d&b Installer Flying system
User Manual

d&b audiotechnik

References in the manual

WARNING!	**This refers to a potentially dangerous situation which may lead to personal injury.**
CAUTION!	**This refers to a potentially dangerous situation which may lead to damage to the equipment.**
IMPORTANT!	**This refers to a situation which may cause the equipment to malfunction.**

Symbols on the equipment

Please refer to the information in the operating manual.

General Information

Installer Flying system User Manual

Version 2.0E, 08/2002, D2938.E.02

The information presented in this document is, to the best of our knowledge, correct. We will however not be held responsible for the consequences of any errors or omissions.

Technical specifications, weights and dimensions should always be confirmed with d&b audiotechnik AG prior to inclusion in any additional documentation.

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Contents

Safety instructions

Before you use our products, please read this manual carefully and note all the safety instructions contained herein. They are designed for your own safety and help to avoid damage to appliances as the result of incorrect use. Please keep this manual in a safe place where it is close at hand to provide the answers to any questions you may have in the future.
If you hire out d&b systems commercially, please ensure that your customers are aware of these safety guidelines. Please provide the relevant user manuals with every system. In the event that you require additional manuals for this purpose, please order these from d&b (you will find a form for this purpose on the last page).

Aspects of safety and safety procedures

WARNING!

When the chain pulleys are in operation, it is essential to ensure that there is nobody directly underneath or in the proximity of the array.

WARNING!

For safety reasons, the flying system may only be rigged in public areas or in working areas by specialist companies or by members of a touring crew who can provide evidence that they have sufficient experience as riggers. It is the responsibility of the individuals assigned with rigging the system on location to guarantee that the system is safely mounted, adjusted and operated. All the system components must be subjected to stringent tests before they are put into operation. All damaged components must be removed and replaced. If there is even the slightest doubt about the safety and function of the system, it must on no account be used. The degree of system safety is directly related to the prevailing site conditions. If, for example, there is heavy rain, gusty winds or storms during an open air event, the safety of the system will be unavoidably impaired. This must be taken into account and the system checked immediately.
Like all other mechanical systems, flying systems may show signs of wear in the course of time. Negligent treatment of the system, inadequate maintenance, poor protection against corrosion, and warping or damage due to incorrect storage or transportation will accelerate the wearing process and impair the safety of the system. For this reason, owners and users of the flying system are obliged to take all the necessary steps to protect the system from negative factors of this kind. The most important rule when rigging and using the system is: check, check and check again to be sure. Basically, it should never be assumed that anything can be taken for granted, even the most experienced and most competent riggers and technicians can make mistakes occasionally. It is therefore extremely important for everyone always to check their own work and that of their colleagues one more time! The chains bear the entire weight of the speakers. For the uppermost row of speakers in every vertical row, the short 11-link chains should be used, so that the load carried by the system is not transferred to the lashing strap when the row is lashed. In order to achieve larger vertical array angles than the usual angle of -5° for the top row (up to approx. -10°), the uppermost strap guide in the vertical row should be omitted. The strap must, of course, be pulled though all the remaining strap guides in the loudspeakers.

It is always important to ensure that the chains are not twisted. The openings of all safety hooks must face towards the front and the brackets must be closed. The loudspeaker cables must be laid safely and neatly, so that they do not affect the balance or mobility of the array. It is very easy for mistakes to happen when a Speakon connector is connected. For this reason, it is important to remember that the connector housing should first be turned clockwise before the safety ring is turned. Multipolar loudspeaker connectors must be fully secured. These things should, of course, be checked while the system is still on the floor. With larger arrays, it may be appropriate to set up a working platform of a suitable height, so that nobody has to climb up the boxes to make settings or readjustments. At this point, we would once more draw your attention to the fact that the adjustable lifting slider can only be adjusted when it is completely relieved of its load. The array must be lowered right to the floor for this purpose. Horizontal angling and strap tensioning for vertical adjustment can, however, be carried out when the ntire system is suspended above the floor.

WARNING!

In order to avoid unpleasant surprises and consequently to save as much time as possible, we recommend the following, particularly for larger arrays: connect the system provisionally to the racks and test the function of the cabling and loudspeakers with a test signal while the system is still on the floor. However, please do not forget to disconnect the loudspeaker cables on the racks before the array is hoisted.

IMPORTANT!

During rigging and in particular during all hoisting procedures, the safety of the crew has top priority. The safety regulations must be taken note of and observed by all. Operation of the chain pulleys may only be entrusted to an experienced and reliable person who must supervise the entire procedure. A plain and clear warning must always be given before the system is hoisted, lowered or unlashed. All persons must then move out of the area in which the system is hoisted and can swing. For safety reasons, only individuals directly involved in rigging or unrigging should ever enter the working area. A supervisor should stand where he or she has an unobstructed view of the entire flying system in order to supervise hoisting of the system and, if necessary, to give a signal if the system is raised out of balance or if hindrances arise.

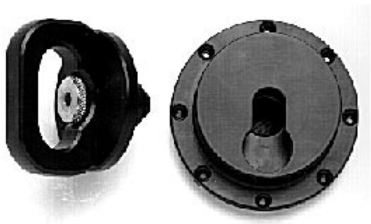
WARNING!

1. Components

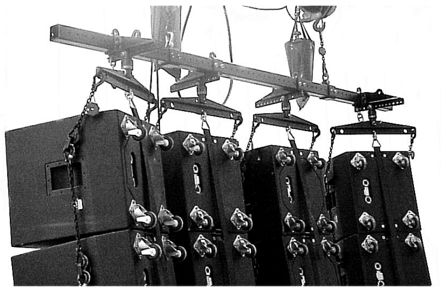
3-wide Installer flying system (4 deep)

The d&b "Installer" flying system is a modular construction suspension system for d&b loudspeaker types C3, C4-TOP, C4-SUB, C7-TOP, F2, B1 and MAX. Like the "Transformer" flying system which was introduced several years ago, this system can be used to position several columns adjacently 1 to 8 deep and at almost any angle.
While the well-known "Transformer" system is designed mainly for mobile applications (hiring, touring), the "Installer" system has been developed primarily for permanent installations.
The loudspeaker types listed above have so-called cabinet fixings of type MAN CF-4 fitted at the side. The purpose of these fittings is to hold the MAN "flying stud", a D-shaped adapter that snap-fits into the CF-4 fitting with a quick-change fastener. The speakers suspended vertically one above the other are linked together vertically with chains at these studs so that the load is transferred only to the chains.
The Installer flying system for d&b loudspeakers C3, C4, C7-TOP, F2, B1 and MAX consists of the following combinable elements:

- Z5200.XXX box section in lengths of 100 cm, 150 cm, 200 cm, 250 cm and 300 cm. Hole matrix with holes at intervals of 50 mm.
- Z5201.000 lifting slide
- Z5201.30, Z5201.140, Z5201.230, Z5201.280, Z5201.350 sliders with holes at maximum intervals of 36 mm, 144 mm, 230 mm, 288 mm and 350 mm on the supporting arm
- Z5202 rota swivel
- Z5203 sub bar
- Z5204 2-leg safety wires
- Z5201.001 spreader lift slide
- Z5201.002 adjustable lift slider
- Z5209 lifting chain



Flying Stud and CF-4



Rear view of the top row of a 4-wide Installer flying system

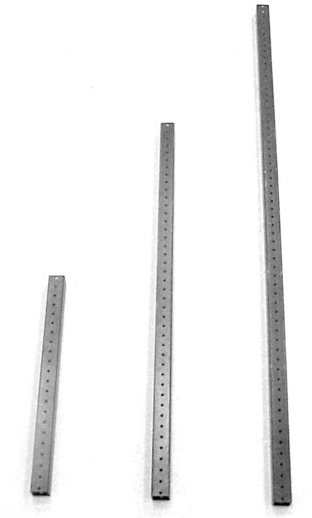
A box section can be used to construct a flying system with up to four sliders, so that four columns of loudspeakers can be arranged adjacently. This is then known as a 2-wide, 3-wide or 4-wide flying system. Larger arrangements (X-wide) can also be made by positioning several box sections precisely next to one another.
The sliders can be pushed along the box section and are screwed into the hole matrix of the box section with two through bolts on each slider. The rota swivel, which is firmly attached to a slider, forms a movable connection with the sub bar, from which the loudspeakers are suspended with chains. The rota swivel has a swivel bearing so that the sub bar can be fixed in place and adjusted horizontally in relation to the box section.
The rota swivel is secured by an additional chain from the sub bar to the slider, to prevent the sub bar falling in the event that the connecting mechanism is used incorrectly or fails.
The distances between the holes in the supporting arms of the sliders are selected so that the flying system balances out vertically when it is suspended evenly.
The flying system must be secured additionally with one or more 2-leg steel cables, depending on the size of the loudspeaker arrangement. The most constructive method is to attach these safety steel cables to the suspension eyes of the sliders.

1.1. Box section (Z5200.XXX)

The box section (see picture to the right) is the central supporting beam and constitutes the main element of the Installer flying system, since all the other system components are connected to it. It is available in five different nominal lengths, ranging from 1000 mm to 3000 mm, in steps of 500 mm. The total length of a box section is 88 mm longer than the nominal length.
There are holes in the front and back of the box section at intervals of 50 mm. This hole matrix is used to fix the different sliders in place and determines the intervals between them.

WARNING!

The load-bearing capacity of the box section is determined by the quantity and position of the suspension points. The instructions in Chapter 4.1. "Selecting suspension points" concerning this aspect must be adhered to without fail.



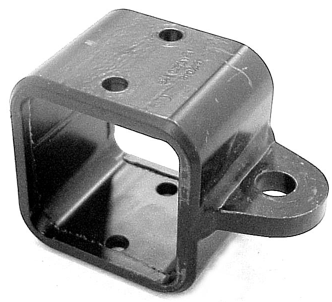
1000, 2000 and 3000 mm box section

1.2. Lifting slider (Z5201.000)

The lifting slider serves as the suspension device on the flying system, and can also be used to secure a safety wire. For this purpose, the end of the cable or chain is fitted with a shackle to the Unilock shackle (which is firmly mounted in the suspension eye of the lifting slider) of the lifting slider which is screwed to the box section.

WARNING!

The load-bearing capacity (SWL) of a lifting slider is 1250 kg when the chain or cable acts vertically on the slide bush, or 900 kg for a load suspended at an angle of 45°.



Lifting slider

1.3. Spreader lift slider (Z5201.001)

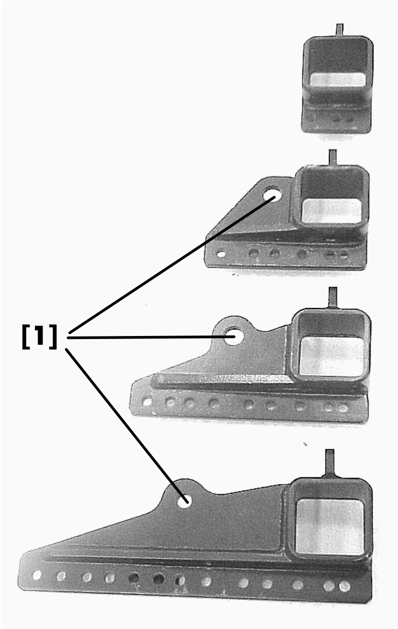
The spreader lift slider can be used to make a vertical connection between several box sections, in the same way as a mobile. The spreader lift slider is constructed in the same way as the lifting slider and has an additional suspension eye on the underside.

WARNING!

The load-bearing capacity (SWL) of a spreader lift slider is 1250 kg when the chain or cable acts vertically on the slide bush, or 900 kg for a load suspended at an angle of 45°.

Spreader lift slider

1.4. Sliders 36, 144, 230, 280 and 350 (Z5201.030, Z5201.140, Z5201.230, Z5201.280, Z5201.350)



From top to bottom:
Slider 36, slider 144, slider 230 and slider 350

Sliders can be used to arrange the top row of speakers in an array in a circular or ellipse-shaped pattern. The sliders are available in five sizes for this purpose, with the maximum distance from the supporting arm holes to the middle of the slide measuring 36 mm, 144 mm, 230 mm, 288 mm or 350 mm. a slider is basically constructed in the same way as a lifting slider, but also has a supporting arm with a fixed hole matrix. The rota swivel / sub bar combination is fastened in these holes. The hole matrix runs along the entire length on all four types but the longer the slider, the more holes are provided. The intervals between the holes are selected so that a load ratio of 2:1 (load behind to load in front of the supporting beam, see Chapter 3.3. 3-wide) can always be balanced out. On sliders 144 to 350 there is an additional suspension eye **[1]** fitted in about the centre top of the supporting arm. This can be used when the system can only be balanced out with additional bracing (e.g. a very unevenly hung 3-wide array that is suspended from a three-leg chain).
All sliders are fastened to the box section with two M10 x 120 Allen screws and self-locking nuts (8 mm Allen key required for this purpose - the screws may only be fastened hand-tight with the key).

WARNING! **The load-bearing capacity (SWL) of a slider is 625 kg with a vertical load.**

1.5. Rota swivel (Z5202)

Rota swivel

The rota swivel functions on the one hand as a flexible joint between a slider and a sub bar and on the other hand as a means of fixing the angle of the sub bar in relation to the box section. The set angle can be read off a scale at the centre of the swivel. The two rotating halves of the swivel are fixed with a countersunk Allen screw (5 mm Allen key required for this purpose). The connections to the slider and sub bar are made with M12 x 50 Allen screw and self-locking nuts (10 mm Allen key required for this purpose - the screws may only be fastened hand-tight with the key).

WARNING! **The load-bearing capacity (SWL) of the rota swivel is 625 kg.**

1.6. Sub bar (Z5203)

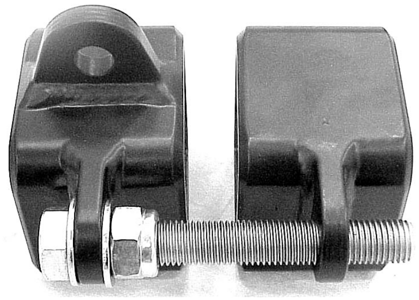
Sub bar with delta link

The loudspeaker enclosures are hung from the sub bar on chains at one pair of the two outer sets of holes. The two outermost holes are the right distance apart for types C3, C4, C7 and MAX, and the inner holes are the right distance apart for types F2 and B1. The tensioning strap is threaded through the delta bar for stabilisation and vertical adjustment of the box columns. The sub bar is screwed to the rota swivel at the top centre hole and secured with an additional 7 mm safety chain. This chain is attached at the hole next to the suspension hole of the sub bar and at the rear hole in the slider arm.

WARNING! **The load-bearing capacity (SWL) of the sub bar is 625 kg.**

1.7. Adjustable lifting slider (Z5201.002)

In some cases, if the flying system is suspended unevenly, it may be necessary to take additional measures to balance out the flying system. The adjustable lifting slider is designed for this purpose. It consists of two sliders that are connected with a sturdy M20 screw. One slider functions as a lifting slider, and the flying system is suspended from this. The other slider is firmly screwed to the box section using 10 mm Allen screws with self-locking nuts, while the position of the slider designed for suspension is only fixed by the screw. The balance can be adjusted at the screw using a 30 mm open-end wrench (this adjustment **cannot** be made when a load is exerted!). The adjusting range is about 50 mm, which corresponds with the hole matrix in the box section.



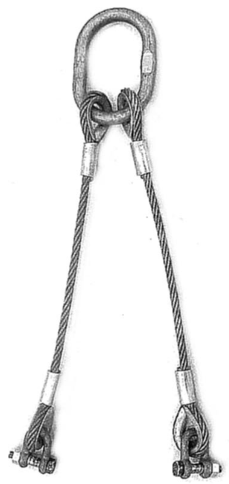
Adjustable lifting slider with adjusting screw

WARNING!

The load-bearing capacity (SWL) of the adjustable lifting slider is 1250 kg when the chain or cable acts vertically, or 900 kg for a load suspended at an angle of 45°.

1.8. Safety wire (Z5204)

The 2-leg safety wire can be used to secure the flight system with a second independent safety device, which is required by regulation BGV C1. For this purpose, it is best to attach it at the free suspension eyes of the slider of an Installer flying system, using the shackles. Several safety wires are required with larger and consequently heavier arrays.



2-leg safety wire with shackles

The safety wire is available in three lengths:

- 1 m for 2-wide (Z5204.100)
- 1.5 m for 2-wide (Z5204.150)
- 2 m for 3-wide (Z5204.200)

WARNING!

The nominal load (SWL) of the safety wire is 2.8 t at a cable angle of 0°-45° and 2 t at an angle of 45°-60°.

2. Rigging instructions

WARNING!

Before rigging, please check all screws, nuts, washers, shackles, split pins and chains to ensure that they are in good condition. Damaged or very rusty components must on no account be used and must be replaced with material of an equivalent quality (quality class 8.8 or higher).

CAUTION!

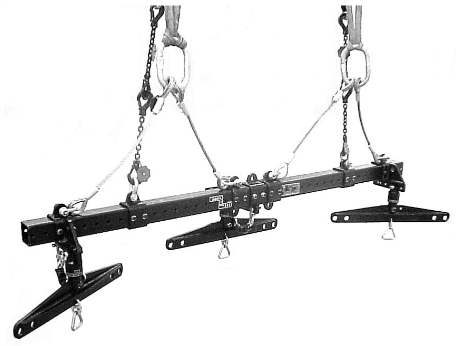
All screw connections must be made with the correct fastening torques.

2.1. Tools required

- 5 mm, 8 mm and 10 mm Allen keys
- 16 mm, 18 mm and 30 mm open-end or open-end ring spanner (ideally a torque wrench)
- a pair of pliers

2.2. Procedure

When the configuration of the flying system has been decided on (for further information on this subject, please see Chapters 3 and 4), the individual components can be put together.
The sequence for mounting the individual components on the overall system is the same for all X-wide systems, and the different sliders are always fastened to a box section in the same sequence, from the inside to the outside.
A rigging example is described below for a 3-wide Installer flying system with 5 speakers per slider, which is suspended from two points and additionally secured with two safety wires (see picture to the left). The setting parameters for this setup can be found in appendix 7.1.2.



Example of a 3-wide system

The following Installer components are needed for this flying system:
- 1 x 2000 mm box section
- 4 x lifting sliders
- 2 x sliders 144
- 1 x slider 288
- 3 x rota swivels
- 3 x sub bars with safety chain and delta bar
- 2 x safety wires

The following mounting hardware is needed:
- 14 x M10 x 120 Allen screws
- 14 x self-locking M10 nuts
- 28 x washers for M10
- 6 x M12 x 60 Allen screws
- 12 x washers for M12
- 6 x self-locking M12 nuts

This mounting hardware is part of the individual components.

We recommend rigging the system in the following stages:

1. Preassembly of the sub bar - rota swivel - slider units
2. Mounting of the lifting slider and the preassembled sub bar - rota swivel - slider units on the box section from the inside to the outside
3. Mounting of the safety wires
4. Adjustment of the horizontal angle of the sub bar

Safety chain

Stage 1:
The rota swivel is screwed to the sub bar using an M12 x 60 screw with washers and a self-locking nut. The rota swivel is mounted in the correct position if the writing on the degree scale can be read off normally, as shown in the picture below.

The sub bar is supplied with the delta bar ready mounted.

The slider is then screwed to the free end of the rota swivel in the required hole of the slider supporting arm, using an M12 x 60 screw with washers and a self-locking nut.

When the rota swivel is screwed together with the slider and the sub bar, the screws and nuts should only be hand-tightened to prevent prestressing of the components.

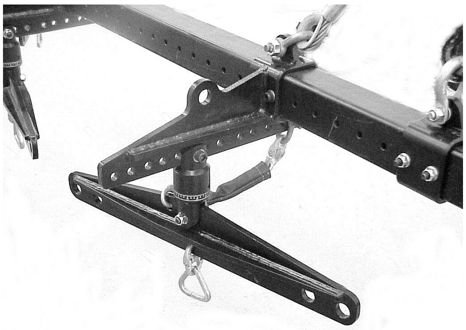
WARNING!

Finally, the safety chain shackle, which is firmly secured to the sub bar at one end with a connecting link, should be fastened in the last hole of the slider supporting arm (see picture below).

It is extremely important to ensure that the safety chain is not twisted.

WARNING!

Preassembled sub bar - rota swivel - slider 36 unit



Sub bar - rota swivel - slider288 unit mounted on the box section

Stage 2:

The following rigging work is considerably easier when it is carried out by two people. One person holds the box section steady while the other pushes the sliders onto the box section. When pushing on the sliders, it is important to ensure that they do not jam.

In our 3-wide example configuration, the slider 288 is positioned exactly in the middle of the box section. For this reason, the preassembled sub bar - rota swivel - slider 288 unit should be pushed onto the box section first and screwed in place in the middle of the box section using the two M10 x 120 Allen screws with washers and self-locking nuts.

Then one lifting slider should be screwed in place at the left and one at the right of this slider (with M10 x 120 screws, washers and self-locking nuts). The safety wires are later attached to these.

Next, two lifting sliders are mounted, each at a distance of 60 cm from the central slider. The flying system is later suspended from these.

Each end is finished off with a preassembled sub bar - rota swivel - slider 144 unit. These should both be mounted at a distance of 20 cm from the ends of the box section, and their supporting arms must point in the opposite direction to the supporting arm of the central slider 288.

WARNING! **When the slider is screwed to the box section, the screws and nuts should only be hand-tightened to prevent prestressing of the components.**

Lifting slider mounted on the box section

Stage 3:

The last mounting operation is to attach the safety wires in the free suspension eyes of the sliders. For this purpose, the shackle on one leg of the safety wire is fastened to the Unilock shackle in the suspension eye. Then the shackle on the second cable leg is attached to the other slider in such a way that the safety wire is not twisted.

A safety wire fastened correctly in a suspension eye

Stage 4:

Finally, the angle between the sub bar and the box section should be set as required. A 5 mm Allen key is required for this purpose. Use this to loosen the clambing screws **[S]** of the rota swivel, set the required angle on the scale and then tighten the clamping screws **[S]** evenly to both sides .

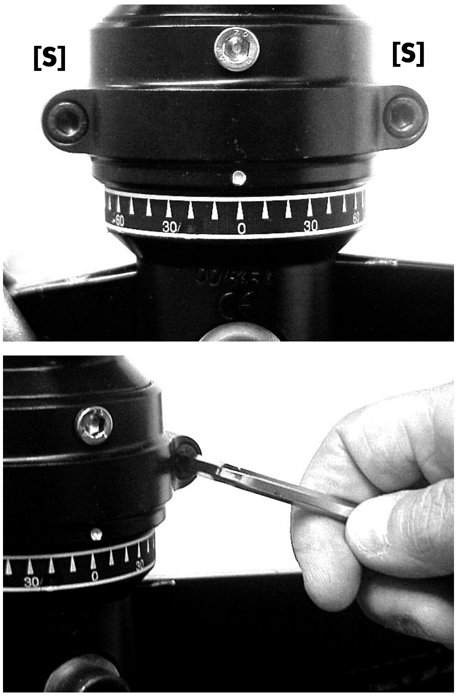
WARNING!

The clamping screws [S] must be tightened evenly to both sides. The torque of the clamping screws [S] of the rota swivel must not exceed 10 Nm.

Once the clamping screws has been tightened, you can check whether the screws has been tightened correctly by turning the sub bar. If the screw has been fastened too tightly, the thread may be damaged, but if the clamping screws has been tightened with insufficient torque, the loaded sub bar can turn when the entire flying system is hoisted.

Note:

As an alternative to the method described here, it is also possible to omit preassembly of the sub bar - rota swivel - slider units and to mount the rota swivel and sub bars on the sliders when these have been pushed onto the box section in advance and screwed in place. For this purpose, it is useful to suspend the box section with its mounted sliders from the suspension eyes designed for this purpose - this makes handling more easy.



Tightening the clamping screws [S] on the rota swivel

3. Basic configurations

The system components introduced in Chapter 1 can be used to construct almost any design of flying system. A standard configuration is absolutely adequate for many applications. The most important basic configurations will be described in this chapter.

Where d&b loudspeaker types C3, C4 and C7-TOP are used, different lengths of box section and different types of load suspension must be used, according to the suspension depth of the flying system. These are shown in the table below. A weight of 60 kg per speaker is estimated here in order to keep calculations simple.

The following abbreviations are used in the table for the suspension types:

- 1P1 : Single-point suspension with a single-leg chain
- 1P2 : Single-point suspension with a 2-leg chain
- 1P3 : Single-point suspension with a 3-leg chain
- 2P1 : Two-point suspension with two single-leg chains
- 2P2 : Two-point suspension with two 2-leg chains
- 3P1 : Three-point suspension with three single-leg chains

	1-wide	2-wide	3-wide	4-wide
Sub bar	max. 8 deep 1P1			
Box section 1000		max. 8 deep 1P1 (max. 5 deep = 600kg),1P2, 2P1		
Box section 1500		max. 8 deep 1P2, 2P1	max. 3 deep 1P2, 1P3, 2P1, 2P2	
Box section 2000			max. 8 deep 1P3, 2P1, 2P2	Special cases possible
Box section 2500			max. 8 deep 2P1, 2P2	max. 8 deep (0° chain betw. 1st & 2nd row) 2P1, 2P2, 3P1
Box section 3000				max. 8 deep 2P2, 3P1

Table of the box sections required and possible suspension variants for different large arrays

In order to keep the choice of components simple for the user, we have included four basic configurations as a standard feature in our range of products.

3.1. 1-wide

The 1-wide basic configuration is the most simple, and only consists of a sub bar that is suspended from a single-leg chain (cable). It can be used to suspend up to 8 type C3, C4 or C7-TOP speakers including a MAX.

1-wide	Quantity
Sub bar	1
Total weight:	7.5 kg
SWL	625 kg

3.2. 2-wide

The 2-wide basic configuration consists of a 1000 box section, a lifting slider and two slider36 - rota swivel - sub bar units. It can be used to suspend up to 2 x 8 type C3, C4 or C7-TOP speakers including two MAX.

2-wide	Quantity
Box section 1000	1
Lifting slide	1
Slider36	2
Rota swivel	2
Sub bar	2
Total weight:	40 kg
SWL	1250 kg

- This 2-wide system can be suspended in three different ways:
-
- Single-point suspension with a single-leg chain (cable) at the lifting slider (1P1)
- Single-point suspension with a 2-leg chain at the two sliders36 (1P2)
- Two-point suspension with a chain (cable) at each of the lifting sliders (2P1)
-

WARNING!

Please note: central single-point suspension (1P1) is only approved for maximum 5 deep (600 kg) (for further information on this subject, please see Chapter 4.2.1.1.).

3.3. 3-wide

The 3-wide basic configuration consists of a 2000 box section, two lifting sliders, two slider144 - rota swivel - sub bar units and a slider288 - rota swivel - sub bar unit. It can be used to suspend up to 3 x 8 type C3, C4 or C7-TOP speakers including three MAX.

3-wide	Quantity
Box section 2000	1
Lifting slide	2
Slider144	2
Slider288	1
Rota swivel	3
Sub bar	3
Total weight:	74 kg
SWL	1875 kg

This 3-wide system can be suspended in four different ways:

- Single-point suspension with a 2-leg chain (cable) at the two lifting sliders (1P2)
- Single-point suspension with a 3-leg chain at the central slider 288 and the two lifting sliders (1P3)
- Two-point suspension with a chain (cable) at each of the lifting sliders (2P1)
- Two-point suspension with two 2-leg chains (ropes), one at each pair of lifting sliders/sliders 144 (2P2)

WARNING!

The single-point suspension with a 2-leg chain (cable) is only approved for maximum 3 deep (540 kg). The two-point suspension with two 2-leg chains (cables) is recommended (two additional lifting sliders may be necessary here in certain circumstances).

3.4. 4-wide

4-wide	Quantity
Box section 3000	1
Lifting Slide	2
Slider288	4
Rota swivel	4
Sub bar	4
Total weight:	104 kg
SWL	2500 kg

The 4-wide basic configuration consists of a 3000 box section, two lifting sliders and four slider 288 - rota swivel - sub bar units. It can be used to suspend up to 4 x 8 type C3, C4 or C7-TOP speakers including four MAX.

This 4-wide system can be suspended in three different ways:

- Two-point suspension with a chain (cable) at each of the lifting sliders (2P1)
- Two-point suspension with two 2-leg chains (ropes), either one at each pair of lifting sliders/sliders 288 or one at each pair of sliders (2P2)
- Three-point suspension with three single-leg chains (cables) at two lifting sliders between the two outer sliders and an additional lifting slider in the middle (3P1).

WARNING!

With the two-point suspension (2P1) with two single-leg chains (cables), the position of the lifting slider must be selected very carefully (please see Chapter 4.1.). The two-point suspension (2P2) with two 2-leg chains (cables) is recommended.

3.5. X-wide

As well as the standard configurations described above, it is also possible to construct even larger systems. With the help of spreader lift sliders and rota swivels, several box sections can be combined in the same way as a mobile. Since complex constructions of this kind require careful planning, they are only available as custom-built systems.

You can, however, construct very large arrays yourself by arranging standard systems next to one another. The only difference is that the number of suspension points increases, and these must also be selected and positioned very carefully. d&b Technical Support is pleased to provide assistance in special cases of this kind.

3.6. Basic settings

The settings for slider distances and the slider matrix are provided in detail in the Appendix (Chapter 7) for standard arrays with C3, C4 and C7-TOP systems.

4. Installation of the Installer flying system

Because the Installer flying system is constructed in modules, the system can be adapted mechanically to suit the acoustic requirements and the on-site conditions, since the number of suspension points and the width of the flying system are variable. Also, special chain sets can be mounted at any time, in order to reduce the overall height of the flying system.
It is important to take a close look at the statics of the flying system, to ensure that the applicable safety regulations can be observed in all cases.
As already mentioned in the description of the individual components, the box section is the central supporting element of the Installer flying system. This square steel profile has a high load-bearing capacity. However, the effective lever arms must be taken into consideration when compiling slider combinations and positioning the lifting sliders.

Please note: in the following text, the terms "horizontal" and "vertical" balance will be used to describe the balance of the flying system.

"Horizontal" balance is the balance of the box section in a longitudinal direction. (Example: a 2-wide flying system with 2 speakers at the left and 3 speakers at the right (each group suspended at the same distance from the centre of the box section) will hang "horizontally" crooked, when it is suspended from a point in the middle.)

"Vertical" balance is the balance of the box section along its longitudinal axis. (Example: a 3-wide flying system has 3 speakers hung at the left-hand end and 3 at the right in the outermost hole position of sliders 144 and 4 speakers on the centre slider 288 in the outermost hole position. When this system is hung on two chains, the 4 centre speakers cause the box section to rotate around its longitudinal axis, and the flying system will hang "vertically" crooked.)

4.1. Selecting suspension points

4.1.1. 1-wide

There is only one suspension point available, and for this reason the 1-wide flying system must be secured to prevent it rotating. This can be achieved with, for example, a tensioning rope.

4.1.2. 2-wide

You should always try to achieve suspension from two points here. Suspension from only one point, i.e. centrally at a lifting slider or with a 2-leg chain (cable) is only recommended if the load on the flying system is not very heavy and if the system can be secured to prevent it rotating.

With two-point suspension, the two chains (cables) are attached directly to the suspension eyes in the sliders, then the box section only functions as a spacer device.

2-wide Installer flying systems that are hung with uneven weights should always be suspended from two points.
If this is not possible for some reason, an adjustable lifting slider must be integrated (for further information on this subject, please see Chapter 4.2.).

The overall height of the flying system can only be kept to a minimum in a two-point suspension system if the hooks of the cable or chain pulleys are attached directly in shackles mounted on the sliders or lifting sliders.

4.1.3. 3-wide

The same applies for 3-wide systems as for 2-wide systems, i.e. that they should always be suspended from two points. On small to medium-sized arrays, this is possible with two single-leg chains (cables) (2P1), while on large arrays, two 2-leg chains (cables) (2P2) are required.

Suspension from just one point with a 2 or 3-leg chain (cable) is only recommended in special cases, in which the system must also be secured to prevent it rotating. If the load on the 3-wide flying system is not very heavy (generally a maximum of 8 C3/C4/C7-TOP systems) and the system is evenly hung (i.e. balanced out horizontally), a 2-leg chain (cable) on two lifting sliders can be used (1P2). 3-wide flying systems which are larger or are hung with loads that make them vertically uneven can be suspended with the correct balance from a 3-leg chain (cable) (1P3) with a tensioning link in the centre leg.

The overall height of the flying system can only be kept to a minimum in a two-point suspension system if the hooks of the cable or chain pulleys are attached directly in shackles mounted on the sliders.

4.1.4. 4-wide

A 4-wide system must be suspended from at least two points. On smaller arrays, this is possible with two single-leg chains (cables) (2P1), while on large arrays, two 2-leg chains (cables) (2P2) are required.

4-wide flying systems that are hung with uneven loads can be balanced out horizontally with adjustable lifting sliders. The vertical balance can only be evened out with specially adapted chain sets. In cases of this kind, please contact d&b Technical Support for assistance with detailed design.

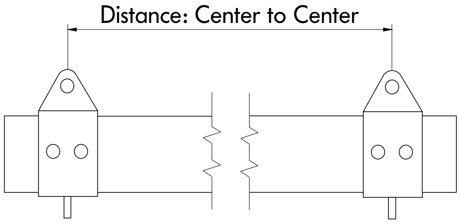
4.2. Calculating the position of the lifting sliders

Before you decide how and from how many points a flying system should be suspended, it is important to understand the principles of mechanical loading within the system.

As already mentioned previously, the box section is the load-bearing element of the Installer flying system. Firstly, it is subjected to a **bending load** from the lever arm created between the sliders and lifting sliders, and secondly, the sliders exert **torsional forces** from the load on their supporting arms which cause the box section to rotate around its longitudinal axis.

The problem of torsional forces has been solved constructively in advance, by limiting systems to a maximum of 4-wide system and by limiting the length of the slider supporting arms to a maximum of 400 mm.

The bending load can be calculated relatively easily. It is, however, important to ensure that the **maximum torque** occurring in the planned flying system does not exceed a specified value. This maximum value M_{Max} is about 1660 Nm for the Installer flying system (Nm = Newtons multiplied by metres ⇒ unit for measuring torque, torque = force multiplied by distance). **When this maximum value is adhered to, a safety factor of 10 is guaranteed.**



Definition of distance

Example:

The distance (always measured from centre to centre. ⇒ Ref. to the figure on the left.) between a lifting slider and a slider from which 4 type C4-TOP speakers are suspended is 40 cm. The speaker dimensions of 4 x 60 kg give a force of 4 x 60 kg x 9.81 m/s^2 = 2354.4 N (force = mass multiplied by acceleration due to gravity, Newton = kg x m/s^2 ⇒ unit of force, acceleration in m/s^2). The torque can now be calculated as the product of distance (= lever arm or distance) multiplied by force, i.e. 0.4 m x 2354.4 N = 941.76 Nm, and is therefore considerably lower than the highest permissible value of 1660 Nm.

Strictly speaking, the torque illustrated here only occurs when a lever which is firmly mounted (with a bearing) at one end is loaded, and when its loaded end moves freely. On the Installer flying system the conditions are more complicated, since there are several loads and several suspension points (= bearing points), particularly in larger systems. It is possible for the torques caused by loads to add up in the bearing points, however they may also equal each other out. For this reason, a decision must be made in each individual suspension case.

Furthermore, when a 2-leg lifting device is suspended, an additional lateral force (and a buckling force) is exerted on the box section, which increases the bending load. This is however, low in comparison to the actual bending forces.

4.2.1. 2-wide, central single-point suspension with a single-leg lifting device (1P1)

In this case, M_{Max} = 4 x 1660 Nm = 6640 Nm. The total load *F* and the opposing distance *L* (in metres) between the two outer sliders (centre to centre!) of the flying system are decisive for calculation of the maximum torque. The total load *F* can be calculated from the weight (in kg) of the suspended speakers m_B and the weight m_F of the flying system.

The resulting torque is therefore

$M = 9.81 \times L \times (m_B + m_F)$

This result can be used immediately to calculate the maximum possible slider distance for a given load:

$L = M_{Max} / (9.81 \times (m_B + m_F) = 677 / (m_B + m_F)$

Example:

2-wide Installer with 1000 box section and 8 type C4-TOP loudspeakers. Total weight is 40 kg + 8 x 60 kg = 520 kg. Distance between the outer sliders 80 cm. Consequently M = 9.81 x 0.8 x 520 = 4081 Nm, which is below the maximum permissible value of 6640 Nm. On the other hand, the maximum permissible distance between sliders for this configuration with 8 speakers is L = 677 / 520 = 1.3 m.

4.2.2. 2-wide, single-point suspension with a 2-leg lifting device (1P2)

If the two free ends of the lifting device are connected directly at the suspension eyes of the sliders, there is no limitation.

If lifting sliders are used, the distance of a lifting slider from the outer slider on which the boxes are hung is decisive for the torque.

In this case, M_{Max} = 1660 Nm. The load *F* on the slider and the opposing distance *L* (in metres) between the lifting slider and the outer slider (centre to centre!) of the flying system are decisive for calculation of the maximum torque. The total load *F* on the slider can be calculated from the weight (in kg) of the suspended speakers m_B and half the weight m_F of the flying system.

The resulting torque is therefore

$M = 9.81 \times L \times (m_B + m_F / 2)$

This result can be used immediately to calculate the maximum possible slider distance for a given load:

$L = M_{Max} / (9.81 \times (m_B + m_F / 2) = 169 / (m_B + m_F / 2)$

Example:

2-wide Installer with 1500 box section and 2 x 6 type C4-TOP loudspeakers. Total weight per slider is 46 kg/2 +6 x 60 kg = 383 kg. The maximum permissible distance between the lifting slider and a slider for this configuration with 12 speakers is L = 169 / 383 = 0.44 m.
In practice, a smaller value should always be selected in order to compensate for the lateral force.

4.2.3. 2-wide, two-point suspension with two single-leg lifting devices (2P1)

If both lifting devices are connected directly at the suspension eyes of the sliders, there is no limitation.
Where lifting sliders are mounted further towards the centre, the maximum distance of the lifting sliders from the slider should be calculated in the same way as in the case above.

4.2.4. 3-wide, central single-point suspension with a 2-leg lifting device (1P2)

For this construction, the 2-leg lifting device is mounted on two lifting sliders which are attached between the centre slider and one of each of the outer sliders at a distance of *a*. The two outer sliders are mounted at a distance of *L*. The flying system must be hung with symmetrical loads for this type of suspension. The total load *F* exerted on the slider can be calculated from the weight m_B (in kg) of all the boxes hung from a slider and the weight m_F of the flying system. The maximum permissible torque is $M_{Max} = 1660$ Nm.
The following specifications only apply for a 3-wide system with sliders that are almost equally loaded.
The occurring torque is minimal if $a = 0.8 \times L$, i.e. the distance between the lifting sliders must be 80% of the distance between the outer sliders.
The resulting torque *M* is then:
$M = 9.81 \times L \times (m_B + m_F / 3) / 10$

Example:

3-wide system with 2000 box section and a maximum of 6 C4-TOP type speakers on one slider. The load on the slider is then 6 x 60 kg = 360 kg. The weight of the flying system is about 74 kg. The distance between the outer sliders is 180 cm. The mathematically calculated distance between the lifting sliders should then be 1.8 m x 0.8 = 1.44 m. However, the hole matrix in the box section only allows for steps of 5 cm, so that the distance between the sliders can only be set in steps of 10 cm. In this case, it is practical to select the rounded down value of 1.4 m, which fits in with the hole matrix. The value calculated for the torque is M = 9.81 x 1.8 x (360 kg + 74 kg/3) / 10 = 679.2 Nm, which is uncritical.
Suspension from the two outer sliders is not recommended here.

4.2.5. 3-wide, central single-point suspension with a 3-leg lifting device (1P3)

With this type of suspension it is also possible to achieve level adjustment of flying systems that are hung with vertically asymmetrical load arrangements.
Two methods are possible: either to attach the centre leg to the supporting arm eye of the centre slider and the outer legs to the suspension eyes of the outer sliders or to attach the outer legs to the supporting arm eyes of the outer sliders and the centre leg to the suspension eye of the centre slider.
There are no limitations to observe here with relation to the maximum torque.

4.2.6. 3-wide, two-point suspension with two single-leg lifting devices (2P1)

In this case the same applies as for the central, single-point suspension method with a 2-leg lifting device.
Suspension from the two outer sliders is not recommended here.

4.2.7. 3-wide, two-point suspension with two 2-leg lifting devices (2P2)

With this type of suspension, one of the two 2-leg lifting devices is attached at the suspension eye of each of the two outer sliders and to the suspension eye of a lifting slider mounted next to the centre slider. The bending load is then basically equivalent to the suspension of a 2-wide flying system on a 2-leg lifting device that is attached directly to the slider suspension eyes.

4.2.8. 3-wide, three-point suspension with three single-leg lifting devices (3P1)

With three-point suspension on three individual chains (cables), the latter are attached directly at the suspension eyes of the sliders. With this type of suspension, no significant bending loads are exerted when the chains (cables) are loaded vertically.

4.2.9. 4-wide, two-point suspension with two single-leg lifting devices (2P1)

This suspension method can be used when a lifting slider is positioned between the two outer sliders at each end. The bending load is similar to that of a 3-wide system suspended from two points.
The position of the lifting sliders is decisive for the occurring torques. On a 4-wide system hung with equal loads, the lifting sliders should be positioned centrally between the two outer sliders. If the loads are unequal, the lifting sliders must be pushed further towards the slider that bears the heavier load.
It is advisable to contact d&b Technical Support if two-point suspension on two single-leg lifting devices is required. Also, this suspension type is not recommended for large arrays. The following suspension type is more suitable for this purpose.

4.2.10. 4-wide, two-point suspension with two 2-leg lifting devices (2P2)

Suspension from two 2-leg chains (cables) should ideally be arranged so that each pair of chains is attached at the suspension eyes of two neighbouring sliders. The load is then basically equivalent to that of a 2-wide system with single-point suspension on a 2-leg chain (cable).
This type of suspension is also suitable for large arrays.

4.2.11. 4-wide, three-point suspension with three single-leg lifting devices (3P1)

Three-point suspension is achieved with three individual chains (cables), each of which is attached at a lifting slider. Alternatively, it is also possible to attach the two outer chains to the suspension eyes of the sliders. This method is recommended where loads are unevenly distributed between the front and back of the array. It is advisable to contact d&b Technical Support if this type of suspension is required.

4.3. Balance correction

4.3.1. Vertical balance

The vertical balance of an Installer flying system is usually adjusted by selecting different holes in the supporting arms of the sliders. These holes are always available in a ratio of 2:1, so that, for example, a 3-wide system with evenly hung loads can be balanced out vertically.

An unevenly loaded Installer flying system can almost always be balanced out vertically by using adapted lifting devices.

With 3-wide systems, this can even be achieved on single-point suspension arrangements using a 3-leg chain set, the centre leg of which includes an adjustable tensioning link. All that is necessary here is for the hole on the centre slider supporting arm for attachment of the rota swivel to be selected so that the hung load makes the flying system tilt slightly forwards. Then the centre chain leg is attached to the supporting arm suspension eye on this slider and the flying system is balanced out by adjusting the tensioning link. In practice, single-point suspension arrangements can only rarely be constructed effectively. A two-point suspension arrangement can be set up in a similar way to the single-point suspension method. All that is needed here are two identical 2-leg lifting devices. One leg of each is attached to the supporting arm suspension eye of the central slider while the two other legs are connected to the two lifting sliders. This suspension method automatically balances the flying system vertically.

WARNING!

A slider may only be loaded on the supporting arm suspension eye with one upward acting force or with two forces that act symmetrically at each side. One-sided lateral pull is not permitted.

Adjustment of the vertical balance on an unevenly hung 4-wide flying system is considerably more difficult. A two-point suspension arrangement is possible using two 3-leg lifting devices which have centre legs with an adjustable tensioning link. The procedure is similar to that for single-point suspension of a 3-wide system. Here, each of the centre legs is attached to one of the two centre supporting arm suspension eyes and the other two outer legs are attached to the lifting sliders.

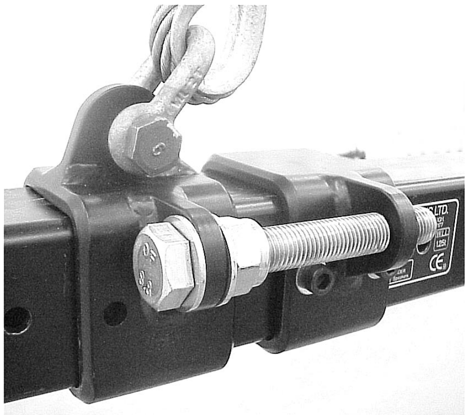
4.3.2. Horizontal balance

The horizontal balance can be adjusted with the help of the adjustable lifting slider. This element allows a suspension point to be moved along the box section by up to 5 cm.

On an 2-wide system with uneven loads that is suspended from a lifting slider, the displacement *V* of the suspension point from the centre between the two sliders can be calculated from the distance *L* (centre to centre):

$$V = 0.5 \times L \times (M_{right} + M_{left}) / (M_{left} + M_{right} + M_{Inst})$$

where M_{left} and M_{right} are the weights of the speakers at the left and right and M_{Inst} is the weight of the 2-wide flying system. Negative values indicate that the suspension point must be moved to the left and positive values that it must be moved to the right.



Adjustable lifting slider mounted on a box section

Example:

Equal loads hung with 3 x C4-TOP speakers at the left and at the right, but an additional MAX is under-hung at the left. The weights of the loudspeakers at the left and right then amount to 208 kg and 180 kg respectively. A 2-wide system is used with 1000 box section, a weight of 40 kg and a distance of 90 cm between the sliders. The displacement of the suspension point is then as follows:

$$V = 0.5 \times 90 \text{ cm} \times (180 \text{ kg} - 208 \text{ kg}) / (208 \text{ kg} + 180 \text{ kg} + 40 \text{ kg}) = 45 \text{ cm} \times (-28 \text{ kg}) / 428 \text{ kg} = -2.9 \text{ cm}$$

The same formula applies for single-point suspension of a 2-wide system on a 2-leg lifting device, since it gives the value for displacement of the centre of gravity of the entire system. For this type of suspension system, this means that the suspension point on the heavier side of the box section must be moved outwards by **double** the amount or the suspension point on the lighter side must be moved inwards by **double** the amount.

There are no difficulties with the horizontal balance with two-point suspension of 2-wide, 3-wide or 4-wide systems with 1 or 2-leg lifting devices.

3-wide and 4-wide systems that are loaded horizontally with uneven loads should always be suspended from at least 2 suspension points.

4.4. Safety device

WARNING!

For safety reasons, it is essential for the flying system to be fitted with an additional safety device which is independent of the suspension points.

A 2-leg steel safety wire is available for this purpose, which must be attached to the sliders or lifting sliders of the box section with the 4 t shackles that are supplied with the safety wire. As previously shown in point 1.8., the nominal load-bearing capacity of this safety wire is 2.8 t at a suspension angle of 45° and 2 t at a suspension angle of 45-60°. This information makes it clear that in some cases just one safety wire is not sufficient to act as the second independent safety device for a large flying system.

WARNING!

The safety wire must be mounted so that the flying system can only drop by a maximum of 20 cm in the event that the suspension system fails.

4.5. Rigging

Before rigging the system, it is important to familiarise yourself with the on-site conditions and to draw up the rigging plan. The rigging plan must include information about the number and type of loudspeaker enclosures that are to be flown, their position in the array and the necessary angle for correct acoustic results in the audience area. If the flying system is not already supplied on site in a preassembled condition, it is important to draw up a detailed parts list and description of the flying system which is to be constructed.

The weight, the planned height and the position of the suspension points should not be forgotten in this plan, so that the riggers can gain some impression of how the complete flying system should be suspended from the overhead construction in question.

If the local safety regulations require adherence to the 10:1 safety factor for the flying system, the ceiling or other structures, the rigging equipment and the motorised pulleys must be able to bear ten times the weight of a fully loaded system. The full specified load-bearing capacity and the safety margin of the flying system only apply for a vertically suspended system. All deviations from the perpendicular lead to a decrease in the load-bearing capacity.

Using the plan as a guide, the riggers are able to set the exact position of the suspension points for the configuration. Chains and supporting elements must hang vertically from the suspension points when the load is hung, otherwise the load-bearing capacity of the flying system is diminished. The riggers themselves must take special care to ensure that the suspension points are correctly positioned and aligned. A flying system can be rigged in five stages:

- Unpacking, safety checks and preadjustment
- Hanging and wiring the array
- Lashing
- Final clearance check of the array
- Hoisting and securing the array

A great deal of unnecessary work can be avoided by planning operations carefully in advance, for example by ensuring that loudspeakers are set up ready in the right sequence on the floor so that the entire array can be put together row by row. Heavy lifting work should be carried out with motorised chain pulleys.

4.5.1. Unpacking, safety checks and preadjustment

It is assumed in the following description that all preparatory work right through to the chain pulley/motor and including the securing points has already been conducted, and that the pulleys are already set at working level ready for the fully assembled flying system to be hung.

We recommend ensuring beforehand that there is sufficient free working area to unpack and set up the flying system.

It is also important to ensure that the area which is required for hoisting and securing the array is clear and that there are no people (e.g. riggers) in this area.

WARNING!

Firstly, check that the chains of the motorised pulleys are hanging straight and are not twisted and that the motors are in the position specified in the rigging plan. The chain bag should be placed behind the box section (when viewed looking towards the stage), and the steel safety wires should ideally be left hanging in front of the box section.

Before the flying system is suspended from the pulleys, the weight balance should be adjusted on the unloaded flying system. The balance adjustment cannot be made once there are speakers hung on the sub bars.

IMPORTANT!

The chains or cables attached to the flying system can then be attached to the motor hook and the flying system hoisted, so that the safety checks described later in Chapter 5 "Maintenance and care" can be carried out before the system is preadjusted.

4.5.2. Hanging and wiring the array

We recommend setting up the array row by row at the beginning. The assembled and adjusted flying system must be hoisted to working level for this purpose. The cable holders and distributors and the lashing straps can then be attached. Now you can begin with the actual hanging of the speakers. The first, uppermost row of speakers should be set up in the correct sequence on the floor underneath the sub bar of the flying system. It is important to ensure here that the TOP and SUB speakers are arranged in the order specified in the configuration plan. Every enclosure in the first row is attached to its sub bar with a pair of flying studs and chains (standard chain length 11 links). The flying system should then be raised high enough for the next row of speakers to be set up underneath it and aligned so that the first row can subsequently be lowered again exactly onto the upper surface of the second row. Finally, the flying studs are mounted and fastened with the chains (standard chain length 23 links) to the flying studs on the first row of speakers. When rigging the array, it is also important to ensure that the open ends of all the safety hooks are hooked in from the back and point to the front, that the clips are closed and that the chains are not twisted. This process is repeated until all the rows of speakers are attached to the flying system. At the latest at the point when two speakers are suspended freely underneath one another, all horizontal angles must be checked again to ensure they are correctly adjusted, the lashing straps must be threaded through the sub bars and the top speakers, the load points attached for the loudspeaker cables and the top loudspeakers wired according to plan.

As soon as the last row is attached and the entire array is hoisted, all errors made in the prealignment of the horizontal balance of the box section become obvious. All necessary adjustments to the horizontal equilibrium that are made at the adjustable lifting slider must always be carried out by first lowering the array and setting it down safety on the floor.

Finally, check that the motors function correctly, that they run at the same speed so that the system is hoisted evenly and that the chains are not twisted and run safely into the chain bags. The chain bags must not touch the sub bars. When hoisting the system, make a final check for twisted chains or tilted hooks!

4.5.3. Lashing

Once the adjustments and checks described above have been carried out, the lashing straps must be pulled through the delta bars of each sub bar. Starting with the top loudspeaker, the free end of the lashing strap is pulled through all the strap guides on the back of the speakers in each vertical row. The strap provided is long enough to lash a row with up to eight type C3, C4 or C7-TOP speakers. You will, however need assistance with inserting the end of the strap in the ratchet mechanism - helpers must pull the entire row back on the underside to tension the strap sufficiently. The spindle of the ratchet mechanism can only take up a limited length of strap, so that the strap must be pulled right through and pre-tensioned as far as possible before it is finally lashed in place. Ideally, the ratchet should be positioned at the top edge of the second loudspeaker from the bottom, so that it can be worked with comfortably during subsequent work. The lashing strap is tensioned with the ratchet handle. A sketch for operation of the ratchet is attached to the ratchet of every lashing strap supplied by d&b. As the strap tension increases, a curvature is formed in the row of speakers until the entire row forms a vertical angle towards the bottom. It is important to ensure that the straps are not lashed too tightly and that the top load chain is never slack.

4.5.4. Final clearance check of the array

The right time has now come to make a visual inspection of the entire arrangement. You can check that the balance is correctly adjusted by ensuring that the sub bars are parallel to the box section.

You should not forget here that the rows that are suspended next to each other do not necessarily have to hang in exactly the same way in every direction, even in a correctly balanced flying system. If we assume that the top speakers in every vertical row are set at the same vertical angle, there can still be a difference in height of several centimetres between the individual rows. The different combinations of TOP and SUB speakers in each vertical row also cause different centres of gravity in each row, and these are ultimately responsible for slight differences in position. These positional differences of the rows can be ignored as far as the acoustic characteristics of the array are concerned.

This aspect also shows that the correct horizontal position of the flying system should not be judged on whether the speakers are flush with one another at the bottom edge, but by checking the position of the sub bars.

4.5.5. Hoisting and securing the array

When all the mechanical adjustments, system checks and safety checks have been made the array can be hoisted up to its operating position. The steel safety wires must then be connected at a separate, suitably strong point on the ceiling construction. The rigger responsible for attaching the steel safety wires must be informed that he or she must avoid impairing the balance or position of the entire array due to tension on the safety wires. When hoisting the array, ensure that the loudspeaker cables do not get caught anywhere. The cables can be bound together with the motor cable to form a hank while the system is hoisted. All the (moved) chain pulley motors must raise the system slowly and evenly so that it is held level during hoisting and does not rock from side to side.

4.6. Unrigging

It may be necessary to dismantle or at least to lower the flying system for service purposes.

To lower the array and to unlash and dismantle it, you should basically follow the instructions for rigging in reverse order. The same safety instructions apply.

First, the steel safety wires (safeties) connected to the ceiling construction should be released.

While the array is lowered slowly and evenly, nobody should be anywhere near the working area underneath it.

WARNING!

The motors must be stopped when the array is about half a metre above the floor. The ratchets on the lashing straps can then be released, so that the vertical rows hang down freely.

Take care when releasing the ratchets: the sudden relief of tension in the rows makes them swing out and they can injure people or damage objects in front of the array.

WARNING!

The straps should then be pulled out of the strap guides in the two lower rows of speakers. The loudspeaker cables and the connecting cables must be disconnected. The array should then be set down slowly and carefully on the floor so that the speakers are stacked on top of each other. The studs and chains in the two lowest rows should be unhooked and the other rows in the array carefully raised again a little so that the two bottom rows can be cleared away.

Proceed in the same way for the remaining rows, always dismantling two rows of loudspeakers at a time.

Use the same practices as during rigging work - the individual who is charge of unrigging should check every step and situation and announce every lifting or lowering movement of the motors loudly and clearly!

WARNING!

5. Maintenance and care

WARNING!

All mechanical systems with moving parts are subject to wear and tear. The Installer flying system is no exception. Damage to the system components caused by long-term symptoms of wear or incorrect handling during rigging and adjustment work can result in an increased risk of accident.

Because the flying system is a mechanical device in which safety is of prime importance, it is essential for owners and users of the system to adhere to strict and well documented maintenance and inspection practices. All employees involved in rigging and using the system must be informed about the necessary safety inspections and be aware that they should carry them out independently as a matter of course. The following information and instructions are designed to promote this safety concept and to protect owners, users, performers and of course audiences from injury.

The main components of the flying system, i.e. the box section, lifting slider, rota swivel and sub bar have a black powder coating. This surface treatment protects the main components against rust and corrosion under normal conditions, but not in cases of damage. The materials can, however, be stressed more than usual by extreme environmental conditions, for example water, including rainwater, aggressive chemicals or similar substances. The highest risk is posed by steel rigging components and the retaining elements used to connect the different parts of the system. For this reason, regular inspections for signs of corrosion are strongly recommended. We also recommend protecting all bare metal parts with a flowing anti-moisture/ anti-corrosion product such as WD40.

As a general practice, the system must undergo a visual inspection every time it is unpacked or packed. More than one person should be entrusted with this job so that they can check each other's work. For documentation purposes and in order to encourage routine, it is, for example, a good idea to include a logbook with this system. This should contain a check list of the individual inspection steps, so that the user can tick off each element during the inspection process. The logbook should also include a register with detailed information about the system, for example a complete inventory list, a list of the serial numbers printed on or engraved in the components, a column for comments, and information about times and places where the system is used for events, with reference to the rigging plan and system details. The annual test certificate should also be kept with the logbook.

WARNING!

No system may be used without a valid test certificate.

Every system must be unpacked in a storage area and checked thoroughly whenever it is returned from a job and before it is dispatched for use at the next event.

The system should be fully and realistically rigged and suspended during an inspection.

All parts must be checked for fastness and for signs of wear. All joints and connections should be checked for mobility and for wear on the bearing surfaces. Adjusting and clamping screws must be easy to turn. If this is not the case, the threads may be damaged. The box section must be inspected for deformation or signs of wear.

WARNING!

It must be possible to make all system adjustments by hand. Levers, hammers, mechanical aids, etc. may not be used.

All other components like studs, shackles, chains and steel safety wires must be checked thoroughly for signs of wear. It is also important to ensure that they have not been replaced with other components on location. For this reason, the SWL number engraved or stamped on each element (if it has a number) should also be checked. The safety chains between the sub bar and slider must also undergo a thorough inspection. The fastening elements used to attach the chains to the sliders must move smoothly.

All sliders must be inspected thoroughly. It is also important here to check for the slightest signs of warpage, twisting or other deformation. The surfaces and welded seams of the components must be clean and should not show any signs of corrosion. The nameplates and engraving must be checked for signs of tampering.

WARNING!

In the event that faults are found during the inspection or there is any doubt about the safety of the flying system, it should not, of course, be used.

5.1. Annual inspection and certification

Ideally, every flying system should be sent back to MAN every year for inspection and renewal of its certification. However in many cases this is not possible from a practical point of view. For this reason, we recommend having the entire system checked annually by an authorised agency or institution, in addition to the regular inspections described above. The load test is described in detail in Appendix 7.2. with a 3-wide configuration taken as an example. A "Proof load test sheet" (see example in Appendix 7.2.1.) is provided with every system.

WARNING!

No system may be used without its test certificate, which must be renewed once a year and is issued by an independent testing agency. A copy of the valid test certificate, on which the engraved serial number of the components are listed, should be provided with every system so that it can be presented to the local safety authorities whenever necessary. As well as requiring a valid test certificate, some insurance companies may structure their contracts so that the system is required to be tested and cleared by their own experts.

6. Technical specifications

6.1. Component dimensions and weights

The dimensions given in the following tables are external dimensions and the weights already include the necessary fastening screws.

Box section 80mm x 80mm	**Length in mm**	**Weight in kg**
1000	1088	13.5
1500	1588	19.75
2000	2088	26.0
2500	2588	32.25
3000	3088	38.5

Slider	**Dimensions (WxHxD) in mm**	**Weight in kg**
Lifting Slider	80 x 144 x 100	2.1
Spreader Lift Slider	80 x 188 x 100	2.3
Adjustable Lifting Slider	160-210 x 144 x 146	4.5
Slider36	80 x 183 x 100	2.4
Slider144	80 x 183 x 214	3.7
Slider230	80 x 183 x 300	4.7
Slider288	80 x 183 x 358	5.4
Slider350	80 x 183 x 420	5.9

	Dimensions (WxHxD) in mm	**Weight in kg**
Rota swivel	∅ 64 x 160	2.3
Sub bar	690 x 108 x 72 (without Delta link)	7.6

The overall height of a flying system is about 36 cm measured from the lower edge of the sub bars to the upper edge of the slider suspension eyes.

The external dimensions of the basic configuration are:

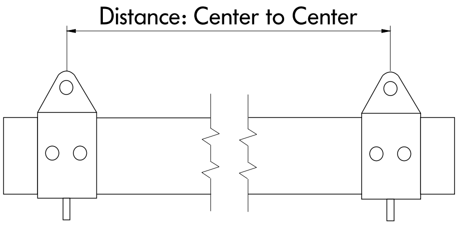
	Width x depth (cm)
2-wide Z5212	109 x 10
3-wide Z5213	209 x 48
4-wide Z5214	309 x 62

When different sliders are combined, the depth of an Installer flying system can be calculated from the sum of the external dimensions of the longest slider in front of the box section and the longest slider behind it, minus 10 cm.

6.2. Slider hole matrix

Matrix (mm)	**Slider36**	**Slider144**	**Slider230**	**Slider288**	**Slider350**
-18	X	X	X	X	X
0	X	X	X	X	X
36	X	X	X	X	X
72		X	X	X	X
100		X	X	X	X
144		X	X	X	X
175			X	X	X
200			X	X	X
230			X	X	X
260				X	X
288				X	X
320					X
350					X

7. Appendix



Definition of distance

7.1. Basic settings

The basic settings for the slide distances (in cm, each from centre of slider to centre of slider. ⇒ Ref. to the figure on the left) and the slider matrix are provided in the table below for different low hanging loads on the flying systems.

The values are for type C4 loudspeakers, which are usually angled 30° horizontally and 5° vertically in relation to one another. With non-standard vertical angles, there may be considerable deviations from these values. Smaller vertical overall angles do not cause any problems.

The distance of the outermost slider also defines the length of box section required.

7.1.1. 2-wide

Sliders 36 are used here. The information given in the table is the distances (in cm) for sliders 36 for angles of 0°, -5° and -10° in the top row of speakers.

Angle of the top row of speakers	0°	-5°	-10°	Suspension
1 deep	70	70	70	1P1,1P2,2P1
2 deep	70	70	80	1P1,1P2,2P1
3 deep	80	80	80	1P1,1P2,2P1
4 deep	80	90	90	1P1,1P2,2P1
5 deep	90	90	100	1P1,1P2,2P1
6 deep	90	100	110	1P2,2P1
7 deep	100	110	120	1P2,2P1
8 deep	110	120	130	1P2,2P1

7.1.2. 3-wide

The information given in the table is the distances (in cm) for the outer sliders for angles of 0°, -5° and -10° in the top row of speakers. The centre slider is always positioned exactly in the middle between these two sliders. The second column for each angle contains the hole distance (in mm) at the left and right-hand and the centre sliders. Since the values for the left and right-hand sliders are the same, only one value is shown in the table. The third column is the distance between the two lifting sliders for two-point suspension.

Angle of the top row of speakers	**0°**			**-5°**			**-10°**		
3-wide 100° / C4	**Slider distance**	**Matrix**	**Lifting slider distance**	**Distance**	**Matrix**	**Lifting slider distance**	**Distance**	**Matrix**	**Lifting slider distance**
1 deep	130	72/144	100	130	72/144	100	140	72/144	110
2 deep	140	72/144	110	140	72/144	110	140	72/144	110
3 deep	140	72/144	110	150	72/144	120	150	72/144	120
4 deep	150	72/144	120	160	72/144	120 (130)	160	72/144	120 (130)
5 deep	160	72/144	120 (130)	170	72/144	140	180	100/200	140
6 deep	180	100/200	140	190	100/200	150	200	100/200	160
7 deep	200	100/200	160	210	100/200	170	220	100/200	180
8 deep	220	100/200	180	240	100/200	190	250	144/288	200

7.1.3. 4-wide

A differentiation is made between 4-wides with an overall angle of 100° and 130°. In the 100° system, the two centre sub bars are aligned parallel to the box section, whereas in the 130° system a standard angle of 30° is set between the two central speaker columns.

In the tables, the first column for each angle contains the distances (in cm) between the outer and inner sliders for angles of 0°, -5° and -10° in the top row of speakers. The sliders are always positioned symmetrically, whereby the supporting arms of the centre sliders point to the front and the arms of the out sliders point to the back.

The second column for each angle contains the hole distance (in mm) at the sliders, whereby the values for the two outer and the two inner sliders are always the same.

Angle of the top row of speakers	**0°**		**-5°**		**-10°**	
4-wide 100° / C4	**Distance**	**Matrix**	**Distance**	**Matrix**	**Distance**	**Matrix**
1 deep	210 / 70	100	210 / 70	100	210 / 70	100
2 deep	210 / 70	100	210 / 70	100	210 / 70	100
3 deep	210 / 70	100	220 / 70	100	220 / 70	100
4 deep	220 / 70	100	220 / 70	100	230 / 70	100
5 deep	230 / 70	100	240 / 70	100	250 / 70	100
6 deep	250 / 70	100 (144)	260 / 70	144 (100)	260 / 70	144
7 deep	260 / 70	144	280 / 70	144	290 / 70	144
8 deep	280 / 70	144	300 / 70	144	320 / 70	175

4-wide 100°, slider distances and slider hole matrixes. The values shown in brackets should be selected if the required configuration deviates slightly from the standard configuration.

Angle of the top row of speakers	**0°**		**-5°**		**-10°**	
4-wide 130° / C4	**Distance**	**Matrix**	**Distance**	**Matrix**	**Distance**	**Matrix**
1 deep	180 / 70	175	190 / 70	175	190 / 70	175
2 deep	180 / 70	175	190 / 70	175	190 / 70	175
3 deep	190 / 70	175	200 / 70	175 (200)	210 / 80	200
4 deep	210 / 80	175 (200)	210 / 80	200	230 / 90	200
5 deep	220 / 80	200	240 / 90	200 (230)	260 / 100	230
6 deep	250 / 90	230	260 / 100	230	290 / 110	260
7 deep	280 / 110	260 (230)	300 / 110	260	320 / 120	288
8 deep	300 / 110	288	330 / 120	288	360 / 130	320 (350)

4-wide 130°, slider distances and slider hole matrixes. The values shown in brackets should be selected if the required configuration deviates slightly from the standard configuration.

7.2. Load test

In Chapter 5.1., it was emphasised in connection with care and maintenance of the Installer flying system that it is important to have the system tested regularly by an expert. A "System specification sheet" and a "Proof load test specification sheet" is supplied with every Installer flying system.

The system specification sheet (abbr. SyS) includes the serial number (part ID nos.) of the individual components. The SyS bears the serial number of the manufacturer MAN at the top left, and at the bottom right the serial number of the complete flying system.

The proof load test specification sheet (abbr. TS) details the different methods of conducting a load test with a nominal load. This load test may only be carried out by an expert in the sense of BGV C1. The TS also bears the serial number of the manufacturer MAN at the top left, and at the top right the serial number of the complete flying system.

The proof load test specification sheet and the system specification sheet are in important part of the flying system test book.

A load test for the 3-wide flying system is described below. The same **[B]**method can also be used for a 2-wide or 4-wide system. Three variants are possible, depending on the type of equipment used by the company commissioned with the load test.

7.2.1. Method with distributed loads (Fig. 1)

The flying system is suspended from two points or from a two-leg lifting device, as shown in the sketch. Two individual weights of 315 kg are hung on each sub bar.

7.2.2. Method with single loads (Fig. 2)

The flying system is suspended from two points or from a two-leg lifting device, as shown in the sketch. A weight of 625 kg is hung on each sub bar.

7.2.3. Back to back method (Fig. 3)

Two identical installer flying systems are suspended back to back, one underneath the other, from two points or from a two-leg lifting device. This is achieved by connecting the opposing sub bars of the two flying systems with 2 short chains or cables per sub bar. The entire arrangement is then loaded with double the test load of an individual system, i.e. 3750 kg. This can be done by hanging a weight of 3750 kg on a two-leg lifting device or two weights of 1875 kg on two single-leg lifting devices from the lifting sliders of the lower flying system.
The following slider and lifting slider settings should be made in all three methods (see also Chapter 7.2.4.):

- Position the centre slider in the middle of the box section.
- Secure the outer sliders in the outermost holes of the box section.
- When **[B]** is the distance of the centre slider from the outer slider, the lifting sliders should be mounted at a distance **[A]** of 25-50% of the dimension **[B]** from the outer sliders (see Fig. 2).
- The sub bars should be aligned parallel to the box section.

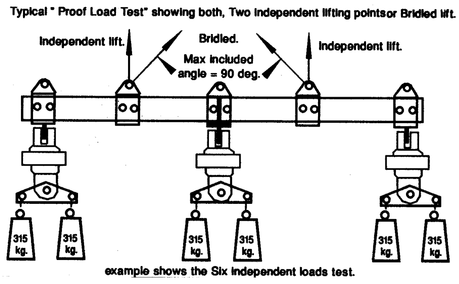


Fig. 1

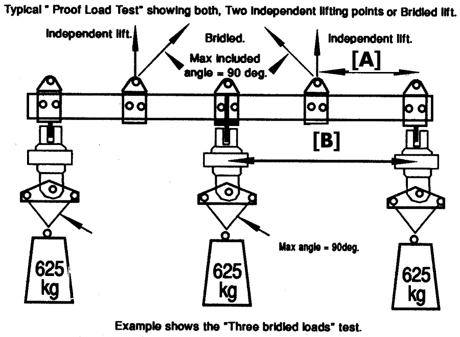


Fig. 2

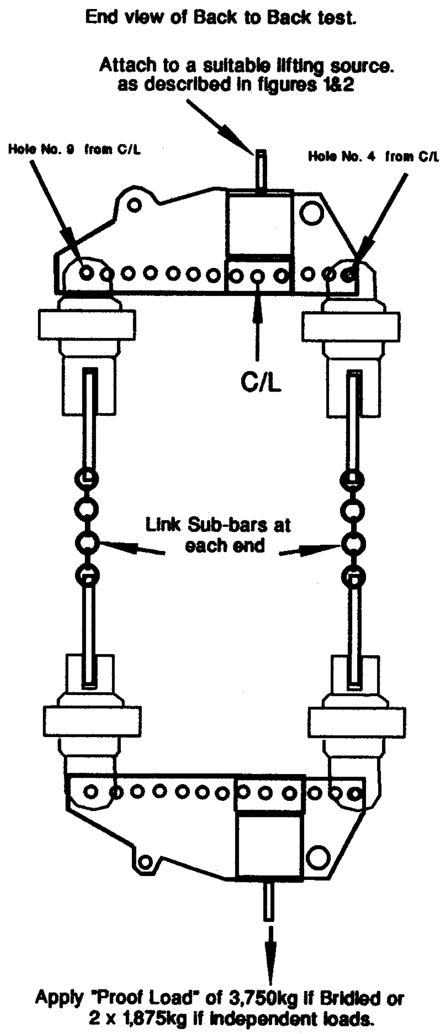


Fig. 3

TS No.00/360 | **Proof Load Test Specification Sheet.** | Assembly No. 00/016

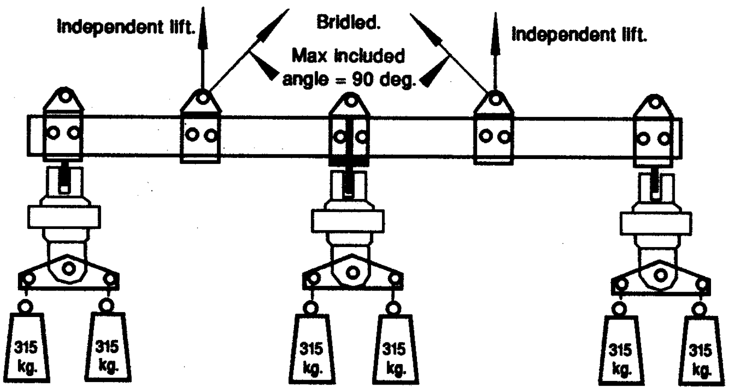
To be used in conjunction with SS No. 00/360

Date. 1-2-00

Recommended test procedures.

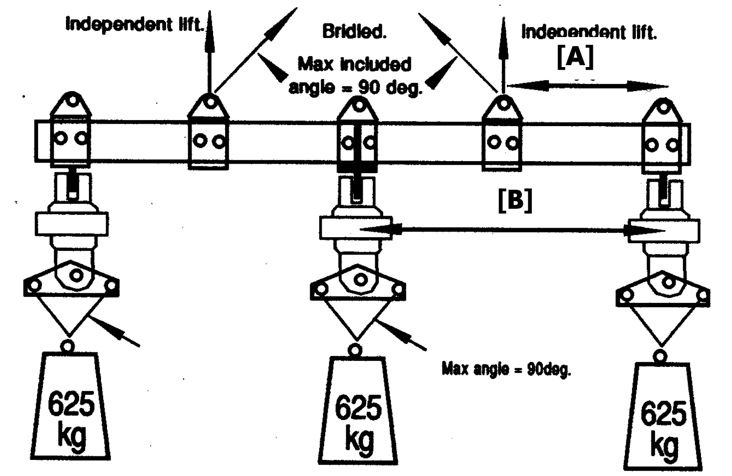
1. Set the centre slide in the middle position on the bar, and the two outer slides to their most extreme positions.
2. Set Sub-bars to the position shown in the side view below (FIG 3.).
3. Adjust the lifting slides to within the range stated in the lower right hand box.
4. Suspend the system from-
   - (a.) Two independent lifting sources, these are to be positioned directly above the lifting points.
   - or (b). Support on a suitable two leg bridle chain or wire, having leg angles within the 0-45deg range.
5. Select which method of loading is to be used-.
   - (a.) Six individual live loads, each weighing 315kg.
   - (b) Three bridled live loads, each weighing 625kg.
   - (c) Back to back testing of two identical bars, requiring a single load of 3,750kg or a tensile testing machine.

Fig 1.
Typical " Proof Load Test" showing both, Two independent lifting pointsor Bridled lift.



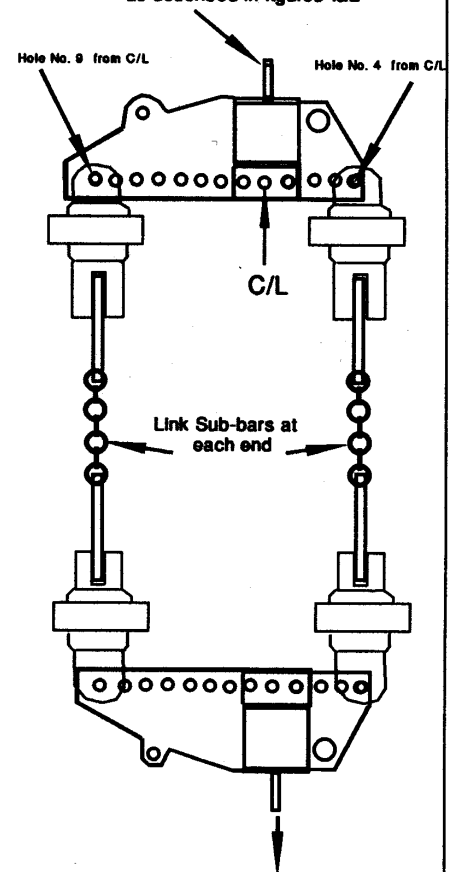
example shows the Six independent loads test.

Fig 2.
Typical " Proof Load Test" showing both, Two independent lifting points or Bridled lift.



Example shows the "Three bridled loads" test.

Figure 3.
End view of Back to Back test.



Apply "Proof Load" of 3,750kg if Bridled or 2 x 1,875kg if independent loads.

System description. Three Wide INSTALLER/tour.	Suspension Point Configuration. Two Point- Individual or Bridled.
Consisting off. 1off 2mtr box, 1 x 288 slide, 2 x lift slide, 1 x 144 slide, 3xd&b Sub-bar 3 x rotor/swivel, 3 x Sub-bar safety,	Suspension Point Positional Range. No. hole from C/L Dedicated position. Adjustable Within Range. __ "A"= 25% to 50% of "B"
W.L.L./S.W.L. 1,875kg	

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