



Front end loaders and their attachments on tractors

A guide on health and
safety standards

February 2011

OIR Disclosure Log

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Disclaimer

This publication may contain occupational health and safety and workers compensation information. It may include some of your obligations under the various legislations that WorkCover NSW administers. To ensure you comply with your legal obligations you must refer to the appropriate legislation.

Information on the latest laws can be checked by visiting the NSW legislation website (www.legislation.nsw.gov.au).

This publication does not represent a comprehensive statement of the law as it applies to particular problems or to individuals or as a substitute for legal advice. You should seek independent legal advice if you need assistance on the application of the law to your situation.

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1. INTRODUCTION

The Industry Solutions Program is a research and development initiative undertaken by WorkCover NSW, which has worked with industry to devise practical solutions to problematic issues in an industry. It recognises the need for assistance in some industry sectors to overcome particular difficulties or challenges in order to improve workplace safety.

Solutions to safety issues are developed in partnership with industry and released for industry-wide implementation. Within 12 months, an evaluation is conducted to determine the effectiveness and practicality of the solutions. If necessary, further refinements, including additional solutions, are included after the evaluation.

WorkCover is aiming to harmonise industry solutions in conjunction with other occupational health and safety (OHS) jurisdictions to develop a common approach to control hazards.

The Industry Solutions Program identified that front end loader attachments designed for use on a tractor can be hazardous to operate and that there is currently no practical guidance available in Australia for their design and use – hence this guide was developed.

Contributors to this guide include:

- Burder Group Australian
- Challenge Implements
- Howard Australia
- Farmsafe Australia
- John Deere
- Kentan Machinery (FIMDA)
- Kubota Tractor Australia
- Motor Traders Association NSW
- Nowra Truck and Tractor (FIMDA)
- NSW Farmers Industrial Association
- Online Safety Systems
- Tractor and Machinery Association of Australia
- Workplace Health and Safety Queensland, Department of Justice and Attorney-General
- WorkSafe Victoria
- WorkSafe Western Australia
- Workplace Standards Tasmania, Department of Justice.

This guide provides practical guidance for designers, manufacturers, suppliers and users of front end loader attachments on tractors. OHS legislation requires the control of risk to health and safety, and following this guide is a means to achieve such compliance.

2. SCOPE

This guide covers the design, manufacture, supply and safe use of a front end loader (FEL), and its ancillary attachments, on a tractor. It also covers used front end loaders, and their attachments for resale.

This guide excludes workboxes and associated slinging equipment.

3. DEFINITIONS

For the purpose of this guide, the following definitions apply:

Attachment	a bucket or other implement designed to be attached to the FEL.
Competent person	for any task means a person who has acquired, through training, qualifications or experience, or a combination of them, the knowledge and skills to carry out that task.
FEL	front end loader, a unit consisting of lifting arms and fastening devices, designed to be mounted on the front of an agricultural tractor and equipped for fitting of a bucket or other attachment.
Rated capacity	the maximum lift capacity (in kilograms) at maximum height for the FEL and standard bucket, determined in accordance with ASAE S301.
Rollback	losing control of the load, resulting in the load falling rearwards onto the tractor and/or operator.
ROL	rated operating load, the maximum load (in kilograms) that can be lifted to full height without exceeding the tractor specifications and still maintaining stability – ROL is determined for a specific tractor, FEL and attachment combination.

4. DESIGN

OHS legislation places obligations on designers to identify hazards and control the risks associated with the design, manufacture, supply and use of plant. The designer must, where reasonably practicable, design-out any risks associated with the use of the FEL and/or its attachments. Where the risks cannot be designed-out, a means to control the risks must be provided.

The designer must provide information to the manufacturer, which includes advice on:

- results of testing and examination conducted during the design phase
- purpose for which the FEL and its attachments are designed
- limitations on its use
- testing and inspections to be carried out on the FEL and its attachments
- installation and commissioning, operation, maintenance, transport, storage and dismantling
- systems of work necessary for the safe use of the FEL and its attachments
- knowledge, training and skills necessary for undertaking inspection and testing of the FEL and its attachments.

The following sections provide advice on specific hazards that are associated with FELs and their attachments, and should be addressed in the design.

4.1 ROLLBACK

Rollback of the load onto the operator is a cause of serious incidents when handling materials. Therefore, it is essential that all FELs incorporate a rollback elimination system.

The designer must eliminate the possibility of rollback when the tractor, FEL and attachment combination is used for its intended purpose on a level surface. They should also provide information on how to control rollback on sloping ground, including the load limitations for manufacturer-approved attachments.

If the FEL and its attachments are not from the same designer, the person putting the two together must ensure they are compatible, and that rollback is eliminated.

Self-leveling systems must be designed so they cannot be overridden to create rollback. Figures 1b and 2b illustrate self-leveling as a control for rollback.



Figure: 1a

The angle of the earthmoving bucket attachment, relative to the ground, is greatly increased as the FEL is raised, which allows the load to rollback on to the tractor or operator.

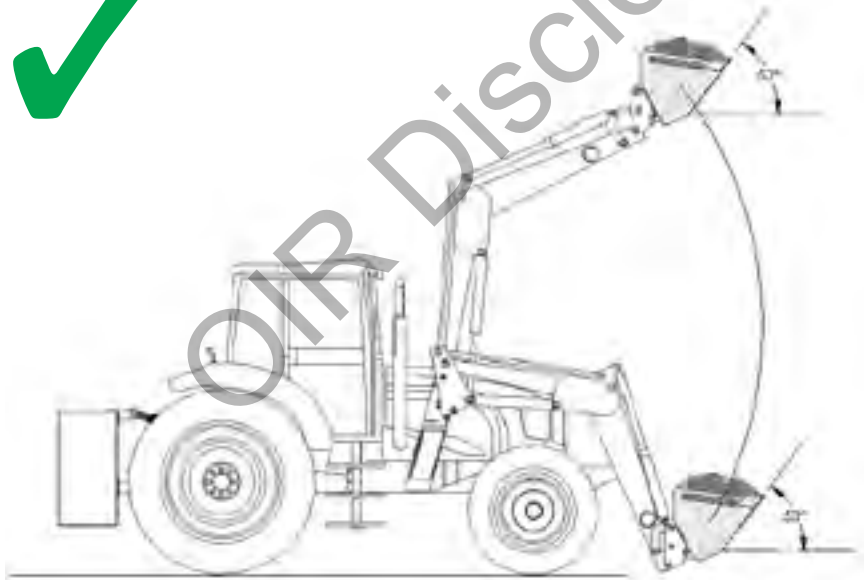


Figure: 1b

With self-leveling anti-rollback device incorporated into the FEL and its attachments, the angle remains the same and ensures the risk of rollback is eliminated when operated correctly.



Figure: 2a

The angle of the pallet fork attachment, relative to the ground, is greatly increased as the FEL is raised, which allows the load to rollback on to the tractor or operator.

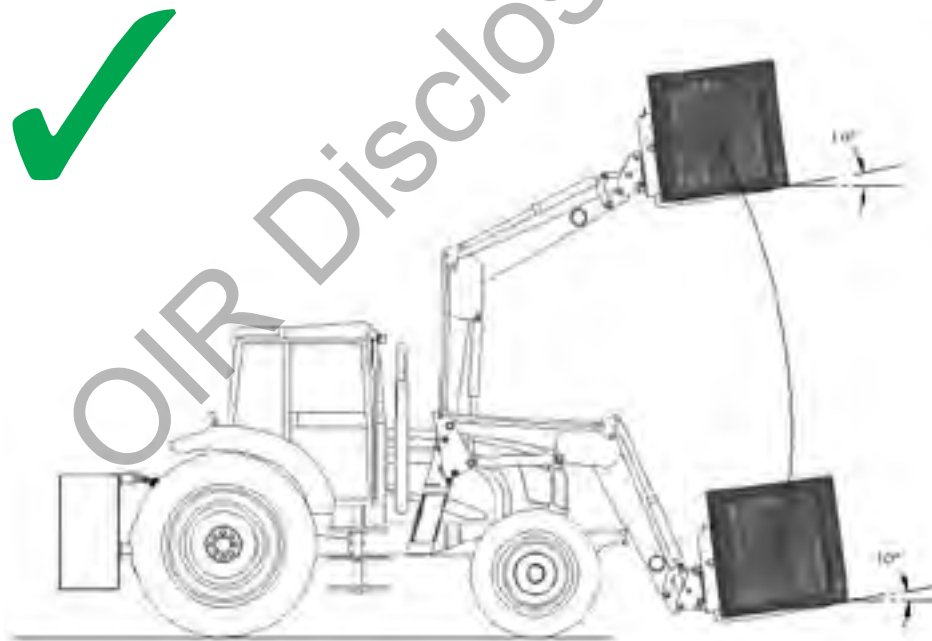


Figure: 2b

With self-leveling anti-rollback device incorporated into the FEL and its attachments, the angle remains the same and ensures the risk of rollback is eliminated when operated correctly.

4.2 HYDRAULIC SYSTEMS

New hydraulic hoses must have a safety factor of 4:1 – ie the minimum burst pressure of the hose must be four times greater than to the maximum working pressure. All hydraulic hoses must be in good condition and be serviceable.

Operator controls and hoses should be located, and/or guarded if reasonably practicable, to prevent oil injection, or burn injuries caused by contact with oil over 50 degrees celsius, in the event of a hose or coupling failure. Guarding can take the form of a hose sock or rigid guard.

It is not always reasonably practical to guard quick-disconnect couplers.

4.3 STABILITY AND RATED OPERATING LOAD (ROL)

The addition of the FEL attachment to a tractor will adversely affect its stability and axle loadings. Counterweights or ballasting may be required to improve stability.

The ROL of the FEL and its attachments, and associated ballast requirements, must be determined in accordance with:

- EN 12525 – *Agricultural machinery – Front loaders – Safety*
- *Code of practice for manufacture and supply of front end loaders for use on agricultural tractors in Australia* (Tractor Machinery Association of Australia)
- ASAE EP562 – *Procedure for determining recommended ballast and minimum rear wheel tread settings for agricultural tractors with agricultural front loaders.*

The designer must also ensure that the tractor specifications are not exceeded, whether the attachment is loaded or empty. Therefore, specifications must not be exceeded for:

- rear axle loads
- front axle loads
- allowable loadings for attachment points
- tyre ratings
- total allowable tractor mass.

4.4 SECURITY OF LOAD

The FEL and its attachments should be designed to retain the load, when used according to the designer's limitations.

4.5 CONTROLS

Operating controls of the FEL and its attachments should be of the hold-to-run (ie deadman) type, except for a float position on the FEL lowering control, which can be retained in position.

All controls for the FEL and its attachments must be clearly and permanently identified (wording must be in English) – see figure 3.

Controls should not result in any movement that is counter intuitive to the direction of control movement. The direction of the raise/lower lever or joystick controls must follow the direction of movement of the assigned function – eg lever forward to lower, lever back to raise.

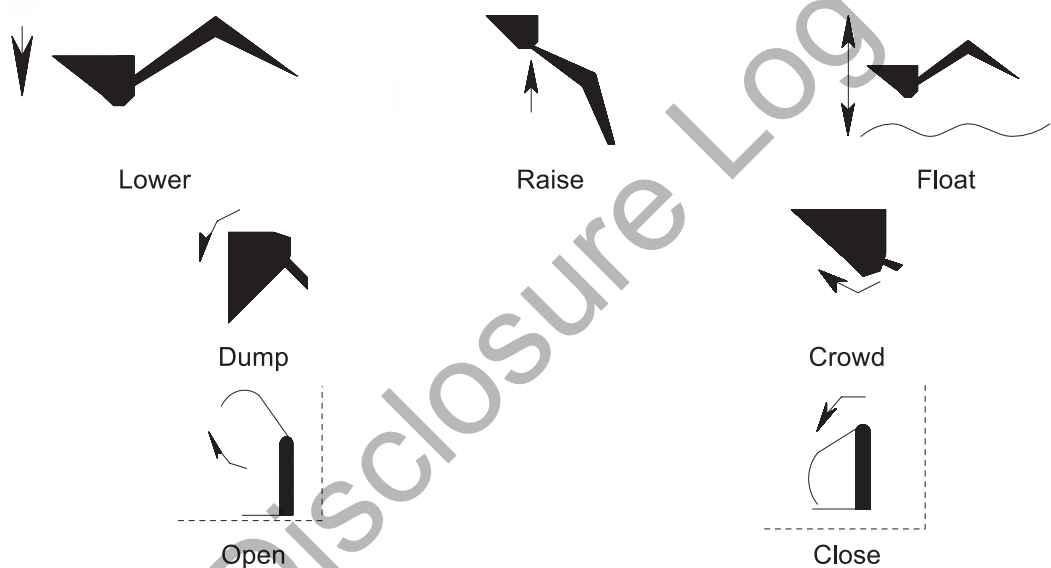


Figure 3: Typical operating control identification

4.6 CRUSH AND SHEAR HAZARDS

Shear hazards between the moving arm and stationary structure of the tractor must be identified and eliminated, where practicable. Where a hazard cannot be eliminated, information and instructions must be provided in the manufacturer's instructions that identify the potential hazards and recommended controls.

The FEL should be removable, to allow unobstructed access for tractor maintenance and inspection. It should be stable when disconnected from the tractor.

If it is impracticable to disconnect the FEL, such as in field service, a safe system of work must prevent inadvertent lowering of the raised lift arms when there is hydraulic pressure loss of the FEL. A mechanical or hydraulic safety device must be provided as part of the design. Where a mechanical safety device is provided, it must be located on the FEL or the tractor, and readily available for use.

Where a hydraulic safety device is provided, there must be no possibility of the raised arm lowering in the event of a single or multiple hydraulic leak or failure in the system – eg hose failure, ram seal damage, valve leakage.

4.7 SAFETY SIGNS AND DECALS

The FEL and its attachments should prominently display pictorial and/or written signs that warn against serious safety risks. Examples (see appendix A) of these signs include:

- Do not exceed ROL
- Crush zone
- Use of mechanical devices during maintenance.

Symbols should conform to AS 1319 *Safety signs for the occupational environment*, all words must be in English and units in metric.

5. MANUFACTURERS

5.1 MANUFACTURER'S RESPONSIBILITIES

OHS legislation places obligations on manufacturers to identify hazards and control the risks associated with the manufacture, supply and use of plant. The manufacturer must ensure all relevant advice provided by the designer is incorporated into the manufacture of the FEL and its attachment.

The manufacturer must ensure that the FEL and its attachments conform to this guide, or provide an equivalent or higher level of safety.

A manufacturer must provide those who have responsibilities under the legislation with all available information about the FEL and its attachments that enables them to fulfil their responsibilities with respect to identifying hazards and controlling the risks associated with the manufacture, supply and use of the FEL and its attachments. This includes advice on the:

- purpose for which the FEL and its attachments were designed
- limitations on its use
- suitable tractors, their counterweight requirements and ROL
- testing and inspections to be carried out on the FEL and its attachments
- installation, commissioning and dismantling
- operation, maintenance, transport and storage
- systems of work that are necessary for the safe use of the FEL and its attachments
- knowledge, training and skills that are necessary for undertaking inspection and testing of the FEL and its attachments.

The manufacturer should affix a compliance decal or plate to the FEL's sub frame or arm – it should be accessible, and clearly and permanently marked. It should indicate:

- tractor model*
- FEL model
- identification or serial number
- manufacturer's identification
- counterweight requirements*
- ROL*

- warning not to exceed ROL
- year of manufacture (or date of supply*).

*These may be stamped by the supplier, or provided on a separate decal or plate, so that the FEL can be fitted to different tractor models, as per the manufacturer's instructions.

5.2 MANUFACTURER'S INSTRUCTIONS

The manufacturer must provide documented operator instructions in English. These instructions must clearly specify all information outlined in section 5.1.

As a minimum, the instructions should include information about:

- tractor requirements
- FEL and attachment capabilities
- inspection and maintenance requirements
- method to attach and detach the FEL and its attachments
- storage
- operation.

The manufacturer should consider providing more practical means for communicating their instructions, such as an instructional DVD or web based information, in addition to the documented operator instructions.

6. SUPPLIERS

6.1 SUPPLIER'S RESPONSIBILITIES

The supplier includes anyone involved in the supply, sale, transfer, lease or hire of plant that is used in a workplace.

OHS legislation places obligations on suppliers to identify hazards and control the risks associated with the supply and use of a FEL and its attachments. They must ensure that any FEL and its attachments, manufactured after the commencement of this guide, conforms to the requirements outlined herein, particularly if imported from abroad, or from another State or Territory, as the manufacturer may not be aware of these requirements – see sections 5.1 and 5.2.

Suppliers who:

- provide advice on the suitability of a FEL
- provide a FEL for a known tractor
- fit a FEL to a tractor, or
- provide a FEL/tractor combination

must ensure that the FEL and its attachments are compatible with the tractor, and any ancillary attachments that the purchaser has advised will be used.

The checklist in appendix B assists the supplier to check whether they are complying with this guide. This guide can be used to assist you in complying with those requirements.

Note: FELs first manufactured prior to the commencement of this guide may not comply with the requirements herein. However, this guide should still be used to assist you in meeting the risk control obligations in the OHS legislation. Where compliance with the requirements in this guide is not reasonably practicable other measures should be implemented to control the identified risks.

6.2 USED EQUIPMENT

Regulatory jurisdictions have different requirements for the sale and transfer of used plant. Ask your workplace regulator for information on the sale or transfer of used plant in your State or Territory. This guide can be used to assist you in complying with those requirements.

6.3 PROVISION OF INFORMATION

The manufacturer's instructions and all other information relevant to the safe use of the FEL and its attachments must be provided at the point of supply.

Prior to sale, the supplier should obtain information from the purchaser and compare this with the specifications provided by the manufacturer, to ensure the FEL and its attachments are fit for the described purpose (when used according to the manufacturer's instructions). The supplier should get information about the type of tractor to be used, the loads to be handled, and the type of terrain on which the FEL will be used.

6.4 PRACTICAL SAFETY INFORMATION

The supplier should establish a means to instruct, at the point of supply, those who purchase a FEL and its attachment on its safe use. This may include a DVD, an instructional session, or an explanation of the manufacturer's instructions.

6.5 RETENTION OF INSTRUCTIONS

The FELs operating instructions must be provided at the point of sale and a copy must be stored in a permanent weatherproof receptacle in the tractor, or on the FEL.

6.6 MODIFICATIONS

Anyone who modifies the FEL or its attachments assumes the role and responsibilities of the designer and manufacturer. As a general rule, modifications should not be done and, if they are, they must be done by a competent person and based on a risk assessment. Before any modifications are done, contact the manufacturer or supplier.

When modifications are carried out, review the safety instructions and revise them where necessary.

7. USE

7.1 EMPLOYER/CONTROLLER RESPONSIBILITIES

OHS legislation places obligations on the employer, or person in control of the plant, including FELs and their attachments, to identify hazards and control the risks associated with their use in the workplace.

When purchasing a FEL or attachments:

- ensure the manufacturer's instructions are provided at the point of purchase
- ensure the FEL and the attachments conform to this guide
- discuss your needs with the supplier to ensure the FEL and the attachments are compatible with your tractor and appropriate for the type of work to be undertaken
- seek practical advice and instruction from the supplier on the use and limitations of the FEL and the attachments.

If you are hiring, leasing or borrowing a FEL or an attachment on a temporary basis, get safe use instructions from the person supplying it.

7.2 ROLL-OVER PROTECTIVE STRUCTURES (ROPS)

ROPS must be manufactured and maintained according to AS1636 (series) *Tractors – Roll-over protective structures – Criteria and tests*. A plate or decal confirming compliance should be attached to the ROPS' frame, or inside the tractor cabin.

Note: A falling object protective structure (FOPS) is not normally required for agricultural tractors but you should assess whether the change of activity relating to the FEL and its attachments introduces a falling risk. If so, you may need to consider installing a FOPS.

7.3 SECURITY OF LOAD

FEL attachments are designed for specific applications and must be used only for the purpose for which they are designed – eg large round hay bales cannot be lifted safely using a bucket.

7.4 TRACTOR STABILITY

The addition of FEL will raise the tractor's centre of gravity, making the tractor/FEL combination less stable than the tractor on its own. Having a raised load in the attachment further raises the centre of gravity. This effect is demonstrated in figure 4.

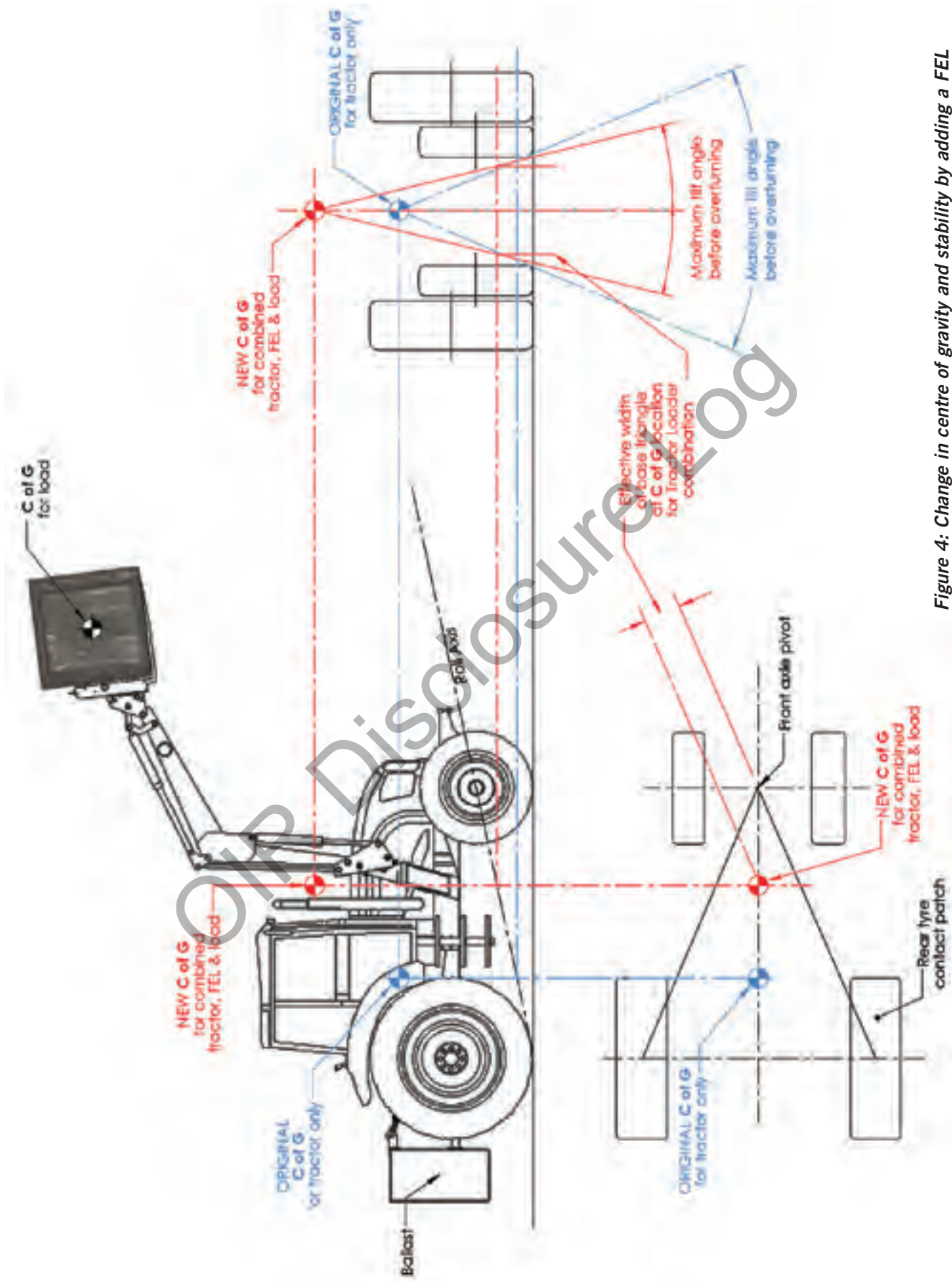


Figure 4: Change in centre of gravity and stability by adding a FEL

7.5 SAFETY INSTRUCTIONS

The employer must provide safety instructions to all those involved in using a FEL and its attachments. A copy of the safety instructions must be kept in good condition with the FEL and its attachments, or with the tractor.

Generally, the safety instructions should be the manufacturer's instructions. Any variations from the manufacturer's instructions must be based on a risk assessment, and must not remove any of the safety features nor expose anyone to risks.

7.6 SUPERVISION, INSTRUCTION AND TRAINING

The employer must provide safe systems of work, adequate supervision, instruction and training to all those involved in using a FEL. They must be instructed in the safe operation of the FEL and its attachments, including hazards specific to the workplace, including the terrain, stability of the tractor, working environment and the like. The employer should ensure that everyone achieves a level of understanding that enables them to safely and competently operate the FEL and its attachments.

Regulatory jurisdictions have different licensing requirements for operation of a front end loader. Ask your workplace regulator for information on the licensing requirements in your State or Territory.

7.7 OPERATION

Prior to use, the FEL and its attachments should be inspected. All safety features must be included in this inspection. If any safety feature is not working correctly, the FEL and its attachments must not be used. The FEL and its attachments must be operated according to the manufacturer's instructions.

There are number of issues that need to be considered prior to operation, such as:

- overhead powerlines and obstructions
- underground services
- terrain
- people within vicinity of operation
- load, mass, dimensions, security
- ROL
- travel speed
- counterweights.

Regulatory jurisdictions have different approach (or separation) distances for work that is done in close proximity to overhead powerlines. Check with your OHS or electrical regulator for the relevant distances in your jurisdiction.

A load should be transported in its lowest practical position, at a safe speed, not exceeding 10 km/h. Consider the terrain and ensure the tractor remains stable during travel and use. A tractor's stability, and the ability of the FEL and its attachments to prevent roll back, are reduced when operating on a slope.

7.8 PERSONAL PROTECTIVE EQUIPMENT (PPE)

Prior to use, a risk assessment must be undertaken to determine the appropriate PPE required. Any identified PPE must be provided by the employer and must be used by those involved in the operation and maintenance of the FEL and its attachments. Examples of PPE are appropriate footwear, hearing protection and eye protection.

7.9 STORAGE

When not in use, the FEL and its attachments should be stored according to the manufacturer's instructions. FELs attached to tractors are safest when rested on the ground. If detached from the tractor, ensure it is stable and poses no risk of falling.

7.10 INSPECTION, MAINTENANCE AND REPAIR

- The FEL and its attachments must be inspected according to the manufacturer's instructions, prior to use.
- All problems identified must be rectified, prior to use.
- The FEL and its attachments must be maintained according to the manufacturer's instructions.
- Replacement parts must be to the original manufacturer's specifications, or their equivalent.
- For replacement hydraulic hoses, the safety factor of 4:1 applies.
- Safety signs and decals should be legible, maintained and, where necessary, replaced.
- Repairs should be carried out by a competent person.

When servicing the tractor, remove the FEL to provide unobstructed access. If this is not practicable – eg for field repairs – use the mechanical or hydraulic safety device provided, to prevent unplanned lowering of the FEL and its attachment.

7.11 MODIFICATIONS

The FEL and its attachments should not be modified or altered. However, if it is necessary to make modifications, they must be done by a competent person and based on a risk assessment. All modifications must comply with this guide. Before any modifications are done, contact the manufacturer or supplier.

The instructions relating to the FEL and its attachments may need to be revised following a modification.

APPENDIX A – SAFETY SIGNS/DECALS

The FEL must clearly display pictorial and written signs warning against the serious safety risks. FEL attachments may also require pictorial and written signs warning against their specific serious safety risks. The following are examples of safety signs that may be used.



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APPENDIX B – PRE-PURCHASE CHECKLIST

Use this checklist to purchase a FEL or an attachment, to ensure it complies with the safety features outlined in this guide.

FELs first manufactured prior to the commencement of this guide may not comply with the requirements herein. However, this guide should still be used to assist you in meeting the risk control obligations in the OHS legislation. Where compliance with the requirements in this guide is not reasonably practicable other measures should be implemented to control the identified risks.

Tick **YES** or **NO** against each item. If all **YES** answers, your FEL and attachment should enable you to meet your legal safety obligations. If **NO** to any question, you will need to address the issue to ensure that you comply with those obligations.

ITEM	YES	NO	COMMENT
Is the FEL and attachments suitable for use with your tractor? – eg stability and capacity (See section 4.3)			
Is the FEL and attachments appropriate for your needs? – eg security of load and terrain (See section 4.3)			
Does the FEL and attachments prevent rollback? (See section 4.1)			
Do hydraulic hoses have a safety factor of 4:1? (See section 4.2)			
Are counterweights or ballasting, if required, provided for use with the FEL? (See section 4.3)			
Are the controls clearly and permanently identified? (See section 4.5)			
Are the controls (other than the float control) hold-to-run? (See section 4.5)			
Is a mechanical or hydraulic safety device provided? (See section 4.6)			
Are safety signs/decals in place? (See section 4.7 and appendix A)			
Are the manufacturer's instructions provided in English? (See section 5.2)			
Is there a manufacturer's compliance decal or plate located on the subframe of the FEL? (See section 5.1 and 5.2)			
Is information provided on safe storage of the FEL when disconnected from the tractor? (See section 5.1)			
Is maintenance information provided with the FEL? (See section 7.10)			
Is there practical safety information provided by the supplier? (See section 6.4)			

APPENDIX C – FOR FURTHER INFORMATION

WorkCover NSW

- Visit www.workcover.nsw.gov.au
- Call the WorkCover Assistance Service on **13 10 50**
- Call the WorkCover Publications Hotline on **1300 799 003**
- Visit your nearest WorkCover office
- For technical specifications for FELs and attachments, contact your local supplier.

SafeWork South Australia

GPO Box 465
Adelaide SA 5001
Help Centre: 1300 365 255
Website: www.safework.sa.gov.au

Workplace Health and Safety Queensland, Department of Justice and Attorney-General

GPO Box 69
Brisbane QLD 4001
Workplace Health and Safety Infoline: 1300 369 915
Electrical Safety Infoline: 1300 650 622
Website: www.worksafe.qld.gov.au

Workplace Standards Tasmania, Department of Justice

PO Box 56
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Email: wstinfo@justice.tas.gov.au
Website: www.wst.tas.gov.au

WorkSafe Victoria

Advisory Service
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Melbourne VIC 3000
Telephone: 03 9641 1444
Toll free: 1800 136 089
Email: info@worksafe.vic.gov.au
Website: www.worksafe.vic.gov.au

WorkSafe Western Australia

1260 Hay Street
West Perth WA 6005
Telephone: 08 9327 8777
Toll Free: 1300 307 877
Email: safety@commerce.wa.gov.au
Website: www.worksafe.wa.gov.au

STATE OHS LEGISLATION

For specific OHS State requirements, refer to:

New South Wales

- *Occupational Health and Safety Act 2000*
- *Occupational Health and Safety Regulation 2001*

Queensland

- *Workplace Health and Safety Act 1995*
- *Workplace Health and Safety Regulation 2008*

South Australia

- *Occupational Health, Safety and Welfare Act 1986*
- *Occupational Health, Safety and Welfare Regulations 1995*
- *Workers Rehabilitation and Compensation Act 1986*
- *Workers Rehabilitation and Compensation (General) Regulations 1999*

Tasmania

- *Workplace Health and Safety Act 1995*
- *Workplace Health and Safety Regulations 1998*

Victoria

- *Occupational Health and Safety Act 2004*
- *Occupational Health and Safety Regulations 2007*

Western Australia

- *Occupational Safety and Health Act 1984*
- *Occupational Safety and Health Regulations 1986*

INDUSTRY CODE OF PRACTICE

Tractor Machinery Association of Australia

Manufacture and supply of front end loaders for use on agricultural tractors in Australia.

AUSTRALIAN STANDARDS

Australian Standards can be purchased from SAI Global by contacting the Customer Service Centre on **13 12 42**, or online at **www.saiglobal.com/shop**

Check if any updates or additions to the Australian Standards have been made.

AS 4100	<i>Steel structures</i>
AS 3990	<i>Mechanical equipment – Steelwork</i>
AS 1636	<i>Tractors – Roll-over protective structures – Criteria and tests – Conventional tractors.</i>

INTERNATIONAL STANDARDS

- ASAE S301 *Front-End Agricultural Loader Ratings*
- EN 12525 *Agricultural machinery – Front loaders – Safety*
- ASAE EP562 *Procedure for Determining Recommended Ballast and Minimum Rear Wheel Tread Settings for Agricultural Tractors with Agricultural Front Loaders.*
- ASAE S441 *Safety Signs*
- ASAE S304 *Graphical control symbols*
- ISO 3600 *Tractors, machinery for agriculture and forestry, powered lawn and garden equipment – Operator's manuals – Content and presentation*

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Catalogue No. WC02800 WorkCover Publications Hotline 1300 799 003
WorkCover NSW 92-100 Donnison Street Gosford NSW 2250
Locked Bag 2906 Lisarow NSW 2252 WorkCover Assistance Service 13 10 50
Website www.workcover.nsw.gov.au
ISBN 978 1 74218 631 3 © Copyright WorkCover NSW 0211

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DIAGONAL (BIAS) PLY AGRICULTURAL TRACTOR
DRIVE WHEEL TIRES
TIRES USED AS SINGLES

BASIC TIRE LOAD RATINGS FOR TIRE SELECTION

TIRE TYPE NOMENCLATURE		
		MAX. SPEED
		SPEED INDEX
TRA	TIRE TYPE	A8
R-1	Drive Wheel, Regular Tread	25 MPH
R-2	Cane & Rice, Drive Wheel, Deep Tread	25 MPH
R-3	Drive Wheel, Shallow Tread	25 MPH
R-4	Industrial Tractor, Drive Wheel, Intermediate Tread	25 MPH

TIRE SIZE	INFLATION	TIRE LOAD LIMITS AT VARIOUS COLD INFLATION PRESSURES													
		psi	12	14	16	18	20	22	24	26	28	30	32		
		kPa	80	100	110	120	140	150	170	180	190	210	220		
8.3-22	lbs	785	910	965	990	1100	1170(4)	1230	1280	1320	1390	1430			1760 @ 36(6) psi
	kg	355	412	437	450	500	530(4)	560	580	600	630	650			800 @ 250 (6) kPa
8.3-24	lbs	880	965	1020	1100	1170	1230(4)								
	kg	400	437	462	500	530	560(4)								
9.5-16	lbs	825	910	965	1050	1100(4)	1170	1230	1280	1360	1390(6)				
	kg	375	412	437	475	500(4)	530	560	580	615	630(6)				
9.5-22	lbs	990	1140	1200	1230	1360(4)	1430	1520	1570	1650	1710	1760(6)			
	kg	450	515	545	560	615(4)	650	690	710	750	775	800(6)			
9.5-24	lbs	1100	1200	1280	1390	1480(4)	1570	1650	1710	1820	1870(6)				
	kg	500	545	580	630	670(4)	710	750	775	825	850(6)				
9.5-32	lbs	1230	1360	1480	1570	1650(4)	1760	1870	1930	2040	2090(6)				
	kg	560	615	670	710	750(4)	800	850	875	925	950(6)				
9.5-36	lbs	1320	1430	1570	1650	1760(4)									
	kg	600	650	710	750	800(4)									
9.5-42	lbs	1430	1570	1650	1820	1930(4)	2040	2150	2270	2340	2400 (6)	2540			2910 @ 40(8) psi
															3200 @ 48(10) psi
	kg	650	710	750	825	875(4)	925	975	1030	1060	1090 (6)	1150			1320 @ 280(8) kPa
														1450 @ 330(10) kPa	
11.2-24	lbs	1320	1430	1570	1650(4)	1760	1870	1980	2090(6)	2150	2270	2340	2540 @ 36(8) psi	2830 @ 44(10) psi	
	kg	600	650	710	750(4)	800	850	900	950(6)	975	1030	1060	1150 @ 250(8) kPa	1285 @ 300(10) kPa	
11.2-28	lbs	1390	1520	1650	1760(4)	1930	1980	2090	2200 (6)						
	kg	630	690	750	800(4)	875	900	950	1000(6)						
11.2-36	lbs	1570	1760	1870	2040(4)										
	kg	710	800	850	925(4)										
11.2-38	lbs	1650	1760	1930	2090(4)	2200	2340	2470	2540(6)						
	kg	750	800	875	950(4)	1000	1060	1120	1150(6)						
12.4-16	lbs	1200	1320	1430(4)	1520	1650	1710	1820(6)	1930	1980	2090	2150(8)		2760 @ 48(12) psi	
	kg	545	600	650(4)	690	750	775	825(6)	875	900	950	975(8)		1250 @ 330(12) kPa	
12.4-24	lbs	1570	1710	1870(4)	1980	2150	2270	2400(6)	2470	2600	2680	2830(8)		3520 @ 48(12) psi	
	kg	710	775	850(4)	900	975	1030	1090(6)	1120	1180	1215	1285(8)		1600 @ 330(12) kPa	

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TIRE SIZE	INFLATION	TIRE LOAD LIMITS AT VARIOUS COLD INFLATION PRESSURES													
	psi	12	14	16	18	20	22	24	26	28	30	32			
	kPa	80	100	110	120	140	150	170	180	190	210	220			
12.4-28	lbs	1710	1870	1980(4)	2150	2270	2400	2540(6)							
	kg	775	850	900(4)	975	1030	1090	1150(6)							
12.4-36	lbs	1930	2090	2270(4)	2400	2540	2680	2830(6)	3000	3080	3200	3420(8)		3860 @ 40(10) psi	
	kg	875	950	1030(4)	1090	1150	1215	1285(6)	1360	1400	1450	1550(8)		1750 @ 280(10) kPa	
12.4-38	lbs	1980	2150	2340(4)	2470	2600	2760	2910(6)				3520(8)	4400 @ 48(12) psi	4800 @ 56(14) psi	
	kg	900	975	1060(4)	1120	1180	1250	1320(6)				1600(8)	2000 @ 330(12) kPa	2180 @ 385(14) kPa	
12.4-42	lbs	2040	2270	2470(4)	2600	2760	2910	3080(6)	3200	3420	3520	3640(8)		4180 @ 40(10) psi	
	kg	925	1030	1120(4)	1180	1250	1320	1400(6)	1450	1550	1600	1650(8)		1900 @ 280(10) kPa	
13.6-16	lbs	1430	1570(4)												
	kg	650	710(4)												
13.6-24	lbs	*1870	2040(4)	2200	2340	2540	2680(6)	2830	2910	3080(8)					
	kg	*850	925(4)	1000	1060	1150	1215(6)	1285	1320	1400(8)					
13.6-26	lbs	1930	2090(4)	2270	2470	2600	2760(6)	2910	3000	3200(8)					
	kg	875	950(4)	1030	1120	1180	1250(6)	1320	1360	1450(8)					
13.6-28	lbs	*1980	2200(4)	2340	2540	2680	2830(6)	3000	3080	3300(8)	3420	3520	3740 @ 36 (10) psi	4180 @ 42 (12) psi	
	kg	*900	1000(4)	1060	1150	1215	1285(6)	1360	1400	1500(8)	1550	1600	1700 @ 250 (10) kPa	1900 @ 290 (12) kPa	
13.6-36	lbs	*2270	2470(4)	2680	2830	3000	3200(6)								
	kg	*1030	1120(4)	1215	1285	1360	1450(6)								
13.6-38	lbs	2340	2540(4)	2760	2910	3080	3300(6)								
	kg	1060	1150(4)	1250	1320	1400	1500(6)								
13.6-46	lbs	2540	2830(4)	3000	3200	3420	3640(6)	3860	4080	4180(8)					
	kg	1150	1285(4)	1360	1450	1550	1650(6)	1750	1850	1900(8)					
14.9-24	lbs	*2200	2400(4)	2600	2830	3000(6)	3200	3300	3520(8)	3640	3740	3960		4400 @ 38(12) psi	
	kg	*1000	1090(4)	1180	1285	1360(6)	1450	1500	1600(8)	1650	1700	1800		2000 @ 260(12) kPa	
14.9-26	lbs	*2270	2540	2680	2910	3080(6)	3300	3420	3640	3740	3960	4080(10)			
	kg	*1030	1150	1215	1320	1400(6)	1500	1550	1650	1700	1800	1850(10)			
14.9-28	lbs	*2340	2600(4)	2830	3000	3200(6)	3420	3520	3740(8)	3860	4080	4180(10)			
	kg	*1060	1180(4)	1285	1360	1450(6)	1550	1600	1700(8)	1750	1850	1900(10)			
14.9-30	lbs	*2470	2680	2910	3080	3300(6)	3520	3640	3860(8)	3960	4180	4300(10)			
	kg	*1120	1215	1320	1400	1500(6)	1600	1650	1750(8)	1800	1900	1950(10)			
14.9-38	lbs	*2760	3000	3300	3520	3740(6)	3960	4180	4300(8)	4540	4680	4940(10)		5360 @ 38(12) psi	
	kg	*1250	1360	1500	1600	1700(6)	1800	1900	1950(8)	2060	2120	2240(10)		5840 @ 44(14) psi	
15.5-38	lbs	*2600	2830	3080	3300	3520(6)	3740	3860	4080(8)						
	kg	*1180	1285	1400	1500	1600(6)	1700	1750	1850(8)						
16.9-24	lbs	*2680	*2910	3200	3420(6)	3640	3860	4080(8)	4300	4400(10)					
	kg	*1215	*1320	1450	1550(6)	1650	1750	1850(8)	1900	2000(10)					
16.9-26	lbs	*2760	*3080	3300	3520(6)	3740	3960	4180	4400	4540(10)					
	kg	*1250	*1400	1500	1600(6)	1700	1800	1900	2000	2060(10)					
16.9-28	lbs	*2910	*3200	3420	3640(6)	3860	4080	4300(8)	4540	4680(10)					
	kg	*1320	*1450	1550	1650(6)	1750	1850	1950(8)	2060	2120(10)					

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TIRE SIZE	TIRE LOAD LIMITS AT VARIOUS COLD INFLATION PRESSURES												
	INFLATION	12	14	16	18	20	22	24	26	28	30	32	
	psi	80	100	110	120	140	150	170	180	190	210	220	
16.9-30	lbs	*3000	*3300	3520	3740(6)	3960	4180	4400(8)	4680	4940(10)			
	kg	*1360	*1500	1600	1700(6)	1800	1900	2000(8)	2120	2240(10)			2500 @ 230 (12) kPa
16.9-34	lbs	*3200	*3420	3740	3960(6)	4300	4540	4680(8)	4940	5200(10)			
	kg	*1450	*1550	1700	1800(6)	1950	2060	2120(8)	2240	2360(10)			
16.9-38	lbs	*3300	*3640	3960	4180(6)	4540	4800	4940(8)					
	kg	*1500	*1650	1800	1900(6)	2060	2180	2240(8)					
18.4-16.1	lbs	*2150	*2340	2540(6)	2680	2910(8)	3080	3200	3300(10)				
	kg	*975	*1060	1150(6)	1215	1320(8)	1400	1450	1500(10)				
18.4-26	lbs	*3300	*3640	3960(6)	4180	4540(8)	4800	4940	5200(10)	5520	5680	5840(12)	
	kg	*1500	*1650	1800(6)	1900	2060(8)	2180	2240	2360(10)	2500	2575	2650(12)	
18.4-28	lbs	*3420	*3740	4080(6)	4400	4680(8)	4940	5200	5360(10)	5680	5840	6150(12)	
	kg	*1550	*1700	1850(6)	2000	2120(8)	2240	2360	2430(10)	2575	2650	2800(12)	
18.4-30	lbs	*3520	*3860	4180(6)	4540	4800(8)	5080	5360	5520(10)	5840	6150	6400(12)	
	kg	*1600	*1750	1900(6)	2060	2180(8)	2300	2430	2500(10)	2650	2800	2900(12)	
18.4-34	lbs	*3740	*4180	4400(6)	4800	5080(8)	5360	5680	6000	6150	6400	6600(12)	
	kg	*1700	*1900	2000(6)	2180	2300(8)	2430	2575	2725	2800	2900	3000(12)	
18.4-38	lbs	*3960	*4400	4680(6)	5080	5360(8)	5680	6000	6400(10)	6600	6800	7150(12)	7600 @ 36(14) psi
	kg	*1800	*2000	2120(6)	2300	2430(8)	2575	2725	2900(10)	3000	3075	3250(12)	3450 @ 250(14) kPa
18.4-42	lbs	*4180	*4680	4940	5360	5680(8)	6000	6400	6600(10)	6950	7150	7400(12)	
	kg	*1900	*2120	2240	2430	2575(8)	2725	2900	3000(10)	3150	3250	3350(12)	
18.4-46	lbs	*4400	*4800	5200	5680	6000	6400	6600	6950	7400	7600	7850	8550 @ 36 (14) psi
	kg	*2000	*2180	2360	2575	2725	2900	3000	3150	3350	3450	3550	3450 @ 250 (14) kPa
20.8-34	lbs	*4540	*4940	5360	5840(8)	6150	6600(10)						
	kg	*2060	*2240	2430	2650(8)	2800	3000(10)						
20.8-38	lbs	*4800	*5360	5680	6150(8)	6600	6950(10)	7150	7600	7850(12)	8250	8550(14)	
	kg	*2180	*2430	2575	2800(8)	3000	3150(10)	3250	3450	3550(12)	3750	3875(14)	
20.8-42	lbs	*5080	*5520	6000	6400	6950	7400(10)	7600	8050	8550(12)	8800	9100(14)	
	kg	*2300	*2500	2725	2900	3150	3350(10)	3450	3650	3875(12)	4000	4125(14)	
23.1-26	lbs	*4800	*5200	5680(8)	6000	6400(10)	6800	7150(12)	7600	7850(14)			
	kg	*2180	*2360	2575(8)	2725	2900(10)	3075	3250(12)	3450	3550(14)			
23.1-30	lbs	*5080	*5520	6000(8)	6400	6800(10)		7600 (12)					
	kg	*2300	*2500	2725(8)	2900	3075(10)		3450 (12)					
23.1-34	lbs	*5360	*5840	6400(8)	6800	7400(10)							
	kg	*2430	*2650	2900(8)	3075	3350(10)							
24.5-32	lbs	*5840	*6400	6800	7400	7850(10)	8250	8800(12)	9100	9650(14)		10400(16)	
	kg	*2650	*2900	3075	3350	3550(10)	3750	4000(12)	4125	4375(14)		4725 (16)	

LOW SECTION HEIGHT

TIRE SIZE	INFLATION	TIRE LOAD LIMITS AT VARIOUS COLD INFLATION PRESSURES											
		psi	12	14	16	18	20	22	24	26	28	30	32
		kPa	80	100	110	120	140	150	170	180	190	210	220
19.5L-24	lbs	3080	3420	3640	3860	4180(8)	4400	4680(10)	4800	5080	5200(12)		
	kg	1400	1550	1650	1750	1900(8)	2000	2120(10)	2180	2300	2360(12)		
21.5L-16.1	lbs	2760(6)	3000	3200	3420(8)	3640	3860(10)						
	kg	1250(6)	1360	1450	1550(8)	1650	1750(10)						
28L-26	lbs	5520	6000	6600	6950(10)	7400(12)	7850	8250(14)	8800	9100(16)			
	kg	2500	2725	3000	3150(10)	3350(12)	3560	3740(14)	4000	4125(16)			
30.5L-32	lbs	6950(8)	7600	8250(10)	8800	9350(12)	9900(14)	10500	11000(16)				
	kg	3150(8)	3450	3750(10)	4000	4250(12)	4500(14)	4750	5000(16)				
35.5L-32	lbs	9350	10200(10)	11000(12)	11700(14)	12800	13200(16)	13900(18)	14800	15200(20)	16100(22)	16500(24)	
	kg	4250	4625(10)	5000(12)	5300(14)	5800	6000(16)	6300(18)	6700	6900(20)	7300(22)	7500(24)	

METRIC

TIRE SIZE	INFLATION	TIRE LOAD LIMITS AT VARIOUS COLD INFLATION PRESSURES																					
		psi	23	26	29	32	35	38	41	44	46	49	52	58	61	64							
		kPa	160	180	200	220	240	260	280	300	320	340	360	400	420	440							
520/85D38	LI	155			158			160			164			167			169			170			173
	lbs	8550	9100	9350	9650	9900	10500	11000	11400	12000	12300	12800	13200	13900	14300								
	kg	3875	4125	4250	4375	4500	4750	5000	5150	5450	5600	5800	6000	6300	6500								

* Values at these inflation pressures are for determination of dual loads only.

NOTES:

- Figures in parentheses denote ply rating for which boldface loads and inflations are maximum.
- For shipping purposes, tire inflation pressures may be increased to 30 psi (210 kPa). Consult tire manufacturer for minimum tire shipping pressure. Inflation pressure must be reduced to operating inflation before the machine is removed from the carrier.
- When used as duals, tire loads must be reduced 12%. (Multiply figures in above table at .88.)
- When used as triples, tire loads must be reduced 18%. Multiply figures in above table by .82.)
- For R-3 tires used in free rolling service at speeds up to 10 mph (15 km/h) maximum, above loads may be increased 50% with a 4 psi (30 kPa) increase in inflation pressure.
- For R-4 tires in transport service see Table G.
- The above loads are also applicable to equipment, including hillside combines, operating on slopes above 11° (20% grade). Load adjustments below 20 mph (30 km/h) do not apply.
- For cyclic loading field service, see Table F2 on page 146. For tire sizes not shown, see Note 4 on page 148.
- For R-1, R-2 and R-3 tires in transport service and operations which do not require sustained high torque, the following load limits at various speeds apply:

MAX. SPEED	% CHANGE IN ABOVE LOADS	CHANGE IN INFL. PRESSURE
Stationary	+200%	30%
10 mph (15 km/h)	+34% (except hillside combines)	None
15 mph (25 km/h)	+22% (except hillside combines)	None
20 mph (30 km/h)	+11%	None
25 mph (40 km/h)	Same As Table	None

FOR RIM AND WHEEL LOAD INFORMATION, SEE IMPORTANT NOTES ON PAGES 174-178.

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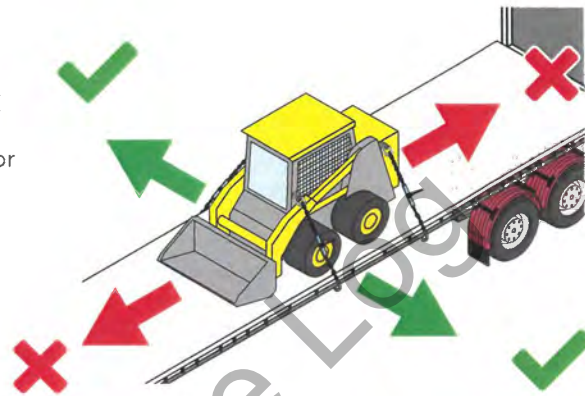
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RESTRAINING VEHICLES AND EQUIPMENT ON RUBBER TYRES OR TRACKS

- ✓ Directly restrain rubber-tyred vehicles and equipment in the forward and rearward direction, wherever possible.
- ⚠ If you are using tie-down lashings to restrain rubber-tyred and rubber-tracked vehicles, make sure it is only in the sideways direction – not in the forward or rearward directions – *Figure 284*.

Figure 284 Tie-down for sideways only



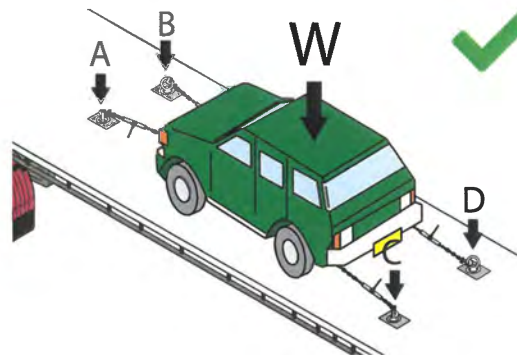
- ✗ Do not use tie-down restraint at all if friction between wheels/tracks and loading decks is extremely low (i.e. when wet or greasy) – *Figure 285*.
- ✓ Make sure the vehicle/equipment's tyres are always in contact with the deck.

Figure 285 Low-friction surface



- ✓ In all cases, pre-tension lashings to provide a clamping force equal to a minimum of 20% of the load's weight, as this will keep tyres in contact with the deck – *Figure 286*.

Figure 286 Minimum pre-tension

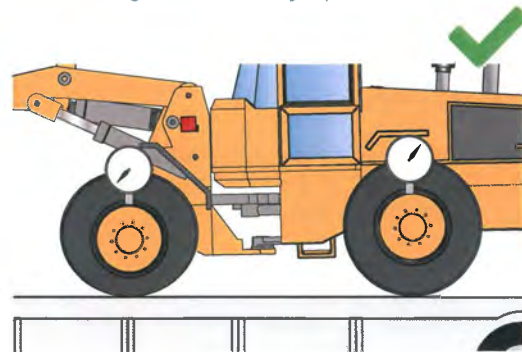


$$A + B + C + D = 20\% W$$



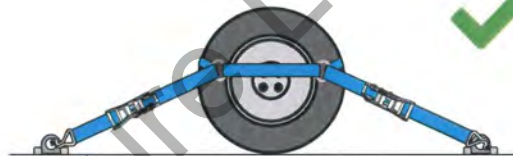
- ✓ Check the tyres to ensure they are the correct pressure and have no leaks before transporting, as this may lower the height of equipment and cause lashings to slacken – *Figure 287*.
- ✓ To prevent lashings becoming detached if the chain slackens, use chain assemblies or wire to tie chain tensioners into position.

Figure 287 Check tyre pressure



- i** Where lashings prevent a wheel from rotating, friction from the rubber can provide some of the load restraint in the forward and rearward directions – *Figure 288*.

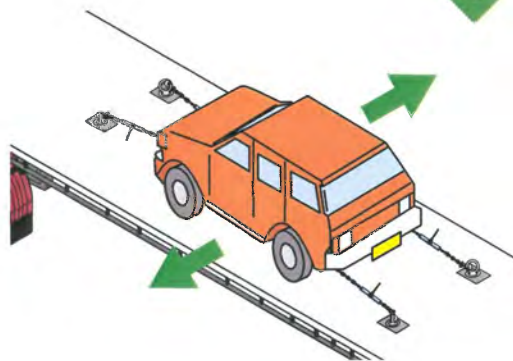
Figure 288 Lashing preventing rotation



- i** If tyres are not lashed, friction from the tyres can provide some of the load restraint in the sideways direction only – *Figure 289*.

Figure 289 Friction-assisted sideways restraint

- ✗ Do not rely on brakes to prevent wheels rotating.



i Large and medium-sized equipment and motor vehicles can experience significant movement when being transported, including:

- loads swaying excessively (e.g. equipment on large balloon tyres) – *Figure 290*
- vehicles bouncing on their tyres or suspension due to high shock forces in lashings – *Figure 291*.

Figure 290 Excessive load sway

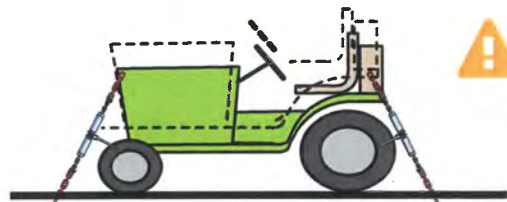


Figure 291 Shock forces from bouncing

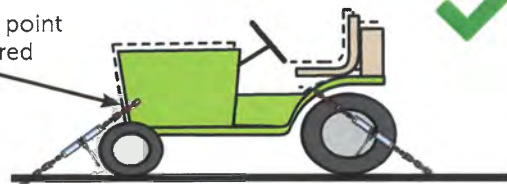


i Steeply angled chains pull down on the load more than chains at a lower angle, making the bouncing worse – *Figure 292*.

Figure 292 Lashing angle effect on bouncing

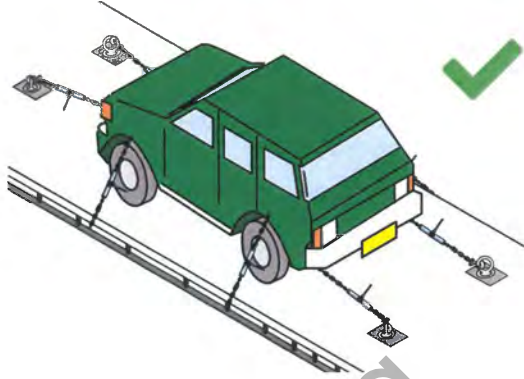


Lashing point lowered



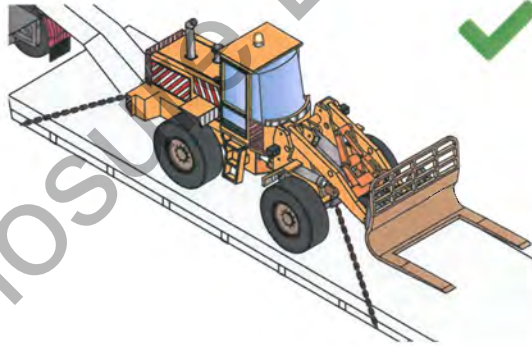
- ✓ To minimise bounce:
 - angle direct lashings on vehicles/equipment at no more than 25° to the horizontal (i.e. 1:2)
 - add vertical lashings at each wheel position – *Figure 293*.

Figure 293 Vertical lashings at wheel positions



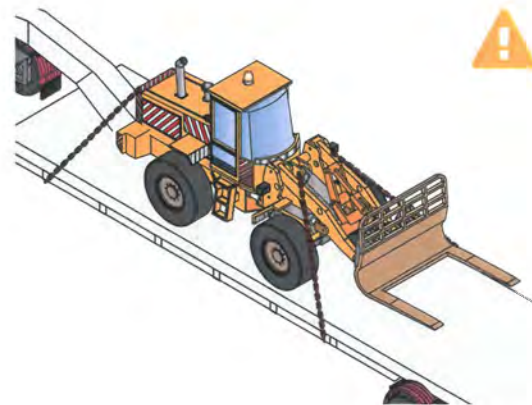
- ✓ If using vertical lashings at the wheels, make sure they have a lashing capacity of at least half the weight of the equipment and are as tight as possible.
- ✓ To prevent bounce altogether, remove the wheels or support the vehicle/equipment on blocks.
- ✓ Directly restrain rubber-tyred vehicles/equipment if the load can sway excessively – *Figure 294*.
- ✓ Fit new lashing points to large equipment, if required, to provide adequate restraint.

Figure 294 Load directly restrained



- i** Lugs on some large equipment are positioned for lifting (not load restraint) and can result in high lashing angles and excessive bounce – *Figure 295*.

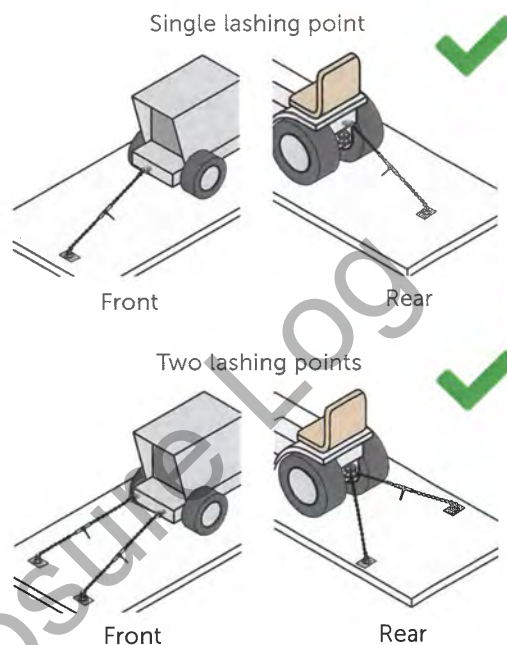
Figure 295 Steep lashing angle



Small equipment

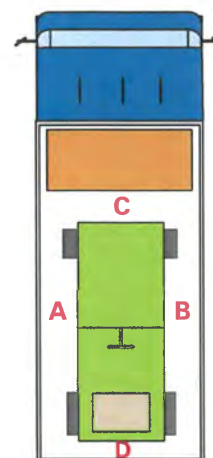
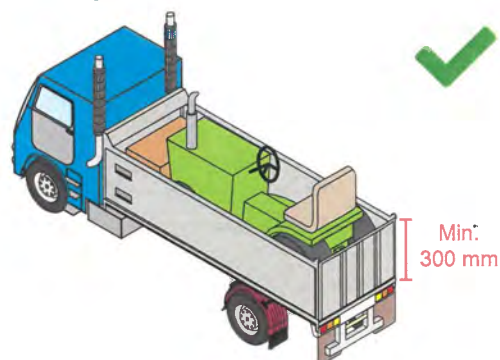
- ✓ Restrain small equipment such as mowers, skid-steer loaders, etc. by direct lashings or containment.
- ✓ If using direct lashings, attach at least one lashing to the equipment at each end to provide forward and rearward restraint.
- ✓ Connect lashings directly from the equipment to the deck, or passed through a lashing point (i.e. towing bracket), and attach to the deck at two points – *Figure 296*.
- i** The rubber tyres are likely to provide adequate sideways restraint.

Figure 296 Small rubber-tyred equipment



- ✓ If containing small equipment, make sure the containment bodies are suitably engineered to restrain the equipment.
- i** Containment bodies should have walls that sit at least 300 mm above the deck or higher than the top of any equipment tyres, whichever is greater – *Figure 297*.
- ✓ If there are gaps between the equipment and walls that are greater than 100 mm side to side or 200 mm front to back, fill them with packing that is the same height as the walls and that is separately restrained.
- ✗ Do not restrain small vehicles by containment if there are unfilled gaps greater than 100 mm side to side or 200 mm front to back.

Figure 297 Adequate containment

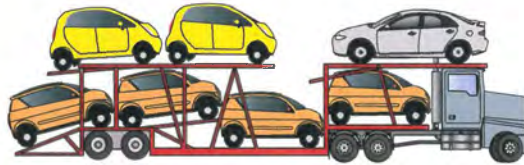


A+B less than 100 mm
C+D less than 200 mm

Motor vehicles

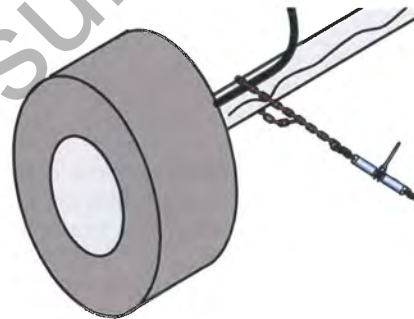
- ✓ Transport motor vehicles on specialised carrying vehicles or on general freight vehicles – *Figure 298*.
- i** Modern light vehicles are equipped with special underbody brackets to enable lashings to be attached; some brackets are designed for vertical lashings and are only suitable for use with purpose-built car carriers.
- ✗ Do not transport vehicles unrestrained on car carriers, even if it appears the motor vehicles are contained by the car carrier structure.

Figure 298 Car carrier



- ✓ Restrain motor vehicles using wheel restraint, tie-down restraint or direct lashing.
- ✓ Make sure lashings attached to axles or wheels do not damage brake pipes, hoses, anti-lock brake sensors or other components – *Figure 299*.

Figure 299 Chain looped over hoses



- ✓ If using wheel restraint, attach direct lashings or tie-down lashing assemblies to the wheels of the vehicle – *Figure 300*.

Figure 300 Tie-down lashing attached to wheel



- ✓ If using tie-down restraint, attach vertical chains or straps underneath the vehicle and tension them using a fixed winch.
- ✓ Make sure the wheels are prevented from rotating by chocks or recesses in the deck, or the tie-down restraint will not work – *Figure 301*.
- ✗ Do not use tie-down lashings if the vehicle parking brakes or transmission locks are the only way of preventing the wheels from rotating.
- ✓ Restrain chocks and any other loose equipment (including ramps and lashing assemblies) to prevent them from dislodging from the vehicle during transport – *Figure 302*.

Figure 301 Chocked wheel

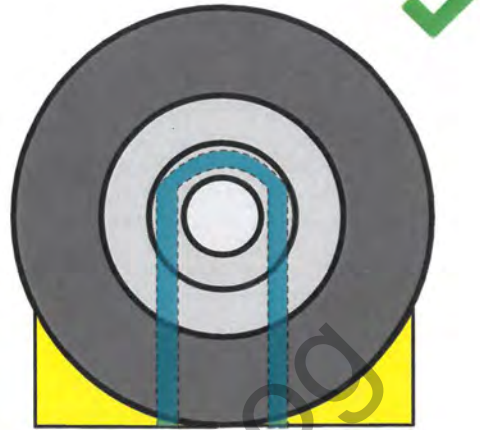
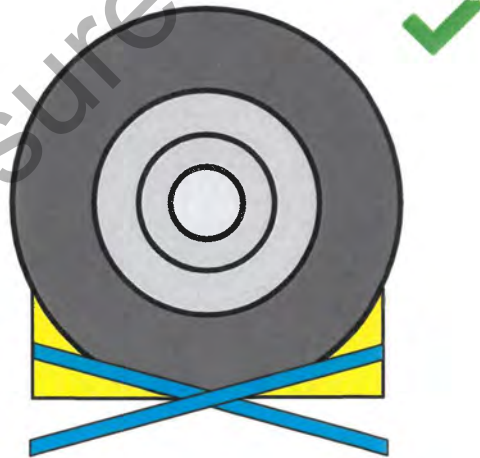
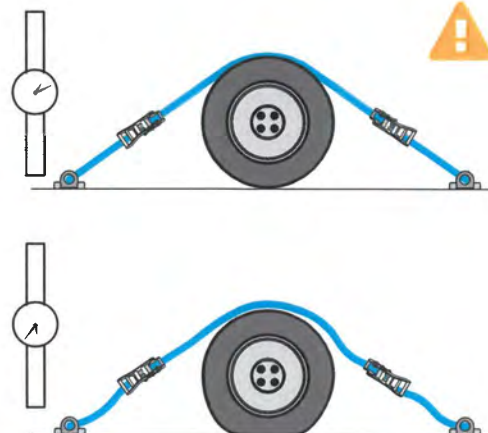


Figure 302 Chocks restrained



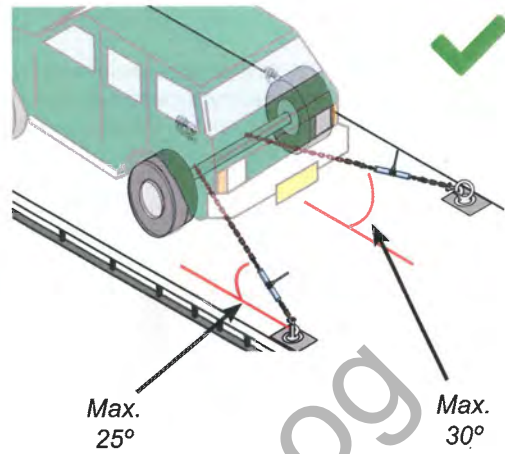
- ✓ Check tyre pressure before and during the journey.
- ⚠ Wheel restraint and tie-down depend on the tyres remaining inflated during transport; if the tyre loses air, all restraint is lost – *Figure 303*.

Figure 303 Loss of tyre pressure



- ✓ If using direct restraint, attach restraints to the axles, suspension or lashing points.
- ✓ Make sure direct lashings are angled at 25° to the horizontal to minimise bounce, and within 30° of the centreline of the carrying vehicle – *Figure 304*.
- ✓ Attach at least two direct lashings at each end of the vehicle so that downward force is applied to all wheels.

Figure 304 Motor vehicle directly restrained



- ✓ Only use recovery winches to restrain loads if they are fitted with a positive lock mechanism – *Figure 305*.
- ⚠ If using a recovery winch, it should be tensioned to pull down on one end of the vehicle at a minimum of 25° (i.e. 1:2) or give an equivalent force of 20% of the weight on the axle at that end.

Figure 305 Winch with positive lock



9.7 Restraining Rubber Tyred Vehicles and Equipment

The friction from rubber tyres can provide some of the load restraint.

However, because brakes cannot be relied on to prevent the wheels rotating, the friction of the rubber tyres on the deck can only be used to prevent sideways movement.

Where lashings prevent a wheel from rotating, the restraint provided is in all horizontal directions.

Lashings must be pre-tensioned to keep the tyres in contact with the deck. The resulting clamping force must be at least 20% of the weight of the load.

Where large balloon tyres are fitted, excessive sway of the load may occur if the sideways restraint is only the friction of the rubber tyres on the deck. In such cases, the load should be directly restrained sideways.

9.7.1 Rubber tyre bouncing

High shock forces can develop in chains, when vehicles or mobile equipment that are being carried 'bounce' on their tyres or suspension during transport. This can occur during braking, accelerating, travelling on hills and rough roads.

During braking, the tension increases in the chains that prevent forward movement.

Because the chains are angled upwards from the deck, they pull down on the load when the tension increases. This pull down force compresses tyres and suspensions and the load rocks forward.

When the braking, or accelerating, is finished, the increased chain tension reduces to its original value. The tyres and suspension then rebound upward to their original position causing the vehicle or mobile equipment to 'bounce' or rock backwards (see Figure E.47).

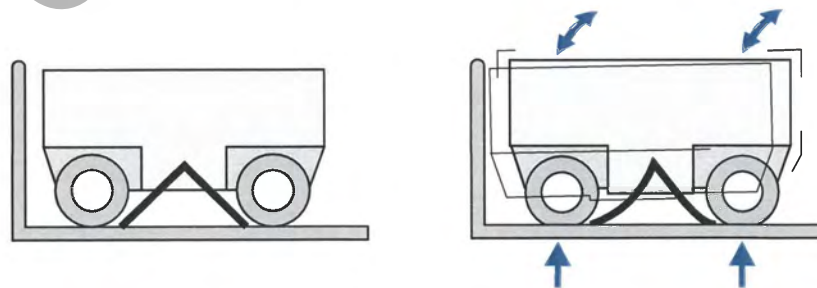


Fig. E.47

RUBBER TYRE BOUNCING



The bouncing effect is magnified when the chains are angled steeply to the deck. This is because steeply angled chains pull down on the load more than chains at a lower angle.

Direct lashings should be angled at no more than 25 degrees to the horizontal (1:2) to minimise bouncing.

Bouncing can also be reduced by adding vertical lashings at each wheel position. These lashings should have a lashing capacity of at least half the weight of the equipment and should be as tight as possible.

Bouncing can also be prevented by supporting the equipment on blocks or removing wheels for transport.

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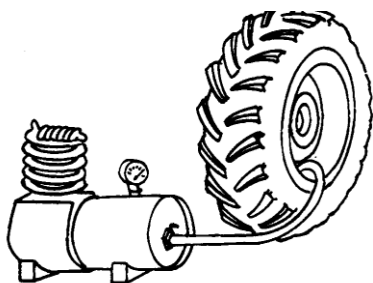
543R Front End Loader Operators Manual

Manual Number OMCC60503 – Accessible at manuals.deere.com

Section 30 – Preparing the Tractor

Sub-Section 3

Checking Front Tire Pressure



W11375-UN-06OCT88

Inflate front tires to pressure recommended by the tire manufacturer for front loader and heavy front-mounted implements.

See your tractor operator's manual for more informations.

AG,OUCC006,488-19-20000804

Sub-Section 5

Remove Front Weights



W21684-UN-01AUG11

A - Additional Front Weights

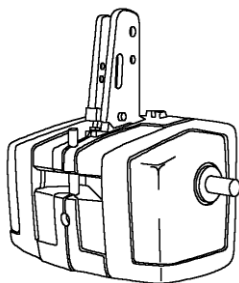
B - Weight Support

IMPORTANT: To prevent damage to tractor or loader, remove additional front weights (A) from tractor. Remove additional front weights (A). Weight support (B) can remain on the tractor.

OUCC006,0001891-19-20120110

Sub-Section 9

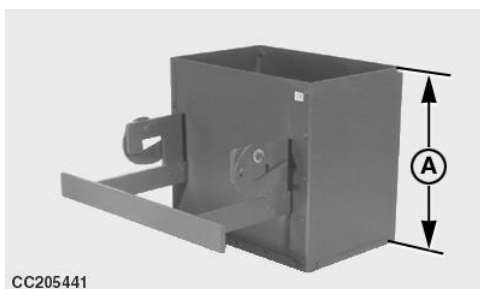
Ballast Tractor with Loader



CC015444

CC015444-UN-16APR99

Pick-Up Ballast



CC205441

CC205441-UN-12SEP13

Rear Ballast Box

A - Material Filling Height

Use a pick-up ballast of 900 kg (2000 lb.), 1150 kg (2550 lb.), 1500 kg (3300 lb.), 1800 kg (4000 lb.) or an adjustable rear ballast box as required to ballast tractors with loaders.

Refer to Application Charts section to properly ballast tractor in regard to loader.

Fill the rear ballast box as required to obtain the target ballast for tractor and loader combination.

Always use the rear ballast box if required ballast does not match with pickup-up ballast weight.

Following table gives rear ballast box weight depending on filling height and material type. After filling the rear ballast box, drill a hole to avoid water accumulation (over ballast).

Rear Ballast Box Weight	Material Filling Height (A)		
	Sand	Gravel	Cement
250 kg (550 lb.)	115 mm (4.5 in.)	130 mm (5.1 in.)	65 mm (2.6 in.)
300 kg (660 lb.)	175 mm (6.9 in.)	200 mm (7.9 in.)	105 mm (4.1 in.)
350 kg (800 lb.)	235 mm (9.3 in.)	275 mm (10.8 in.)	140 mm (5.5 in.)
400 kg	300 mm	345 mm	175 mm

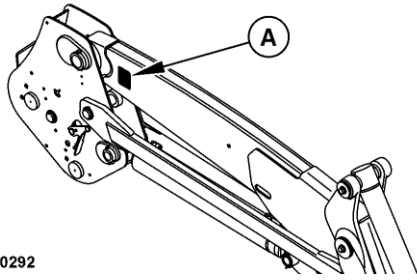
(900 lb.)	(11.8 in.)	(1 ft. 1.6 in.)	(6.9 in.)
450 kg (1000 lb.)	360 mm (1 ft. 2.2 in.)	415 mm (1 ft. 4.3 in.)	210 mm (8.3 in.)
500 kg (1100 lb.)	420 mm (1 ft. 4.5 in.)	490 mm (1 ft. 7.3 in.)	250 mm (9.8 in.)
550 kg (1210 lb.)	485 mm (1 ft. 7.1 in.)	560 mm (1 ft. 10 in.)	285 mm (11.2 in.)
600 kg (1350 lb.)	545 mm (1 ft. 9.5 in.)	630 mm (2 ft. 0.8 in.)	320 mm (1 ft. 0.6 in.)
650 kg (1450 lb.)	610 mm (2 ft.)	700 mm (2 ft. 3.6 in.)	360 mm (1 ft. 2.2 in.)
700 kg (1550 lb.)	670 mm (2 ft. 2.4 in.)	775 mm (2 ft. 6.5 in.)	395 mm (1 ft. 3.6 in.)
750 kg (1650 lb.)	730 mm (2 ft. 4.7 in.)	845 mm (2 ft. 9.3 in.)	430 mm (1 ft. 4.9 in.)
800 kg (1800 lb.)	795 mm (2 ft. 7.3 in.)	915 mm (3 ft.)	465 mm (1 ft. 6.3 in.)
850 kg (1880 lb.)	855 mm (2 ft. 9.7 in.)	990 mm (3 ft. 3 in.)	505 mm (1 ft. 7.9 in.)
870 kg (1950 lb.)	880 mm (2 ft. 10.6 in.)	1015 mm (3 ft. 4 in.)	515 mm (1 ft. 8.3 in.)
900 kg (2000 lb.)	915 mm (3 ft.)	NOT OK	540 mm (1 ft. 9.3 in.)
1150 kg (2550 lb.)	NOT OK	NOT OK	720 mm (2 ft. 4.3 in.)

OUCC006,0001AF1-19-20130913

Section 90 – Specification

Sub-Section 1

Record Tractor Information (Australia Only)



CC230292

CC230292-UN-29JUN15

TRACTOR MODEL :
COUNTERWEIGHT/BALLAST :	
3-POINT HITCH KG
REAR AXLE KG
ROL : KG
WARNING: DO NOT EXCEED ROL	
ROL : RATED OPERATING LOAD	

CC1036540

CC1036540-UN-25JAN12

A - Tractor Identification Plate

The tractor identification plate (A) is located on the loader inside the left boom. Verify that accurate tractor information is recorded on the plate and record the information here. See [Rated Operating Load](#) in this section for tractor set-up information.

If loader is installed on a different tractor, update the information on this page, then replace and update the plate. See your John Deere dealer.

JC87117,00001C9-19-20150722

Sub-Section 2

Rated Operating Load

Rated Operating Load should be used as a guide to operate specified loader.

See Implements section for available implements.

Loader Model Number	543R MSL	603R MSL	623R MSL	643R MSL	663R MSL	683R MSL
Rated Operating Load	1120 kg (2470 lb.)	1670 kg (3685 lb.)	1940 kg (4275 lb.)	1950 kg (4300 lb.)	2120 kg (4675 lb.)	2310 kg (5100 lb.)
Rear Hitch Ballast	See Application Charts Section.					

NB02380,00001C4-19-20160926

Sub-Section 3

Specification Parameters

IMPORTANT: To avoid damage to the tractor front axle, refer to your tractor Operator's Manual for the maximum permissible front axle load during loader operation.

Dimensional specifications are based on static loaded tire radius, front and rear.

All loader specifications are calculated values. Digging depth, lift capacities and other specifications vary from tractor to tractor due to using different tires and front axle.

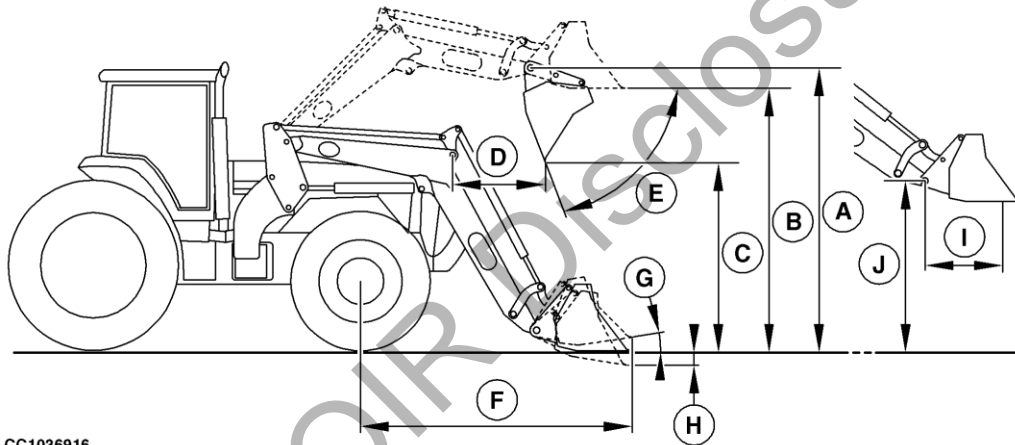
Lift capacities are measured at bucket pivot point and 800 mm (2 ft. 7 in.) in front of pivot. Objects such as round bales or bins on a pallet fork, displace the weight ahead of this point, decreasing lift capacity.

Dimensions and capacities are in compliance with ASABE Standard S301.4.

JC87117,00001E8-19-20150706

Sub-Section 5

543R MSL Loader Specifications on 5125R Tractor



CC1036916

CC1036916-UN-03FEB12

Tractor Model 5125R	
Minimum Rear Ballast	3-Point Hitch 900 kg (2000 lb.)
Front Tires	575/13.6R24
Rear Tires	750/16.9R34
Maximum Loader Weight Including Mounting Frame	
Mass	695 kg (1530 lb.)

Standard Material Bucket	
Width	1850 mm (6 ft. 13/16 in.)
Length	—
Mass	235 kg (520 lb.)
Hydraulic System	
Rated Flow	70 L/min. (19 gpm)
Maximum Pressure	19500 kPa (195 bar) (2828 psi)
Cycle Times (in seconds)	
Loader Raise Time	4
Loader Lower Time	2.9
Bucket Dump Time	2.2
Bucket Roll-Back Time	2.2
Lift Height (Maximum)	
To Pivot Pin (A)	3680 mm (145 in)

NOTE: Specifications and design subject to change without notice

Clearance	
Bucket Level (B)	3440 mm (136 in)
Bucket Dumped (C)	2680 mm (106 in)
Digging Depth (H)	100 mm (4 in)
Reach	
At Maximum Lift Height with Bucket Dumped (D)	775 mm (30 in)
Bucket on Ground with Bucket Leveled (F)	2400 mm (94 in)
Angles (Maximum)	
Dump (E)	58°
Dump at Ground	100°
Roll back (G)	47°
Lift Capacity	
To Maximum Height (A) at Pivot Point	1700 kg (3745 lb.)

To Maximum Height (A) at 800 mm (2 ft. 7 in.) (I) Ahead of Pivot Point	1715 kg (3780 lb.)
To 1500 mm (4 ft. 11 in.) (J) at Pivot Point	2085 kg (4600 lb.)
Breakout Force	
At Pivot Point	2545 kg (5615 lb.)
800 mm (2 ft. 7 in.) (I) Ahead of Pivot Point	2090 kg (4610 lb.)

NB02380,00001C3-19-20160926

OIR Disclosure Log

5090R Tractor Manual Tire Pressures

Manual number OMSU56834

Section 280

Sub-Section 4

Tire Pressures

Long life and satisfactory performance of the tires depend on proper tire inflation. Underinflation of tires leads to rapid wear. Overinflated tires reduce traction and increase wheel slippage.

Since correct tire pressures depend not only on working conditions and load but also on tractor model, tire size and manufacturer, we recommend that you approach your John Deere dealer or tire company for advice.

GS25068,0005728-19-20180926

Sub-Section 5

Tire Inflation Pressure Guidelines

Check tire inflation pressure while tires are cool, using an accurate dial or stick-type gauge having 10 kPa (0.1 bar) (1 psi) graduations.

Use a special air-water gauge and measure with valve stem at bottom, if tires contain liquid ballast.

Correctly inflated radial tires will show a deflection of the sidewall. This is normal and will not damage the tire.

Inflation pressures less than 83 kPa (0.8 bar) (12 psi) should be monitored frequently because of increased risk of low-pressure leaks.

Bead-slip can be experienced in high-traction conditions when using single tires. Increasing inflation pressure will help, but will reduce traction.

Maximum tire pressure is specified on tire sidewall.

Determining Correct Tire Pressure

Integral implements transfer significant weight to the rear axle. Always include this weight when determining correct inflation pressures. Weigh the tractor as described below in order to determine the correct tire pressure:

Rear-Mounted Implement - The front axle must be weighed with implement lowered. The rear axle must be weighed with the implement raised.

Front-Mounted Implement - The front axle must be weighed with implement raised. The rear axle must be weighed with the implement lowered.

Front-Mounted and Rear-Mounted Implements - Weigh the tractor with front and rear implements both raised.

Set tire inflation pressures according to weight measured. Ballasting and tire inflation pressure may need to be adjusted when operating conditions change. Use the following inflation tire charts. For tires not found in charts, refer to manufacturer's recommended inflation pressures.

Altering Tire Inflation Pressure

Tractors operating with a loader should increase front tire pressures 30 kPa (0.3 bar) (4 psi) above the values listed to compensate for weight transfer.

Tractors operating on steep side slopes or furrow plowing should increase rear tire pressures 30 kPa (0.3 bar) (4 psi) above the values listed for base pressures 80 kPa (0.8 bar) (12 psi) and above to compensate for lateral weight transfer. For base pressures below 80 kPa (0.8 bar) (12 psi), pressure should be increased by 30%.

Reduce inflation pressure when using towed implements.

Tractors with heavy hitch-mounted implements that require additional front cast weights to maintain steering stability require increased front and rear tire inflation pressure to carry the increased weight.

GS25068,0005729-19-20181002

Sub-Section 6

Maximum Tire Pressures

	Tire Size	Tire Brand	Tread	Load/Speed Rating	kPa	bar	psi
Front Tires	9.5R28	Kleber	R1W	109/A8	207	2.1	30
	11.2R24 (280/85R24)	Michelin	R1W	114/A8	193	1.9	28
	11.2R24 (280/85R24)	Mitas	R1W	115/A8	200	2.0	29
	11.2R28 (280/85R28)	Mitas	R1W	118/A8	200	2.0	29
	12.4R24 (320/85R24)	Michelin	R1W	119/A8	193	1.9	28
	12.4R24 (320/85R24)	Firestone	R1W	122/D	207	2.1	30
	12.4R24 (320/85R24)	Mitas	R1W	122/A8	200	2.0	29
	12.5/80-18 12PR	Titan	I3	12 PR	310	3.1	45
	13.6R24 (340/85R24)	Mitas	R1W	125/A8	200	2.0	29
	13.6R24 (340/85R24)	Michelin	R1W	123/A8	193	1.9	28
	13.6R24 (340/85R24)	Firestone	R1W	125/A8	207	2.1	30
	13.6R28 (340/85R28)	Mitas	R1W	127/A8	200	2.0	29

	14.9R24 (380/85R24)	Mitas	R1W	131/A8	200	2.0	29
	14.9R24 (380/85R24)	Michelin	R1W	126/A8	193	1.9	28
	44X18-20	Titan	R3	4 PR	207	2.1	30
	230/95R32	Kleber	R1W	128/A8	207	2.1	30
	230/95R48	Kleber	R1W	137/A8	207	2.1	30
	380/70R20	Mitas	R1W	122/A8	200	2.0	29
	380/70R24	Mitas	R1W	125/D	200	2.0	29
	380/70R24	Michelin	R1W	125/D	200	2.0	29
	400/80R24	Nokian	Hakkapeliitta TRI (SNOW)	149/A8	317	3.2	46
	400/80R24	Nokian	TRI 2	149/A8	317	3.2	46
	440/65R24	Mitas	R1W	128/D	200	2.0	29
	440/65R24	Michelin	R1W	128/D	200	2.0	29
	480/65R24	Mitas	R1W	133/D	200	2.0	29
	480/65R24	Michelin	R1W	133/D	200	2.0	29
	Tire Size	Tire Brand	Tread	Load/Speed Rating	kPa	bar	psi
Rear Tires	12.4R36	Michelin	R1W	124/A8	193	1.9	28
	13.6R38 (340/85R38)	Mitas	R1W	133/A8	200	2.0	29
	15.5R38 (380/85R38)	Firestone	R1	125/A8	207	2.1	30
	16.9R30 (420/85R30)	Michelin	R1W	137/A8	193	1.9	28
	16.9R30 (420/85R30)	Mitas	R1W	140/A8	200	2.0	29
	16.9R34 (420/85R34)	Michelin	R1W	142/A8	193	1.9	28
	16.9R34 (420/85R34)	Mitas	R1W	142/A8	200	2.0	29

16.9R38 (420/85R38)	Michelin	R1W	144/A8	193	1.9	28
16.9R38 (420/85R38)	Mitas	R1W	144/A8	200	2.0	29
18.4R30 (460/85R30)	Mitas	R1W	145/A8	200	2.0	29
18.4R30 (460/85R30)	Firestone	R1W	145/D	207	2.1	30
18.4R34 (460/85R34)	Michelin	R1W	144/A8	193	1.9	28
19.5L-24	Goodyear	R4	10 PR	207	2.1	30
23.1-26	Titan	R3 (Turf)	8 PR	207	2.1	30
160/95R46	Mitas	R1W	117/A8	207	2.1	30
230/95R48	Kleber	R1W	137/A8	207	2.1	30
270/95R44	Kleber	R1W	141/A8	200	2.0	29
380/85R34 (14.9R34)	Michelin	R1W	137A8	193	1.9	28
480/70R28	Mitas	R1W	140/A8	200	2.0	29
480/70R34	Mitas	R1W	143/D	200	2.0	29
480/70R34	Michelin	R1W	143/D	193	1.9	28
480/80R34	Nokian	TRI 2	164/A8	317	3.2	46
480/80R34	Nokian	Hakkapeliitta TRI (SNOW)	164/A8	317	3.2	46
540/65R34	Michelin	R1W	145/D	200	2.0	29
540/65R34	Mitas	R1W	145/D	200	2.0	29
540/65R38	Michelin	R1W	153D	200	2.0	29
540/65R38	Mitas	R1W	147/D	200	2.0	29
600/65R34	Michelin	R1W	151/D	200	2.0	29
600/65R34	Mitas	R1W	151/D	200	2.0	29

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Section 400 – Specifications

Sub-Section 5

Machine Weight

Machine weight is measured with more than 18.9 L (5 gal) of fuel and all other fluids at full capacity. Machine weight is approximately shipping weight. Adding or removing options will change the weight. If more accurate weight is desired, weigh on a platform scale.

	Kilograms	Pounds
Base Machine Weight (MFWD Axle)	4450	9811
Base Machine Weight (SFA)	4650	10251

GS25068,00047DC-19-20180307

Sub-Section 16

Weight Distribution

Implement Attachment	Rear Weight (% of machine weight)	Front Weight (% of machine weight)
Drawbar	65	35
Integral (Hitch)	60	40

GS25068,00047E7-19-20180307

Sub-Section 17

Permissible Load

Always consult your tire manufacturer's information, as permissible load varies per manufacturer, load capacity, inflation pressure, speed-radius index, and travel speed.

Axle Configuration	Max Permissible Weight	Max Front Axle Load	Max Rear Axle Load	Max Payload
MFWD (Closed Center)	8600 kg 18960 lb	3600 kg 7937 lb	6000 kg 13228 lb	4150 kg 9149 lb
MFWD (Open Center)	8600 kg 18960 lb	3200 kg 7055 lb	6000 kg 13228 lb	4150 kg 9149 lb
SFA	8600 kg 18960 lb	3600 kg 7937 lb	6000 kg 13228 lb	3950 kg 8708 lb

For tires below, pressure must be set as indicated in the table to achieve max axle load for MFWD (closed center) and SFA axle configurations.

Tire Size	Tire Brand	kPa	bar	psi
440/65R24	Mitas	200	2.0	29
440/65R24	Michelin	200	2.0	29
480/65R24	Mitas	200	2.0	29
480/65R24	Michelin	200	2.0	29

GS25068,00047E8-19-20180319

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