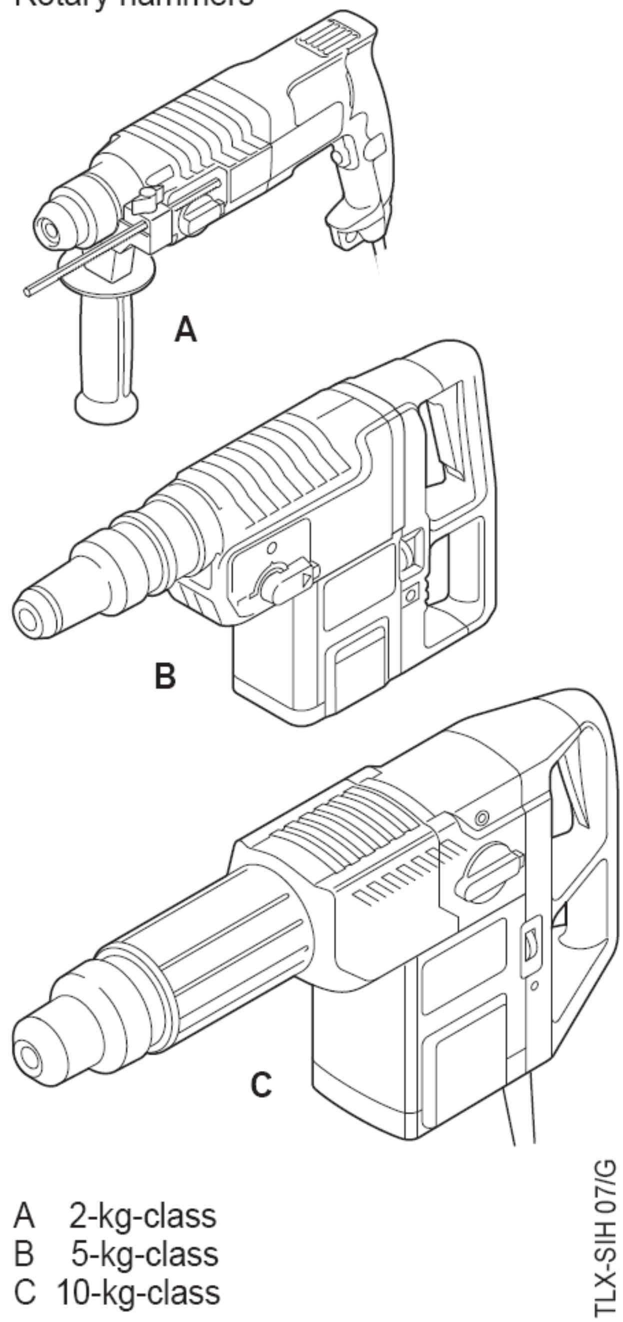
MANUAL MACHINES (POWER TOOLS)

1. Electric hammer

All rotary hammers are generally equipped with safety clutches which limit the maximum torque buildup in case of a blockage. However, the safe response of the clutch requires that the rotary hammer is held and guided with a strong grip. Basically, you should always use the auxiliary handle during rotary hammer drilling and guide the machine with both hands. Drill bits for stone eventually wear out and become slightly conical which increases their tendency for jamming. These worn drill bits have to be replaced in time which also makes sense for economic reasons (work progress decreases strongly). Restricted working positions should be avoided whenever possible. Auxiliary devices such as ladders must be approved for the intended purpose and in faultless condition. Improvised scaffolds and working platforms are to be avoided under any circumstances.

Chipping hammers cannot block and therefore even jammed chisel bits cannot generate any hazards. The main risks involved here are created by dust and splinters produced during chiselling in stone as well as by the sudden penetration of a wall during break-through chiselling. Basically, the recommended protective measures are passive, such as safety goggles, dust masks and hearing protection.

Rotary hammers

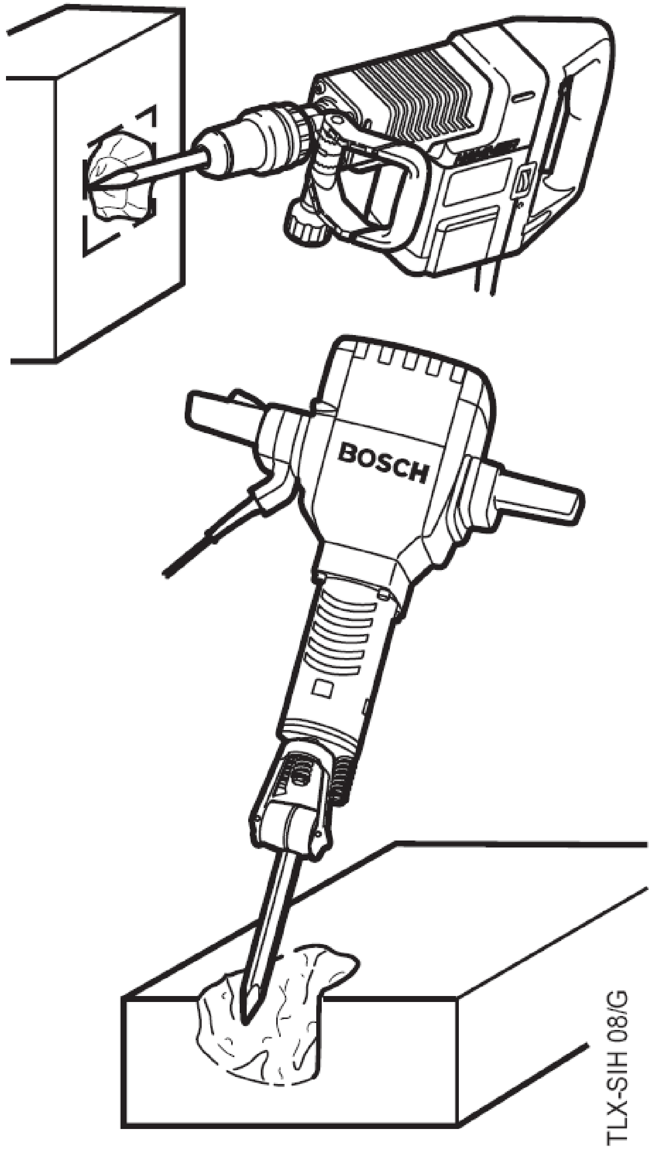


A 2-kg-class
B 5-kg-class
C 10-kg-class

Chipping hammers are guided by both hands at all times and a stable footing is also required.

Rotary hammers operate with rotation and impact. Their force per impact is very high, in contrast their impact rate with an average of 1000 to 3000 blows per minute is very low. Rotary hammers are the more effective, the harder the stone into which the hole is drilled. So-called hammer drill bits are used as application tools.

Chiselling in stone

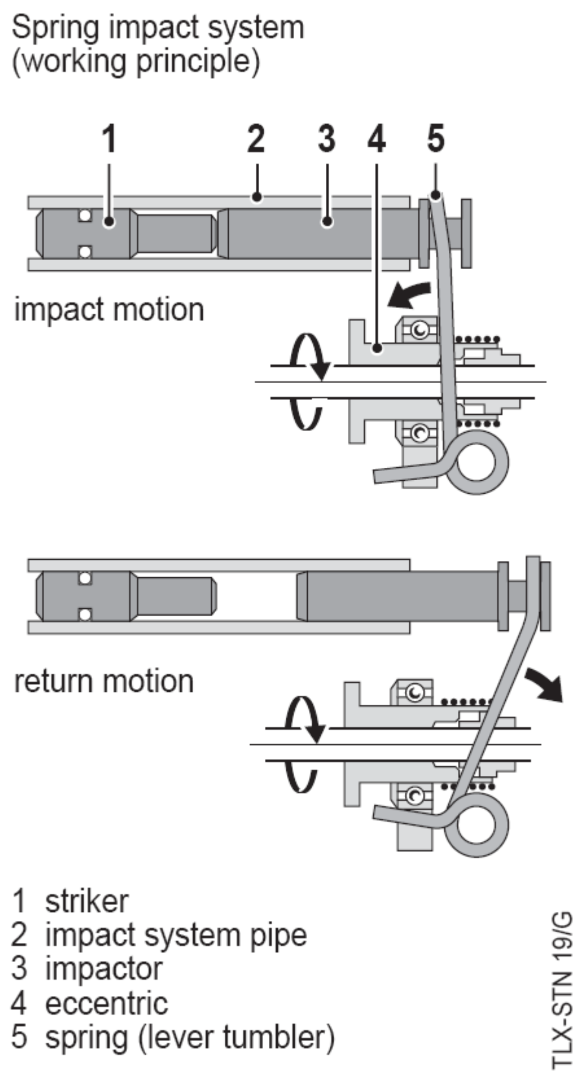


As the latest developments in technology stand, 2 systems have come out on top:

– the electro-mechanical impact system;

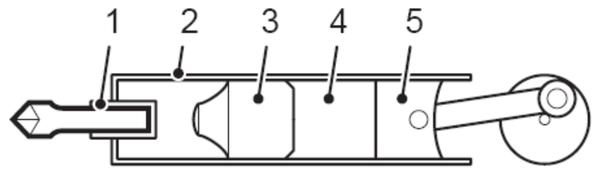
– the electro-pneumatic impact system.

All hammer impact systems have in common that only little feed pressure is required in comparison to impact drills. An eccentric sets a lever spring in oscillating motion. Driven by the lever spring, the impactor transfers the energy through a striker onto the application tool. The recoil energy of the impactor is absorbed by the lever spring and has an amplifying effect during the forward motion of the impactor. The electro-mechanical impact system is simple, robust and its mechanical friction is low. It requires very little intrinsic energy and with optimum construction it has good characteristic properties up to the range of the 2-kg rotary hammer class. It is used in mains-operated light-weight rotary hammers and in rotary hammers for cordless operation.

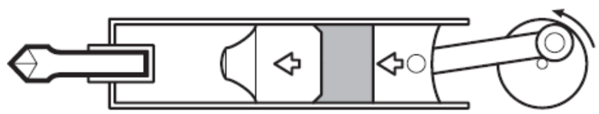


In principle, electro-pneumatic impact systems consist of a drive piston and a flying piston (impactor), which move back and forth in a cylinder pipe. An air cushion between the drive piston and the impactor transfers the motion of the drive piston onto the impactor.

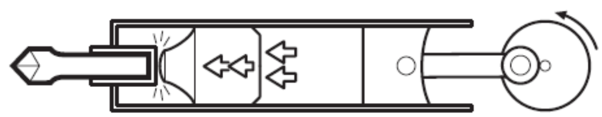
Pneumatic impact system



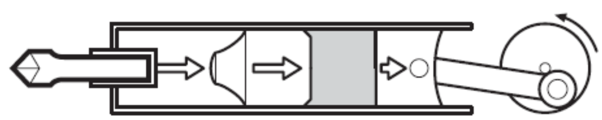
1 striking pin/application tool
2 cylinder pipe
3 flying piston (impactor)
4 air cushion
5 drive piston



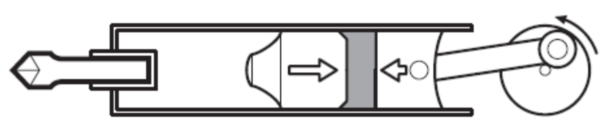
Drive piston compacts air cushion, drives flying piston forward.



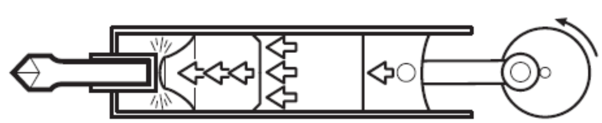
flying piston “flies” freely onto striking pir and transfers impact energy.



Drive piston returns. Flying piston has recoiled off the striking pin and “flies” back.



Drive piston moves forward.
Flying piston is still “flying” back and as a result it increases compression.

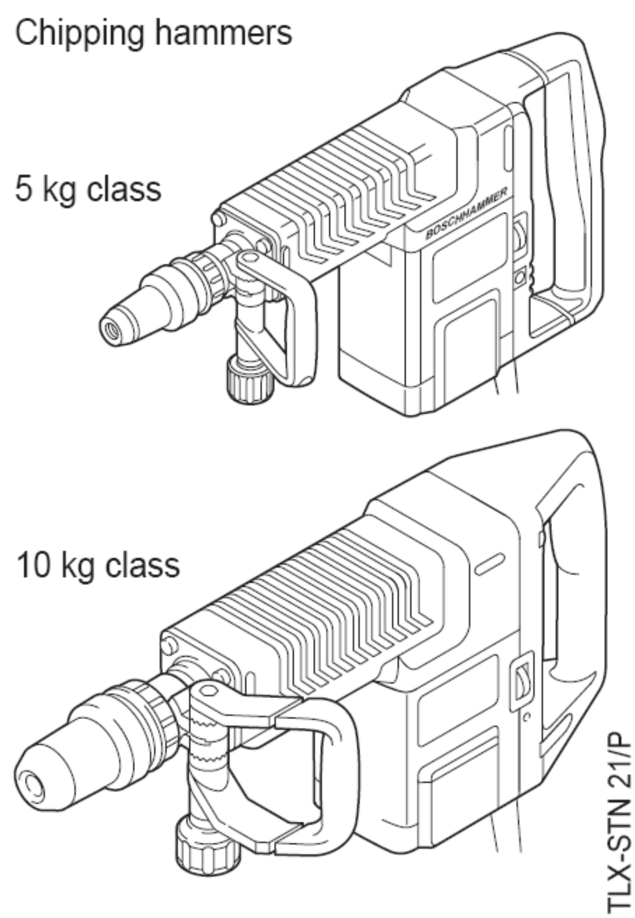


Flying piston has stopped, has reversed its moving direction and the higher compression makes it “fly” with increased speed and higher energy onto the striking pin.

TLX-STN 20/P

The recoil energy of the impactor is absorbed by compression in the air cushion and during the forward stroke of the drive piston it has an amplifying effect on the acceleration of the impactor. The harder the processed material, the higher the stored recoil energy and consequently the impact force. Electro-pneumatic impact systems have come out on top as standard system in the market. Their construction is more elaborate and their intrinsic energy consumption is slightly higher, bu their lower noise emission in comparison to electro-mechanical systems compensates for that. Above the 2-kg hammer class they are mandatory with today's technical possibilities. The reciprocating parts require reliable lubrication and have to be serviced at regular intervals.

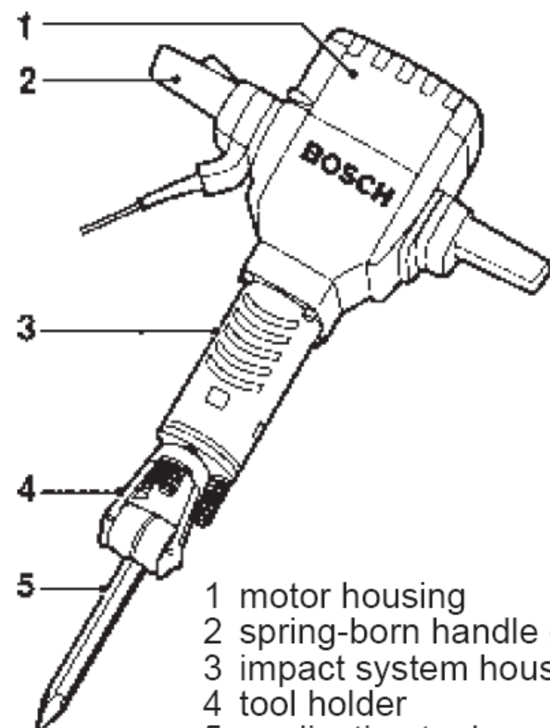
Chipping hammers operate exclusively with impact motion and on account of the lack of rotation their mechanical construction is much simpler. Since there are no energy reserves required for rotational friction, their impact force is in most cases higher in comparison to a rotary hammer of equal output power.



Considering their external dimensions, percussive hammers are a little smaller than comparable rotary hammers and so somewhat more ergonomic. Typical chipping hammers are available approximately to the 11-kg weight class. Their operating positions are vertically downward, horizontal and in the lower weight class also vertically upward, i. e. over head.

Demolition hammers have the same working principle as chipping hammers; however, in contrast to them they are larger, heavier and designed for a downward working position. The machine weights range between 15 and 30 kg. Their main advantage is that they can be connected to the standard mains or to mobile power generators which makes them independent of heavy compressed-air generators and unwieldy high-pressure hoses.

Demolition hammer



1 motor housing
2 spring-born handle grips
3 impact system housing
4 tool holder
5 application tool

In the power tool sector needle descalers are used as attachments driven by rotary hammers. The impact energy is transferred to a bundle of needles guided in a sleeve (usually 19 HSS needles). These needles are designed for surface treatment. Needle descalers are used for small-scale removal of weathered concrete layers, to expose and derust reinforcing iron bars during concrete restoration and also for the descaling and subsequent machining of welding seams.

Go to the outline

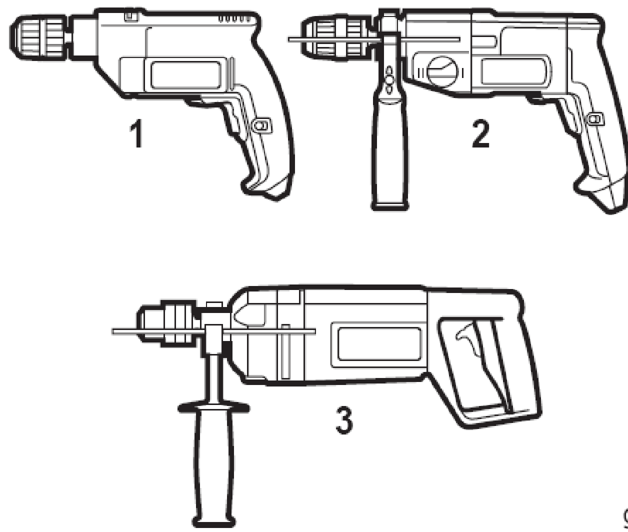
2. Drills. Impact drills

One can choose between single-gear drills and drills with two or more mechanical gears. required or where drilling takes place only in a certain diameter range. Typical diameter ranges are: up to 6.5 mm, 6.5–10 mm, 10–13 mm. The maximum drilling capacity of these machines is specified as 6 mm, 10 mm, or 13 mm. Wherever universal application of the machine is required and where a number of different bits with varying diameters are often used. These are typical diameter ranges: 6/10 mm, 8/13 mm and 10/16 mm. Machine specifications usually include the largest possible drilling diameter and the designation “two-gear”. Historically speaking, drills became popular in times and countries where the Anglo-Saxon imperial measuring system based on inch was common. The current performance categories are derived from this:

- 1/4" = 6,5 mm 3/8" = 10 mm;
- 1/2" = 13 mm 5/8" = 16 mm.

For a 10 mm drill, for example, this means that the motor power, its speed and the required torque are designed for a maximum drilling diameter of 10 mm in steel. In contrast, impact drills have their maximum drill diameter stated for drilling in stone (with additional specifications for steel and wood) , because impact drills are usually selected for drilling in stone. The smaller the diameter of the applied bit, the slower its peripheral speed which means that the work progress is also slower. It takes considerably longer to drill a 6 mm hole with a 10 mm drill than with a 6 mm drill, although the engine power of the 10 mm machine is usually greater than that of the 6 mm machine. The higher the drill diameter, the higher the strain on the machine. If, for example, you use a bit larger than 10 mm in a 10 mm machine, the increased load will reduce the machine speed and the motor will no longer be adequately cooled. If this overload condition lasts for too long, the machine will eventually overheat and “burn out”. The pistol-shape makes the machines more compact and easy to operate. For this reason it has become widely accepted in the drilling ranges up to 13 mm. The lever arm of the pistol grip drill helps to compensate the restoring torque in case of jamming. The use of an auxiliary handle is recommended, it is a must for larger diameters.

Typical drill grips

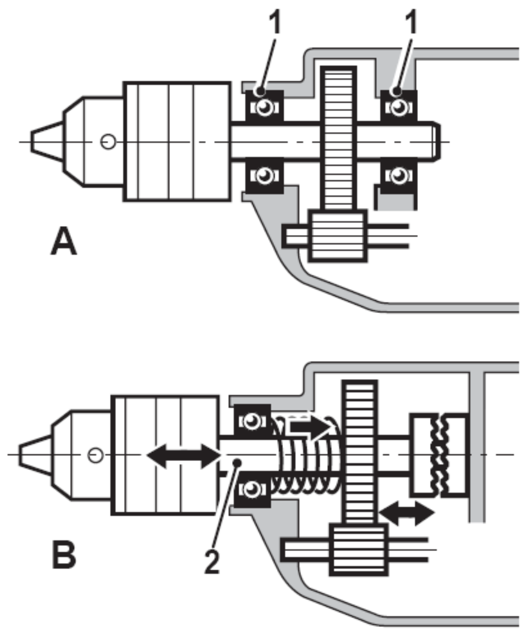


1 pistol-grip
2 pistol-grip with auxiliary handle
3 spade-grip with auxiliary handle

TLX-DRL 23/G

The spade grip allows the application of ergonomically higher feed pressure directly in line with the tool spindle. For this reason it has become widely accepted for drilling ranges above 13 mm. Since the lever arm of the spade grip is practically non-existent, a potentially occurring restoring torque cannot be compensated. Machines with spade grip have to be used in conjunction with an auxiliary handle at all times. Drills have a spindle which is permanently fixed in its bearings. This ensures high concentricity. The rotational speed is optimised to suit drilling in metal. Impact drills have a spindle which can move in its bearings. The resulting concentricity is naturally not as good as with a drill. The rotational speed of an impact drill is usually higher since they are designed for drilling in stone which requires a high impact rate. The drill spindle is firmly guided by the spindle bearing on the side of the drill chuck which does not allow for linear or radial play.

Comparison drill – impact drill



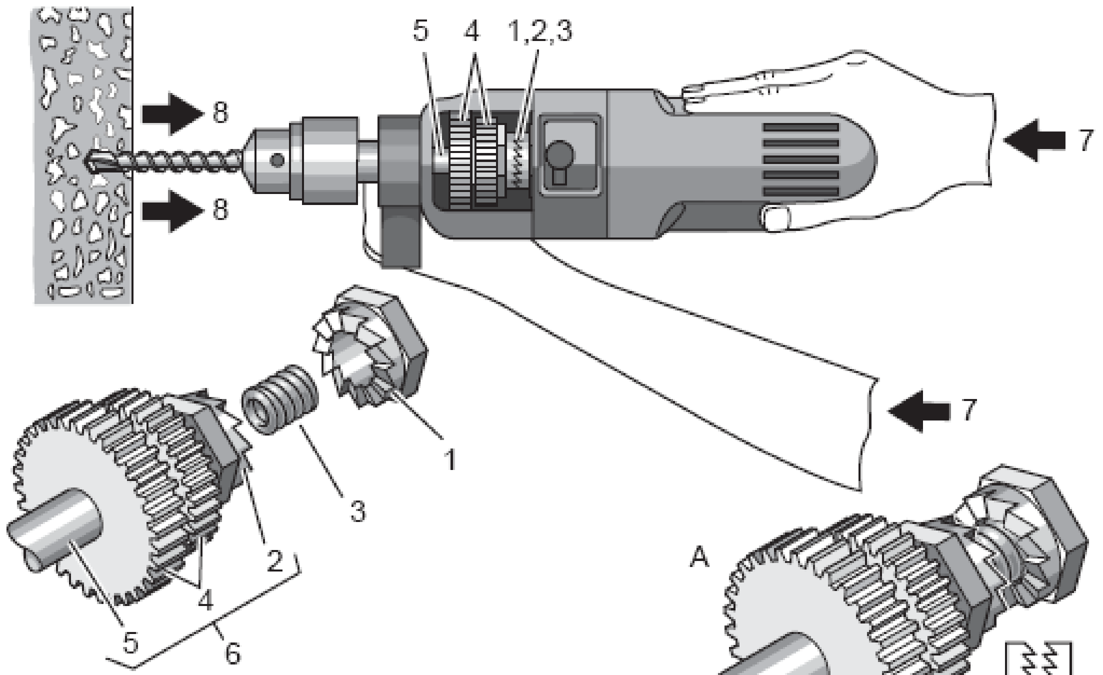
A drill
B impact drill

1 drill spindle pressed into permanent bearing
2 drill spindle with axial motion in the bearing

The drill spindle in an impact drill has to be able to move back and forth to allow drilling with impact. The spindle bearing on the side of the drill chuck must have linear (and for the same reason also a little radial) play which is the cause for the reduced concentricity. In the DIY sector impact drills are commonly chosen.

They have become widely accepted due to their universal applicability. “Single-purpose” drills are available in professional versions at specialised retailers. They should be preferred for frequent drilling.

Impact drill, working principle



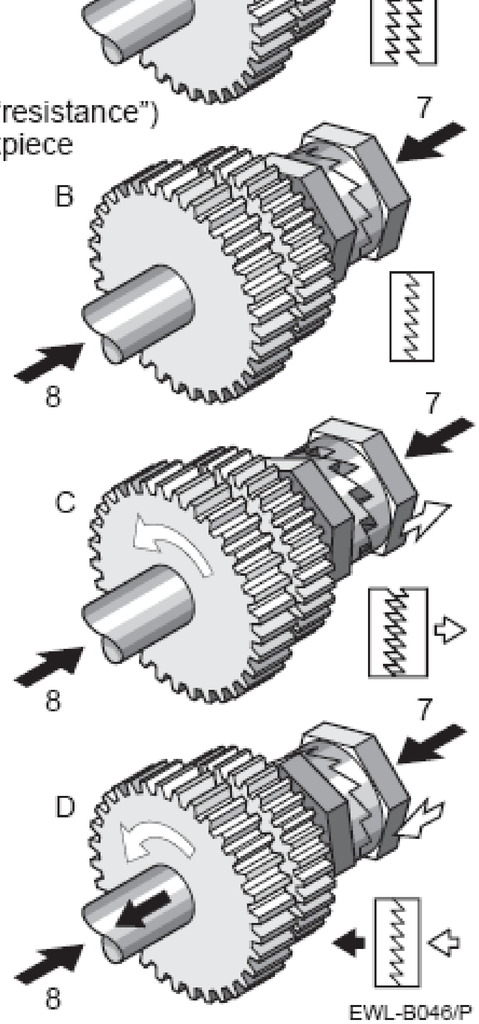
1 Notched disc, rigid
2 Notched disc, rotating
3 Pressure spring
4 Drive wheels
5 Drill spindle
6 Output unit (2,4,5)
7 Manual pressure
8 Counter-pressure (“resistance”) of the material/workpiece (equal to 7)

A Neutral position. The spring (3) pushes the drive unit (6) away from the rigid notched disc (1) which is mounted in the machine casing and allows the freerunning motion of the rotating notched disc (2).

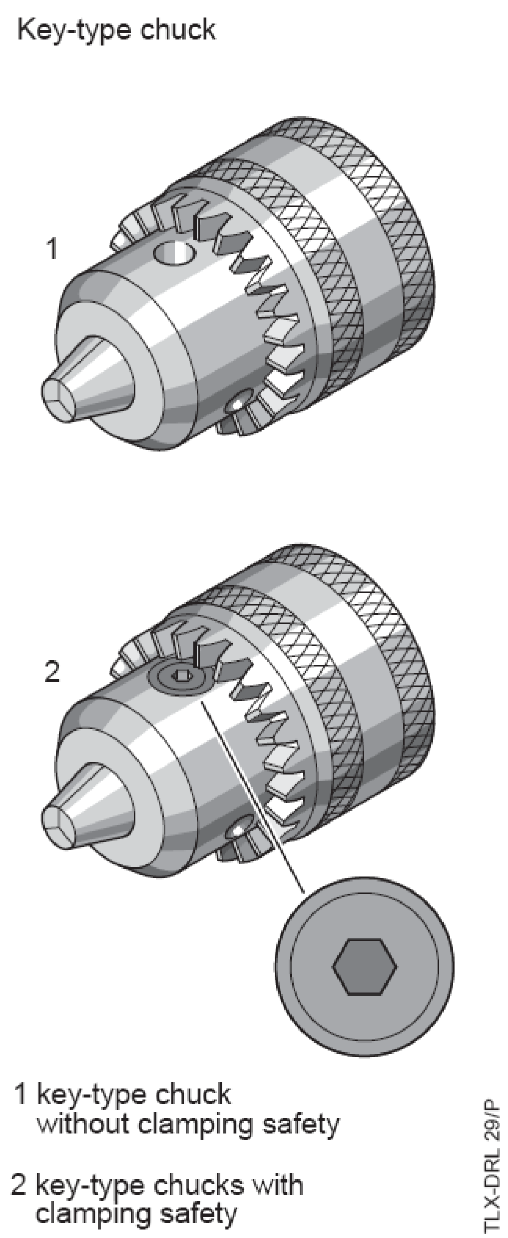
B The manual feed pressure (7) and the counter-pressure (8) push the teeth of the notched discs (1 and 2) together against the force of the spring (3).

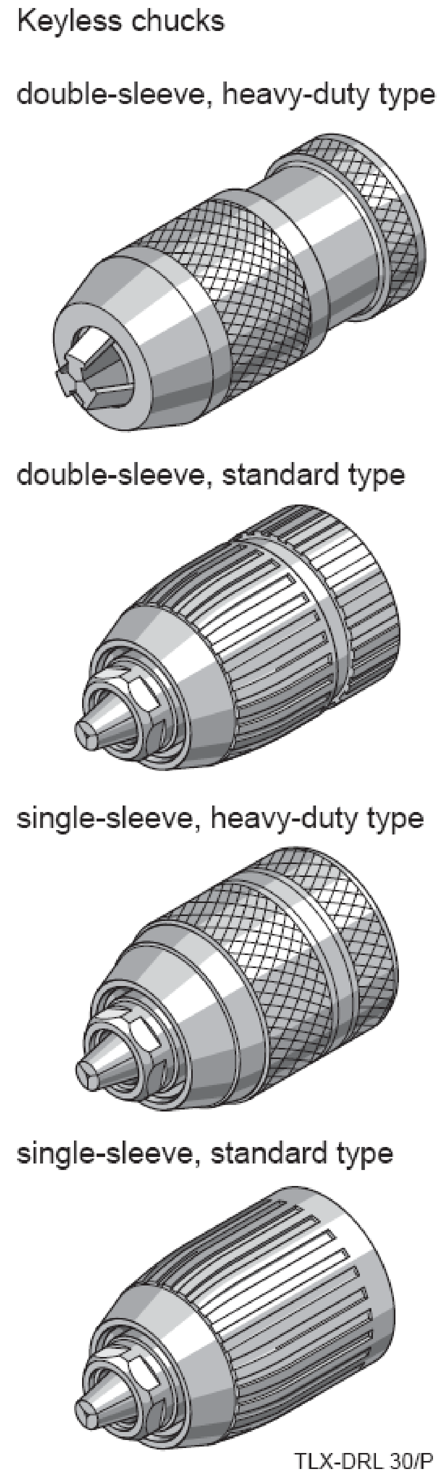
C The rotation of the drive unit (6) makes the teeth on the notched discs (1 and 2) slide up over each-other and the machine is pushed back against the feed pressure (7).

D When the drive unit (6) keeps turning past the tips of the teeth on the notched discs (1 and 2), the machine is abruptly pushed forward by the manual feed pressure (7). The forceful contact of the notched discs is the “impact motion”.



A **drill chuck** usually contains three clamping jaws or grips which move along a tapered sliding surface by turning the chuck sleeve until they come to rest in parallel on the drill bit shank.





By further tightening of the chuck sleeve, the clamping jaws are pulled so tightly onto the drill bit shank that they can safely transfer any torque delivered by the drill from the drill spindle to the bit. You can see that the same three clamping jaws are responsible for centring and torque transmission. The clamping force of the drill chuck is created by the frictional engagement of the clamping jaws on the drill bit shank and depends on the force with which the chuck sleeve is tightened. The drill chuck will release the bit if the sleeve is turned in the opposite direction. The force necessary to close and open the drill chuck is exerted by using a toothed chuck key which grips into the crown gear on the front of the chuck sleeve. Tightening and opening can be done with only one hand, however, you always need the chuck key at hand.

Go to the outline

3. Screwdriver

The screwdriver must be capable of tightening or releasing the screw (nut) according to the particular screwdriving conditions reliably and economically in the shortest possible time and with the least effort and feedback for the tool user. On account of their working principle a distinction is made between:

– depth-stop screwdrivers;

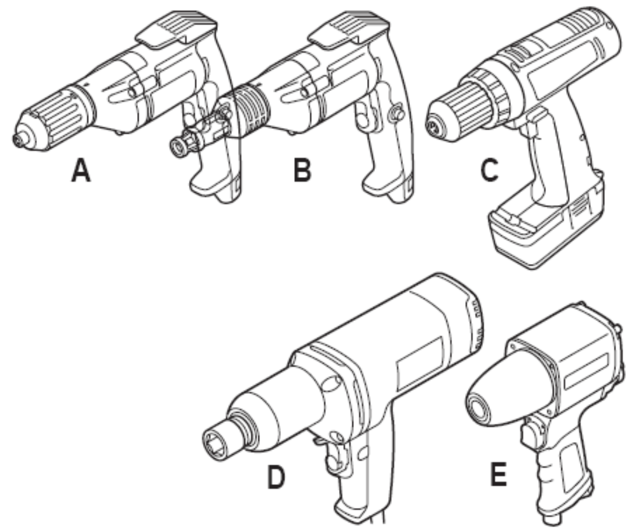
– torque-clutch screwdrivers;

– rotary-impact screwdrivers.

Because universal tools always represent a compromise. And compromises are not capable of achieving the perfect job result with respect to quality as well as speed. In principle, a drill is not a screwdriver. Screwdriving with drills in comparison to screwdrivers is inferior in reference to quality, speediness, economic efficiency and handling.

The use of drills in the professional field is limited to rare occasions. In the DIY sector, however, drills are often used for screwdriving on account of the low number of screw connections required there.

Screwdrivers



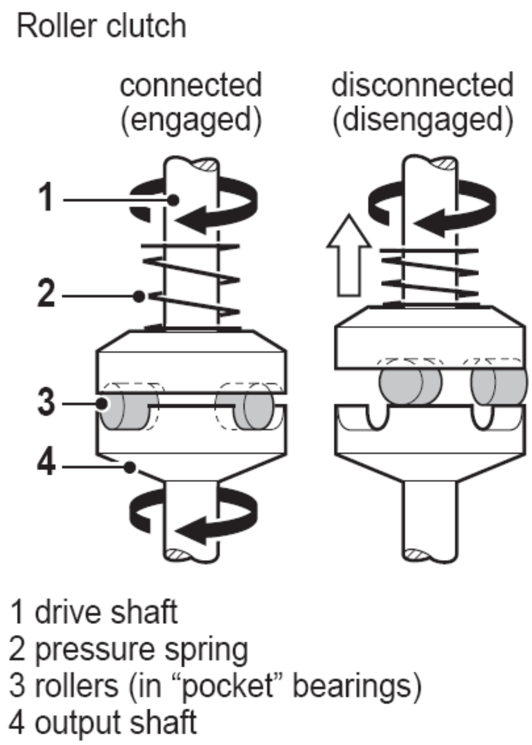
A torque screwdriver
B depth-stop screwdriver
C drill/driver for cordless operation
D rotary-impact screwdriver
E rotary-impact screwdriver for
compressed-air operation

TI X-SCR 26/G

If the torque increases at the screwdriver bit, the motor will react by increasing its power consumption. The increased power consumption is detected by the electronic control and compared with a preset maximum value (torque limit). When this specified value is reached, the electronic control cuts off the power supply to the motor.

The use of cordless screwdrivers is recommended in places where easy manageability and independence from the mains power supply are important. If, however, outstanding performance and continuous operation are required, you should best use a tool which runs on mains power.

When a certain torque, which was previously set on the tool, is reached, the clutch will disengage and interrupt power train between motor and screwdriver bit. The torque is usually set by changing the preliminary tension of the clutch pressure spring.



When you drive, for example, a countersunk screw into soft material, the screwdriving torque does not increase abruptly enough to trigger the torque clutch at exactly the right moment. In addition, the texture of most soft materials (wood) is irregular, which means that the same torque setting will produce different screwdriving results.

For the application of self-drilling screws higher rotational speeds are an advantage in most cases. For all other screws and, above all, for threads (nuts, bolts) low rotational speeds are better. In addition, there is the basic rule of thumb: high rotational speed for small screw diameters, low rotational speed for large screw diameters.

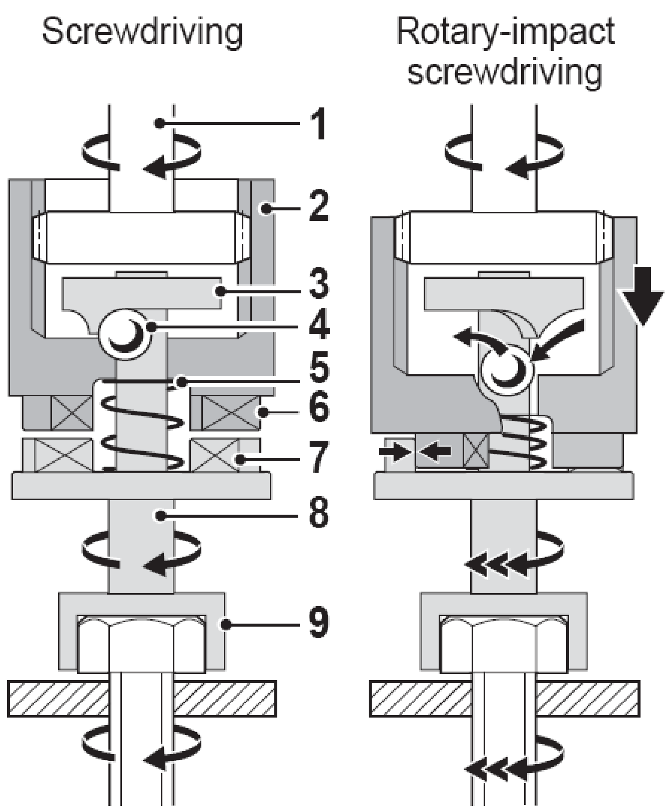
Impact wrenches (correct: **rotary-impact screwdrivers**) are screwdrivers whose torque does not increase steadily during operation, but acts through repeated “rotary impacts” upon the screw joint.

The impact duration determines the achievable torque within a certain range.

– the shorter the impact duration, the lower the achieved torque.

– the longer the impact duration, the higher the achieved torque.

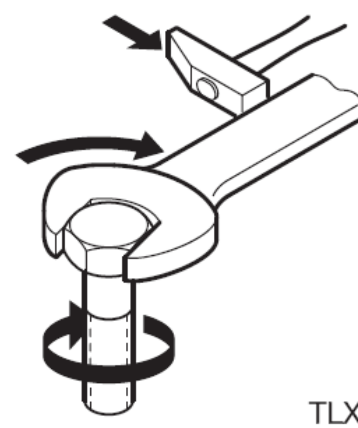
Rotary-impact system, cam impact system (principle)



1 drive shaft
2 impact system mass (guided internally)
3 guide cams
4 transmission balls
5 pull-back spring
6 impact system cams
7 output cams
8 output shaft
7 hexagon socket spanner

TLX-SCR 29/G

Working principle of a rotary-impact screwdriver



TLX-S

But: After a certain impact duration (in most cases approx. 5 seconds) the torque will not increase anymore.

Go to the outline

4. Angle grinder

The category rotational sanders/grinders includes grinding machines (“bench grinders, wheel stands”), straight grinders and angle grinders. The high peripheral speed (rotational speed) of the applied abrasive are their common feature. If the abrasive disintegrates or breaks apart, the fragments are flung away with high energy and can cause severe accidents. Also, there is a great risk of injury from contact with the abrasive. Rotational sanders/grinders remove material quickly and generate a lot of dust while doing so. Rotational sanders/grinders with powerful motors can produce high restoring torques during start-up.

Angle grinders operate exclusively on the basis of rotation. Angle grinder motors operate at high speeds and the abrasives used on them rotate with high peripheral velocity. The drive motor is positioned at an angle to the output shaft which allows the safe handling of the high output power typical for these machines.

Angle grinders distinguish themselves by their high removal rate and their fast work progress. Because of the high peripheral speeds, a lot of heat develops at the point of contact with the processed material. Therefore angle grinders are less suitable for the processing of wood materials or plastic. Technically, the abrasive performance of an angle grinder depends on the number of revolutions per unit of time. For practical purposes, however, the ergonomic design of an angle grinder plays an important role. The better the handling and the lower the power-to-weight ratio of the machine, the less the strain on the tool operator who will tire less easily and achieve better work progress. In accordance with their size angle grinders for general application are divided up into:

– small angle grinders (one-handed angle grinders);

– large angle grinders (two-handed angle grinders);

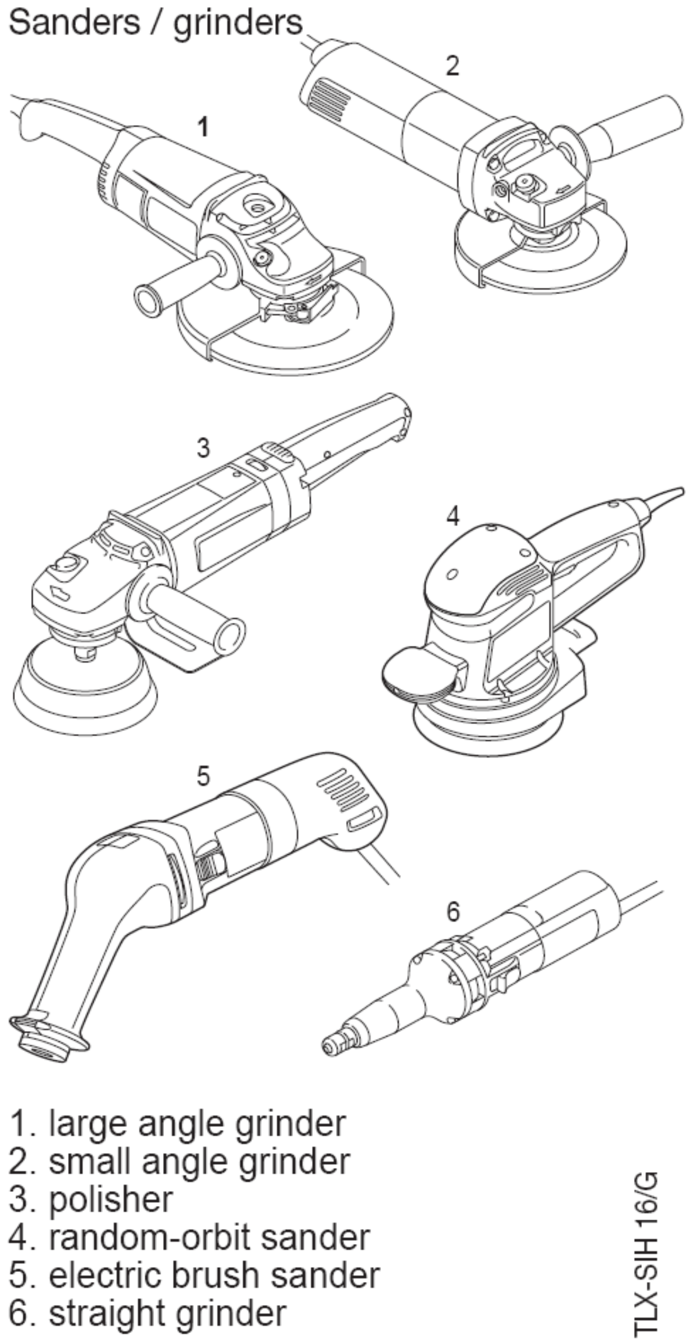
and these special models:

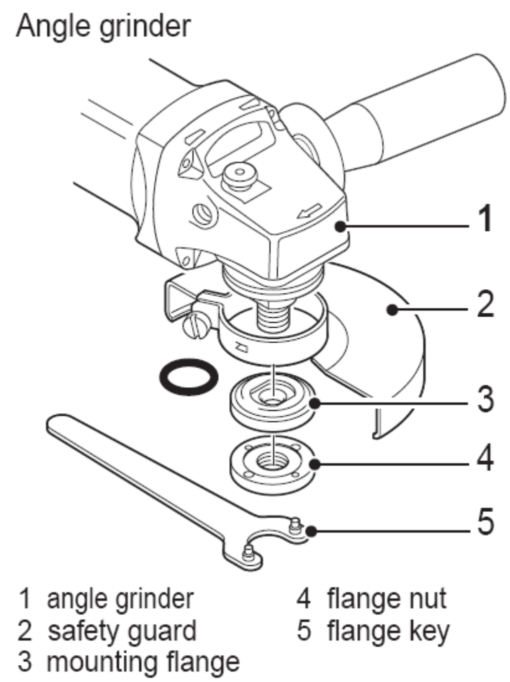
– polishers;

– concrete grinders;

– wet grinders.

In addition, there are angle grinders with low rotational speed which are recommended for abrasive cutting on account of their larger disc diameter.



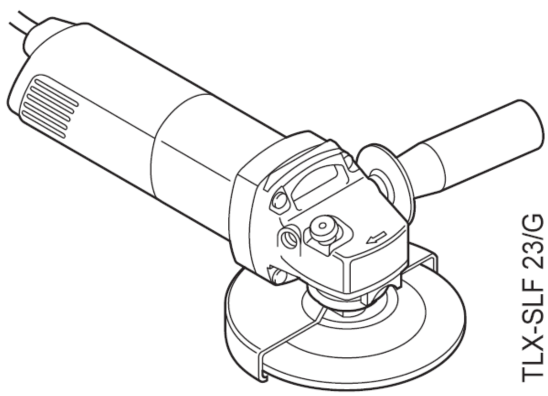


Small angle grinder: Small angle grinders are also known as one-handed angle grinders or mini-grinders. They come with power ratings between 600 …1500 watt. Normally, their disc diameters are 115 mm; 125 mm; 150 mm. The corresponding idling speeds are 11 000 min-1; 11 000 min-1; 9500 min-1. They are gripped and guided by the motor housing and the auxiliary handle. Despite their misleading popular name, they should always be operated with both hands to control the high motor power. Their application range spans from light to medium grinding to minor cutting.

Large angle grinder: Large angle grinders are also known as two-handed angle grinders. They come with power ratings between 1800 … 2500 watt. Normally, their disc diameters are 180 mm; 230 mm; 300 mm. The corresponding idling speeds are 8500 min-1; 6500 min-1; 5000 min-1. They are gripped and guided by the elongated motor housing and the auxiliary handle. Their application range spans from heavy-duty grinding (rough grinding) to cut-off grinding (abrasive cutting).

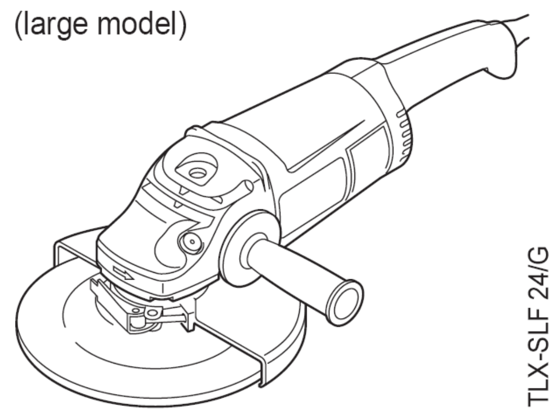
Angle grinder

(small model)



Angle grinder

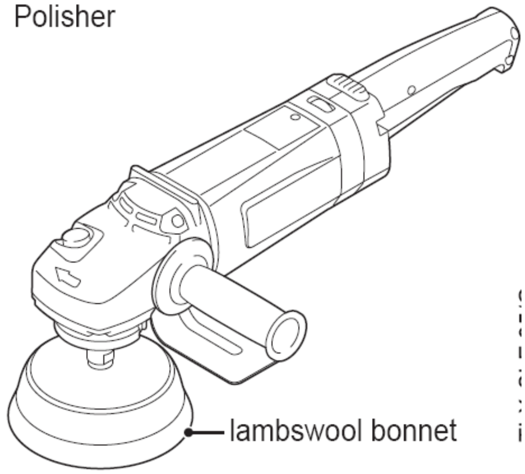
(large model)



Polisher: Polishers are special versions of angle grinders for the superfine finishing of surfaces. Since the surfaces to be polished can be metal, but also heat-sensitive paintwork, polishers are equipped with adjustable speeds between approx. 700…3000 min^{-1}. Their application tools include felt, linen and lambswool discs, the abrasive agent is applied as polishing paste or wax.

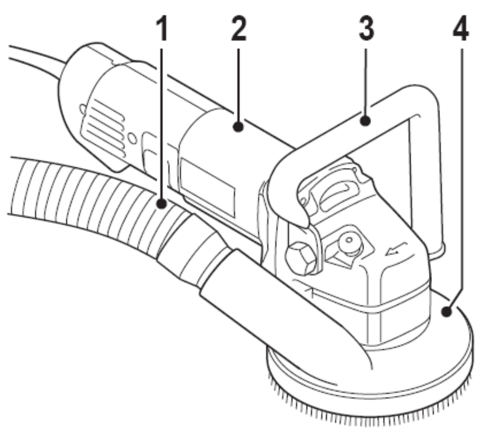
Concrete grinder: Concrete grinders are special versions of small angle grinders designed for flat grinding and processing of stone surfaces. Diamond-tipped sanding pads are used as application tools.

Polisher



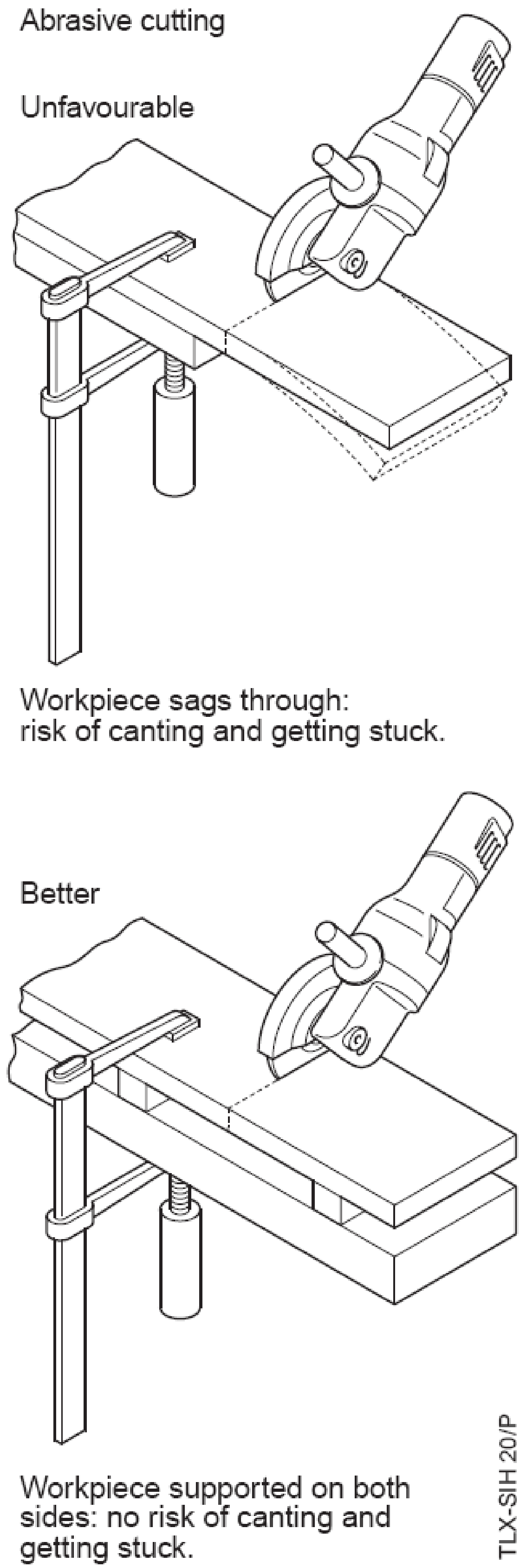
These machines are designed for dry grinding at speeds of up to 11000 min^{-1}. Because of the dry application and the very high speed concrete grinders have a high removal rate and develop large quantities of dust. For this reason concrete grinders are equipped with a closed dust extraction hood and only to be used in conjunction with approved high-capacity dust extraction equipment.

Concrete grinder

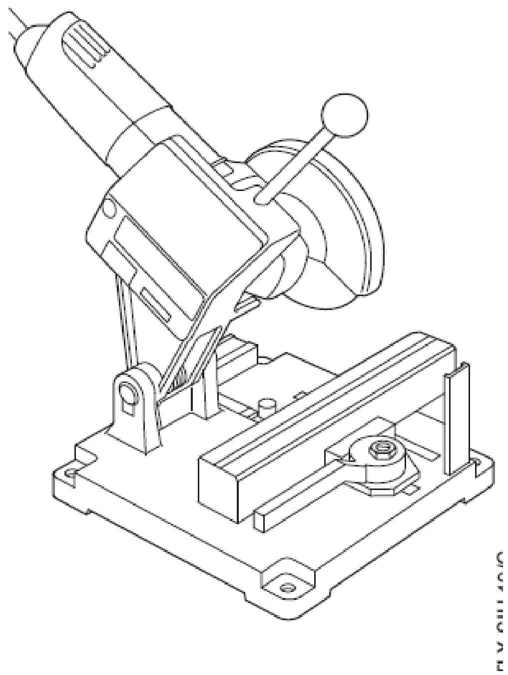


1 extraction hose
2 drive motor
3 handle bracket
4 closed safety guard

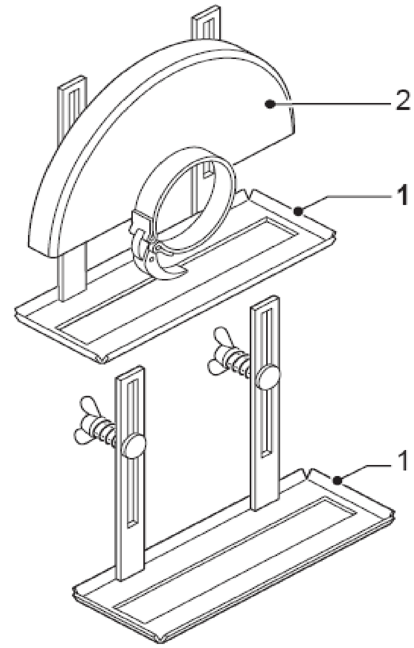
Cut-off grinding (abrasive cutting) is mainly performed with angle grinders or a special version of them, the so-called cut-off grinders (abrasive cut-off machines). With respect to risks and hazards the same applies as already discussed in the context of angle grinders. However, there is an additional risk through canting during hand-held (freehanded) cutting-off which can lead to disc fractures because of the high restoring torques.



Cut-off stand for angle grinders



Cutting guide for angle grinders



1 cutting guide
2 safety guard

Basically, the same precautions have to be taken as in the case of angle grinders. This risk of tilting or canting can be largely reduced by using a stationary device (cut-off stand) or, for freehanded operation, a so-called cutting guide. This is a special accessory for angle grinders used for cut-off grinding.

They are required by law for the cutting of stone materials. Special cut-off grinders are factoryequipped with a cutting guide as integrated machine component.

The sanding dust must always be vacuumed off during the cutting of stone materials. This can be done by integrated or external dust extraction devices. Safety goggles and breathing protection are mandatory.

Go to the outline

5. Saws

Saws are hand-held (power) tools or application tools with chip-producing cutting edges (teeth) arranged in consecutive linear fashion which come into action one after the other. The expression used for the application tool is “saw blade”. In the case of motor-driven saws, the motion of the saw blade is based on one of these three basic principles:

– stroke

– rotation

– circulation

As a rule, saw blades are not named after their working principle, but after the power tool they are used with.

Saws must be capable of performing the required work in the shortest possible time and with the highest possible quality. While doing so, they should provide the technically highest possible degree of safety to the user.

The key properties of a saw blade are determined by:

– the saw blade material;

– the number of teeth;

– the tooth shape.

Depending on their intended application and purpose, saw blades are made of:

– CV;

– HCS;

– HSS;

– Bimetall;

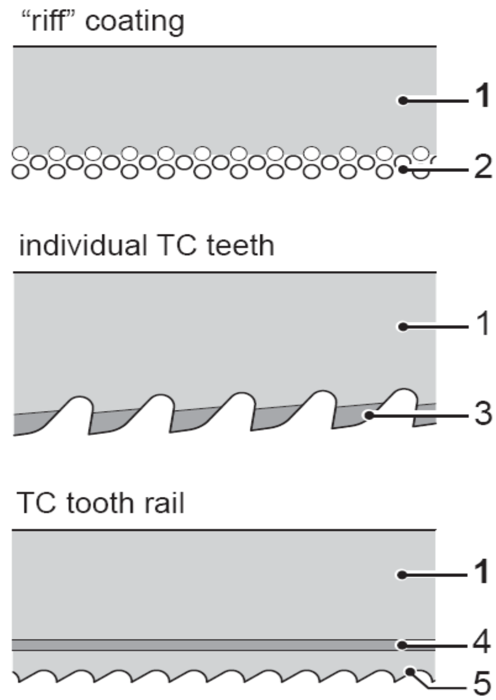
– TC.

Combinations of the mentioned materials are also possible.

CV stands for ***C***hrome-***V***anadium (steel plate) and refers to the principal components of the alloyed steel. CV steels are marked by high elasticity and moderate hardness. They are mainly used for the blade core of circular saw blades. Circular saw blades for soft wood are also made completely of CV steel.

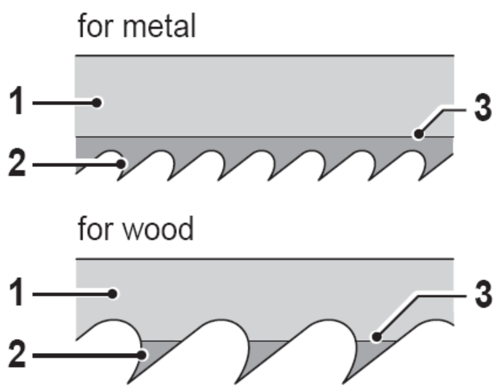
HCS stands for ***H***igh ***C***arbon ***S***teel, and refers to a type of steel which is very hard on account of its high carbon content.

Jigsaw blades, TC-tipped



1 blade body
2 TC grain
3 TC tooth (brazed)
4 laser weld
5 TC tooth rail

Jigsaw blades, bimetal blades



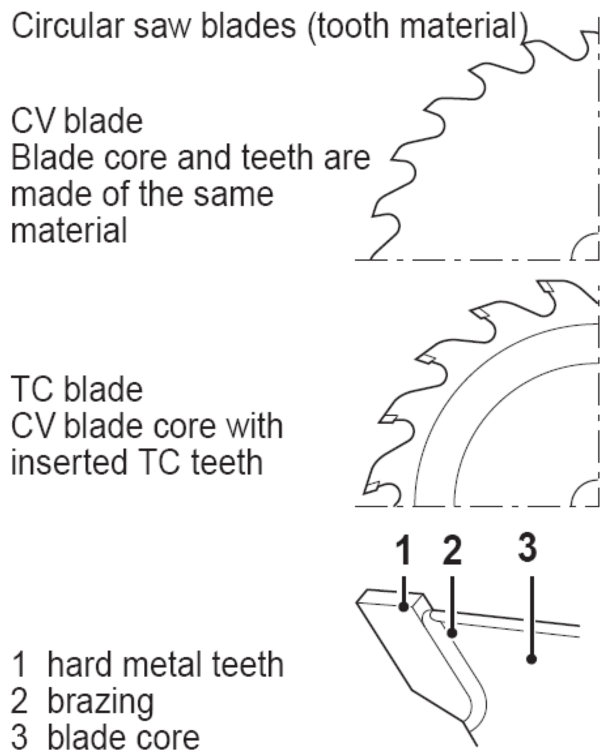
1 body made of HCS
2 teeth made of HSS
3 laser weld

HSS stands for ***H***igh-***S***peed ***S***teel. These high-alloy steels are mainly used to make application tools for metalwork, but also to process wood and plastic. They distinguish themselves through higher bearing strength and longer service life. Because of their greater hardness HSS blades are usually more brittle, which has to be remembered during their application.

HS-steels are often used in connection with low-alloy, tough tool steels. Their properties (tough-elastic and hard) are combined in this fashion. This combination, also known as bimetal, is produced by welding the two different metals together.

TC is the abbreviation for ***T***ungsten ***C***arbide, or so called "hard metals". Hard metals are sintered materials made up of various components such as tungsten, titanium, tantalum, cobalt, and carbides. They are extremely resistant to pressure and wear, but rather brittle. Hard metals are often used as tooth material for highly stressed saw blades. Hard metal or carbide-tipped saw blades are made for heavy-duty applications, however due to the higher brittleness of the hard metal they require specific minimum sizes for their teeth.

For a specific saw blade size, the number of teeth is determined by the tooth size. During each stroke or revolution of the saw blade there are more or less teeth in action. The quality of the cut increases with the number of teeth. On the same length of saw blade, fewer large teeth increase the tooth spacing, and more small teeth reduce the tooth spacing. Few large teeth reduce the costs, many small teeth increase the costs.



The tooth shape determines the cutting quality and the bearing strength. A distinction is made between basic shapes and combinations. The most important basic shapes are:

– pointed teeth;

– coarse teeth;

– flat teeth;

– alternating teeth;

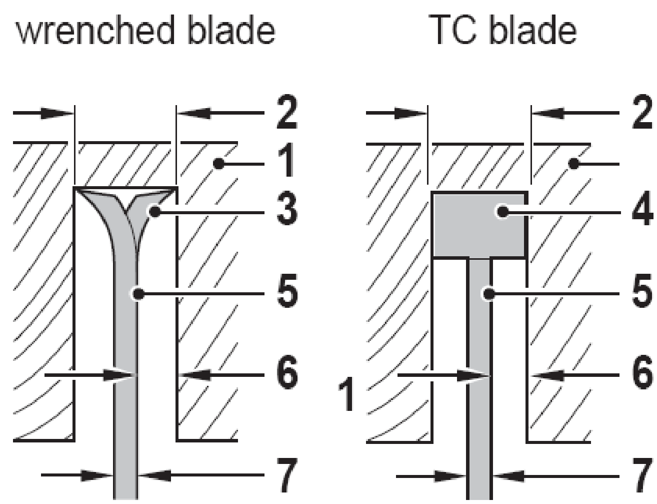
– trapezoidal teeth;

– hollow teeth

as well as mixed shapes. Pointed teeth and coarse teeth are mainly used on CV, HSS and bimetal saw blades, the other shapes are found on carbide-tipped saw blades. The best cutting quality is often achieved with combinations of different tooth shapes which are more cost-intensive due to the elaborate grinding process.

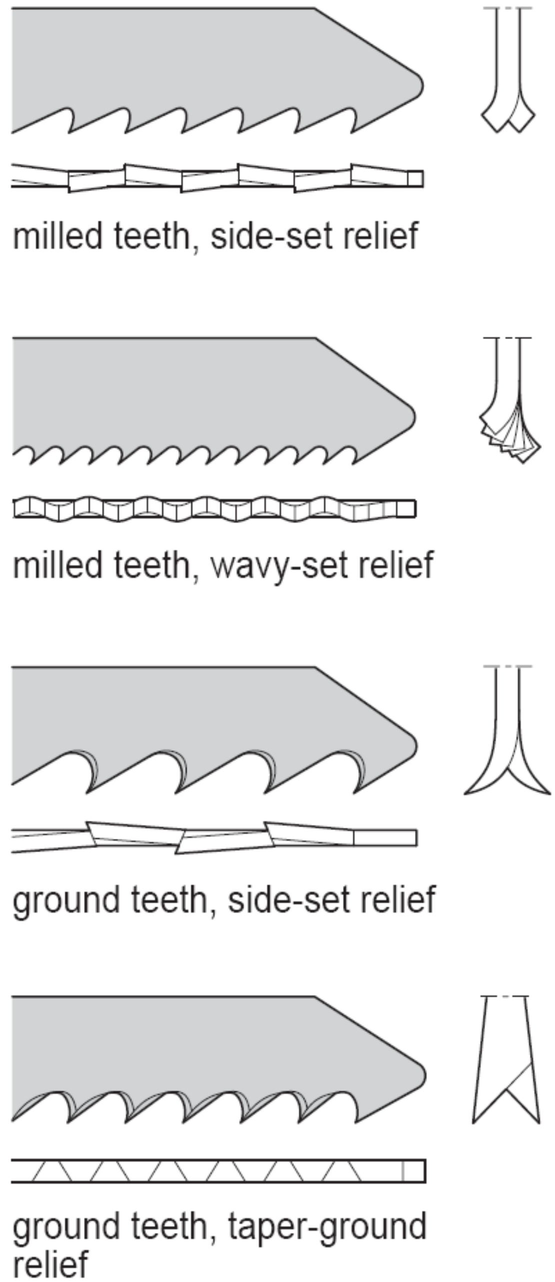
Relief is the difference between the width of the saw cut and the width of the blade core or the blade heel. The so-called relief is necessary to ensure that the heel of the saw blade does not get stuck during cutting. The relief can be obtained by wrenching the saw in opposite directions or by using wavy teeth, by an eccentric clearance or by wider teeth (TC). The larger the relief the better the curve-going ability of the saw blade on a stroke-type saw.

Circular saw blades (relief)



1 processed material
2 tooth width
3 wrenched teeth
4 TC teeth
5 blade core
6 relief
7 width of blade core

Jigsaw blades, tooth geometry



Saw blades with medium to large teeth are used to cut wood since wood is a long-chipping material. The tooth size should be chosen to suit the thickness of the processed workpiece to make sure that there are always at least two teeth engaged in the cut.

Quick cuts require saw blades with few large teeth which, however, produce coarse cuts. Saw blades with many small teeth produce fine cuts, but their work progress is rather slow. The re-sharpening of circular saw blades can be purposeful and economical if it is carried out by a qualified sharpening service. Depending on their tooth shape, circular saw blades can be re-sharpened several times.

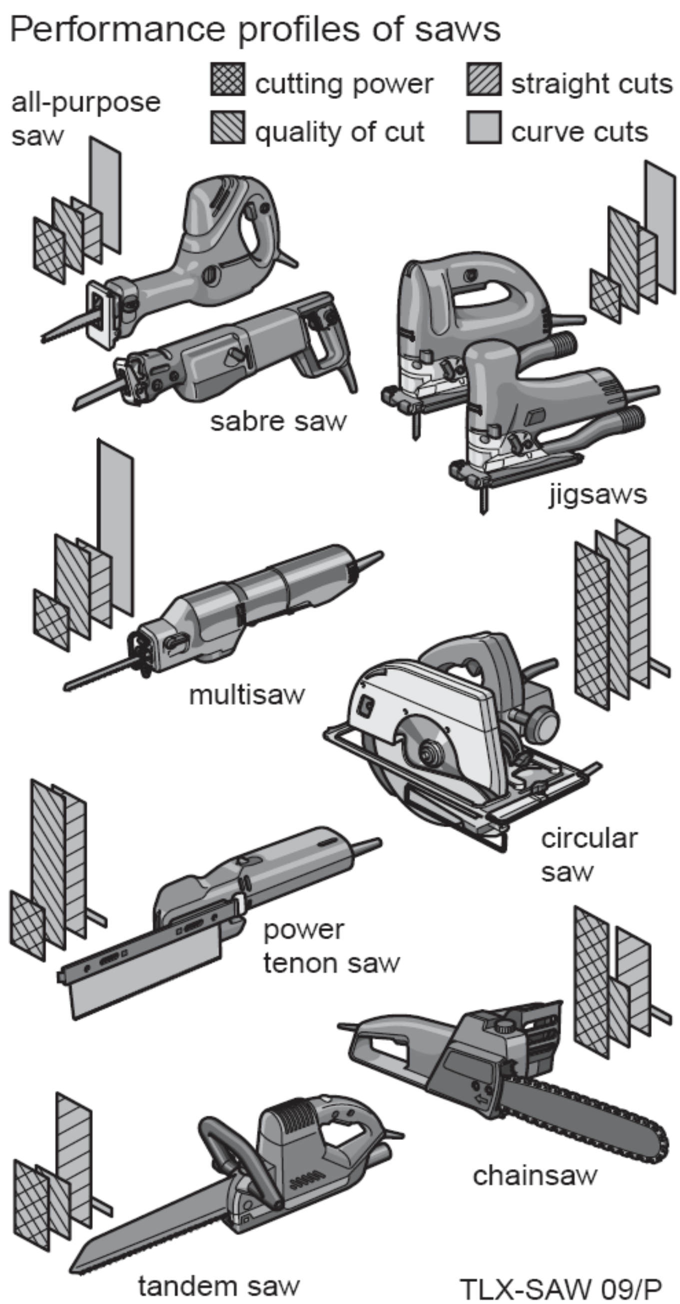
Motor-driven saws function according to one of three basic principles: stroke, rotation, circulation.

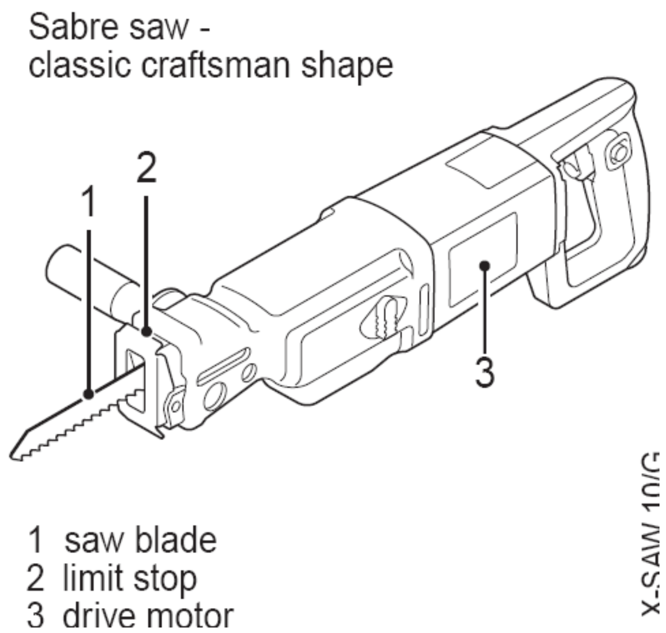
According to these principles, the following basic saw types are available:

– stroke-type saws

– rotary saws (circular saws)

– circulating saws (band saws, chainsaws).



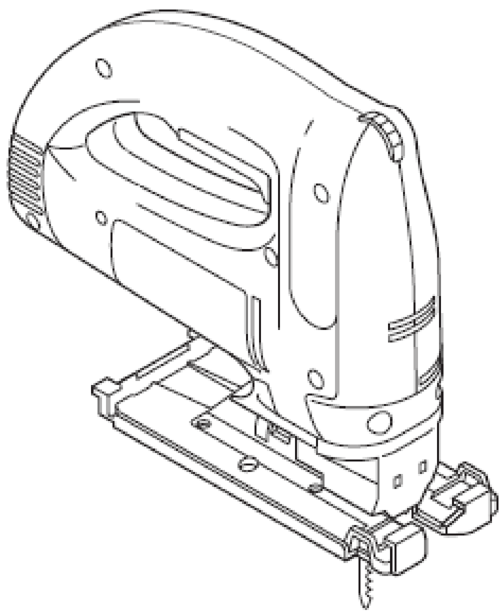


Stroke-type saws can be applied to all sawable materials. The common feature of all stroke-type saws is one or two reciprocating saw blade(s). Their sawing motion is similar to manual sawing. Most stroke-type saws are designed in such a fashion that the saw blade is active in only one stroke direction. The preferred direction is the pulling stroke since it allows better mastering of the tool which is not subject to pressure or blade-bending forces. The pulling direction of most stroke-type saws is superposed by orbital action. This activates more teeth during cutting and improves the work progress substantially while requiring less operator pressure.

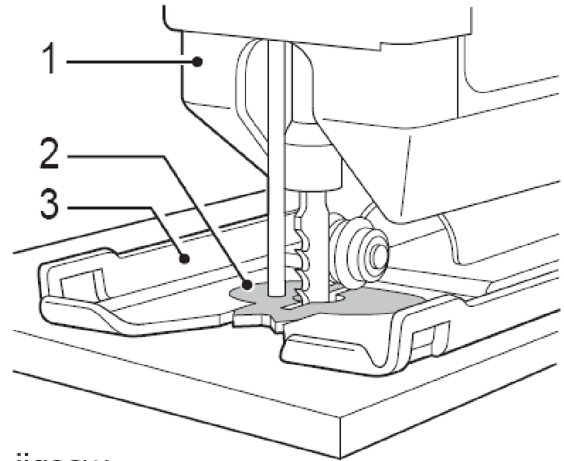
The tandem saw resembles the power hand saw in appearance, its drive motor is arranged at an angle to the saw blade axis. Tandem saws are equipped with two reciprocating saw blades which move in a sword-shaped blade guide. The shape of the saw teeth is symmetrical.

Apart from circular saws, jigsaws are the most popular sawing tools for woodworking. Manageability and universal applicability are ideally combined in a jigsaw. Motor and saw blade are arranged at right angles to each-other, the motor housing (rod-shaped or with top handle) is used for gripping.

Jigsaw (top handle)



Anti-splintering device

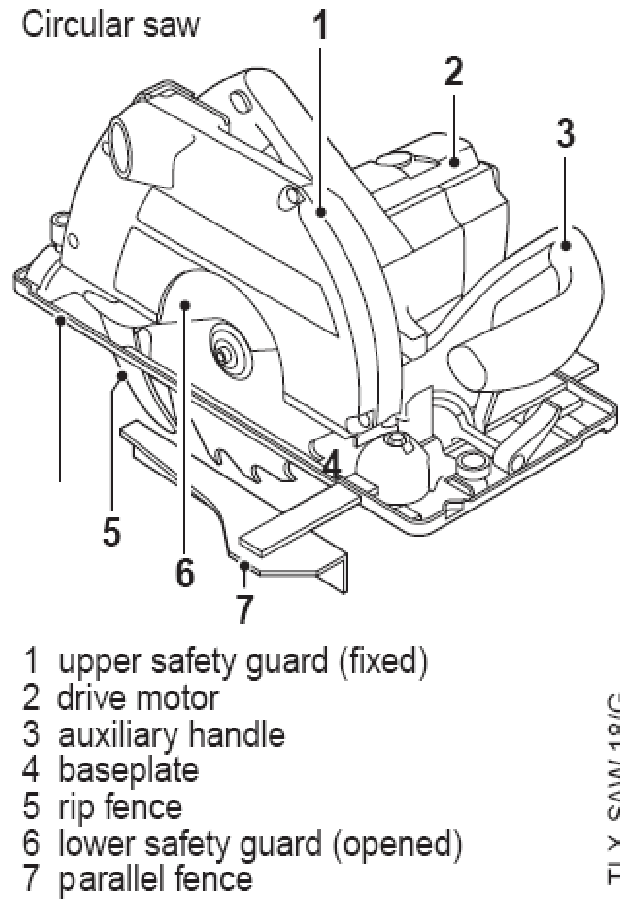


1 jigsaw
2 anti-splintering device
3 baseplate

Hand-held circular saws are the most important power tools for woodworking. The name comes from the circular saw blade on whose periphery the saw teeth are located. Hand-held circular saws are mounted on a baseplate in such a fashion that the motor-transmission-saw blade unit can be adjusted in height and angle in relation to the baseplate. In this fashion the cutting depth and the mitre angle (up to 45°) can be adjusted.

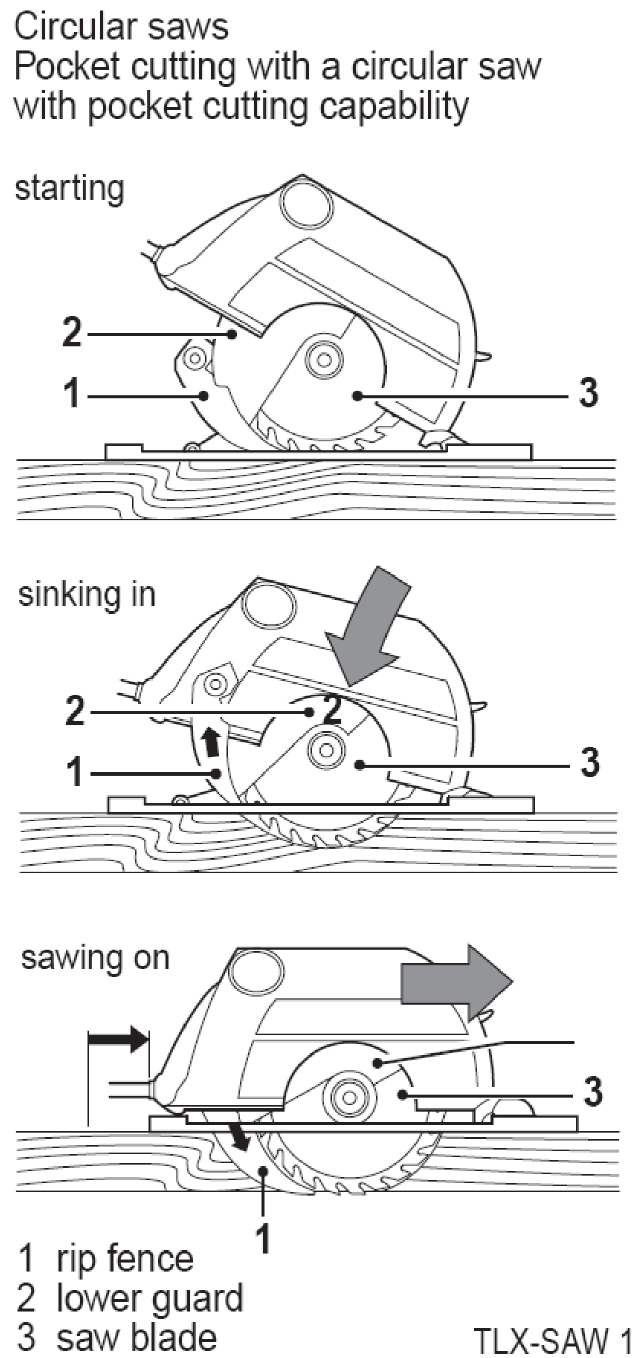
The working principle of rotation allows much higher cutting speeds, better quality cuts and faster penetration than handheld stroke-type saws. On account of their working principle, all rotational saws can only produce straight cuts. The feed direction is always counter-rotational, i.e. in opposite direction to the rotation of the saw blade. The majority of hand-held circular saws have cutting depths of 40...85 mm. Their power consumption rating lies between 350...1600 watt.

Hand-held circular saws with adjustable speed and electronic regulation for constant speed under load can be preset to suit the material to be processed. They keep the preset rotational speed more or less constant under changing load conditions. This improves the cutting quality and the work progress.

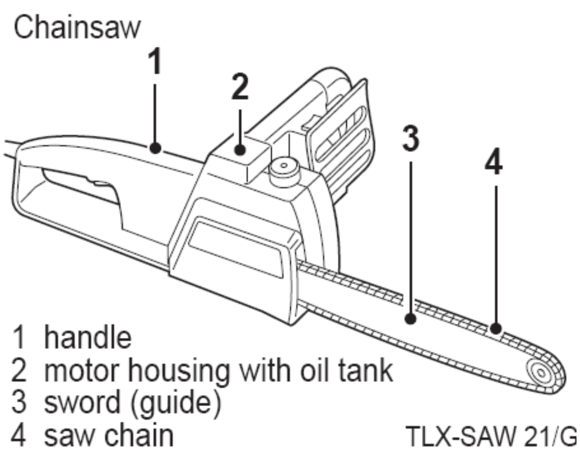


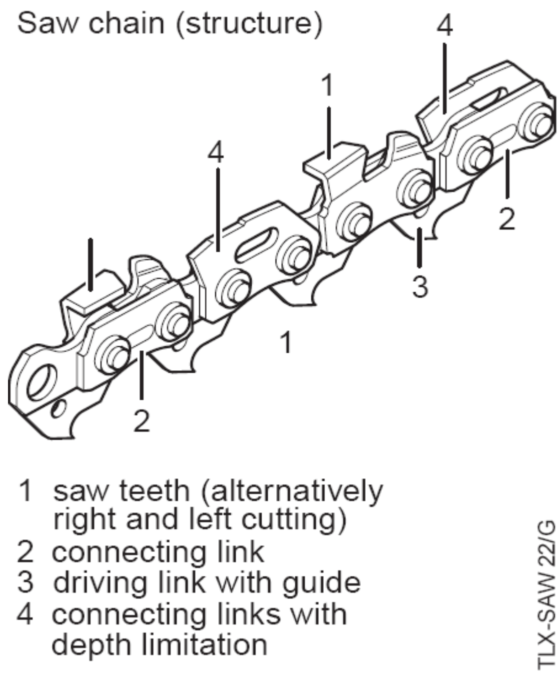
A so-called rip fence follows the saw blade to prevent recoil through saw blade jamming in the material. Contact with the saw blade during running or coasting is prevented by a lower guard with remote lift lever which opens automatically when the saw cut is started.

The saw chain of a chainsaw is equipped with saw teeth and driven by a motor arranged rectangular to the chain. The saw teeth on the saw chain are so-called planer teeth which cut a wide chip from the wood and create enough room for the rather wide saw chain. The saw chain runs over a rigid blade guide (sword) and is totally exposed in both forward and reverse running direction. In order to reduce friction and the resulting chain wear in the sword guide, the saw chain has to be lubricated with a suitable oil (“chainsaw oil”).

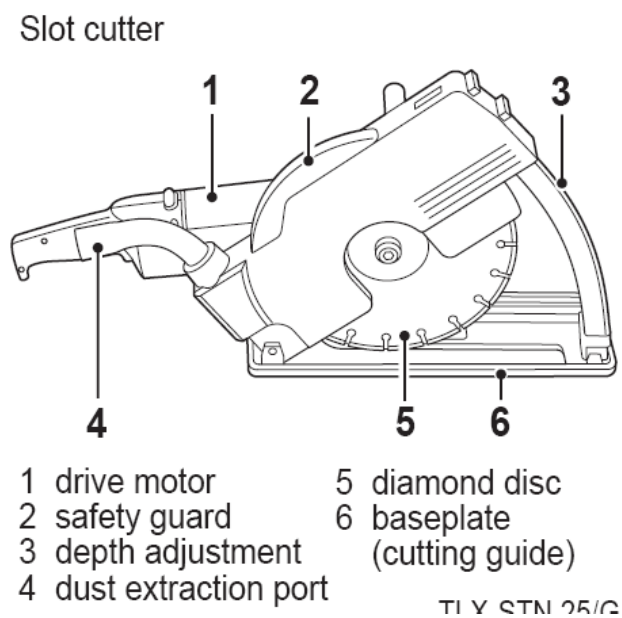


Chainsaws operate at high circulation speeds and with very fast work progress (penetration). The rigid sword guide allows only straight cuts. On account of the working principle, both sides of the saw chain are exposed. For this reason two-handed operation and the wearing of suitable safety equipment are mandatory. As power tools, electric chainsaws are equipped with a safety lock on the power switch, an emergency stop and a very quickly reacting electro-mechanical chain brake. The usual sword lengths vary between 300...400 mm, they have power consumption ratings between 1000...1500 watt.





Slot cutters are used to cut deep slots in stone, concrete and brickwork. They are especially constructed for this purpose and can not be used as angle grinders. Slot cutters are equipped with a cutting guide integrated into the machine construction, with a dust extraction safety guard and an adjustable depth stop. The powerful drive motor is usually equipped with constant-electronic speed regulation and overload protection.



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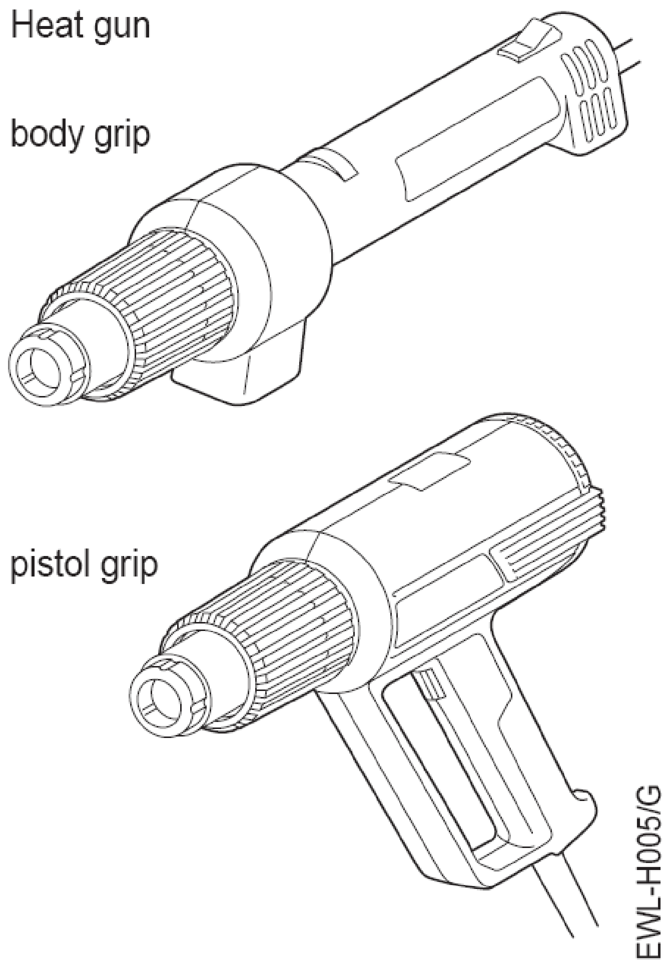
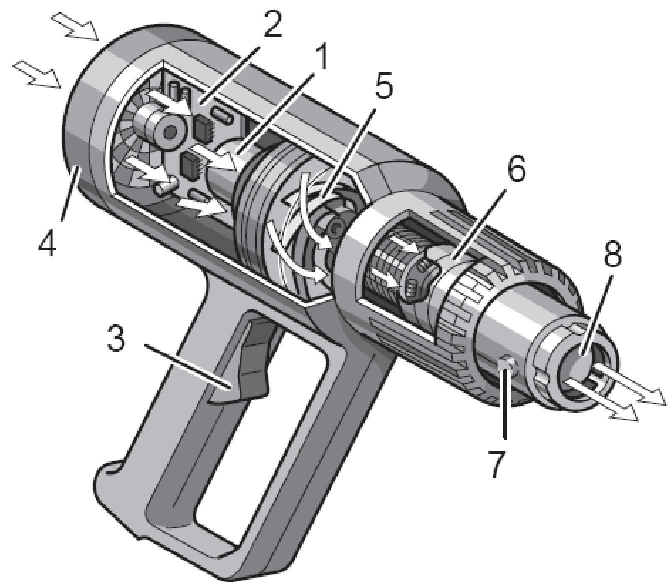
6. Hot-air guns

Hot-air guns are used to weld plastics. Typically these tools are produced in pistol or rod shape. They are only suitable for the welding of plastics. The high temperatures required for the welding of metal can not be reached by hot-air guns. The welding of plastics is a rather complex process which requires a lot of experience to achieve perfect results. The most important factor is the constant temperature of the hot-air stream.



The most important components of a hotair gun are the heating element, the ventilator and the temperature control. The ventilator usually has several speeds and blows a steady stream of air through the heating element which heats the air. It comes out of the nozzle as a directional hot-air stream. A temperature sensor is located in a suitable place, usually in the air outlet, measures the temperature and sends an electric signal to an electronic temperature control unit. The temperature control unit regulates the power supply to the heating element in order to reach and hold the temperature preselected by the user on a setting wheel. The air outlet temperature is usually displayed on a scaled LED. The hot-air stream generated by hot-air guns can usually be adjusted in a range from 50…600°C.

Hot-air gun

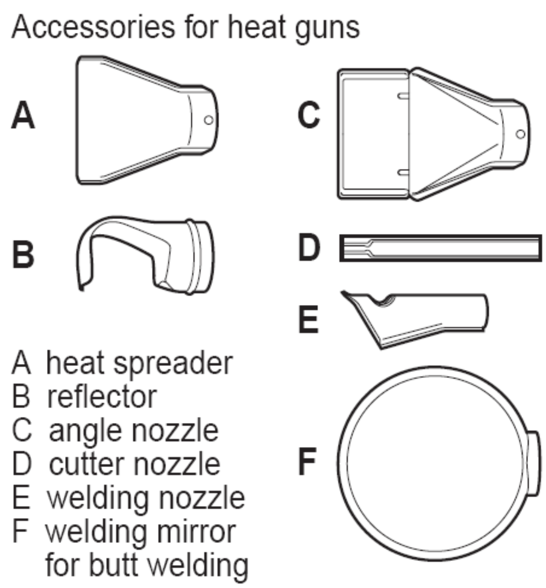


1 Motor
2 Control board
3 Switch
4 Controller
5 Ventilator
6 Heat unit
7 Temperature sensor
8 Shutter

Available as system accessories for hotair guns are specially formed nozzles which are plugged on the hot-air outlet. Frequently used nozzles are:

- ***surface nozzle*** (wide distribution of hot air for drying, preheatingand paint removing);
- ***angle nozzle*** (nozzle to deflect the hot air stream);
- ***reflector nozzle*** (for hose shrinking and, if necessary, for the soldering of pipes);
- ***glass protection nozzle*** (for the protection of heat-sensitive materials like glass, PE, PP, LZ hard and soft PVC);
- ***reduction nozzle*** (required for all auxiliary nozzles);
- ***welding shoe nozzle*** (for plastic welding with plastic welding wires up to 5 mm);

- ***cutting nozzle*** (to cut rigid foam and polystyrene);
- ***slot nozzle*** (for overlap welding of PVC foils);
- ***butt welding nozzle*** (for butt welding of plastic profiles and pipes);
- ***extension nozzle*** (for the heating of hard-to-reach places);
- ***angle nozzle*** (for large-surface deflection of hot air stream).



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