

The combine, also known as a combine harvester is an expensive and complex piece of machinery, which must work to its maximum for its short working season. With some top of the range combines costing in excess of £100,000 any downtime is very expensive in terms of lost production.

The modern combine harvester is a versatile machine designed to efficiently harvest a variety of grain crops. Its name comes from doing three separate parts of harvesting crops at once:

- **Reaping:** cutting and collecting crops when they are ready for harvesting,
- **Threshing:** separating the parts of a crop that can be eaten by people from the parts that can't, and
- **Winnowing:** removing the already separated parts of the crop that can't be eaten by people, the chaff, while keeping the part that can be eaten, the grain.

So what crops can be harvested using a combine?

- Wheat
- Oats
- Rye
- Barley
- Corn (maize)
- Sorghum
- Soybeans
- Flax (linseed)
- Sunflowers
- Canola

Once the crop is harvested, farmers will leave all of the waste straw behind in the field. This the remaining dried stems and leaves of the crop with limited nutrients which is either chopped and spread on the field or baled for feed and bedding for livestock.

FACT: Far fewer people work in the farming industry because of the combine harvester. They are one of the most economically important labour saving inventions, significantly reducing the fraction of the population that must engaged in agriculture.

There are two main reasons for machine inefficiency: combine malfunction and operator error. The first of these can be reduced by efficient out of season servicing and repair. The second can be reduced by training, and most manufacturers run excellent operator courses.

Threshing and separation

Once the cut crop is fed into the combine it is threshed and separated:

- Threshing frees the seed from the ear.
- Separation sends the grain for cleaning and the straw to the straw walkers.

Threshing and separation are different for conventional and rotary combines.

In the conventional combine the threshing and separation is carried out by a cross mounted threshing drum and concave. Behind this are up to

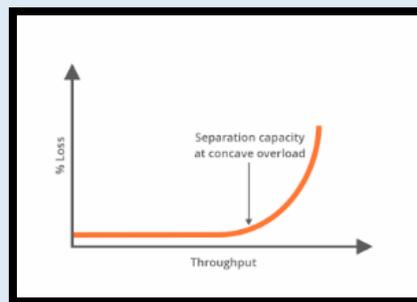


six stepped straw walkers which continue separating the grain from the straw. As there is a limited amount of concave wrap around the threshing drum – up to 120 degrees – there is only a limited time in which threshing can take place. As a result conventional combines need straw walkers to complete the separation.

Combine performance monitors

Performance monitors enable the operator to obtain maximum output from the machine at an acceptable grain loss. These very useful aids to harvesting are fitted as standard equipment to most combines but can be fitted to other models as an optional extra.

The graph below shows how grain loss remains acceptable until a point where the loss increases rapidly when the separation capacity of the concave is overloaded.



The performance monitor – a light band or needle indicator– shows the level and degree of grain loss and so allows the operator to drive just below point of overload.

The grain lost from the combine falls on two sensors, one at the end of the sieves and the other under the back of the straw walkers. The hard grain hits the sensors and generates small electrical impulses passing via the wiring loom to the control box on the operator's platform. The control box filters and amplifies these impulses to give a visual reading of loss. The monitor must be set up for the crop being harvested, by noting the ground speed at which an acceptable loss occurs.

Note that monitors cannot be used effectively to detect small seeds (grass, rape, etc), as the impulses caused by the straw are greater than those caused by the seed. Always refer to the operators manual for correct settings and use.

Grain stripping head combines

Combines fitted with a grain stripping head instead of a cutter bar can increase throughput by up to 100% whilst generally maintaining loss figures at levels as good or even better than a conventional cutter bar.

A stripping action reduces the straw intake by as much as 80% in good conditions. However in laid crops it is inevitable that more straw is taken in and this reduces the increase in throughput.

Crops that have been successfully harvested with a grain stripping head include barley, wheat, grass, linseed, rice and peas and, with less success, navy beans, flax, and sugar beet seed. In practice the capacity of the stripping head has not yet been fully exploited as combine rear end losses and driver comfort at high speeds often prove to be limiting factors.

The harvesting is completed by a stripping rotor that pulls the ear and top part of the stem from the main body of straw, thus reducing the amount of straw entering the combine. The pulling action is carried out by the specially shaped plastic fingers mounted on an octagonal steel rotor. These fingers are manufactured in lengths of 600mm which are easily replaced if they should become damaged. They have a life expectancy of around 300 ha.

The height of the header rotor is adjustable from the cab but is normally set at around 150mm from the ground. When working in laid crops the header is allowed to float over the ground using header skids and a combine float system.

Stripping rotor

The rotor is driven mechanically and has a six speed gearbox mounted on the rear of the header. The speed range available is 300 rpm to 800rpm and the drive line is protected by a ratchet type torque limiter and an over running clutch.

Conveyers and auger

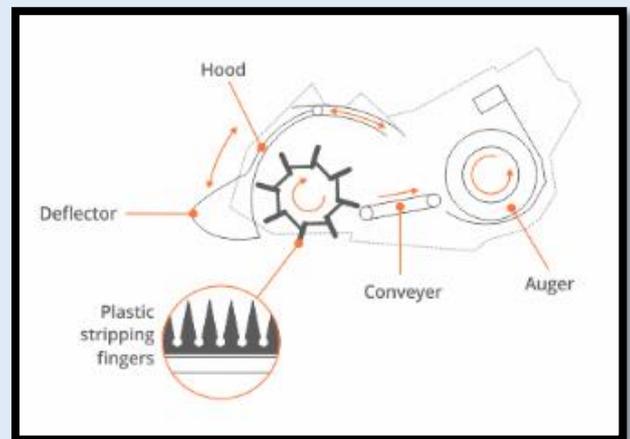
The conveyers are designed to require minimal maintenance and are fitted with endless plastic belts complete with guide strips. The belts are self tensioning but can be adjusted using a torsion tube arrangement. A conventional scroll-type auger is fitted with four rows of retracting fingers to aid the crop flow into the combine elevator. The conveyers and auger are chain driven from the combine drive shaft via a lay shaft at the rear of the header; the auger is protected by a slip clutch.

Adjustable deflector and hood

An adjustable deflector can be varied in height to suit differing crop heights. It is set so that the lowest heads of crop are approximately 100mm below the top of the nose. The hood shape ensures optimum crop flow and minimal grain loss.

Combine power requirements

The stripper header requires more power than the conventional header because 40% - 90% of the grain is threshed at the rotor and forward speeds may be twice that of the conventional header. In some combines additional curtains over the straw walkers may be required to aid grain separation and increase throughput.



Warning statements

Most manufacturers use this symbol to draw the operator's attention to a specific safety issue; the symbol may then have a precautionary statement displayed: CAUTION, WARNING or DANGER.

Caution

The word CAUTION is used where following operating and maintenance instructions will protect the operator and others from accidents.

Warning

The word WARNING means a potential or hidden hazard which could possibly cause injury. It is used to warn operators and others to exercise due care and attention to avoid a surprise accident with machinery.

Danger

The word DANGER denotes a forbidden practice that would pose a serious risk. Failure to follow the CAUTION, WARNING or DANGER instructions may result in serious bodily injury or death.

Machine safety

Additional precautionary statements ATTENTION and IMPORTANT are followed by by specific instructions. These statements are intended for machine safety.

Attention

This is used to warn operators of potential major machine damage if a certain procedure is not followed. Important. This is used to inform the operator of potential minor machine damage if a certain procedure is not followed.

General operating safety

Most farm machinery accidents can be avoided by following a few simple safety precautions.

The combine should only be used by a skilled operator familiar with all the controls and harvesting techniques on cultivated land with slopes up to a maximum of 25% (15° degrees) uphill and downhill and a maximum 36% (19° degrees) sideways (with good even ground and sufficient tyre grip conditions).

Before operating the combine ensure that all safety guards are installed. Before starting the engine, ensure everyone is clear of the combine.

The diagram below is labelled with all of the key parts of a combine harvester.

