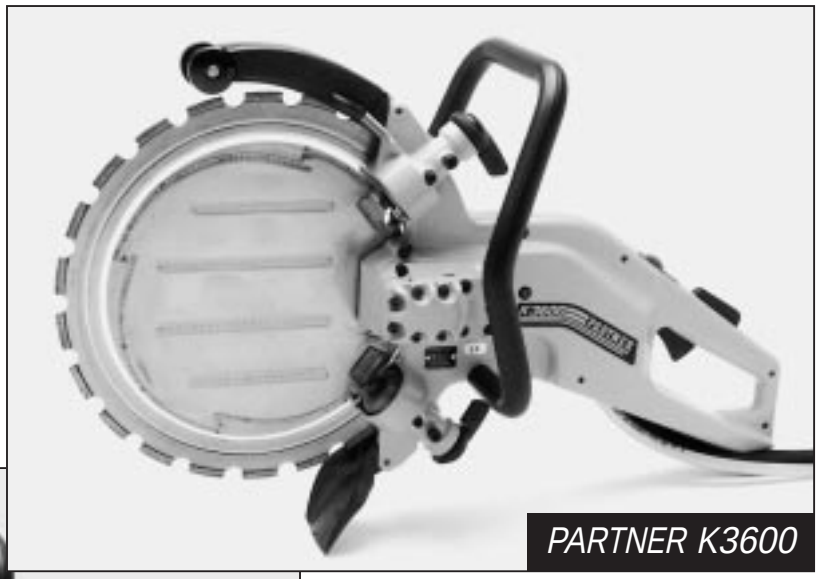
PARTNER TECHNICAL DESCRIPTION

PARTNER FC40



PARTNER K3600

PARTNER K2500

PARTNER HYDRAULICS

The Partner K3600 and K2500 are hydraulic power cutters that are powered by an external hydraulic power source with a capacity of 40 l/min according to HTMA standards.

PARTNER K3600

The Partner K3600 is the only power cutter in the world whose blade is driven without an axle in the centre. The eccentric drive allows the K3600 to cut to a depth of 260 mm with a blade diameter of 350 mm. No other hand-held cutter comes close to this cutting depth.

Apart from the extreme cutting depth, eccentric drive also means that the need for overcutting at angles is either non-existent or minimal. This feature makes the machine outstanding for cutting openings for windows, doors and so on in building work.

PARTNER K2500

The Partner K2500 is centre-driven in the traditional way. It is renowned for its low weight in relation to power output. There is a 16" cutting blade that gives a cutting depth of 145 mm.

The handle gap, weight distribution and the slim body configuration makes the K2500 a very comfortable machine to work with on long shifts.

PARTNER FC40

The Partner FC40 is a combined flow- and pressure regulator that is connected to external hydraulic sources with a flow rate of up to 120 l/min and a maximum pressure of 210 bar. The FC40 reduces flow rates to 20, 30 or 40 l/min as required.

Partner has hydraulic units that are tailored to suit the hydraulic cutters, although these are not described here.

Partner K3600

History

The idea of getting a wheel to rotate without a central shaft has kept engineers busy for purposes far removed from the world of power cutters. Efforts to engineer this drive principle for a cutter focused on the possibility of supplementing fixture-mounted wall-cutters with a hand-held machine. A traditional wall-cutter is heavy and bulky. It has rails that must be attached securely to the wall using expansion bolts, and in many cases it is not even possible to attach the wall-cutter, which in turn requires complex special solutions.

Several companies have tried to design a cutter that is not driven by a central shaft, a principle referred to in this publication as eccentric drive. All these trials have collapsed due to functional problems with the complicated drive and control of the blade. This in turn is made even more difficult due to the operating environment in which the mechanism is required to work, characterized by very abrasive concrete slurry and water.

The engineering solution adopted for the Partner cutter is based on a design originally produced by an independent innovator, Mats Johansson of Sweden. The design was patented and small-scale production got under way.

Partner K3500 - 1987

Partner bought the company and acquired the patent rights. In less than two years, the concept was further developed into a machine which significantly differed from the original version, primarily in terms of improved ergonomics.

The result was Partner K3500 – a cutter whose features make it a perfect complement to the rest of the Partner range – a hand-held power cutter with high performance, good ergonomics and simple maintenance.

Target group

The RingSaw does not replace the traditional power cutter in any respect. After all, it does require more of the user, as well as the services of a robust hydraulic unit. The cost per cut unit is also higher compared with the traditional centre-driven power cutter.

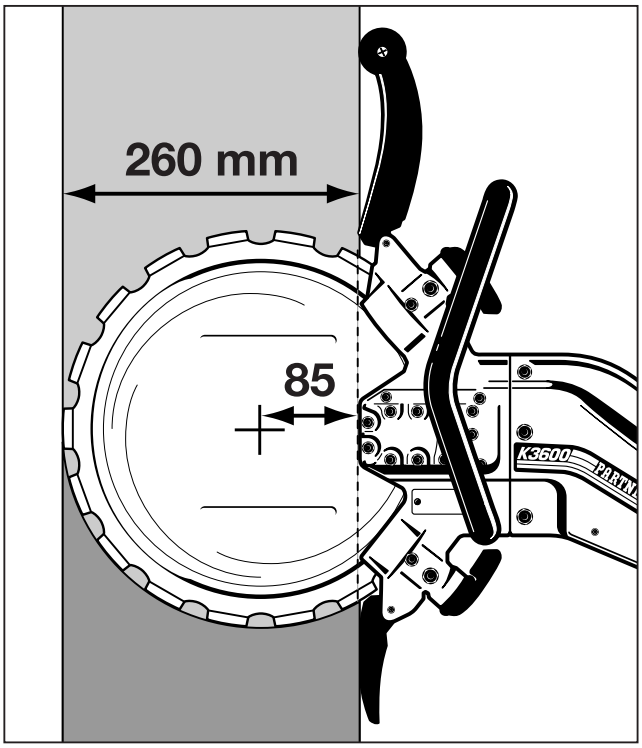
The RingSaw is aimed primarily at companies working with cutting openings in concrete structures where the RingSaw, in competition with machines requiring initial rigging of fixtures, can do the required work far more quickly and at lower total cost.

Rebuilding and extension operations often include tasks where the RingSaw is unbeatable. Typical operations include cutting openings for windows and doors, often with smaller tasks at a number of different locations, where the RingSaw's mobility is the decisive factor. When erecting new structures, the RingSaw would scarcely be needed if every casting and building element was given exact dimensions and nothing was forgotten.

An intelligent idea

260 mm cutting depth with a 350 mm blade

Eccentric drive of the cutting blade is the revolutionary engineering solution that gives the Partner K3600 its remarkably generous cutting depth in relation to the blade's diameter. The centre of rotation lies roughly 85 mm into the cut at maximum cutting depth (measured from the centre of the blade to the hydraulic motor's housing).



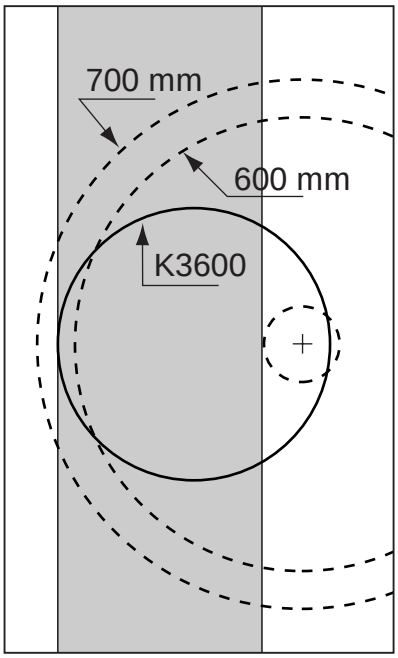
Comparison: blade diameter/cutting depth

Machines for concrete and stonecutting with a considerable cutting depth have long been available on the market and are usually called floor- or wall-cutters. Floor-cutters are mounted on wheels while wall-cutters feature a fixture that must be attached to the wall. The fixture is usually built in the form of a pair of rails along which the machine runs. Normally, these machines are hydraulically powered.

The flange washer, sometimes the transmission too, reduces the cutting depth by at least 50 mm (2″).

With a traditional centre-driven wall-cutter, cutting depth of 260 mm would require a blade diameter of at least 600 mm. The most common diameters of cutter blades are 600 and 700 mm.

The Partner K3600 offers a 260 mm cutting depth with a blade diameter of just 350 mm!



Partner K3600 – a complement to the wall-cutter
Bearing in mind the intelligent design of the RingSaw, it is only natural to assume that this would replace all other techniques for cutting stone and concrete. However, many cutting operations are so long-lasting that hours may be needed for a single cut, and it is here that the time needed to set up the fixture-mounted cutter becomes worth all the time and effort. Feed along the cut line takes place automatically with most wall-cutters.

Typical characteristics of the jobs for which the Partner K3600 is ideally suited are that they are on a smaller scale, preferably with several shorter cuts in different directions. Congested working locations may also make the K3600 the only power cutter capable of handling the job. The only other generally feasible method is using a jackhammer.

Overcutting
Overcutting refers to the extra distance that has to be cut in order for two cuts facing each other at a right angle to overlap each other with full cutting depth. Examples are openings for windows and doors. Two horizontal and two vertical cuts must be made, meeting in the corners and requiring overcutting. In the two upper figures, the darker line marks the horizontal cut and the lower line shows the essential overcut for total removal of the intended section.

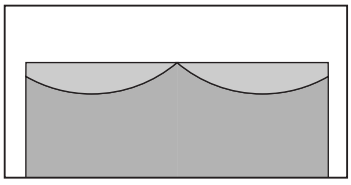
Less overcutting with the K3600
As the figures here show, the need for overcutting is considerably less with the K3600 than with the centre-driven wall-cutter at modest cutting depths. In the example, the wall is 200 mm thick, a common dimension for a brick or cast interior wall. The blade is 700 mm in diameter and the blade's flange washer is 100 mm in diameter.

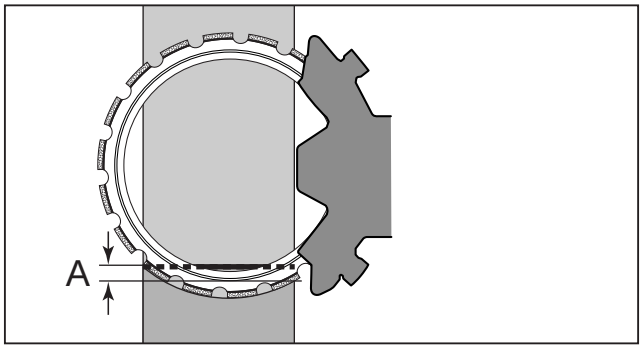
With the Partner K3600, only 23 mm (A) overcut is needed, while the centre-driven cutter requires an overcut of 85 mm (B). If we use a cutting blade that just manages the cutting depth, the overcut would approach the radius of the cutting blade (the radius minus the flange washer).

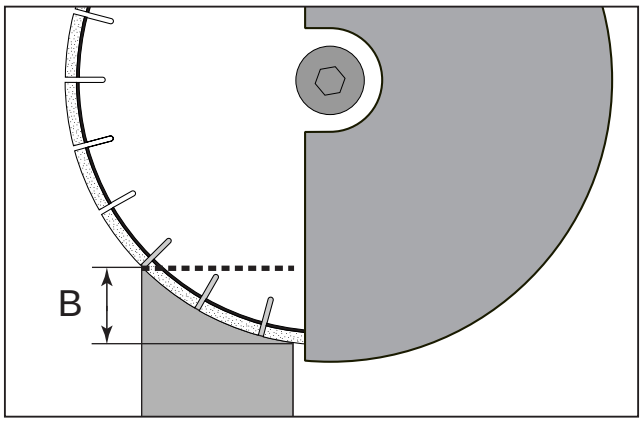
Since the RingSaw's centre is 85 mm inside the cut, the result in a wall thickness of 170 mm is a cut that finishes as the same height on both sides of the wall – in other words, no overcut at all.

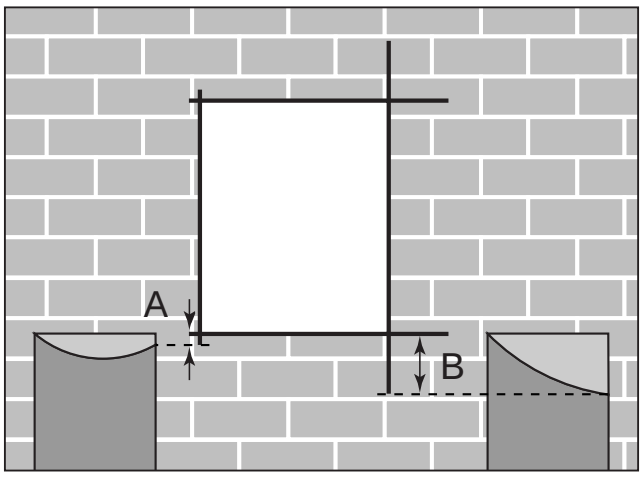
An operator with an eye for precision and order would quite rightly observe that the K3600 overcut is larger than that shown in the figure. However, this overcut is inside the wall, which only causes problems in exceptional cases, for instance if reinforcement rods in the load-bearing joists are found in the path of the cut.

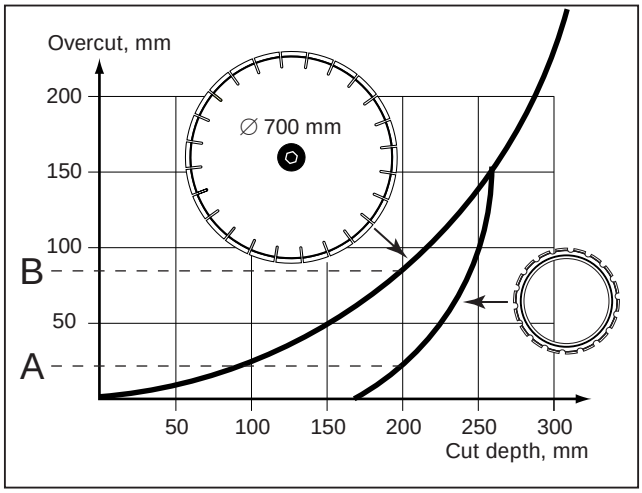
Cutting from two directions
If it is possible to cut from two directions, cutting depth is naturally doubled, while overcut remains unchanged. With the K3600, it is thus possible to cut an object that is half a metre thick with minimal overcutting. The tricky part is to find the corresponding line on the other side of the wall, a problem that is normally solved by drilling along the cut's intersection.











Wall thickness in the above examples is 200 mm. The two upper figures show overcut with the Partner K3600 and a centre-driven cutter (diameter 700 mm). The third figure shows the corresponding cuts as viewed by the operator and in cross-section.
The diagram shows the need for overcutting with the K3600 and a centre-driven cutter respectively, at various cutting depths.

Application areas

The methods available for cutting in concrete, stone and similar materials are in principle as follows:
Small cuts are made with an angle-grinder and dry-cutting blade. Hand-held power cutters can handle cutting depths of up to 150 mm (16" blade) and this can be done with wet-cutting, except in the case of electrically powered cutters. Deep cuts, up to about 500 mm, are made with a fixture-mounted wall-saws or a floor-saws mounted on wheels. Wet-cutting is used virtually all the time. Exceptionally deep cuts are made with diamond-wire or a jet of water under exceptionally high pressure, special methods that we can ignore in this particular context.

The alternative to cutting is hacking with jackhammer and chisels, either hydraulic or powered by compressed air.

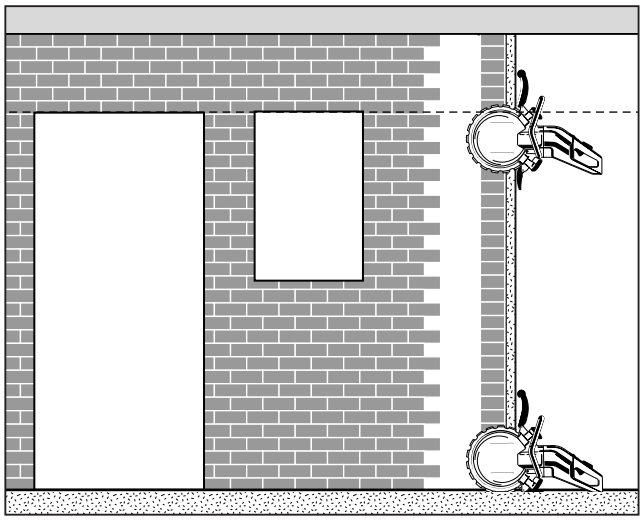
Application areas, Partner K3600
From the viewpoint of capacity (cutting depth), the K3600 lies between the traditional power cutter and the wall/floor-saw.

Compared with the hand-held centre-driven power cutter, the cutting depth is almost double with comparable handling convenience (hand-held and light in weight).

Compared with the wall-cutter, the K3600 has a corresponding cutting depth for normal operations, but it does not require any fixture mounting. In this comparison, the Partner cutter gains the advantage due to its mobility.

In summary, the features that set the K3600 apart are its considerable cutting depth in combination with the convenience of hand-held operation. The drive principle, with the centre of rotation within the cut itself, is another of this machine's unique properties in practical operations, of which we will give a few examples.

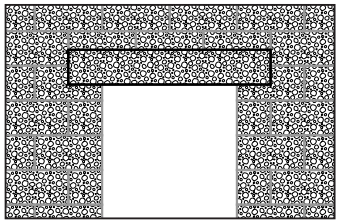
Cutting openings for doors and windows
These very common operations in already-existing buildings demonstrate all the RingSaw's benefits in one and the same example. Assume that the wall is made of brick, 200 mm thick, and that the floor is covered with tiles, in other words a material that cannot be repaired neatly.
– The small scope of the operation, with four short cuts, does not justify the time-consuming setting up of a fixture. What is more, the holes drilled for the fixture will have to be subsequently repaired.
– After necessary overcutting, the cuts cannot be repaired invisibly in the brick wall or tiled floor.
If the wall is cut from one side, the overcut is 23 mm,



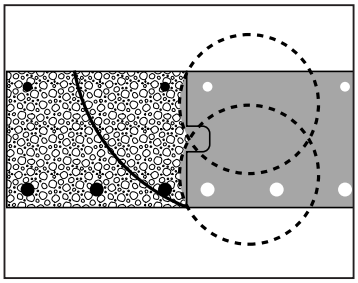
which will be entirely covered by the frame around the door or window. If the cut is made from two directions at the end points, overcut can be eliminated completely at cutting depths of up to 340 mm!

This characteristic, the very modest overcutting need, is a direct consequence of the drive system – centre-driven power cutters always produce overcutting.

Phasing-in of load-bearing joists
After being cut, walls made of breeze-block must usually be provided at the top with a sturdy support, for example a reinforced load-bearing joist or a steel beam. This work requires several cuts in different directions. The hand-held Partner K3600, with its relatively small blade, is usually perfect for this task. The prevalent methods for tackling this job today are to use a wall-cutter or to hack with a compressed-air chisel.



Openings in reinforced elements
Concrete constructions are today being increasingly cast as prefabricated elements, almost without exception featuring reinforcement which should not be cut for reasons of strength maintenance. The RingSaw's considerable cutting depth and minimum overcutting requirement makes it ideal for cutting in reinforced concrete elements. The figure shows cuts in a reinforced joist, cut from two directions using a K3600. The element on the left is to be retained. The solid arch shows the cut that a centre-driven floor-cutter would make.



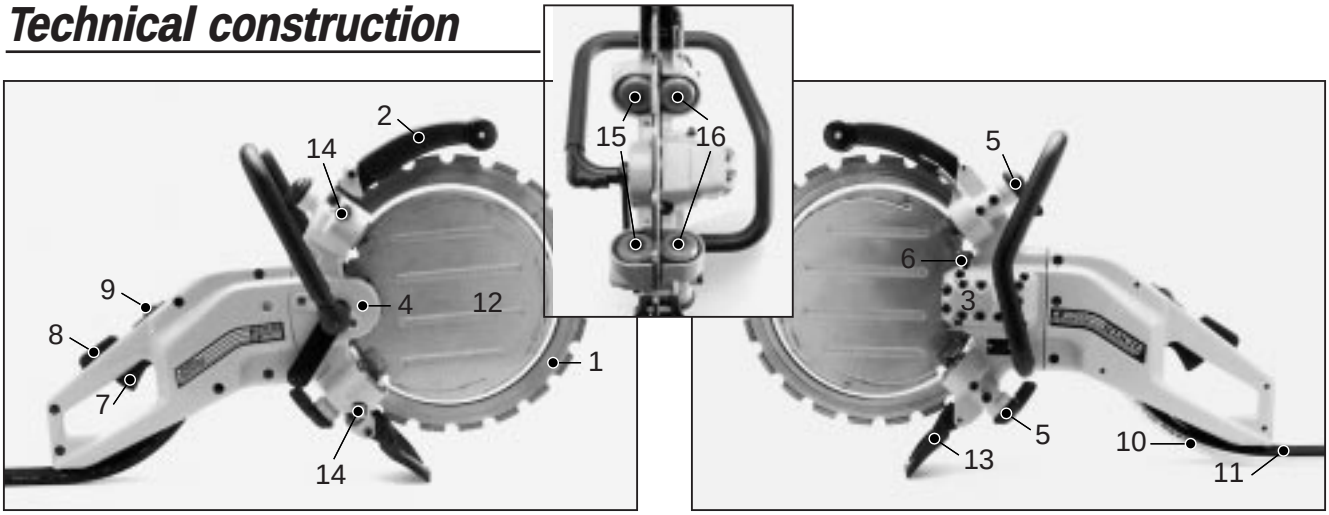
Partner K3600 for the building industry
Just as for power cutters in general, the area of use for the Partner K3600 is difficult to define precisely, but the building industry offers most applications for the Partner K3600.

For rental firms
The K3600 allows companies that only work with concrete constructions on a more irregular basis to use their own personnel to carry out the necessary operations using rented equipment.

Water, sewage, roads...
The cutting depth and the built-in hydraulics give the Partner K3600 an excellent role in other operations too. Cutting in trenches, cutting of openings in culverts and manhole covers are perfect operational areas.

The general requirement in such operations is for a generous cutting depth using a compact hand-held machine that does not produce exhaust gases.
A suitable hydraulic source, such as an excavator, is also often already on site.

Technical construction



Components, Partner K3600
The Partner K3600 consists of the following main units:

1. Cutting blade – ring-shaped steel disc with laser-welded diamond segments
2. Blade guard
3. Hydraulic motor
4. Drive disc
5. Engagement roller handle
6. Lock button for drive disc
7. Throttle trigger
8. Throttle trigger lockout and water on/off
9. Control for adjustment of water flow
10. Water hose
11. Hoses for hydraulic unit
12. Water disc
13. Splash guard
14. Roller adjustment screws
15. Support rollers
16. Engagement rollers

Hydraulic motor

PRESSURE and FLOW
It is important to have a sound working knowledge of pressure and flow in order to understand how the principle of hydraulics works - and even more so when something does not work! We know that for many people, the principles of hydraulics are obvious, while others who do not have previous experience of hydraulic machines are not at all familiar with their workings. That is why we have decided to include a basic section on hydraulics in a separate appendix on page 12. Read this section first if you are not familiar with the principles of hydraulics.

Flow
The hydraulic motor is designed to operate with a maximum flow of 40 litres a minute when the cutter blade has reached its maximum permitted speed of about 3,000 rpm. The speed of flow to the motor is naturally directly proportional to the speed of the blade. The RingSaw itself does not have protection against excessive incoming flow. The hydraulic unit determines the blade's speed entirely independently, and it must be adjusted so that a flow rate of 40 litres/minute is not exceeded. The hydraulic motor itself gives a maximum speed of 15,000 rpm at maximum flow. The ratio between the drive disc and the cutting blade gives the blade the lower speed. Since we know the speed at which the motor operates at 40 litres/minute, we can quickly calculate that pump volume at one turn of the disc is about 3 cl (40,000 cl/15,000 rpm = 2.7 cl). So what we are talking about here is a small motor that has to produce considerable drive force (high hydraulic pressure).

Pressure
The hydraulic pressure in to the machine should never exceed 140 bar. The maximum permitted pressure only ever occurs when the blade is stuck, which is when an overpressure cutout should be triggered in order to prevent damage to the hydraulic cutter and the unit. Since the Partner K3600 does not have a pressure relief valve, the hydraulic unit itself must have some form of pressure limiter. Every hydraulic unit for universal use has a facility for adjusting the maximum pressure.

Partner hydraulic unit
Partner markets its own units that are designed for direct connection to Partner's hydraulically powered machines. These units are available both with electrical power (Partner HE42) and with petrol power (Partner HP40).

Both hydraulic units feature pressure limitation at 140 bar and provide a maximum of 40 l/min. The Partner HP40 allows flow to be changed to 30 or 20 l/min, the stipulated flow-rate classes according to the HTMA standard. The unit can thus be used for tools requiring smaller flow rates.

Both units feature hydraulic fluid cooling.

For further details about the hydraulic units, please see the separate product sheets and technical descriptions.

Other sources of hydraulic power
Construction machines are turning increasingly to hydraulics for their various functions, so many such machines have their own hydraulic pump that we can utilise to drive the hydraulic cutter.

Here are a few common figures: truck with tipper platform, approx. 60 l/min, with crane about 150 l/min. Max. pressure about 200 bar. Excavator (Cat M-series) approx. 40 l/min, max. pressure about 200 bar. Mini-excavator/loader (Bobcat) 30-80 l/min. In other words, most of these machines provide sufficient pressure and flow to drive the Partner K3600 and K2500. The probability that the specifications for flow and max. pressure will fully match those of the K3600 is, however, very slight. The measure that should therefore be adopted is to furnish the hydraulic system with an overpressure valve that triggers at 140 bar, which is a simple remedy. Flow is often proportional to the machine's engine speed, so flow must be measured to determine the correct engine speed in rpm for 40 l/min.

Partner FC40
A simpler and, above all safer, way of regulating flow and max. pressure from other sources is to use the Partner FC40 flow and pressure regulator. It is adjustable for three different output flow rates according to the HTMA standard. The FC40 is described in greater detail on page 11.

Hydraulic connectors

The power cutter is connected to the hydraulic unit via two hoses, a pressure hose and a return hose. Their inner diameter is 1/2".

The hose couplings are 3/8" as per the HTMA standard. They are of drip-free design, that is to say a sealing cap is opened at the same time as the coupling is hooked up. This also reduces the risk of dirt entering the system.

Hose length/pressure loss
Hose length can be extended with an additional 6 m long section, but this results in a slight pressure loss at full flow (40 l/min) owing to the friction generated by the fluid on its way through the hose. Cold fluid and low viscosity exaggerate the pressure loss. If it is necessary to further increase hose length, it is possible to counteract pressure loss by using a larger-diameter hydraulic hose and couplings. The table shows the effect this has.

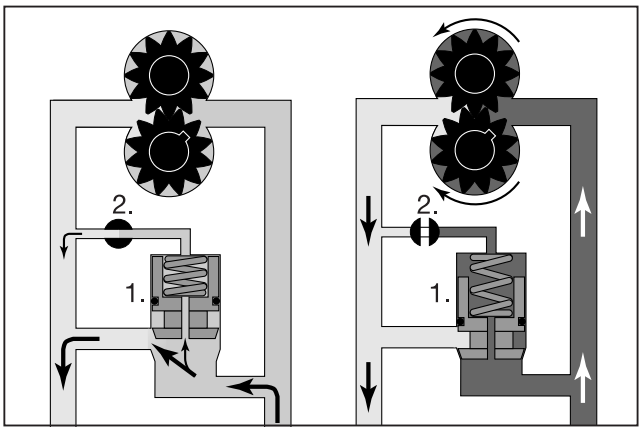
This are the approximate pressure losses at 38 l/min with fluid 30 cSt at 50ºC:

	Dimension	Pressure loss
Hydraullic hoses	3/8˝	2,0 bar/m
	1/2˝	0,5 bar/m
	5/8˝	0,16 bar/m
	3/4˝	0,06 bar/m
Couplings (each)	3/8˝	1,3 bar
	1/2˝	0,4 bar

Throttle

The throttle unit controls the path of the hydraulic fluid, either through the motor when the machine is operating, or past the engine through a bypass channel when the machine is at rest.

Servo-assisted throttle
The new K3600 has a servo function for the throttle, which its predecessor the K3500 lacked. Using this technology, the force needed to maintain the throttle application during cutting has been able to be kept at a comfortably low level.



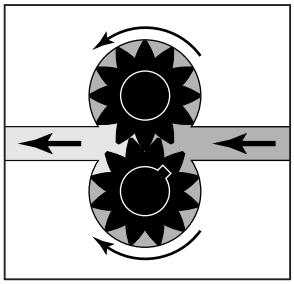
In order to understand the operating principle, we must first examine a few vital components. The main valve (1) has a very small opening that permits a small volume of fluid to flow through the piston, after which it passes the servo valve (2) when this is open. The servo valve is operated on mechanically by the throttle action. A weak spring, which tends to pull the main valve downwards, is also featured. This spring is needed to be able to switch between start and stop.

Engine at rest. The servo valve is open. The fluid can pass through both the bypass channel and the servo channel via the hole in the main valve. The cutter blade gives the motor a certain degree of resistance, sufficient to compress the weak spring above the main valve. Even when the motor is at a standstill, there is a slight pressure difference between the pressure and return sides. This pressure difference provides the flow through the hole in the main valve at the same time as the main valve is pressed upwards and allows the fluid to pass through the bypass channel.

To start the motor. The servo valve is closed. The same pressure is now built up on both sides of the main valve. The spring slowly pushes the main valve down at the same speed as the fluid fills the space above the cylinder. When the bypass channel is fully closed, the motor starts, the main valve is kept in the closed position because the area above the main valve is larger than the area below, at the bypass channel. In this position and with operating pressure, the spring has no locking function. The channel remains closed irrespective of how high the pressure is on the pressurised side.

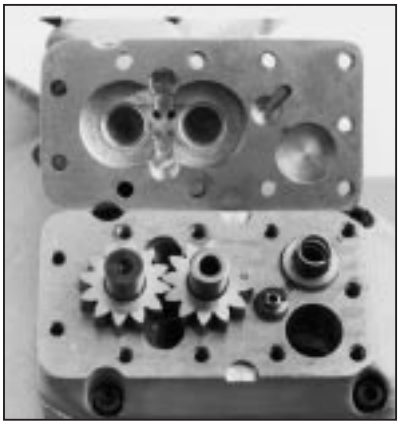
Hydraulic motor

The hydraulic motor is of the gear-driven type. The two gears form a seal where they grip one other and hydraulic fluid is forced into the space between the gears and the motor housing (the outsides) to reach the return side.

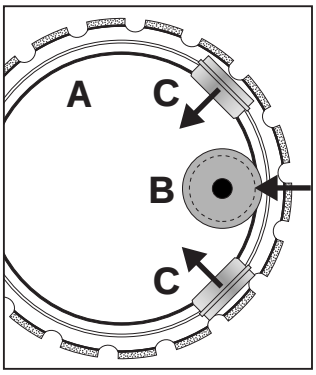


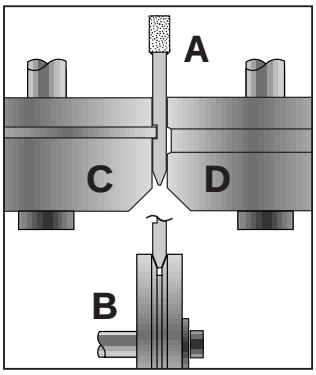
One gear has an output shaft linked to the cutter blade's driving wheel. Since the gears are mechanically linked to one another, power is transferred to the shaft by both gears.

The photograph shows the servo valve on the right of the gear and in the top right, the spring-loaded main valve is visible.



Eccentric drive





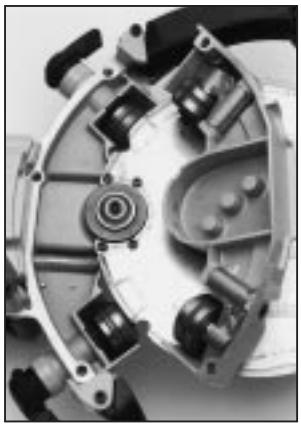
The unique concept behind the K3600 is the eccentric drive of the cutter blade. If the drive system had not given the machine such unique properties, then it would scarcely have made it to the market today. Eccentric drive in practical implementation has imposed considerable demands on development resources and is continuing to place major demands on day-to-day production.

The blade (A) is driven and controlled as follows: the drive disc (B) which is directly linked to the hydraulic motor, has a groove in which the blade rests securely. The two engagement rollers (C) applies considerable tension to the centre of the blade, as a result of which the blade is pressed against the drive disc. The figure on the right shows how the engagement roller runs in the blade groove and provides tension against the drive disc. The only job of the support roller (D) is to provide counterpressure against the engagement roller.

With this design, the blade is located both radially and axially (rotating and lateral movement). Three points regulate the blade at the same time as the force against the drive disc creates sufficient friction to drive the blade.

Drive disc and rollers

Parts subject to wear



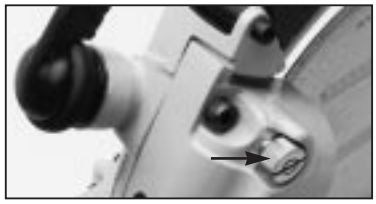
The drive disc, engagement rollers and support rollers are the components that are subjected to wear. The working environment for these components are the worst imaginable, water combined with the finest grade of sand - creating what is probably the best sort of grinding paste known! That is why considerable importance has been attached to making service quick and easy. Since only parts that wear need to be replaced, costs are kept to a minimum.

Drive disc

The drive disc unit can be split and the disc itself can be easily replaced after the centre bolt is removed. The drive disc wears at roughly the same rate as the blade, so both are normally replaced at the same time. During the dismantling process, the drive disc is locked with a catch (above the hydraulic motor).

The correct force against the drive disc and cutting blade is ensured by the spring above the engagement roller, which is compressed when the control is rotated to the locked setting.

Engagement and support rollers



The support rollers are adjusted against the blade to eliminate play via the adjustment screws on the outside of the housing.

The engagement and support rollers are designed in the same way. They consist of a bearing housing that encloses two encapsulated ball-bearings and a (rotating) steel cup to create either a engagement or a support roller. The grooved space is greased to prevent the penetration of water and solid particles into the ball-bearings.

Since only the wear-prone parts (the rotating steel cups) need to be replaced, maintenance costs are kept to a low level.

Cutting blades

Cutting blades for the Partner K3600 are available with a variety of hardness ratings.

They are special blades that are manufactured to stringent demands concerning dimensional precision and body material so as to work in perfect harmony with the blade's drive and control system.

Laser-welded segments - TwinWeld

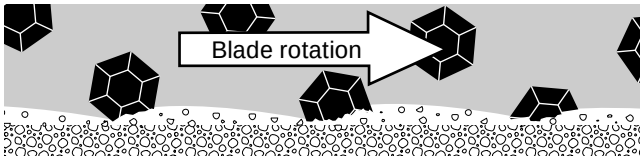
The diamond segments are laser-welded from two directions onto the blade body to stand up to the stresses that a hand-held power cutter can generate. The Partner K3600 is a machine intended for professional use and the diamond segments' quality is among the best that the market offers. Quality in this context means high content of pure (hard) industrial diamonds, which in practice means high cutting speed and long service life. The cutters should always be operated with water-cooling.

The cutting blade package contains a recommendation table for the choice of blade according to material type.

The blade's hardness rating

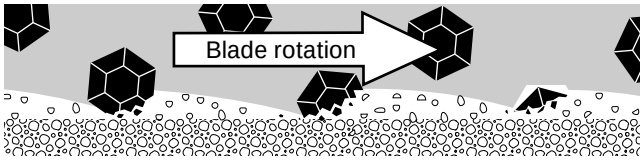
The segment, which is the working part of the blade, consists of small diamonds cast in a metal alloy. When we talk about the blade's hardness, it is the durability of the binding metal to which we refer, not the diamonds themselves. Severely wearing but soft materials, such as brick, require a hard blade while hard materials such as granite need a soft blade.

The diamond is the hardest material known to man. It shatters during the process of wear, thus generating new aggressive and sharp cutting edges. The binding metal, on the other hand, wears away in fine particles. A correctly chosen blade offers a good balance between wear of the diamond and the binding metal.



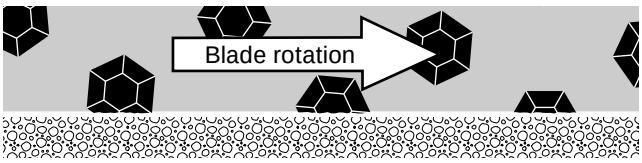
Optimum hardness

The segment wears at a pre-determined rate so that the binding metal wears steadily, slightly more than the diamond cutting edge. On the diamond's "lee" side, the metal is protected by the diamond, thus producing a support lip.



Excessively soft blade

The binding metal wears faster than the diamond. The diamond protrudes too far out of the metal and is split into excessively large pieces before the diamond's potential operating life is actually utilised. The result is high wear rates and poor blade economy.

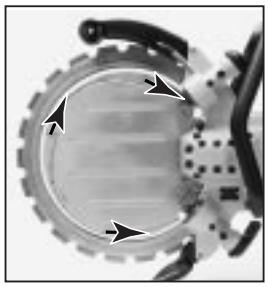


Excessively hard blade

The binding metal does not wear sufficiently to allow the diamond to work. The result is low or even non-existing cutting effect, sometimes together with overheating and glazing of the surface. By cutting in a strongly wear-inducing material such as brick or light concrete, the blade can be returned to operational condition. (Light concrete causes little wear of the diamond, but greater wear of the binding metal.

Water-cooling

Water disc



In order for the cooling water to be effective at the cutting edge, while using as little water as possible for practical reasons, the K3600 is equipped with a water disc with three nozzles that distribute water to the blade. In addition to cooling the blade, the water binds the fine pulverised stone particles so that it can be easily led out via the cutting groove. The U-shaped recess in the blade between the diamond segments serves as a transport channel for the water and the cut material's powder particles.

In addition to leading water to the cutting edge, the water disc also supports the blade to prevent twisting and thus helps ensure a straight cut.

Throttle action regulates water flow

Several practical improvements have been incorporated into the Partner K3600. Instead of having a separate valve for the water, as previously, this function has now been integrated into the throttle action. As a result, water is only delivered to the cutting blade when the machine is operating. The tap has two settings, closed and open.

Variable water flow control

The flow volume is regulated steplessly via a separate valve above the throttle lock-out. This is done conveniently with the thumb while cutting.

The purpose of these improvements is to be able to better control water volume to provide ideal flow and to be able to handle cutting operations more easily in water-sensitive environments, such as indoors. For the operator, there is also less water splash. When cutting in locations where no regard needs to be paid to water splashing, a wet vacuum cleaner can be used to suck up the water.

Ergonomics

Ergonomics are a high-priority area in the design of every Partner cutter. In concrete terms, this means that the machine should be comfortable and safe to use.

Low weight
Every bit of weight that can be saved improves the operator's comfort on the job. The K3600 is made of an aluminium casting instead of as previously from magnesium. Aluminium is stronger, so it can be made thinner. The machine body consists of two cast plastic halves which house the throttle and water cooling controls. Complete with cutting blade, the Partner K3600 weighs only 8.7 kg.

The hoses run under the machine, which means that some of the hose weight is transferred to the cutter blade in the cutting groove – more comfortable for the operator.

Handle configuration
The front handle is longitudinally adjustable. The long handle distance is normally used to ensure best ergonomics and control. By adjusting the handle in the rear position makes it possible to cut against the roof or other obstacles.

Blade guard
The blade guard has two purposes: to protect the operator from unintentional contact with the blade, and to serve as a splash-guard.

The upper blade guard can be angled rearwards so it is not in the way when cutting up against the roof. The rollers at the top ensure that the guard does not get stuck in joins or other surface irregularities.

The lower guard can also be angled fully back to permit unhindered cutting against the floor.

All the controls in the handle
As described earlier, both water supply and the actual volume of water are both regulated from the handle, without requiring the operator to move his hand. This means the operator can work more safely and more comfortably.

Simple service
Regular service encompasses replacement of the engagement and support rollers and the drive disc. Their replacement is quick and simple. After completing a shift, the machine can be simply hosed clean - all the vulnerable parts are fully sealed.

Partner K2500

The hydraulically driven Partner K2500 is the ideal power cutter for many operations, but it is also a valuable complement to the K3600 RingSaw.

The K2500 has a cutter unit for 16" (400 mm) blades, and can handle cuts to a depth of 145 mm. With its weight of 8.3 kg (without a blade) it has an unbeatable power to weight ratio. The K2500 is ideal for large operations that require free-hand cutting for long periods of time.

Application area

The Partner K2500 naturally requires a source of hydraulic power, so it usually comes into its own in larger, more stationary operations or where there is always easy access to hydraulic power.

Indoors – no exhaust gases
The K2500 is unsurpassed among centre-driven machines for free-hand cutting indoors with water-cooling. Electrically powered cutters can, of course, only be used for dry cutting.

Trenches, wells
The Partner K2500 is ideal for cutting in trenches, wells and so on – operations typical of water & sanitation maintenance, road-building and similar applications. With its entirely sealed drive system, the K2500 is less vulnerable in difficult environments such as clay, water, dust etc., compared with a petrol-powered cutter. Carbon monoxide, which is produced by combustion engines, is toxic and is heavier than air, so it collects in recesses. The K2500 is a safer choice for such environments.

Almost all operations involving work underground also require the services of an excavator, and many have a hydraulic flow suitable for the K2500.

Supplement to the K3600
With its centre-driven design, the K2500 is less sensitive to rough handling and has virtually no components that are subjected to wear, which lowers the cost per cut surface compared with the K3600.

Since both machines use the same hydraulic source, many cutting specialists supplement their K3600 with a K2500 for work that does not involve greater cutting depths. The K2500 can thus also be used for cutting walls, for shallow cuts before switching to the K3600 for the full cutting depth. Blades for this purpose are available with the same segment width as for the K3600 (4.5 mm).

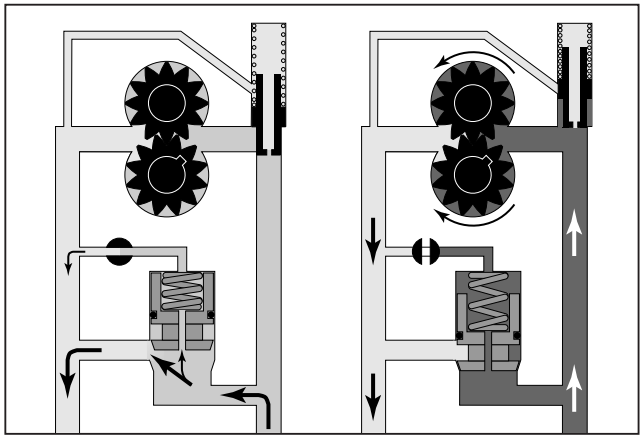
Rail-cutting
The Partner K2500 is an ideal machine for cutting rails owing to its high power output. Together with the Partner RA10 rail-cutting fixture, it is easy to produce a perfect right-angle cut in just a couple of minutes.

Hydraulic motor

The hydraulic motor and servo system are virtually identical with those of the K3600 (see page 6). The hydraulic motor's gear is 25.8 mm high instead of 9.5 mm, giving the K2500 a lower rotating speed of 4,100 rpm at 40 l/min, which the belt transmission then steps up to the blades speed of 4,800 rpm.

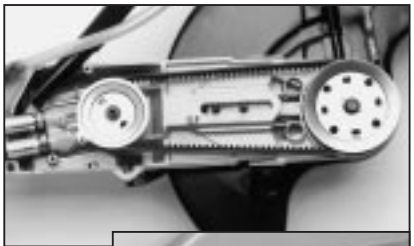
The transmission system of the K2500 is virtually friction-free and the small pressure difference between the feed and return sides when no throttle is being activated, would easily allow the hydraulic fluid to pass through the motor via the bypass valve. The solution is the spring-loaded valve at the motor that forces the fluid to pass through the main valve. The thin duct is the drainage route for the valve.

When the throttle is activated, pressure increases and the valve gives the fluid a free path to the motor. The valve also serves as a brake and stops the blade in just a few seconds when the throttle is released.



Cutter unit

Like Partner's petrol-powered power cutters, the K2500 has belt-drive transmission. Compared with direct drive, the belt provides gentle power transmission that is easy on the hydraulic motor's bearings. The spindle shaft's bearings, which are far more robust, are instead designed and dimensioned to absorb the vibration generated in cutting operations.



The K2500 has naturally been equipped with Partner's semi-automatic belt adjustment - the work of just a few seconds - making this the only scheduled service that the Partner K2500 requires!

The machine is built for 16" cutting blades and the flange washers for the blade are rotation-inhibited to the spindle shaft, avoiding any tendency to self-tighten. The spindle shaft features easily replaceable centre bushings for fitting blades with the following hole diameters: 20.0, 22.2, 25.4 (1") and 30.0 mm.

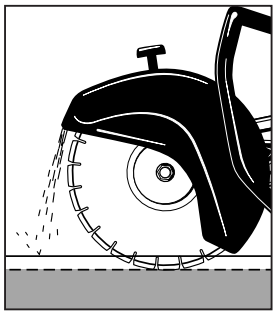
Reversible cutter arm

One valuable feature is that the cutter arm is reversible. This makes it possible to cut close to a wall or at floor height with the blade guard as the only limiting factor. In order to exploit the machine's excellent ergonomic properties, the cutter arm should normally face the right way.

Blade guard

The blade guard is by far the machine's most vital safety feature. Its normal task is to direct cutting dust away from the operator, but it must also withstand the effects of a malfunctioning blade. The blade guard is made of steel plate, with its thickness doubled at the periphery.

The blade guard must be adjusted to suit the type of work being undertaken, and often even during the course of the work itself. This adjustment must therefore be able to be done quickly and simply, as with Partner's single-hand operated blade guard. In general, the blade guard's rear edge should rest against the object being cut. Most of the particles then follow the guard and exit forwards.



The blade guard is factory-prepared for fitting of a wet-cutting unit.

Ergonomics

Design solutions with a firm eye on good ergonomics are a hallmark of Partner machines, and in this family, the K2500 belongs among the elite.

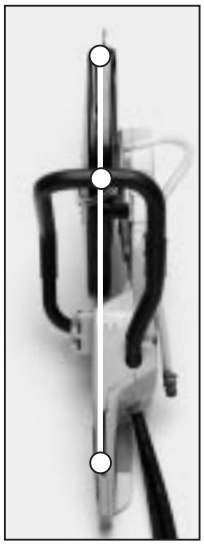
Weight: 8.3 kg

The fact that the drive unit lies outside the machine gives the K2500 first prize in ergonomics, owing to its low weight and balanced weight distribution. What is more, the machine is slim, so the operator has the machine's centre of gravity close to his body, which is the most comfortable position.

Handles

The grip on the front and rear handles is in line with the cutting blade, so that feed pressure lies directly over the blade and the cut itself is automatically straight.

For horizontal cutting, when the operator carries the whole machine, the forward handle gives correct weight balance.



Partner FC40

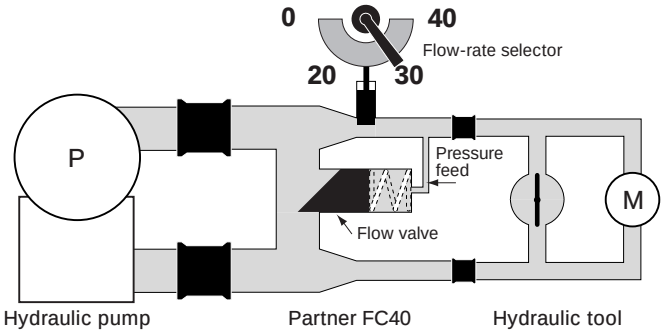
The Partner FC40 is a practical accessory for regulating pressure and flow from a variety of hydraulic pumps to hydraulic tools. The FC40 can be coupled to a hydraulic pump which produces maximum 120 l/min and a max. pressure of 210 bar.

In the construction industry, there are many machine types with suitable ratings for hooking up to the FC40, such as excavators, loaders, trucks and so on.

HTMA standard

The FC40 can be set at a choice of three fixed output flow rates – 20, 30 and 40 l/min. These ratings match the HTMA standard, which means that the FC40 can be used for tools other than Partner's own power cutters. For tools that do not conform to the HTMA standard, intermediate ratings can be set.

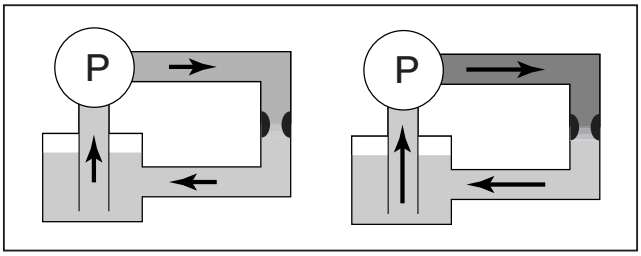
The maximum pressure against the tool is set at 140 bar, but this can be adjusted if necessary.



Structure

A hydraulic pump with its return system is connected to the FC40's "IN" coupling, while the tool is coupled to the "OUT" coupling.

Flow to the tool is set with the flow-rate selector. Flow is reduced by constricting the inlet duct. This increases the pressure in front of the restriction as in the following diagram.

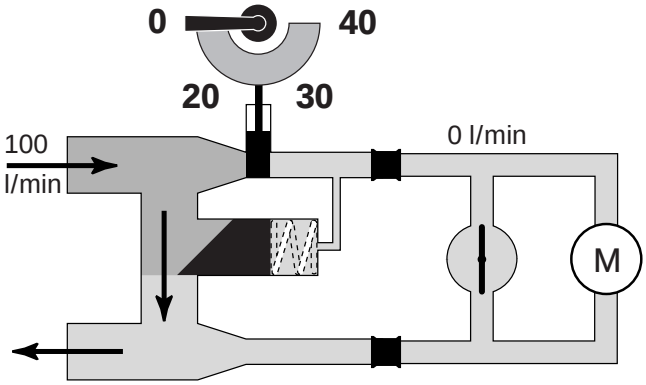


In the diagram on the left, the flow rate is slow and the pressure difference on the two sides of the restriction is very small.

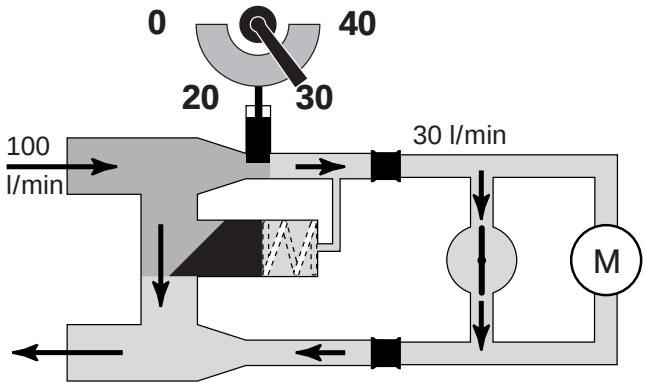
In the diagram on the right, the flow rate is high. The pressure ahead of the restriction is high, while the pressure after the restriction is the same as before. This pressure differential at varying flow rates is used by the FC40 for flow-rate regulation.

FC40 flow-rate regulation

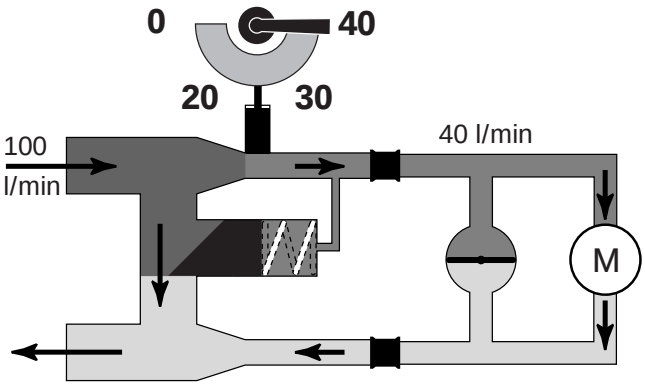
In order to explain the function of the flow-rate regulation system, we can study a few different cases.



We can first study the function of the flow-rate selector. This is set at "0", the duct is closed and the full volume of fluid must be fed back to the return side. Flow from the pump presses the spring-loaded flow valve to the side and allows the fluid to pass under relatively low pressure.



In the above figure, the flow-rate selector is set at 30 l/min. The inlet to the FC40 is partially restricted and most of the fluid passes through the flow valve directly to the return side.

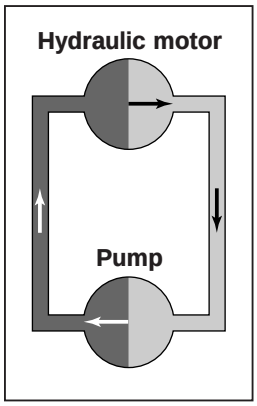


A Partner cutter is put to work (40 l/min). The pressure (resistance) increases in the supply line. This pressure is also led through the narrow duct to the rear of the flow valve, pushing it to the restricted setting. The higher the pressure in the feed line, the firmer the restriction and vice versa. Flow to the tool remains constant.

In this description, we have entirely ignored pressure control, which is an over-pressure valve in line with the simple principle described on page 14, "Overload protection".

Appendix: Hydraulics

The term "hydraulic" refers to the transfer of power using some form of fluid. The fluid that is used in this context is oil, which apart from serving as the medium for transferring power, also lubricates and cools the system's components. Hydraulic power transfer normally operates in a sealed system, that is to say the fluid medium that is used is returned to a container from where it is reused. A hydraulic system consists of a power source, a pump of some sort and a recipient that performs some kind of work, for example a hydraulic motor. Often, transmission links of some kind are also required, for example hoses or pipes. A comparison with a mechanical system helps clarify this set-up, for example with a motor or engine, a chain and a wheel.

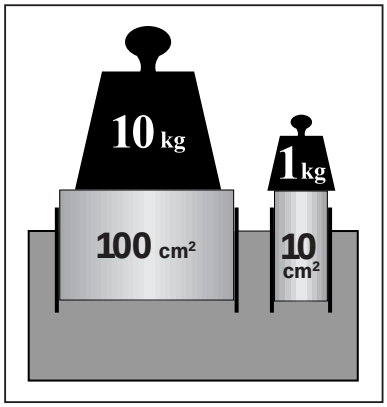


PRESSURE AND FLOW

Two terms are fundamental when it comes to hydraulics, namely pressure and flow. Proper understanding of how these work and interact will help solve most problems and answer most questions that may arise.

Pressure

In order to describe pressure, we use the example of a static hydraulic system. This example also shows how hydraulics can be used for motion and power gearing. The figure here shows a sealed container containing water. The container has two movable pistons, one with an area of 100 cm^2 and the other just 10 cm^2. We place a weight of 1 kg on the smaller piston and 10 kg on the large piston. The following will apply:



Weight balance. Since the weights are proportional to the areas on which they are placed (1 hg/cm^2), the system remains in balance, and the pistons will not move.

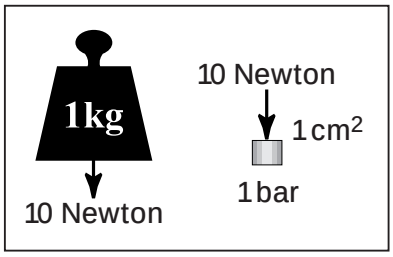
Movement gearing. The piston areas in contact with the fluid have a ratio of 1 to 10. If we press down the small piston 10 mm into the fluid, the large piston will rise 1 mm. The same fluid volume will now have exchanged places between the two pistons, and we have used hydraulics to create movements of different magnitudes.

Power gearing. Gearing of movement also promotes gearing of power – that which is lost in terms of movement is gained in terms of power. The load of the small piston gives a lifting power on the large piston that is 10 times greater.

These basic physical properties are used for functions in hydraulic and pneumatic systems and in such applications, very complex functions can often be carried out using surprisingly simple mechanical designs.

Dimensions for pressure.

Pressure must always be measured over a given area in order for it to be meaningful as a dimension, usually per square centimetre. Pressure was previously often measured as kg/cm^2 (actually kp/cm^2), a method that is still widely used because it is so easy to grasp since we have a clearer understanding of weight as a dimension. Since engineers and physicists prefer the dimension of Newton for weight and power (10 N corresponds to 1 kp), the "bar" is often nowadays used as the unit for expressing pressure, for instance in hydraulic systems (1 bar corresponds to 1 kp/cm^2). A power of 10 Newton/cm^2 gives a pressure of 1 bar. Note that each square centimetre-sized surface unit of the container we described earlier is subjected to a pressure of 1 bar. We can thus measure pressure anywhere we like in the container.



Flow

Flow in a hydraulic system is the fluid's speed of movement, often measured in litres per minute (l/min). In more or less static systems, such as a hydraulic jack, flow is unimportant. However, if we want to drive various devices hydraulically at set speeds, such as cranes, vehicles, power cutters and so on, flow is a vital parameter.

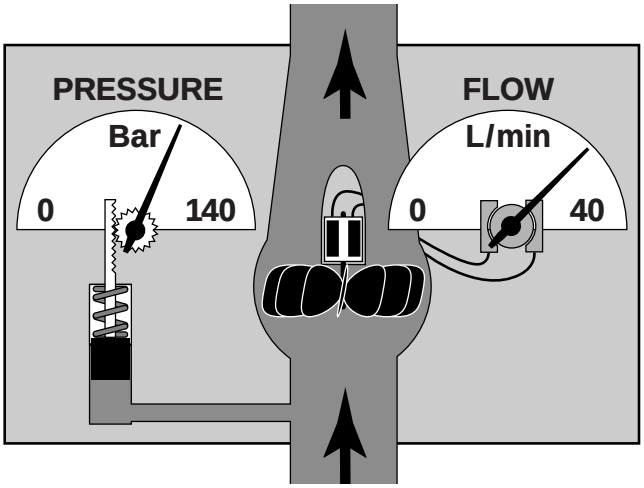
The hydraulic unit pumps a predetermined volume at a given rotational speed or pump stroke. If the pump's speed is altered, then flow too is changed. If we know the pump's capacity, we can calculate the movement at the other (receiving) end. If we know the hydraulic piston's area, we can calculate the rotational speed, and if we know the hydraulic motor's flow-through volume per revolution, then we can calculate the speed.

Measurement of pressure and flow

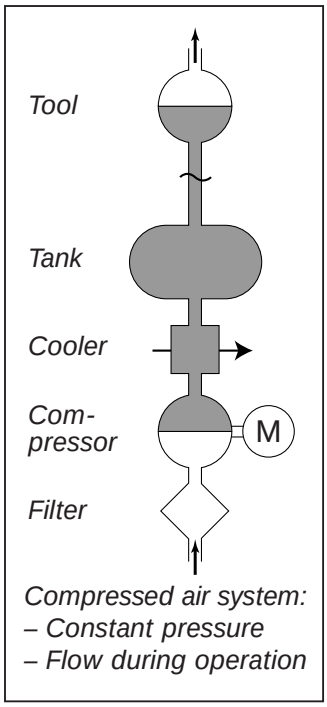
For many hydraulic applications, we want to be able to measure pressure and flow. The model below shows the principle of how such a measuring device is designed.

Flow is measured through an open duct with a propeller connected to a generator that serves as a sensor. An electrical gauge shows the flow rate.

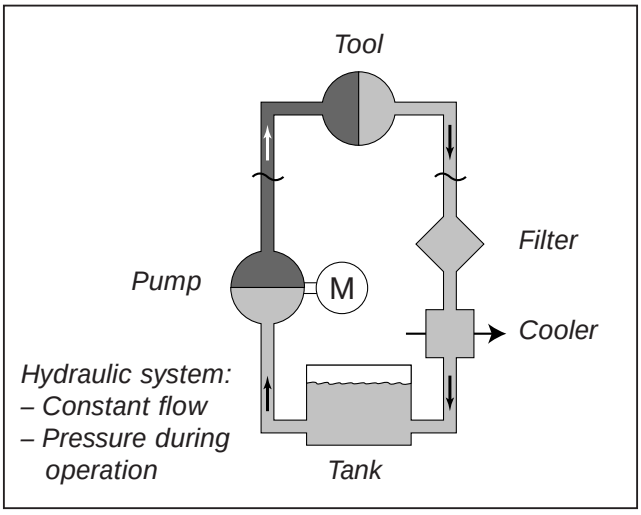
Pressure is measured by a spring-loaded piston that varies its position with changes in pressure. The piston's position is registered by a gauge.



Hydraulics compared with compressed air
For people used to compressed-air applications but not familiar with hydraulics, a comparison between the two is valuable since the operational principles are entirely different. One basic difference is the following:
A gas can be compressed whereas a fluid cannot.
A compressed air system utilises this to build up the energy that is subsequently used: the compressor builds up pressure that is collected in a tank. When no air is being consumed, there is no flow. The pressure in the system is constant.
In practice, there is normally a slight variation in pressure. The compressor has an activation and deactivation pressure within a given interval, which however does not play any role in the operational principle.



Hydraulics - rigid power transmission
For practical reasons, hydraulic systems are always built in a closed loop. Hydraulic fluid is pumped in a circuit where in each cycle it passes through an operational phase and a return phase before being collected in a tank for reuse.



As we said earlier, a fluid cannot be compressed, which means that as long as the pump runs at a constant speed, the flow in the system is also constant, which is exactly the opposite of the compressed-air system.

At what pressure does the hydraulic system operate? If we imagine for a moment that no resistance is offered by any part of the system, the fluid will be pumped without any pressure. If we connect a tool that performs heavy work (high resistance), pressure will naturally increase between the pump and the tool. Pressure is thus dependent on the work that is being carried out.

Practical differences - pneumatics/hydraulics
One important difference between pneumatics and hydraulics is that several cools can be connected to the same compressor in a pneumatic system since the pressure is constant and there is a state of flow during the work. Since the hydraulic system provides varying pressure during operation, it is impossible to add more power cutters to a single hydraulic unit.

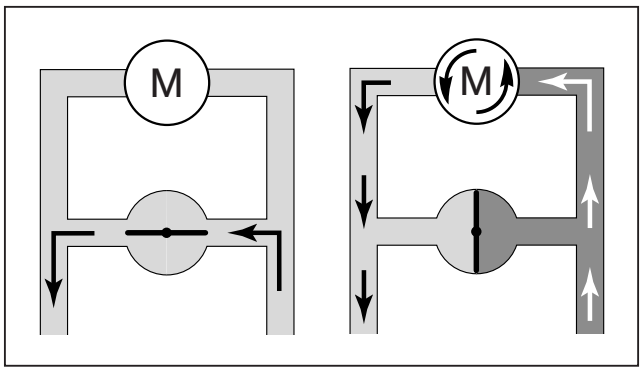
The benefit of the hydraulic system in driving a power cutter – and for many other applications – is the fact that a fluid cannot be compressed. Therefore, power transmission remains exactly the same as if there was a mechanical link. As a result, the cutting blade rotates at the same speed irrespective of load – as long as the power source maintains a steady pump capacity.

If instead we imagine a pneumatic system, the cutting blade's speed would vary with load. We have admittedly said that a pneumatic system operates with steady pressure, but as soon as the air has the opportunity to expand, it will do so. If we inject compressed air into a pneumatic motor that does not have any resistance, the volume of that air will expand upon entry and thus boost speed; under load, the air would once again shrink in volume. The disadvantage of compressed air for equipment that needs to operate at a steady speed under varying load conditions is thus obvious.

The hydraulic system's constant flow, which cannot be varied at will, naturally requires constructive solutions so as to be able to vary the tool's rotating speed. We will now see a few common solutions that are applied in hydraulic systems and for Partner hydraulic power cutters.

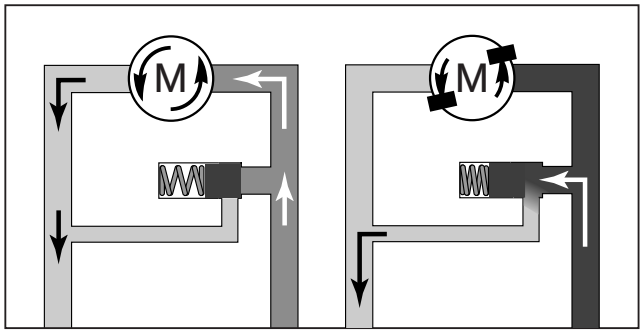
Bypass
Since we cannot vary flow in a hydraulic system, an alternative solution must be employed. We must instead lead some or part of the fluid via a different path. This so-called bypass solution is used for many functions in various hydraulic tools. This basic principle is also termed "open centre". (A hydraulic jack operates according to the "closed centre" principle.)

Regulating flow. Assume that we want to vary flow to the tool (M) but that we cannot change either the pump's speed or displacement (volume).



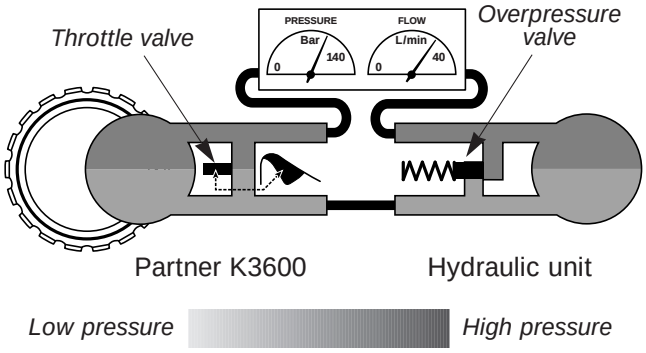
By leading some of the fluid directly to the return side, the flow to the tool can be varied. This principle is used for throttle control in Partner hydraulic cutters. When the machine is not operating, the entire flow passes virtually without pressure through the bypass valve. When the throttle control is pressed in, the bypass valve is closed and the hydraulic fluid is forced to pass through the motor.

Overload protector
A bypass valve is also used in hydraulic systems to protect the equipment from overpressure. A spring-loaded valve keeps the duct closed up to the maximum permitted pressure. If the hydraulic motor is suddenly blocked during operation (the cutter blade gets stuck while spinning) the pressure rises abruptly to the level at which the pressure pushes the piston towards the return side and permits the fluid to pass through.

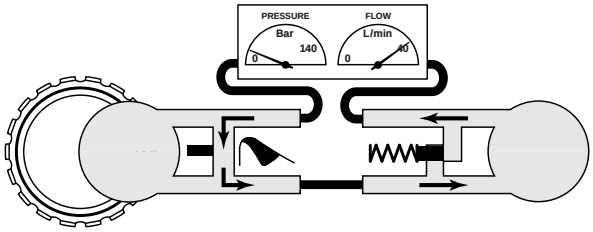


An overload protector of this type is normally found in all hydraulic units. Partner hydraulic cutters therefore do not have this feature duplicated in the machines themselves.

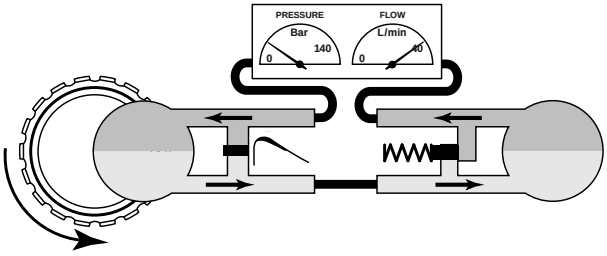
Partner K3600 and hydraulic unit
We will now see how pressure and flow interact in principle in a variety of situations with the Partner K3600/ K2500 and the Partner hydraulic unit. Measuring equipment for pressure and flow are connected to the pressure side. The cutter has a bypass valve that is regulated by throttle action and the hydraulic unit has an overpressure valve that activates if pressure exceeds the maximum permitted.



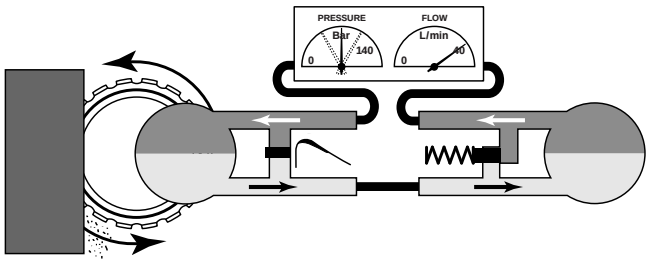
The pressure side of the hydraulic system is described by the upper half and the return by the lower half. As we shall see, there will be no change of pressure on the return side, only the flow path is changed under certain circumstances. That is why we only need to measure what happens on the pressure side, that is to say the side to which the hydraulic unit provides flow and pressure, and which drives the power cutter.



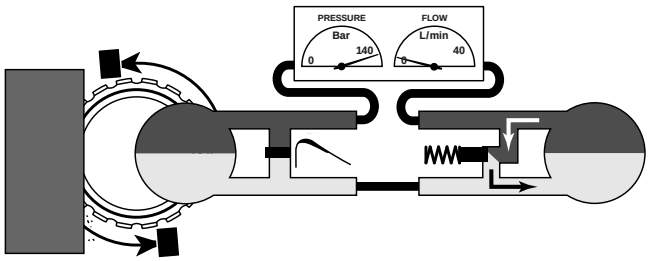
Idling
The hydraulic unit is operational and provides its preset 40 l/min. The throttle on the cutter is at the stop setting, so the throttle valve is open and allows all the fluid to pass freely through the bypass valve. The pressure and return sides are practically without pressure, and the blade is at a standstill.



Start
Work is about to begin, the throttle is pressed in so the throttle valve closes. The fluid is now forced to pass through the hydraulic motor and the blade rotates. The pressure is somewhat higher now since some power is required to rotate the blade.



Cutting
When the blade rotates in the material to be cut, resistance naturally increases and pressure rises on the pressure side. Depending on how heavily the machine has to work, the pressure gauge will show readings close to the normal rating.



Blade gets stuck
The blade gets stuck. Flow to the power cutter is cut off and pressure rises to the level at which the overload protector valve in the unit opens and allows the fluid to enter the bypass duct. As soon as the operator releases the throttle, the overpressure valve will close and the fluid will pass through the power cutter's bypass valve, as in the picture entitled "Idling".

Technical specifications

Partner K3600

Blade diameter		350 mm (14″)
Cutting depth		260 mm (10″)
Peripheral speed – max speed		55 m/s – 3000 rpm
Engine speed at 40 l/min (max)		15,500 rpm
Hydraulic motor		gear-wheel (open-center)
Power		4.3 kW
Hydraulic pressure, max		150 bar (2,200 psi)
Oil flow, min – max		35 – 42 l/min (9–11 gpm)
Weight, excl. blade		8.3 kg (18.3 lbs)
Weight, blade		0.8 kg
Dimensions with blade :	Length	730 mm
	Width	275 mm
	Height	410 mm
Spec. hydraulic fluid		46 cSt HSH
(Partner recommends environmentally classified hydraulic fluid)		
Fluid temperature during operation, approx		ca 60°C
Hydraulic couplings		1/2″ FF (3/8″ thread)
Water consumption, approx		4 l/min
Noise pressure level, at the operator's ear, as per CEN/TC255N150 och ISO/DIS11201		99 dB(A)
Noise power level, as per CEN/TC255N150 och ISO3744		110 dB(A)
Vibration level, handle vibration as per ISO/DIS 8662-4:		
Front handle		4.3 m/s^2
Rear handle		6.0 m/s^2
Tightening torque:		
Bolts, power cutter housing		4 Nm
Bolts, motor housing (socket head cap screw)		10 Nm
Drive gear (socket head cap screw)		10 Nm
Bolts, roller cover (socket head cap screw)		10 Nm
Motor installation bolts (socket head cap screw)		10 Nm

Partner K2500

Blade diameter		400 mm (16″)
Cutting depth		145 mm (5-3/4″)
Peripheral speed – max speed		55 m/s – 4,300 rpm
Engine speed at 40 l/min (max)		15,500 rpm
Hydraulic motor		gear-wheel (open-center)
Power		5.2 kW
Hydraulic pressure, max		150 bar (2,200 psi)
Operational pressure		130–140 bar (2,000 psi)
Oil flow, min – max		35–42 l/min (9–11 gpm)
Weight, excl. blade		8.3 kg (18.3 lbs)
Dimensions with blade :	Length	710 mm
	Width	180 mm
	Height	430 mm
Spec. hydraulic fluid		46 cSt HSH
(Partner recommends environmentally classified hydraulic fluid)		
Fluid temperature during operation, approx		ca 60°C
Hydraulic couplings		1/2″ FF (3/8″ thread)
Noise pressure level, at the operator's ear, as per CEN/TC255N150 och ISO/DIS11201		84.5 dB(A)
Noise power level, as per CEN/TC255N150 och ISO3744		105 dB(A)
Handle vibration as per ISO/DIS 8662-4:		
Front handle		7.5 m/s^2
Rear handle		5.2 m/s^2

Partner FC40

Input flow, max		120 l/min
Input pressure, max		210 bar
Output flow		20, 30 or 40 l/min
Justerbar övertrycksventil, förinställt		140 bar
Couplings on the outside		1/2″ flat face (3/8″ thread)
Thread on the input side		1/2″ BSP
Pressure gauge		0–200 bar
Weight		4.2 kg
Dimensions with hydraulic couplings:	Length	190 mm
	Width	210 mm
	Height	225 mm

Conversion tables

Other dimensions for pressure and flow than those we have given here are also in use. The following conversion tables can be used when non-Partner equipment is being used.

USA

The following units of measurement are common in the USA:

Flow: gpm (gallons per minute)
1 US gallon = 3.785 litres

1 gpm = 3.785 litres/minute
1 litre/minute ≈ 0.264 gpm

Note: when calculating volume, the Imperial gallon (from the British Imperial System) is also used.
1 Imperial gallon = 4.546 litres.

Pressure: psi (pounds per square inch)

1 psi = 0.0689 bar
1 bar = 14.51 psi

Calculation of power

Hydraulic power (P) expressed in kilowatts can be calculated as follows:

$$P = \frac{Q \cdot p}{600}$$

P = kW
Q = flow in l/min
p = pressure in bar

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