SWAG



Best Fit
With SWAG Timing Chain Kits

BEST CHOICE
FOR SPARE PARTS

www.swag.de



SWAG – Trust in Quality
The Brand You Can Rely On

Trust is not given. Trust must be earned through the highest quality, an impressive range of products, continuous precision, and reliable service.

For more than 60 years, customers have trusted SWAG as a reliable, durable, and precise Aftermarket specialist. SWAG is a strong brand you can rely on. Anytime, anywhere.

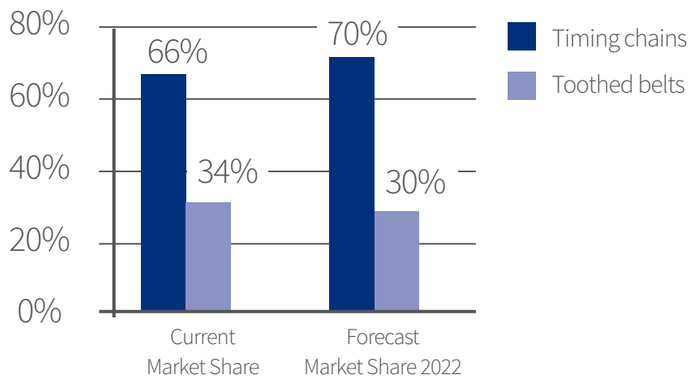
SWAG is one of the world‘s leading partners in the Independent Aftermarket. The brand is internationally renowned for providing more than 25,000 vehicle parts in OE matching quality covering all German and other European passenger cars. The constant availability and short delivery times ensure optimal planning and safety for customers.

Partners throughout the world rely on SWAG products arriving at the workshop at the required time with the added confidence of a fit-the-first-time installation. Moreover, SWAG is certified according to the quality management system DIN EN ISO 9001:2015.

Timing Chain Development

Modern engines, in particular direct-injection gasoline and turbo charged diesel engines, require the least resistance and the highest strength from moving parts. Timing chains are specially designed to cope with the parameters required by modern engine designers.

Certain manufacturers, such as BMW and Mercedes-Benz, are traditionally loyal to the chain drive while various other car manufacturers also rely on the timing chain. Above all, car manufacturers still prefer timing chains for high-performance engines and are increasingly designing and equipping smaller engines with timing chains.



Reasons for this include:

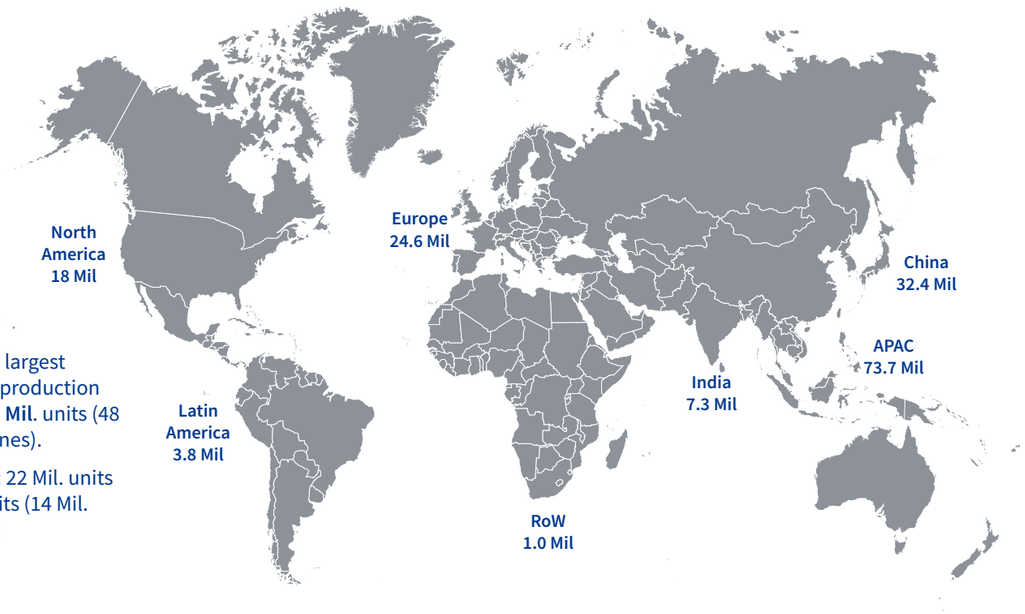
- Less space, more power
- Fuel saving (reduction of CO_2 emissions)
- Smaller assembly space (downsizing)
- Pedestrian protection by lower construction of the vehicle front
- Greater reliability

66% of all new car registrations have an engine fitted with a timing chain. There is a forecast market share of **70%** by 2022.

Development of diesel engines with timing chain drive:
Currently: **40%**
2020: **47%**

Development of gasoline engines with timing chain drive:
Currently: **73%**
2020: **77%**

Source: IWIS



Asia will have the largest growth in engine production by 2022 with **59.5 Mil.** units (48 Mil. gasoline engines).

Europe currently: 22 Mil. units 2022: 24.6 Mil. units (14 Mil. gasoline engines)



Advantages

- Replace with longer service life
- Maintenance-free
- When the timing chain is stretched/elongated, that does not necessarily mean engine damage (adjustment of the control times)
- More compact design possible
- Higher force transmission and bridging of large distances between components
- High efficiency (up to 98%)
- Higher costs of chain drives during engine production are paid for over the entire car life due to wear resistance and lower service costs

Legal Changes

- Spacing between bonnet and motor is maximized resulting in greater protection
- Positioning of the components changes. For example, the timing chain drive is positioned on the gearbox side with engines mounted longitudinally
- “Softer” materials in the front area

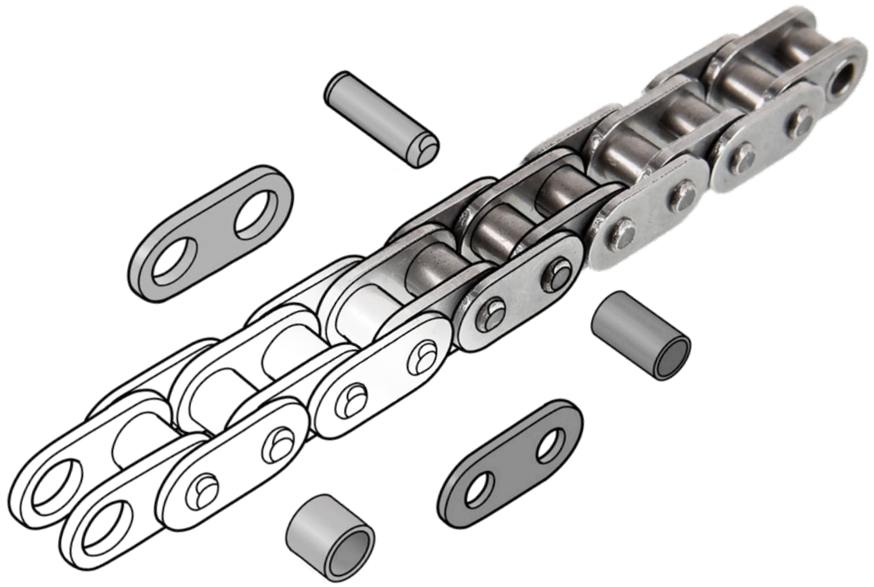
Considerations for Workshops

- The number of vehicles fitted with timing chains is increasing
- Demand for training and education rise
- More frequent use of special tools
- Potential for increased timing chain repairs
- Installation and removal of engine and transmission components is changing
- Replacement of the engine/timing chain becomes more complicated
- Repairs become more complex

Timing Chains with Strength, Flexibility, and Reliability

Engine timing chains are made from steel links and are available in different designs to suit each engine‘s requirements and load. The most commonly used designs are sleeve, roller, and tooth chains which are also known as silent chains.

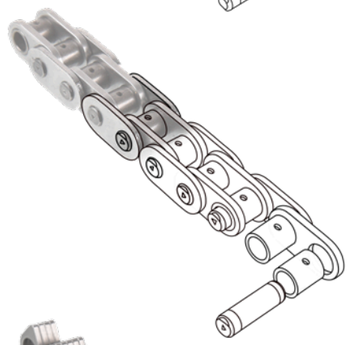
Each chain is made from high-grade, heat-treated steel, for accurate tolerance and surface quality. It is manufactured with the same precision giving a constant geometry and high surface quality.





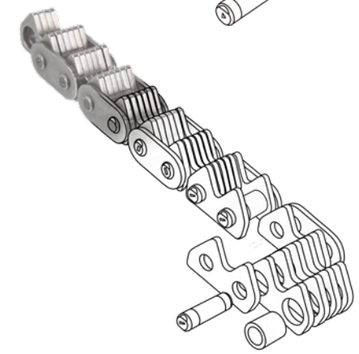
Roller Chain

The roller chain is the most popular chain used and offers an ideal combination of strength and NVH performance. The inner link of a roller chain consists of two inner lobes, two sleeves pressed into the link eyes, and two rollers rotating above the sleeves.



Bush Chain

With the bush chain, the two rollers are dispensed so the sleeves are correspondingly enlarged in diameter and are directly engaged with the sprocket. Sleeve chains have a larger joint surface than corresponding roller chains. SWAG bush chains provide excellent strength and wear performance in high load conditions and are mainly used in fast running diesel engines.



Toothed Chain

The special design of this steel link chain is the toothed chain – also known as a silent chain. The middle and inner lugs are formed to provide exceptional transmission force between the chain and sprocket. SWAG toothed chains offer excellent NVH performance with enhanced durability characteristics.

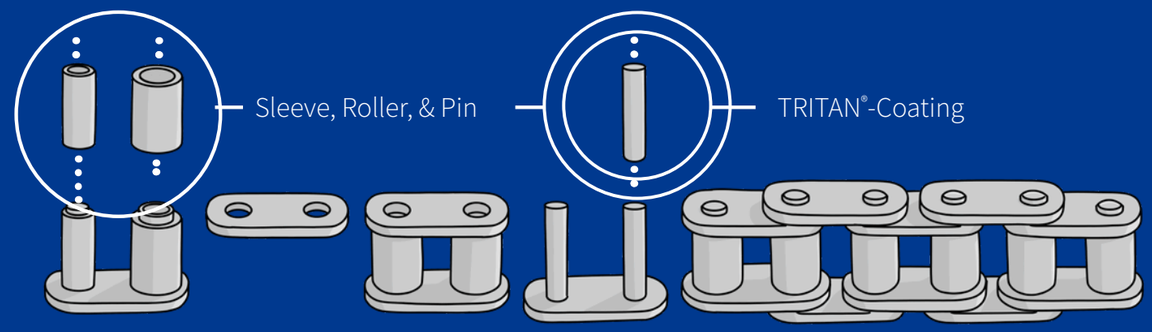
TRITAN®-Coating is the Solution!

Damage can occur and the timing chain may need to be exchanged early for highly-stressed engines. The most common causes include an elongation of the chain as well as wear on the joints. The use of a newer type of chain is not always practical due to the design of the engine.

TRITAN®-Coating is an initiative process developed to coat chain bolts. At its core, Physical Vapour Deposition technology (PVD) produces a coating on the chain bolt which counteracts the wear caused by aggressive oil-carbon fuel mixtures within the engine. Thus, by comparison, significantly reduces the wear-induced elongation of the timing chain through the reduction of friction.

Advantages of the TRITAN®-Coating

- Wear reduction of at least 50% compared to conventional coating methods
- Approximately 20% less friction helps to reduce emissions



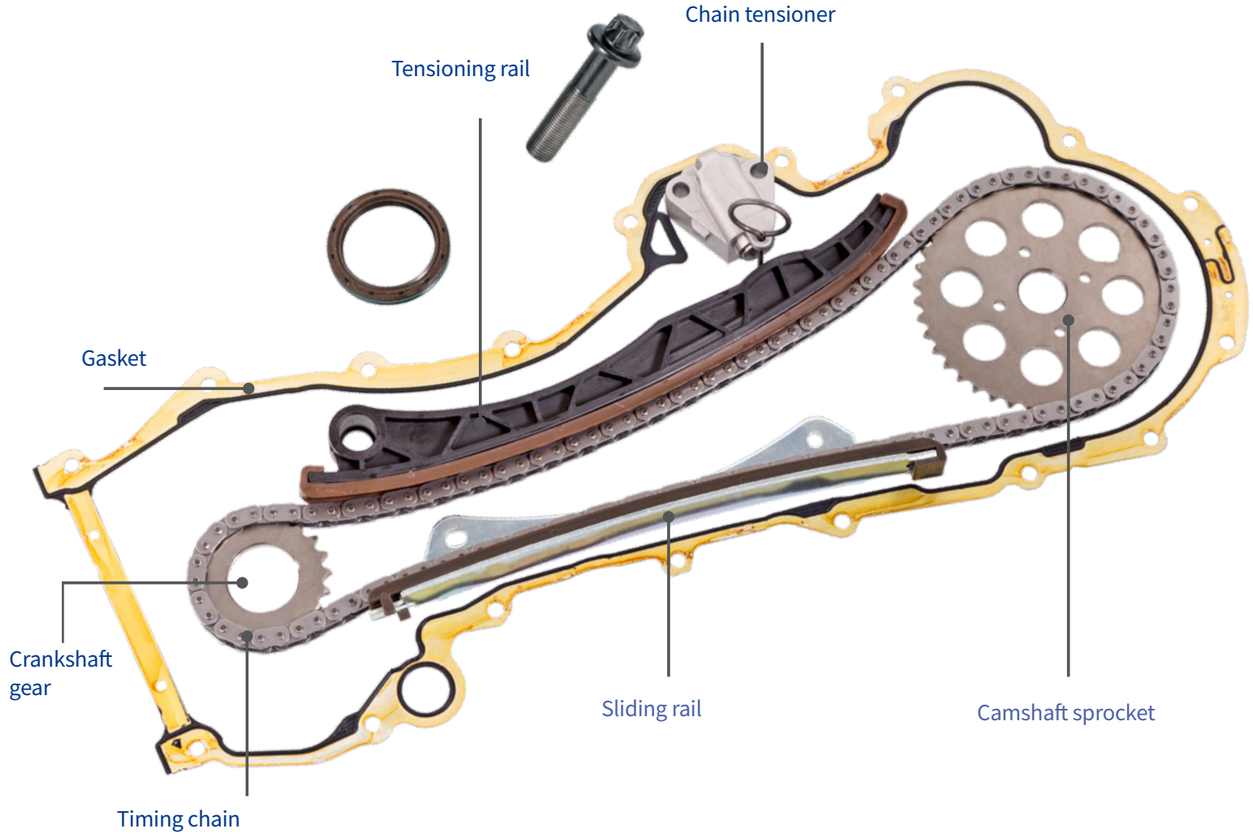
Timing is Everything

The precison of a four stoke, internal combustion engine relies on the perfect synchronisation of internal components. This includes the crankshaft, camshaft, balancer shafts, and any other accessory drives which control the opening and closing of the intake and exhaust valves and the fuelling of the engine. Each engine design has its own characteristics providing the best solution for driving these vital parts.

The timing chain is made up of a series of steel links which connect to each driven shaft. This meshes positively with each respective sprocket.

The chain runs on rails between the sprockets so vibrations and noises are dampened. The chain elongates over time due to wear. This can be compensated for via a pivoted tensioning rail supported by a tensioner.

In most applications, a hydraulic chain tensioner is used. This tensioner is connected to the engine's oil circuit. It dampens the dynamic torsional vibrations of the shafts in the drive which act upon the chain. It keeps the engine perfectly in tune for optimal, smooth running while also reducing exhaust emissions.



Guiding with Precision

The timing chain slide and tensioner rails serve a vital role for the optimal running of the chain while in operation. Each rail is precisely matched to the respective engine design giving the timing chain drive an optimal service life and enabling it to be smoothly guided to each sprocket.

Tensioning Rails

Tensioning rails are pivoted at one point and are supported against the chain tensioner to provide tension to the chain. They guide the chain and tend to be subjected to greater stress due to the contact pressure of the chain tensioner on the timing chain. Therefore, they must be correspondingly dimensioned and derive from materials with a higher strength than the sliding rail.

In addition, special attention is given to the stressed contact surface of the chain tensioner and the tensioning rail. Tension rails are predominantly used in a curved form so the chain is guided precisely even at the maximum wear tolerance.



Glass fibre reinforced base with plastic tread



Aluminium die-cast base with plastic running surface



Plastic

Sliding Rails

The slide rails are made from many different materials that are to specification. Aluminium, steel, rubber, and plastics are used. There even may be a mixture of these materials. The chain slides over a lining of unreinforced plastic or elastomer rubber and is often guided by the side ribs to each respective sprocket.

Sliding rails can be straight or curved depending on the chain track required and are typically fixed in their position at no less than two points. To reduce the risk of the chain moving from side vibrations, the slide rails lateral guide surfaces are inserted with plastic or rubber. This is utilized as a means of guiding the chain between the sides so they enclose the chain in a ''U'' shaped profile.



Glass fibre reinforced base with plastic tread



Steel sheet base with plastic running surface



Plastic

Under Tension for Accuracy

The chain tensioner's function is to keep the chain drive under tension in all operating conditions. It must compensate for chain wear and must re-tension the chain drive accordingly to allow for the elongation of the timing chain during engine operation. This is to maintain an accurate synchronisation of all rotating components being driven by the chain drive.

Hydraulically Damped Chain Tensioner

Hydraulic chain tensioners are used in chain drives. They optimally adjust the hydraulic chain tensioner and dampen the dynamic chain forces in the chain drive. The positioning deviations of the shafts in relation to each other are reduced in order to provide optimal combustion.



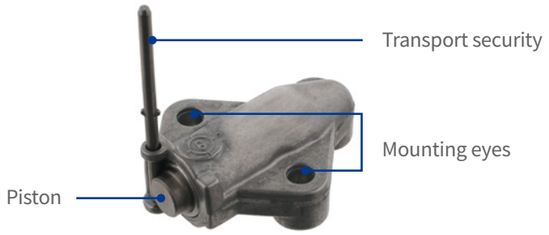
Tensioner for V-engines



Thread chain tensioners



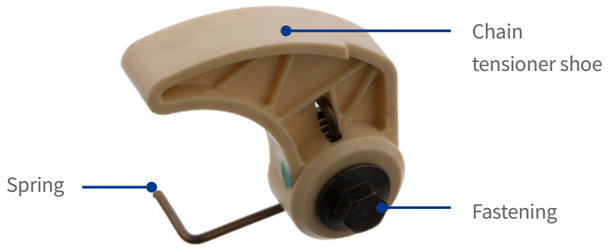
Tensioner for a camshaft coupling drive



Flange chain tensioner

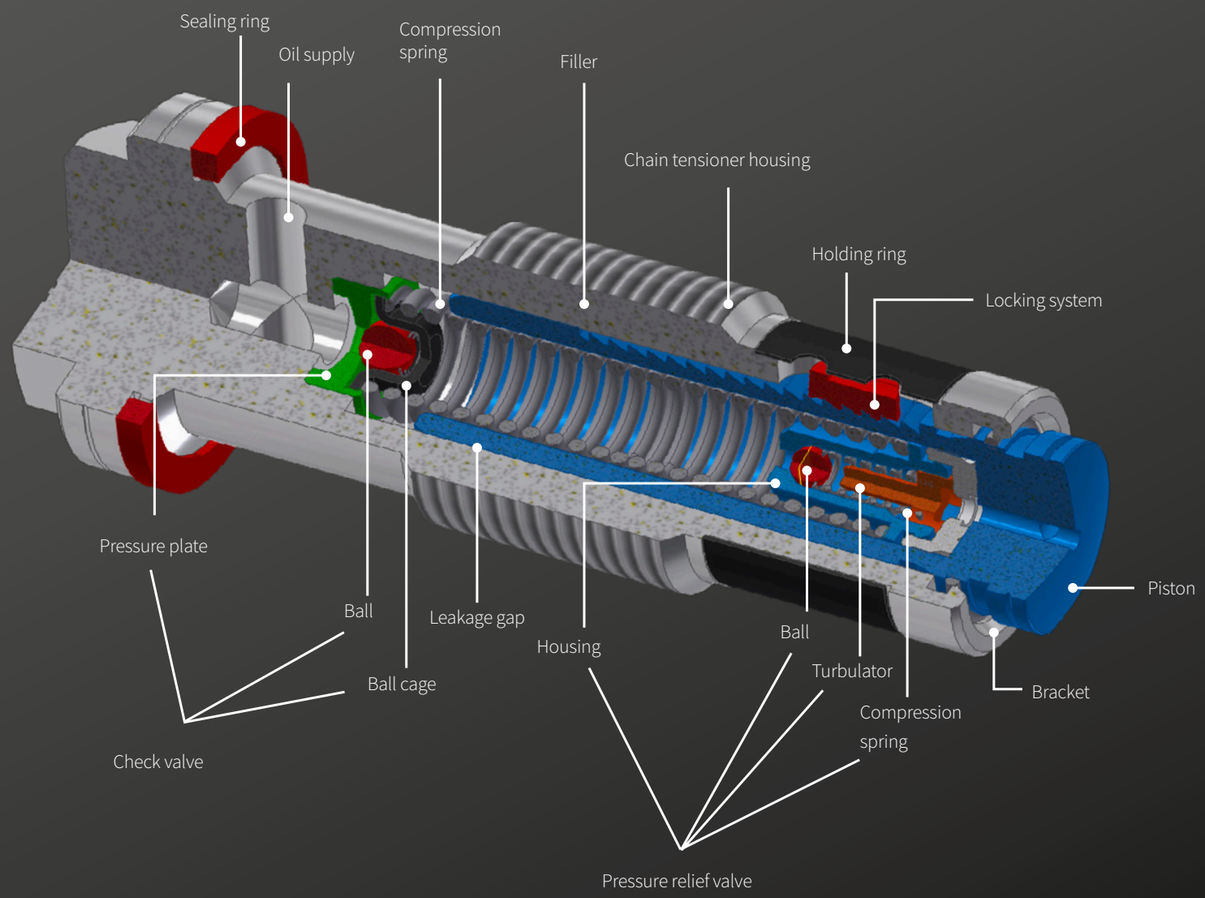
Mechanical Chain Tensioner

This tensioner design is of a rotary or linear type. The tensioning shoe is only supported by a spring which gives a very low damping force. These tensioners are used in less stressed oil or water pump drives which do not produce the same dynamic stresses as a timing chain drive.



All tensioners are designed to each individual engine. As a result, tensioners cannot simply be replaced by tensioners featuring a similar or identical external design.

Structure of a Hydraulic Chain Tensioner with Non-Return Valve



- A check valve regulates the amount of oil which is fed to the chain tensioner
- The gap between the piston and the housing is called a leakage gap
- In the high-pressure chamber is a pressure spring where the necessary pre-tension is generated
- Filling element reduces the free space in the chain tensioner and minimises its reaction at the same time
- An additional pressure relief valve can be used to further reduce the load on the chain
- The pressure of the piston ultimately stresses the timing chain via a guide rail and thereby dampens and reduces the chain forces dynamically occurring in the chain drive
- Since air can be compressed easily thereby impairing the damping properties, it must be ensured that there is no air in the tensioner
- A variety of chain tensioners are provided with a locking system to limit the return stroke of the piston

Sprockets Pitched for Perfect Rotation



Sprocket in disc shape (Camshaft)



Sprocket with rubber coating (Camshaft)



Sprocket with single-sided hub (Crankshaft)



Double row sprocket (Crankshaft)

Timing chain sprockets connect the driven shafts with the chain to transfer the generated forces of the engine. There are many different designs of the sprocket. They can come in a simple disc form or they can be equipped with a single sided or a double sided hub.

The material used for each sprocket depends on each engine and the specific power output requirements. These sprockets are usually made from a sintered metal or they can be fine blanked. They can also be fully machined which saves on weight. This reduces the impact of the chain link on the tooth base of the sprocket. Sprockets can have a rubber coating or padded rings. This is intended to decrease weight and friction which, in turn, is meant to reduce vehicle emissions, noise, vibrations, and harshness characteristics.

Sprockets are attached by a securing bolt or a tapered fit. Many have grooves, or similar, to fit a key way to guide the alignment during installation. This is for an accurate fit. Sprockets also often have markers adjacent to the teeth for accurately timing the engine. They are often embossed or have coloured markers.

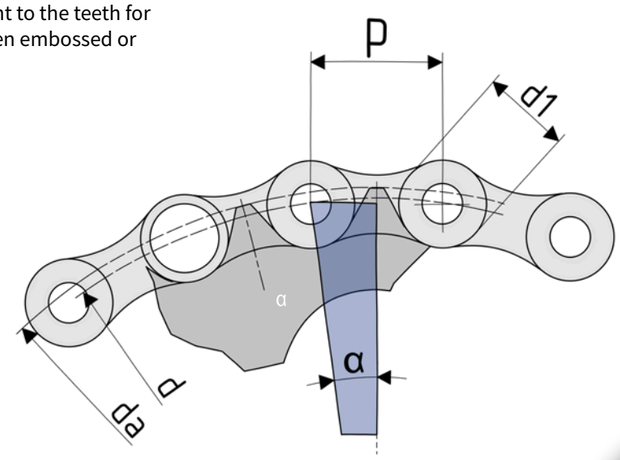
Each sprocket tooth pitch is determined by its application. The tooth form of the sprocket for roller, sleeve, and tooth chains are machined to tolerances according to the standardised DIN 8196. The design of the tooth form used for this purpose is important for the safe operation of a chain drive and gives good fatigue strength.

Sprockets often have a maximum tooth gap shape (low tooth head height / large tooth gap opening). This is for the smooth running of the chain as it enters and exits the sprocket which is particularly important for high engine speeds.

- Sprockets with at least 19 teeth are ideally used for petrol engines
- Diesel engines run at lower engine speeds compared to petrol engines. Sprockets with only 18 teeth can be used (when using chains with 3/8“pitch)

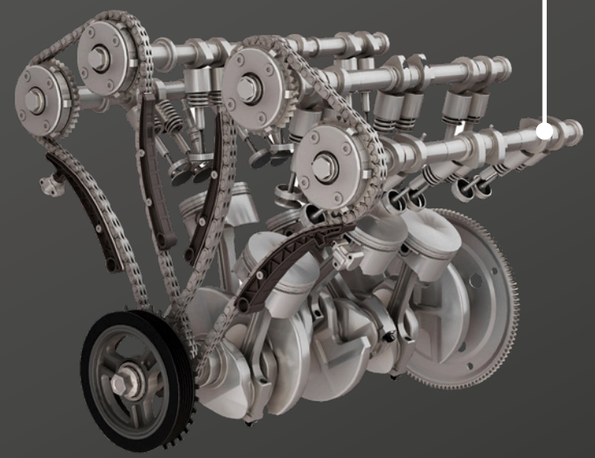
Relevant dimensions for calculating the tooth gap shape:

- α: P/2 (for calculating the tooth pitch)
- d1: Roll diameter max.
- d: Diameter of pitch circle
- da: Tip diameter
- p: Tooth pitch

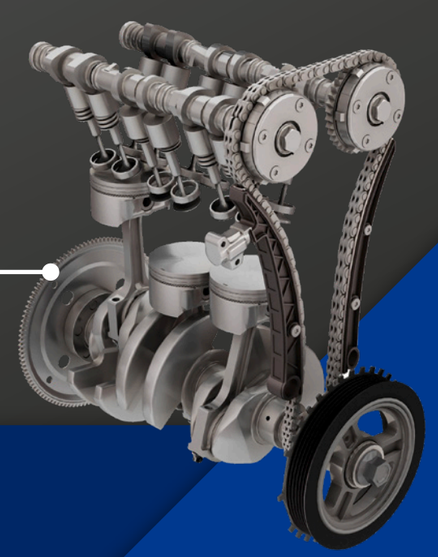


Modules and Systems

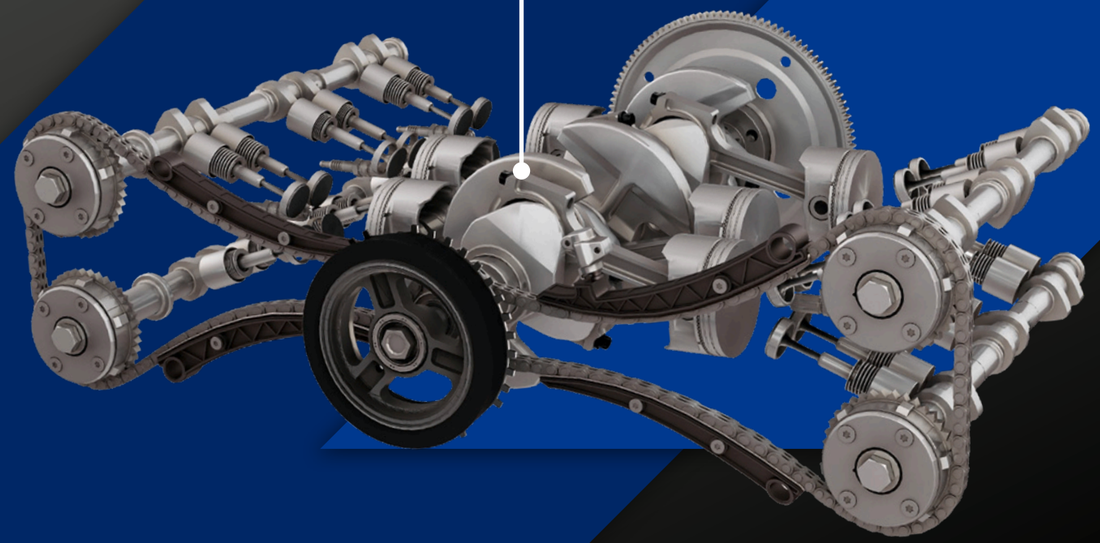
V6 cylinder engine



3-cylinder in-line engine



6-cylinder boxer engine



Failure and Wear Causes

In principle, timing chains are almost maintenance-free if properly lubricated. Nevertheless, the question arises of how and when causes of failure occur and when wear-and-tear occurs. Additionally, the question also arises of how possible indicators can be identified.

Inappropriate Engine Oil

- Incorrect viscosity/oil too thick: oil does not reach all lubrication points fast enough, especially during a cold start; chain tensioner does not build up pressure quickly enough
- Incorrect viscosity/oil too thin: the chain tensioner may not build up the necessary pressure
- Wrong oil: oils have different approvals and different exchange intervals - always use an oil which adheres to manufacturer‘s specifications

Vehicle-Specific Design

» Small displacement
» High performance engines
» High rotational speeds to bring performance (high crankshaft dynamics)
» Stop-start operation
» Rotational irregularity
» Gasoline: Increased torque peaks due to higher injection and/or injection pressure requirements
» Diesel: Higher camshaft drive torque by technologies such as variable camshaft timing and high pressure fuel pump drive

Damage Examples

Elongation of the chain drive can occur in many parts of the system:



Chain - wear occurs mainly on the pins and in the bushes.



Guide rails - become worn as other components wear, cutting grooves into the guiding surface.



Sprockets - contact area with the chain, wear on the sprocket teeth.

- Oil change intervals not observed
- Improper engine oil
- Mix of different engine oils
- Too much condensed water - short trips
- Too high of a fuel ratio in oil - short trips
- Excessive soot in the oil
- Elongation of the chain and wear of the joints
- Oil coking
- Oil pressure not correct
- Not all components in the chain drive replaced
- Aftermarket products that do not meet OE quality requirements

Maintenance and Service Neglect

Service Intervals:

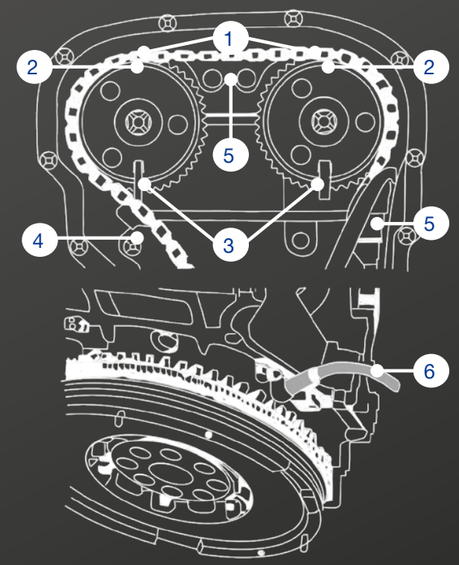
- If engine oil is not changed regularly, the oil becomes saturated with suspended particles/coking
- Unburned hydrocarbons/unburned carbon can cause the chain tensioners and the camshaft adjusters to stop working properly (the smallest drill holes get blocked, meaning pressure/stress build-up is no longer possible)
- Good lubrication is indispensable for a long service life of the timing chain

Abrasive Wear:

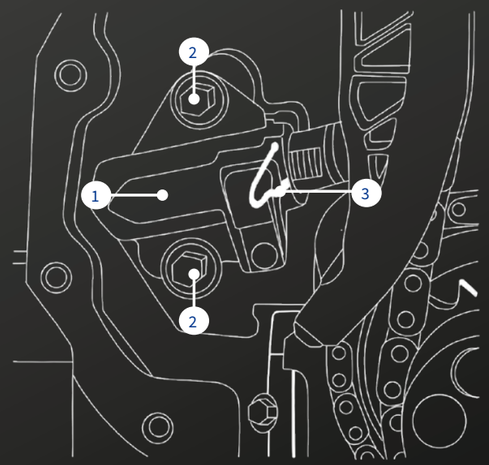
- The main cause of wear describes the detachment of single, very small particles (abrasion) which adversely affect the chain run (loss of material due to the mechanical action of one friction part on the other)

Indicators for a Timing Chain Change:

- Chain noise, e.g. rattling
- Misalignment of the control timing or loss of power of the engine (elongation of the chain)
- Chain tensioner is fully extended (only visible when dismantling)
- Engine is already dismantled and a replacement would be possible with little effort (avoiding consequential damage and repairs)



1 chain link
2 marking(s) – camshaft sprockets
3 locking pin(s) – cam roller(s)
4 tensioning rail
5 guide rail
6 locking pin(s) – flywheel



Defective System Parts:

When changing the timing chain, it is strongly recommended to change the described system parts or components to prevent consequential damage. Only the exchange of all components of the timing chain kit contributes to a long service life. Chains and slide rails are available separately.

Not only does the right oil with the correct viscosity and approval contribute to a long service life, but also the driving behaviour has a significant influence.

1 chain tensioner
2 screw(s) – chain tensioner
3 blocking pin(s) – chain tensioner

Quality Testing

In the Independent Aftermarket, there are different suppliers of timing chain kits. The quality difference is sometimes significant. Timing chain kits from SWAG are manufactured according to the specifications and standards of the original equipment manufacturer in order to guarantee a perfect fit and a long service life. A test which reflects real-world aspects shows the deficient product quality of a leading competitor.

OE Matching Quality:

- 100% check of all timing chains and system parts
- Partnerships with OE suppliers
- Timing chains from the OE manufacturer
- Timing chains with TRITAN®-Coating

Production Expertise:

- Own production at bilstein group Engineering of important system components, such as chain tensioners
- Technical training for workshops

SWAG has developed a test bench for chain tensioners in cooperation with one of the largest German manufacturers of hydraulic systems. Conditions simulated using this multi-station test stand are present in operating engines so the chain tensioner is exposed to realistic stresses. All hydraulic SWAG chain tensioners are subjected to a complete check on this test stand. The advantage is that there is even more safety in this very sensitive engine area.

Quality Assurance:

- Pinch, roll, tension, and pressure checks through slug tests to test chain strength
- Trust in a 3 Year Manufacturer Guarantee for all timing chain kits (when using the engine oil prescribed by the manufacturer and observing change intervals specified by the manufacturer)

The chains are checked for dimensional accuracy including length tolerance, freedom of articulation, and the assembly component integrity. Inspection of the press-in seating of the pin outer links and bush-inner link interfaces is conducted. The chains conform to the requirements of the automotive industry - ISO 9002- 1987 – and other national and international standards.



(when using the engine oil prescribed by the manufacturer and observing change intervals specified by the manufacturer)



All the Advantages at a Glance

- All components from a single source – naturally, in the proven quality of SWAG
- Selected timing chains from SWAG have the patented TRITAN®-Coating
- Original chain tensioner produced by SWAG
- Very high market coverage for all popular vehicle brands
- Continued growth of the product range
- Repair kits with all relevant system components
- Consistent customer satisfaction at the sales and customer level

We Have the Right Products for You:

- Timing chains
- Tensioning and sliding rails
- Hydraulic and mechanical chain tensioners
- Sprockets
- Seals
- Timing chain kits ready for installation

Solutions for Everyday Challenges

SWAG PROTIPS offer practical support with everyday issues encountered in the workshop and, when possible, follow the explanation structure of Problem, Cause, Solution.

Follow the Trend:

- More than half of all motor vehicles are now equipped with a chain drive
- Trust the high-quality timing chain kits in OE matching quality from our wide product range
- Avoid costly, subsequent damage and ensure higher satisfaction for your customers

Find further product related information at:
partsfinder.bilsteingroup.com





Scan the QR code to watch the SWAG video about Timing Chain replacement

One Box – All You Need

SWAG offers over 230 timing chain kits and a comprehensive range of sliding rails, chain tensioners, and sprockets.

With one of the largest coverages for European passenger car applications, SWAG is the Best Choice for Timing Chain Kits.

The product line is extended annually by an average of more than 30 current timing chain models. All SWAG timing chain kits are rigorously tested to meet or exceed exact OE standards. They are manufactured in high-quality to maximise safety and longevity.

Benefit from our market monitoring and get to know the trends of tomorrow. We offer not only a wide assortment, but also the know-how which gives us the credibility to explain the causes of wear and give relevant tips. Explore our range of technical training courses and get your workshop into shape.

Trust in your Best Choice for Timing Chain Kits to get the complete solution for the right vehicle and a timely, cost effective professional repair all in one box.



Product Range

Some examples of the vast variety of SWAG Timing Chain Kits



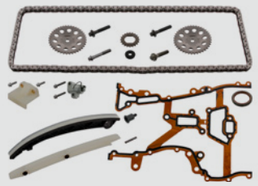
SWAG 38 94 4462
to fit: Porsche (petrol)
Follow the assembly instructions.



SWAG 30 94 0672
to fit: Audi, Seat, Škoda, VW (petrol)
Follow the assembly instructions.



SWAG 30 94 4486
to fit: Audi, VW (TDI V6)
Follow the assembly instructions.



SWAG 99 13 3082
to fit: Opel, Vauxhall (petrol)
Follow the assembly instructions.



SWAG 20 94 7662
to fit: BMW (petrol)
Follow the assembly instructions.



SWAG 70 94 9722
to fit: Alfa Romeo, Chevrolet, Citroën, FIAT, Ford, Lancia, Opel, Peugeot, Suzuki, Vauxhall (diesel)
Follow the assembly instructions.



SWAG 10 94 4975
to fit: Mercedes-Benz (petrol)
Follow the assembly instructions.



SWAG 99 13 0300
to fit: Mercedes-Benz (diesel)
Follow the assembly instructions.



SWAG 99 13 0349
to fit: BMW, Mini (diesel)
Follow the assembly instructions.



SWAG 99 13 0607
to fit: Seat, Škoda, VW (petrol)
Follow the assembly instructions.

youtube.com/SWAG1954

You can find the entire passenger car product range of SWAG under:

partsfinder.bilsteingroup.com

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