ring.



NOTE!

The structure of the radome can deviate on a building-specific basis.

3.2.2 Panels

Panel types

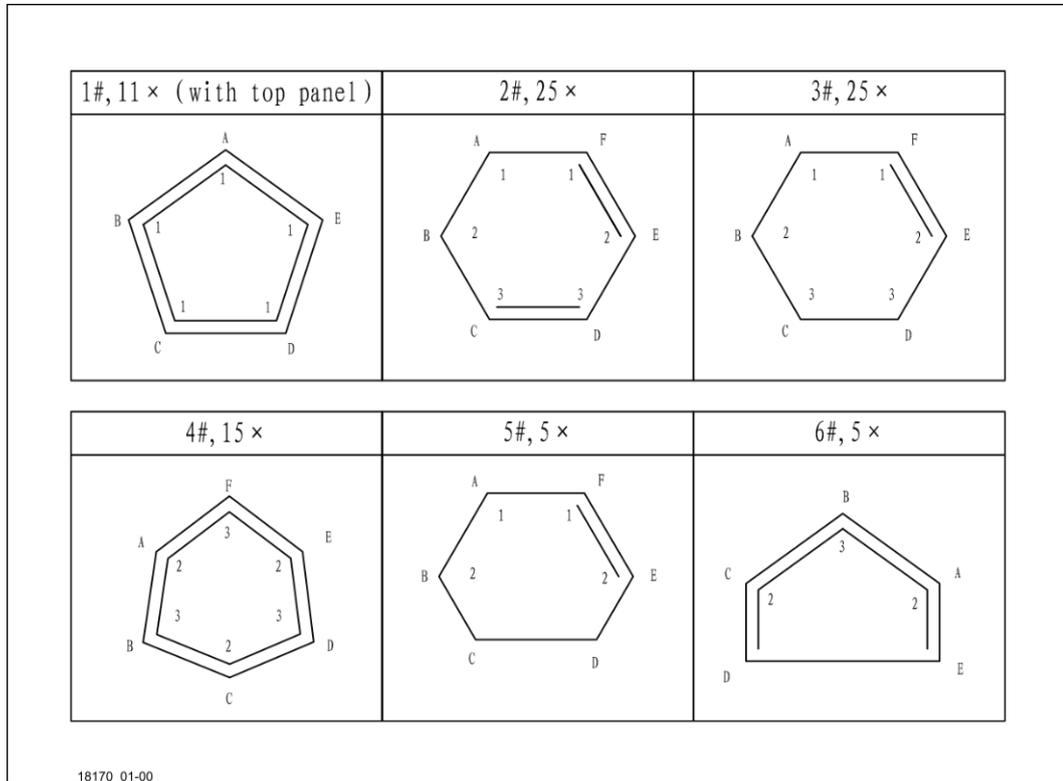


Fig. 6: Panel types

Structure and function

Panel arrangement

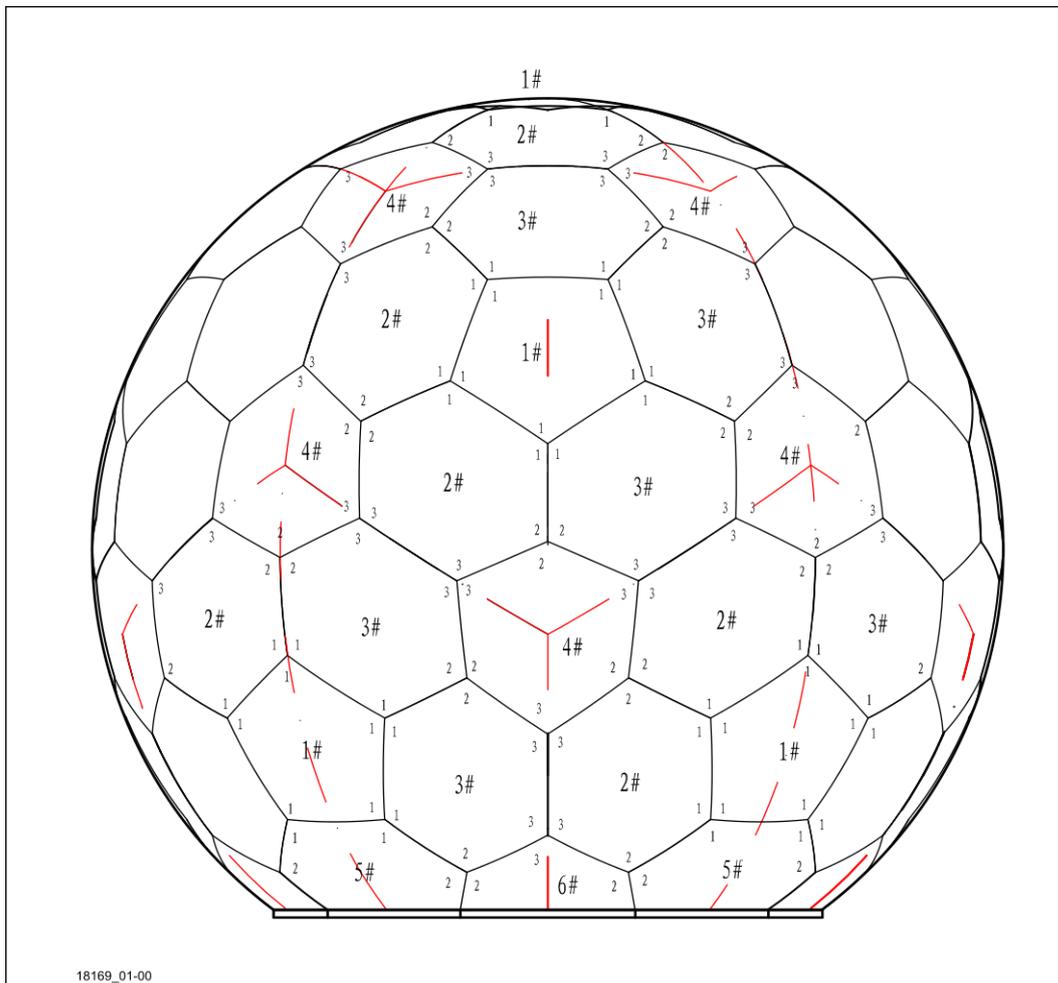


Fig. 7: Panel arrangement

3.2.3 Roof components

On the radome following roof components are installed:

- Lightning protection rod
- Obstruction lights

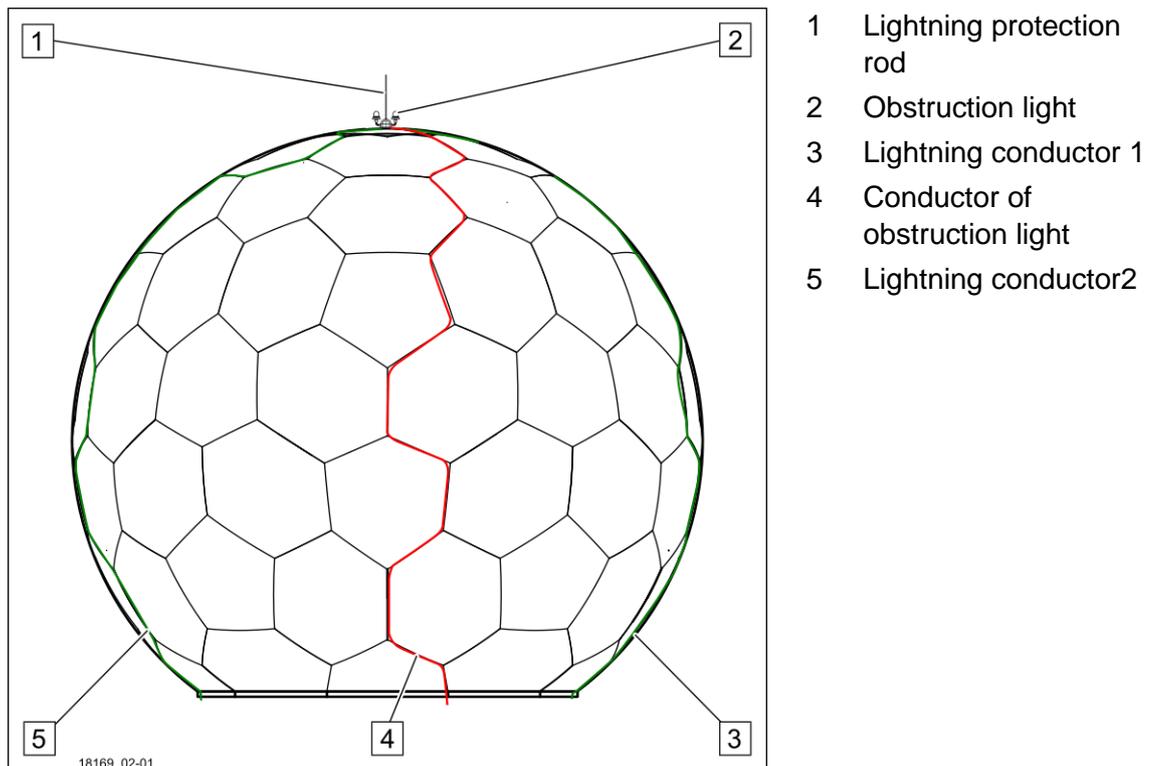


Fig. 8: Radome – cabling (sample arrangement)

The lightning conductor consists of 2 conductors that are routed from the lightning protection rod on the opposite sides downward. The wiring of the lightning conductors is installed inside the radome vertically downward along panel fittings to the extent possible.

The wiring of the obstruction lights is installed inside the radome along panel fittings with a maximum distance to the lightning rods.

3.3 Other components

If the scope of delivery of the radar system includes additional components (e.g. air conditioner), these additional components are described here.

3.4 Operating modes

The operating modes of the radar unit are only available when the voltage supply is switched on.

All available modes are listed in the system service manual for the radar system.



*For further information see:
03 System Service Manual*

Structure and function

3.4.1 Control modes – radar unit

There are 4 types of system control. A mode with a higher priority always overrules the control mode with lower priority.

- **Hand mode:**
 - This mode has the highest priority.
 - The mode is possible in addition to the local mode or Ravis® mode.
 - In hand mode, the radar system can only be controlled by means of the portable hand-held terminal on the positioner unit. Switching to hand mode triggers an emergency stop.
 - No operative data is sent.

- **Local mode:**
 - Mode with the second-highest priority.
 - The Local Control Unit controls the system for all hardware-related settings.
 - This is the mode in which maintenance tasks are generally executed.
 - No operative data is sent.

- **Ravis® mode:**
 - Mode with the third highest priority.
 - Likewise this is a maintenance mode.
 - No operative data is sent.

- **Application mode:**
 - Mode with the lowest priority.
 - The radar unit is controlled via the application software.
 - Can be overruled by through the maintenance modes at any time.
 - Radar unit can send out operative data.

3.4.2 Operating modes – transmitter

The following operating modes are provided for operation of the transmitter:

- **Transmitter off mode:**
 - The transmitter is switched off.
 - Only the fieldbus system for control is supplied with power.
 - From this mode, first you must wait until the preheating time has elapsed, before transmission operation is possible.
- **Transmitter standby mode:**
 - All low-voltage power supply units and also the tube heating are supplied with voltage.
 - The preheating time of the electronic tube has elapsed and the high voltage can be switched on in order to transmit (transmit mode).
- **Transmit mode:**
 - All components of the transmitter, including the high-voltage transformer will be supplied with voltage.
 - The transmitter transmits.

3.4.3 Operating modes – antenna control unit

The following operating modes are provided to control the antenna unit:

- **Servo safe stop mode:**
 - The servo end stages will not be supplied with power.
 - At least 1 safety circuit (e.g. radome...) has tripped or the safety PLC has not yet been reset.
- **Servo standby mode:**
 - The servo end stages will be supplied with power.
 - No safety circuit has tripped.
 - The servo drives can be switched on at any time.
- **Servo-active mode:**
 - Servo end stages will be actively actuated.
 - No safety circuit has tripped.
 - The brakes are disengaged.

Structure and function

3.5 Control elements

Empty section.

3.6 Power supply

Empty section.

3.7 Status displays

Empty section.

4 Technical data

4.1 General information

Specific values		
Specification	Value	Unit
Operating frequency	2,7..2,9	GHz
Transmission losses (when outer radome surface is dry)	≤ 0.2	dB
Sidelobe perturbation	at -26 dB	1 dB
	at -35 dB	2 dB
Boresight error	≤ 0.01	°
Reflected power (in relation to the antenna transmission capacity)	≤ 2	%
Cross polarization degradation	≤ 1	dB
Beamwidth increase	at 3 dB	≤ 2 %

Dimensions		
Specification	Value	Unit
Total overall height (including lightning conductor)	11.882	m
Height	10.614	m
Diameter	11.800	m
Diameter spherical segment (hole circle)	6.970	m
Weight including screws (without basering)	3400	kg

Technical data

4.2 Operating conditions

Specification	Value	Unit
Maximum ambient temperature	-55 .. 70	°C
Maximum humidity	5 .. 100	%
Maximum wind speed	80	m/s
Maximum load bearing ice (coating strength)	5	cm

4.3 Name plate

The type plate is located on a base panel inside the radome and contains the following information:

- Company name
- Address
- Description
- Type
- Year of manufacture

Technical data

5 Transport, packaging, and storage



*For further information see:
01 System Operating Manual*

Transport, packaging, and storage

6 Installation and commissioning



*For further information see:
01 System Operating Manual*

Installation and commissioning

7 Configuration



*For further information see:
03 System Service Manual*

Configuration

8 Operation

8.1 Safety

**WARNING****Improper operation!**

Improper operation can cause serious injury or property damage.

Therefore:

- Execute all operating steps in accordance with the information in this operating manual.
- Ensure that all covers are installed.
- Ensure that all safety devices are installed and functioning properly.

8.2 Bringing the machine to a standstill in an emergency

In dangerous situations, the movements of the machine must be stopped as quickly as possible and the power supply must be switched off.

Therefore:

1. Trigger an emergency stop immediately.
2. Inform the responsible parties at the implementation site.
3. Notify a physician and the fire department.
4. Get people out of the danger zone, initiate first-aid measures.
5. Safeguard the main switch from being switched on again.
6. Keep entry ways clear for rescue vehicles.



DANGER

Unauthorized restart!

If a radar unit that was switched off is restarted again prematurely, there is life-threatening hazard for persons in the danger zone.

Therefore:

- Always comply with the procedure for safeguarding the radar unit against restart.
- Before switching on ensure that there are no persons in the danger zone.

After the rescue measures

7. Depending on the seriousness of the emergency situation, inform the responsible government agencies.
8. Assign specialized personal to correct the error.
9. Prior to starting up the radar unit again check and ensure that all safety devices are installed and functioning.

8.3 Switching on and create operational readiness



*For further information see:
01 System Operating Manual*



*For further information see:
03 System Service Manual*

8.4 Activating control modes



*For further information see:
03 System Service Manual*

8.5 Activating transmitter operating modes



*For further information see:
03 System Service Manual*

8.6 Activating antenna control unit operating modes



*For further information see:
03 System Service Manual*

8.7 Switching the radar unit off for the long term



*For further information see:
01 System Operating Manual*



*For further information see:
03 System Service Manual*

Operation

9 General preparation and steps to be taken afterwards

9.1 Safety



DANGER



High voltage

The radar system is energized with life-threatening voltage potentials. In particular, the hot box in transmit mode is energized with life-threatening high voltage of several 10000 V. Touching these components or underranging the safety distance to these components results in death.

Therefore:

- Only radar engineers or electrical engineers should perform tasks on the electrical equipment.
- Prior to starting all tasks on electrical equipment, switch off the energy supply and safeguard it from being switched on again.
- After switching off the energy supply, wait for 5 minutes until the voltage has dissipated.
- Ensure that electrically conductive components are de-energized before they are replaced.
- Only start up the radar system if the grounding is functioning faultlessly.
- If the insulation is damaged, immediately switch off the power supply, and initiate the repair.
- Do not bypass fuses or render them inoperable. Always use the correct amperage when changing fuses.
- Keep moisture away from live parts.
- Prior to switching on the radar system, ensure that all maintenance accesses (terminal boxes, access openings, covers, hoods, and hatches) are closed.

General preparation and steps to be taken afterwards

9.2 Basic tasks

9.2.1 Disconnecting electrical connections

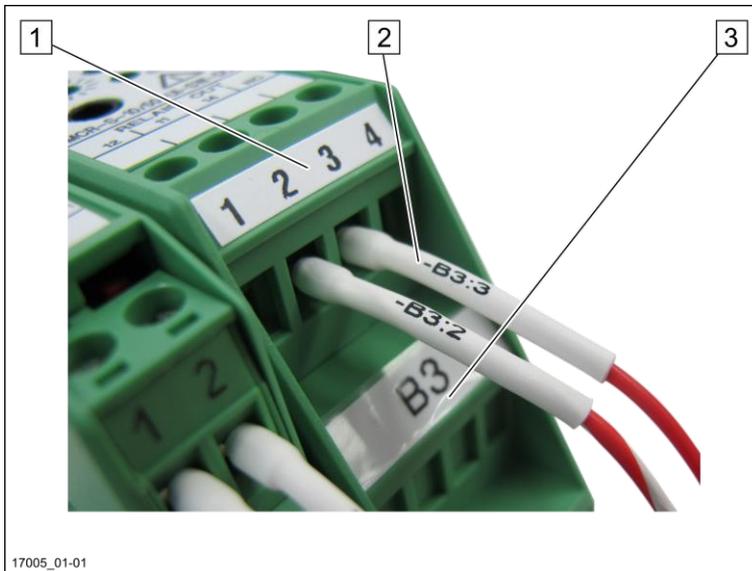
Various troubleshooting operations require loosening connections to, for example, replace components. When re-connecting the cables, pay attention to the following:

All device connections are encoded to allow for the easy assignment of the cables to their connections.



NOTE

The labeling can be different if the components are not manufactured by Leonardo-Gematronik



- 1 Pin labeling
- 2 Line / cable labeling
- 3 Component labeling

17005_01-01

Fig. 9: Coding (example)

The coding of the connections is performed in accordance with the following pattern (the pin specification is optional):

Syntax

Component:Connection:Pin

Example:

"B3:2"

Explanation: The cable is connected to the component "B3 (contact 2)".

Removal

1. Check the labeling of cables and terminals for legibility.
2. Replace illegible or missing cable identification labels.

General preparation and steps to be taken afterwards

3. Disconnect cables.

9.2.2 Removing / installing components

Mark install position

For spare part replacement or fault rectification it may be necessary to remove its components. Before detaching the component, mark the install position so that after the fault is corrected the component can be reinstalled correctly.

Components on DIN rails

Many components are fastened on DIN rails.



Fig. 10: Release the arrest

Removal

1. Components can be taken off the rail after the arrest has been released. To release the locking mechanism use the respective fixture under the component.
Example: Use a small screwdriver to release the lever, by performing a lateral lever movement.
2. Take off the component.

Installation

1. Press the component onto the rail until the component engages.

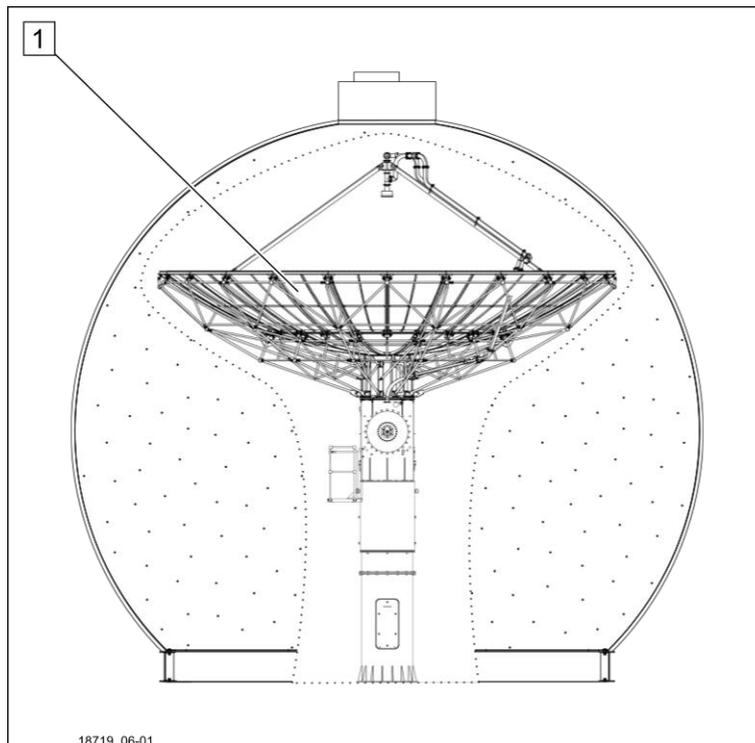
General preparation and steps to be taken afterwards

9.3 Preparatory tasks

9.3.1 Align the antenna

Overview

Align the antenna in such a manner that all components relevant for maintenance are easily accessible.



1 Antenna

Fig. 11: Align the antenna

Safety

Personnel qualification

- To be executed only by an instructed person

General preparation and steps to be taken afterwards

Dangers



WARNING

Danger of injury due to presence in the rotation area of the antenna!

Presence of personnel in the rotation area of the antenna can result in severe injuries, if the antenna is set in motion.

Therefore:

- Ensure that no one is in the danger zone.



WARNING

Staying in the beam range of the antenna!



Staying in the beam range of the antenna when the transmitter is activated, can cause serious injury by microwave radiation.

Therefore:

- Just switch on the system if there are no persons in the danger zone.

Prerequisites

- None

Execution

1. Activate "Local mode" or "Ravis® mode".
2. Activate "Transmitter off mode".
3. For general tasks in the radome without having to go to the upper radome hatch, as a rule it suffices to position the antenna unit in elevation at 90°.

Continued

The required tasks can now be continued.

General preparation and steps to be taken afterwards

9.3.2 Switching radar unit de-energized

Overview

The radar unit is de-energized via a lockable load disconnecting switch on the main power distribution box. The peripheral equipment (air conditioner, maintenance power outlets, etc.) are not de-energized.

Safety

Personnel qualification

- Execution only by an electrical engineer

Dangers



DANGER

Unauthorized restart!

If a radar unit that was switched off is restarted again prematurely, there is life-threatening hazard for persons in the danger zone.

Therefore:

- Always comply with the procedure for safeguarding the radar unit against restart.
- Before switching on ensure that there are no persons in the danger zone.

Special tools, auxiliary material

- Lock
- Safeguard sign

Measurement equipment

- Digital multimeter

Prerequisites

1. Ensure that the radar unit has been switched off for the long term:
Section – Switching the radar unit off for the long term



For more information see:

01 System operating manual



For more information see:

03 System Service Manual

General preparation and steps to be taken afterwards

Execution



Fig. 12: Load disconnecting switch safeguarded with padlock

1. Switch off the load disconnecting switch.

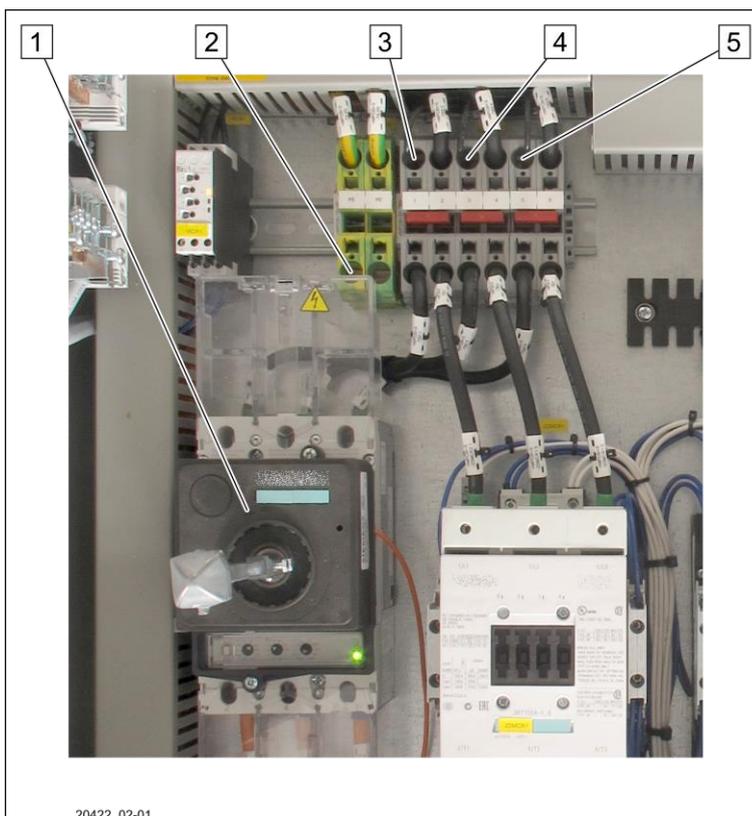


Fig. 13: MPDB terminals – determine de-energized status

2. Determine de-energized status with a digital multimeter.
3. Safeguard the load disconnecting switch with a lock (not included in the scope of delivery).

- 1 Load disconnecting switch
- 2 PE conductor
- 3 External conductor L1
- 4 External conductor L2
- 5 External conductor L3

General preparation and steps to be taken afterwards

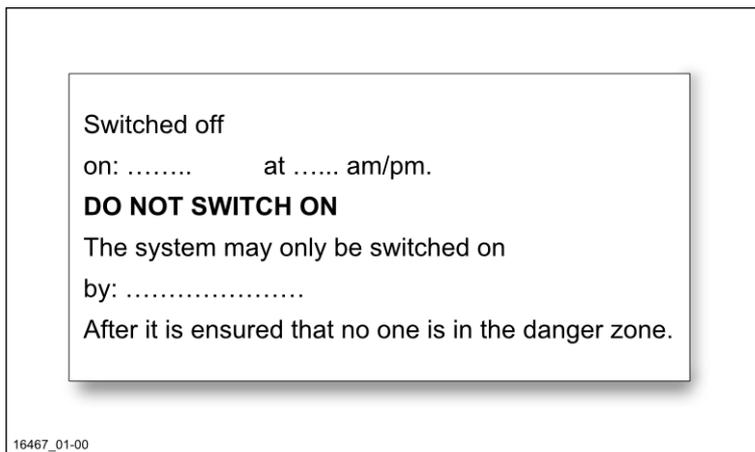


Fig. 14: Warning sign

4. Attach a sign that is legible on the switch.
5. The employee designated on the sign should carry the key with him.

Continued

The required tasks can now be continued.

General preparation and steps to be taken afterwards

9.3.3 Entering the antenna area

Overview

Specific test procedures require entering the antenna area.

Safety

Personnel qualification

- To be executed only by an instructed person

Dangers



WARNING

Danger of crushing due to automatic start-up!



As long as key 38 is in the door locking mechanism, the antenna area access can be locked by unauthorized personnel. Presence of personnel in the antenna area is only safe when the key is removed.

Therefore:

- When entering the antenna area, always remove key 38 from the door locking mechanism.

Prerequisites

The prerequisite for execution of this preparation is that the listed tasks must be concluded.

- The system is in system „Ravis® mode“.

Execution

1. In elevation position the antenna at 90°.
2. Activate "Servo standby mode".
3. Activate "Transmitter off mode" or "Transmitter standby mode".

General preparation and steps to be taken afterwards

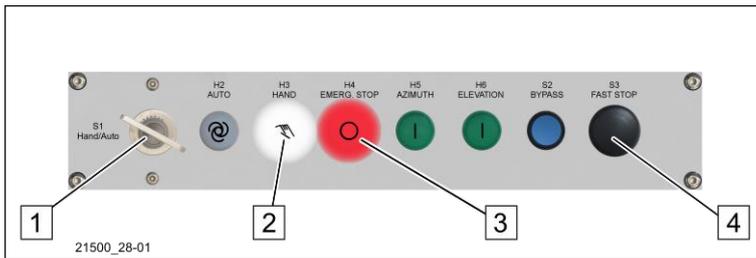


Fig. 15: Control panel of the antenna control unit

- 1 Key switch S1 Auto/Manual
- 2 Indicator light H3 "Manual"
- 3 Indicator light H4 "EMERG" STOP"
- 4 Fast stop switch S3 "FAST STOP"

4. Switch the key switch "Auto/Manual" on the control panel of the antenna control unit is in the "Manual" position and remove the key (#200).
Activation of "transmit mode" or "servo active mode" is now no longer possible.
The indicator light H3 (MANUAL) and H4 (EMERG. STOP) on the control panel of the antenna control unit are illuminated.

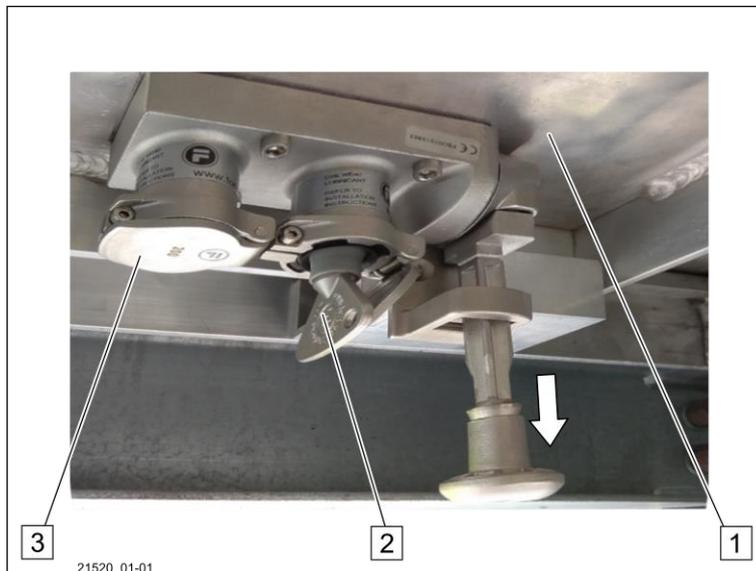


Fig. 16: Access to the antenna area

- 1 Access
- 2 Lock cylinder with key (#38)
- 3 Lock cylinder with key (#200)

5. With the key (#200) cancel the locking of the access hatch with the aid of the key transfer system and open the access hatch.
6. Take the 2nd key (#38) out of the guard locking device, to prevent unintentional locking of the access hatch.
7. Enter the antenna area.

Continued

The required tasks can now be continued.

General preparation and steps to be taken afterwards

9.3.4 Reaching roof components

Overview

The roof components are accessible with the maintenance ladders.

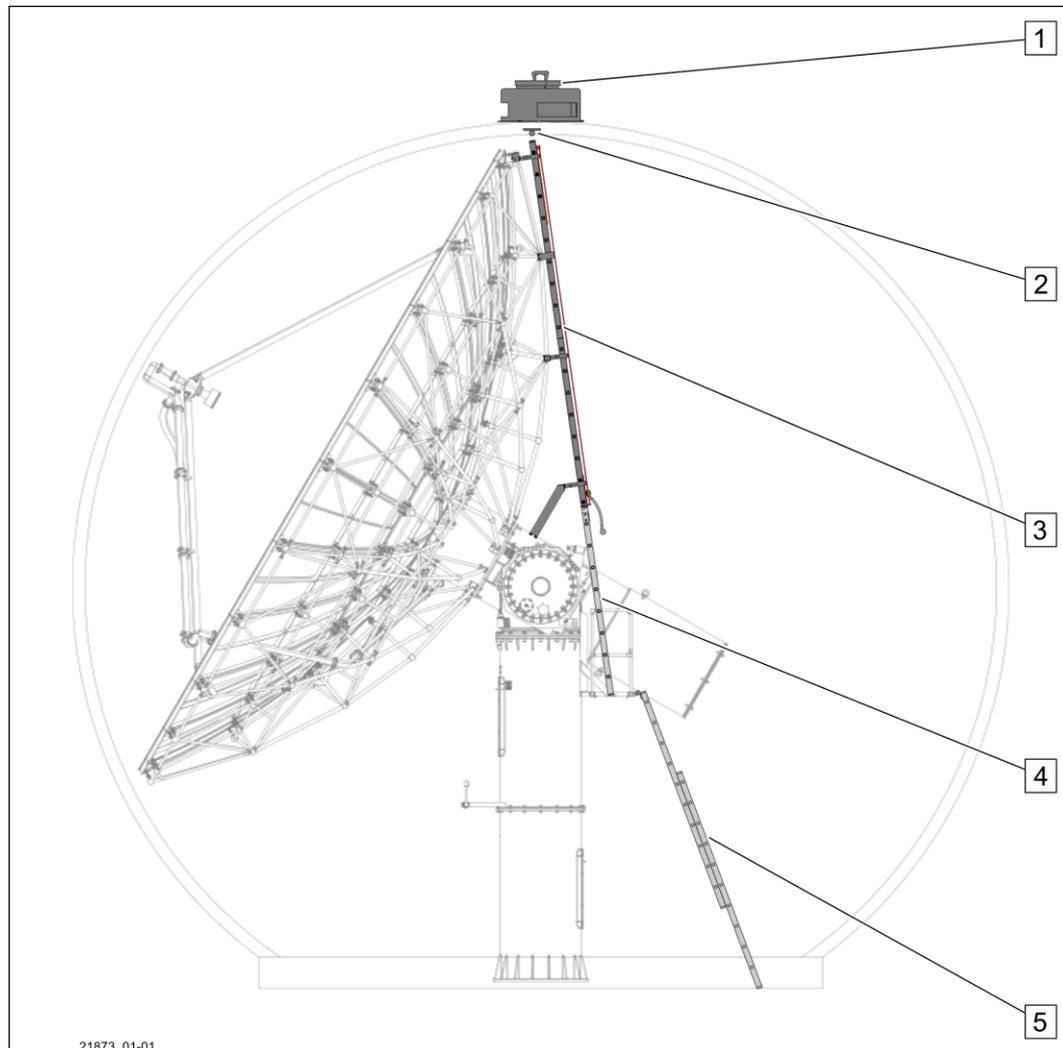


Fig. 17: Maintenance ladder in the radome (section)

- | | | | |
|---|---|---|---|
| 1 | Radome hatch (access to roof components) | 4 | Maintenance ladder B (from maintenance platform elevation unit to antenna maintenance ladder) |
| 2 | Safety bracket | 5 | Maintenance ladder to the maintenance platform of the elevation unit |
| 3 | Maintenance ladder A of the antenna (with fall protection system, permanently mounted on the rear of the antenna) | | |

General preparation and steps to be taken afterwards

The maintenance ladder A is connected to the antenna via 8 brackets.

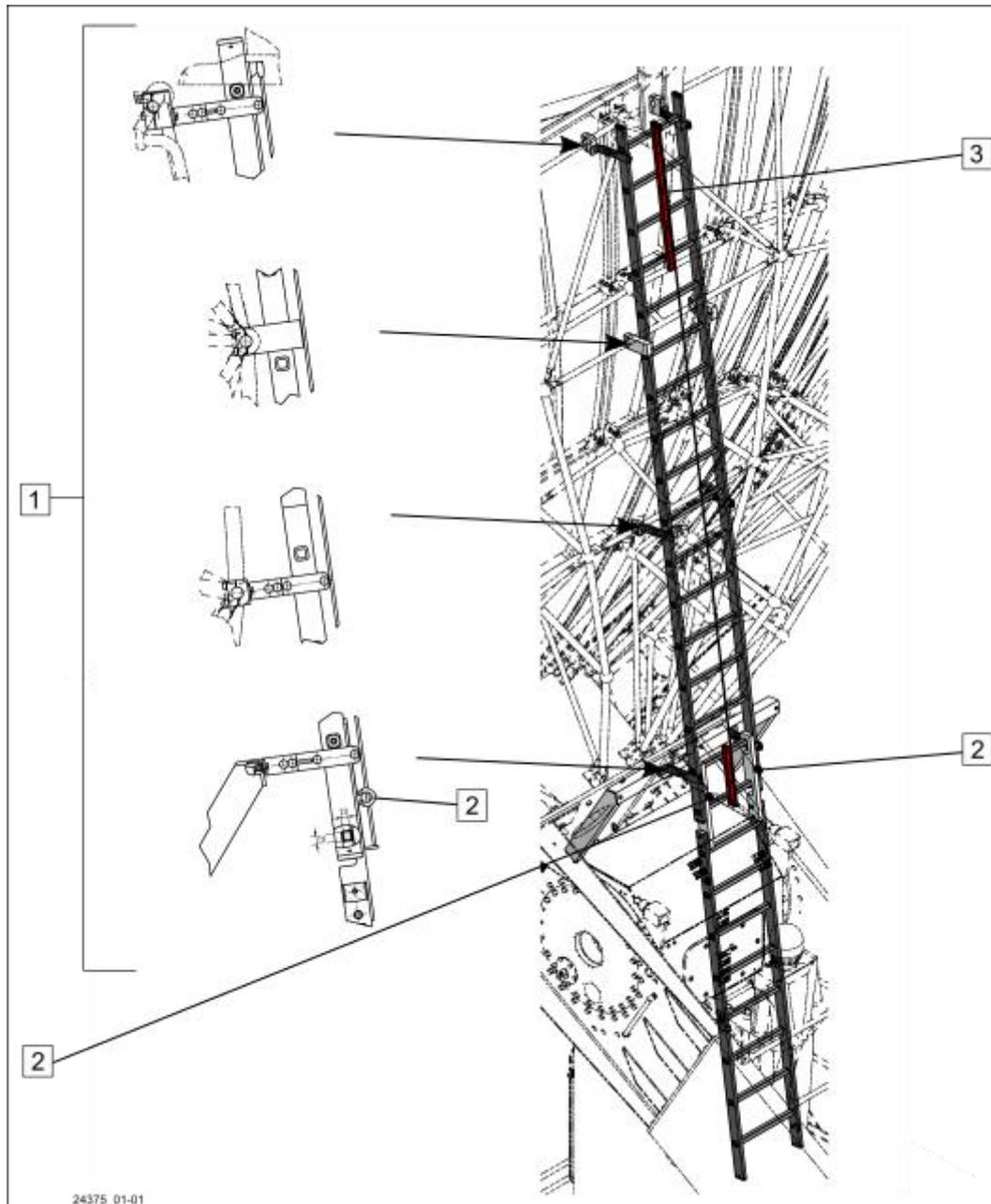


Abb. 18: Maintenance ladder with brackets

- 1 Brackets for ladder (8x)
- 2 Attachment points for the personal protective equipment (PPE)
- 3 Fall protection system

General preparation and steps to be taken afterwards

Safety

Personnel qualification

- To be executed only by an instructed person

Dangers



DANGER

Injury due to falling from a great height!



The radome is approximately 12 meters high, a fall can be fatal.

Therefore:

- Put on a body harness and fasten it to a load-bearing attachment point, (for example, on the fall protection system or safety bracket).

Personal protective equipment

- Protective work clothing
- Hard hat
- Body harness
- Safety rope system



*For more information see:
31 Vendor manuals*

Prerequisites

The prerequisite for execution of this preparation is that the listed tasks must be concluded.

For more information, see:

1. Align the antenna unit in maintenance position “Radome hatch”.
2. Screw in the retaining bolt into the elevation unit so that it can no longer rotate.



*For more information see:
07 Antenna Unit Service Manual*

3. Switch off the radar unit.
See chapter “9.3.2 Switching radar unit de-energized” on page 56.
4. Enter the antenna area.

General preparation and steps to be taken afterwards

Execution

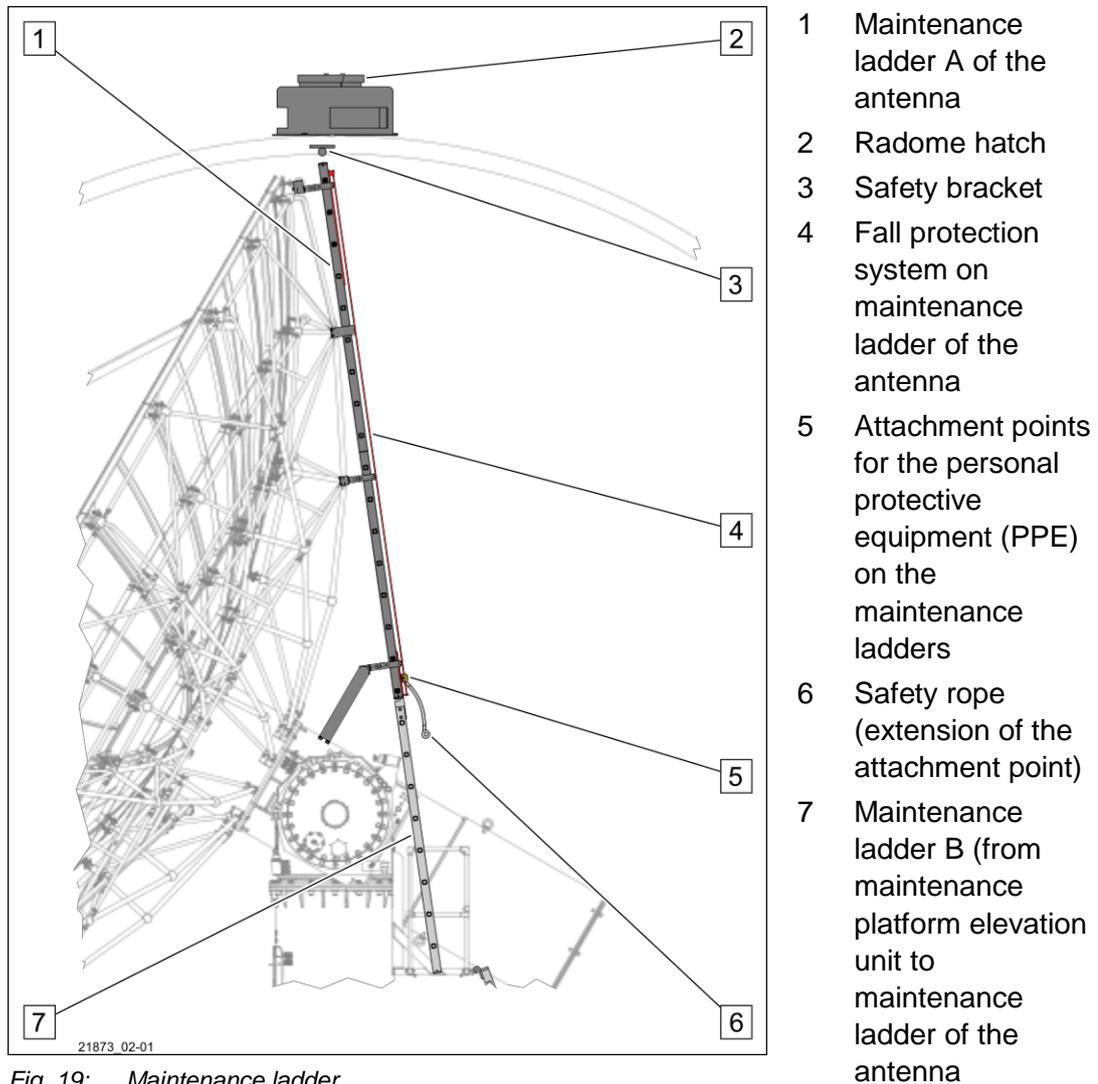


Fig. 19: Maintenance ladder

1. Climb onto maintenance platform, pull up maintenance ladder B and hang it into the rungs of maintenance ladder A. Place maintenance ladder B on the maintenance platform of the elevation unit.
2. Fasten the body harness to the safety rope.
3. Climb up the maintenance ladder and attach to the fall protection system of maintenance ladder A as soon as possible.
Release the body harness from the safety rope.
4. Climb up the maintenance ladder and attach to the safety bracket as soon as possible.
Release the body harness from the fall protection system.
5. Open the radome hatch.

General preparation and steps to be taken afterwards

Continued

The required tasks can now be continued.

General preparation and steps to be taken afterwards

9.3.5 Install climbing aids on the inside

Overview

For tasks on the panels of the radome on a higher level, suitable auxiliary equipment must be provided.

Safety

Personnel qualification

- To be executed only by an instructed person

Dangers



WARNING

Tasks at height!

For tasks at a height of more than 2 meters fatal falls can occur. In addition, impact and cutting injuries are possible on components.

Therefore:

- Put on a body harness and fasten it to a load-bearing anchor point before using climbing aids.



NOTICE

Point load of the radome panels!

The panels are manufactured in lightweight design (sandwich construction). High point loads can damage the panels.

Therefore:

- Only lean ladders that are equipped with padded stringers on the panels.
- When climbing on the outside, only wear shoes with rubber soles.

Special tools, auxiliary material

- Only place ladders that are equipped with cushioned stringers

General preparation and steps to be taken afterwards

Prerequisites

The prerequisite for execution of this preparation is that the listed tasks must be concluded.

For more information, see:

- Chapter “9.3.1 Align the antenna” on page 54.
- Chapter “9.3.2 Switching radar unit de-energized” on page 56.
- Chapter “9.3.3 Entering the antenna area” on page 59.

Execution

1. Identify the planned work area and estimate the height.
2. Set up a ladder with a sufficient length at a suitable point.

Continued

The required tasks can now be continued.

9.3.6 Install climbing aids on the outside

Overview

The measures for reaching the outside of the radome are determined by the set up conditions, in particular, through:

- The height of the tower
- Presence / absence of a platform
- Space and accessibility for a truck-mounted crane

For tasks on the outside, the following situation is ideal:

- The radome is surrounded by a platform that is accessible without additional auxiliary equipment.
- The platform offer sufficient space so that panels can be transported to and from the radome.
- The platform offers a safeguard (barrier) to protect against falling.
- The platform is equipped with load-bearing points that can be used to secure personnel and material (panels). Ideally one such load-bearing point is also available above the radome.

The procedure described here applies for the case that a platform is present.

General preparation and steps to be taken afterwards



NOTE

If a platform is not present, a crane must be set up, from which the appropriate tasks are executed.

If a parking place is not available for the crane, or if the installation location is not accessible for vehicles contact Leonardo-Gematronik.

Safety

Personnel qualification

- Execution only by a supervisory worker at height.

Dangers



DANGER

Longer free suspension at a great height!

Depending on the condition of radome and tower, abseiling (rappelling) from a load-bearing point may be required. Hanging freely suspended for an extended period of time may result in suspension trauma including life-threatening orthostatic shock.

Therefore:

- Only workers at height are allowed to execute tasks on the outside of the radome.
- Ensure safety for the tasks through a supervisory worker at height.
- Put on a body harness and secure it to a load-bearing anchor point.



WARNING

Microwave radiation due to "transmit mode"!

In "transmit mode" microwave radiation occurs that can overheat the body and cause severe injuries.



The system is equipped by the manufacturer with all necessary safety devices that prevent this.

Therefore:

- Ensure that all safety devices are in force.



WARNING

Tasks at height!

For tasks at a height of more than 2 meters fatal falls can occur. In addition, impact and cutting injuries are possible on components.

Therefore:

- Put on a body harness and fasten it to a load-bearing anchor point before using climbing aids.

General preparation and steps to be taken afterwards



NOTICE

Point load of the radome panels!

The panels are manufactured in lightweight design (sandwich construction). High point loads can damage the panels.

Therefore:

- Only lean ladders that are equipped with padded stringers on the panels.
- When climbing on the outside, only wear shoes with rubber soles.

General preparation and steps to be taken afterwards

Personal protective equipment

For tasks above 2 m in height wear:

- Body harness

Special tools, auxiliary material

- Only place ladders that are equipped with cushioned stringers

Prerequisites

The prerequisite for execution of this preparation is that the listed tasks must be concluded.

For more information, see:

- See chapter “9.3.2 Switching radar unit de-energized” on page 56.

Execution

1. Identify the planned work area and estimate the height.
2. Put on a body harness and secure it to a load-bearing anchor point.
3. Set up a ladder with a sufficient length at a suitable point.

Continued

The required tasks can now be continued.

General preparation and steps to be taken afterwards

9.4 Tasks to be performed afterwards

9.4.1 Locking the antenna area

Overview

In order to start the radar unit, the access to the antenna area must be locked.

Safety

Personnel qualification

- To be executed only by an instructed person

Dangers



DANGER

Personnel can be trapped inside the antenna area!

The presence of personnel in the antenna area during operation results in fatal injuries due to impact and microwave radiation.

Therefore:

- Prior to locking the access, ensure that no one is in the antenna area.

Protection from material damage



NOTICE

Objects in the movement range of the antenna!

Tools, mounting equipment or other objects that have been left behind in the movement range of the antennas, result in severe damage.

Therefore:

- Prior to recommissioning, ensure that there are no foreign objects in the antenna area.

Prerequisites

- All tasks in and on the antenna area must be concluded.

General preparation and steps to be taken afterwards

Execution

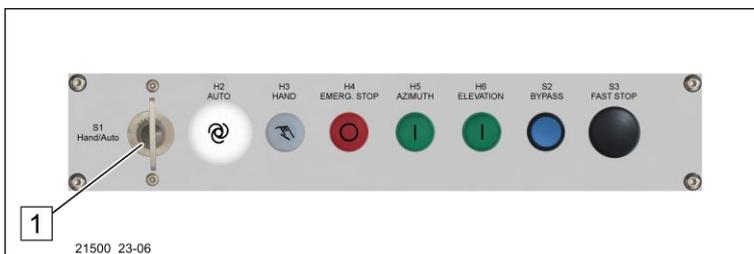
1. Ensure that no one is in the antenna area and that no objects are in the movement range of the antenna.
2. Close the access to the antenna area.
3. Insert key (#38) in the guard locking device.
4. With key (#200) lock the access hatch on the guard locking device and remove key (#200).



- 1 Access
- 2 Lock cylinder with key (#38)
- 3 Lock cylinder with key (#200)

Fig. 20: Access to the antenna area

5. Insert the key (#200) into the key switch S1 Auto/Manual on the control panel of the antenna control unit and switch to "Auto" position.
The indicator light H2 (AUTO) on the control panel of the antenna control unit is illuminated.



- 1 Key switch S1 Auto/Manual

Fig. 21: Control panel of the antenna control unit

Steps to be taken afterwards

1. Chapter "9.4.2 Place the radar unit in service again" on page 73.

General preparation and steps to be taken afterwards

9.4.2 Place the radar unit in service again

After concluding the service tasks, execute the following tasks to ensure safe start-up of the radar unit:

1. Ensure that all tools, materials, and other pieces of equipment have been removed from the work area.
2. Clean the work area and remove any substances that may have escaped.
3. Ensure that all maintenance hatches and doors are locked and bolted.
4. Ensure that no one is in the danger zone.
5. Ensure that all emergency stop switches and emergency off switches are reset.
6. Ensure that the safety devices are functioning.
7. Switching on and create operational readiness.



*For more information see:
01 System operating manual*



*For more information see:
03 System Service Manual*

General preparation and steps to be taken afterwards

10 Maintenance

Personnel qualification

- The work described here can be executed by an instructed person unless otherwise indicated.
- Some tasks should only be executed by especially trained, expert personnel. On the required qualifications will be pointed separately in the respective description.
- Only qualified electricians must perform work on the electrical equipment.

Any maintenance tasks or adjustment tasks, or fault correction tasks that are not described in the scope of this operating manual should only be executed by the manufacturer or by persons authorized by the manufacturer.

Dangers



Danger

Contact with live electrical components!



Contact with live electrical components can cause a fatal electric shock.

Therefore:

- Before starting any maintenance work or fault correction switch off the electrical voltage.



WARNING

Improper service!

Improperly executed service work can cause serious injury or property damage.

Therefore:

- Only perform work which was released by admission to the service instructions of the manufacturer.
- Leave perform work only by persons with the relevant qualifications.

Maintenance



WARNING

Unintentional system operation!

The radar system is controlled in normal operation. For maintenance tasks and fault corrections, unintentional access to the system can cause severe injuries.

Therefore:

- Prior to all tasks on the radar system activate the "local mode".



NOTICE

Loss of system-relevant data!

When replacing spare parts, data loss can occur in the control software or in the signal processing. This can cause malfunctions or failure of the radar unit.

Therefore:

- A data backup must be performed before each spare part replacement.

10.1 Safety



NOTICE

Objects in the movement range of the antenna!

Tools, mounting equipment or other objects that have been left behind in the movement range of the antennas, result in severe damage.

Therefore:

- Prior to recommissioning, ensure that there are no foreign objects in the antenna area.

10.2 List of maintenance tasks

Overview

Service tasks required for optimal and trouble-free operation are described in the sections below.

If increased wear is detected during regular inspections, reduce the required service intervals according to the actual indications of wear.

All service tasks listed here are also listed in the overall maintenance schedule.



*For further information see:
02 System Maintenance Schedule*



NOTE

To record and log the service tasks digitally, a maintenance form is available on the System CD of the radar system.

List

Interval	Service task	Qualification	System/Subsystem	Date	Name
6 months	Check obstruction light (if exists)	4	12		
12 months * ¹	Check panel surface	5	12		
12 months * ¹	Check radome for leaks	5	12		
24 months * ²	Check threaded unions on the panel	4	12		

*¹This maintenance cycle can be extended to 36 months if the following ambient conditions apply:

- If there is not a high level of air pollution
- If the air does not contains salt
- If the environment is not sandy and windy

*²This maintenance cycle will apply in stormy environments where wind speeds in excess of 100km/h have occurred directly on site in the last 24 months. Ensure that the 24-month cycle is maintained at least once after installation. Based on experience, the cycle can later be extended to a maximum of 36 months.

Maintenance

Legend

Interval

Shown here is the number of months in which the maintenance work is to be repeated.

Service task

Shown here is the short description of the service task. Under heading of the same name are the detailed instructions.

Qualification

Shown here is the personal qualification of the executive personnel.

Key	Explanation
1	Radar engineer
2	Electrical engineer
3	Mechanical engineer
4	Instructed person
5	Supervisory worker at height

System/Subsystem

Shown here is the register number of the Service Manual in which the service task is described.

Date

Field for logging the service task in the overall maintenance schedule or in the maintenance form.

Name

Field for logging the service task in the overall maintenance schedule or in the maintenance form.

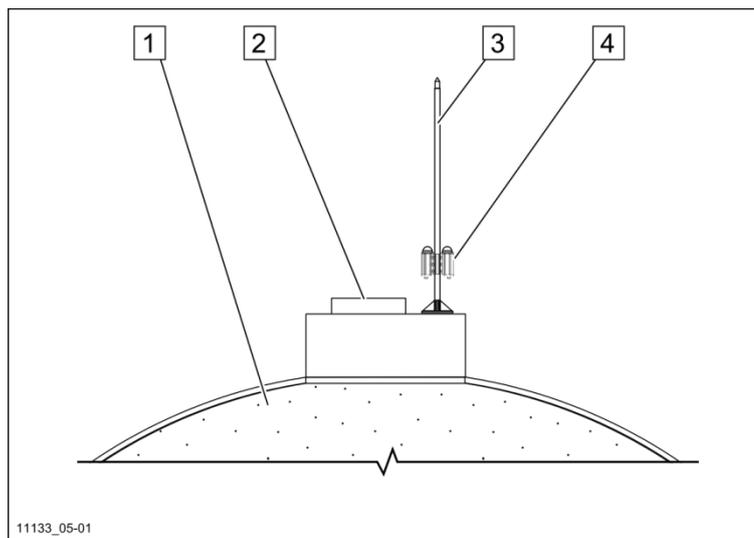
*²This maintenance cycle will apply in stormy environments where wind speeds in excess of 100km/h have occurred directly on site in the last 24 months. Ensure that the 24-month cycle is maintained at least once after installation. Based on experience, the cycle can later be extended to a maximum of 36 months.

10.3 Maintenance tasks

10.3.1 Checking the obstruction light

Overview

Position



- 1 Radome
- 2 Radome hatch
- 3 Lightning protection rod
- 4 Obstruction light

Fig. 22: Roof components – position of the obstruction light

Designation from spare parts list without specification

Obstruction Light

Function

The obstruction light is attached at the highest point of the radome. It is permanently illuminated red (2-flame) and thus marks the highest point of the radar unit. This is primarily used to avoid air traffic accidents.



NOTE

Checking the obstruction light is possible at night through visual inspection at night, without auxiliary equipment.

In the daytime inspection using binoculars is recommended depending on the installation conditions. The obstruction light must be replaced immediately in the event of a fault.

Maintenance

Safety

Personnel qualification

Visual inspection:

- To be executed only by an instructed person

Special tools, auxiliary material

- Binoculars

Measurement equipment

- not necessary

Preparation

- not necessary

Execution

1. Check obstruction light for function.

Test type:

- Visual inspection

Setpoint:

- The obstruction light is continuously illuminated red.

Test result:

- Setpoint reached
The test is concluded.
- Setpoint not reached
Chapter "11.3.1 Replacing the obstruction light" on page 95.

Steps to be taken afterwards

- not necessary

10.3.2 Check the panel surface

Overview

Radome damage results in transmission losses and consequential damage to the subsystems that are in the radome.

As part of maintenance work, the panels are cleaned contamination and damage is repaired. If damage is determined, in addition it must be assessed.

Safety

Personnel qualification

Tasks on the outer skin:

- To be executed only by a worker at height

Personal protective equipment

For all tasks wear:

- Protective work clothing
- Protective gloves
- Hard hat
- Safety footwear
- Body harness

Tasks on the outer skin:

- Shoes with soft rubber soles
- Safety rope system



*For more information see:
31 Vendor manuals*

Special tools, auxiliary material

- not necessary

Measurement equipment

- not necessary

Maintenance

Preparation

1. Align the antenna.
2. Switch off the radar unit.
3. Entering the radome.
4. Install climbing aids on the inside.
5. Install climbing aids on the outside.

Execution

1. Check all panels of the radome for contamination, inside and out.
Test type:
 - Visual inspectionSetpoint:
 - CleanTest result:
 - Setpoint reached
Continue test in the next step.
 - Setpoint not reached
2. Check all panels of the radome for contamination, inside and out.
Test type:
 - Visual inspectionSetpoint:
 - UndamagedTest result:
 - Setpoint reached
The test is concluded.
 - Setpoint not reached
Continue test in the next step.

3. Assess damage:

- Scratches or extensive abrasion of the surface coating
- Damage of the laminate layer:
 - Fracture point **50 cm** in length with minimal core damage
 - Fracture point or hole on the interior with a length or diameter of up to **20 cm** with severe core damage
 - Fracture point or hole on the interior and exterior with a length or diameter of up to **15 cm**.
- Damage over a greater surface area

Steps to be taken afterwards

Re-attach all dismantled assemblies and components and reconnect all disconnected connections.

1. Remove climbing aids.
2. Locking the radome.
3. Place the radar system in service again.
4. Switching on and create operational readiness.



*For more information see:
03 System Service Manual*

Maintenance

10.3.3 Checking radome watertightness

Overview

To prevent damage to the radar unit, moisture must not penetrate into the radome.

The leak-tightness of the radome should only be checked after eliminating all damage on the panels.

The ideal test condition is present during a heavy rainstorm.

Safety

Personnel qualification

Tasks on the outer skin:

- To be executed only by a worker at height

Dangers



NOTICE

Panel damage due to water jet!

The surface structure of the radome is not designed for a high point load. Panels can be damaged by a strong water jet.

Therefore:

- Only aim a moderately strong and scattered water jet at the radome.

Personal protective equipment

For all tasks wear:

- Protective work clothing
- Hard hat
- Safety footwear

Tasks on the outer skin:

- Body harness
- Shoes with soft rubber soles
- Safety rope system



*For more information see:
31 Vendor manuals*

Special tools, auxiliary material

- Sealant: Sikaflex® -521 UV

Measurement equipment

- not necessary

Preparation

1. Align the antenna.
2. Switch off the radar unit.
3. Entering the radome.
4. Install climbing aids on the inside.

Execution

1. Wait for a rainstorm or spray off the entire radome with a moderately strong, scattered water jet.
2. Inspect the entire interior surface of the radome one section at a time and check for leaks.
 Test type:
 - Visual inspection
 Setpoint:
 - No pooling on the surface
 Test result:
 - Setpoint reached
The test is concluded.
 - Setpoint not reached
Continue test in the next step.
3. Identify leaks in the radome through water pooling.



NOTE!

Drops of penetrating liquid can form below the leak. Consequently the location where the drops form does not necessarily mark the leak.

Maintenance

4. Mark all leaks.
5. Wait for a period of continuing dry weather for the sealing task.
6. Seal the marked points on the outer skin of the radome with a suitable sealing compound.
7. Recheck radome for leaks. To do this, a water jet can be aimed at the parts that have just been sealed.

Steps to be taken afterwards

Re-attach all dismantled assemblies and components and reconnect all disconnected connections.

1. Remove climbing aids.
2. Locking the radome.
3. Place the radar system in service again.
4. Switching on and create operational readiness.



*For more information see:
03 System Service Manual*

10.3.4 Check threaded unions on the panel

Overview

This maintenance task is for the threaded unions between panels and base ring, also between the panels.

The threaded unions for the base ring must be re-tightened in any case. The threaded unions between the panels only need to be re-tightened if the result of the inspection is negative.

Safety

Personnel qualification

- To be executed only by an instructed person

Personal protective equipment

For all tasks wear:

- Protective work clothing
- Safety goggles with side and eyebrow guard
- Hard hat
- Safety footwear
- Body harness

Special tools, auxiliary material

- Torque wrench (10-50 Nm)

Measurement equipment

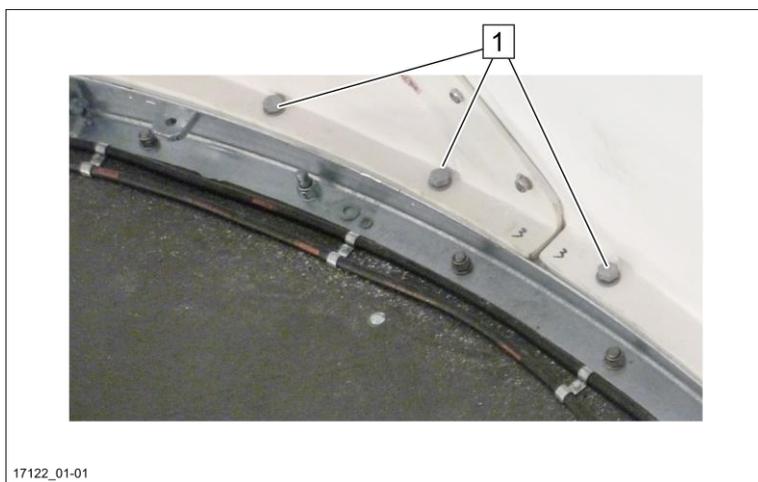
- not necessary

Maintenance

Preparation

1. Align the antenna.
See chapter “9.3.1 Align the antenna” on page 54.
2. Switch off the radar unit.
See chapter “9.3.2 Switching radar unit de-energized” on page 56.
3. Entering the radome.
See chapter “9.3.3 Entering the antenna area” on page 59.

Execution



- 1 Threaded union between panels and base ring

17122_01-01

Fig. 23: Connection between panels and base ring
(sample illustration)

1. Firmly tighten all panel threaded unions for the base ring to target torque.
 - See chapter “13.1 Screw tightening torque” on page 123.
2. Select 50 threaded unions between the panels at different height levels and deflection areas of the radome, as samples:
Test type:
 - Torque test

Setpoint:

- See chapter “13.1 Screw tightening torque” on page 123.

Test result:

- Setpoint reached
The test is concluded.
- Setpoint not reached
Tighten screws to target torque and record the number of retightened screws.

3. Calculate the number of screws that were retightened.

Setpoint:

- Maximum 10% of the retightened screws

Test result:

- Setpoint reached
The test is concluded.
- Setpoint not reached
Perform the fault correction „Retighten threaded unions on the panel“.
See chapter „Retighten threaded unions on the panel“

Steps to be taken afterwards

Re-attach all dismantled assemblies and components and reconnect all disconnected connections.

1. Locking the radome.
See chapter “9.4.1 Locking the antenna area” on page 71.
2. Place the radar system in service again.
See chapter “9.4.2 Place the radar unit in service again” on page 73.
3. Switching on and create operational readiness.
See chapter “8.3 Switching on and create operational readiness” on page 49.



*For more information see:
03 System Service Manual*

Maintenance

11 Fault

11.1 Safety

11.1.1 Personnel

- The work described here can be executed by an instructed person unless otherwise indicated.
- Some tasks should only be executed by especially trained, expert personnel. On the required qualifications will be pointed separately in the respective description.
- Only qualified electricians must perform work on the electrical equipment.
- Some tasks should only be executed by the manufacturer.

Any maintenance tasks or adjustment tasks, or fault correction tasks that are not described in the scope of this operating manual should only be executed by the manufacturer or by persons authorized by the manufacturer.

11.1.2 Dangers



Danger

Contact with live electrical components!

Contact with live electrical components can cause a fatal electric shock.

Therefore:

- Before starting any maintenance work or fault correction switch off the electrical voltage.



WARNING

Unintentional system operation!

The radar system is controlled in normal operation. For maintenance tasks and fault corrections, unintentional access to the system can cause severe injuries.

Therefore:

- Prior to all tasks on the radar system activate the "local mode".

Fault



WARNING

Improper service and technical modifications!

Servicing the device in an improper manner or introducing unauthorized technical modifications can affect the device's suitability for the intended use and cause dangerous situations.

Therefore:

- Only perform tasks which have been approved by the manufacturer by inclusion in a service manual.
- Service the device only in accordance with the technical specifications provided by Leonardo-Gematronik.
- For service activities, use only spare parts approved by Leonardo-Gematronik and considered to be compatible by Leonardo-Gematronik.
- Strictly comply with all information in this service manual.



NOTICE

Loss of system-relevant data!

When replacing spare parts, data loss can occur in the control software or in the signal processing. This can cause malfunctions or failure of the radar unit.

Therefore:

- A data backup must be performed before each spare part replacement.

11.1.3 Behavior in the event of fault

The following always applies:

1. For faults that pose an imminent danger for personnel and or material, immediately execute the emergency-off function.
2. Immediately inform the responsible parties at the installation site of the fault.
3. Determine the cause of the fault.
4. If correction of the fault requires work in the danger zone, switch off the radar unit and safeguard it against being restarted.
5. Depending on the type of fault, either have authorized specialized personnel correct the fault, or correct it yourself.

**NOTICE****Objects in the movement range of the antenna!**

Tools, mounting equipment or other objects that have been left behind in the movement range of the antennas, result in severe damage.

Therefore:

- Prior to recommissioning, ensure that there are no foreign objects in the antenna area.

11.2 Fault analysis

Fault analysis occurs as part of the maintenance tasks:

For more information, see:

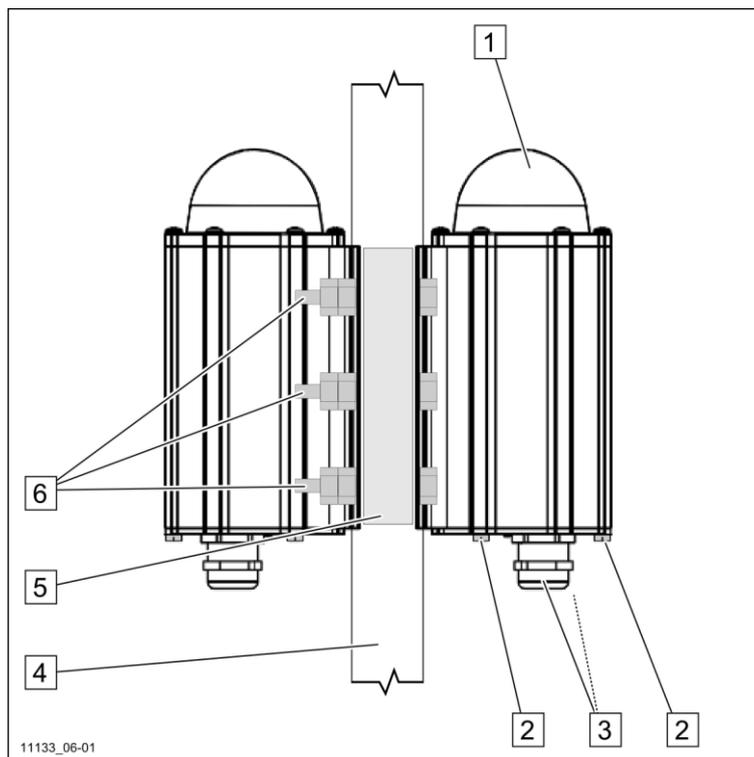
- See chapter “10.3 Maintenance tasks” on page 79.

11.3 Fault correction

11.3.1 Replacing the obstruction light

Overview

Position



- 1 Light fixture
- 2 Housing screw
- 3 Strain relief element
- 4 Lightning protection rod
- 5 Spacer
- 6 Mounting screw

Fig. 24: Component overview

Designation from spare parts list without specification

Obstruction Light

Function

The component consists of 2 separate light illuminants. The voltage is supplied via 3-conductors, and (electrically considered) looped through to the 2nd light illuminant.

Fault

Safety

Personnel qualification

Visual inspection:

- Execution only by an electrical engineer

Dangers



DANGER

Electrical voltage on the obstruction light!



The power supply for the obstruction light is not disconnected by switching off the main switch on the main power distribution box.

Therefore:

- For all tasks on the obstruction light, the fuse for the obstruction light in the main power distribution box must always be switched off.
- Prior to performing tasks on the obstruction light, ensure that it is de-energized.

Personal protective equipment

- Protective work clothing
- Safety footwear
- Safety goggles with side and eyebrow guard
- Hard hat
- Body harness

Special tools, auxiliary material

- not necessary

Measurement equipment

- not necessary

Preparation

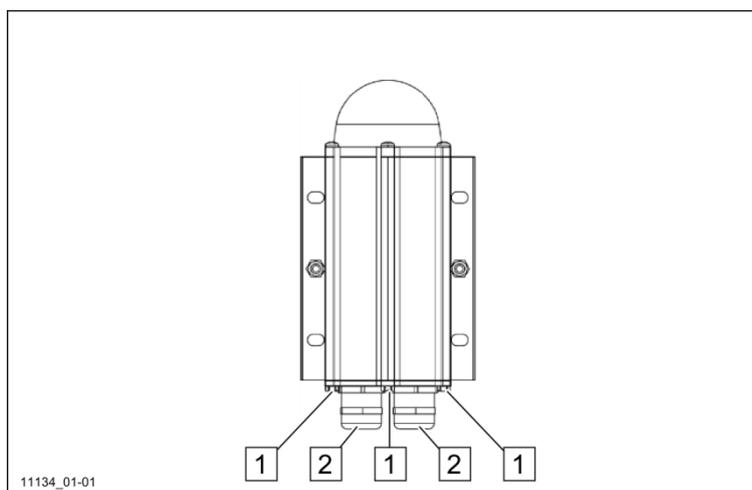
As preparation for execution, the cited tasks must be performed in the proper sequence.

For more information, see:

- Chapter “9.3.1 Align the antenna” on page 54.
- See chapter “9.3.2 Switching radar unit de-energized” on page 56.
- See chapter “9.3.3 Entering the antenna area” on page 59.
- See chapter “9.3.4 Reaching roof components” on page 61.

Execution

1. **⚠ DANGER**
Electrical shock due to 230 VAC power on the terminals!
Ensure that the obstruction light is de-energized.
2. Prior to mounting, check the new illuminants for function.
3. De-energize the obstruction light on the main power distribution box.
4. Open the hatch.
5. Disconnect the connections on the defective illuminant:

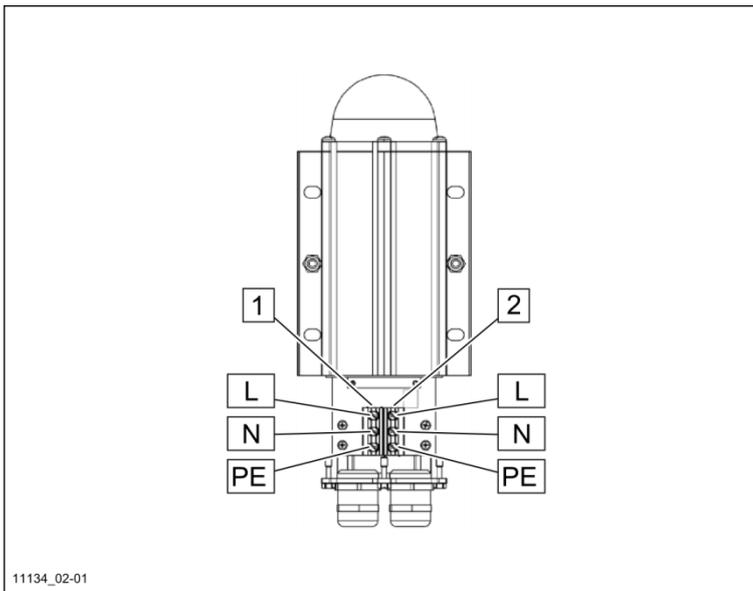


- 1 Housing screw (3x)
- 2 Strain relief element (2x)

Fig. 25: Open the housing

- a. Detach the strain relief elements.
- b. Unscrew the housing screws.
- c. Pull housing downward.

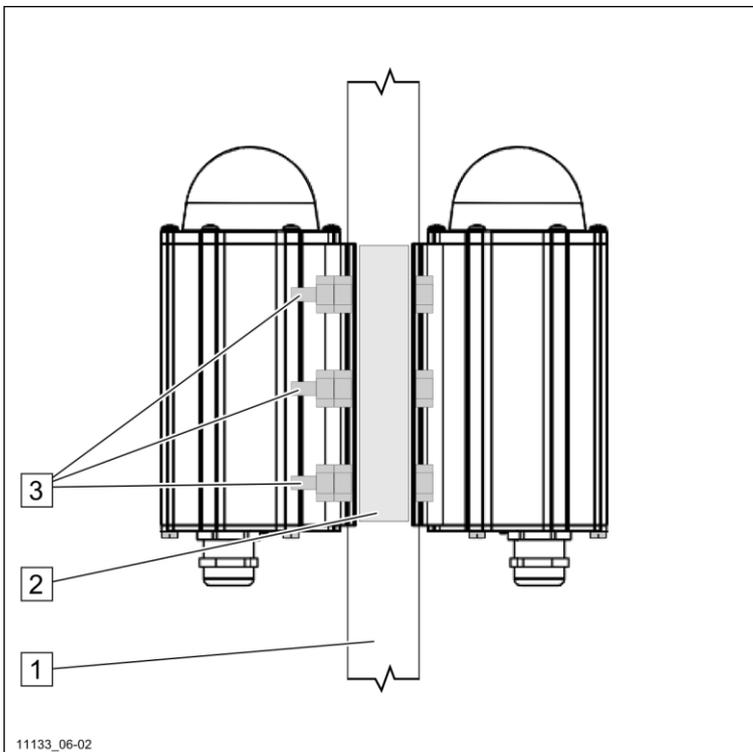
Fault



- 1 Input terminals
- 2 Output terminals

Fig. 26: Disconnect cable

- d. Check for de-energized status.
 - e. Disconnect the cables on the terminals.
 - f. Pull cables out of the housing.
6. Unscrew mounting screws on the obstruction light and remove the defective illuminant.



- 1 Lightning protection rod
- 2 Spacer (4x)
- 3 Mounting screw (6x)

Fig. 27: Detach obstruction lights

7. Mount new obstruction lights and spacers on the lightning protection rod.
8. Electrically connect the obstruction lights.
To do this, remove 3 screws.
9. Ensure that the housing of the obstruction light has been properly mounted and that it can withstand the weather influences.
10. Check obstruction light for function.

Steps to be taken afterwards

Re-attach all dismantled assemblies and components and reconnect all disconnected connections.

- Remove climbing aids
- See chapter "9.4.1 Locking the antenna area" on page 71.
- See chapter "9.4.2 Place the radar unit in service again" on page 73.
- Section "Switching on and establishing operational readiness"



*For more information see:
03 System Service Manual*

Fault

11.3.2 Cleaning panels

Overview

Contamination that stays on the inside or on the outside can corrode the surface coating and must be removed.

Safety

Personnel qualification

Tasks on the outer skin:

- To be executed only by a worker at height

Dangers



NOTICE

Improper cleaning of the panels!

Abrasive cleaning agents and unsuitable auxiliary equipment can damage the surface coating and the laminate layer of the panels.

Therefore:

- Only use suitable auxiliary equipment.
- Apply only little pressure when cleaning.

Personal protective equipment

For all tasks wear:

- Protective work clothing
- Protective gloves
- Hard hat
- Safety footwear

Tasks on the outer skin:

- Body harness
- Shoes with soft rubber soles

Special tools, auxiliary material

- Cleaning agent soft soap

Measurement equipment

- not necessary

Preparation

1. Align the antenna.
Chapter “9.3.1 Align the antenna” on page 54.
 2. Switch off the radar unit.
See chapter “9.3.2 Switching radar unit de-energized” on page 56.
 3. Entering the radome.
See chapter “9.3.3 Entering the antenna area” on page 59.
 4. Install climbing aids on the inside.
See chapter “9.3.5 Install climbing aids on the inside” on page 66.
- or
5. Install climbing aids on the outside.
See chapter “9.3.6 Install climbing aids on the outside” on page 67.

Execution

1. Locate the contamination that must be removed.
2. Clean panels with cleaning agent using a soft brush or cotton cloth.
3. Visually inspect the panels for damage after cleaning them.

Steps to be taken afterwards

Re-attach all dismantled assemblies and components and reconnect all disconnected connections.

1. Remove climbing aids.
2. Locking the radome.
See chapter “9.4.1 Locking the antenna area” on page 71.
3. Place the radar system in service again.
See chapter “9.4.2 Place the radar unit in service again” on page 73.
4. Switching on and create operational readiness.
See chapter “8.3 Switching on and create operational readiness” on page 49.



*For more information see:
03 System Service Manual*

Fault

11.3.3 Restoring the surface coating

Overview

The surface coating is applied on the exterior panel surface. It is water-resistant and protects the laminate layer from the effects of sunlight. Damage must be rectified so that foreign objects (e.g. sand) or moisture cannot penetrate into the panels.

Safety

Personnel qualification

- To be executed only by a worker at height

Dangers



CAUTION

Exposed glass-fiber fabric!

When processing the laminate layer, glass-fiber fabric is exposed, its particles can harm the eyes and respiratory tract.

Therefore:

- Wear safety goggles with side and eyebrow guard.
- Wear respirator with particle filter.



NOTICE

Improper surface coating

Over the long term, improper restoration of the surface coating can result in panel damage and radome leaks.

Therefore:

- Only use Leonardo-Gematronik approved repair materials.
- Do not use repair materials with a use-by date that has expired.

Personal protective equipment

For all tasks wear:

- Protective work clothing
- Respirator with particle filter
- Safety goggles with side and eyebrow guard
- Protective gloves
- Hard hat
- Safety footwear
- Body harness
- Shoes with soft rubber soles

Special tools, auxiliary material

Repair kit authorized ■ by Leonardo-Gematronik.

Measurement equipment

- not necessary

Prerequisites

- Completely dry panels
- Dry weather within the next 24 hours (according to weather report).
- Temperatures above 7 degrees centigrade within the next 24 hours (according to the weather report)
- Minimum wind speed in sandy or dusty environments

Preparation

1. Align the antenna.
Chapter "9.3.1 Align the antenna" on page 54.
 2. Switch off the radar unit.
Chapter "9.3.2 Switching radar unit de-energized" on page 56.
 3. Entering the radome.
Chapter "9.3.3 Entering the antenna area" on page 59.
 4. Install climbing aids on the inside.
Chapter "9.3.5 Install climbing aids on the inside" on page 66.
- or
5. Install climbing aids on the outside.
Chapter "9.3.6 Install climbing aids on the outside" on page 67.

Fault

Execution

1. Use sand paper to sand off the damaged surface coating. Ensure that the sanded spot is consistently smooth and smooth.
2. Prime the sanded point. To do this, apply the primer in several thin coats.
3. Wait until the primer is dry to the touch.
4. Carefully mix the surface coating.
5. Use a spray gun to apply the surface coating. Apply the coating as thick as possible while avoiding the formation of sags.

Steps to be taken afterwards

Re-attach all dismantled assemblies and components and reconnect all disconnected connections.

1. Remove climbing aids.
2. Locking the radome.
See chapter "9.4.1 Locking the antenna area" on page 71.
3. Place the radar system in service again.
See chapter "9.4.2 Place the radar unit in service again" on page 73.
4. Switching on and create operational readiness.
See chapter "8.3 Switching on and create operational readiness" on page 49.



*For more information see:
03 System Service Manual*

11.3.4 Repair panel

Overview

Smaller area panel damage can be rectified without having to move the panel in question. To do this, core and laminate layer on the damaged point are cut out and replaced by a precisely fitted replacement core.

In this regard, note that the core can also show damage caused by cracks or fractures even if the laminate layer above seems intact. Consequently the laminate layer and the core may have to be cut out of a larger area than planned during the inspection.



NOTE

The description assumes damage on one side. If there is a hole, after inserting the core, the laminate layers on both sides must be replaced, thus twice the number of glass-fiber mats must be prepared.

Safety

Personnel qualification

Tasks on the outer skin:

- To be executed only by a worker at height

Dangers



WARNING

Explosive binder!

The binder used for the repairs is mixed from the 2-component polyester resin and catalyst (MEK peroxide). The effect of heat or force can cause explosions.

Therefore:

- Avoid the effects of heat or force.
- Provide sufficient ventilation.
- Provide for sufficient hygiene during and after processing.



WARNING

Flammable acetone!

Acetone is highly flammable.

Therefore:

- Avoid the effects of heat.
- Provide sufficient ventilation.

Fault



CAUTION

Corrosive binder!

Contact with the binder MEK peroxide may cause trachoma, respiratory disorders and, if swallowed, disorders of the digestive tract.

Therefore:

- Wear plastic gloves (e.g. vinyl or latex).
- Avoid skin and eye contact.



CAUTION

Acetone fumes occur!

When cleaning with acetone, fumes occur that can harm the respiratory tract and cause headaches.

Therefore:

- Wear respirator.
- Provide sufficient ventilation.



CAUTION

Exposed glass-fiber fabric!

When processing the laminate layer, glass-fiber fabric is exposed, its particles can harm the eyes and respiratory tract.

Therefore:

- Wear safety goggles with side and eyebrow guard.
- Wear respirator with particle filter.

Personal protective equipment

For all tasks wear:

- Protective work clothing
- Protective gloves
- Hard hat
- Safety footwear

Tasks on the outer skin:

- Body harness
- Shoes with soft rubber soles

Special tools, auxiliary material

- Binder, consisting of polyester resin and the catalyst MEK peroxide
- Cleaning agent acetone!
- Putty knife

Measurement equipment

- not necessary

Prerequisites

For repairs on the outside of the panel:

- Completely dry panels
- Dry weather within the next 24 hours (according to weather report).
- Temperatures above 7 degrees centigrade within the next 24 hours (according to the weather report)
- Minimum wind speed in sandy or dusty environments

Preparation

1. Align the antenna.
See chapter "9.3.1 Align the antenna" on page 54.
 2. Switch off the radar unit.
See chapter "9.3.2 Switching radar unit de-energized" on page 56.
 3. Entering the radome.
See chapter "9.3.3 Entering the antenna area" on page 59.
 4. Install climbing aids on the inside.
See chapter "9.3.5 Install climbing aids on the inside" on page 66.
- or
5. Install climbing aids on the outside.
See chapter "9.3.6 Install climbing aids on the outside" on page 67.

Fault

Execution

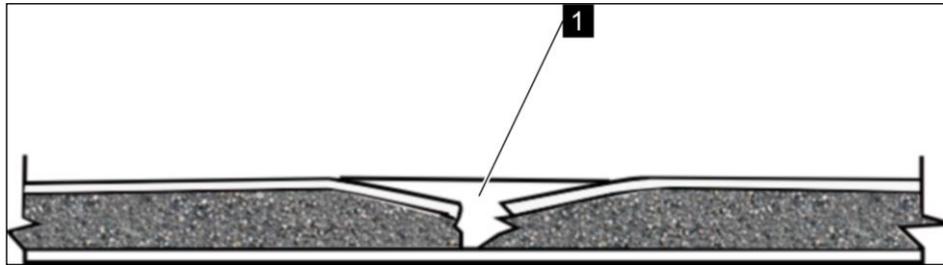


Fig. 28: Panel damage on laminate layer (1) and core

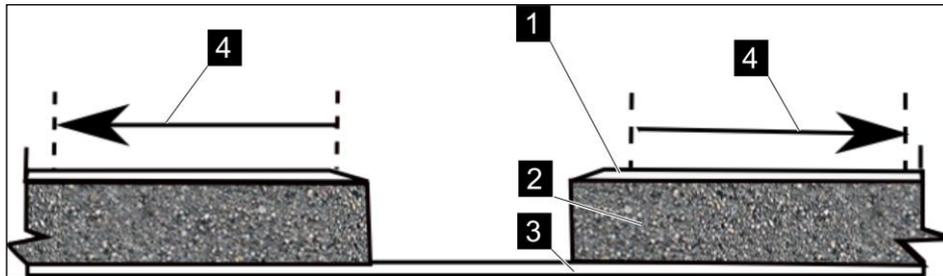


Fig. 29: Cutting out damaged portions

- | | | | |
|---|--|---|---|
| 1 | Angled first cut of the damaged laminate layer | 3 | Intact laminate layer of the other side |
| 2 | Core | 4 | Sanding direction |

1. ! CAUTION

Cut injuries due to inadvertent slip off!

Put on protective gloves and keep your hands away from the cutting direction.

2. Use a sharp knife to cut the damaged laminate layer out of the panel. While doing so, hold the knife at an angle towards the damaged portion.
3. ! NOTICE
Careless cut-out of the core!
To cut out the core, proceed cautiously with minimal expenditure of force, to ensure that the intact laminate layer of the opposite side is not damaged.
4. Very carefully cut the core out of the panel. While doing so, hold the knife at a right angle to the panel surface.



NOTE!

Be aware that the replacement core must be cut to size precisely. It is easiest to replace a rectangular section.

5. Carefully remove all loose core and laminate fragments.
6. Sand off the laminate layer at the fracture point down to a smooth and sharp edge.
7. If there is damage on the outside of the panel. Sand surface coating of the laminate layer at a distance of 10 cm to the fracture point.
8. Carefully remove any contamination and dust from the area to be repaired.

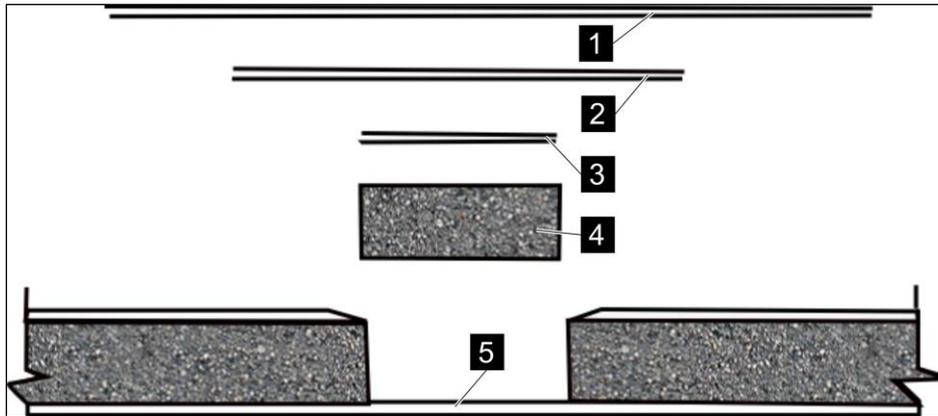


Fig. 30: Replacement materials

- | | |
|---------------------------------|---|
| 1 Upper class-fiber fabric mat | 4 Spare core |
| 2 Middle glass-fiber fabric mat | 5 Intact laminate layer of the other side |
| 3 Lower glass-fiber fabric mat | |

9. Cut the replacement core so that it fits.
10. Cut 3 glass-fiber fabric mats for repair of the laminate layer to size as follows:
 - Overlap the fracture point by 75 mm.
 - Overlap the fracture point by 50 mm.
 - In the size of the replacement core.
11. **! CAUTION**
Working with corrosive and explosive binder!
 Mix the two components of the binder. In this process strictly comply with the packaging information.
12. Brush core aperture and spare core with binder. Use a brush to do this.
13. Insert the replacement core into the core aperture.
 - a. Ensure that the replacement core is positioned so that it is flush.
 - b. Fill out gaps in the core transition area with binder and fill pieces.
14. Apply binder to the previously sanded-off laminate layer.
15. Place the lower glass-fiber fabric mat on the replacement core.
 - a. Brush binder into the glass-fiber fabric mat.
 - b. Carefully brush the glass-fiber fabric mat smooth until all air bubbles and any other kind of unevenness are removed.

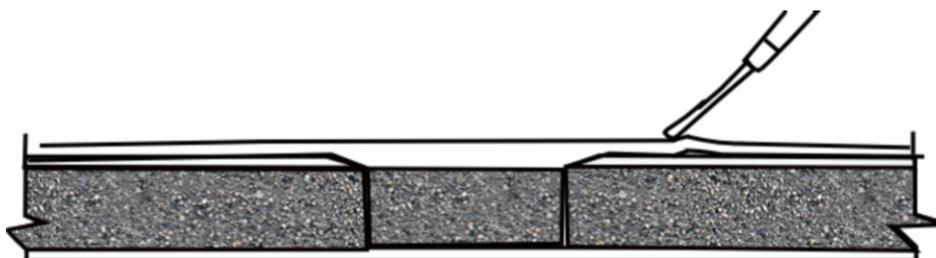


Fig. 31: Smooth down the glass-fiber fabric mat

Fault

16. Repeat the procedure for the middle glass-fiber fabric mat. In this process, fit on the glass-fiber fabric so that the structure is rotated 45° relative to the first mat.
17. Repeat the procedure for the upper glass-fiber fabric mat. In this process, fit on the glass-fiber fabric so that the structure rotated by an additional angle.
18. Ensure that the composite of the glass-fiber fabric connects flush all around on the existing laminate layer.

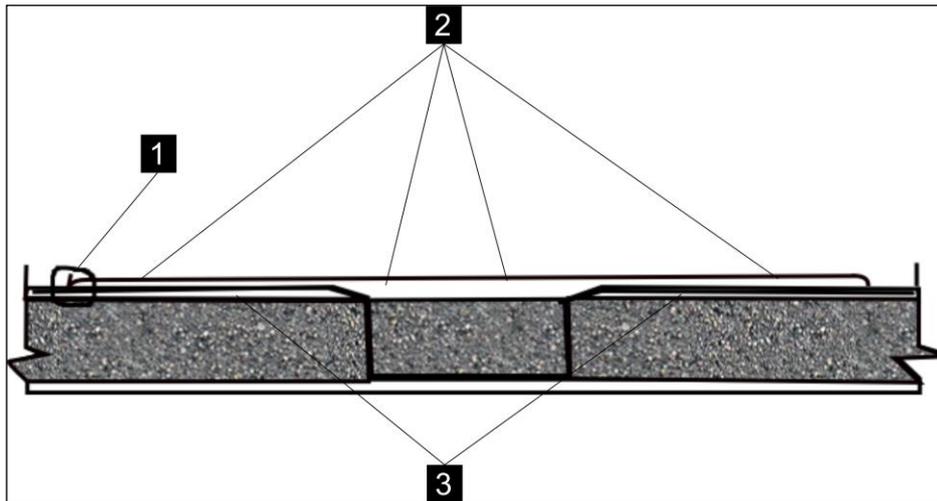


Fig. 32: Composite of the glass-fiber fabric mats

- | | | | |
|---|---|---|--|
| 1 | Seam between glass-fiber fabric and existing laminate layer | 2 | Composite of the glass-fiber fabric mats |
| | | 3 | Existing laminate layer |

19. Use your fingers to smooth the seams with the laminate layer.
20. Allow the drying period specified on the binder package to elapse.
21. **! CAUTION**
Acetone fumes!
Prior to working with acetone, ensure adequate ventilation and avoid inhaling the fumes.
22. Sand all uneven points until smooth and clean them with acetone.
23. Examine the repair point. Apply a thin coat of the binder on the exposed fibers.

Steps to be taken afterwards

For repairs on the outside of the panel:

For more information, see:

1. Restoring the surface coating.

See chapter “11.3.3 Restoring the surface coating” on page 102.

Re-attach all dismantled assemblies and components and reconnect all disconnected connections.

2. Remove climbing aids.

3. Locking the radome.

See chapter “9.4.1 Locking the antenna area” on page 71.

4. Place the radar system in service again.

See chapter “9.4.2 Place the radar unit in service again” on page 73.

5. Switching on and create operational readiness.

See chapter “8.3 Switching on and create operational readiness” on page 49.



For more information see:

03 System Service Manual

Fault

11.3.5 Replacing a panel

Overview

If the panel damage is so considerable that it cannot be repaired, then the panel must be replaced.

Safety

Personnel qualification

Tasks on the outer skin:

- To be executed only by a worker at height and 3 instructed persons

Dangers



WARNING

Unsuitable lifting tackle!

The tearing of ropes and break-out of load attachment points result in uncontrolled movements of the load. Impact and falling due uncontrolled loads can result in fatal injuries.

Therefore:

- Adequately dimension eye bolts and ropes.
- Only use intact eye bolts and ropes.
- Take wind effects into account.



CAUTION

Pane replacement in a strong wind!

If there is a gusty or strong wind the panels can shake and cause falls and injuries.

Therefore:

- Only replace panels when wind conditions are calm.
- Always wear the personal protective equipment.



NOTICE

Improper handling of the panels!

The panels can tear and break due to impact, particularly on the corners.

Therefore:

- Remove the packaging from the replacement panel as late as possible.
- Handle the panels with extreme care.

Personal protective equipment

For all tasks wear:

- Protective work clothing
- Protective gloves
- Hard hat
- Safety footwear
- Body harness

Tasks on the outer skin:

- Shoes with soft rubber soles

Special tools, auxiliary material

- not necessary

Measurement equipment

- not necessary

Preparation

1. Align the antenna.
See chapter "9.3.1 Align the antenna" on page 54.
2. Switch off the radar unit.
See chapter "9.3.2 Switching radar unit de-energized" on page 56.
3. Entering the radome.
See chapter "9.3.3 Entering the antenna area" on page 59.
4. Install climbing aids on the inside.
See chapter "9.3.5 Install climbing aids on the inside" on page 66.
5. Install climbing aids on the outside.
Chapter "9.3.6 Install climbing aids on the outside" on page 67.

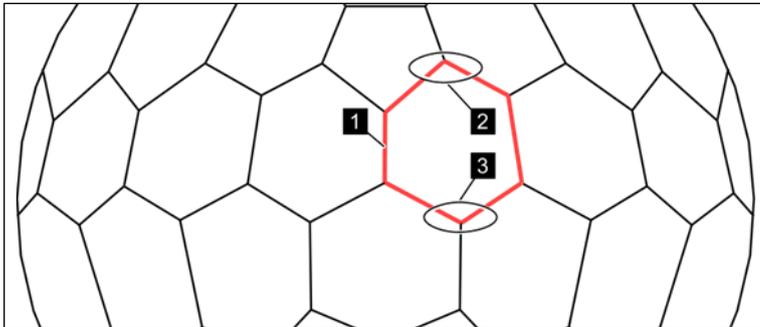
Fault

Execution



NOTE!

The panel replacement is described using a mid-level panel as an example.



- 1 Panel to be replaced
- 2 Connection seam – panel top side
- 3 Connection seam – panel underside

Fig. 33: Radome – exterior view

1. With a knife, carefully and cautiously remove sealing compound of the connection seams of the panel to be replaced on the outside of the radome.

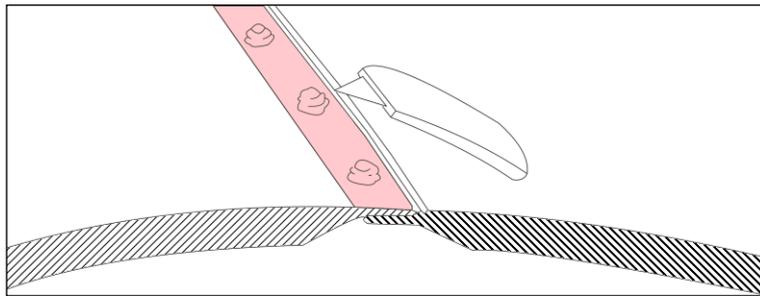


Fig. 34: Detail view: Connection seam – exterior view

2. Unscrew threaded unions on the top side of the panel to be replaced.

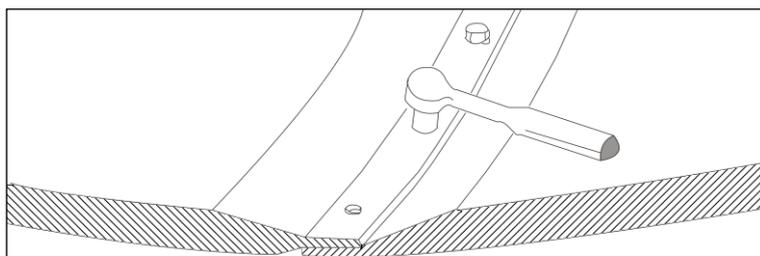


Fig. 35: Detail view: Threaded union between panels – interior view

3. Carefully pull the panel to be replaced away from the connecting point:
The gap must be wide enough to allow the panel to be fitted in place with a safety rope.

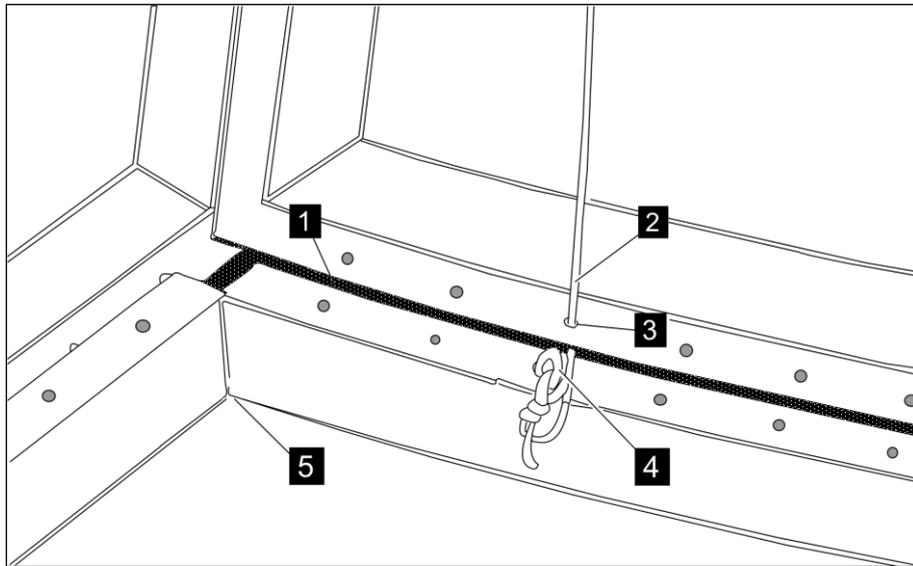
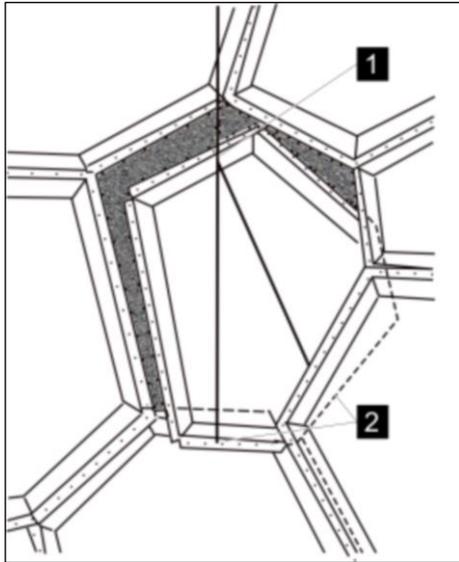


Fig. 36: Detail view: Panel underside – interior view

- | | | | |
|---|----------------------|---|-------------------------|
| 1 | Gap | 3 | Opening for safety rope |
| 2 | Safety rope | 4 | Eye bolt |
| 5 | Panel to be replaced | | |

4. To enlarge the gap, if necessary remove additional screws on the upper connection seam.
5. Tighten the eye bolt in one of the (previously removed) threaded unions on the panel.
6. **⚠ WARNING**
Panel falling over!
Have one person on the inside and one person on the outside secure the panel.
7. Fasten the safety rope on the eye bolt.
8. Guide the safety rope through the opening and fasten it on the scaffold.
9. Unscrew the threaded unions on the underside of the panel to be replaced.
10. Attach two eye bolts in the lower area.

Fault



- 1 Eye bolt – top
- 2 Attachment of the eye bolts in the lower area

Fig. 37: Position of the eye bolts – exterior view

11. Fasten 2 supporting ropes on the eye bolts in the lower area and knot them on the upper eye bolt.
12. Fit the scaffold with a suitable hoist.
13. Fasten the open end of the support rope to the hoist and tauten it.
14. Have one person on the inside and one person on the outside secure the panel. In this process, unscrew all remaining threaded unions on the panel.



NOTE!

Removing a base panel may require that you remove an adjacent panel. This is due to the condition of the connecting points (positioned on the inside or the outside).

15. Position 2 additional persons at the appropriate locations. Assign the responsibilities as follows:
 - The 1st person is positioned inside the radome and maneuvers the panel into the radome.
 - The 2nd person is positioned outside of the radome and supports person 1.
 - The 3rd person is positioned inside the radome and coordinates the loading process from the radome platform.
 - The 4th person is positioned inside the radome and releases the support rope one stretch at a time.
16. Lower the panel.

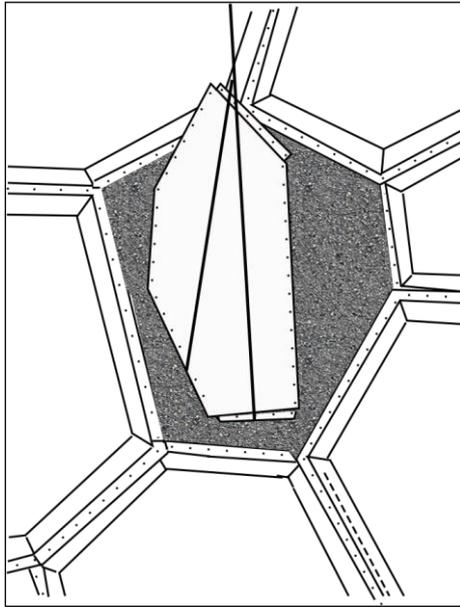


Fig. 38: Loading the panel – external view

17. Fit the new panel with 3 eye bolts and support ropes.
18. Fasten the open end of the support rope to the hoist.
19. Ensure that the 4 people are in position; see Panel removal.
20. Lift the panel and very carefully position it in the install position.

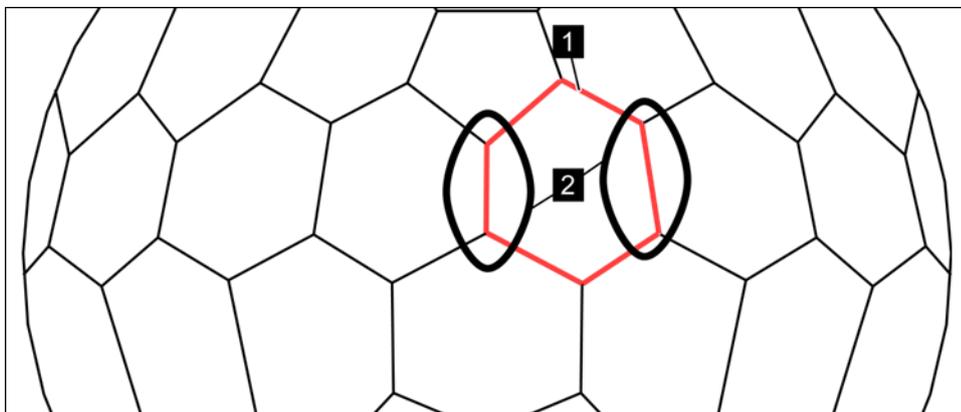


Fig. 39: Mounting the panel – exterior view

- | | |
|--------------------------|--|
| 1 | 2 |
| Positioning of the panel | Areas in which to start with the screw fastening |

21. Have one person each on the inside and the outside in order to secure the panel. While doing so, hand-tighten the threaded unions in the areas.



NOTE!

Guide a mandrel into the bores and align it vertically in case of fitting inaccuracies.

22. Remove support ropes and eye bolts.
23. Attach and hand-tighten all threaded unions on the panel.

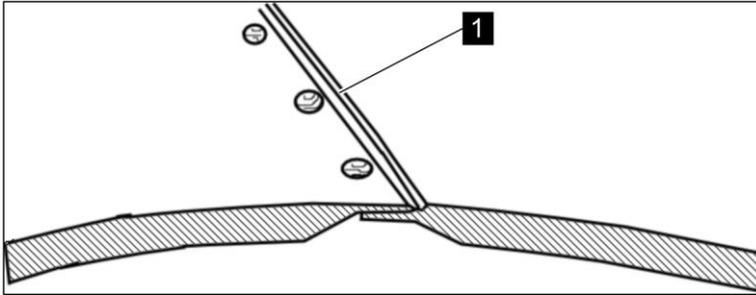
Fault

24. Tighten all threaded unions to the target torque (see Appendix).
25. Seal the panel joints from the outside using silicon and uniformly brush with sealing compound.



NOTE!

We recommend that you wear plastic gloves when sealing the radome. Use your fingers to spread the silicone evenly into the joints.



1 Panel joints

Fig. 40: Seal the panel joints – exterior view

26. Wait for the drying time specified on the packaging of the sealing compound to elapse.
27. Check seams for leaks.

Steps to be taken afterwards

Re-attach all dismantled assemblies and components and reconnect all disconnected connections.

1. Remove climbing aids.
2. Locking the radome.
See chapter “9.4.1 Locking the antenna area” on page 71.
3. Place the radar system in service again.
See chapter “9.4.2 Place the radar unit in service again” on page 73.
4. Switching on and create operational readiness.
See chapter “8.3 Switching on and create operational readiness” on page 49.



*For more information see:
03 System Service Manual*

11.3.6 Retighten threaded unions on the panel

Overview

This fault correction is carried out either when required, or if the set point of the maintenance task "Check threaded unions on the panel" is not reached.

Safety

Personnel qualification

- To be executed only by a worker at height

Personal protective equipment

For all tasks wear:

- Protective work clothing
- Safety footwear

Special tools, auxiliary material

- Torque wrench (10-50 Nm)

Measurement equipment

- not necessary

Fault

Preparation

1. Align the antenna.
See chapter "9.3.1 Align the antenna" on page 54.
2. Switch off the radar unit.
See chapter "9.3.2 Switching radar unit de-energized" on page 56.
3. Entering the radome.
See chapter "9.3.3 Entering the antenna area" on page 59.
4. Install climbing aids on the inside.
See chapter "9.3.5 Install climbing aids on the inside" on page 66.

Execution

1. Select 150 threaded unions between the panels at different height levels and deflection areas of the radome, as samples:
Test type:
 - Torque test
 Setpoint:
 - See chapter "13.1 Screw tightening torque" on page 123.
2. Calculate the number of screws that were retightened.
Setpoint:
 - Maximum 7% of the retightened screws
 Test result:
 - Setpoint reached
The test is concluded.
 - Setpoint not reached
Tighten all other screws to target torque.

Steps to be taken afterwards

Re-attach all dismantled assemblies and components and reconnect all disconnected connections.

1. Remove climbing aids.
2. Locking the radome.
See chapter "9.4.1 Locking the antenna area" on page 71.
3. Place the radar system in service again.
See chapter "9.4.2 Place the radar unit in service again" on page 73.
4. Switching on and create operational readiness.
See chapter "8.3 Switching on and create operational readiness" on page 49.



*For more information see:
03 System Service Manual*

12 Disassembly and disposal



*For further information see:
01 System Operating Manual*

Disassembly and disposal

13 Appendix

13.1 Screw tightening torque

Type of threaded union	Value	Unit
Panel to panel	15	Nm
Panel for the base ring	50	Nm

Appendix

14 List of abbreviations

14.1 Abbreviations Leonardo-Gematronikspecific

Abbreviation	Meaning
2nd.LO-unit	2nd lo-unit (2nd local oscillator unit)
ACU	Antenna Control Unit
ADP	Adapter
ARX	Analog-Receiver
AZ	Azimuth
CBU	Centrifugal Blower Unit
CU	Control Unit
ECU	Environment Control Unit
EL	Elevation
GDRX®	Gematronik Digital Reception
GDRX®-RX	GDRX®-Digital Receiver
GDRX®-SP	GDRX®-Signal Processor
ITSG	Internal Test Signal Generator
LCU	Local Control Unit
LDR	Linear Depolarization Ratio
LNA	Low Noise Amplifier
LP	Long Pulse
MP	Medium Pulse
MPDB	Main Power Distribution Box
MPS	Modulator Power Supply

List of abbreviations

Abbreviation	Meaning	
NGS	News Group Server	
NPS	Network Power Switch	
OVP	Over Voltage Protector (surge voltage protector)	
PW	Pulse Width	
RCCAB	Receiver / Control Cabinet	
RCP	Radar Control Processor	
RCU	Radome Control Unit	
RNI	Radar Network Interface	
RNI-RT	RNI Network Router	
RNI-SW	RNI Network Switch	
RNI-SW _{EXT}	RNI Network Switch external	
RNI-SW _{INT}	RNI Network Switch Internal	
RSA	Remote Service Access	
RXCU	Receiver Control Unit	
SAU	Switch Array Unit	
SB	Switch Board	
SBC	Switch Board Controller	
SNI	Site Network Interconnection	
SP	Short Pulse	
SP	Signal Processor	
SSA	Save Spatial Averaging	Person-safe spatial averaging of the transmission power. This is monitored by the safety PLC.
SSP	Save Sector Protection	Person-safe sector protection. This is monitored by the safety PLC.
STALO	Stable Local Oscillator	
TSU	Transfer Switch Unit	

List of abbreviations

Abbreviation	Meaning
TXCU	T ransmitter C ontrol U nit
UPS	U nterrupted P ower S upply
WFG	W ave F orm G enerator
WG	W aveguide
WSCU	W aveguide S witch C ontrol U nit

List of abbreviations

14.2 Abbreviations general

Abbreviation	Meaning
HV	High Voltage
IGBT	Insulated Gate Bipolar Transistor
JP	Jumper
PLC	Programmable Logic Controller
PRF	Pulse Repetition Frequency
PRT	Pulse Repetition Time
RF	Radio Frequency
RX	Receiver
TX	Transmitter
VSWR	Voltage Standing Wave Ratio
ZDR	Differential Reflectivity

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