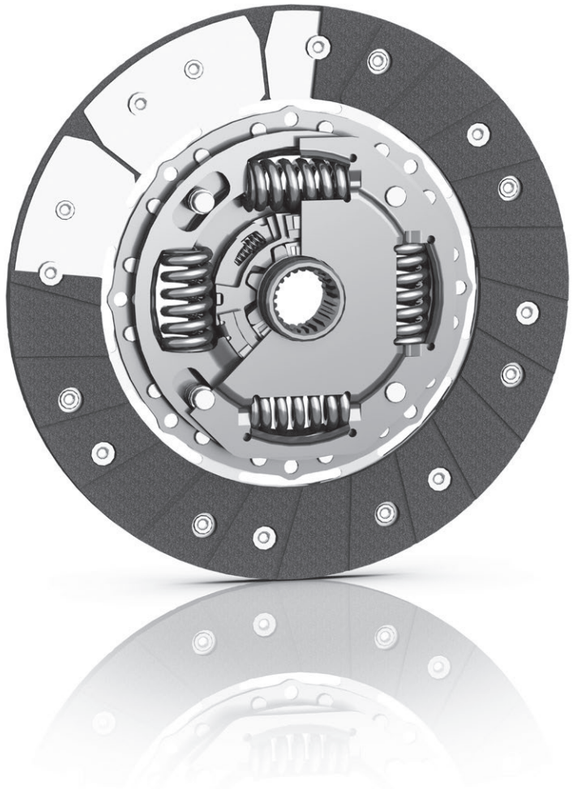
Clutch disc with torsional damper

The task

Ignition-induced irregularities in rotational speed and rapid load alterations generate vibrations in the powertrain, which in turn cause disturbing noises in the vehicle body and unpleasant rattling in the transmission. Modern engines are featuring smaller displacements and supercharging (down-sizing) in order to reduce fuel consumption. These engines generate high levels of torque at low rpm levels (down-speeding). This constellation of engine characteristics leads to an increase in torsional vibrations. Yet drivers continue to demand higher performance from their damping systems.

The technology

The torsional damper integrated in the clutch disc is the main element for adjusting torsional rotation properties throughout the powertrain, from the combustion engine to the wheels. This effective vibrational damping system consists of a friction unit and spring sets for both driving and idling. Coil springs positioned in windows allow a limited degree of rotation between the crankshaft and the transmission input shaft. Torsional dampers are individually tuned because each engine/transmission aggregate has its own characteristics. The resulting superior spring and damping characteristics generate outstanding decoupling qualities.



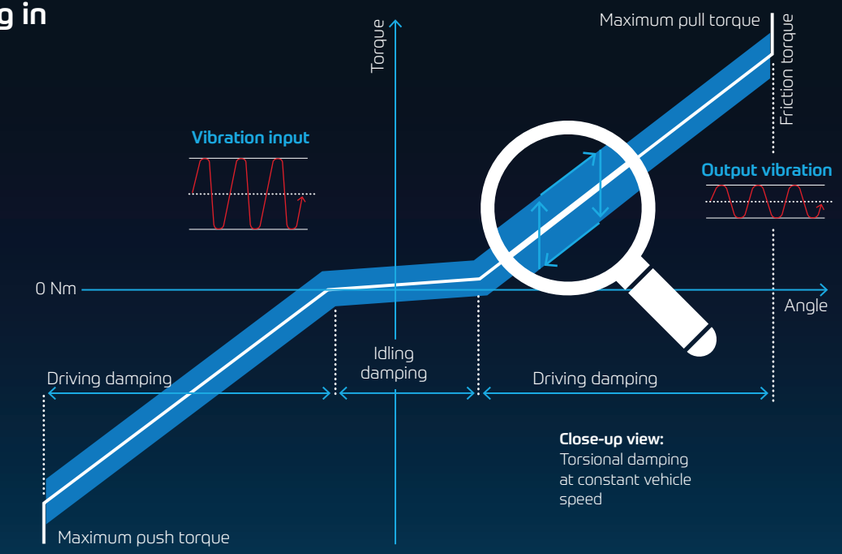
Benefits

- Complex individual characteristics
- Compact construction
- Low inertia
- Modular design

Clutch disc with torsional damper
The torsional dampers are tuned for the characteristics of each vehicle model. Thanks to multistage main dampers and extra preliminary dampers, engine vibrations are effectively minimized both when idling and driving.

Vibrational damping in a torsional damper

Torque and angular travel



Close-up view:
Torsional damping at constant vehicle speed

ZF clutch facings – all-rounder under the most extreme conditions

450°C

Peak temperature through friction

Challenge: tribological characteristics
The clutch facing is subject to high frictional load during clutch engagement. The frictional load particularly occurs during starting but also during normal driving operation. Temperatures of up to 450°C may develop at times. Even under such extreme conditions, the clutch facing ensures a sufficiently high frictional coefficient to prevent fading and slipping of the clutch and, as a result, stranding of the vehicle. In addition to the stable friction coefficient, the clutch facing offers high wear resistance.

Challenge: mechanical characteristics
Due to the high rotational speed and the acceleration of a combustion engine, the clutch facing requires very good mechanical characteristics. Strong acceleration leads to an accelerating force which results in high tensile shear in rotation direction. High rotational speed leads to high radial force which results in high tractive forces in radial direction. The minimum burst strength of the clutch facing is correspondingly high. This is still the case when the facing has been partly pre-damaged by thermal load. The clutch facing is still able to bear high pressure as the diaphragm spring presses it strongly against the engine flywheel via the pressure plate during clutch engagement.

Challenge: heat dissipation thanks to high thermal conductivity
The clutch facing requires the highest possible heat conductivity to quickly dissipate friction-induced heat to the neighboring metal parts, thereby avoiding thermal damage of the facing.

Challenge: comfort
The friction facings allow fi ne dosing of the engine torque during the starting phase which, in combination with the cushion springs, make smooth starting possible. Particularly unpleasant clutch grab during starting (vibrations in the range of 10Hz) is prevented.

Challenge: material composition
ZF clutch facings consist of a number of well-matched materials: Yarns of glass or polymer fi bers as well as copper or brass wire, embedded in a mixture of resin, rubber, and filler materials. They are lead-free and are manufactured in environmentally friendly processes. They comply with EU regulations for vehicle recycling.