3m LDT
(Low Disturbance Toolbar)
Operator Manual

VAT No: 256 156 792

Manual reference: GM/3mLDT/Iss1.0

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CONTENTS

1.0 Identification of manual

This operator's manual is for retention with the machine during all times of operation. If the machine is to be sold onto other users, please provide the manual as part of the transaction.

In the event that the manual becomes damaged beyond effective use, please contact the manufacturer for updated copies, stating the machine specification and serial number.

The contents of this operator manual are correct at the time of print but may be subject to additions and change at any time in the future.

This manual refers to the following Grange Machinery Ltd equipment;

MACHINE TYPE	WORKING WIDTH	SERIAL NO'S
3m LDT	3m	

The serial plate is located on the headstock of the Grange 3m LDT, as detailed in the photo below.

SERIAL PLATE LOCATION

1.1 Introduction to the Grange 3m LDT

The Grange 3m LDT is designed for primary cultivation practices where soil pans need to be removed to allow root penetration and water infiltration. The discs cut through any surface trash and allow the legs to alleviate the subsurface compaction with minimal disturbance to the top soil and reducing moisture loss.

The Grange 3m LDT incorporates both a lower linkage arm assembly and a clevis hitch on the rear to allow secondary cultivation or seed drill equipment to be attached. Hence providing the solution for one pass seed establishment.

1.2 Meanings and definitions

Throughout the manual various definitions are used.
Their meanings are referred to here;

REFERENCE TERM	MEANING
2nd stage cultivation / seeding equipment	Cultivation or seeding equipment coupled to the Grange 3m LDT machine via the clevis hitch or 2 point linkage.
Ballast	Additional weights or other equipment to ensure tractor stability when the Grange 3m LDT equipment is in operation.
Qualified and experienced	A person (operator) who has received appropriate instruction and where necessary undertaken a qualification for operating the relevant machinery. The operator understands the health and safety procedures for use of the Grange 3m LDT.
Machines life cycle	The use by the owner of the Grange 3m LDT from delivery by the manufacturer to its end of operational life and subsequent authorised disposal.

The hazard symbol is used throughout the manual to highlight areas of importance to the operator. Please note the specific content referred to in these sections.

In the event of requiring further support beyond the content of this manual, please contact the manufacturer at;

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1.3: Declaration of Conformity

CE DECLERATION OF CONFORMANCY

The equipment which accompanies this declaration is in conformity with EU Directive(s):-

2006/42/EC Machinery Directive

Manufacturer Name:	Grange Machinery Ltd
Manufacturer Address:	Sproatley Grange Boggle Lane Hull HU11 4PT
Product:	3m Low Disturbance Toolbar (LDT)
Individual Serial Number:	
Product Description:	Toolbar (6 leg) with ability to trail secondary cultivation or seed drill equipment.
Date of Last Load Test Report:	N/A
Supplementary Information:	
Manufacturing Standards Adhered to:	Standard of manufacturing
Authorised Signatory on Behalf of Manufacturer:	
Name of Signatory:	Rhun Jones
Position in Company:	Director
Date of Issue:	

2.0 Safety considerations during the machines life cycle

The Grange 3m LDT is designed to high quality engineering principles. However there are potential hazards which the operator must be aware of during use. The owner of the Grange 3m LDT equipment is responsible for ensuring that all operators familiarise themselves with the contents of the manual before use.

Non-compliance with safety instructions can lead to warranty claims becoming invalid. Grange Machinery Ltd shall not be responsible for any damage caused by the use of spare parts or accessories and ancillary equipment not supplied or approved by Grange Machinery Ltd

3.0 Check your own working systems!

i. Ensure only qualified and experienced tractor operators are given permission to use the Grange 3m LDT.

ii. Ensure the operator has the correct Personal Protective Equipment (PPE) when working with the Grange 3m LDT. The recommendation is safety boots, close fitting coveralls and wear required work gloves.

iii. Does the operator understand the principles of operation for the Grange 3m LDT? For example, the 3 point linkage settings, depth control and replacement parts such as shear bolts and points.

iv. Is the operator aware of the safe equipment configuration for the Grange 3m LDT and 2nd stage cultivation/seeding systems when coupled to the tractor on the public highway? Refer to section 11.0 in this manual.

v. Can the operator seek advice on operational parameters for the Grange 3m LDT equipment from other persons when working remotely in the field?

vi. When performing any adjustments to the Grange 3m LDT and any 2nd stage cultivation/seeding equipment, the tractor engine must be turned off, the key removed and handbrake applied to prevent the hydraulics from operating.

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3.1 Risk assessment for use of Grange 3m LDT across its intended lifecycle

The risk assessment summarised below in Table 1.0 demonstrates how the design specification of the Grange 3m LDT when operated in accordance with the guidance from this operators manual have reduced the risk to operators and other persons to an acceptable level. The risk assessment also identifies what further control measures are required by the end-user when operating the Grange 3m LDT.

OVERALL RISK RATING – REF COLUMN 6.0

LOW	The operation and use of the Grange 3m LDT presents a low level of risk.
MEDIUM	Please note; some hazards may occur during operation with the use of the Grange 3m LDT which require the operator to demonstrate caution. For example when the Grange 3m LDT is in a raised position or during transport mode. Also take care when operating tractor controls and undertaking linkage connections.
HIGH	Please note; extreme caution is required during all operational use of the Grange 3m LDT.

TABLE 1.0: RISK ASSESSMENT: USE OF GRANGE 3M LDT

1.0: Activity	2.0: Hazard	3.0: Persons who might be harmed	4.0: Applicable sections in this manual	5.0: Residual risk (responsibility of end-user)	6.0: Overall risk rating
Lifting & slinging of 3m LDT	Cuts / bruises Crush injuries	Haulage driver, other persons in immediate area	5.0; 6.0; 7.0; 8.0; 15.0	Only use approved lifting systems and slings / hooks. Lift only from the specified lift locations. Contact Grange Machinery Ltd for replacement components if any damage occurs to lifting & slinging eyes.	**MEDIUM**
Connecting up to the tractor	Cuts / bruises crush and entrapment.	Operator and by-standers	4.0; 5.0 8.0; 9.0; 10.0	Only trained and authorised personnel to operate tractor coupled to Grange 3m LDT. Operators to read this manual and understand content before use of Grange 3m LDT. Verify tractor front ballast requirements.	**LOW /** **MEDIUM**
Maintenance schedules	Cuts / bruises / entrapment	Operator	4.0; 8.0; 13.0; 14.0; 15.0	Use of compliant axle stands systems for supporting Grange 3m LDT. Use of appropriate tools and PPE. Adhere to maintenance schedules.	**MEDIUM**
Use of 2nd stage cultivation / seeding equipment	Cuts / bruises / entrapment	Operator	4.0; 5.0; 10.0; 11.0	Uses of compliant coupling pins with securing lynch pins. Set-up 2nd stage cultivation/ seeding equipment in accordance with relevant operators manual. Verify tractor front ballast requirements.	**LOW /** **MEDIUM**
Transportation on the public highway	Road traffic incident with other road users. Collision with pedestrians.	Other road users and pedestrians	4.0; 9.0; 10.0; 11.0	Adhere to public highway legislation and any specific weight limit restrictions on routes. Check all tractor and machinery couplings are secure & lighting / braking systems functioning correctly.	**MEDIUM**
Setting up in the field and use for tillage operations.	Cuts / bruises / entrapment	Operator	4.0; 5.0; 12;0; 13.0; 14.0; 16.0	Operate Grange 3m LDT and 2nd stage cultivation/ seeding equipment to suit soil conditions. Apply safe working practices for any maintenance activities undertaken in the field.	**LOW /** **MEDIUM**

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4.0 Safety decals

Safety decals are located on the machine to inform the operator of the appropriate procedures to prevent harm to themselves or others persons nearby. These refer to the following procedures where operator interaction with the Grange 3m LDT is required;

i) Unloading from the transporter on delivery to the customer.
ii) Assessing the correct tractor specification and front ballast requirements.
iii) Hitching the Grange 3m LDT equipment to the tractor.
iv) Coupling up 2nd stage cultivation on the rear two point lower linkage or clevis drawbar.
v) Planning for transportation on the public highway of the Grange 3m LDT equipment and where required 2nd stage cultivation/seeding system to the field.
vi) Setting the Grange 3m LDT equipment and 2nd stage cultivation/seeding systems up for the soil working conditions.
vii) Undertaking inspection and maintenance and replacement of wearing part procedures on the Grange 3m LDT equipment.

Table 1.0 summarises the safety decals in use on the Grange 3m LDT and their meanings.

The colour definitions for the decals are as follows;

i. Yellow: Caution: Hazard potential and where appropriate keep clear of moving parts.
ii. Blue: Mandatory: Requirement to undertake an action.
iii. Red: Prohibited. Do not undertake depicted action.

TABLE 1.0

Safety decal	Meaning	Safety Decal	Meaning
	General hazard warning sign.		Switch off engine and remove key before undertaking maintenance or repair work.
	Potential for injection of hydraulic fluid under high pressure.		Stay a safe distance from the machine.

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TABLE 1.0

Safety decal	Meaning	Safety Decal	Meaning
	Crushing of toes or foot. Force applied from above.		Do not use manual lifting techniques.
	Wear protective gloves		Grease lubrication connection
	Specified lifting point. Attachment with approved lifting component.		

In the event of safety decals wearing away please contact the manufacturer for replacements.

5.0 Equipment specifications

The equipment specifications are an important reference to establish the correct tractor specification and front ballast requirements to ensure stability.

Equipment specification	Hitch Category to tractor connection	Mass (Kg)	Working width (m)	Transport width (m)	Machine length (m) from 3 point linkage to rear clevis
3m LDT	Cat III / Cat IV	1250	3.0	3.0m	1.49m

Equipment specification	No of legs / leg spacing.	Minimum tractor auxiliary hydraulic connection requirements.	Recommended tractor power output (hp)
3m LDT	6 / 0.5m	1 x Double acting hydraulic service.	150hp +

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5.1 Rear attachments

The rear clevis hitch and linkage arms are designed for coupling up and towing only 2nd stage cultivation / seeding equipment which complements the use of the Grange 3m LDT in tillage practices.

If you have any queries on the specification of equipment which can be coupled or hitched up to the Grange 3m LDT please contact the team at Grange Machinery Ltd for further advice.

LINKAGE OPTIONS FOR TRAILED IMPLEMENT

i. Cat III Clevis Hitch
ii. Cat III lower link hooks to attach to linkage frame of trailed implement
iii. Scharmuller Piton Pin Hitch 45mm
iv. Scharmuller K80 Ball Hitch
v. Braking: Where a hydraulic braking supply is required for 2nd stage cultivation/seeding equipment this facility will be incorporated into the auxiliary valve assembly on the rear. (Ref Section 8.0, component information).

COMPLETE LEG ASSEMBLY

i. Top Leg –c/w 3 x adjustable heights
ii. Bottom leg. c/w shear bolt and pivot bolt.
iii. Points – Wing width range of 40mm – 110mm c/w fastening bolt.

DEPTH ADJUSTMENT SPACERS FOR LIFT / LOWER HYDRAULIC RAMS

Black - 38 mm
Yellow - 19 mm
Green -13 mm
Red -10 mm
Blue -07 mm

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6.0 Lifting and slinging of Grange 3m LDT

The Grange 3m LDT range includes two lifting eyes (Ref fig 1.0) for use with appropriate and compliant shackles and webbing or chains. Ensure that the lifting equipment has the required lift capacity and is operated by trained and authorised personnel. Ensure that there is adequate space in the immediate area and check for overhead obstacles such as electric power cables. For further guidance on safe lifting techniques please refer to HSE guidance at; **http://www.hse.gov.uk/work-equipment-machinery/planning-organising-lifting-operations.htm**

FIG 1.0: LIFTING AND SLINGING POINTS

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7.0 Storage of machinery when not in use

When not in use the Grange 3m LDT must be stored on level hard standing, as illustrated in fig 2.0. If the machines are unhitched in the field overnight, support plates might be required under the two stands to prevent the machines weight forcing the supports into the soil.

FIG 2.0: GRANGE 3M LDT STORED CORRECTLY ON HARDSTANDING

8.0 Component identification

Fig's 3.0 below identifies the main components. The operator must familiarise themselves with all adjustment functions and component location in both transport and field working modes before commencing operations. When going from the transport mode to working mode for the Grange 3m LDT always make sure no people are in distance of been hurt or trapped.

8.1 Soil engaging components & Main Frame

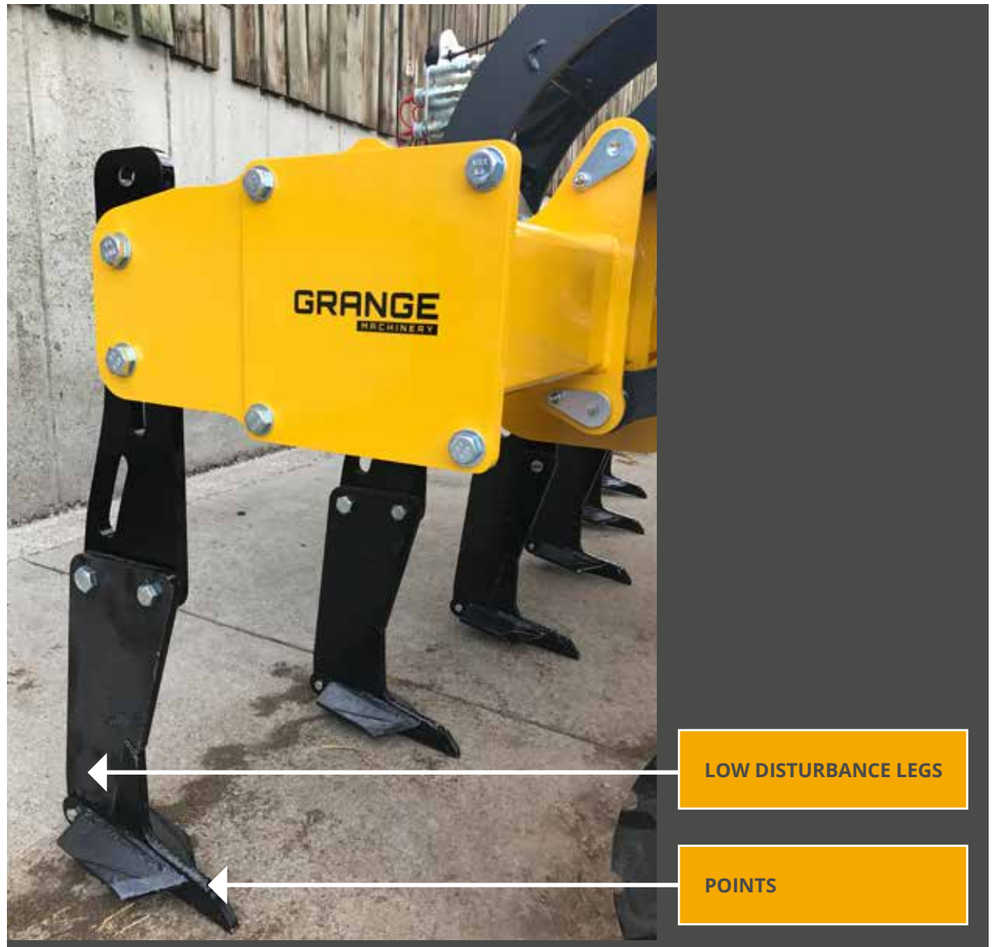

FIG 3.0 COMPONENT IDENTIFICATION

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CAT IV LOWER LINK COUPLING

CAT III LOWER LINK COUPLING

HANDLE ON STAND FOR EASE OF MOUNTING / DISMOUNTING

2 X ADJUSTABLE STANDS & LOCKING PIN.

CUTTING DISCS

FIG 3.0 COMPONENT IDENTIFICATION

8.2 Hydraulic services to operate the Grange 3m LDT

CAT III TOP LINK POSITION

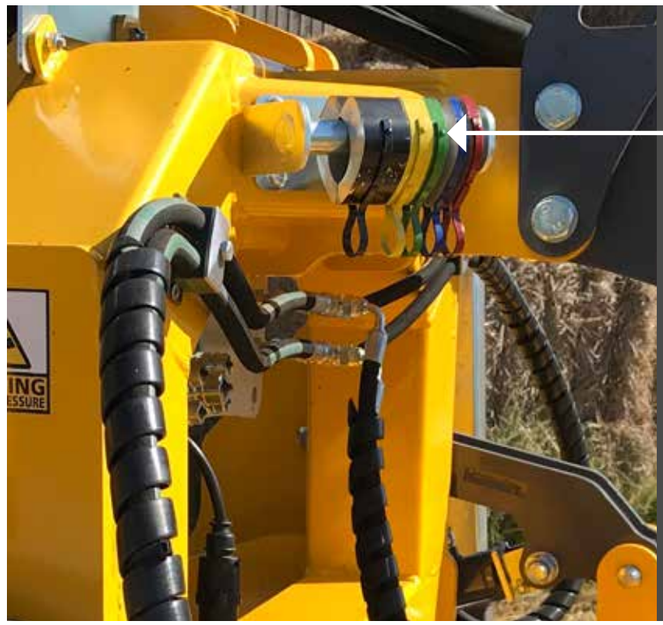
CAT IV TOP LINK PIN

2 X DOUBLE ACTING HYDRAULIC SERVICES TO OPERATE AND FUNCTION THE GRANGE 3M LDT

HOSE WRAP **[DO NOT REMOVE]**

FIG 3.0 COMPONENT IDENTIFICATION

8.3 Lift and lower rams - depth control



MAIN BEAM LIFT RAM DEPTH CONTROL SPACERS IN STORAGE POSITION

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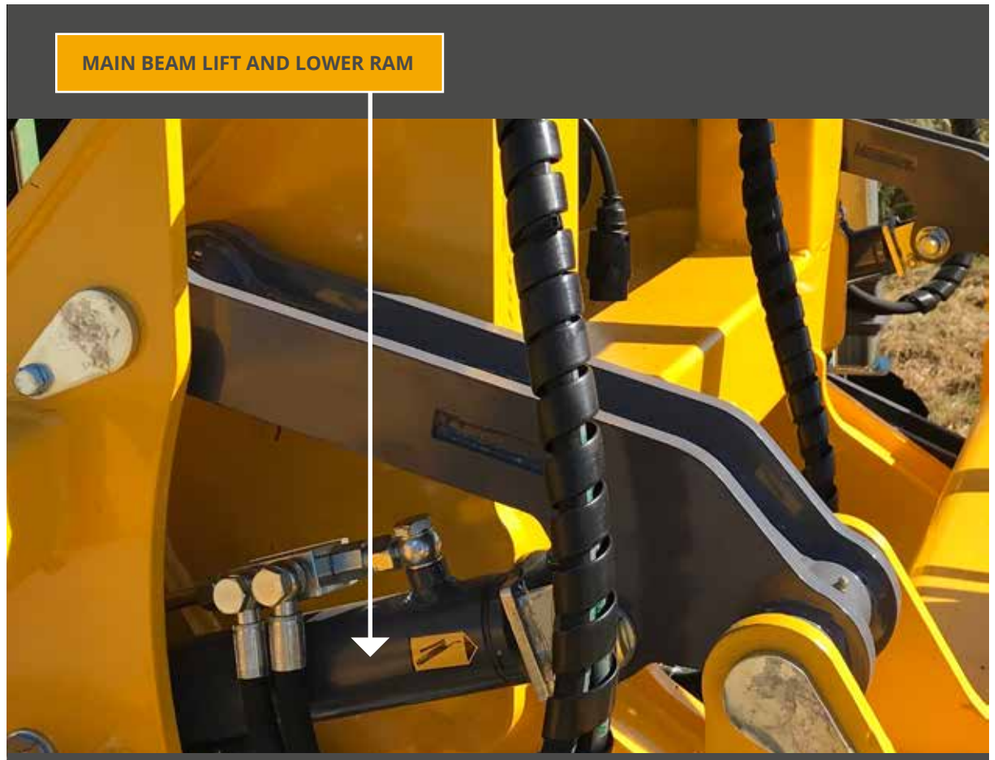

FIG 3.0 COMPONENT INFORMATION

8.4 Disc ram – Depth control

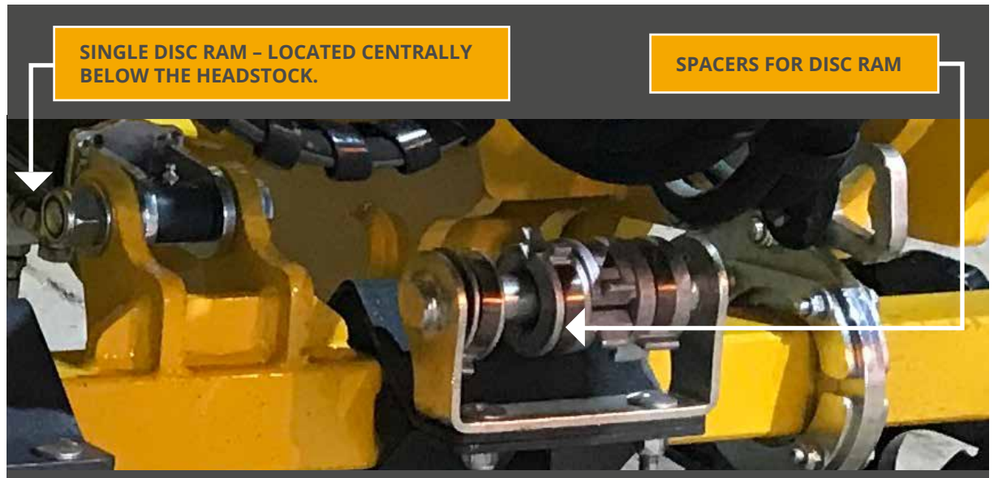

FIG 3.0 COMPONENT INFORMATION

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8.5 Attachment options

FIG 3.0 COMPONENT INFORMATION

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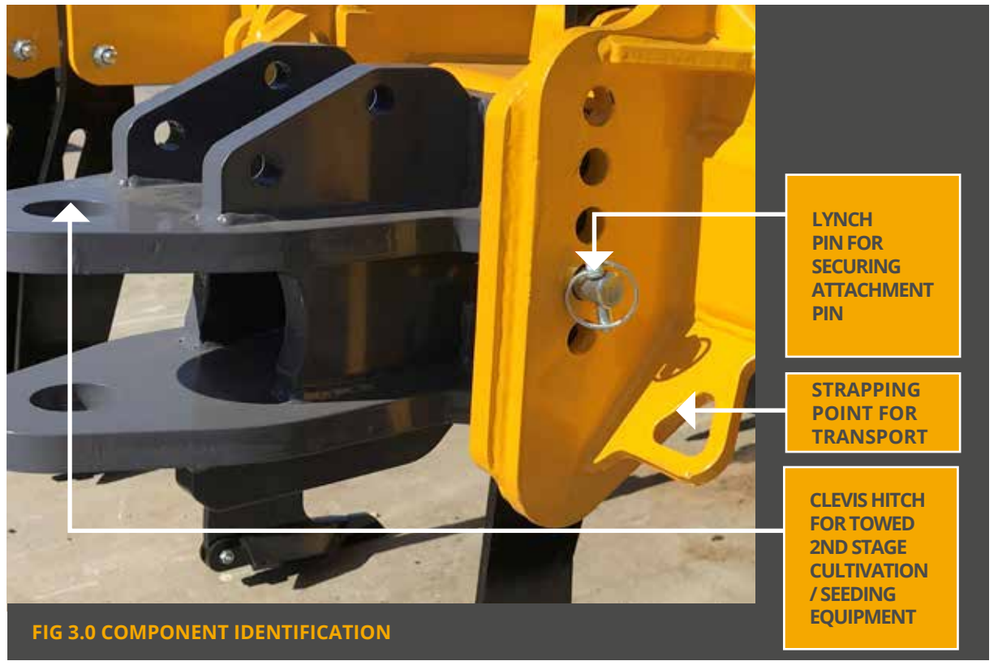
8.5 Attachment option



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9.0 Coupling up

Before operational use, the tractor front ballast needs to be checked to ensure there is sufficient stability when coupled up the Grange 3m LDT and any 2nd stage cultivation/seeding equipment. The diagram and example calculation in Fig 4.0 demonstrates the values which need to be established. Note the value ***d [m]*** is taken from the centre of the linkage balls to the centre of the lifting eyes (e.g. the Grange 3m LDT centre of gravity)

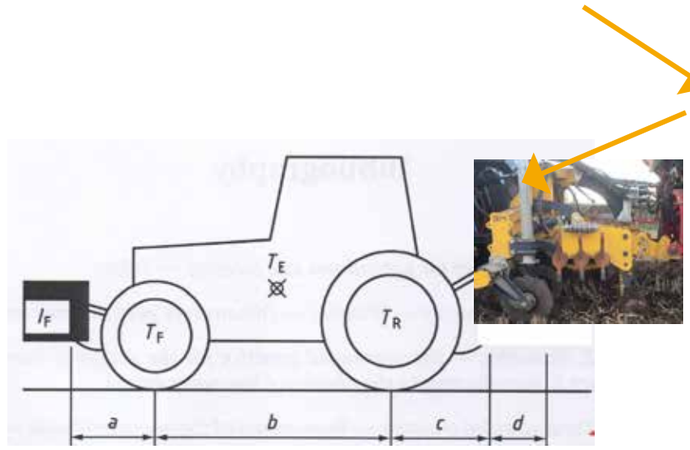

Fig 4.0 Calculation to determine tractor front ballast requirement

$$I_F,\min = \frac{(I_R \times (c+d))-(T_F \times b)+(0{,}2 \times T_E \times b)}{a+b}$$

Please refer to the definitions in the table in section 9.0 which identifies the variables which are required to calculate the value (kg) for the front ballast; ***IF min*** The value ***IF min*** allows to have a load on the front axle equivalent to 20% of the un-laden mass of the tractor.

Please refer to Appendix 1.0 at the rear of the manual for example calculations.

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FIG 4.0 CALCULATION TO DETERMINE TRACTOR FRONT BALLAST REQUIREMENT

Key	Definition	Where to find values
T_E [kg]	Mass of un-laden tractor	1
T_F [kg]	Front axle load of un-laden tractor	1
T_R [kg]	Rear axle load of un-laden tractor	1
I_R [kg]	Combined mass of rear-mounted implement / rear ballast	2
I_F [kg]	Combined mass of front mounted implement / front ballast	To be calculated
a [m]	Distance from centre of gravity for combined front mounted implement / front ballast to front axle centre.	1/ FBD
b [m]	Tractor wheelbase	1 / 3
c [m]	Distance from rear axle centre to centre of lower link balls.	1 / 3
d [m]	Distance from centre of lower link balls to centre of gravity for combined rear-mounted implement / rear ballast.	0.57m. (Design specification of Grange 3m LDT).
1	See instruction handbook of the tractor. Check maximum front axle permissible load.	
2	The mass of the Grange 3m LDT **without** a 2nd stage cultivation/seeding equipment coupled to the clevis hitch or linkage arm assembly is **1250kg.** When connecting any other equipment to the 3m LDT the drawbar / hitch mass (Kg) of the 2nd stage cultivation/seeding equipment must be added that of the Grange 3m LDT [1250Kg] to establish an overall kilogram loading on the tractor hitch, value ***IR.*** Please note that the maximum mass of seed or other materials held in a hopper in the 2nd stage cultivation/seeding equipment needs to be included in the overall value of ***IR'***	
FBD [m]	FBD: Front balance distance Measurement of the centre of gravity of the tractor front weight assembly or centre of gravity of front mounted implement to the tractor front axle. Refer to operator's manual for front mounted implements to verify the position of the centre of gravity.	
3	To be measured	

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10.0 Setting up machine for work

When setting up the tractor for connection to the Grange 3m LDT, firstly adjust the lower link check chains to reduce the lateral sway as much as possible (ideally less than 20mm). Ensure that the linkage balls are not corroded and can turn on the pins.

The correct top link setting is important to ensure the Grange 3m LDT is safe and efficient in operation, ref Fig 5.0. Fig 6.0 shows a correctly configured Grange 3m LDT coupled up to 2nd stage cultivation / seeding equipment via the link arm hitch.

The lower link arms should remain locked in position during all work and transport mode operations. Minimal adjustment of the link arms can provide additional clearance over obstacles. Activate the auxiliary hydraulics to raise the cutting discs and legs to their top position to clear any surface obstacles. This setting then provides a consistent coupling height for 2nd stage cultivation/seeding equipment connected to the clevis hitch.

FIG 5.0 CORRECT LINKAGE CONFIGURATION IN WORKING POSITION

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FIG 6.0 3M LDT IN COUPLING POSITION WITH 2ND STAGE CULTIVATION EQUIPMENT IN WORKING MODE

Refer to the tractor's operators manual for safe use of the coupling controls. Keep all personnel clear of the zone between the tractor rear linkage and the Grange 3m LDT when undertaking coupling procedures.

Ensure that the tractor is safely coupled to the 3m LDT before raising the implement and engaging transmission.

When connecting 2nd stage cultivation/seeding equipment; activate the tractor auxiliary hydraulics to lift the Grange 3m LDT main beam and cutting discs to the top of their travel. This provides suitable clearance to lower the main frame on the tractors three point linkage to couple up with the Grange 3m LDT with the 2nd stage cultivation/seeding equipment using either clevis or link arm attachment.

Ensure that the 2nd stage cultivation/seeding equipment is safely attached the rear of the Grange 3m LDT along with hydraulic and electrical connections.

Connect the hydraulic couplings to the tractor double acting services. Be-aware of the hazards associated with hydraulic hoses under pressure.

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10.1 Clevis hitch

The mass of the rear clevis hitch on the Grange 3m LDT equipment has a mass of 45kg. Therefore the safe working procedure is to put the coupling pin through the clevis hitch and secure in place, with a washer and nut and bolt. Use a workshop crane or other approved lifting systems to take the weight before removing the locating pin. Readjust and relocate securing pin with the appropriate lynch pin before releasing from the lifting equipment. Fig 7.0 and 8.0 illustrates the component and securing method.

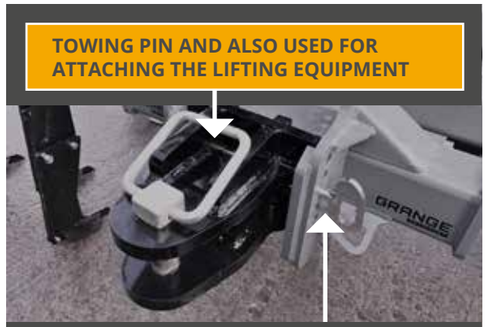

FIG 7.0 ATTACHMENT PIN

FIG 8.0 LYNCH PIN FOR SECURING ATTACHMENT PIN

10.2 link arm hitch

The mass of the rear link arm hitch has a mass of approximately 100kg. Removal of the rear link arm hitch will require the use of mechanical handling equipment with adequate lift capacity and counterbalance, with the use of compliant strops or chains and lifting hook. Fig 9.0 identifies the lifting point, which is at located at the components centre of gravity and Fig 10.0 illustrates the Grange 3m LDT once the link arm hitch has been removed.

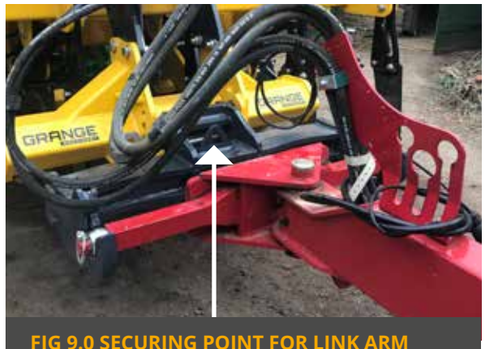

FIG 9.0 SECURING POINT FOR LINK ARM HITCH REMOVAL

FIG 10.0 LINK ARM HITCH REMOVED FROM REAR OF GRANGE 3M LDT

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11.0 Transport safety

Before undertaking transport of the Grange 3m LDT equipment on the public highway refer to the details in section 11.1 with regards to road legislation.

Please refer to section 9.0 for the correct tractor front counterbalance when connecting 2nd stage cultivation / seeding equipment.

11.1 Road Vehicles (Construction and Use) Regulations 1986

The legislation which covers the transportation of the Grange 3m LDT equipment on the UK public highway when coupled to the tractor is The Construction and Road Use Regulations (C&U) 1986. The requirements to apply are as follows;

i) Check the dimensions (width and length) and mass (kg) of and 2nd stage cultivation/seeding equipment which are coupled to the Grange 3m LDT equipment.

The maximum permitted masses and vehicle dimensions for transporting the Grange 3m LDT and associated 2nd stage cultivation/seeding equipment is as follows (Not including the tractor);

i) The maximum permitted mass of a trailed implement is 14,230kg. The operator's manual for the 2nd stage cultivation/ seeding equipment must be checked to verify its mass, including any restrictions on transportation on the public highway with material in a seed hopper.

ii) A maximum width of 2.55m

iii) A maximum length of 15m.

The speed limit and required notification to the authorities are as follows;

i) If the overhang of the Grange 3m LDT equipment in the transport position exceeds 305mm from the widest point of the tractor wheel / tyre setting, a width marker board is required.

ii) As the transport width of the 3.0m LDT equipment is between 3.0m and 3.5m with or without any 2nd stage cultivation / seeding equipment coupled up, the maximum speed limit of the tractor and the Grange 3m LDT equipment is 20mph. If the planned journey exceeds 5 miles, or the speed limit on any of the public highway is 40mph or less, the operator must notify the Police in advance of the journey.

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12.0 Getting started in the field

Note the requirement for the use of appropriate PPE (gloves, overalls and safety boots) as components such as cutting discs have sharp edges.

Once arriving in the field, the machine must be set-up correctly for the cultivation routines. Stop the movement controls of the tractor, apply the handbrake, stop the engine

i) Using the tractor hydraulics lower the three point linkage to position the rear attachment of the hitch of the Grange 3m LDT to resemble the same height as the tractor drawbar. Refer to the tractors operators' manual for the safe operation of externally mounted hydraulic controls. **Please note the three point linkage of the tractor now needs to be locked in position.** The Grange 3m LDT is now setup in the working position, ref fig 11.0. Stop the movement controls of the tractor, apply the handbrake, stop the engine and remove the key.

ii) There is one disc ram located centrally under the headstock. There are two main beam lift rams. The disc ram rotates the cutting discs out of work, whereas the main beam rams elevate the low disturbance legs out of the ground eliminating the need to raise the tractor three point linkage on the headland turns.

iii) Assess the soil conditions and starting with the single disc ram apply the required number of spacers, ref fig 12.0. Following on with the main beam lift rams; apply a consistent number of spacers to each ram as illustrated in fig 13.0. Each spacer is colour coded to represent different thicknesses. For safe and efficient operation of the Grange 3m LDT, the two main beam rams must be operating to an even depth. The low disturbance legs can cultivate to a depth of 300mm.

iv) When commencing work the cutting discs need to enter the ground between 50mm and 75mm.

v) Return to the tractor, restart the engine and activate the tractor auxiliary hydraulics to engage the discs and lower the main beam to the ground whilst engaging a slow forward speed.

vi) In the event that adjustments need to be made in the field for the Grange 3m LDT working depth, apply the following procedure; Firstly raise the main beam fully and rotate the discs out of work. Stop the movement controls of the tractor, apply the handbrake, stop the engine and remove the key. The adjustment of the spacers can be performed safely with the operator positioning themselves at the front of the Grange 3m LDT.

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FIG 11.0 3M LDT SETUP IN WORKING POSITION

FIG 12.0 LOCATION OF DISC RAM SPACERS

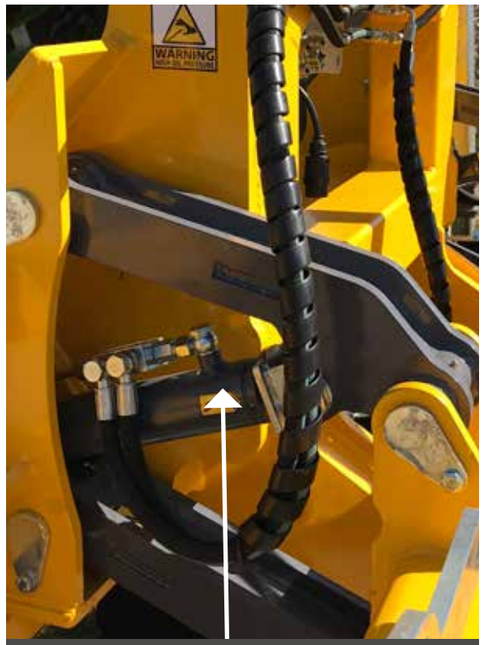

FIG 13.0 LOCATION OF DEPTH SPACERS ON MAIN BEAM RAM

12.1 Headland turns and working sequence

i. Upon reaching the headland turn the beam will be in its lowest working position with the cutting discs and legs engaged in the soil.

ii. Operate the auxiliary hydraulics until the beam lifts to the top of the ram travel, with the legs exiting work. Maintain activation of the auxiliary hydraulics to rotate the cutting discs out of work.

12.2 Back into work after headland turn

i. Activate the auxiliary hydraulics to lower the beam to engage the legs into the soil to the set working depth.

ii. Maintain activation of the auxiliary hydraulics to rotate the cutting discs into work.

Please note!

i. Never try turning bends with the Grange 3m LDT legs in the ground.

ii. Always lift the legs out of working position before turning on headlands or short turns.

13.0 Maintenance

The maintenance routines which are required on the Grange 3m LDT equipment are as follows;

i) Check all nuts and bolts after the first two hours use and then check weekly.

ii) Regular greasing of the ram pivot points. (Ref: fig 14.0).

iii) Replacement of shear bolts in the event of excessive forces applied to the tine. (Ref: fig 15.0 & 16.0). **Note the position of the bolt head is always on the lower leg outside face when replacing the shear bolt.**

iv) Replacement of the tines when worn.

v) Replacement of the cutting discs when worn.

vi) Replacement of the cutting disc bearings when failure occurs.

vii) Replacement of hydraulic ram seals in the event of failure.

FIG 14.0 GREASE LOCATIONS

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Before undertaking maintenance on the Grange 3m LDT ensure the following safety procedures are put in place.

i) Never undo hydraulic pipes until all the pressure is released.

ii) Identify whether the maintenance activity requires the Grange 3m LDT equipment to be raised off the ground. If so any 2nd stage cultivation/seeding equipment will need to be safely uncoupled.

iii) Locate suitable hard standing which can take the full weight of the Grange 3m LDT. If requiring the 3m LDT machine to be raised off the ground, apply safe chocking methods, such as adjustable axle stands with adequate load capacity. Refer to the equipment specification; Section 5.0.

iv) Stop the movement controls of the tractor, apply the handbrake, stop the engine and remove the key.

v) Wear appropriate PPE.

vi) Select the correct workshop tools.

vii) Remove any residual mud or other extraneous material from the machine.

viii) Use lubrication spray oils to free up bolts to facilitate ease of removal.

13.1 Replacing shear bolts

RED LINE – LOWER LEG (15MM)

YELLOW LINE – UPPER LEG (20MM)

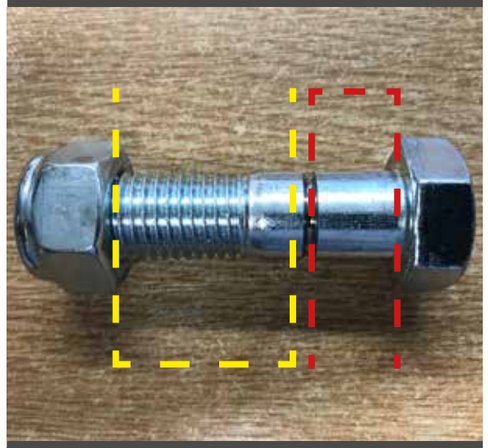

FIG 15.0 SHEAR BOLT WITH SHEAR PLANE

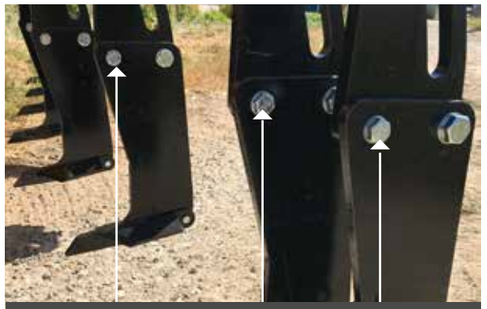

FIG 16.0 SHEAR BOLT LOCATION

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13.2 Replacing points

When replacing the points use suitable solid level ground e.g. concrete/tarmac, to avoid the risk of sinking and potential injuries whilst changing the points as well as potential damage to tungsten tipped points. The implement must be raised on the tractor linkage and the tractor engine turned off and handbrake applied.

It is important to support the weight of the Grange 3m LDT with appropriate axle stands to enable safe access to the points. Please be aware it is forbidden to work under a suspended load without the adequate support.

Wear appropriate PPE which is safety glasses and gloves. In addition the use of a safety bump cap will prevent any inadvertent contact by your head with the frame.

Once you are confident that you have met the safety standards required you can proceed.

Unbolt the single fixing (M10 x 40mm long bolt) from the worn point to free the point. A new point can then be replaced into the same position using the same size fixing. Ensure the bolt is fully tightened, ref Fig 17.0.

When you have finished replacing the points, remove the axle stands supports/chocks in order to proceed.

FIG 17.0 NEW POINTS FITTED AND SECURING CONNECTIONS

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14.0 Troubleshooting

This section provides the operator with a reference in the event of experiencing difficulty in operational mode and in the event of component failure.

	Example of failure	Possible causes	Investigation to address root causes of failure.
1.0	Inability to achieve rapid entry of soil engaging legs.	Points are worn.	Replace points according to soil profile and equipment usage. Contact Grange Machinery Ltd personnel for sourcing replacements and additional spares.
		Incorrect linkage configuration.	Is the machine raising and lowering on the linkage parallel to the rear of the tractor? Review tractor linkage adjustments in accordance with manufacturer's guidance.
		Tractor hydraulic pressure is insufficient or flow rates / response times require adjustment.	Review tractor hydraulic system and settings in accordance with manufacturer's guidance.
2.0	Hydraulic oil leakage	Tighten up hydraulic fittings	General operation routines
		Hydraulic ram seals need replacing. Before removing rams contact Grange Machinery Ltd directly.	Check that the ram bores aren't scored and causing premature failure of the seals.
3.0	Inadequate performance of 2nd stage soil engaging equipment which is coupled up to the Grange 3m LDT.	Check hitch / linkage connection position on rear of Grange 3m LDT. Check hydraulic connections and flow settings through to auxiliary equipment.	Set-up the tillage configuration in the field in the working position, isolate the tractor engine, secure the handbrake. Check all adjustment variables and depth of soil penetration. Check all equipment settings in accordance with soil profile. Check wearing parts and refer to operator's manual for connection 2nd stage cultivation/ seeding equipment. Check tractor tyre pressures and front ballast. If required refer to Grange Machinery Ltd personnel for further advice.
4.0	Discs stop rotating when engaged in the ground.	Bearing failure.	Bearings are sealed although do have a finite life. Remove disc section and contact Grange Machinery Ltd personnel for sourcing replacements and additional spares.
5.0	Trash building up around the legs.	Discs have lost their cutting edge and need replacing.	Replace discs. Check all discs for wear and plan to replace in sections to maintain a constant profile across the machine. Contact Grange Machinery Ltd personnel for sourcing replacement disc sections and additional spares.
6.0	Repeated failure of shear bolts.	Incorrect shear bolt specification and tightness. Main leg assembly bolts are loose.	Check the leg points for wear. Using the points beyond their useful wear life will put excessive stress on the shear bolts. Replace points. Contact Grange Machinery Ltd personnel for sourcing replacement shear bolts and additional spares. Check the shear bolt locating section for any signs of elongated holes or loose fitting. Tighten main leg assembly bolts.
7.0	Uneven cultivation depth	Incorrect lower link arm settings	Check lower link arm settings on the tractor and adjust in accordance with tractor manufacturer's guidance.

15.0 End of season storage

At the end of the working season, undertake the following maintenance procedures. Ensure that the machine is lowered to the ground, the hand brake applied, tractor engine stopped and key removed.

i) Dry brush and remove extraneous soil and vegetation matter.

ii) If the points or discs need replacing follow the procedure in Section 13.0.

iii) Check shear bolts for signs of excessive shear loadings and replace if necessary following the procedure in Section 13.0.

iv) Check hydraulic hoses, couplings and ram seals for evidence of leaks and excessive wear. Replace as required.

v) Apply anti-corrosion oils or grease to all wearing parts and exposed hydraulic cylinder rods and linkage connections. Grease all pivot points liberally.

vi) Park on hard standing in a dry covered storage area.

16.0 End of life recycling

The Grange 3m LDT is manufactured from predominantly steel components with hydraulic pipes and activating rams. Once the Grange 3m LDT has completed its working life, the steel can be recycled via an authorised outlet. Where components have been in contact with hydraulic oil they will need to be disposed of via an appropriate hazardous waste recycling outlet. If you are unsure of the correct disposal method please contact Grange Machinery Ltd for further advice.

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17.0 Spare parts listing

PART NUMBER	DESCRIPTION	WING WIDTH
SP-0028	Narrow Point	40mm
SP-004	Standard Steel Point	60mm
SP-0020	Standard Tungsten Tipped Point	60mm
SP-0019	Intermediate Point	80mm
SP-0019T	Intermediate Tungsten Tipped Point	80mm
SP-0018	Wide Point (110mm wing width)	110mm

PART NUMBER	DESCRIPTION
SP-0002	Shear Bolt Leg Bottom
GMSB	Shear Bolt
SP-0003	Leg Top
SP-0023	Hydraulic Reset Leg Bottom
SP-0022	Hydraulic Reset Leg Top
SP-0007	Cutting Disc

PART NUMBER	DESCRIPTION
BAA	Bearing
SHAB	Rubber Suspension
GM16006	Disc Arm
HSLC	Depth Spacers (Full Pack)
CLEV3	Towing clevis hitch
CAT3RL	Link arm attachment

17.1 Hydraulic legend & component specifications

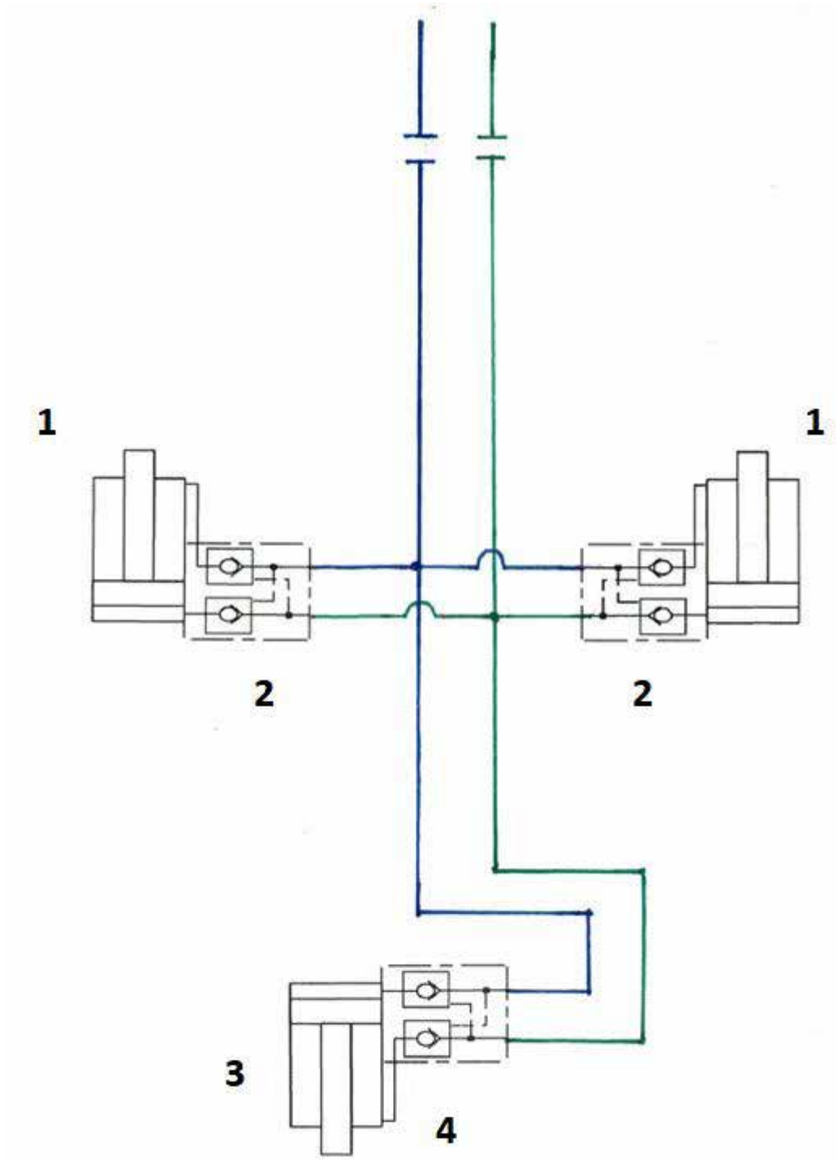
Please refer to Fig 18.0

REF	COMPONENT DETAIL	QUANTITY OF COMPONENTS
1.0	Main beam lifting ram	2
2.0	Pilot Operated Check Valve	2
3.0	Disc ram 30/60/100 CB	1
4.0	Port mounted pilot operated chack valve (3/8” POC)	1

17.2 Fig 17.0 Hydraulic schematic of Grange 3m LDT

Legend

1. Main Beam Lifting Ram 30/60/200CB
2. Pilot Operated Check Valve
3. Disc ram 30/60/100CB
4. Port Mounted Pilot Operated Check Valve (3/8” POC)



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18.0 Warranty

The Grange Machinery Ltd. 3m Low Disturbance Toolbar is covered for a period of 12 months from the date of delivery to farm (which is recorded on our files) against faulty components and/or bad workmanship. All products are checked and hydraulically tested prior to delivery/collection.

We cannot be responsible for claims arising from ignorance, occurrences outside our control, such as accidents, and malicious damage.

Warranty claims for damage during transport

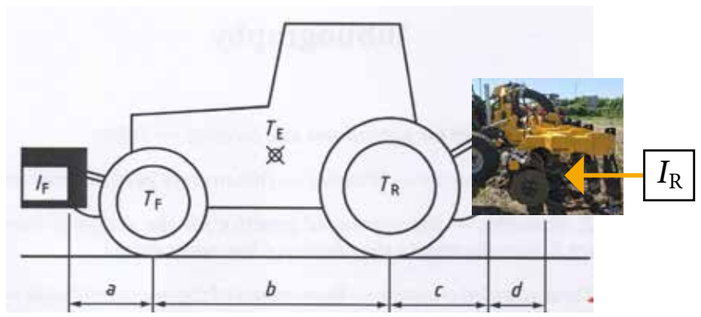
Damage occurred during transit via an external haulier must be reported immediately upon unloading and signing for the item. The limit of our liability to undertake repairs to products damaged during transit is dependent on signing for any damaged product upon delivery as “DAMAGED”.

Machines must return to Grange Machinery Ltd to have any warranty work carried out. Grange machinery Ltd genuine pars must be used to keep warranty valid throughout use.

Any modification or tampering to the Grange 3m LDT without prior consent from Grange Machinery Ltd will invalidate the 12 month machine warranty.

The content of this operator manual are correct at the time of print but may be subject to additions or change at any time in the future. Replacement operator manuals must be ordered in relation to the model and serial number provided.

Appendix 1.0: Example calculations: Ref Fig 4.0



$$I_{F,\min} = \frac{(I_R \times (c+d)) - (T_F \times b) + (0{,}2 \times T_E \times b)}{a+b}$$

Please note these are indicative calculations using industry examples for typical 200hp tractor specifications. Due to the combination of the Grange 3m LDT and 2nd stage cultivation/ seeding equipment the tractor machine combination can become unstable. The following expression can be applied for the calculation of the minimum ballasting at the front (IF min) which allows to have a load on the front axle equal to 20% of the unladen mass of the tractor. The operator of the Grange 3m LDT and and coupled 2nd stage cultivation / seeding equipment must input the relevant values for the tractor and 2nd stage cultivation / seeding equipment they are using. In addition variables such as tractor tyre pressures also need to be checked and set to suit operational conditions.

Key	Definition	Values inputted
T_E [kg]	Mass of un-laden tractor	7300Kg
T_F [kg]	Front axle load of un-laden tractor	2701Kg
T_R [kg]	Rear axle load of un-laden tractor	4599Kg
I_R [kg]	Combined mass of rear-mounted implement / rear ballast (Grange 3m LDT)	1250kg
I_F [kg]	Combined mass of front mounted implement / rear ballast	See calculations below
a [m]	Distance from centre of gravity for combined front mounted implement / front ballast to front axle centre.	1.48m
b [m]	Tractor wheelbase	2.884m
c [m]	Distance from rear axle centre to centre of lower link balls.	1.1m
d [m]	Distance from centre of lower link balls to centre of gravity for combined rear-mounted implement / rear ballast. (Grange 3m LDT)	0.57m

1.0 Example tractor specifications: Typical 200hp, including integral front linkage and weight block with only the Grange 3m LDT attached;

IF (min) = (1250x(1.1+0.57)) – (2701x2.884) + (0.2x 7300 x 2.884) / 1.48 + 2.884

IF (min) = (1250x(1.67))-(7789)+(4210) / 4.364

IF (min) = **- (minus)** 342kg (e.g no front counterbalance required)

2.0 Example tractor specifications: Typical 200hp including integral front linkage and weight block with the Grange 3m LDT attached and also a 2nd stage cultivation/ seeding equipment with a drawbar load of 2500kg. The clevis hitch on the Grange 3m LDT is located at approximately the same position as the units centre of gravity. Therefore the ***IR*** = (1250kg + 2500kg)

IF (min) = (3750x(1.1+0.57)) – (2701x2.884) + (0.2x 7300 x 2.884) / 1.48 + 2.884

IF (min) = (3750x (1.67))-(7789)+(4210) / 4.364

IF (min) = **+ 615 Kg** (e.g 615kg of front counterbalance required on the tractor)

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