Technical Bulletin

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# TIPS & TRICKS

## Hydraulics: Dampers and Isolators

**APPLICATION**

All models

## HYDRAULIC DAMPERS

Master Cylinder CMC Fig.1

Clutch Slave Cylinder CSC Fig.2

Concentric Slave Cylinder Bearing CSCB Fig.3

Hoses Fig.3

**Benefit of Clutches system**

The clutch system is installed between the engine crankshaft and the input of transmission to give us the ability of changing gears and vehicle standstill while the engine is in idle state.
The release and engagement is made via cable or hydraulic.

The Hydraulic clutch system consist of Clutch Master Cylinder (CMC) , Clutch Slave Cylinder (CSC) ,Concentric Slave Cylinder Bearing (CSCB) and Hoses, example see **Fig. 1, 2, 3 & 4** respectively

**Pressure pulsation in Hydraulic clutches**

Due to the internal combustion which happens in the engine, low frequency vibrations are generated and crankshaft imbalance is produced. These results are transmitted by the clutch cover through clutch bearing and hydraulic column to the pedal as hydraulic pulsations.
This pulsation is felt by the driver when the driver depresses the pedal which results in uncomfortable feeling.

To eliminate the problem there are three possible solutions:

A. Damping the pulsation amplitudes

B. Isolating the clutch circuit from the master cylinder

C. Modulating the pulsation frequency by increasing the vibration frequency from the engine

## A. Hydraulic Damping Pulsation

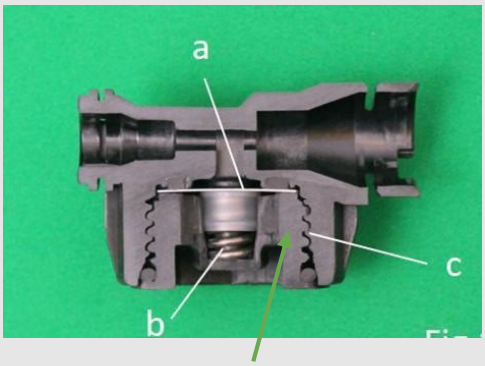
The damping can be performed either by **hydraulic circuit design** or by **installing damper (frequency modulator)** in the circuit.

1. **Damping by circuit design:-** the pulsation is affected and dampened by the volume and the elastic material in the circuit

**This table shows the methods of hydraulic circuit design**

| Methods | Method 1:Volume | Method 2: Shape design | Method 3: Material |
|---|---|---|---|
| Design | • Increase the length of the metal pipe | • S shape<br>• U Shape<br>• Spiral shape | • Rubber with elastic walls |
| Advantages | • **Method 1& 2:**- Increasing the length of the metal pipe or cross section or having different shapes will increase the flow resistance and damping effect<br>• **Method 3:**- Using soft materials like rubber or elastic materials will decrease the pulsation effect in the pedal | | |
| Disadvantages | • Increasing the volume of hydraulic circuit will results in soft pedal (**spongy feeling**) and lack of tactile feedback or having longer stroke<br>• Having longer pipes with **higher** flow resistance will results in exerting more force on the pedal and reducing the return speed of the pedal especially when the the fluid temperature is low (high viscosity)<br>• Some systems are working on specific frequency, so it may not reduce the pulsation on the entire frequency range | | |

Hydraulic Damper Fig. 4




Hydraulic damper structure Fig. 5

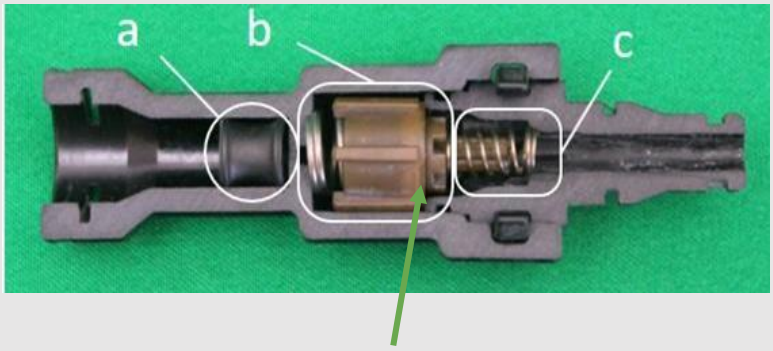
### 2. Hydraulic Damper; Frequency modulator

For better driving comfort, cost efficiency and space reduction, a hydraulic damper is installed in the hose pipes to separate the slave cylinder from the master cylinder and pedal ( **Fig. 4 )**

**Damper operation** :The engine generates low frequency pressure pulsation. This low frequency will vibrate the membrane in the damper **( Fig.5 a)** at higher frequency than the disruptive source. This high frequency is transmitted to the master cylinder and pedal, but due to the inertia generated, it prevents the driver from feeling any vibrations in the pedal.

**Advantages of Hydraulic dampers.**

- Temperature doesn't affect the system
- More sensitive to pressure variation and range
- Plastic molding house, therefore, high productivity with low cost
- The housing and the closing cap are rounded threaded profile which ensure increased durability, (**Fig 5. C)**
- Housing construction allows air bleeding
- Possibility of increasing diameter/thickness ratio membrane. This has great affect of hysteresis loss and system elasticity which should be as small as possible
- Housing structure allows using thinner metallic membrane with large diameter without risk to be damaged by high pressure
- As membrane is pretensioned by coil spring **(fig. 5 b) it** allows to control the volume. If there is no pressure in the system the membrane is still pretensioned leading to a stiffer pedal and shorter stroke compared to other systems not having a coil spring
- Hydraulic dampers can be fit for almost all systems. Just using same housing and change the thickness, diameter of membrane and coil spring rigidity




hydraulic Isolator Fig. 6

## B. Hydraulic Isolators

How does it work?

The pulsation isolator **( Fig. 6)** is installed on the hydraulic line between the master cylinder and slave cylinder.

The housing consist of two valves with two coil springs **(Fig 6 b, c.)** depending on the direction of the fluid flow only one valve can be opened. This table shows the open/close status of each valve.

| **Isolators Valve b, c status** | | | |
|---|---|---|---|
| Valve Status | Valve b | Valve c | Flow direction |
| Pedal depressed | open | closed | from Master cylinder to slave cylinder |
| Pedal released | closed | opened | from slave cylinder to master cylinder |
| No Fluid flow | closed | closed | No flow |

**The advantage of hydraulic isolators.**

- No temperature affect on the hydraulic circuit.
- Pedal clutch rigidity, travel and elasticity are always same as there is no volume variation.
- Isolating the master cylinder from the rest of the circuit results in no pulsation felt by the driver.
- Very simple and compact design requires small space to be fitted.
- The valve design allows a great quantity of fluid to flow with minimum flow resistance.
- The spring which is located in the housing **(Fig. 6 a)**, serves to dampen the remaining pulsation.
- The isolation device can be fitted in any direction, having no dependence on the direction of flow