HIRUN
HI TECH CIVIL ENGINEERING

# HIFLUID®

## VISCOUS DAMPERS VDD & LOCK-UP DEVICES LUD

CE MARKED

G&P intech®
Distributore esclusivo

## ◎COMPANY INTRODUCTION

Founded in 1998, Wuhan Hirun Engineering Equipment Co., Ltd. (HIRUN) is a wholly owned subsidiary of Wuhan Marine Machinery Plant Co., Ltd. (WMMP), which is a subsidiary of China Shipbuilding Industry Corporation (CSIC), one of the world's top 500 enterprises, and it is a professional manufacturing enterprise of research, development, production and sales in bridge and anti-seismic products.

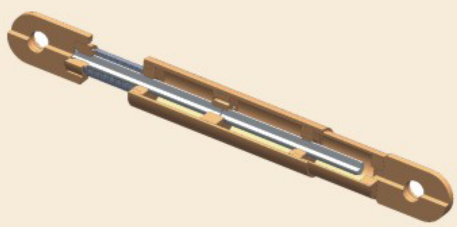
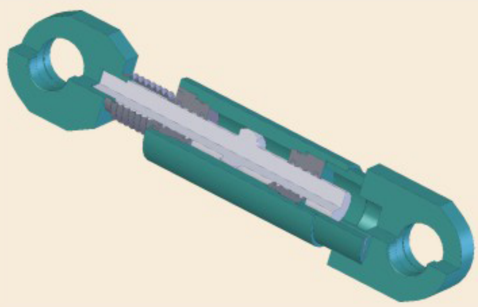
## ◎FUNCTION

**Viscous Dampers Devices (VDD)** are manufactured by HIRUN in accordance with EN 15129 Chapter 7.
They can provide important energy dissipation and are applied to mitigate the effects of the earthquake or to reduce vibrations or displacements generated by wind or other dynamic effects like the braking of the trains.
They are applied to bridges, including railway bridges, to apartments and industrial buildings.
One typical application is in combination with Tuned Mass Dampers.

**Lock-Up Devices (LUD)** are manufactured in accordance with EN 15129 Chapter 5.
In presence of thermally induced or other slowly imposed movements, LUD shall produce a small reaction force (generally less than 10% of the design force). In presence of a dynamic excitation, they shall produce the full design force with limited displacement. LUD do not provide great energy dissipation.
LUD are mainly applied in bridges, including railway bridges.
One typical application of the LUD is in continuous railway bridges in order to share the braking force among many piers.

## ◎FEATURES AND CONSTITUTIVE LAW

This kind of devices has a strictly velocity dependent behaviour. They can provide different performances in function of their hydraulic circuit but always consist of a steel cylinder with a piston dividing it in two chambers filled with oil. The cylinder at one side and the piston at the other one are connected through spherical hinges at two structural parts between which the earthquake will generate a displacement. The displacement forces the oil to flow from one chamber to the other though the hydraulic circuit.

| | | | |
|---|---|---|---|
| HIFLUID VDD Fluid Damper Device |  | HIFLUID LUD Lock Up Device |  |

Their behaviour, in a simplified way not taking into account the oil compressibility, can be represented by the following equation:

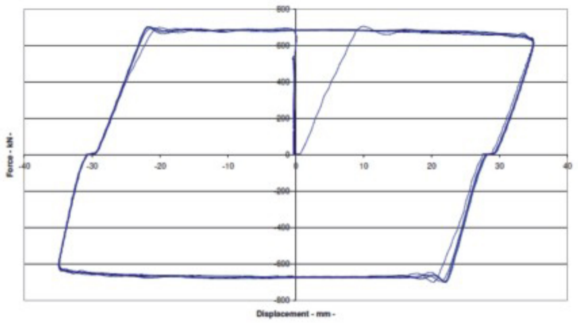
$$F = C \times V^{\alpha}$$

Where:
F is the force applied to the piston.
C is a constant depending from the physical-geometrical characteristics of the device.
$\alpha$ is an exponent ranging between 0,01 and 2 (with force in kN and velocity in m/s) depending on the adopted hydraulic circuit.

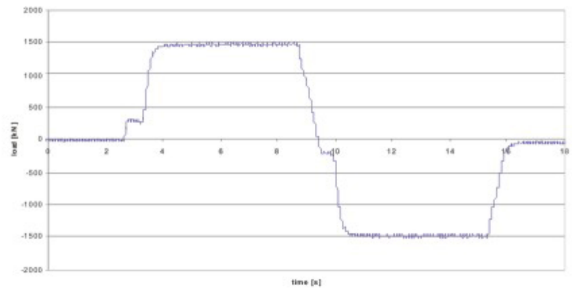
# ◎TEST REQUIREMENTS

Tests are performed in accordance with EN 15129.
The tests on hydraulic devices, Viscous Dampers and Lock-Up Devices, always require a dynamic testing device.
HIRUN is equipped with its own testing equipment suitable to test up to medium/big size devices (not exceeding 6000 kN).
The tests required by the EN 15129 are listed in the following table.

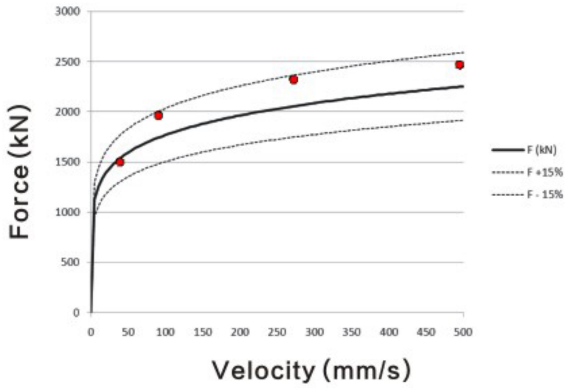
| TEST / REQUIRED FOR | LUD | VDD |
| --- | --- | --- |
| Pressure test | X | X |
| Low velocity test | X | X |
| Seal Wear test | X | X |
| Impulsive load test | X | |
| Overload test | X | |
| Cyclic load test | X | |
| Constitutive law test | | X |
| Damping efficiency | | X |
| Wind load cycle test | | X |
| Stroke verification | | X |




Damping efficiency test on a HIFLUID VDD 700/300




Impulsive test on a HIFLUID LUD 700/300

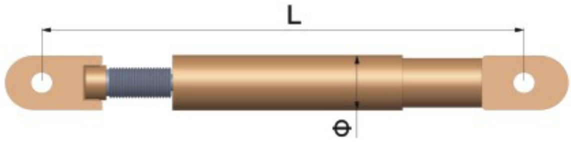


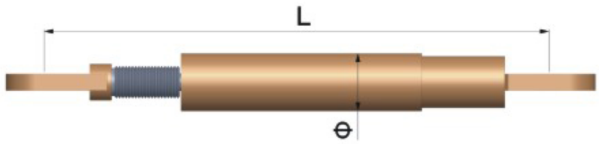

Constitutive law test on a HIFLUID VDD 2500/500 with α = 0,15

## ◎DIMENSIONS TABLES: HIFLUID VDD

They are identified by the following Mark:
VDD Vd(kN)/D(mm)

EXAMPLE:
**VDD 2000/300:** Viscous damper with 2000 kN design axial load and 300 mm axial displacement (± 150)



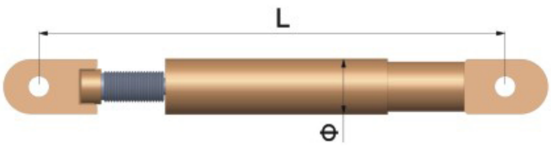

| $V_d$ | D | L | Ø | α |
|---|---|---|---|---|
| kN | mm | mm | mm | - |
| 1000 | ± 150 | 1750 | 260 | 0,01−2,0 |
| 1000 | ± 250 | 2350 | 260 | 0,01−2,0 |
| 1500 | ± 150 | 1850 | 270 | 0,01−2,0 |
| 1500 | ± 250 | 2450 | 270 | 0,01−2,0 |
| 2000 | ± 150 | 1950 | 310 | 0,01−2,0 |
| 2000 | ± 250 | 2550 | 310 | 0,01−2,0 |
| 2500 | ± 150 | 2050 | 350 | 0,01−2,0 |
| 2500 | ± 250 | 2650 | 350 | 0,01−2,0 |
| 3000 | ± 150 | 2150 | 370 | 0,01−2,0 |
| 3000 | ± 250 | 2750 | 370 | 0,01−2,0 |
| 3500 | ± 150 | 2300 | 410 | 0,01−2,0 |
| 3500 | ± 250 | 2900 | 410 | 0,01−2,0 |
| 4000 | ± 150 | 2400 | 430 | 0,01−2,0 |
| 4000 | ± 250 | 3000 | 430 | 0,01−2,0 |
| 5000 | ± 150 | 2600 | 480 | 0,01−2,0 |
| 5000 | ± 250 | 3200 | 480 | 0,01−2,0 |

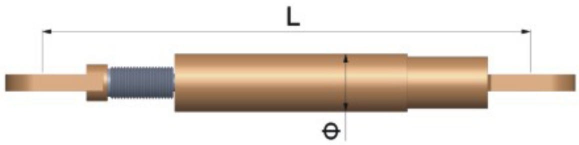
$V_d$: DESIGN AXIAL LOAD (ULS)
D: TOTAL DISPLACEMENT (± D/2)
L: TOTAL LENGTH (PIN TO PIN)
Ø: EXTERNAL DIAMETER
α: EXPONENT RANGE

## ◎DIMENSIONS TABLES: HIFLUID VDD

They are identified by the following Mark:
VDD Vd(kN)/D(mm)

EXAMPLE:
**VDD 2000/300:** Viscous damper with 2000 kN design axial load and 300 mm axial displacement (±150)



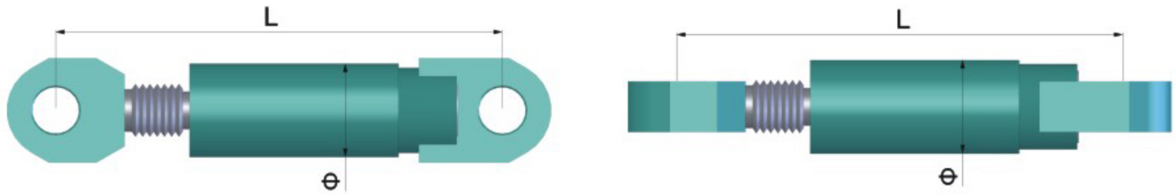

| $V_d$ | D | L | Ø | α |
|---|---|---|---|---|
| kN | mm | mm | mm | - |
| 1000 | ±150 | 1750 | 260 | 0,01–2,0 |
| 1000 | ±250 | 2350 | 260 | 0,01–2,0 |
| 1500 | ±150 | 1850 | 270 | 0,01–2,0 |
| 1500 | ±250 | 2450 | 270 | 0,01–2,0 |
| 2000 | ±150 | 1950 | 310 | 0,01–2,0 |
| 2000 | ±250 | 2550 | 310 | 0,01–2,0 |
| 2500 | ±150 | 2050 | 350 | 0,01–2,0 |
| 2500 | ±250 | 2650 | 350 | 0,01–2,0 |
| 3000 | ±150 | 2150 | 370 | 0,01–2,0 |
| 3000 | ±250 | 2750 | 370 | 0,01–2,0 |
| 3500 | ±150 | 2300 | 410 | 0,01–2,0 |
| 3500 | ±250 | 2900 | 410 | 0,01–2,0 |
| 4000 | ±150 | 2400 | 430 | 0,01–2,0 |
| 4000 | ±250 | 3000 | 430 | 0,01–2,0 |
| 5000 | ±150 | 2600 | 480 | 0,01–2,0 |
| 5000 | ±250 | 3200 | 480 | 0,01–2,0 |

$V_d$: DESIGN AXIAL LOAD (ULS)
D: TOTAL DISPLACEMENT (±D/2)
L: TOTAL LENGTH (PIN TO PIN)
Ø: EXTERNAL DIAMETER
α: EXPONENT RANGE

# ◎DIMENSIONS TABLES: HIFLUID LUD

They are identified by the following Mark:
LUD Vd(kN)/D(mm)

EXAMPLE:
**LUD 500/50:** Lock Up Device with 500 kN design axial load and 50 mm axial displacement (±25)




| $V_d$ | D | L | Ø |
|---|---|---|---|
| kN | mm | mm | mm |
| 200 | ±25 | 520 | 140 |
| 200 | ±50 | 670 | 140 |
| 300 | ±25 | 550 | 160 |
| 300 | ±50 | 690 | 160 |
| 500 | ±25 | 590 | 200 |
| 500 | ±50 | 740 | 200 |
| 1000 | ±25 | 980 | 250 |
| 1000 | ±50 | 1100 | 250 |
| 1500 | ±25 | 1060 | 280 |
| 1500 | ±50 | 1200 | 280 |
| 2000 | ±150 | 1950 | 310 |
| 2000 | ±250 | 2550 | 310 |
| 2500 | ±150 | 2050 | 350 |
| 2500 | ±250 | 2650 | 350 |
| 3000 | ±150 | 2150 | 370 |
| 3000 | ±250 | 2750 | 370 |
| 3500 | ±150 | 2300 | 410 |
| 3500 | ±250 | 2900 | 410 |
| 4000 | ±150 | 2400 | 430 |
| 4000 | ±250 | 3000 | 430 |
| 5000 | ±150 | 2600 | 480 |
| 5000 | ±250 | 3200 | 480 |

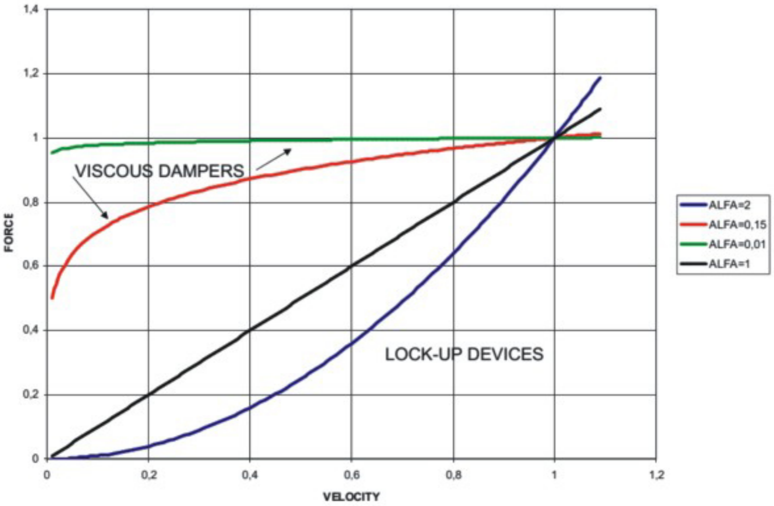
$V_d$: DESIGN AXIAL LOAD (ULS)
D: TOTAL DISPLACEMENT (±D/2)
L: TOTAL LENGTH (PIN TO PIN)
Ø: EXTERNAL DIAMETER

## ◎DESCRIPTION OF THE CONSTITUTIVE LAW

Devices with exponent 2 are utilized with the aim of maximizing the behaviour difference at low velocity (with minimum reaction for slow movements due to temperature, creep and shrinkage) and high velocity (with maximum reaction for earthquake conditions). These devices are normally called Shock Transmission Units (STU) or Lock-Up Devices (LUD) and belong to the Rigid Connection Devices category as described in EN 15129 Chapter 5. They are not suitable to dissipate large energy quantities.

If the main scope of the devices is the dissipation of energy, then the exponent $\alpha$ shall be as low as possible: 0,15 or lower, until nearly zero. This can be obtained through a suitable hydraulic circuit. These devices are normally called Viscous Dampers and belong to the category of Velocity Dependant Devices (VDD) as described in EN 15129 Chapter 7. They can be utilized for several applications, but, to be integrated in a seismic isolation system, they shall be combined to other devices supporting the weight of the structure and providing a re-centring force. In some cases, the re-centring force may be generated by the structure itself through the elasticity of some of the piers or some frames.

Also hydraulic devices with re-centring capacity are available. Their behaviour is described by EN 15129 Chapter 7 and they are named Visco-Elastic Dampers.





VDD 5000/600 Lanzhou Hekou Bridge (China)

LUD 12000/300 Jinmeng Bridge (China)

## ◎STANDARD

HIFLUID devices are designed in accordance with the EN 15129. All the materials are conforming to the relative standard: EN 10025 and EN 10088 . All the devices will be supplied with the CE-MARK.

On demand the devices can be designed and manufactured in accordance with any other standards as:

- ◆BS 5400
- ◆AASHTO

HIFLUID DEVICES FOR NANXI YANGTZE RIVER BRIDGE

HIFLUID DEVICES FOR LANZHOU HEKOU YELLOW RIVER BRIDGE

HIFLUID DEVICES FOR SIXIANJIAO BRIDGE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HIRUN® ENGINEERING

**G&P intech** s.r.l
via Retrone 39 - 36077 Altavilla Vic. (VI) - ITALY
Tel. +39 0444 522797 - Fax +39 0444 348692
E mail: info@gpintech.com