STEERING AND SUSPENSION SYSTEMS

STANDARD AND CUSTOM MADE
Breeman International Supplies was founded in 1961 and developed into an important (inter) national machine builder, known for its expert knowledge, its creativity and its problem solving capacity. The international customer base of Breeman acts in the dredging, maritime, transport, stevedoring and energy industry. Our customers are served from our production plant in Zuidland, closely located to the port of Rotterdam, the Netherlands.

All systems are engineered and produced in-house, what makes the team of Breeman Steering and Suspension systems the perfect partner to solve your special requests for non-standard solutions.

In 2010 Breeman realized a Multi trailer for the Japanese Market. This system exists of a 3 axle bogie and a 4 axle bogie. The bogies have independent hydraulic suspension and the system has 13 configurations. The trailer can be steered with a radio remote control and after changing a configuration the bogies automatically align with the goose neck.

Breeman International Supplies has more than 20 years experience in steering systems of trailers; hydraulic, mechanical and electrical. In 1989 the first approved electronic system went on the road. This year Breeman improved their sys-tem and will be presented for approval. The improved Breeman Electronic Sys-tem is ready for the “LZV” market (the prototype is on the road for 7 years in England) and will be a new type next to the existing types of steering and suspension systems.

Breeman presents:
- Mechanical Steering
- Hydraulic Steering
- Eletronical Steering
- Hydraulic Suspension
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Why power steering for semi-trailers?

In considering this question theoretically, we begin with turntable steering. This makes explanation simpler. Later you will see that hydraulic steering axle steering has many advantages over turntable steering. There are various reasons why semi-trailers are steered.

- To conform to legal requirements
- To reduce tire wear
- To reduce turning space
- To increase load capacity
- To reduce fuel consumption
- To reduce maneuvering
- To reduce road surface damage

Reducing tire wear

Consider in detail, what happens when a combination is turning. The front wheels (2) of the tractor are steering. If the centre line of this axle, along with that of the tractor rear axle, are projected inwards, they intersect at a point P, called the centre of rotation. The tractor is turning about this point with a constant steering angle. At the same time, the semi-trailer turns the fifth wheel inwards until the centre line of its centre axle also passes through point P.

In reality, this line does not coincide exactly with the centre line of the axle, but lies a little to the rear. The position of the centre line depends on the speed of the combination, but it is not necessary to take this into consideration for this theoretical analysis.

Now, drawing circles, with centre P, tangential to the tires of the centre axle, gives the turning radius of the semi-trailer, it will be seen that the tires of the rear and front axles are outside these circles. The distance of the tire from the circle is a sideward component of the movement of the tires. This is a scrubbing, rather than a rolling action, and results in a very high level of tire wear.
Imagine, now, that one axle is removed, and the remaining two axles positioned centrally across the line from point P. If tangential circles are now drawn through the tires, it can be seen that there is no sideward movement, but only a twisting on the road surface. This results in a very great reduction in tire wear. However, because of load requirements, a third axle is needed.

If this third axle is now steered so that its centre line also passes through point P, the theoretical wheel base remains constant, and the wear on the tires of the two front axles remains as for the tandem. The steered axle aligns itself with Point P, and tire wear is minimal.
**A case in practice**

A company has two semi-trailers. Averaging over 6 tires, the trailer 1 needs new tires every 75,000 km. For trailer 2, the average is 240,000 km. If the trailers cover 200,000 km a year, and the price of a tire is €750.00, trailer B results in a saving, on tires alone, of €8,250.00 a year.

The exact savings will depend on the type of haulage work, the driving style, and the outline of the axles. For a semi-trailer on international transport, with long runs, the savings will be less than for a semi-trailer collecting milk from farms, with short runs and much maneuvering.

**Reducing turning space**
If a tractor drives on a circle with radius $D$, the tri-axle semi-trailer will turn about the fifth wheel so that the centre line of the centre axle passes through point $P$. The shortest distance from the side of the semi-trailer to point $P$, is that measured on the centre line of the theoretical wheel base. This is distance $E$. Now, the width of the path required by the combination is $D - E = A$. The angle between truck and semi-trailer is $\alpha_1$, known as the coupling angle.

If the rear axle is again imagined to be removed, the theoretical wheel base will be a half axle spacing shorter, and the fifth wheel angle decreases to $\alpha_2$, with the consequence that the distance from the side of the semi trailer to $P$ increases to $F$. The width of the required path is now $D - F = B$. The reduction in the width of the required path is $A - B = C$

If a steering axle is now placed behind the fixed axles, its centre line aligns with point $P$, and it has no influence on the path width because the theoretical wheel base is unaffected.

These considerations apply to all axle configurations. With a tandem semi-trailer for example, the theoretical wheel base of the unsteered arrangement lies between the two fixed axles. If the rear axle is steered, however, the theoretical wheel base passes through the front axle. This will also be true if the two rearmost axles of a tri-axle semi-trailer are steered. In case of a tri-axle semi-trailer with all axles steered, the theoretical wheel base is less clear, as it is not determined by the fixed axles.
With a single-axle semi-trailer with fixed axle, for example, the theoretical wheel base passes through the fixed axle. However, if the axle is steered, the centre line of the axle passes through point P, and a perpendicular A, can be drawn from point P to the centre line of the semi-trailer. This line is now the theoretical wheel base of the semi-trailer.
For a semi-trailer with two or more steered axles, and no fixed axles, the same obtains as for the single-axle semi-trailer.

As will be seen later, the essential difference between a semi-trailer with a combination of fixed and steered axles, and one with only steered axles, is that the theoretical wheel base of the former is governed by the fixed axles and remains in a constant position. In the case of the semi-trailer with all steered axles, the theoretical wheel base moves rearwards as the semi-trailer negotiates tighter curves.
Increasing load capacity

As an example, we considered a two axle van, with a cargo floor of 7.8 m in length, being driven through a narrow street so that it just cleared all obstacles.

We then considered the same situation using a single-axle semi-trailer combination. It can be seen that the semi-trailer cargo floor can be longer than that of the van, by about 1.8 meter.
Reducing fuel consumption

If a semi-trailer is equipped with three fixed axles, it will turn about a point P in line with the centre axle. To move the semi-trailer straight forward, a force A is required at each tire. However, while the tire tends to move straight forward, the tractor pulls in direction B. It can be seen from the drawing that force B is considerably greater than force A, so that greater power is required from the tractor, and this is immediately translated into fuel consumption. A decrease in fuel consumption up to 6% is not unusual.
Reducing maneuvering

To drive an unsteered combination backwards into an entrance, requires the tractor to take a large winding path, X, to force the rear of the trailer into the right direction. Also, the truck has to swing outwards to ensure straightening up with the semi-trailer. This means that the combination needs a large dimension Z to accomplish the maneuver.

A steered semi-trailer requires a much smaller winding path because, with a smaller angle between tractor and semi-trailer, the rear axle will begin to steer in the right direction. Because the winding path is smaller, the turning distance Y will also be smaller.

As a result, the dimension Z is smaller, and the steered semi-trailer is able to maneuver into more restricted entrances than the unsteered vehicle. More deliveries and increased profits can result.

Reducing road surface damage

As already described, an unsteered tri-axle semi-trailer driving in a curve causes a sideward force on the road surface. In places where many such trailers maneuver, the road surface is very quickly damaged. The use of semi-trailers with steered axles reduces the sideward forces and, consequently, reduces surface damage. The difference is that impressive that more and more companies refuse unsteered multi-axles semi-trucks on their sites.

What steering angles are necessary?

- The necessary steering angle depends on many factors, such as:
  - Type of semi-trailer
  - Its wheelbase
  - Its axle spacing
  - Overhang behind the rear axle
  - Whether or not all axles steered?
  - Legislative requirements
  - The customer’s wishes
**Type of semi-trailer**
The most important factor here is the field of application. For example, a semi-trailer on distribution work needs a greater degree of steer than a one deployed on long distance transport. The former needs high maneuverability, the latter needs low tire wear.

**Wheelbase**
Basically, the shorter the wheelbase of a semi-trailer, the less steering is required. Nevertheless, a semi-trailer with a combination of fixed and steered axles needs greater steering angles for a shorter wheelbase and equal axle spacing.

**Axle spacing**
If the distance between the fixed axles and the steering axles become greater on an equal wheelbase, larger steering angles are necessary.

**Rear overhang**
The greater the semi-trailer overhangs behind the rear axle, the greater the trailer swing-out will be when turning.

**All axles steered?**
When the semi-trailer has a combination of fixed and steered axles, the steering angles depend on the ratio between the wheelbase and the axle spacing. With all-steered axles, the choice depends on stability, the wishes of the customer, and any legislative requirements.

**Legislation**
The differing legislative requirements in many countries must be carefully considered.

**Customers wishes**
In most cases, this is the most important factor in considering the steering requirements for a semi-trailer.

**Types of steering**

- Self-steering axles
- Turntable steering
- Powered Steering axles
**Self-steering axles**

In a self-steering axle the points of rotation (the kingpins) are situated in front of the centre line of the axle. Such an axle must always be used in conjunction with a fixed axle. On a semi-trailer with a self-steering axle, the wheelbase will always pass through the centre line of the fixed axles.

Because of friction on the road surface, the wheels of a self-steering axle will always turn until they point in the direction of the turning point of the combination. This type of steering is mainly used on semi-trailers where it is necessary to make the wheelbase so long that, without them, legislative requirements would not be met. Alternatively, they can be used to save tires.

The great advantage of self-steering axles is that they give a relatively cheap form of steered semi-trailer. Their disadvantage is that the axle must be locked when the vehicle is reversing; there is also a tendency to vibration, which can increase wear on tires and bearings.

**Turntable steering**

With turntable steering the whole axle, including its suspension, is attached to a turntable; when the semi-trailer is steered the whole axle rotates. The main advantages of this form of steering are that they are relatively easy to manufacture and that dual tires can easily be used.

There are, however, disadvantages, such as:

- The forces in the mechanism are much higher than in an axial pivot steering system, in some cases up to five times greater.
- More space is needed, so that the semi-trailer chassis must be higher and during steering, the track decreases. For this reasons the stability of the semi-trailer is much reduced in comparison with an axial pivot steering system, especially in tank trailers.
**Axial pivot steering system axles**

In this system, the body of the steering axle is fixed, and has rotating points (kingpins) at each end. The main difference with a self-steering axle is that the kingpins are positioned on the axle centre line, instead of in front of it.

The main advantages of the system are:

- There is little track decrease during steering, and hence better stability.
- Because of the small track decrease, the wheels stay outside the chassis, even during full steer, so that the semi-trailer chassis can be lower. Again, better stability.
- Simple to mount.
- Lower axle spacing compared with turntable steering.
- Lower weight.
- Lower forces.

A disadvantage of an axial pivot steering system is their cost, due to the need for the specially developed steering axle.
Types of powered steering axles

- Cable steering with cross-cable
- Cable steering with reverser
- Rod steering
- Hydraulic steering

**Cable steering with cross cable**

In this system, a cable pulley with a turntable is mounted at the front of the semi trailer. The turntable is connected to the steering wedge. The axle is mounted under a turntable, above which is a larger cable pulley. Because of the required steering action, the cable crosses under the semi-trailer.

The great advantage of this system is its low cost.

Disadvantages, in addition to those inherent in the turntable system, are:

- Can only be used under a flatbed trailer.
- The steering cable will always stretch, and the resulting slack will cause vibration and increased tire wear.
- The steering characteristic is linear and, when a good characteristic is needed, is only applicable to a small number of semi-trailer types.
- All the steering forces are transferred through the chassis.

**Cable steering with reverser**

In this system, the front cable pulley is positioned behind the fifth wheel. Over a sliding mechanism, the pulley is forced to turn at the rear of the semi-trailer. (The equipment is the same as for the cross-cable system).

The maximum steering is obtained when the angle between tractor and semi-trailer is between 60 and 70 degrees. The steering is therefore more progressive, and can be used on a larger variety of semi-trailers. The system has the same advantages and disadvantages as valid for the cross-cable system.
Rod steering

This concept works on the same system as cable-steering with reverser but, instead of cables, rods are used. Apart from the fact that there is no stretch, rod steering has the same disadvantages as cable steering. Normally, rod steering is used with a turntable at the rear. Some manufacturers use steering axles, but this is very complicated.

Basically simple to make, rod steering with a turntable gives rise to many derived systems. A disadvantage of the method is its high weight.

Hydraulic steering

In this system, two hydraulic cylinders are connected directly, or over a reverser, to a front turntable. The turntable is connected, through a steering wedge, to the fifth wheel. On the rear unit, two cylinders are connected to a steering axle or a turntable. The most important advantages of hydraulic steering are (1) the flexibility of steering angles, (2) flexibility of mounting, (3) low weight and (4) no steering forces on the chassis. Against these, hydraulic steering is more expensive than other systems and the installation requires a little more attention.

According to progressiveness

- Steering with reverser (progression high)
- Steering without reverser (progression low)
Steering with override

An override is usual on hydraulic systems for tow semi-trailers and extendible semi-trailers. Provision is then made for the axles to be steered independently of the direction of the tractor.

The "Breeman" steering

The "BREEMAN" steering system is based on the modular principle (See enclosure). This means that very many different types of steering can be constructed from a small number of different parts.

The following modules are used for the assembly of BREEMAN" steering systems.

Front unit

The front unit (Fig. 1) is used for all types of steering, whether hydraulic or mechanical. The front unit is only 155 mm in height, and is able to turn 105 degrees in both directions.

The unit can be mounted by bolting or welding

The front unit boasts the following remarkable features:

1. The reverser bearings are of a synthetic material, and require no lubrication.
2. The sliding block from the reverser is of the same material. Again, no lubrication.
3. The sliding block runs between replaceable stainless steel wear strips.
4. The resilient steering wedge is conforming to DIN 74085. The resilience of the wedge means that no adjustment is needed when tractors are changed.

5. The kingpin is a standard item and is changeable without any problem.
6. The turntable is designed for a load of 18 Ton, is sealed, and is manufactured to the highest quality.

The turntable is the only item of the steering system that requires any lubrication. The lubrication points are normally connected to the rear of the unit, and there is a choice between manual and automatic lubrication (not supplied by BREEMAN).
Transmission
Transmission from the front unit to the rear unit can be carried in three ways
1. Small hydraulic cylinders
2. Large hydraulic cylinders
3. Rods

1. Small hydraulic cylinders are used for axial pivot steering systems up to three axles.
2. Large hydraulic cylinders are used for axial pivot steering systems with four axles and on turntable systems.

"BREEMAN“ hydraulic steering systems are always equipped with duplicate hydraulics. The loss of one circuit does not affect the safe steering of the semi-trailer.

All hydraulic cylinders are manufactured in house.
The characteristics of our cylinders are.
1. The ball bearings are of liberal dimensions and require no maintenance
2. The cylinder rods are finished with a nickel coating to prevent corrosion and a chromium coating to give high wear resistance.

3. The scrapers, which are able to remove both dirt and ice, are manufactured for us to our own specification.
4. All seats are designed to resist extremely high pressure. Cylinders are assembled in clean conditions and, after assembly, are tested to 325 bar.

The cylinders are mounted in a frame, so that the positions of connections are fully determined by us.
The rods for mechanical steering are provided with maintenance-free ball bearings, and are adjustable in length.

The following rear units are available:

Hydraulic pivot axle steering unit for welding onto the axle body (suitable for one or two steered axles). With this unit we supply the necessary track rods. The configuration is developed in such a way that the axle is steered according to the Ackermann principle. This means that the inner wheel steers more than the outer wheel, so that both run on their correct circle and tire wear is reduced to a minimum.

Because the units are welded to the axle body, there are no steering-angle deviations through the suspension.

The following are some of the characteristics of "BREEMAN" rear units.

- Bearings are of synthetic material, and no lubrication is necessary.
- The "BREEMAN" rear unit can be fitted on almost all existing axles available on the market/of all make.

Hydraulic steering unit for mounting in the semi-trailer chassis (Fig. 6). This unit is used mainly with two or more steered axles, where one axle is steered hydraulically, the others mechanically. They must be mounted in the chassis so that the track rods are horizontal by the driving height. In this way the steering angle deviations through the suspension are minimized. The unit also has the further characteristics mentioned above.
Mechanical pivot axle steering unit for mounting in the chassis (Fig. 7). These units are used with a larger number of steered axles. They are forced to turn by "BREEMAN"-supplied steering rods from the hydraulic unit.

Front unit driven turntable unit (Fig. 8). This unit can be steered by hydraulic cylinders or by rods. The turntable is from the same manufacturer as the front unit turntable, and hence of the same high quality. It has four lubrication points. The unit is delivered with a frame for mounting the axle. For hydraulic steering, we supply a welding frame, so that the positions of the cylinder connections are fixed by us.

Mechanical turntable steering units. These are used for two and three axle turntable steering systems. They are actuated by rods from the front-unit driven unit.
Control of hydraulic steering systems

With a basic hydraulic steering system we supply a stainless steel control cabinet and loose hand pump.
It is not necessary to open the control cabinet to pressurize the steering system: pumping only is required. It is, however, necessary to open the control cabinet to access the control valve when the axles are to be aligned.
A low system-pressure warning lamp is sited on the side of the control cabinet. It is not possible to close the control cabinet unless all valves are in their safe position.

Options

- Hand pump in stainless steel box
- Hydraulic Power unit (24 volt)
- Hydraulic power unit in stainless steel box
- Hydraulic power unit with special features
- Electrical control (alignment and pressurizing)
- Manual override with plug-in control panel
- Manual override from tractor cab
- Manual override with radio control
- Alignment indication.
Mechanical Steering

*MDB-1-18/10*

Technical specification:
- Coupling-load max.: 18 Ton
- Axle-load max.: 10 Ton
- D-value: 160 kN

These values obtain by 80 km/hour.

Maximum steering-angle from axle will depend on type of semi-trailer and purpose.

- Kingpin: 2”
- Steering-wedge DIN 74085-A 40 degrees.

Part numbers:
1. Coupling plate
2. Steering pin
3. Revolution mechanism
14. Mechanical axle unit
15. Steering arm

**How the system works:**

During coupling the trailer to the truck, the steering-wedge will fit into the fifth wheel from the truck.

When the combination will make a bend, the coupling plate 1 with steering pin 2 will rotate regarding to the trailer. Now the revolution mechanism 3 will also rotate what causes that the steering arms 11 will move in- and out.

Because of this movement the mechanic axle-unit 14 will rotate the axle regarding to the trailer.
**MDB-2-18/10**

**Technical specification:**
- Coupling-load max.: 18 Ton
- Axle-load max.: 10 Ton
- D-value: 160 kN

These values obtain by 80 km/hour.

Maximum steering-angle from axle will depend on type of semi-trailer and purpose.

- Kingpin: 2"
- Steering-wedge DIN 74085-A 40 degrees.

**Part numbers:**
1. Coupling plate
2. Steering pin
3. Revolution mechanism
11. Steering arm
13. Mechanic axle-unit
14. Mechanic axle unit
15. Steering arm

**How the system works:**
During coupling the trailer to the truck, the steering-wedge will fit into the fifth wheel from the truck.

When the combination will make a bend, the coupling plate 1 with steering pin 2 will rotate regarding to the trailer. Now the revolution mechanism 3 will also rotate what causes that the steering arms 15 will move in- and out.

Because of this movement the mechanic axle-unit 14 will rotate the axle regarding to the trailer.

If the mechanic axle-unit 14 rotates, this rotation will go through steering arm 11 to the mechanical driven axle-unit 13. Because of the different mounting points from the steering arm the last axle will make a bigger angle than the first axle.
**MDB-3-18/10**

Technical specification:
- Coupling-load max.: 18 Ton
- Axle-load max.: 10 Ton
- D-value: 160 kN

These values obtain by 80 km/hour.

Maximum steering-angle from axle will depend on type of semi-trailer and purpose.
- Kingpin: 2”
- Steering-wedge DIN 74085-A 40 degrees.

Parts:
- Coupling plate
- Steering pin
- Revolution mechanism
- Steering arm
- Mechanic axle-unit
- Mechanic axle unit
- Steering arm

**How the system works:**
During coupling the trailer to the truck, the steering-wedge will fit into the fifth wheel from the truck.

When the combination will make a bend, the coupling plate with steering pin will rotate regarding to the trailer. Now the revolution mechanism will also rotate what causes that the steering arms will move in- and out.

Because of this movement the mechanic axle-units will rotate the axle regarding to the trailer.

If the mechanic axle-unit rotates, this rotation will go through steering arm to the mechanical driven axle-units. Because of the different mounting points from the steering arm the last axle will make a bigger angle than the middle axle.
Hydraulic Steering

**HDB-1-18/10**

Technical specification:
- Coupling-load max.: 18 Ton
- Axle-load max.: 10 Ton
- D-value: 160 kN

These values obtain by 80 km/hour.

Maximum steering-angle from axle will depend on type of semi-trailer and purpose.
- Kingpin: 2”
- Steering-wedge DIN 74085-A 40 degrees.

Part numbers:
1. Coupling plate
2. Steering pin
3. Revolution mechanism
4. Cylinder front unit
5. Controlbox
12. Hydraulic axle-unit

**How the system works:**
During coupling the trailer to the truck, the steering-wedge will fit into the fifth wheel from the truck.

When the combination will make a bend, the coupling plate 1 with steering pin 2 will rotate regarding to the trailer. Now the revolution mechanism 3 will also rotate what causes that one cylinder 4 will go in and the other one will go out. This will cause an oil-movement, which goes through iron bars and hoses to the cylinders from the axle-unit.

At the hydraulic axle-unit 12 one cylinder will go in and the other will go out. Because of this movement the turntable will rotate the axle regarding to the trailer.

With the controlbox 5 the hydraulic axle-unit 6 can be aligned towards the trailer. To insure a steady behavior, the hydraulic system will be put on a initial tension.
**HDMB-2-18/10**

Technical specification:
- Coupling-load max.: 18 Ton
- Axle-load max.: 10 Ton
- D-value: 160 kN

These values obtain by 80 km/hour.

Maximum steering-angle from axle will depend on type of semi-trailer and purpose.
- Kingpin: 2”
- Steering-wedge DIN 74085-A 40 degrees.

Part numbers:
1. Coupling plate
2. Steering pin
3. Revolution mechanism
4. Cylinder front unit
5. Controlbox
6. Steering arm
7. Hydraulic axle-unit
8. Mechanic axle-unit

**How the system works:**
During coupling the trailer to the truck, the steering-wedge will fit into the fifth wheel from the truck.

When the combination will make a bend, the coupling plate 1 with steering pin 2 will rotate regarding to the trailer. Now the revolution mechanism 3 will also rotate what causes that one cylinder 4 will go in and the other one will go out. This will cause an oil-movement, which goes through iron bars and hoses to the cylinders from the axle-unit. At the hydraulic axle-unit 12 one cylinder will go in and the other will go out. Because of this movement the turntable will rotate the axle regarding to the trailer.

If the hydraulic axle-unit 12 rotates, this rotation will go through steering arm 11 to the mechanical driven axle-unit 13. Because of the different mounting points from the steering arm the last axle will make a bigger angle than the first axle.

With the controlbox 5 the hydraulic axle-unit 6 can be aligned towards the trailer. To insure a steady behavior, the hydraulic system will be put on a initial tension.
**Technical specification:**

- **Coupling-load max.**: 18 Ton
- **Axle-load max.**: 10 Ton
- **D-value**: 160 kN

These values obtain by 80 km/hour.

Maximum steering-angle from axle will depend on type of semi-trailer and purpose.

- **Kingpin**: 2”
- **Steering-wedge DIN 74085-A 40 degrees.**

**Part numbers:**

1. Coupling plate
2. Steering pin
3. Revolution mechanism
4. Cylinder front unit
5. Controlbox
11. Steering arm
12. Hydraulic axle-unit
13. Mechanic axle-unit

**How the system works:**

During coupling the trailer to the truck, the steering-wedge will fit into the fifth wheel from the truck. When the combination will make a bend, the coupling plate 1 with steering pin 2 will rotate regarding to the trailer. Now the revolution mechanism 3 will also rotate what causes that one cylinder 4 will go in and the other one will go out. This will cause an oil-movement, which goes through iron bars and hoses to the cylinders from the axle-unit.

At the hydraulic axle-unit 12 one cylinder will go in and the other will go out. Because of this movement the turntable will rotate the axle regarding to the trailer. If the hydraulic axle-unit 12 rotates, this rotation will go through steering arms 11 to the mechanical driven axle-units 13. Because of the different mounting points from the steering arms the last axle will make a bigger angle than the first axle.

With the controlbox 5 the hydraulic axle-unit 6 can be aligned towards the trailer. To insure a steady behavior, the hydraulic system will be put on a initial tension.
**GHFB-10-1**

**Technical specification:**
- **Coupling-load max.** : 18 Ton
- **Axle-load max.** : 10 Ton
- **D-value** : 160 kN

These values obtain by 80 km/hour.

Maximum steering-angle from axle will depend on type of semi-trailer and purpose.

- **Kingpin** : 2”
- **Steering-wedge DIN 74085-A 40 degrees.**

**Part numbers:**
1. Coupling plate
2. Cylinder front unit
3. Controlbox
4. Hydraulic axle-unit
5. Steering arm
6. Track rod

**How the system works:**
During coupling the trailer to the truck, the steering-wedge will fit into the fifth wheel from the truck.

When the combination will make a bend, the coupling plate 1 will rotate regarding to the trailer. Now one cylinder 4 will go in and the other one will go out. This will cause an oil-movement, which goes through iron bars and hoses to the cylinders from the axle-unit. At the hydraulic axle-unit 6 one cylinder will go in and the other will go out. Because of this movement the steering arm 9 will rotate. This rotation goes through the track rods 10 to the steering arm which will steer the wheels regarding to the trailer.

With the controlbox 5 the hydraulic axle-unit 6 can be aligned towards the trailer. To insure a steady behavior, the hydraulic system will be put on a initial tension.
**HFB-1-18/10**

Technical specification:
- **Coupling-load max.**: 18 Ton
- **Axle-load max.**: 10 Ton
- **D-value**: 160 kN

These values obtain by 80 km/hour.

Maximum steering-angle from axle will depend on type of semi-trailer and purpose.

**Kingpin**: 2”

**Steering-wedge DIN 74085-A 40 degrees.**

Part numbers:
- 1. Coupling plate
- 2. Steering pin
- 3. Revolution mechanism
- 4. Cylinder front unit
- 5. Controlbox
- 6. Hydraulic axle-unit
- 9. Steering arm
- 10. Track rod

**How the system works:**

During coupling the trailer to the truck, the steering-wedge will fit into the fifth wheel from the truck.

When the combination will make a bend, the coupling plate 1 with steering pin 2 will rotate regarding to the trailer. Now the revolution mechanism 3 will also rotate what causes that one cylinder 4 will go in and the other one will go out. This will cause an oil-movement, which goes through iron bars and hoses to the cylinders from the axle-unit. At the hydraulic axle-unit 6 one cylinder will go in and the other will go out. Because of this movement the steering arm 9 will rotate. This rotation goes through the track rods 10 to the steering arm which will steer the wheels regarding to the trailer.

With the controlbox 5 the hydraulic axle-unit 6 can be aligned towards the trailer. To insure a steady behavior, the hydraulic system will be put on a initial tension.
**HFB-2-18/10**

Technical specification:
- Coupling-load max.: 18 Ton
- Axle-load max.: 10 Ton
- D-value: 160 kN

These values obtain by 80 km/hour.

Maximum steering-angle from axle will depend on type of semi-trailer and purpose.
- Kingpin: 2"
- Steering-wedge DIN 74085-A 40 degrees.

Part numbers:
1. Coupling plate
2. Steering pin
3. Revolution mechanism
4. Cylinder front unit
5. Controlbox
6. Hydraulic axle-unit
9. Steering arm
10. Track rod

**How the system works:**
During coupling the trailer to the truck, the steering-wedge will fit into the fifth wheel from the truck.

When the combination will make a bend, the coupling plate 1 with steering pin 2 will rotate regarding to the trailer. Now the revolution mechanism 3 will also rotate what causes that one cylinder 4 will go in and the other one will go out. This will cause an oil-movement, which goes through iron bars and hoses to the cylinders from the axle-unit.

The cylinders 4 at the outside will operate the last hydraulic axle 6.

The cylinders 4 at the inside will operate the first hydraulic axle 6.

At the hydraulic axle-unit 6 one cylinder will go in and the other will go out. Because of this movement the steering arm 9 will rotate.

This rotation goes through the track rods 10 to the steering arm which will steer the wheels regarding to the trailer.

The steering angle from the last axle will be bigger than the first axle.

With the controlbox 5 the hydraulic axle-unit 6 can be aligned towards the trailer. To insure a steady behavior, the hydraulic system will be put on a initial tension.
**HMFB-2-18/10**

Technical specification:
- Coupling-load max.: 18 Ton
- Axle-load max.: 10 Ton
- D-value: 160 kN

These values obtain by 80 km/hour.

Maximum steering-angle from axle will depend on type of semi-trailer and purpose.
- Kingpin: 2”
- Steering-wedge DIN 74085-A 40 degrees.

Part numbers:
1. Coupling plate
2. Steering pin
3. Revolution mechanism
4. Cylinder front unit
5. Controlbox
6. Hydraulic chassis-unit
7. Mechanic chassis-unit
8. Steering arm
9. Track rod
10. Steering arm

**How the system works:**
During coupling the trailer to the truck, the steering-wedge will fit into the fifth wheel from the truck.

When the combination will make a bend, the coupling plate 1 with steering pin 2 will rotate regarding to the trailer. Now the revolution mechanism 3 will also rotate what causes that one cylinder 4 will go in and the other one will go out. This will cause an oil-movement, which goes through iron bars and hoses to the cylinders from the axle-unit.

At the hydraulic axle-unit 6 one cylinder will go in and the other will go out. Because of this movement the steering arm 9 will rotate. This rotation goes through the track rods 10 to the steering arm which will steer the wheels regarding to the trailer.

If the hydraulic axle-unit 6 rotates, this rotation will go through the steering arm 11 to the mechanical driven axle-unit 8. Because of the different mounting points from the steering arm the last axle will make a bigger angle than the first axle.

With the controlbox 5 the hydraulic axle-unit 6 can be aligned towards the trailer. To insure a steady behavior, the hydraulic system will be put on a initial tension.
**HMFB-3-18/10**

**Technical specification:**
- Coupling-load max.: 18 Ton
- Axle-load max.: 10 Ton
- D-value: 160 kN

These values obtain by 80 km/hour.

Maximum steering-angle from axle will depend on type of semi-trailer and purpose.

Kingpin: 2”
Steering-wedge DIN 74085-A 40 degrees.

**Part numbers:**
1. Coupling plate
2. Steering pin
3. Revolution mechanism
4. Cylinder front unit
5. Controlbox
6. Hydraulic chassis-unit
7. Mechanic chassis-unit
8. Steering arm
9. Track rod
10. Steering arm

**How the system works:**
During coupling the trailer to the truck, the steering-wedge will fit into the fifth wheel from the truck.

When the combination will make a bend, the coupling plate 1 with steering pin 2 will rotate regarding to the trailer. Now the revolution mechanism 3 will also rotate what causes that one cylinder 4 will go in and the other one will go out. This will cause an oil-movement, which goes through iron bars and hoses to the cylinders from the axle-unit.

At the hydraulic axle-unit 6 one cylinder will go in and the other will go out. Because of this movement the steering arm 9 will rotate. This rotation goes through the track rods 10 to the steering arm which will steer the wheels regarding to the trailer.

If the hydraulic axle-unit 6 rotates, this rotation will go through steering arms 11 to the mechanical driven axle-units. Because of the different mounting points from the steering arms the last axle will make a bigger angle than the first axle.

With the controlbox 5 the hydraulic axle-unit 6 can be aligned towards the trailer. To insure a steady behavior, the hydraulic system will be put on a initial tension.
**HMFB-4-18/10**

Technical specification:
- Coupling-load max.: 18 Ton
- Axle-load max.: 10 Ton
- D-value: 160 kN

These values obtain by 80 km/hour.

Maximum steering-angle from axle will depend on type of semi-trailer and purpose.

Kingpin: 2”

Steering-wedge DIN 74085-A 40 degrees.

Part numbers:
1. Coupling plate
2. Steering pin
3. Revolution mechanism
4. Cylinder front unit
5. Controlbox
6. Hydraulic chassis-unit
7. Mechanic chassis-unit
8. Steering arm
9. Track rod
10. Steering arm

**How the system works:**

During coupling the trailer to the truck, the steering-wedge will fit into the fifth wheel from the truck.

When the combination will make a bend, the coupling plate 1 with steering pin 2 will rotate regarding to the trailer. Now the revolution mechanism 3 will also rotate what causes that one cylinder 4 will go in and the other one will go out. This will cause an oil-movement, which goes through iron bars and hoses to the cylinders from the axle-unit. At the hydraulic axle-unit 6 one cylinder will go in and the other will go out. Because of this movement the steering arm 9 will rotate. This rotation goes through the track rods 10 to the steering arm which will steer the wheels regarding to the trailer.

If the hydraulic axle-unit 6 rotates, this rotation will go through steering arms 11 to the mechanical driven axle-units. Because of the different mounting points from the steering arms the last axle will make a bigger angle than the first axle.

With the controlbox 5 the hydraulic axle-unit 6 can be aligned towards the trailer. To insure a steady behavior, the hydraulic system will be put on a initial tension.
Electronical Steering

**EFB-1/10**

D-Value 2” king pin : 160 kN  
Maximum Axle load : 10 ton  
Maximal steering angle : depends of the used axle

Optional:  
Radio remote control

**Why Electronical Steering?**

- No front unit  
- Double signal from potentiometer in angle sensor  
- Very light system  
- Cylinder with emergency security.  
- With high speed and errors automatically aligning of the cylinder to center position.
The system contains the following:

- 2” king pin with built in angle sensor. The angle sensor has two tracks and can turn an angle of 350°.
- 1 piece of axle unit with track rods. The axle unit can be mounted on the axle. The axle unit is custom made for the trailer so that the tire wear is as low as possible. A safety cylinder is mounted in the axle unit with also a angle sensor with two tracks for redundant measurement.
- The power pack contains an air driven pump which pressurizes the steering system. As a back-up an electric driven pump will be included. A retour filter with a fineness of 10 micron will be attached. To prevent leakages and for compact mounting, all the valves will be mounted in aluminum hydraulic blocks.
- Two accumulators, one for the speed of the steering system, and one for the safety mode.
- The axles will be fixed if there is a too long delay between the soll-wert and the ist-wert. And with any electronical error.
- The system can be used after the accumulators of the safety mode built up sufficient pressure.
**EFB-2/10**

The system contains the following:

- 2" king pin with built in angle sensor. The angle sensor has two tracks and can turn an angle of 350º.
- 2 piece of axle unit with track rods. The axle unit can be mounted on the axle. The axle unit is custom made for the trailer so that the tire wear is as low as possible. A safety cylinder is mounted in the axle unit with also a angle sensor with two tracks for redundant measurement.
- The power pack contains an air driven pump which pressurizes the steering system. As a back-up an electric driven pump will be included. A retou filter with a fineness of 10 micron will be attached. To prevent leakages and for compact mounting, all the valves will be mounted in aluminum hydraulic blocks.
- 3 accumulators, 1 for the speed of the steering system, and 2 for the safety mode.
- The axles will be fixed if there is a too long delay between the soll-wert and the ist-wert. And with any electronical error.
- The system can be used after the accumulators of the safety mode built up sufficient pressure.

Optional: Radio remote control

**EFB-3/10**

The system contains the following:

- 2" king pin with built in angle sensor. The angle sensor has two tracks and can turn an angle of 350º.
- 1 piece of axle unit with track rods. The axle unit can be mounted on the axle. The axle unit is custom made for the trailer so that the tire wear is as low as possible. A safety cylinder is mounted in the axle unit with also a angle sensor with two tracks for redundant measurement.
- 2 pieces of mechanical back units.
- The power pack contains an air driven pump which pressurizes the steering system. As a back-up an electric driven pump will be included. A retou filter with a fineness of 10 micron will be attached. To prevent leakages and for compact mounting, all the valves will be mounted in aluminum hydraulic blocks.
- Two accumulators, one for the speed of the steering system, and one for the safety mode.
- The axles will be fixed if there is a too long delay between the soll-wert and the ist-wert. And with any electronical error.
- The system can be used after the accumulators of the safety mode built up sufficient pressure.

Optional: Radio remote control
Multi trailer

In 2009 Breeman realized a Multi trailer for the Japanese Market. This system exists of a 3 axle bogie and a 4 axle bogie. The bogies have independent hydraulic suspension and the system has 13 configurations. The trailer can be steered with a radio remote control and after changing a configuration the bogies automatically align with the goose neck.

The front unit is hydraulic but the unit also has an angle sensor. The sensor sends the angle results to a PLC computer which analyses and saves the steering angles. This also for the angles of the bogies. During alignment the PLC calculates how the systems need to steer to get everything in line.
Suspensions

*Independent suspension*

This type:
Capacity: 10 ton per piece
Steering angle: 32°
Cylinder stroke: 155 mm

Metaalunie conditions:
All our quotations, all orders placed with us and all contracts concluded with us are subject to the Metaalunie conditions, filed with the registrar of the District Court of Rotterdam, as stipulated in the latest text lodged with the said court. The conditions of delivery and payment will be sent to you upon request.
Suspension Cylinders

Metaalunie conditions:
All our quotations, all orders placed with us and all contracts concluded with us are subject to the Metaalunie conditions, filed with the registrar of the District Court of Rotterdam, as stipulated in the latest text lodged with the said court. The conditions of delivery and payment will be sent to you upon request.
Pendel Axles

Metaalunie conditions:
All our quotations, all orders placed with us and all contracts concluded with us are subject to the Metaalunie conditions, filed with the registrar of the District Court of Rotterdam, as stipulated in the latest text lodged with the said court. The conditions of delivery and payment will be sent to you upon request.
BPA-12
Nominal load: 12 ton *(Load depends on maximum allowable speed)*
Weight: 210 kg excluding hydraulic cylinder

BPA-16
Nominal load: 16 ton *(Load depends on maximum allowable speed)*
Weight: 290 kg excluding hydraulic cylinder

Metaalunie conditions:
All our quotations, all orders placed with us and all contracts concluded with us are subject to the Metaalunie conditions, filed with the registrar of the District Court of Rotterdam, as stipulated in the latest text lodged with the said court. The conditions of delivery and payment will be sent to you upon request.
Other references
Metaalunie conditions:
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**Inquiry form**

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| Remarks | Max load |