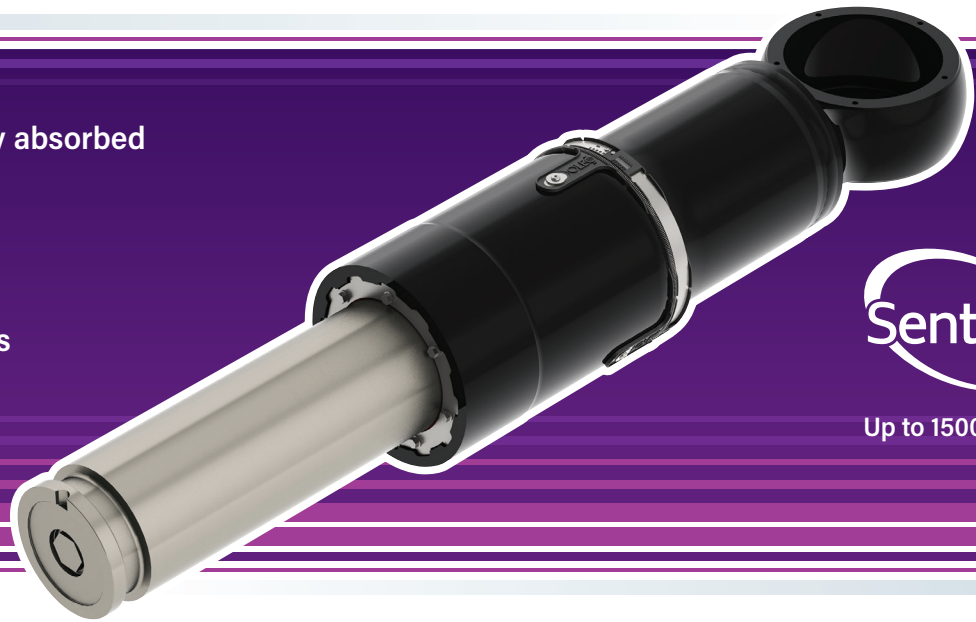


Majority of impact energy absorbed  
 Almost no recoil energy  
 Standard range  
 Cost effective solution  
 Shorter project lead times



Up to 1500 kN force

### Sentry 1500 Clamp to Pivot

The rail industry is focused on improving passenger protection by introducing demanding crash worthiness standards such as EN15227 and ASME-RT-1.

Operators need to manage tight project budgets and reduce life cycle costs.

Oleo has developed the Sentry™ range of standard products that enable lower project costs per train coupling system by reducing the variety and complexity.

The Sentry™ range also offers higher coupling speeds, significant weight savings and reduced life cycle costs.

The Sentry™ range is now available with an integrated pivot, meaning one less part within your coupler assembly and no muff clamp required at the mounting interface end, resulting in decreased forward projection and further overall weight savings.

### Product Details

- Recoverable and non-recoverable crash protection in one standard modular unit.
  - Gas hydraulic buffer
  - Deformation tube
- Fully customisable force/stroke characteristics at no extra cost.
- Integral anti-rotation system.
- Integrated pivot.
- All units tested by Oleo with validated mathematical models in accordance with EN15227. Plug in elements available for Radioss and LS-Dyna finite element software.
- The system used by OLEO for the mathematical modelling of crash scenarios is approved by a European Rail Authority as being accurate, appropriate and properly controlled.

### Product Advantages

- Oleo's Sentry™ Device enables:
- Performance can be fully optimised with Oleo 1D Train™ at no additional cost.
  - Lower Life Cycle Costs
  - Weight Saving
  - Faster Coupling Speeds
  - Reduced Potential Impact Damage
  - Increased Passenger Protection
  - Pre-loads ranging from 50kN to 450kN
  - Higher recoverable energy absorption than any alternative solution.
  - Maintenance free between major train overhaul periods.

### Applications

- Metro
- Light Rail
- Locomotive & Freight
- High Speed
- Mainline



# Sentry™ Coupler 1500 Clamp to Pivot Energy Absorber Specification

| Low Spec                   |       | Description                      | Unit Code | Recoverable Coupling Speed Km/h |      |      |      | Coupler Deformation Speed Km/h |      |      |      | Maximum Collision Speed Km/h |      |      |      |  |  |
|----------------------------|-------|----------------------------------|-----------|---------------------------------|------|------|------|--------------------------------|------|------|------|------------------------------|------|------|------|--|--|
|                            |       |                                  |           | AW0                             | AW1  | AW2  | AW3  | AW0                            | AW1  | AW2  | AW3  | AW0                          | AW1  | AW2  | AW3  |  |  |
| Number of Vehicles         | 1     | Sentry™ Coupler – Front          | M316      |                                 |      |      |      |                                |      |      |      |                              |      |      |      |  |  |
| Empty Vehicle Weight (AW0) | 33T   |                                  |           | 8.5                             | 8.5  | 8.5  | 8.3  | 17.8                           | 17.0 | 16.3 | 16.0 | -                            | -    | -    | -    |  |  |
| Passenger Weight (AW3)     | 16T   |                                  |           |                                 |      |      |      |                                |      |      |      |                              |      |      |      |  |  |
| Vehicle Strength           | 400kN |                                  |           |                                 |      |      |      |                                |      |      |      |                              |      |      |      |  |  |
| Number of Vehicles         | 4     | Sentry™ Coupler – Front          | M316      |                                 |      |      |      |                                |      |      |      |                              |      |      |      |  |  |
| Empty Vehicle Weight (AW0) | 36T   | Sentry™ Coupler – Intermediate   | M323      | 8.0                             | 7.8  | 7.5  | 7.5  | 14.8                           | 14.0 | 13.3 | 12.8 | 28.3                         | 27.0 | 25.8 | 25.0 |  |  |
| Passenger Weight (AW3)     | 18T   | Oleo Anti Climber – Front        | AB90-80   |                                 |      |      |      |                                |      |      |      |                              |      |      |      |  |  |
| Vehicle Strength           | 800kN | Oleo Anti Climber – Intermediate | AL10-50   |                                 |      |      |      |                                |      |      |      |                              |      |      |      |  |  |
| Number of Vehicles         | 5     | Sentry™ Coupler – Front          | M523      |                                 |      |      |      |                                |      |      |      |                              |      |      |      |  |  |
| Empty Vehicle Weight (AW0) | 24T   | Sentry™ Coupler – Intermediate   | M416      | 10.3                            | 10.3 | 10.0 | 10.0 | 18.3                           | 17.0 | 17.0 | 16.8 | 28.7                         | 27.5 | 26.3 | 25.0 |  |  |
| Passenger Weight (AW3)     | 12T   | Oleo Anti Climber – Front        | AF70-80   |                                 |      |      |      |                                |      |      |      |                              |      |      |      |  |  |
| Vehicle Strength           | 800kN |                                  |           |                                 |      |      |      |                                |      |      |      |                              |      |      |      |  |  |
| Number of Vehicles         | 6     | Sentry™ Coupler – Front          | M300      |                                 |      |      |      |                                |      |      |      |                              |      |      |      |  |  |
| Empty Vehicle Weight (AW0) | 47T   | Sentry™ Coupler – Intermediate   | M300      | 7.5                             | 7.3  | 7.0  | 7.0  | -                              | -    | -    | -    | 28.5                         | 27.3 | 26.3 | 25.0 |  |  |
| Passenger Weight (AW3)     | 24T   | Oleo Anti Climber – Front        | AB70-100  |                                 |      |      |      |                                |      |      |      |                              |      |      |      |  |  |
| Vehicle Strength           | 800kN | Oleo Anti Climber – Intermediate | AF50-90   |                                 |      |      |      |                                |      |      |      |                              |      |      |      |  |  |
| Number of Vehicles         | 6     | Sentry™ Coupler – Front          | M416      |                                 |      |      |      |                                |      |      |      |                              |      |      |      |  |  |
| Empty Vehicle Weight (AW0) | 24T   | Sentry™ Coupler – Intermediate   | M423      | 11.0                            | 10.8 | 10.5 | 10.5 | 18.5                           | 17.5 | 16.3 | 16.3 | 27.5                         | 26.3 | 25.3 | 25.0 |  |  |
| Passenger Weight (AW3)     | 12T   | Oleo Anti Climber – Front        | AB70-80   |                                 |      |      |      |                                |      |      |      |                              |      |      |      |  |  |
| Vehicle Strength           | 800kN | Oleo Anti Climber – Intermediate | AL10-60   |                                 |      |      |      |                                |      |      |      |                              |      |      |      |  |  |
| Number of Vehicles         | 8     | Sentry™ Coupler – Front          | M516      |                                 |      |      |      |                                |      |      |      |                              |      |      |      |  |  |
| Empty Vehicle Weight (AW0) | 24T   | Sentry™ Coupler – Intermediate   | M523      | 12.8                            | 12.5 | 12.3 | 12.0 | 19.3                           | 17.8 | 17.8 | 17.5 | 28.0                         | 27.0 | 26.0 | 25.0 |  |  |
| Passenger Weight (AW3)     | 12T   | Oleo Anti Climber – Front        | AF70-80   |                                 |      |      |      |                                |      |      |      |                              |      |      |      |  |  |
| Vehicle Strength           | 800kN | Oleo Anti Climber – Intermediate | AL20-60   |                                 |      |      |      |                                |      |      |      |                              |      |      |      |  |  |

| High Spec                  |        | Description                      | Unit Code | Recoverable Coupling Speed Km/h |      |      |      | Coupler Deformation Speed Km/h |      |      |      | Maximum Collision Speed Km/h |      |      |      |  |  |
|----------------------------|--------|----------------------------------|-----------|---------------------------------|------|------|------|--------------------------------|------|------|------|------------------------------|------|------|------|--|--|
|                            |        |                                  |           | AW0                             | AW1  | AW2  | AW3  | AW0                            | AW1  | AW2  | AW3  | AW0                          | AW1  | AW2  | AW3  |  |  |
| Number of Vehicles         | 5      | Sentry™ Coupler – Front          | M323      |                                 |      |      |      |                                |      |      |      |                              |      |      |      |  |  |
| Empty Vehicle Weight (AW0) | 40T    | Sentry™ Coupler – Intermediate   | M316      | 9.8                             | 9.5  | 9.3  | 9.3  | 18.3                           | 17.5 | 16.3 | 16.0 | 27.8                         | 26.5 | 25.5 | 25.0 |  |  |
| Passenger Weight (AW3)     | 20T    | Oleo Anti Climber – Front        | AF100-120 |                                 |      |      |      |                                |      |      |      |                              |      |      |      |  |  |
| Vehicle Strength           | 2000kN |                                  |           |                                 |      |      |      |                                |      |      |      |                              |      |      |      |  |  |
| Number of Vehicles         | 5      | Sentry™ Coupler – Front          | M516      |                                 |      |      |      |                                |      |      |      |                              |      |      |      |  |  |
| Empty Vehicle Weight (AW0) | 32T    | Sentry™ Coupler – Intermediate   | M400      | 12.0                            | 11.8 | 11.5 | 11.5 | 18.8                           | 17.8 | 17.0 | 16.8 | 28.0                         | 26.8 | 25.8 | 25.0 |  |  |
| Passenger Weight (AW3)     | 16T    | Oleo Anti Climber – Front        | AF70-120  |                                 |      |      |      |                                |      |      |      |                              |      |      |      |  |  |
| Vehicle Strength           | 2000kN |                                  |           |                                 |      |      |      |                                |      |      |      |                              |      |      |      |  |  |
| Number of Vehicles         | 6      | Sentry™ Coupler – Front          | M400      |                                 |      |      |      |                                |      |      |      |                              |      |      |      |  |  |
| Empty Vehicle Weight (AW0) | 24T    | Sentry™ Coupler – Intermediate   | M400      | 16.5                            | 16.0 | 15.5 | 15.0 | -                              | -    | -    | -    | 28.8                         | 27.5 | 26.3 | 25.0 |  |  |
| Passenger Weight (AW3)     | 12T    | Oleo Anti Climber – Front        | AF70-120  |                                 |      |      |      |                                |      |      |      |                              |      |      |      |  |  |
| Vehicle Strength           | 2000kN |                                  |           |                                 |      |      |      |                                |      |      |      |                              |      |      |      |  |  |
| Number of Vehicles         | 6      | Sentry™ Coupler – Front          | M500      |                                 |      |      |      |                                |      |      |      |                              |      |      |      |  |  |
| Empty Vehicle Weight (AW0) | 28T    | Sentry™ Coupler – Intermediate   | M500      | 16.0                            | 15.8 | 15.5 | 15.3 | -                              | -    | -    | -    | 27.5                         | 26.3 | 25.0 | 25.0 |  |  |
| Passenger Weight (AW3)     | 14T    | Oleo Anti Climber – Front        | AF80-120  |                                 |      |      |      |                                |      |      |      |                              |      |      |      |  |  |
| Vehicle Strength           | 2000kN |                                  |           |                                 |      |      |      |                                |      |      |      |                              |      |      |      |  |  |
| Number of Vehicles         | 6      | Sentry™ Coupler – Front          | M416      |                                 |      |      |      |                                |      |      |      |                              |      |      |      |  |  |
| Empty Vehicle Weight (AW0) | 28T    | Sentry™ Coupler – Intermediate   | M423      | 14.0                            | 13.8 | 13.5 | 13.5 | 20.5                           | 19.8 | 18.8 | 18.5 | 27.5                         | 26.5 | 25.5 | 25.0 |  |  |
| Passenger Weight (AW3)     | 14T    | Oleo Anti Climber – Front        | AF40-120  |                                 |      |      |      |                                |      |      |      |                              |      |      |      |  |  |
| Vehicle Strength           | 1500kN |                                  |           |                                 |      |      |      |                                |      |      |      |                              |      |      |      |  |  |
| Number of Vehicles         | 8      | Sentry™ Coupler – Front          | M323      |                                 |      |      |      |                                |      |      |      |                              |      |      |      |  |  |
| Empty Vehicle Weight (AW0) | 32T    | Sentry™ Coupler – Intermediate   | M323      | 11.0                            | 10.8 | 10.3 | 9.3  | 17.8                           | 16.5 | 16.0 | 16.0 | 28.0                         | 27.0 | 25.8 | 25.0 |  |  |
| Passenger Weight (AW3)     | 16T    | Oleo Anti Climber – Front        | AF40-140  |                                 |      |      |      |                                |      |      |      |                              |      |      |      |  |  |
| Vehicle Strength           | 2000kN | Oleo Anti Climber – Intermediate | AF30-120  |                                 |      |      |      |                                |      |      |      |                              |      |      |      |  |  |

## Notes and assumptions

EN15227 collision speeds for design scenario #1 (identical train units impacting) for:

C-I (Locomotives, coaches and fixed train units) is 36km/h.

C-II (Metro) and CIII (Tram vehicles, peri-urban tram) is 25km/h.

C-IV (Tramway vehicles) is 15km/h.

### Car weight designations:

AW0 – empty car weight

AW1 – weight with seated passenger load

AW2 – weight with average peak-hour passenger load

AW3 – crush loaded weight

**Recoverable Coupling Speed** – maximum speed in which two identical trains are coupled together with no damage to the coupler (i.e. Gas Hydraulic stroke only).

**Coupler Deformation Speed** – maximum speed in which two identical trains are coupled together with only controlled damage to coupler (i.e. Gas Hydraulic + Deformation tube stroke).

**Maximum Collision Speed** – maximum speed in which two identical trains are impacted with controlled damage to only coupler and anti-climber. No damage to car body structure.

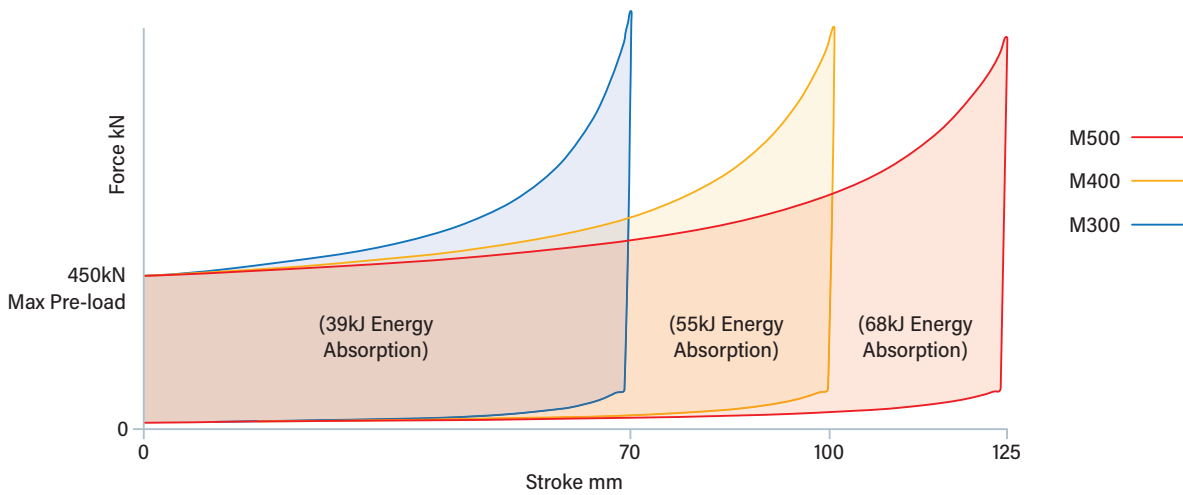
### Assumptions made in example simulations:

Effective vehicle mass (AW0) = 100%

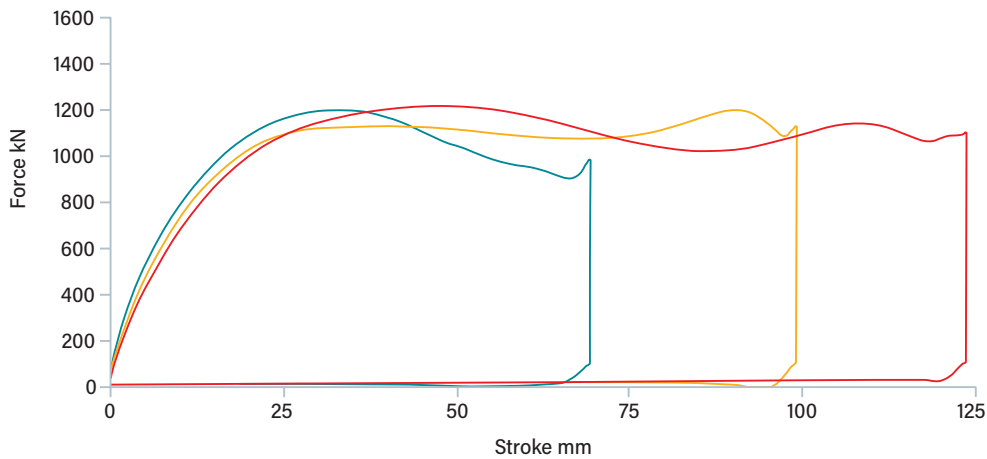
Effective passenger mass = 50%

# Sentry™ Coupler 1500 Clamp to Pivot Energy Absorber Specification

## Range of available quasi-static characteristics at 4mm/sec



## Sentry™ 1500 High Spec examples - Recoverable Coupling Speed (AW3)

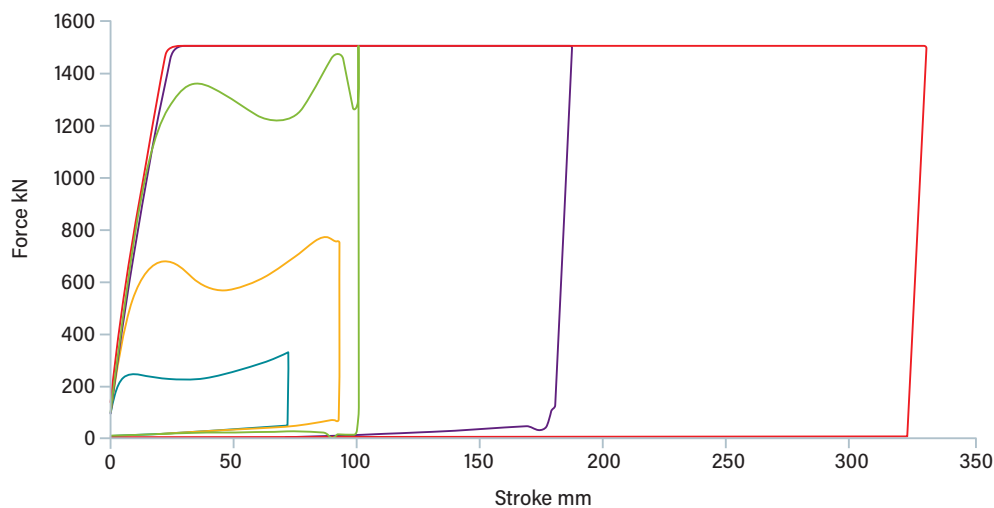


| Device Type | Impact Speed Km/h | Energy Absorption (kJ) |
|-------------|-------------------|------------------------|
| M323        | 9.3               | 67                     |
| M400        | 15.0              | 100                    |
| M500        | 15.3              | 122                    |

Example taken from Hi Spec table for each unit code

Force v Stroke characteristics are shown for front coupler at the Recoverable Coupling Speed under AW3 mass

## Oleo Sentry™ 1500 recoverable and non-recoverable performance at different speeds



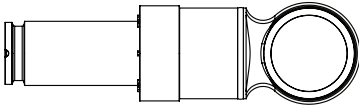
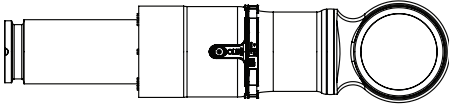
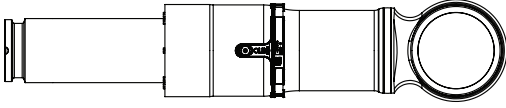
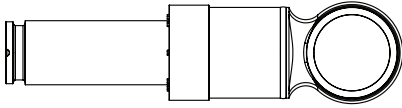
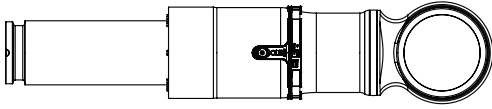
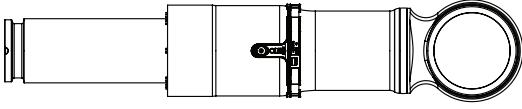
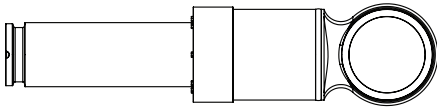
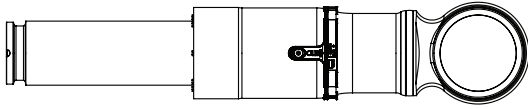
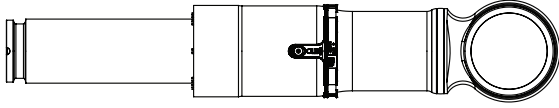
| M423 | Impact Speed Km/h | Energy Absorption (kJ) |
|------|-------------------|------------------------|
| —    | 5                 | 18                     |
| —    | 10                | 55                     |
| —    | 15                | 129                    |
| —    | 20                | 263                    |
| —    | 23                | 478                    |

Example shown is M423 Sentry 1500

Impact speeds are of 6 car rake impacting 6 car rake

Force v Stroke characteristics are shown for front coupler only at each speed

# Sentry™ Coupler 1500 Clamp to Pivot Energy Absorber Specification

| Gas Hydraulic (recoverable) stroke (mm) | Deformation (non recoverable) stroke (mm) | Sentry™ Range  | Maximum Force Rating | Energy Absorption (kJ) |
|---|---|--|----------------------|------------------------|
|   |   |  | Up to 1500kN         |                        |
| 70                                      |   |    | M300                 | 100                    |
|   | 160                                       |    | M316                 | 340                    |
|   | 230                                       |    | M323                 | 445                    |
| 100                                     |   |    | M400                 | 145                    |
|   | 160                                       |   | M416                 | 385                    |
|   | 230                                       |  | M423                 | 490                    |
| 125                                     |   |  | M500                 | 180                    |
|   | 160                                       |  | M516                 | 420                    |
|   | 230                                       |  | M523                 | 525                    |

| Buff                             |           |              | Crash            |              | Operating Temperature | Unit Pre-Load | Allowable Static Movement (mm) |      |      |
|----------------------------------|-----------|--------------|------------------|--------------|-----------------------|---------------|--------------------------------|------|------|
| Gas Hydraulic Fully Customisable |           |              | Deformation Tube |              |                       |               | M300                           | M400 | M500 |
| Stroke                           | Pre Load  | Force        | Stroke           | Force        |                       |               |                                |      |      |
| 70mm                             | 50kN Min  | Up to 1500kN | 160mm            | Up to 1500kN | +60°C<br>-40°C        | 50kN          | 3.0                            | 3.0  | 3.0  |
| 100mm                            |           |              |                  |              |                       | 100kN         | 3.0                            | 3.0  | 3.0  |
| 125mm                            | 450kN Max | Up to 1500kN | 160mm            | Up to 1500kN | +60°C<br>-40°C        | 150kN         | 3.0                            | 3.0  | 3.0  |
|                                  |           |              |                  |              |                       | 200kN         | 3.0                            | 3.0  | 3.0  |
|                                  |           |              |                  |              |                       | 250kN         | 3.0                            | 3.0  | 3.0  |
|                                  |           |              |                  |              |                       | 300kN         | 3.0                            | 3.0  | 3.5  |
|                                  |           |              |                  |              |                       | 350kN         | 3.5                            | 3.5  | 3.5  |
|                                  |           |              |                  |              |                       | 400kN         | 3.5                            | 3.5  | 4.0  |
|                                  |           |              |                  |              |                       | 450kN         | 3.5                            | 3.5  | 4.0  |

Oleo gas hydraulic coupler capsules provide a high start force and guarantees minimal static movement when the gas hydraulic device is installed into the coupler.

The static start force will protect against high draft and snatch loading in normal train running conditions. This can remove the need for heavy draft springs, thereby reducing weight and cost of the complete coupler system.