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# Crane Anti-Collision Devices Types PP1047/2-PV1047/2

## Operating Instructions

### 1. Function

The crane anti-collision device type PP1047/2 is designed to prevent a collision between cranes or other vehicles (e.g. blast furnace burdening cars) travelling on the one craneway or track. However, it is also suitable for ensuring a minimum distance between two cranes to prevent overloading on the craneway. It detects a dangerous approach towards the opposite crane and stops the crane.
Each crane needs a device whose reflector is on the respective opposite crane.
Under some conditions the device can provide protection against collision for cranes on two craneways that are arranged one above the other or which cross each other.

### 2. Device Description

The crane anti-collision device consists of a reflex light barrier part in a waterproof housing (type of protection IP65; not gasproof, condensation can form if a device at operating temperature cools down in a very humid atmosphere and so if in doubt leave energised) in which the current supply, transmitter and receiver optics, evaluation electronics and the switching outputs are located. It is mounted on a JF152S adjustment flange, which allows easy mounting and adjustment. A rain cover is available for operating in the open air. In this case however the JF57Kr adjustment frame is necessary.
To operate, a reflector is required which in the ideal case has as an edge length the scanning light beam diameter 'b' at a maximum optical path length 'l' (craneway length minus the widths of the bridges of both cranes). To attain even better reproducibility of the switching point at minimum clearance, the reflector length 'r'>'b' may be selected of course.
The reflector edge length b is calculated in accordance with the following equation (all dimensions in m): $b = l/120$; Example for l=60m: b=0.5 m.
Thanks to its consistent modular engineering the device is failproof, vibration-proof, resistant to extraneous light and immune to interference to a very high degree. It is self-checking and the PV1047/2 version has a contamination monitor.

### 3. Mode of Operation

A high-performance reflex light barrier at an incline to the craneway is directed at the reflector affixed on the opposite crane and must be able to detect it. Once the two cranes have approached each other up to the minimum clearance, the light barrier’s scanning beam must leave the reflector. The crane travel is changed by the light barrier to slow travel or it is disconnected completely.

## 4. Function Description

A constant dynamic function monitoring of the optical and electronic components leads to a switching-on of the two relays 1 & 2, which monitor each other. In each case a green LED allows a visual monitoring of the switch state of the two relays. If both LEDs light up, crane travel is fully free.
If the beam of light does not have any more contact with the reflector located on the opposite crane or if some component on the light barrier is not functioning properly, the green LEDs go out. The crane travel stops.
Unlike the PP1037/2 the optical system is designed so that surfaces other than the reflector surface will not cause any reflections detectable by the device unless it is a reflecting surface on which a scanning beam falls vertically, which because of the installation geometry is hardly likely.

## Important Notes

With standard plastic reflectors a maximum spacing l of only approx. 60m can be attained suitably. Considerably greater distances (up to 200m) can be attained with optically precisely ground large-scale triples (GR50S). However, these are comparably expensive.
Four reflectors are required for spacing of up to l=100m and 16 for spacing of up to l=200m, each arranged in a square.
In such arrangements, the reflector length r determined in accordance with the calculations below must be realised in addition with conventional plastic reflectors. Accordingly at long distances the high-performance reflectors are effective whereas at short range the plastic reflectors take over. It is of course permissible to gradually reduce the height of the reflector ranges effective at short range (l<40m) in order to economise on reflector material.
Optical path lengths of l=80m can be achieved with PP1047/2t with traditional plastic reflectors; the factor b for the reflector minimum dimensions can then be calculated with: b=l/250.
**Another way to attain long operating ranges at comparably low cost is to use a transmitter-receiver system PP2126Kr in which the transmitter is mounted on one crane and the receiver on the other one.** However, the adjustment is much more complicated here.
Please enquire in this case.

## 5. Assembly

The light barrier is mounted horizontally; the reflector is mounted horizontally too if it is longer than it is high; all descriptions refer to this position; the illustrations in the appendix always show the view from above!
The centre of the optical unit and the horizontal centre line of the reflector must be exactly at the same height over the craneway!
The pictures in the appendix show the most general case, which is used as a basis for the calculations.
In the following special cases, simplifications can be introduced without endangering correct functioning:
a) It is possible to dispense with the inclination of the reflector around the angle $\alpha$ if $\alpha$ is $<2°$.
b) If the optical path lengths l are short, it is not absolutely necessary for the entire light beam diameter b to fall on the reflector (question of power) in the maximum spacing.
The side spacing s of the device lenses of the 'insider' reflector edge is important for smooth disconnection on reaching the minimum clearance g.

s is in a clear connection with the given variables l, g and r
l = maximum optical path length
g = minimum clearance
r = reflector length; whereby for $l>40m$ the reflector length r must be at least equal to b

1. $s = g*\tan\alpha$, with: $\alpha = \arcsin[(r-b/2):(l-g)]$
2. $b = l/120$

Special case: if $r \leq b$, the calculation is: $\alpha = \arcsin[(r/2):(l-g)]$

For $\alpha<1°$ the following calculation is also possible: $s = g*(r-b/2):(l\ g)$
likewise, if $r<b$: $s = g*(r/2):(l-g)$

Example:
1. l=50m, g=12m
B=50m/120=0.4m
To calculate $\alpha$: $\sin\alpha=[(0.4/2):(50-12)]=0.00461 \rightarrow \alpha=0.302° \rightarrow \tan\alpha=0.00526$
$S=12m*0.00526=0.063m$

- **The reflector on the opposite crane must be at the height of the optical unit.**
- **Two devices may never have their optical units facing each other when mounted.**

**6. Adjustment**

Once the device and reflector have been installed in accordance with the criteria described in the above, the cranes are first moved to the minimum clearance. To pre-adjust, a hand signalling lamp placed close to the optical unit is used to illuminate the 'inside' end of the reflector.
When the device lid is opened, two more or less bright reflex images of the reflector in each case can be seen on the transducer bench (the aluminium plate located behind the lenses with two boreholes in which the photo diodes are located).
The light barrier must be adjusted by means of the adjusting screw 'C' so that the reflector images appear in the centre at the level of the transducer boreholes; with the slot fixing D-E the device is turned around a vertical axis until the narrow edges of the two reflector projections are on the transducer bench in about the centres of the boreholes in the transducer bench.
Please note that the reflector images on the transducer benches may appear to be on the wrong side; this is due to the imaging characteristics of optical lenses.
The cranes are then moved to the maximum distance apart. The light barrier must be aligned in relation to the reflector so that it beams in accordance with the requirements. For this purpose, the adjustment flange is turned by means of the slot 'E' around the axis 'D' until the level indicator DIANA shows maximum brightness. Vertical adjustment is done with the aid of the spring-loaded adjusting screw 'C'.
If the level indicator shows full brightness during the adjustment procedure, the devices' optical units should then be covered so that DIANA is dark to a large extent and the adjustment can be further optimised then. At the end of the adjustment procedure remove any covers from the optical units. Carry out the calculation in accordance with point 5 so that at minimum clearance the half light beam diameter q falls on the reflector edge. This means that the light barrier at the minimum clearance will not have turned off yet.
For fine adjustment both cranes are moved to the exact minimum clearance and the side distance s is increased by shifting the reflector in a horizontal direction (slots) until the precise moment of the light barrier turning off.
The same procedure is used for the second device and its reflector.

## 7. Electrical Connection

The operating voltage is to be connected to terminals 1 and 2; the protective conductor to an inside housing screw.
At 230VAC, the terminals B and C are bridged; at 115VAC the terminals A and C and B and D are bridged; 24VDC: special version!
The crane travel may only be influenced by the NO contact pair $S_1/S_2$ (terminals 3/4 and 7/8).
$S_1$ is to be connected in series to $S_2$ unless an external switch gear continuing self-checking that requires two galvanically isolated NO contacts is used.
The NC contact pair $Ö_1/Ö_2$ (terminals 5/6) may only be used for signalling purposes apart from in special test connections (switch-on test).
The contacts must be fused suitably (6A max.).
The system testing does not require any additional wiring; it is conducted permanently and automatically.

## 8. Special Versions

PV1047/2, with contamination warning contact (contamination monitor)
The response level of the contamination monitor is approx. five times higher than that of the working receiver.
The relay that signals the contamination warning picks up with a time delay that is adjustable up to approx. 5s by means of the PZ potentiometer .
The contamination monitor relay's switching contact lies on terminals 9, 10 and 11 and is generally used to switch on an indicator light, if required, by means of a latching contactor.

## 9. DIANA,"i"

DIANA (Digital Analog Display is an array of 4 LEDs which begin to light up one after another as the intensity of the optical signal at the working receiver increases, whereby the brightness of the individual LEDs also increases (**Di**gital **An**alog **A**nzeige / digital analog display).
The total stroke of the 4 LEDs is about 20:1 with reference to the response threshold. Within its working range DIANA can convey a good impression of the power and response status of the working and contamination warning receiver (→PV1047/2) with respect to the reflector signal and it therefore serves as an adjusting aid in relation to the reflector.

- **It is *not* necessary for all 4 LEDs to light up for the DIANA to function perfectly**

## 10. The Potentiometer

In the normal case the working contact potentiometer is set to maximum power. In rare cases it might seem necessary to reduce the power to some degree. It is possible to reduce the power by a maximum 50% (limited by circuit constraint).
Never alter the setting of the two coated potentiometers (test cycle)!

## 11. Series Contact

If a second switching point is desired, a second device, PP1047/2 or PV1047/2, is used. It is not absolutely necessary to have a second reflector.