KYB

*Our Precision, Your Advantage*

# Rolling Stock Equipment

## 鉄道車両用機器

# *In the sky, on the sea, and on the ground,*
## *KYB has a global stage for its product applications.*

## 空に 海に 大地に ―KYBは地球が舞台です。

KYB Corporation was founded as one of the pioneers in hydraulic technology.
Nowadays, we fulfil the needs of a wide range of customers in such industries as automobiles, construction, railways, aircraft, and ships with products based on our R&D efforts that combine hydraulics-our core technology-with electronics, control, and other various technologies.
Our aim is to contribute to society in the 21st century in a broad range of spheres.
With this in mind, we will continue to provide products that offer comfort and strength as well as conducting R&D that strives for harmony with the environment through low energy and resource consumption.

油圧技術の先駆者としてスタートした当社は、油圧技術を核に電子、制御などを複合した技術開発と製品を提供することで、
自動車、建設、鉄道、航空機、船舶などさまざまな分野のお客様の幅広いニーズにお応えしています。
これからも「快適さ、力強さ」をご提供し続けることはいうまでもなく、
省エネルギー、省資源など「地球環境」に配慮した技術開発とその具現化を推進し、
21世紀の豊かな社会作りに大きく貢献できる企業を目指しております。

### Milestone/沿革

| | |
|---|---|
| 1952 | First Lateral Hydraulic Dampers for Japan National Railways developed under accumulated technologies of Landing Gears for Aircraft<br>航空機用支持脚　緩衝器（オレオ）技術の応用によりJNR（旧国鉄）向け鉄道用オイル式左右動ダンパーを開発納入開始 |
| 1958 | First Automatic Height Adjustment Valves, Differential Valves by adopting Air Springs on Bogies<br>鉄道車両へ空気ばね採用により自動高さ調節弁、差圧弁、開発納入開始 |
| 1964 | First Axile Box/Lateral Dampers for “0” Series Shinkansen<br>0系新幹線（210km/h）用各種軸・左右動オイルダンパ開発納入開始 |
| 1980 | First Hydraulic Damper for Shinkansen under cold area(-25 degree)<br>新幹線寒冷地仕様（−25℃）オイルダンパ納入 |
| 1992 | First Caliper Brakes and Yaw Dampers for “300” Series(270 km/h)<br>300系新幹線（270km/h）用キャリパーブレーキ・ヨーダンパ開発納入開始 |
| 1996 | Semi-Active Suspension Systems, Hydraulic Dampers, and Automatic Height Control for High Speed Trains developed and supplied<br>高速車両用サスペンション装置・油圧装置・オイルダンパ・高さ調整弁開発納入 |
| 1997 | Semi-Active Suspension Systems and Inter-Car Yaw Dampers for “500” Series Shinkansen(300 km/h)<br>500系新幹線（300km/h）用セミアクサスペンション・車体間ヨーダンパ開発納入 |
| 2000 | Tread Cleaning Devices developed and supplied for “E2” and “E3” series Shinkansen<br>E2・3系新幹線用踏面清掃装置開発納入開始 |
| 2003 | Hydraulic Dampers and Thread Cleaning Devices for Taiwan High speed railways<br>台湾新幹線向け各種ダンパ・踏面清掃装置納入 |
| 2004 | Hydraulic Dampers with center locking mechanism developed and supplied for Super Express Trains<br>在来特急用操舵台車用センターロック機能付オイルダンパ開発納入開始 |
| 2005 | Hydraulic Caliper Brakes, Tread Cleaning Devices, and Hydraulic Dampers for “CRH-2” series High Speed Trains in China<br>中国中速車CRH-2向けキャリパブレーキ・踏面清掃装置・各種ダンパ納入 |
| 2008 | Established Hydraulic Damper Factory in Changzhou, China for domestic production<br>中国常州市に中国向け国産化ヘダンパ工場設立 |
| 2011 | Various Hydraulic Dampers supplied for “CRH380A” series Chinese High Speed Trains<br>中国高速車CRH380A向け各種ダンパ納入 |

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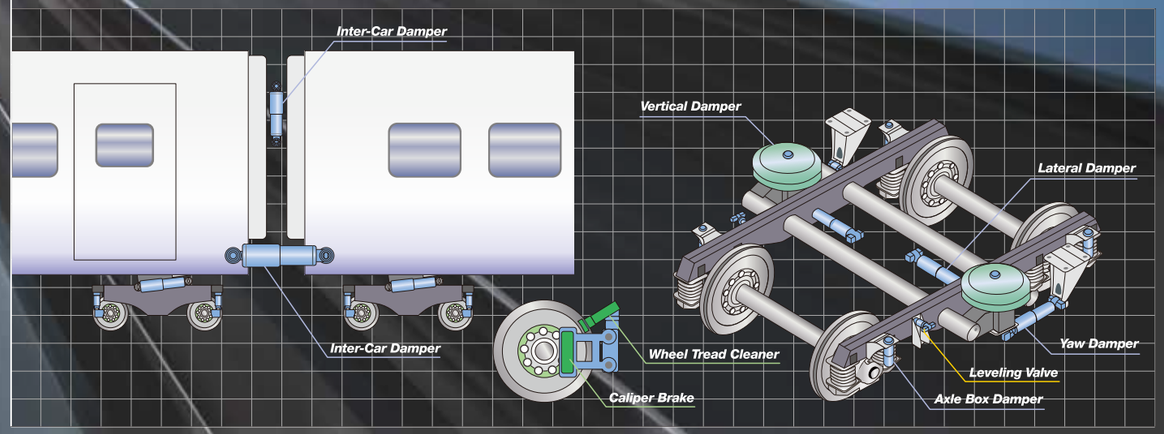


# Semi-Active Suspension System
## セミアクティブ サスペンションシステム

**Features**
- High safety
- Improvement in riding quality (comparing with passive damper)
- Work as a passive damper at power-off
- Built-in self-diagnosis function
- Only one successful semi-active suspension manufacturer

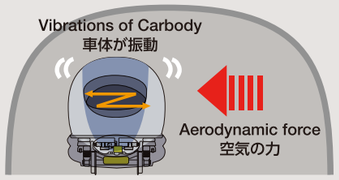
**特長**
- 高い安全性
- 乗り心地向上(パッシブダンパと比べ)
- 電源OFF時パッシブダンパとして機能
- 自己診断機能内蔵
- 唯一の量産実績メーカー

## When the train speed increases/車両の高速化

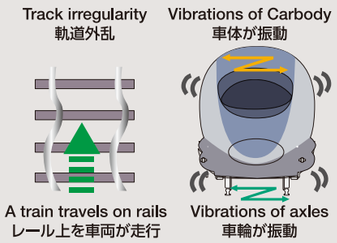
When trains travel
at the high speed (300km/h),
vibration control
in lateral direction is required.

*Solution:*
*Semi-active suspension system*
*improves riding comfort,*
*while lateral passive damper*
*is not sufficient*
*for control vibration.*

High speed through a tunnel
トンネル内高速走行



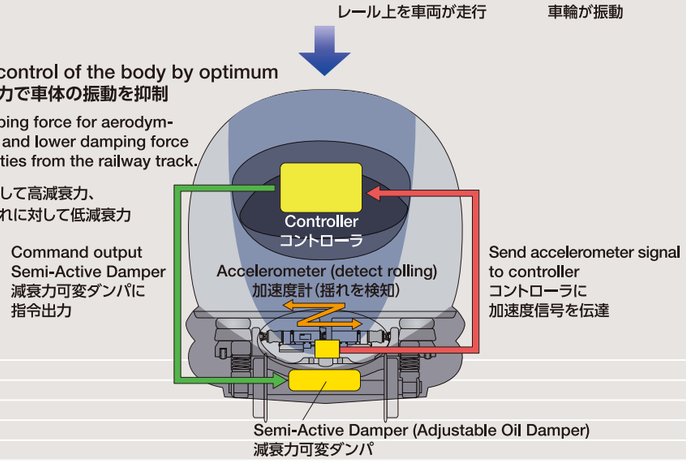

High speed traveling /高速走行



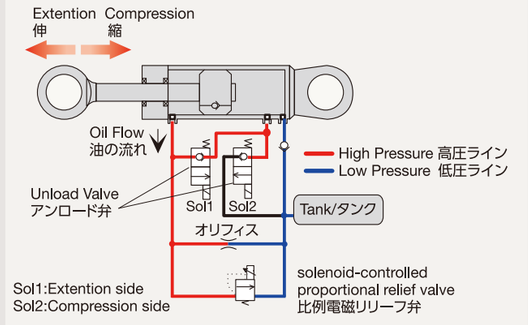

Vibration control of the body by optimum
最適な減衰力で車体の振動を抑制

Higher damping force for aerodynamic force and lower damping force for irregularities from the railway track.

空気の力に対して高減衰力、
軌道からの揺れに対して低減衰力



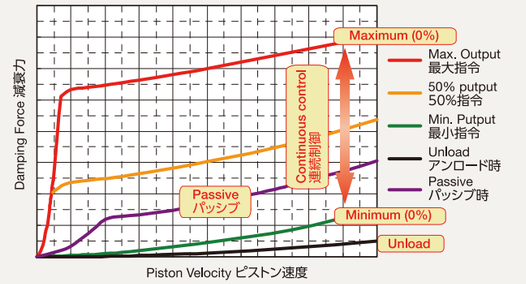

## System specification/仕様




Unidirectional flow design enables damping force control at both directions continuously and variably by a solenoid-controlled proportional relief valve. Unload valves cut damping force undesired in the opposite direction. It works as a passive damper at power-off.
(Passive characteristic as requested)

ユニフロー構造により伸縮両方向の減衰力を比例電磁リリーフ弁により連続可変
アンロード弁により不要な方向の減衰力をカット
電源OFF時はパッシブダンパとして機能(任意のパッシブ特性に設定可能)

**Semi-Active Damper Damping Force Characteristics**
**減衰力可変ダンパ性能図**




| Type | Damping Force | Max. Damping Force | Max. Piston Velocity |
|---|---|---|---|
| Semi-Active Damper | Continuous control and passive static | 15kN | 20cm/s |

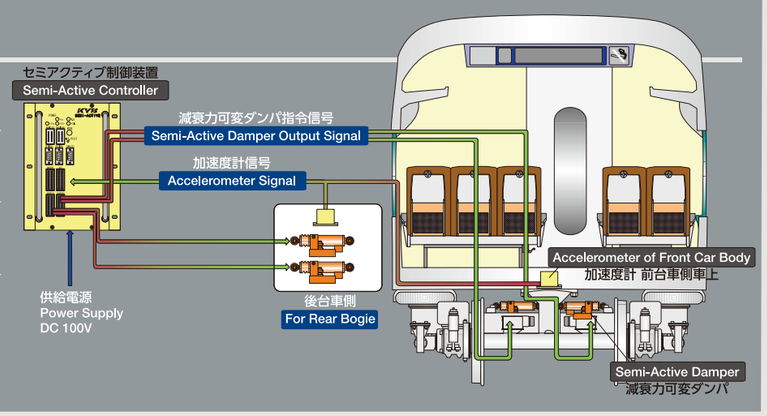
| Type | Max. Acceleration | Sensitivity | Resolution |
|---|---|---|---|
| Accelerometer | ±20m/s² | 0.1V/m/s² | ±2% |

| Type | Power surply | Electric Consumption |
|---|---|---|
| Controller | DC100V (70V to 110V) | 200W (Average) |

## Shinkansen
## 新幹線

### Components/構成品

| | | |
|---|---|---|
| 1. Semi-Active Damper | 2 | Units／Bogie |
| 減衰力可変ダンパ | 2 | 本／台車 |
| 2. Accelerometer | 2 | Units／Car Body |
| 加速度センサ | 2 | 本／車輌 |
| 3. Controller | 1 | Unit／Car Body |
| 制御装置 | 1 | 台／車輌 |




## Shinkansen/新幹線

Semi-Active Suspension System controls vibration coming from aerodynamic force by generating higher damping force at high speed through tunnels and high speed traveling and gives better riding comfort.

高速走行における空力振動や、トンネル走行時の振動を可変減衰ダンパで制御し、
快適な乗り心地を提供します。

## Limited Express and Express/特急、急行

Semi-Active Suspension System controls vibration generated by irregularities from the railway track by supplying optimal damping force indicated from the controller and gives better riding comfort.
No of Semi-Active Dampers is reduced to 1 unit/bogie.

空力だけでなく軌道外乱による振動制御効果も高く、在来線車両においても快適な
乗り心地を提供します。
減衰力可変ダンパが1ボギィ当り2本→1本になります。

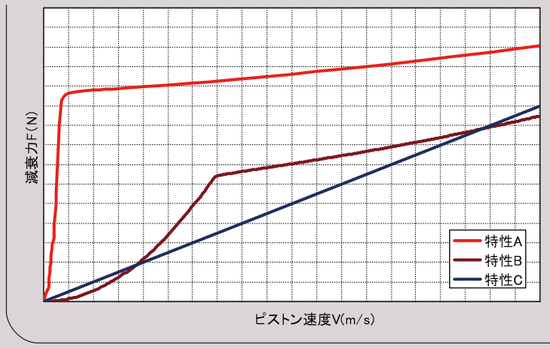
# OIL DAMPER
## 鉄道車両用各種オイルダンパ

These are oil dampers used to improve riding comfort and running stability. They are widely used in a great number of trains, including the Shinkansen and conventional limited express. Kayaba Industry has proudly claimed its remarkable truck record for past years..

乗り心地や走行安定性を向上するために使われる各種オイルダンパです。
新幹線をはじめ在来線特急など、多くの鉄道車両への採用実績を誇ります。

**Features**
- These components offer consistent damping performance.
- The mounting section can be designed to suit a specific application.
- Damping performance can be specified to suit requirements.
- Their construction features outstanding slight ampitude characteristics, particularly for Yaw Dampers and Inter-car Yaw Dampers.

**特長**
- 安定した減衰性能を発揮。
- 取付け部形状は、用途に合わせて設計対応可能。
- 減衰力特性も任意対応可能。
- 微振幅特性に優れた構造を採用。(とくにヨーダンパ、車体間 ヨーダンパ)




Axle Box Dampers (Vertical Dampers)/軸ダンパ(又は 上下動ダンパ)
Lateral Dampers/左右動ダンパ
Yaw Dampers/ヨーダンパ
Inter-Car Yaw Dampers/車体間ヨーダンパ

### Axle Box Dampers
These are installed between the wheelsets and the truck frame to control vertical oscillation and give improved running stability.

### 軸ダンパ
軸箱・台車枠間に設置され、上下方向の振動を抑制。走行安定性の向上を実現します。

| Type/種類 | Axle-box damper/軸ダンパ |
|---|---|
| Max. Piston Velocity/最大ピストン速度 | 0.6m/s |
| Max. Damping Force/最大減衰力 | 10kN |
| Characteristics/特性 | 特性B |
| Working Temperature/環境温度 | -20℃ ～ 60℃ |

### Lateral Dampers
These are installed laterally between the truck and the car body to control lateral oscillation and give improved riding comfort.

### 左右動ダンパ
台車・車体間の左右方向に設置され、左右方向の振動を抑制。
乗り心地の向上を実現します。

| Type/種類 | Lateral damper/左右動ダンパ |
|---|---|
| Max. Piston Velocity/最大ピストン速度 | 0.2m/s |
| Max. Damping Force/最大減衰力 | 10kN |
| Characteristics/特性 | 特性B, C |
| Working Temperature/環境温度 | -20℃ ～ 60℃ |

### Yaw Dampers
These are installed in parallel to the forwarding direction of travel on either side between the truck and the car body to minimize any yawing motion of the car body or snaking behavior of the truck.

### ヨーダンパ
台車・車体間の左右両側に車両の進行方向と平行に設置され、車体ヨーイングと台車蛇行動を抑えます。

| Type/種類 | Yawing damper/ヨーダンパ |
|---|---|
| Max. Piston Velocity/最大ピストン速度 | 0.2m/s |
| Max. Damping Force/最大減衰力 | 10kN or 20kN |
| Characteristics/特性 | 特性A |
| Working Temperature/環境温度 | -20℃ ～ 60℃ |

### Inter-car Yaw Dampers
These are installed in parallel to the forwarding directions of travel on either side and between cars ; they minimize yawing motion through the interaction of adjacent cars.

### 車体間ヨーダンパ
車両間の左右両側に車両の進行方向と平行に設置され、車体相互作用での車体ヨーイングを抑えます。

| Type/種類 | Inter-car Yaw damper/車体間ヨーダンパ |
|---|---|
| Max. Piston Velocity/最大ピストン速度 | 0.2m/s |
| Max. Damping Force/最大減衰力 | 22kN |
| Characteristics/特性 | 特性A |
| Working Temperature/環境温度 | -20℃ ～ 60℃ |

# Train Adjustment Valves
## 鉄道車両用各種調整弁

Automatic Leveling Valves
自動高さ調整弁
Differential Pressure Valves
差圧弁

# Hydraulic Caliper Brake
## キャリパーブレーキ

# Wheel Tread Cleaners
## 踏面清掃装置

### Automatic Leveling Valves
These are installed on the air springs (one valve each) of either side of the car, and enable a constant car height to be maintained, irrespective of car weight variations, by controlling the inflation and deflation of the springs.

**Features**
- A constant car height can be maintained.
- Response delays and dead zones can be set to suit car stability requirements.
- Good airflow characteristics are ensured.

### 自動高さ調整弁
左右の空気ばねに各1個ずつ設置。空気の供気・排気をコントロールすることで、車体の重量変化に関わらず車両の高さを一定に保ちます。

**特長**
- 車両を一定の高さに保持可能。
- 車両安定性条件に応じて応答時間の遅れ・不感帯の設定が可能。
- 良好な空気流量特性を保持。

| Type/種類 | LV : Leveling Valve |
|---|---|
| Response delay/応答遅れ | 1sec or 3 sec |
| Insensitive range/不感帯 | 5mm or 10mm |
| Working Temperature/環境温度 | -20℃ ～ 60℃ |

### Differential Pressure Valves
These are installed between the air springs on either side and control the internal pressure difference between the air springs. If the internal pressure difference is excessive, air is fed from the high-pressure side to the low-pressure side until the springs are balanced at lower pressure than the differential pressure valve get activate.

### 差圧弁
左右の空気ばね間に設置され、空気ばねの内圧差をコントロールします。内圧差が過大になったら、圧力が高い空気ばねから低い空気ばねに空気を流入させ、空気ばね間の内圧差を差圧弁の作動圧以下に制御。

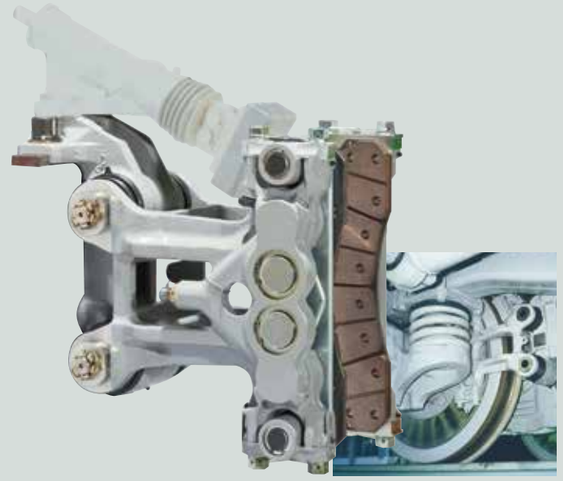
| Type/種類 | DP : Differential Pressure Valve |
|---|---|
| Differential Pressure/差圧 | 100, 120, 150, 200 kPa |
| Working Temperature/環境温度 | -20℃ ～ 60℃ |

### Hydraulic Caliper Brake
Compact, lightweight hydraulic caliper brakes giving the high braking force riding quality and the safety required of trains traveling at higher speeds. These calipers reduce speed proportionally in normal conditions, but stop the train rapidly and reliably in emergencies.

**Features**
- Lightweight, and also suited for compact, minimum space requirement for installation.
- These calipers incorporate an automatic gap adjusting device between the disk and lining.
- They can also be fitted with a tread cleaning device to improve adhesion coefficient between wheels and rails

### キャリパーブレーキ
鉄道車両の高速化に伴い、高い制動力と安全性を実現する小型・軽量の油圧式キャリパーブレーキ。通常時は速度を適切に制御し、非常時には確実かつ速やかに停止させます。

**特長**
- 小型・省スペース設置に対応、しかも軽量。
- ディスクとライニング間の自動隙間調整装置を内蔵。
- 車輪とレール間の粘着係数を向上させる踏面清掃装置も設置可能。



| Type/種類 | Hydraulic Caliper Brake/キャリパブレーキ |
|---|---|
| Max. Speed/最高速度 | 300 km/h |
| Axle Weight/軸重 | 166 KN |
| Max. Hyd. Pressure/最大油圧 | 12 Mpa |
| Working Temperature/環境温度 | -20℃ ～ 100℃ |

### Wheel Tread Cleaners
Ensures full adhesion between the wheel tread and railhead, reduces wheel noise, and ensures comfortable, safe high-speed running.

### 踏面清掃装置
車輪踏面とレールを確実に粘着。車輪騒音を低減させ、快適で安全な高速走行を実現します。

| Type/種類 | Wheel Tread Cleaner/踏面清掃装置 |
|---|---|
| Max. Speed/最高速度 | 300 km/h |
| Axle Weight/軸重 | 118 KN |
| Max. Air Working Pressure/最大作動圧力 | 0.5 Mpa |
| Working Temperature/環境温度 | -20℃ ～ 100℃ |

# Technology Innovation

## 技術革新

We have cultivated simulation technology, so that we can provide customized technology solutions including the right damping characteristics to be requested by clients.

We employ our original and thoroughgoing evaluation method (3-step evaluation), when we develop goods. Then, high reliability can be gained for all products.

Appropriate construction and material are selected in design, by consideration of railway applications and their service life.

System components with vibration control have realized the outstanding improvement of riding comfort.

3-step evaluation: model development → product development → serial production quality

客先の要求減衰特性を忠実に反映するための
シミュレーション技術。

生み出される製品は、KYB独自の徹底した評価
(3段階評価)による高い信頼性を確保。

車両での使われ方や耐久性を考慮し、構造や
材料まで吟味した製品。

車両乗り心地向上を実現した振動制御
システム製品。

三段階評価:先行モデル開発→製品開発→
量産品



# Market

## 市場

KYB provides a variety of hydraulic dampers from passive dampers to electrically controlled suspensions (ECS). We have developed ECS, and accomplished “further improvement of riding comfort on cabins by reduced vibration technology" for high-speed trains by utilizing our core competence, which is “vibration control technology" and “power control technology". We have been developing compact pneumatic caliper brakes in addition to our conventional hydraulic caliper brakes.
Further, we realize innovative and high quality products through high manufacturing expertise, then, aim to be a front runner of rolling stock equipment.

KYBはパッシブダンパから電子制御サスペンションまで幅広いダンパを供給しております。特に電子制御サスペンションについては、KYBのコアコンピタンスである「振動制御技術」、「パワー制御技術」を駆使し、高速鉄道車両の振動低減技術により更なる乗り心地向上を達成してきました。
キャリパーブレーキについては従来の油圧方式に加え、コンパクトな空圧キャリパーブレーキの開発に取り組んでいます。
さらに、高いものづくり力による革新的、高品質製品を実現し、鉄道部品のトップランナーを目指しております。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