

# **LICCON 1**

## **Working Area Limitation (LABB)**

### **Operating instructions**



**THE LICCON-WORKING AREA  
LIMITATION  
(LABB) for  
TELE- and LATTICE CRANES**

**Description of the Technical Realization  
and Operation by the Operator**

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**393200-03-02**

**LIEBHERR**

## 1 The automatically LICCON-working area limitation (LABB)

### 1.1 Tasks

The LICCON-working area limitation assists the operator, especially when handling a load requiring all his attention by monitoring work area limitations.

His working area can be impeded in many different ways, for example, buildings, neighboring cranes, power lines, structural conduiting, bridges, hall roofs, etc.

The automatic LICCON-working area limitation is easy and understandable for the operator, both in programming and actual handling.

It allows for high flexibility when setting work area limitations due to its capabilities, without requiring complicated programming work.

### 1.2 Programming basics of the working area limitation

On the whole, the automatic LICCON working area limitation offers the possibility of 4 different types of limitation functions and overlapping of these:

- The pulley head height limitation
- The radius limitation
- The slewing angle limitation
- The border limitation\*

Each limitation can be activated individually, so that either one limitation only is active, or all four simultaneously.

All four limitation types can be overlapped making it possible to describe relatively complex working area limitations. The activated limitation **cannot** be over-ridden by the mounting switch. If an area limitation requires over-riding then it must be deactivated. If a new limitation is programmed, the old limitation is automatically over-ridden and is no longer valid.

Programming a new limitation can be done at any time, whether the limitation is activated or not. If a new limitation is programmed which over-rides one that has already been programmed, the first limitation function must be deactivated.

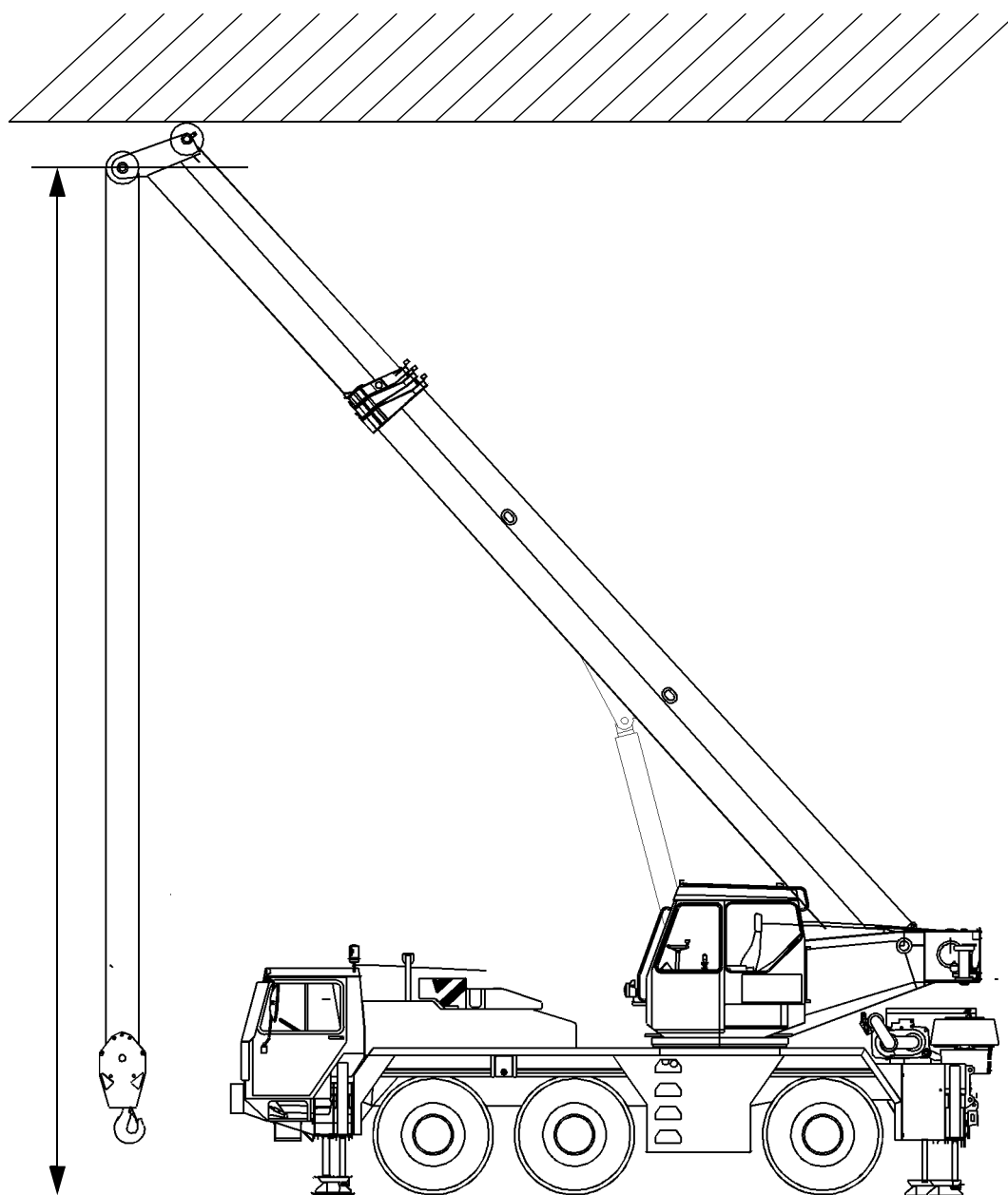
### Warning !

**Before commencing operation with the crane, the operator must be convinced that the previously programmed working area limitation functions are still in accordance with his instructions, activated or deactivated respectively. When the crane's position is changed, new working area limitations have to be programmed.**

\* This function is only featured in LTM cranes!

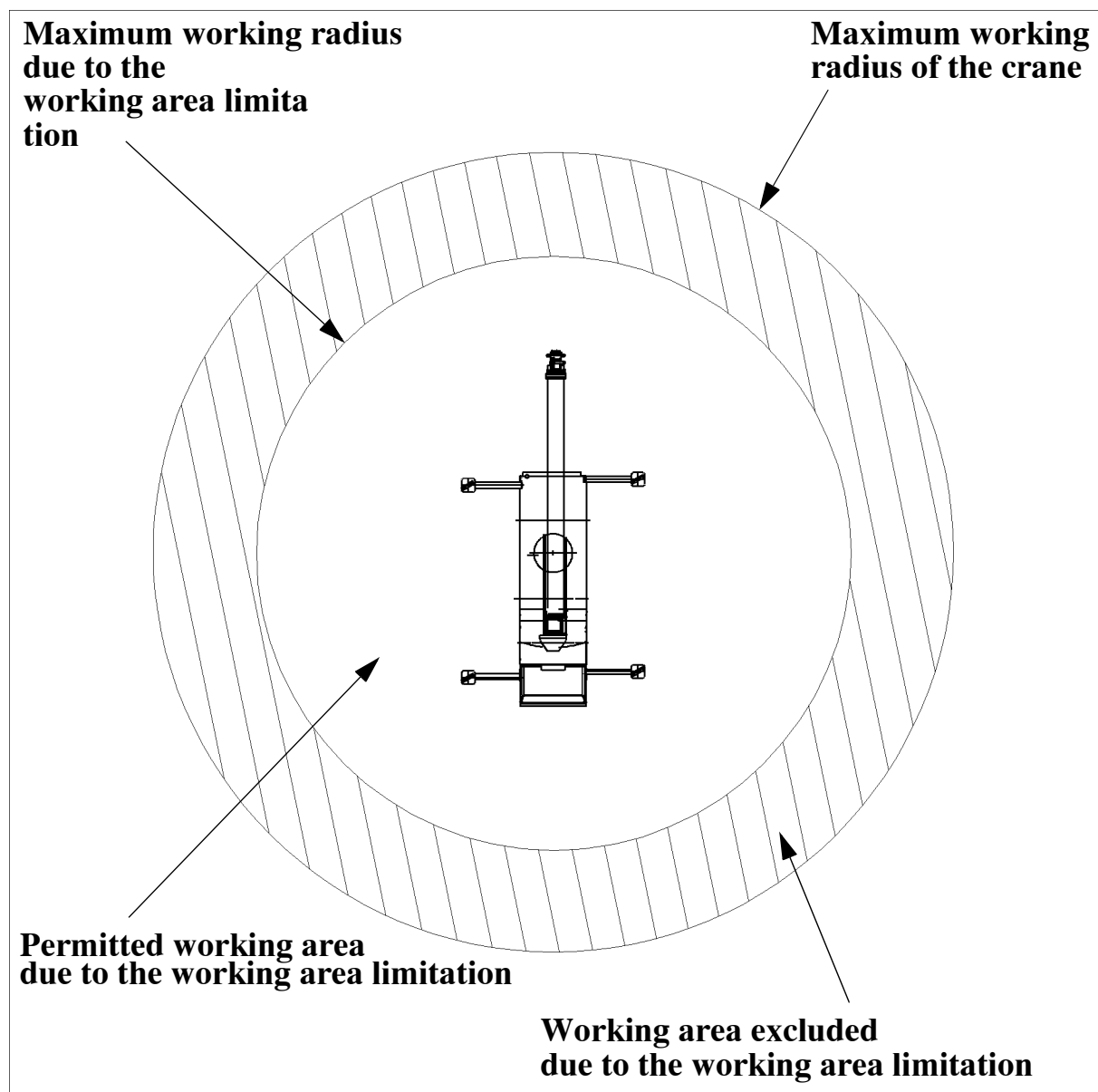
### 1.3 The pulley head height limitation

The pulley head height limitation limits the load pulley to a predetermined height. This allows arrestment of the ***luffing up*** and ***extension*** extension movements (only possible for LTM cranes). The speed of both movements continues to reduce as the programmed limit is reached. Programming is executed by approaching the limit height and applying the key as confirmation so that the actual pulley head height is accepted by the LICCON system as the limit height. ***The limit must be programmed by the operator in such a way that, in the event of the boom height shutting down, all of the higher attached parts, such as the neck pulley, the guy rocker etc. are all taken into account.***



## 1.4 The radius limitation

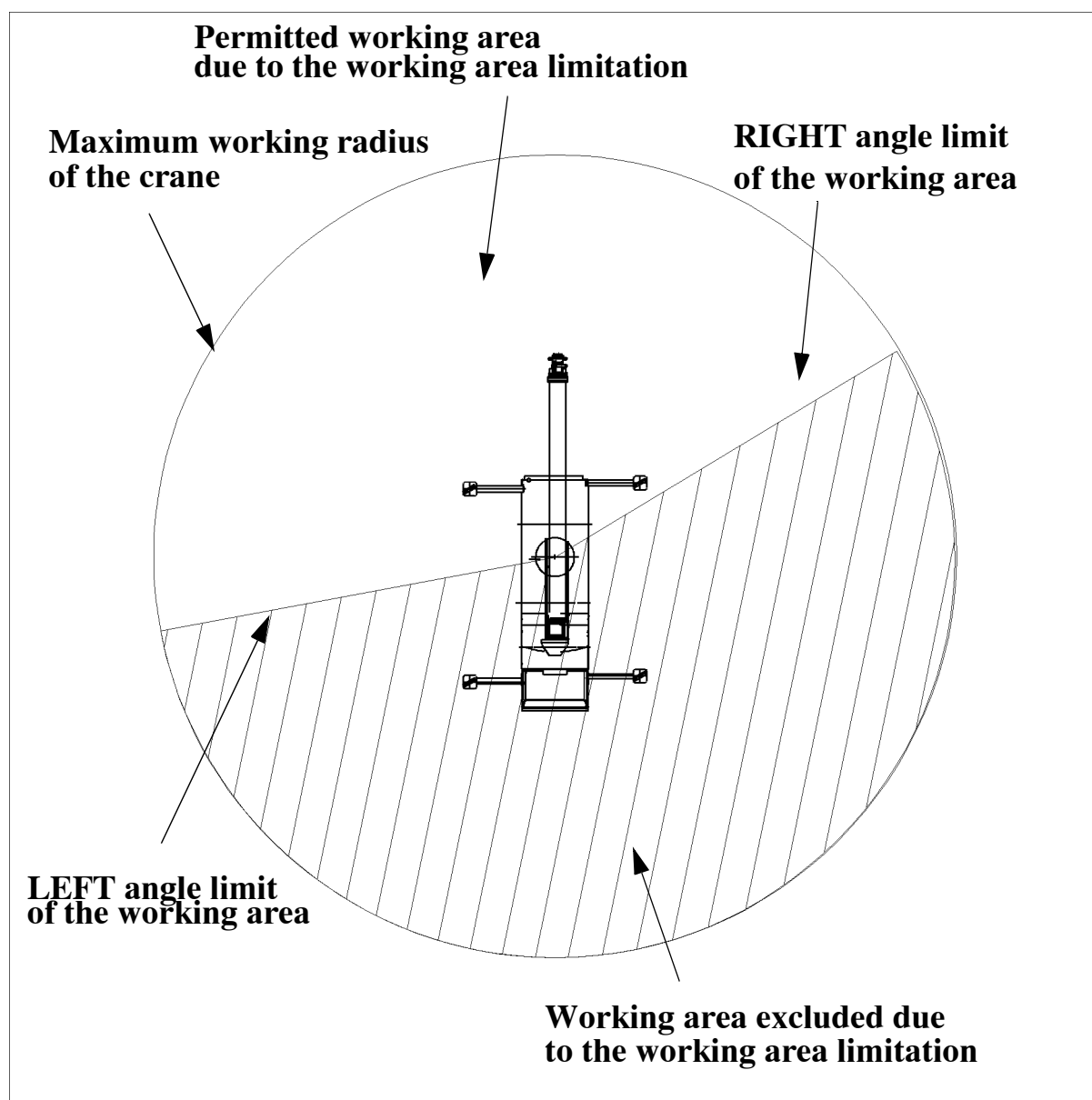
The radius limitation ensures that the load hook does not exceed a specific maximum radius. The ***luffing down*** and ***extension*** movements (only possible for LTM cranes) are discontinued. The speed of both movements continues to reduce as the programmed limit is reached. Programming is executed by approaching the maximum permissible radius and applying the key as confirmation so that the actual radius is accepted by the LICCON system as the limit height.



## 1.5 The slewing angle limitation

The slewing angle limitation consists of a right and left angle limit, which may not be exceeded when the limitation is activated. To program these limits, the maximum angles are approached one after the other and confirmed by pressing the respective buttons which the system sets as the limit.

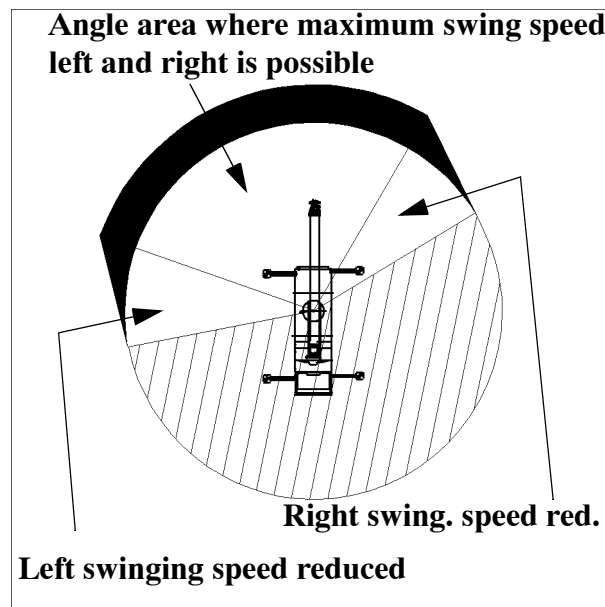
This limitation form, can cause the load to begin swinging upon shut down. This is avoided by the movement being slowed down steadily when an angle limit is approached. The counter movement can then be operated at the maximum permitted speed. If the permitted angle limitation is programmed too narrowly, the boom might only operate at a reduced speed because it is always moving in the reduced speed area.



### 1.5.1 The speed profile with active swing angle limitation

There are 2 different kinds of speed profile with active swing angle limitation and they are displayed as follows. The reduction principle of the shut down limit is also valid for the border limitations described in the next chapter.

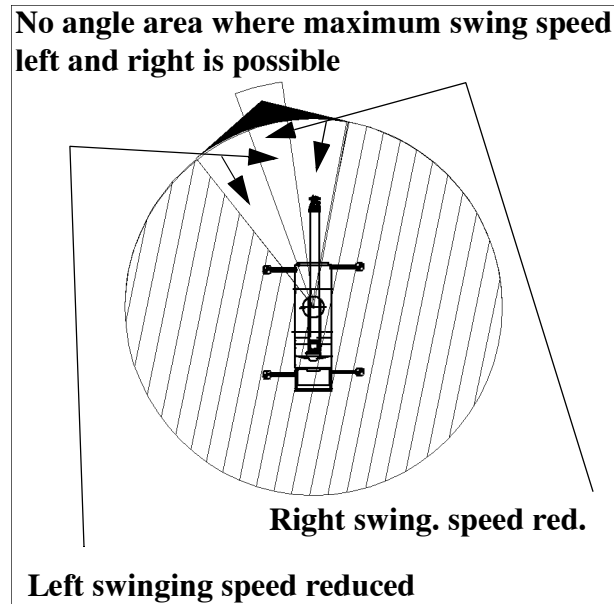
#### 1.5.1.1 Speed profile without overlapping of the reduced areas





### 1.5.1.2 Speed profile with overlapping in the reduced area

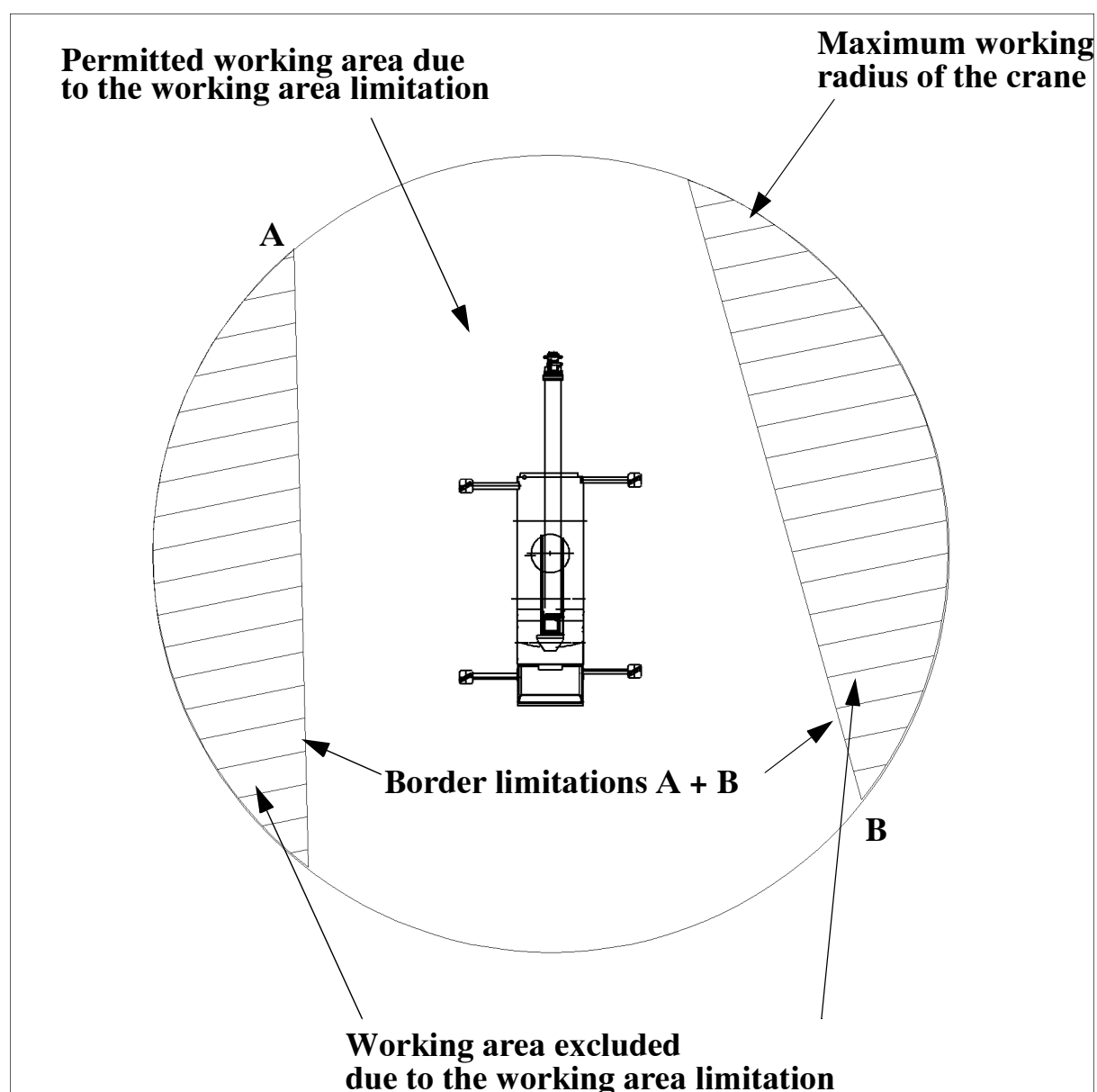
When both left and right angle limitations are set so that the areas for reduced swinging speed overlap, "right" and "left", the maximum swinging speed is never reached within the permitted working area.



## 1.6 The border limitation\*

The border limitation can be seen as the general type of swing angle limitation. It consists of 2 borders, ("A" + "B"), **neither** of which can extend through the center of the slewing ring. It is therefore possible to plot the working area limitation which allows a 360° swing angle compared to the swing angle limitation. However, in this situation, the working radius may have to be reduced.

A maximum of 2 borders can be programmed, provided each border is approached at 2 different coordinates, so that they are clearly defined. The permitted working area is on the side of the border where the center of the slewing ring is located. This approach assumes that the center of the slewing ring of the crane always falls within the permitted working area. This means that it is not possible to define the permitted working area from the center of the slewing ring and therefore is **not authorized**.



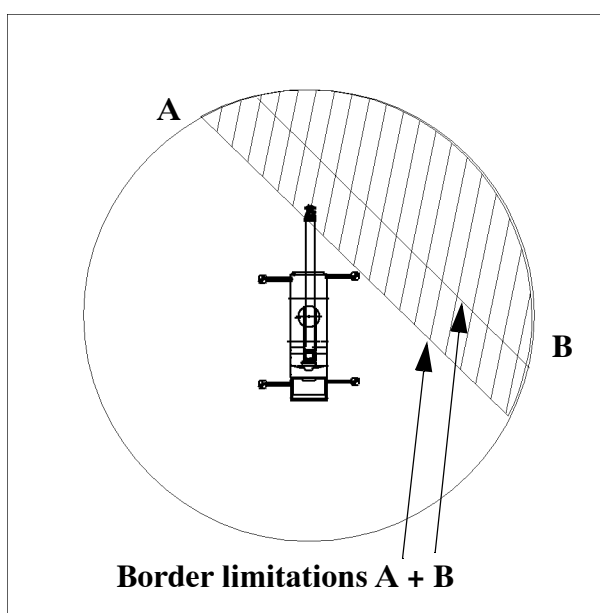
\* This function is only featured in LTM cranes

### 1.6.1 Possible variants of the border limitation

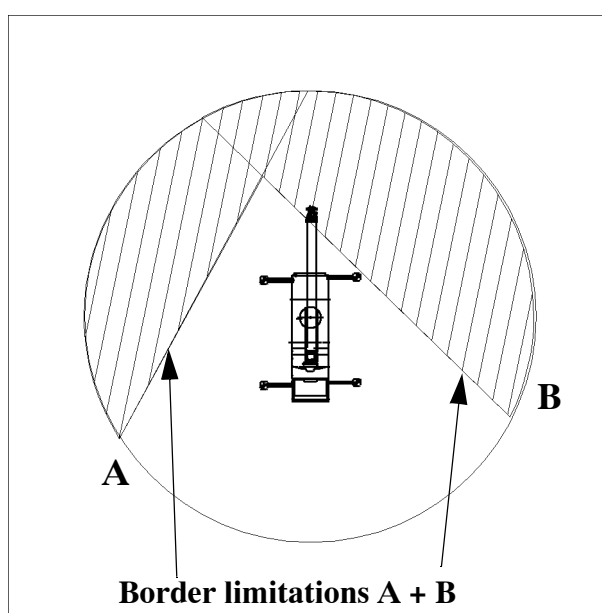
The variant of the graphically plotted form of the border controls is, of course, only one of many possibilities. Two further variants make the underlying philosophy more evident.

#### 1.6.1.1 Two almost parallel borders on one side of the center of the slewing ring

When two borders fall almost parallel on the same side as the center of the slewing ring, the principle that a working area becomes limited by reaching a border is still valid. This means that only the nearest border to the center of the slewing ring only is valid, and the more distant border can not be reached.



#### 1.6.1.2 Borders that overlap within the maximum working radius



## 1.7 Overlapping of different limitation functions

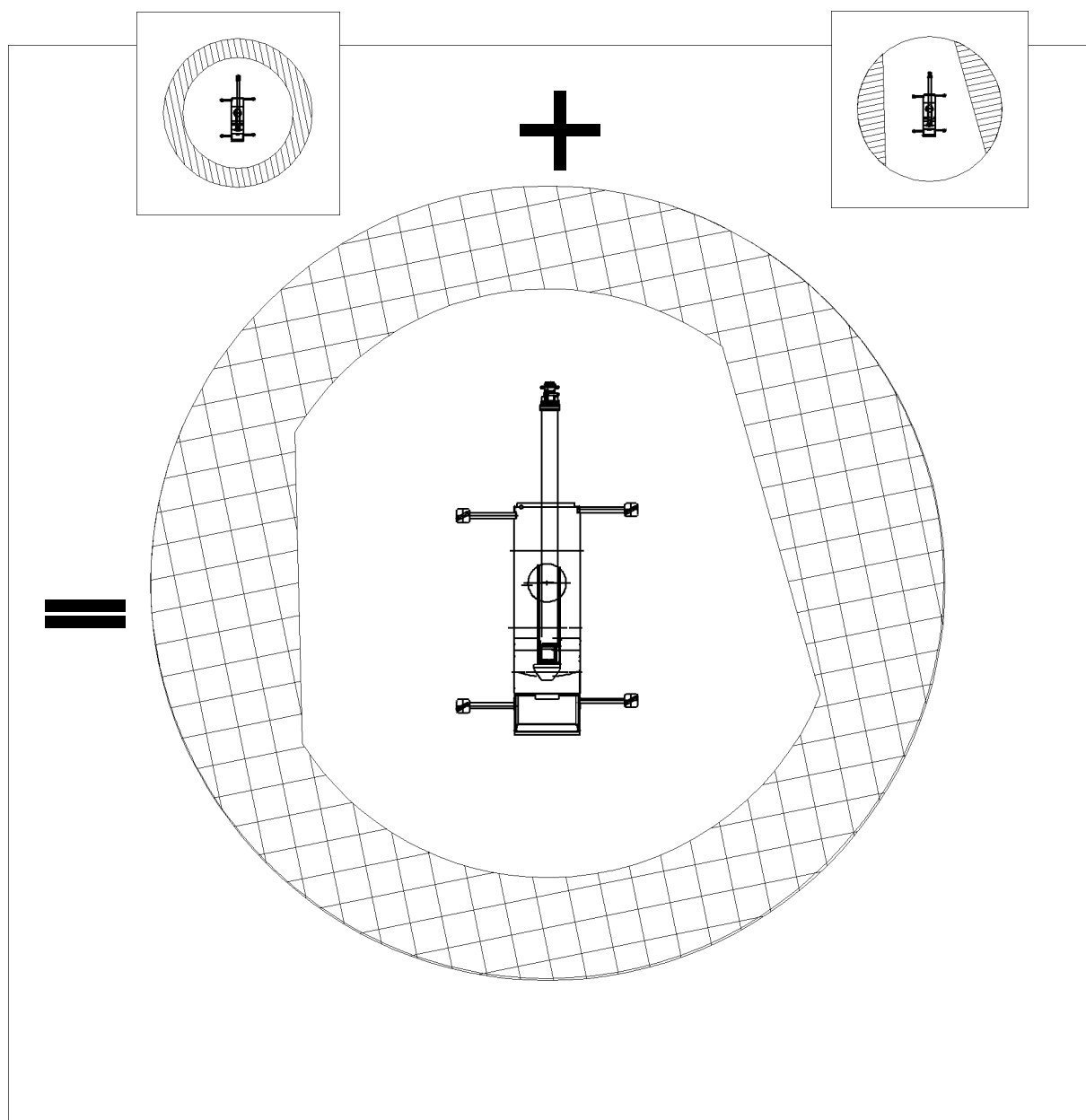
In addition to programming a single working area limitation function, it is possible to program more functions, where the remaining working area is the overlapping section of the individually limited working areas.

The overlapping of 2 and 3 area limitation functions are represented as follows.

The border limitation function is only featured in LTM cranes.

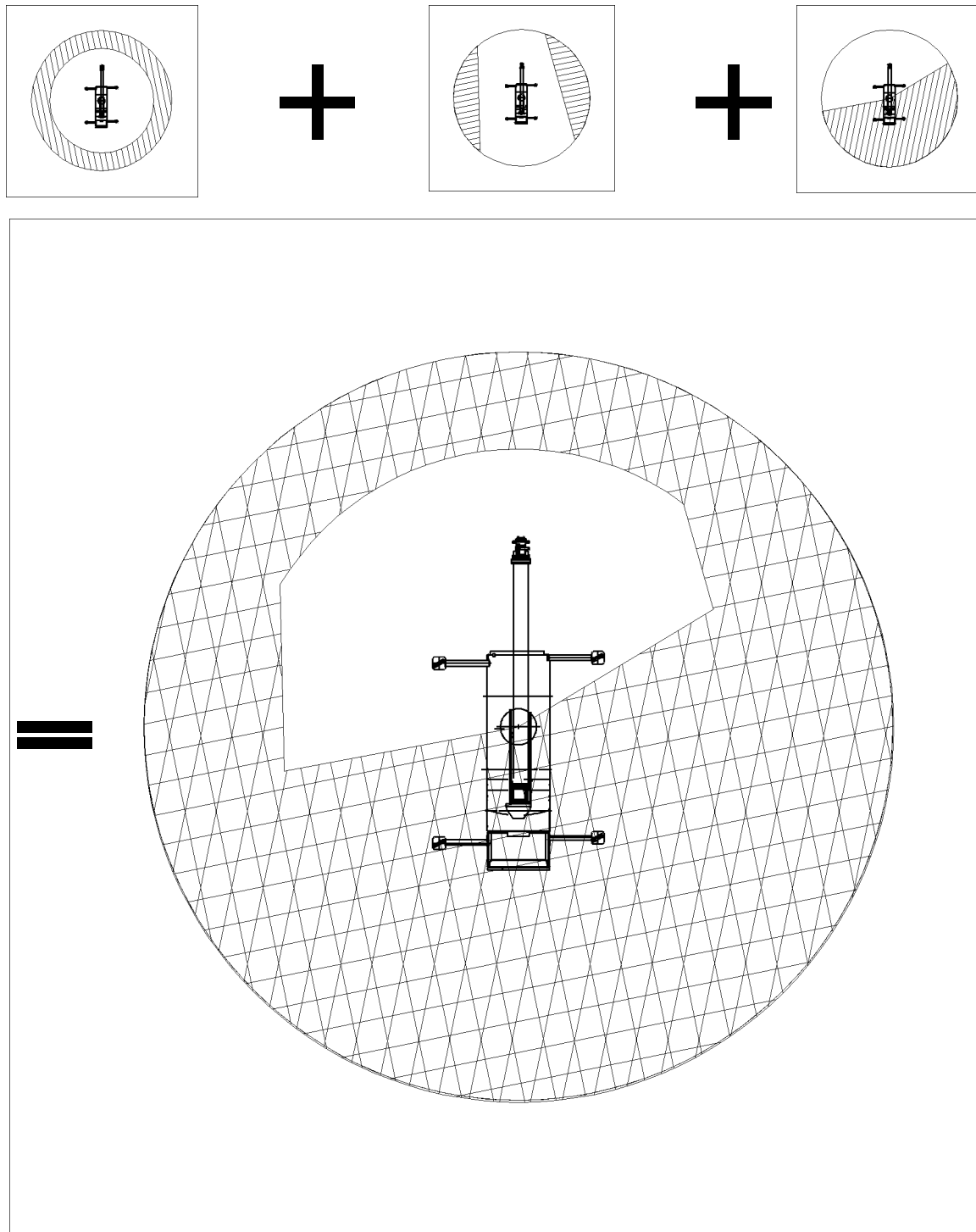
### 1.7.1 Overlapping of radius limitation and border limitation

In the following example, a border limitation additionally constrains a radius limitation. Nevertheless, this does not have to happen, provided that the border limitation falls outside of the programmed maximum radius.



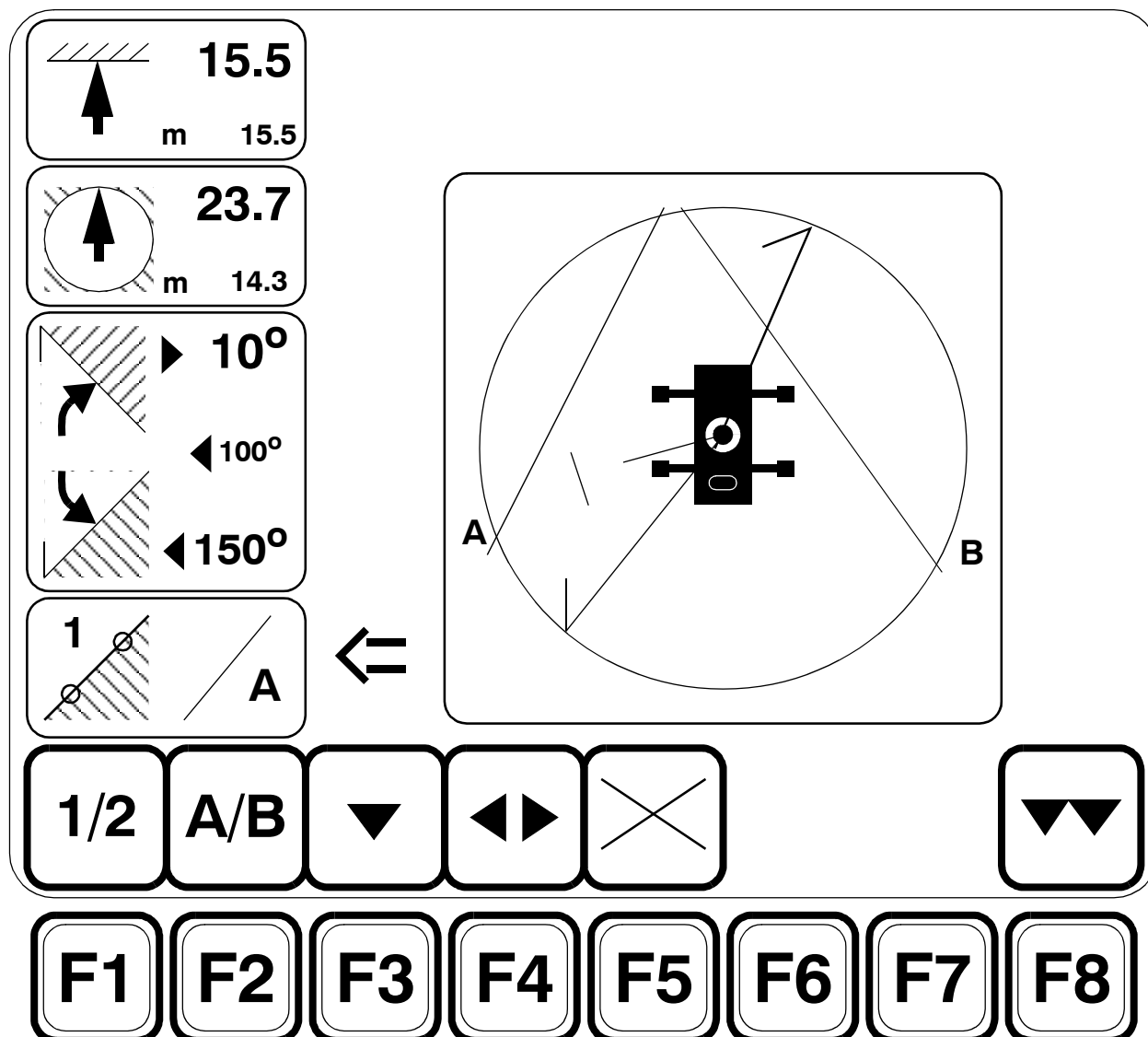
### 1.7.2 Overlapping of radius border and swing angle limitation

With the overlapping of these three area limitations; only a relatively small working area remains. According to how narrow the individual limit is programmed, many different types of working areas can be defined.



## 2 The editing program for setting working area limitations

The operator can set different working area limitations and activate or deactivate them with the simple and user-friendly program.



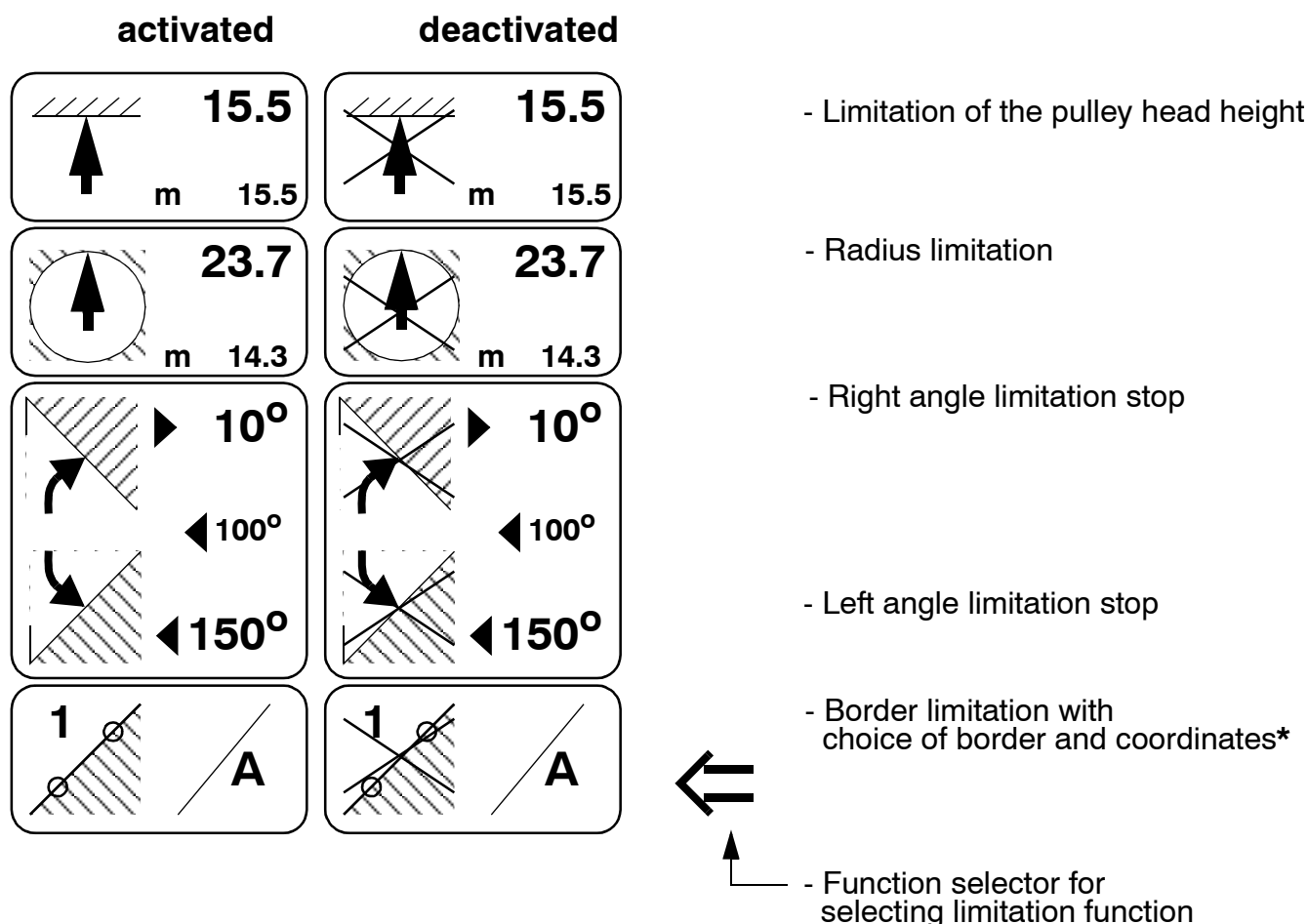
### 2.1 Program description

The screen layout of the program for the working area setting, consists of 4 essential parts:

- The area in which the optional limitation functions are set,
- The function selection area,
- The function key description area and
- The area of the graphic representation of the programmed limitations.

### 2.1.1 The optional limitation functions and the function selector

The optional limitation functions are:



Every symbol of a limitation function is designed, so that in the left half the function is graphically represented, and in the right half, for the pulley head height, the radius and swing area limitations the programmed values are graphically specified in capital letters. The current operating value is represented by regular size letters.

Within the symbol for the border limitation, the current point (for example **1A**) to be programmed is indicated (can be toggled using **F1/F2** or is automatically set via programming).

Should the operator maneuver his boom head to a point on the building site that is defined as a limitation point, the respective value corresponding to the limitation function, which is selected via the function selector („<=“) will be accepted as the programmed value in the symbol and the control system when the ENTER key is pressed.

\* This function is only featured in LTM cranes!

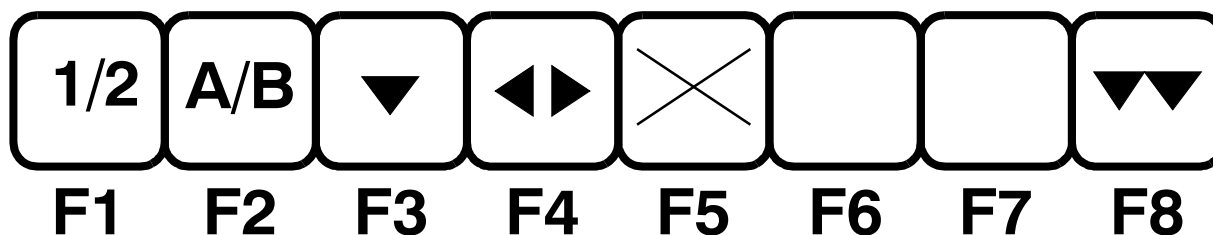
A slightly modified procedure comes into effect with the programming of a border limitation. With the function key **F2 (A/B)**, the respective border "**A**" or "**B**" is selected. With a border change, the indication of a point in the symbol F1, generally reverts to "1". Clicking ENTER, point "1" is then programmed, if the function selector also indicates the symbol of the border limitation. The new point goes directly into the border representation. Then the indicator in the symbol switches over to "2", which means that point "2" is now ready for programming. The second border point can now be re-defined, and a second border or another limitation function can also be programmed. If only the second point is to be changed, the respective border can be pre-selected, via "**F1**" (point 2). Move to the border and program by clicking ENTER, if this has not already been done.

**WARNING!**

Both borders "**A**" and "**B**" can be activated or deactivated independently of each other.



## 2.1.2 Function keys in use



The function keys have the following meanings:

- F1\*:** Choice of points 1 or 2 from the set border A or B. Indicator in the left half of the border limitation symbol.
- F2\*:** Choice of borders A or B to be programmed. Indicator in the right half of the border limitation symbol.
- F3:** The function selector is moved downwards to the next limitation function. If it is already marking the lowermost limitation function and is then moved again via **F3** it returns all the way back up again to pulley head height limitation.
- F4:** The limitation function chosen by the function selector alters its status. If it was previously activated, it is now deactivated and vice versa by applying the **F4** key. A deactivated limitation function is characterized by an X through the symbol. If the function selector indicates the left or right angle limitation, both borders are always activated.

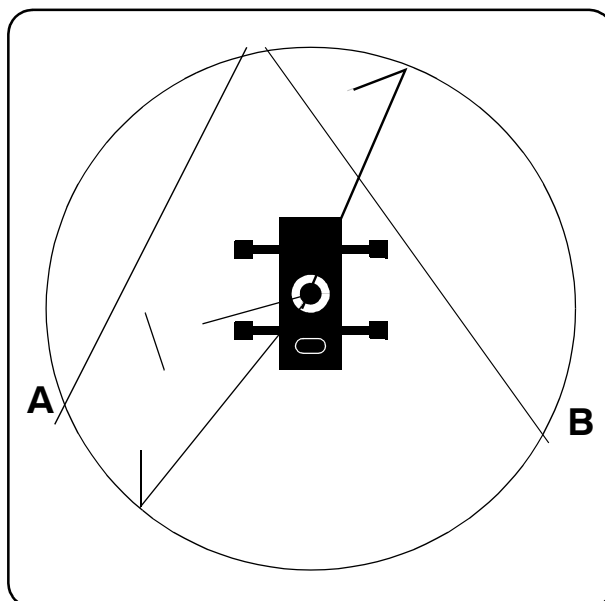
### WARNING !

**With the border limitation, only the pre-selected or indicated border will be activated. The border not indicated, can be activated or deactivated simultaneously!**

- F5:** If the crane is to be operated without any limitation function each limitation function can be disabled individually by selecting with the function selector (**F3**) and then confirming with the **F4** key. This can also be achieved by simply pressing the **F5** key, whereby without requiring specific selection all limitation functions are disabled simultaneously (including all borders which are not displayed).
- F6:** Not programmed.
- F7:** Not programmed.
- F8:** This key is used to exit a program. The system changes over to the operating system.

\* This function is only featured in LTM cranes!

### 2.1.3 Graphic representation of programmed borders



Besides the numerical representation of the programmed working area limitation, the function symbols are also graphically represented as far as possible. The accompanying symbol consists of a frame and a circle, in the middle of which the crane is graphically represented. The circle symbolizes the maximum working radius in the selected mode of operation; the maximum working radius is defined by the main jib length and the length of the mounted auxiliary jib. That does not mean, however, that the crane can reach the working radius stabilized or adjusted according to the load capacity chart. It serves only to standardize the graphic representation.

The working area limitations, "radius", "swing area" and "borders" can be changed statically. In addition to the working area limitations, the direction of the main jib and the current working radius, is represented by a straight line from the center of the slewing ring to the arc of the circle. The direction is given by the horizontal swing sensor signal, and the length is established from the LMB's current working radius. The programmed radius limitation is indicated by a diagonal line at a 90 degree angle to the jib. The exact values are numerically represented in the symbols of the limitation functions, the "radius" and "swing areas".

The swing angle limitation is symbolized by two stripes between the center of the slewing ring and the arc of the circle. Additionally, every border stripe has half an arrow head, which ends on the arc of the circle and characterizes the angle limitation, which allows swinging in both directions. This defines the permitted sector of the swing area.

The border limitation is represented by two lines inside the circle, the endings of which specify designations and which are marked with the letters **A** or **B**.

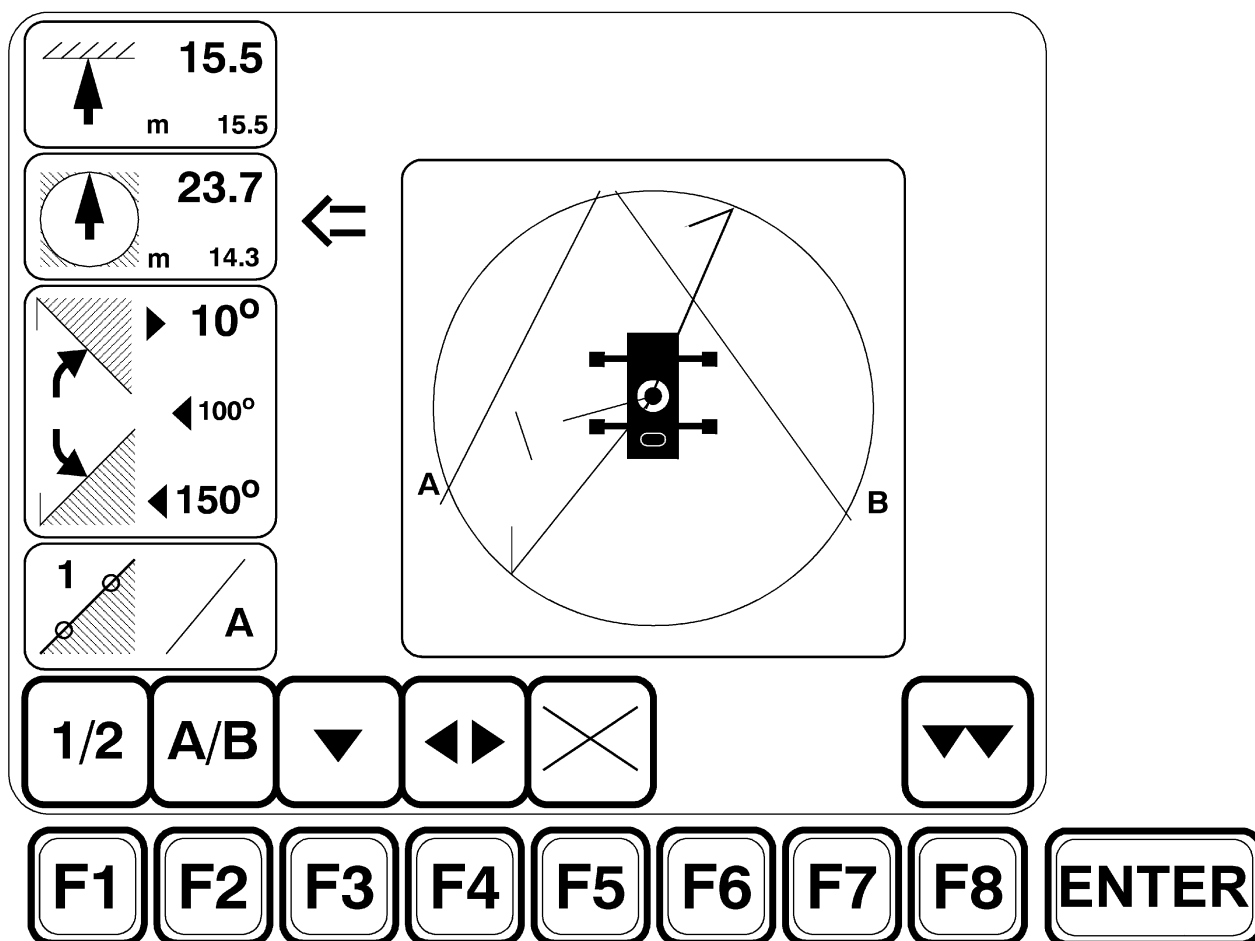
All limitation functions are indicated independently of their permanent status (activated/deactivated). After a "cold start", the following initial conditions are set:

Pulley head height:	maximum jib length in the current mode of operation
Radius:	jib length in the current mode of operation
Swing area right/left :	0°
Border A:	vertical on the left border (hardly visible!)
Border B:	vertical on the right border (hardly visible!)

### 2.1.4 Programming the shutdown limits

**CAUTION:** For LG cranes and LR cranes, the pulley head height limitation and the radius limitation are executed as a shutdown without initiating any reduction in speed. If the crane operator approaches the shutdown limit with too much speed, the limit is exceeded by a significant distance until the movement being executed with excessive speed is braked to zero.

A sufficient safe distance must therefore be considered when programming the shutdown limits.



- Approach the desired limit position
- Set the function selector ( $\Leftarrow$ ) to the programmed function in the working area limitation screen by pressing the function key (F3)
- Press the ENTER key

Upon pressing the Enter key, the numerical value currently indicated in the symbol (number indicated in small font size) is programmed as a shutdown value and adopted in the symbol as a limit value (number indicated in large font size).

Activation and deactivation of the selected limit function is realised via function key (F4).

The programmed limit is only active when the symbol of the limitation function is **not** crossed out with two diagonal lines.

## **2.1.5 Checking the shutdown function**

After programming a shutdown limit, the crane operator must manoeuvre slowly and carefully out of the permissible working area toward the shutdown limit.

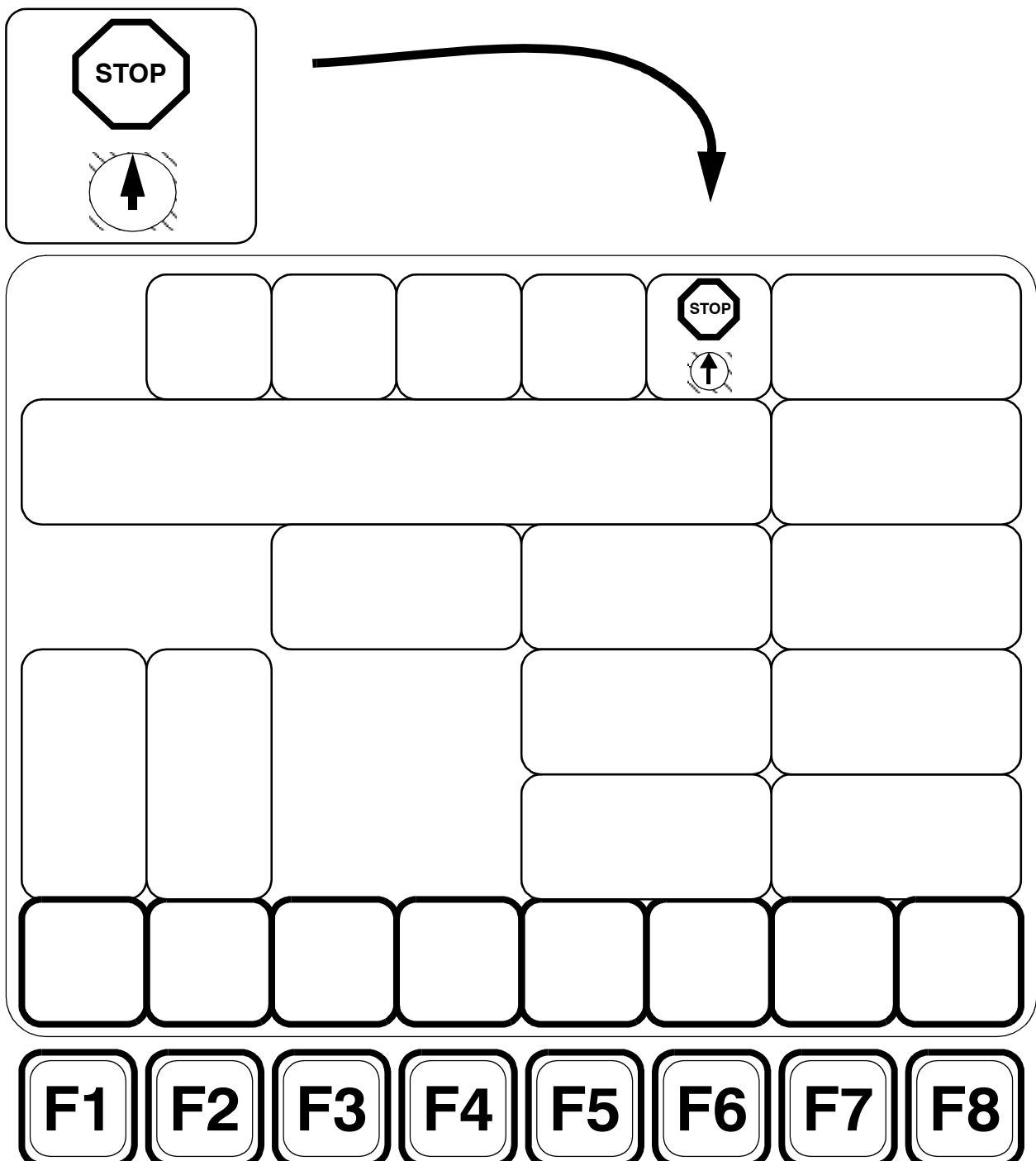
The crane operator must ensure that the working area limitation shuts down the restricted movement.

This inspection must also be carried out prior to each initiation of the LICCON working area limitation.

### 3 LABB functions

#### 3.1 Representation in the operating view

If a programmed working area limitation is approached, this condition in the operating view is indicated by an alternative STOP-symbol in place of the normal LMB-STOP symbol. If it happens at the same time as the LMB-STOP, the alternative LMB-STOP symbol is indicated. The LMB-STOP can then be recognized when an operating error indicates an error number higher than 63, exceeds 100% on the load capacity indicator or the maximum permissible load is indicated as being zero tons.



In addition to the alternative STOP symbol, exceeding any working limitation is indicated in the operating view as follows:

- Pulley head height limitation: flashing of the current pulley head height and the telescopic length.
- Radius limitation: flashing of the current working radius and the telescopic length.
- Angle limitation: independent activation of the swing angle symbols and flashing of the current swing angles.
- Border limitation\*: the border limitation operates as a combination of radius and angle limitations, and is therefore simultaneously indicated as are both limitation types.

### **3.2 Representation in the editing program of the working area limitation setting**

Exceeding the activated limitation functions is represented as in the operating view. In this case, without indicating the alternative STOP-symbol. At the same time the graphic representation of colliding borders is shown, (with the exception of the pulley head height limitation), even if they are deactivated.

\* This function is only featured in LTM cranes!

## 4 Deactivating the working area limitation

Exceeding the limit in an active situation may lead to different types of shutdown for certain crane movements, depending on the working area limitation. With the exception of jib extension limitation, all movement shutdowns undergo attenuation for LTM cranes. Table 1 and Table 2 show which crane movement is shut down for the respective limitation function.

Jib extension crane movement is only possible for LTM cranes.

For LG cranes and LR cranes all shutdowns are executed without attenuation, with the exception of slewing. The crane movements must therefore be executed with slow, measured speed before they are permitted to reach the programmed shutdown limit.

### 4.1 Shutdown of the crane movements via functions of the working area limitation

**Tabelle 1: LTM cranes**

	Luffing down	Luffing up	Jib extension	Slewing left/right
Pulley head height limitation		X	X	
Radius limitation	X		X	
Angle limitation				X
Border limitation	X		X	X

**Tabelle 2: LG- and LR-cranes**

	Luffing down main boom	Luffing down moving accessory	Luffing up main boom	Luffing up moving accessory	Slewing left/right
Pulley head height limitation			X	X	
Radius limitation (angle of moving accessory to the horizontals: $\geq 0^\circ$ )	X	X			
Radius limitation (angle of moving accessory to the horizontals: $< 0^\circ$ )	X			X	
Angle limitation					X

**Note:** Movements indicated in the tables with an X are shut down upon reaching the programmed value.

**WARNING:** Risk of accident!

If the crane movements are not executed at slower, measured speeds prior to reaching the shutdown point, the load begins to oscillate and the boom starts vibrating! Load-bearing parts could become overloaded and cause the crane to topple!

## 5 Function of the working area limitation in the event of an error

**Note:** Functioning sensors and sound measuring results are prerequisite for flawless functioning of the working area limitation.

Sensors on LTM cranes: The angle sensor on the telescopic boom, the longitudinal sensor for ascertaining length of the telescopic boom and the horizontal angle sensor.

Sensors on LG cranes and LR cranes: The angle sensor on the main boom, the angle sensor on the moving accessory and the horizontal angle sensor which measures the angle between slewing platform and undercarriage.

If a limitation function is active, and a sensor, sound functioning of which is essential for monitoring of this movement is identified as having failed, this function will be dealt with as if the limit requiring monitoring has already been reached.

This means for example, that if the horizontal angle sensor fails and angle limitation is active, slewing to the left and right is shut down immediately. The faulty angle sensor is displayed in the operating program with question marks in place of the numerical value. The same applies to all other sensors respectively.

The effects which a faulty sensor has on the working area limitation can only be rectified by deactivating the respective limitation function. This ensures that the crane operator is aware that this function is no longer being monitored.

Table 3 shows which sensor failure affects the respective active limitation function.

**Tabelle 3: Shutdown of crane movements via active limitation functions upon sensor failure**

	Telescopic boom longitudinal sensor*	Boom-angle sensor	Horizontal-angle sensor
Pulley head height limitation	X	X	
Radius limitation	X	X	
Angle limitation			X
Border limitation*	X	X	X

**Note:** Shutdowns indicated in the table with an X are triggered by the respective failure.

\* This function is only featured in LTM cranes!



## 6 Important notes on safety when using the LICCON-Working Area Limitation



The crane operator **must** be aware when using the working area limitation that certain elements for which he is responsible can not be monitored.

The working area limitation has no influence on:

- Oscillation of the load
- Vertical and horizontal vibrations and deformations of the jib

The crane operator must observe the following rules:

- Should an operational movement be reduced and the load begin to oscillate as a direct result of an active working area limitation, this motion must be halted until the load comes to rest once again, as countering with this operational movement, to the degree required for bringing the load to a standstill, can no longer be initiated due to the reduction in movement when approaching the border.
- The programmed limitations may not be set in immediate proximity to hindrances, but rather must be permitted a sufficient safe distance from the hindrance. This applies for whipping movements, both up and down, as well as rotary movements. As a rule of thumb, calculate 3 % of the jib length, including auxiliary jib, however, at least 50 cm, as long as no special guidelines are to be applied for specific hindrances such as overhead power lines, flight paths near airports, transmitters etc.  
Example 1: 60 m telescopic jib with 29 m folding jib:  $(60 \text{ m} + 29 \text{ m}) \cdot 0.03 = 2.67 \text{ m}$   
-> Safe distance = 2.7 m  
Example 2: 13.2 m telescopic boom:  $13.2 \text{ m} \cdot 0.03 = 0.39 \text{ m}$   
-> Safe distance = 0.5 m
- If a programmed radius limitation has been approached without load and the working area limitation has halted the respective crane movement, no load may then be lifted using the hoist gear as the limiting radius would be exceeded due to deformation of the jib.
- If the programmed pulley head height limitation is approached with load, the load may not be set down with the hoist gear as the limiting height would be exceeded due to deformation of the jib.
- The working area limitation may not be used as a positioning device.
- All functions of the working area limitation may only be used for the equipment and the jib length for which their limits have been programmed. For example, it is not permissible to program a limit with a short telescopic jib, and then to initiate operation with a long telescopic jib, including folding jib. In this case, the limit must be programmed again with the new equipment.
- If the position of the crane is changed by travelling on the tyres or the crawler, the working area limitations must be programmed again.

- If the load is raised on the main jib in an operating mode featuring moving accessory, the radius limitation and the pulley head height limitation may only be used with restrictions. For example, in operating modes (L)LN and (S)SDWBW.

If in the aforementioned case, the radius limitation and the pulley head height limitation are programmed in relation to pulley head on the main jib, the radius and the pulley head height of the main jib is monitored by the LICCON working area limitation. In this case, the head of the jib system is not monitored and must be regulated personally by the crane operator.

Operating mode with load on the pulley head of the main jib

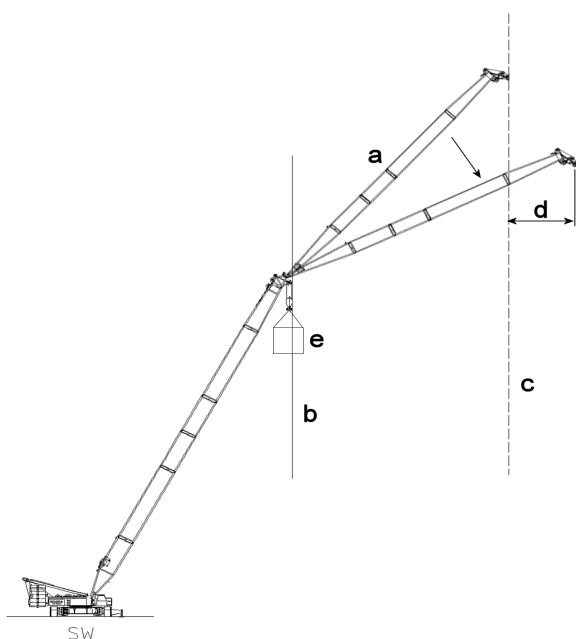


Fig. 1 Radius limitation

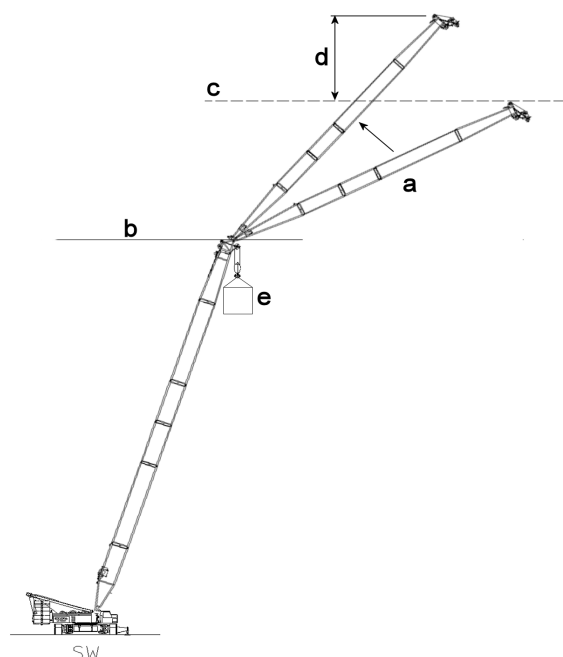


Fig. 2 Pulley head height limitation

- a** Starting position of jib system for which the radius limitation (Fig. 1) or the pulley head height limitation (Fig. 2) has been programmed in relation to the pulley head on the main jib.
- b** Programmed and monitored limitations of the pulley head on the main jib.
- c** Obstacles, such as a house or overhead power lines for example.
- d** Luffing the moving accessory could increase the radius and the pulley head height of the head of the jib system by more than that yielded when programming the limitations. This could cause a collision between obstacle and head.
- e** Load on the pulley head of the main jib.

Example: Operating mode (S)SW

Crane operation with a main jib and mounted luffing lattice jib. The load is raised on the main jib.

The radius limitation and the pulley head height limitation is programmed in relation to the pulley head on the main jib. The radius of the load and the pulley head height of the main jib is now monitored by the LICCON working area limitation. The head of the jib system, however, is not monitored.

In this case, luffing of the jib system, both up and down, must be executed exclusively with the main jib.

- Following programming of the radius limitation or the pulley head height limitation, luffing movements, both up and down, may only be executed with the main jib. If a luffing movement is initiated with the moving accessory, the working area limitation is no longer safe and the crane operator is personally responsible for ensuring that the respective limitations are respected.

- If the load is not raised on the main jib or at the end of the jib system in an operating mode with moving accessory, but rather within the moving accessory, the radius limitation and pulley head height limitation may only be used with restrictions. For example, in operating modes S(W)WF or SWMF.

If in the aforementioned case, the radius limitation and the pulley head height limitation is programmed in relation to the pulley head from which the load is being lifted, the radius of the load and the pulley head height are monitored by the LICCON working area limitation. In this case, the head of the jib system is not monitored and must be regulated personally by the crane operator.

Operating mode with load on mid-fall pulley head

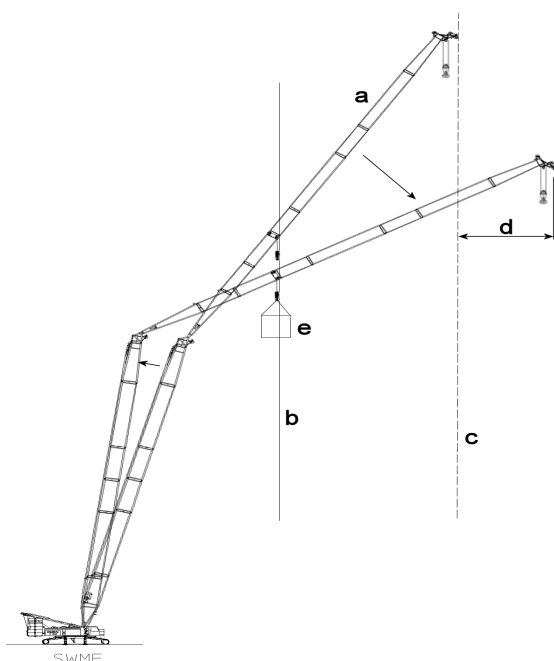


Fig. 1 Radius limitation

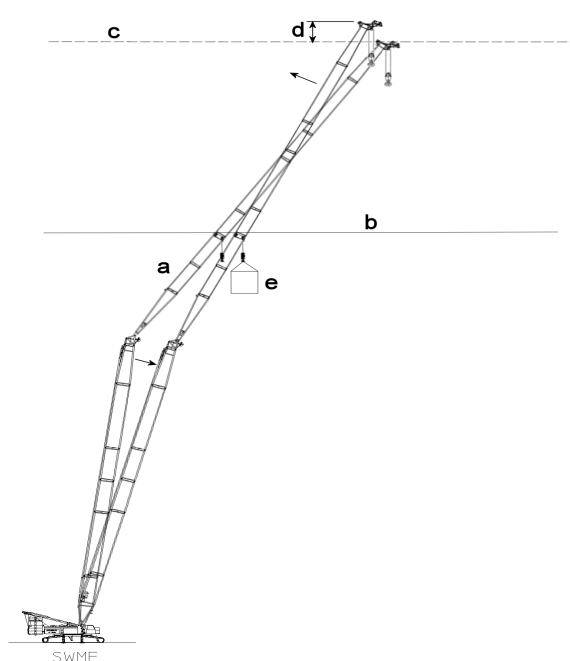


Fig. 2 Pulley head height limitation

- a** Starting position of jib system for which the radius limitation (Fig. 1) or the pulley head height limitation (Fig. 2) has been programmed in relation to the mid-fall pulley head.
- b** Programmed and monitored limitations of the mid-fall pulley height.
- c** Obstacles, such as a house or overhead power lines for example.
- d** Luffing the main jib could increase the radius and the pulley head height of the head of the jib system by more than that yielded when programming the limitations. This could cause a collision between obstacle and head.
- e** Load on mid-fall pulley head.

Example: Operating mode SWMF

Crane operation with main jib and a mounted luffing lattice jib with mid-fall pulley head, at 30 m for example. The load is raised at the mid-fall pulley head.

The radius limitation and the pulley head height limitation is programmed in relation to the mid-fall pulley head. The radius of the load and the pulley head height is now monitored by the LICCON working area limitation. The head of the jib system, however, is not monitored.

In this case, luffing of the jib system, both up and down, must be executed exclusively with the luffing lattice jib.

- Following programming of the radius limitation or the pulley head height limitation, luffing movements, both up and down, may only be executed with the moving accessory. If a luffing movement is initiated with the main jib, the working area limitation is no longer safe and the crane operator is personally responsible for ensuring that the respective limitations are respected.