



Self-Adjusting Clutch (SAC)

Technology

Special tools / User instructions



SCHAEFFLER
AUTOMOTIVE AFTERMARKET



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1 Self-Adjusting Clutch (SAC)

1.1 SAC increases driving comfort

As clutches are subjected to continuous wear and tear, LuK, as the first clutch manufacturer worldwide, has invested tremendous efforts in the development of a wear adjustment solution, which was successfully launched for volume production in 1995.

SAC technology has since asserted itself in a wide variety of motor vehicles, in particular in models with large engines where the clutch can be actuated far more comfortably with an SAC.



Self-Adjusting Clutch (SAC)

1.2 Longer clutch life thanks to the sensor diaphragm spring

The SAC uses a load sensor (sensor diaphragm spring) to activate its wear adjustment function by turning a ramped ring. This wear adjusting mechanism reduces the required actuation forces while increasing clutch life by around 1.5 times. In addition, actuation forces remain nearly unchanged throughout the clutch's service life. The SAC wear adjustment system – which consists of the sensor diaphragm spring (load sensor) and a deep-drawn steel adjusting ring – is characterised by its excellent functional accuracy. As clutch actuation comfort requires a harmonic operating load curve in addition to low actuation forces, the SAC was designed with the capacity to be tuned to each vehicle's specific characteristic curve. One such feature is the compensation spring, which is able to generate the flatter characteristic curves that are frequently desired.

1.3 Further system refinement with the new SAC II

The new SAC II does not use a second diaphragm spring as a load sensor; instead, it has fingers formed from the main diaphragm spring and special tangential leaf springs with a regressive characteristic curve.



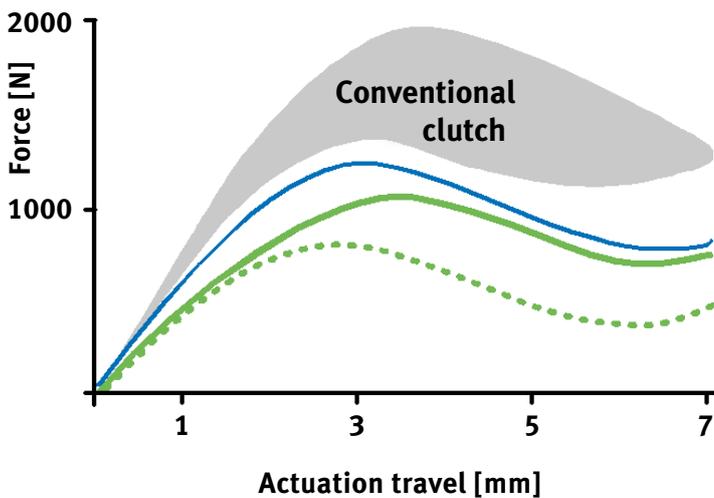
The new SAC II with release bearing

1.4 System optimisation thanks to specific designs

The modified SAC II concept allows for the further reduction of clutch actuation forces and/or the optimisation of the actuation force curve. With this clutch type, the load sensor's performance curve is modified in a way that makes the clutch adjustment mechanism less sensitive to large actuation lifts. This is achieved by using leaf springs with a linear characteristic curve which engage outside the pivot point of the main diaphragm spring.

In many cases, the load sensor can be formed directly from the diaphragm spring in the form of sensor fingers. This design requires no sensor diaphragm spring at all. With the new SAC II, actuation forces can be decreased by up to 15% without reducing torque transfer capacity. Alternatively, the maximum actuation force remains unchanged and the additional potential is used to optimise the characteristic curve.

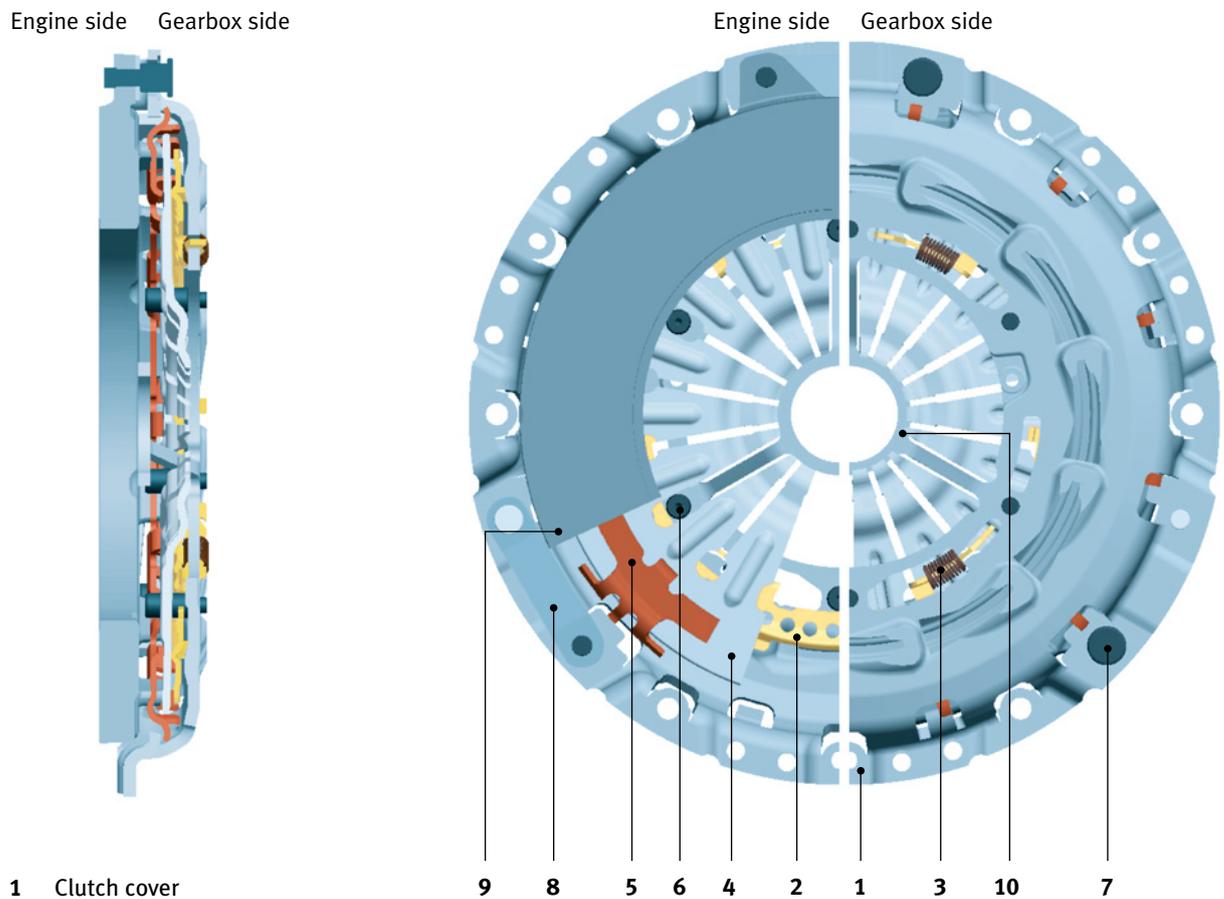
Actuation forces



- SAC I for foot-actuated disengaging
- SAC II for foot-actuated disengaging
- SAC II for automatic disengaging

2 Clutch course

Self-Adjusting Diaphragm Spring Clutch (SAC)



- 1 Clutch cover
- 2 Adjusting ring
- 3 Pressure spring
- 4 Diaphragm spring
- 5 Sensor diaphragm spring
- 6/7 Rivet
- 8 Tangential leaf spring
- 9 Pressure plate
- 10 Cover limit stop

In recent years Self-Adjusting Clutches have become the standard equipment in applications with high engine torque or with increased requirements for wear reserve.

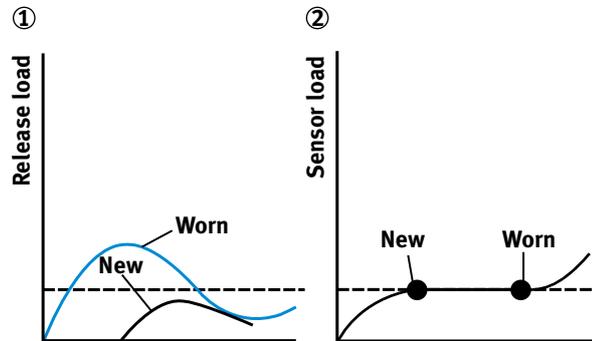
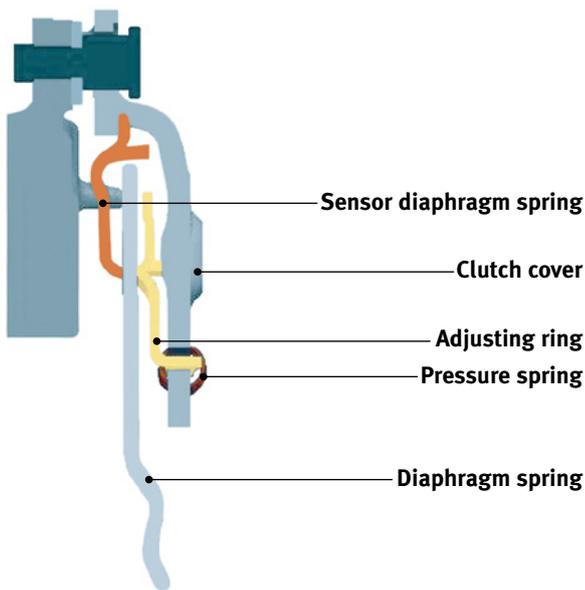
The essential advantages of the SAC over conventional designs are:

- Low release loads which remain constant throughout the entire service life
- Therefore, excellent driving comfort throughout the entire service life
- Increased reserve for wear and consequently longer service life thanks to automatic wear adjustment
- Release bearing over-travel is prevented by the diaphragm spring end stop

This yields a number of further advantages:

- Simplified release system design
- Shorter pedal travel
- New engineering concepts to reduce the clutch diameter (torque transfer)
- Shorter release bearing travel throughout bearing life

2.1 Operating principle of the Self-Adjusting Clutch (SAC)



Load sensor

On the clutch with wear adjustment, the load sensor detects the increase in release load caused by wear and correctly compensates for the reduction in facing thickness. Unlike a conventional clutch, the (main) diaphragm spring is supported by the so-called sensor diaphragm spring instead of being riveted to the cover. In contrast to the strongly regressive main diaphragm spring, the sensor diaphragm spring provides a sufficiently wide range of almost constant load. The constant load range of the sensor diaphragm spring is designed to be slightly higher than the desired release load. As long as the release load is smaller than the load of the sensor spring when disengaging the clutch, the pivot point of the main diaphragm spring remains stationary. When facing wear increases, the release load increases, the counterforce of the sensor spring is overcome and the pivot point moves towards the flywheel to a position where the release load again falls below the sensor load. When the sensor spring deflects, a gap develops between pivot point and cover, which can be compensated for by introducing a wedge-shaped component, for example.

Design of a Self-Adjusting Clutch with load sensor

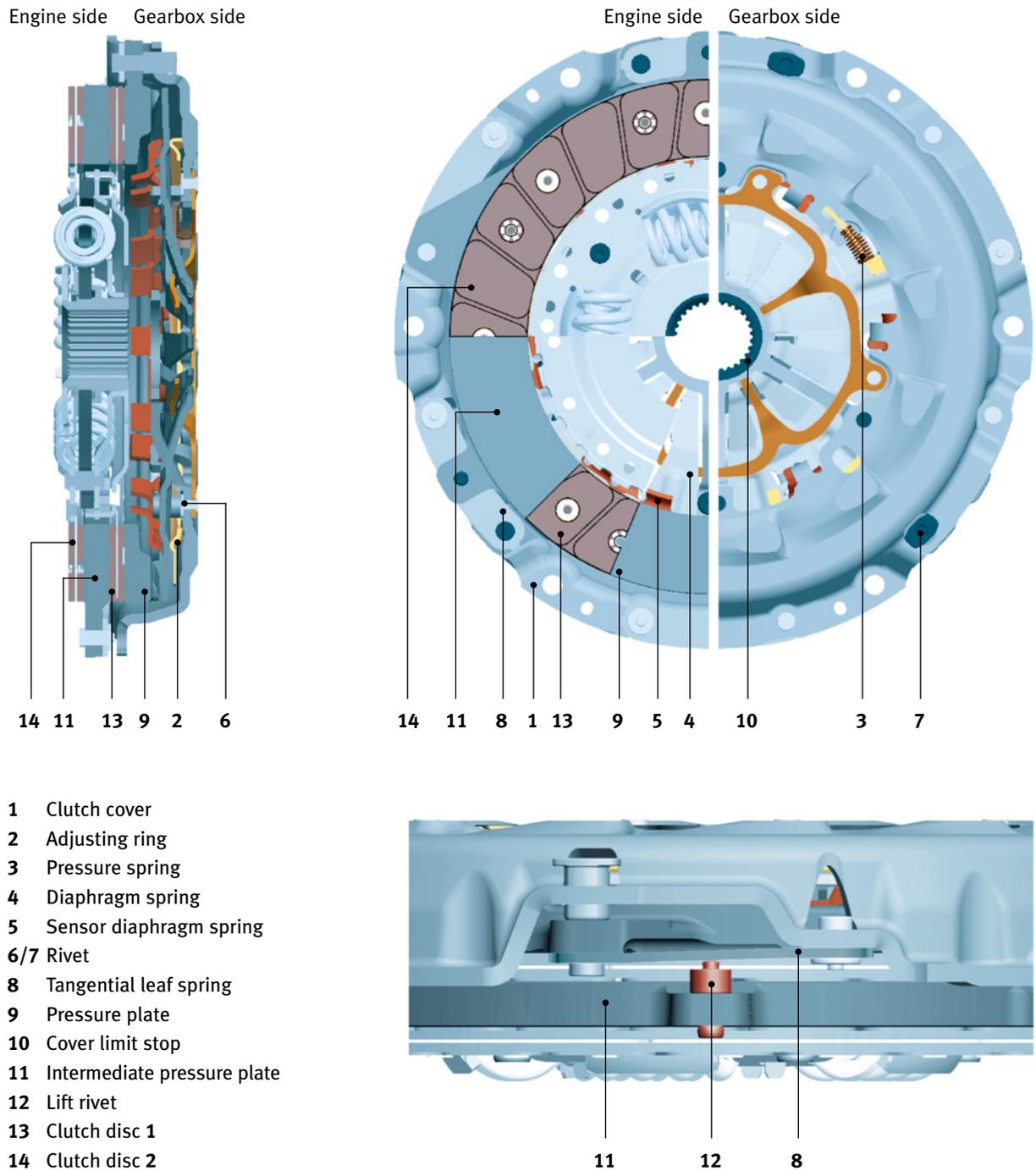
The load sensor with thickness adjustment wedge can be realised in a simple and effective manner. In comparison to the conventional clutch, the only additional parts required by this design are a sensor diaphragm spring (red) and a ramp ring (yellow). The sensor diaphragm spring is suspended in the cover and its inside fingers support the main diaphragm spring. Because of centrifugal forces the wedges which provide the actual adjustment are positioned in circumferential direction. A steel adjusting ring with ramps moves on opposing ramps in the cover.

The steel adjusting ring is preloaded in circumferential direction with pressure springs which force the ring to close the gap between the diaphragm spring and the cover when the sensor spring deflects. Figure ① shows the release load curves for a conventional clutch with new and worn facings. In contrast, compare the significantly lower release load of the SAC as shown in graph ②, which has a characteristic curve that remains virtually unchanged over its service life. An additional advantage is the higher reserve for wear, which no longer depends on the length of the diaphragm spring curve (as in conventional clutches), but rather on the ramp height, which can easily be increased to 3 mm for small and 10 mm for very large clutches. This represents a decisive step towards the development of highly durable clutches.

Multiple-disc SAC

High-performance engines which generate engine torques above 500 Nm require clutches designed to transfer these torques. This involves an almost inevitable increase in pedal force despite the use of a Self-Adjusting Clutch. A variety of technological approaches kept the increase within reasonable limits (e.g. improved release systems); however calls for a clutch with reduced actuation force grew louder.

2.2 Multiple-disc Self-Adjusting Clutch (SAC)



In contrast to the single-disc version, the multiple-disc SAC has an additional intermediate pressure plate and three more tangential leaf spring packages which ensure sufficient lift of the intermediate pressure plate. To achieve even wear of both clutch discs, lift rivets are used to control the intermediate pressure plate. They ensure that the lift of the intermediate pressure plate is half the lift of the pressure plate. A special version of the clutch disc can be modelled to suit vehicle applications which require a damped clutch disc to provide better isolation.

The benefit of the multiple-disc SAC is that it permits a reduction in release load for the same engine torque or, conversely, an increase in engine torque transfer at identical release load levels. On engines where high engine torque is paralleled by high engine speeds, the multiple-disc SAC also offers the option of decreasing the facing outer diameter, which in turn improves the burst speed characteristic of the clutch discs. Furthermore, downsizing the clutch disc helps stabilise or even slightly decrease the disc's mass moment of inertia compared to a single-disc system of corresponding clutch torque capability.

3 Special tools for SAC installation without applying counteracting forces

Using a special tool is an absolute must to ensure correct installation of the Self-Adjusting Clutch. No counteracting forces must be applied during installation to prevent early rotation of the adjusting ring in the clutch pressure plate.

For any questions concerning the SAC or the correct use of the special tool (item no. 400 0237 10) call us on: +49 (0)1801 753-333.

Tool case contents



item no. 400 0237 10

- | | |
|--|---|
| <p>1 Six different tapered bushings to spread both white tensioning/centring elements (15-28 mm) to support the clutch disc</p> <p>2 Universal centring pin with guide and tensioning element</p> <p>3 Three screw-on centring pins of varying diameter (12 mm, 14 mm, and 15 mm) for pilot bearing</p> <p>4 Pressure piece and spindle carrier with 3- and 4-hole pitch</p> | <p>5 Centring sleeve (BMW)</p> <p>6 Four studs M6, M7 and M8</p> <p>7 Four knurled nuts</p> <p>8 Thread closing cover to protect the inner thread</p> <p>9 Two tensioning/centring elements (12-28 mm) to fit pilot bearing and crankshaft bore</p> <p>10 Four special centring pins (BMW) of varying diameter and corresponding screw</p> <p>11 Face spanner/releasing tool for pre-tensioned clutches (Audi, Seat, Skoda and VW)</p> |
|--|---|

4 Centring the clutch disc

It is essential to centre the clutch disc to ensure that the gearbox is correctly mounted and that the clutch works properly. Correct centring of the clutch disc also allows the primary shaft to be positioned in the clutch disc hub smoothly, which minimises the risk of clutch disc or hub profile damage.

We offer a universal centring pin with add-on components developed to fit virtually every vehicle make and model. There is a wide variety of assembly options to suit individual repair needs.

4.1 Universal centring pin – assembly options

Basically, the universal centring pin can be used on every type of vehicle. Normally, a pilot bearing is installed in the crankshaft bore. The bearing's inner diameter is smaller than that of the hub. What makes the universal pin special is its ability to be used even on applications without a pilot bearing, where the inner diameter of the crankshaft bore can be bigger than that of the hub.



Correct assembly of the centring pin is dependent on the inner diameter of the pilot bearing or crankshaft bore, and on the distance between the pilot bearing or crankshaft bore and the clutch disc's hub profile.

There are consequently two types of centring pin adapters:

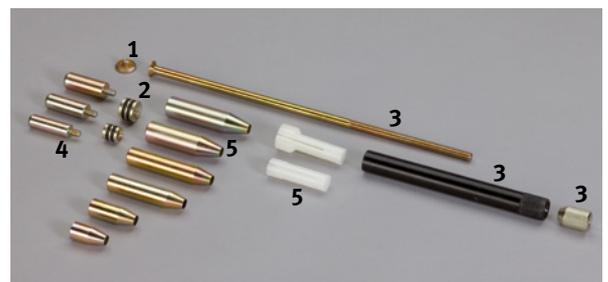
- To fit pilot bearings with an inner diameter of 12 mm, 14 mm or 15 mm use the corresponding screw-on centring pins
- To fit all other applications use the variable tensioning/centring components with diameters ranging from 12-28 mm

Individual components can be combined freely to suit specific centring pin requirements. However, be sure to assemble the components in the following order:

The graphic shows the order in which components need to be assembled. If none of the three screw-on centring pins are used, screw on the closing cover to protect the thread from dirt and impact.

Assemble the universal centring pin according to the specific requirements and insert into the crankshaft bore through the clutch disc hub. Ensure that the tensioning/centring elements are level with the crankshaft guide and the clutch disc hub. Tightening the tensioning element

positioned at the tip of the centring pin spreads the individual components, thereby centring the disc.



- 1 Thread closing cover to protect thread from dirt ingress
- 2 Two tensioning/centring elements (12-15 mm and 15-28 mm) for pilot bearing or crankshaft bore
- 3 Universal centring pin with guide and tensioning element pilot bearing and crankshaft bore
- 4 Three screw-on centring pins of varying diameter to fit pilot bearing
- 5 Spreading of the white tensioning/centring elements (15-28 mm) to receive the clutch disc

4.2 Centring procedure on BMW models



In addition to the numerous possible combinations of the universal centring pin, the tool case also includes special pins to fit the latest BMW models.

Pre-tensioned SAC pressure plates on these applications are equipped with a locking device which has to be removed after installation by means of a hexagon socket spanner.

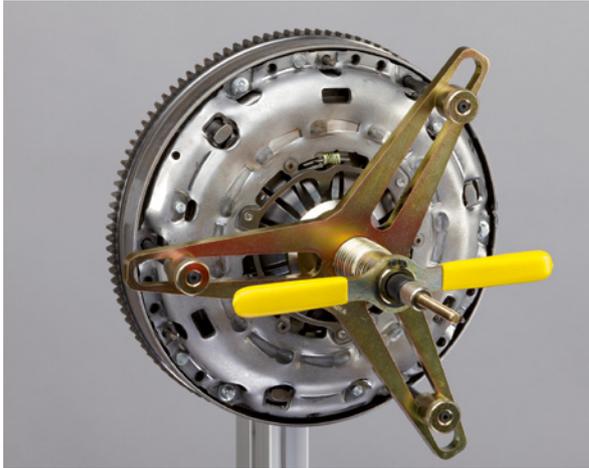


Choose the appropriate centring tool depending on the hub profile diameter of the clutch disc. The tool case contains the following parts:

- Pin 15 mm/34 mm
- Pin 15 mm/28 mm
- Pin 15 mm/26.5 mm
- Pin 15 mm/23 mm
- Centring sleeve

Refer to chapter 5.3 for detailed step-by-step instructions on the use of these tools in this type of SAC.

5 Mounting the SAC



Depending on the flywheel's hole pitch circle (six or eight screws) the pressure piece has to be modified using the corresponding spindle carrier.



Use the 3-hole pitch on flywheels with six mounting threads, and the 4-hole pitch for flywheels with eight mounting threads.

5.1 Sample installation – spindle carrier with 3-hole pitch



Adhere to the following procedure to install this type of SAC correctly:

- Assemble the centring pin according to the specific model – see chapter 4.1.
- Insert the centring pin into the hub profile of the clutch disc.
- Pre-tension the centring pin using the tensioning element at the pin's tip.
- Insert the pin and clutch disc into the pilot bearing or crankshaft bore.
- Tension the centring pin until the parts are perfectly centred.



- Position the pressure plate on the flywheel; align dowels and bolt holes where necessary.
- Insert three studs through the mounting holes of the clutch pressure plate at a distance of 120° from one another and fix them in the threads of the flywheel.

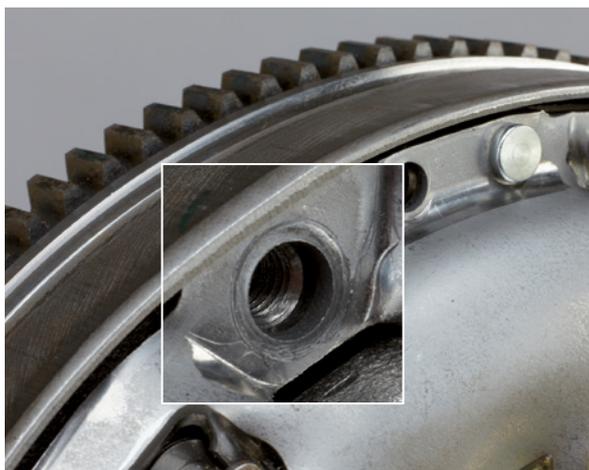
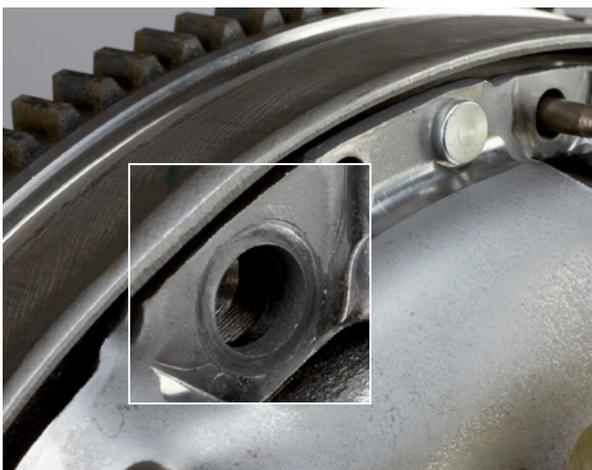
5.1 Sample installation – spindle carrier with 3-hole pitch



- Position the pressure piece with spindle carrier on the centring pin and studs.
- Screw knurled nuts on studs until they fit snugly as shown in the picture; check with your finger.
- Turn the spindle of the pressure piece clockwise to move the pressure plate towards the flywheel.

Caution:

Stop rotating when the pressure plate housing rests against the flywheel. Check through the mounting hole!



- Insert and tighten three fastening bolts of the clutch pressure plate.
- Turn the spindle of the pressure piece anticlockwise to relieve the diaphragm spring.

5.1 Sample installation – spindle carrier with 3-hole pitch



- When the diaphragm spring is completely relieved, remove the knurled nuts and pressure piece.



- Remove studs.
- Insert the remaining three fastening screws of the clutch pressure plate.
- Tighten them down to the specified torque.
- Slacken the knurled nut on the pin's tip to relieve and remove the centring pin.

To remove the SAC using the special tool follow the above procedure in reverse order – see chapter 6.

5.2 Sample installation – spindle carrier with 4-hole pitch



Adhere to the following procedure to install this type of SAC correctly:

- Assemble the centring pin according to the specific model – see chapter 4.1.
- Insert the centring pin into the hub profile of the clutch disc.
- Pre-tension the centring pin using the knurled nut on the pin's tip.
- Insert the pin and clutch disc into the pilot bearing or crankshaft bore.
- Tension the centring pin until the parts are perfectly centred.



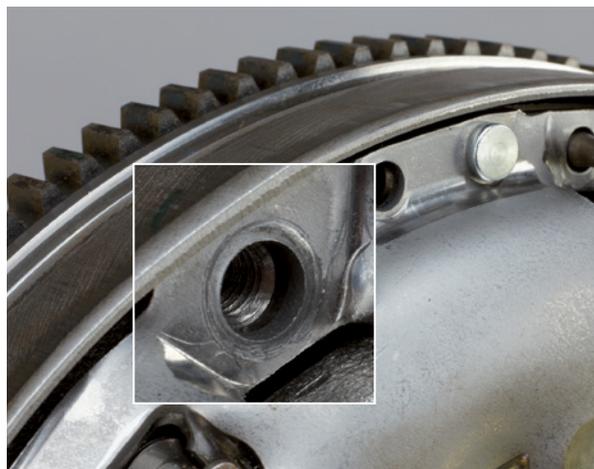
- Position the pressure plate on the flywheel; align dowels and bolt holes where necessary.
- Insert four studs at a distance of 90° from one another into the mounting holes of the clutch pressure plate and fix in the threads of the flywheel.



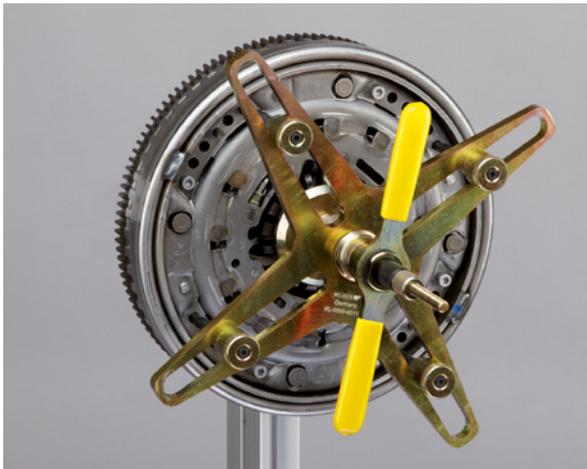
- Position the pressure piece with spindle carrier on the centring pin and studs.
- Screw knurled nuts on studs until they fit flush as shown in the picture; check with your finger.
- Turn the spindle of the pressure piece clockwise to move the pressure plate towards the flywheel.

Caution:

Stop rotating when the pressure plate housing rests against the flywheel. Check through the mounting holes!



5.2 Sample installation – spindle carrier with 4-hole pitch



- Position and tighten four fastening bolts of the clutch pressure plate slightly.
- Turn the spindle of the pressure piece anticlockwise to relieve the diaphragm spring.



- When the diaphragm spring is completely relieved, remove the knurled nuts and pressure piece.
- Remove the studs.



- Insert the remaining four fastening screws of the clutch pressure plate.
- Tighten them down to the specified torque.
- Slacken the knurled nut on the pin's tip to relieve and remove the centring pin.

To remove the SAC using the special tool follow the above procedure in reverse order – see chapter 6.

5.3 Installation instructions for BMW models



Clutch pressure plates on some BMW models are equipped with a locking device which makes the use of a conventional centring pin impossible. This is why a special pin design or centring sleeve is required.

Caution:

Risk of injury! Do not remove the locking device unless clutch pressure plate, clutch disc and flywheel are securely bolted to one another.

5.3.1 Designs with pilot bearing support in the crankshaft



Adhere to the following procedure to install this type of SAC correctly:



- Assemble the centring pin according to the hub diameter of the clutch disc and the pilot bearing.
- Insert the centring pin (without screw) through the hub profile of the clutch disc and the pilot bearing; the centring pin fits flush in the hub profile.

5.3.1 Designs with pilot bearing support in the crankshaft



- Position the pressure plate on the flywheel; align dowels and bolt holes where necessary.
- Insert all fastening screws of the clutch pressure plate and tighten them down to the specified torque.



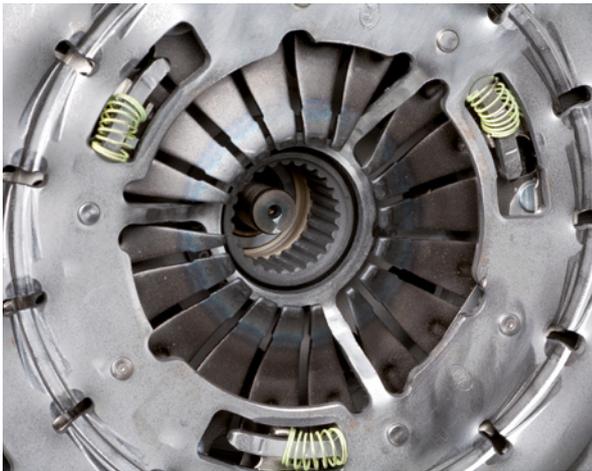
- Unscrew the locking device using an appropriate tool.
- Remove the locking device, it is no longer needed.



- Remove the centring pin using the appropriate screw.

To uninstall the SAC use the special tool according to the procedure detailed in chapter 6.

5.3.2 Designs with pilot bearing in the primary shaft



Adhere to the following procedure to install this type of SAC correctly:



- Screw bolt into the centring sleeve.
- Position the centring sleeve on the flywheel.
- Position clutch disc on the centring sleeve.

Note:

It is important to position the centring sleeve so that the threaded hole is on the gearbox side. Failure to do so will make it impossible to remove the sleeve with the corresponding screw after the SAC has been installed.



- Unscrew the bolt.

5.3.2 Designs with pilot bearing in the primary shaft



- Position the pressure plate on the flywheel and align dowels and bolt holes.
- Insert all fastening screws of the clutch pressure plate and tighten them down to the specified torque.



- Unscrew the locking device using an appropriate tool.
- Remove the locking device, it is no longer needed.



- Remove the centring sleeve using the screw.

To uninstall the SAC use the special tool according to the procedure detailed in chapter 6.

5.4 Installation instructions for Audi, Seat, Skoda and VW models



Clutch pressure plates for these models can be equipped with a locking device. The clutch disc is centred by means of the universal centring pin.

Caution:

Risk of injury! Do not remove the locking device unless clutch pressure plate, clutch disc and flywheel are securely bolted to one another.



Adhere to the following procedure to install this type of SAC correctly:

- Assemble the centring pin according to the required model – see chapter 4.1.
- Insert the centring pin into the hub profile of the clutch disc.
- Pre-tension the centring pin using the knurled nut on the pin's tip.
- Insert the pin and clutch disc into the pilot bearing or crankshaft bore.
- Tension the centring pin until the parts are perfectly centred.



- Position the pressure plate on the flywheel; align dowels and bolt holes where necessary.
- Insert all fastening screws of the clutch pressure plate and tighten them down to the specified torque.

5.4 Installation instructions for Audi, Seat, Skoda and VW models



- Unscrew the locking device using the face spanner.
- Remove the locking device, it is no longer needed.



- Slacken the knurled nut on the pin's tip to relieve and remove the centring pin.

To uninstall the SAC use the special tool according to the procedure detailed in chapter 6.

6 Uninstalling the SAC



If a certain repair procedure requires the SAC to be uninstalled and then re-installed, it is essential to use a special tool as this is the only means to ensure full operational reliability of the part after re-installation.

The following describes how to uninstall the SAC using the example of a spindle carrier with 3-hole pitch:

Note:

The use of the universal centring pin is essential. It prevents the clutch disc from falling when removing the pressure plate.



- Remove three fastening screws from the clutch pressure plate.
- Screw in three studs.
- Assemble the centring pin according to the required model – see chapter 4.1.
- Insert centring pin into the disc's hub profile and position it in the pilot bearing or crankshaft bore.
- Tension the centring pin using the knurled nut on the pin's tip.



- Position the pressure piece with the spindle carrier on the centring pin and studs.
- Screw knurled nuts on studs until they fit flush. Check with your finger as shown in the picture.



- Turn the spindle of the pressure piece clockwise to tension the diaphragm spring until it is visibly moved from the pressure plate.
- Check lift by rotating the centring pin and clutch disc. This ensures the adjusting ring is held in position and the SAC's current wear condition is maintained during re-installation.
- Remove the remaining three fastening screws from the clutch pressure plate.
- Turn the spindle of the pressure piece anticlockwise to relieve the diaphragm spring.



- When the diaphragm spring is completely relieved, remove the knurled nuts and the pressure piece.
- Unscrew the studs and remove the clutch pressure plate.



- Remove the centring pin along with the clutch disc.

7 A short guide to Schaeffler's product catalogs

MERCEDES-BENZ

MERCEDES-BENZ		MERCEDES-BENZ		MERCEDES-BENZ	
A-KLASSE/CLASS (W169)					
A 160 CDI OM 640.942; (60kW)	09.04-	PRO SAC ①	→J 535326; G5	620 2520 33	54 57
		SAC	→J 427274; G6	623 3215 34	54 57
		SAC	J 427275→; G6	623 3216 33	54 57
		②	→30406082; →09.07 excl. <small>...</small>	415 0294 10	

Whether or not a clutch kit contains an SAC can be seen from the 'Information for using items' column in the Schaeffler catalog media on passenger car and light truck clutches. ①

In addition, the "Number of pages for the special tool/ parts list" column includes a reference to the page where the SAC special tool item number is described. ②

						
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