Operating Manual

Mechanical Blossom Thinning Machine

DARWIN 150
DARWIN 200
DARWIN 230
DARWIN 250
DARWIN 300
Subject to technical changes

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Printed in Germany

Before using the mechanical blossom thinner, read carefully these operating instructions!

• The mechanical blossom thinner must be exclusively used for thinning blossoms of pome fruit and stone fruit trees. It is not suitable for any other use.

• The thinner must be towed exclusively by a tractor with a closed cabin. If a closed cabin is not available, it is imperative for the operator to wear protective glasses and apparel.

• The mechanical blossom thinner must not be used on public roads.

• When operating the thinner you must ensure that there are no people within a radius of 10 m.

• Before operating the thinner, please check that all hydraulic hoses are in perfect condition and that all hydraulic connections and fastening screws for the strings are tightened.

• Provide an operating manual before operating the thinner.

• Attaching the thinner might have an impact on the tractor's vibration characteristics.

• If the thinner covers the license plate or the lighting equipment, these have to be mounted in a different location in accordance with the StVZO (German Road Traffic Licensing Regulation).

• Please make sure that the combination of tractor and thinner complies with the current regulations of the country where it is used (e.g. StVZO, permissible axle loads, max. vehicle length, max. vehicle width, max. vehicle height, permissible total weight etc.).
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Please observe the following warning plates on the machine:

- Please read this operating manual and the safety instructions before initial operation.

- Please touch parts of the machine only when it is completely stopped.

- Turn off engine and take off the key prior to all kind of maintenance or repair work.

- Persons are not allowed to come closer than 10 m to the machine during its operation.

The following safety instructions appear in this manual:

**NOTE**
Refers to special working procedures, methods, and information, where the textual instructions are illustrated in/accompanied by a picture.

**CAUTION**
This symbol is used when incorrect working practices could damage the product.

**DANGER**
This symbol is used when failure to be cautious could lead to personal injury or equipment damage.
<table>
<thead>
<tr>
<th></th>
<th>Darwin 150</th>
<th>Darwin 200</th>
<th>Darwin 230</th>
<th>Darwin 250</th>
<th>Darwin 300</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spindle height</td>
<td>1475 mm</td>
<td>1935 mm</td>
<td>2245 mm</td>
<td>2395 mm</td>
<td>2850 mm</td>
</tr>
<tr>
<td>Driving speed</td>
<td>6-18 km/h</td>
<td>6-18 km/h</td>
<td>6-18 km/h</td>
<td>6-18 km/h</td>
<td>6-18 km/h</td>
</tr>
<tr>
<td>Spindle speed</td>
<td></td>
<td></td>
<td></td>
<td>150-450 min*</td>
<td></td>
</tr>
<tr>
<td>Surface performance</td>
<td>1,5-2,5 ha/h</td>
<td>1,5-2,5 ha/h</td>
<td>1,5-2,5 ha/h</td>
<td>1,5-2,5 ha/h</td>
<td>1,5-2,5 ha/h</td>
</tr>
<tr>
<td>Rope length</td>
<td>600 mm</td>
<td>600 mm</td>
<td>600 mm</td>
<td>600 mm</td>
<td>600 mm</td>
</tr>
<tr>
<td>Number of ropes</td>
<td>18</td>
<td>24</td>
<td>30</td>
<td>30</td>
<td>36</td>
</tr>
<tr>
<td>Dimensions: H / W / D mm (in.)</td>
<td>1820/1400/800 (71.7/55.1/31.5)</td>
<td>2285/1400/800 (90.0/55.1/31.5)</td>
<td>2580/1400/800 (101.6/55.1/31.5)</td>
<td>2740/1400/800 (107.9/55.1/31.5)</td>
<td>3200/1400/800 (126.0/55.1/31.5)</td>
</tr>
<tr>
<td>Weight</td>
<td>130 kg (286.6 lbs)</td>
<td>138 kg (304.2 lbs)</td>
<td>142 kg (313 lbs)</td>
<td>145 kg (319.7 lbs)</td>
<td>152 kg (335.1 lbs)</td>
</tr>
<tr>
<td>Necessary oil quantity</td>
<td>25 l/min (26.4 qts/min)</td>
<td>25 l/min (26.4 qts/min)</td>
<td>25 l/min (26.4 qts/min)</td>
<td>25 l/min (26.4 qts/min)</td>
<td>25 l/min (26.4 qts/min)</td>
</tr>
<tr>
<td>Max. operating pressure</td>
<td>210 bar</td>
<td>210 bar</td>
<td>210 bar</td>
<td>210 bar</td>
<td>210 bar</td>
</tr>
<tr>
<td>Mounting</td>
<td>Right-side front mounting with and without front hydraulic system or fork mount</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lateral shift (manual)</td>
<td>595 mm</td>
<td>595 mm</td>
<td>595 mm</td>
<td>595 mm</td>
<td>595 mm</td>
</tr>
<tr>
<td>Lateral shift (hydraulic system)</td>
<td>400 mm</td>
<td>400 mm</td>
<td>400 mm</td>
<td>400 mm</td>
<td>400 mm</td>
</tr>
</tbody>
</table>
1. Unpacking and preparation of the machine

1. Remove the film and the packing strings.

2. Remove the safety clamp and pull out the mount. Assemble the hydraulic cylinders (see picture) and use the 2 M8x20 hex screws to tighten them.

**NOTE**
Check the location and orientation of the hydraulic hoses.

3. Put the machine in the upright position on the ground.
2 Mounting of cord plates

1. Screw the cord plates onto the spindle by means of the M6 x 12 cylinder head screws included in the delivery. For every cord plate you need 4 screws.

NOTE
Alternatively, for each vertical row, the curved ends of the cord plate should point up or down, so that the ends of the cords intersect.

DANGER
Tighten all bolts. Please consider the risk of injury caused by any parts that may spin off when in operation!
3. Thinner assembly

3.1 Attaching the thinner to the front lift tractor

1. Adjust the step-bolts on the lower arm to set the requested category.

2. Secure the lift arm pin with cotter pin to prevent it from falling out.

3. Connect the machine to the ram of the tractor's front lift.

4. Adjust the ram so that the spindle is in the vertical position.

3.2 Attaching the thinner to a tractor with no front lift equipment

1. Put the machine on a pallet.

2. Lift the machine by means of a forklift up to the desired height and connect it to the tractor by means of the preset holes.

**NOTE**
The machine must be at least 25-30 cm from the ground.
3.3 Connect the hydraulic hoses to the tractor.

1. Connect the red line with the pressure plug.
2. Plug in the black line to the depressurized return circuit.
3. Connect both blue lines with the double-acting plug for the lateral inclination (we recommend using a valve which can be easily controlled while driving).
4. Connect the yellow lines to a second double-acting plug for the hydraulic lateral shift (optional).

4 RPM control unit assembly

1. Plug in the RPM control unit’s connector into the outlet and tighten the nut.
2. Secure the RPM control unit by means of the suction cup holder onto the side window of the cabin so that it can be easily operated.

**Note**

Clean the glass before securing the RPM control unit to ensure perfect adherence.
3. Insert the plug for voltage supply into the 12-volt socket.

5. Check the level of motor oil in the tractor
   1. Start the engine of the tractor.
   2. Start motor oil feeding by means of the hydraulic control system.
   3. Pull out completely the Emergency-Off knob (the yellow ring must be visible).
   4. Press the Start-Stop button once to start the machine.
   5. When the spindle reaches $250 \text{ min}^{-1}$ RPM, set the RPM number on $450 \text{ min}^{-1}$ by pressing the + button.

**NOTE**
The RPM number can be adjusted by pressing the + and – buttons only when the spindle has already reached at least $250 \text{ min}^{-1}$ RPMs. Should the minimum RPMs ($250 \text{ min}^{-1}$) not be reached, the unit automatically shuts down after 15 seconds. To reset, press the Emergency/Stop knob and pull it out completely to start the unit again.

6. Should $400 \text{ min}^{-1}$–$450 \text{ min}^{-1}$ RPMs not be reached, gradually increase the tractor’s motor RPMs to reach $450 \text{ min}^{-1}$. $450 \text{ min}^{-1}$ RPMs is the minimum amount of RPMs to operate the machine and ensure a correct regulation of the spindle speed.

**NOTE**
Should the spindle not reach $450 \text{ min}^{-1}$ RPMs, use a different motor oil mount, check the setting of the motor oil flow separator or check the tractor’s manufacturer instructions.
7 Operating the mechanical blossom thinner

7.1 General instructions

The effect of the mechanical blossom thinner is different from region to region and from orchard to orchard. For this reason we are only able to provide reference values with regard to the vehicle speed and spindle speed. Therefore, only the fruit grower, based on his or her experience can determine the optimal vehicle speed(s) and spindle speed(s) when operating the mechanical blossom thinner.

It is recommended to initially thin only a few trees (1-2 rows per variety) in order to test for the optimum spindle and vehicle speed combination. This gives you the opportunity to follow fruit ripening until the moment of harvesting and thus optimize the desired settings of the mechanical blossom thinner for the following season.

7.2 Conditions for use

It is possible to use the blossom thinner from the balloon stage to just before full bloom. However, the ideal time is during the balloon stage with opened king flower. This is perfect timing to check the thinning effectiveness on the thinned blossoms. It is difficult to assess the effectiveness of the thinning if the thinner is used shortly before full bloom, because many flowers do no longer have petals and it is not possible to know whether these will turn into fruits. If the thinner is used before the period above indicated it is possible that many clumps of blossoms are thinned. It is advisable to avoid using the thinner at a later bloom stage to prevent permanent damage of the fruits.

7.3 Adjusting the thinner

1. Use the manual side shift tab to adjust the thinner to the tree row width.
6 Using the RPM control box

6.1 Starting the machine

1. Set the tractor’s RPMs as per point 5 above.

2. Use the hydraulic control unit of the tractor to ensure delivery of oil to the machine.

3. Press the start/stop button once to start the machine.

4. When the spindle reaches 250 RPM, the RPM can be increased or decreased by pressing the Increase spindle speed + or Decrease spindle speed - buttons. Each time the buttons are pressed the speed changes by 5 RPM.

5. When the machine is switched off by pushing the start/stop button and then switched on again, the previously-set spindle speed will be displayed.

Note
The RPM number can be adjusted by pressing the + and – buttons only when the spindle has already reached at least 250min⁻¹ RPMs. Should the minimum RPMs (250min⁻¹) not be reached, the unit automatically shuts down after 15 seconds. To reset, press the Emergency/Stop knob and pull it out completely to start the unit again.

Note
Should the RPM control box be turned off by pressing the Emergency/Stop knob or by unplugging the energy socket, it is necessary to set the RPMs again to start and operate the machine.

Note
Should the spindle fail to reach 250 RPMs after operation of the RPM control box, it is necessary to check the motor oil supply as per point 5 above.
2. Loosen both hex screws.

3. Pull the machine outwards so that when the tractor is positioned in the middle of the drive row, the spindle tower rod is directly close to the tree canopy.

4. Tighten the hex screw and secure with the lock nut. It is possible to adjust the hydraulic lateral shift (optional) by means of the control unit of the tractor's hydraulic system.

**NOTE**
When in operation, the distance between the lowest edge of the thinner and the ground should be about 20 - 25 cm.

**CAUTION**
In case of hail nets, the thinner must be adjusted so that the netting is not damaged when the thinner is positioned fully upright.

**CAUTION**
Please take care that falling blossoms do not interfere with tractor's cooling system.

5. Adjust the spindle's angle to the shape of the tree by means of the hydraulic controls on the tractor.

**NOTE**
The setting of the spindle speed must be consistent with the driving speed, i.e., the RPM/driving speed ratio must always be the same.

**NOTE:**
See Annex for RPM/driving speed reference ratios.

**NOTE**
It must be taken into consideration, that in general, heavy flowering trees must be thinned more intensively (spindle rotating at a higher RPM), and lighter flowering trees must be thinned more cautiously (spindle rotating at a lower RPM).
6. When all settings are completed, the thinning process can begin.

7. Connect the hydraulic control unit to the tractor to ensure the thinner’s oil supply.

8. Press the Start/Stop button to start the thinner. Refer to Chapter 5: “Using the RPM control box”.

9. The spindle begins to rotate slowly and increases speed until it reaches an approximate speed of 250 RPMs.

10. Now you can use the buttons + / — to set the desired spindle speed.

CAUTION
Check spindle rotation direction before you start to thin. The spindle must rotate clockwise because of the front right installation!

NOTE
The motor speed of the tractor must be set to provide enough oil in the hydraulic system.

NOTE
Note that thinning becomes effective with a spindle speed of approximately 200 min⁻¹.

The pre-set spindle speed is maintained constant and independent of the motor speed of the tractor.

10. When the desired spindle speed is attained, the tractor can be driven.

11. When driving the mechanical blossom thinner, check that the spindle tower rod is as close as possible to the tree canopy and that the tractor’s speed is constant.

CAUTION
The spindle tube must be guided into the tree crown. If the spindle tower rod is too distant from the tree canopy, the tree will be thinned only on the outer side, and it is possible that the tree is damaged.
12. After 10 - 20 meters, stop and compare the effect of the thinning (before/after comparison).

**NOTE**
Change the spindle speed: higher (if thinning poorly) or lower (if thinning excessively).

13. If you attained the desired level of thinning, then continue driving with the pre-set parameters.

14. In case of poor thinning, increase spindle RPMs by $20 \text{ min}^{-1}$ and continue following points 13+14 above.

15. In case of excessive thinning, decrease spindle RPMs by $20 \text{ min}^{-1}$ and continue following points 13+14 above.

**CAUTION**
It is very important to note that the thinning process causes an increase in ethylene emissions and therefore a greater June-drop may be a result.

**NOTE**
By pressing and keeping the ESC key pressed, you can stop the spindle rotation to avoid thinning trees which may have naturally low blossom counts.

17. Reduce the speed of the thinner only after the end of the last tree row.

18. Switch off the machine by pushing the start/stop button once at the end of the row. When the machine is switched on again, the previously-set spindle speed will be displayed.

**NOTE**
Should the RPM control box be turned off by pressing the Emergency/Stop knob or by unplugging the energy socket, it is necessary to set the RPMs again to start and operate the machine.
7.4 Cutting cords

**NOTE**
Due to the nature of the soil in some orchards it is not possible to drive the thinner at the minimum requested speed of 6 km/h. It is possible to half the number of cords by cutting every second cord using pruning shears.

It is also possible to cut single segments (1 segment 6 cord plates) to more gently thin only a few parts of the tree (e.g. canopy). Operators can decide how many segments to cut according to needs. In order to ensure uniform thinning, do not remove entire cord plates.

1. Mount the cord plates onto the segment or segments where you intend to cut the cords so that all the ends of the cords point down.

2. Cut the first cord starting from the bottom. Then cut one cord every two and proceed towards the top of the plate.

3. Cut the second cord of the cord plate next to the first. Starting from it, cut one cord every two and proceed towards the top.

4. Repeat step 2 and 3 with all the other cord plates.

5. This process results in having half the number of the cords on the plates.

**Caution**
Cut the cords close to the plate to avoid loose ends that may damage the wood.
8 Machine disassembly

8.1 Uncouple the thinner from the front lift tractor and store it

1. Adjust the spindle so it is in the vertical position by using the hydraulic system.

2. Lower the thinner on even and solid ground by means of the tractor's hydraulic system.

3. Disconnect the RPM control unit from the outlet.

4. Uncouple the hydraulic lines from the tractor and put them into the designated hose holder.

5. Uncouple the thinner from the front mount.

Note
Store the RPM control unit in a dry place.

8.2 Uncouple the thinner from the tractor with no front lift and store it

1. Adjust the spindle so it is in the vertical position by using the hydraulic system.

2. Position a pallet under the machine by using a forklift so that all 3-point hitch supports lay on the pallet.

3. Disconnect the RPM control unit from the outlet.

4. Uncouple the hydraulic lines from the tractor and put them into the designated hose holder.

5. Unscrew the fastening screws and store the machine.

Note
Store the RPM control unit in a dry place.

CAUTION
Ensure that the thinner is in a stable position and secure it with a chain or rope against falling!
The thinner is maintenance-free to the greatest extent.

**NOTE**

If there is visible damage at the ends of the cords or if the cords have been shortened by 5-10 cm by wear, then it is necessary to change the cord plates of the spindle.

### 9.1 Replacing cord plates

**NOTE**
The spindle is divided into several sections vertically and the plates can be unscrewed individually.

1. Remove the four bolts from the plate.
2. Take off the worn cord plate from the spindle and replace it with a new cord plate and tighten it using the four bolts

**DANGER**
Tighten all bolts. Please consider the risk of injury caused by any parts that may spin off when in operation!

**NOTE**
Alternatively, for each vertical row, the curved ends of the cord plate should point up or down, so that the ends of the cords intersect.

**DANGER**
Tighten all bolts. Please consider the risk of injury caused by any parts that may spin off when in operation!
9.2 Cleaning the mechanical blossom thinner

Use water to clean the thinner. Do not use chemical agents, because they might have a negative impact on the cord quality.

If you use a high-pressure washer or a steam jet device, make sure they are no closer than 30 cm (12 inches) to the spindle bearings and the hydraulic control block.

Use only a damp cloth without any cleaning agents to clean the RPM control box.
10. Troubleshooting

<table>
<thead>
<tr>
<th>Problem</th>
<th>Remedy</th>
</tr>
</thead>
<tbody>
<tr>
<td>The spindle does not rotate</td>
<td>Check the RPM control box on the tractor</td>
</tr>
<tr>
<td></td>
<td>Check the hydraulic lines</td>
</tr>
<tr>
<td></td>
<td>Check the connections on the RPM control box</td>
</tr>
<tr>
<td></td>
<td>Check the voltage on the RPM control box</td>
</tr>
<tr>
<td>Rake adjustment without function</td>
<td>Check the hydraulic connections</td>
</tr>
<tr>
<td>Speed on the RPM control box is not displayed</td>
<td>Check the connection of the RPM control unit plug</td>
</tr>
<tr>
<td></td>
<td>Check RPM control unit cable for damage</td>
</tr>
<tr>
<td>The spindle has reached the maximum RPM level and is not possible to</td>
<td>Increase the tractor’s engine speed to increase the oil supply</td>
</tr>
<tr>
<td>increase further RPM</td>
<td></td>
</tr>
<tr>
<td>The RPM control box displays without function</td>
<td>Check whether the Emergency/Stop knob is completely pulled out</td>
</tr>
<tr>
<td></td>
<td>Check socket polarity</td>
</tr>
<tr>
<td></td>
<td>Check voltage supply to the RPM control unit</td>
</tr>
<tr>
<td>Tree(s) has (ve) been damaged</td>
<td>Reduce the spindle speed</td>
</tr>
<tr>
<td></td>
<td>Increase the tractor speed</td>
</tr>
<tr>
<td></td>
<td>Place the spindle closer to the tree</td>
</tr>
<tr>
<td>Only outer side of tree is being thinned</td>
<td>Place the spindle parallel to the tree</td>
</tr>
<tr>
<td>Only the lower part of the tree is being thinned</td>
<td>Adjust the angle of the spindle to the shape of the tree by using the</td>
</tr>
<tr>
<td></td>
<td>hydraulic system</td>
</tr>
<tr>
<td>Thinning is too intensive</td>
<td>Decrease spindle speed</td>
</tr>
<tr>
<td></td>
<td>Increase driving speed</td>
</tr>
<tr>
<td></td>
<td>Reduce the number of cords</td>
</tr>
<tr>
<td>Poor thinning</td>
<td>Increase spindle speed</td>
</tr>
<tr>
<td></td>
<td>Decrease driving speed</td>
</tr>
<tr>
<td></td>
<td>Check the quality of the cords</td>
</tr>
</tbody>
</table>
Hydraulic circuit

Hinweis:
- gefaserte Öleinheit nach ISO 4406 min 18/12 oder besser
- bei Bedarf Druckfilter vorschalten

Montagehinweis:
- Pos. 4: 210 bar bei 4.0 L/min

Betriebsdruck max.: 210 bar
 Magnetspannung: 12 V DC
12 Electrical Circuit
13 Declaration of Conformity

According to the EC Directives 98/37 EC and 2006/42 EC (European Commission)

The manufacturer

Adolf Betz
Schiessstattweg 11
D-88677 Markdorf

declares within exclusive responsibility that the product

**Darwin 150, Darwin 200, Darwin 230, Darwin 250 und Darwin 300**

abides by the fundamental safety and health requirements provided in the CE 98/37/CE and 2006/42/CE directives.

For the adequate conversion of the safety and health requirements specified in the EU directive mentioned above, the following standards and technical specifications were consulted:

EN 1553 4/00

Markdorf, 2016

Adolf Betz
ZERTIFIKAT
LSV-2009/111

Zertifikatinhaber
Fruit Tec Adolf Betz, Harresheim 10, 88693 Deggenhausertal

Hersteller
siehe Zertifikatinhaber

Produktbezeichnung, Typ, Maschinen-Nr.
Blütenausdünnmaschine Typ Darwin 200

Weitere Angaben

Zusatzeinrichtungen

Einbezogene baugleiche Typen
Typ Darwin 250 und Typ Darwin 300

Prüfbericht-Nr.
4.60.20/01/2009-07-06


Der Inhaber des Zertifikats ist berechtigt, an Erzeugnissen, die mit dem geprüften Baumuster übereinstimmen, das Sicherheitszeichen der Prüf- und Zertifizierungsstelle des Spitzenverbands der landwirtschaftlichen Sozialversicherung anzubringen.

Das Zertifikat ist bis zum 05.07.2014 gültig.

Kassel, 06.07.2009

Leiter der Zertifizierungsstelle
Dipl.-Ing. Hartenbach
### Spindle Speed / Driving Speed

**Darwin 150 / 200 / 230 / 250 / 300**

<table>
<thead>
<tr>
<th>Driving speed km/h</th>
<th>Weak thinning</th>
<th>Spindel speed*</th>
<th>Strong thinning</th>
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<tbody>
<tr>
<td></td>
<td>6</td>
<td>200</td>
<td>220</td>
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<tr>
<td></td>
<td>8</td>
<td>220</td>
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<tr>
<td></td>
<td>10</td>
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<td>260</td>
<td>280</td>
</tr>
<tr>
<td></td>
<td>14</td>
<td>280</td>
<td>300</td>
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</tbody>
</table>

**Variety**

<table>
<thead>
<tr>
<th>Variety</th>
<th>Thinning strength</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gala</td>
<td>x</td>
</tr>
<tr>
<td>Golden Delicious</td>
<td>x</td>
</tr>
<tr>
<td>Rubinette</td>
<td>x</td>
</tr>
<tr>
<td>Pinova</td>
<td>x</td>
</tr>
<tr>
<td>Fuji</td>
<td>x</td>
</tr>
<tr>
<td>Delbarestivale</td>
<td>x</td>
</tr>
<tr>
<td>Braeburn</td>
<td>x</td>
</tr>
<tr>
<td>Elstar</td>
<td>x</td>
</tr>
<tr>
<td>Jonagold**</td>
<td>x</td>
</tr>
<tr>
<td>Jonagored**</td>
<td>x</td>
</tr>
<tr>
<td>Idared**</td>
<td>x</td>
</tr>
<tr>
<td>Boskop**</td>
<td>x</td>
</tr>
</tbody>
</table>

**Only mechanical thinning when flower strength >8**

- Trees with heavy bloom require stronger thinning
- Trees with light bloom require lighter thinning