Copyright © 2021, CMEIG. All rights reserved.

ADVISORY NOTICE

Disclaimer: CMEIG is a non-profit organization sponsored by companies involved in the supply of products and services in the construction and mining equipment industry in Australia. This document has been prepared by members of CMEIG and is distributed by the Association. This information is provided for guidance only and no legal liability can be accepted by the Association for its use. CMEIG advises that you should seek appropriate specialist advice to confirm your solution.

Note: This advisory notice was revised in September 2019 as a result of the publishing of ISO 14397-1:2007 (Amd.1:2019)

RATED LOADS FOR WHEEL LOADERS

The aim of this information paper is to clarify the main differences between the various standards used to determine rated loads for wheel loaders (as distinct from crawler loaders and wheel loaders with skid steering).

Load mass, material density, centre of gravity, as well as the mass of the attachment and coupler (if fitted) is included in the determination of the rated operating load and the size / capacity of the attachment.

It is important to understand which standard has been applied by a manufacturer when determining a rated load as it may affect the conditions under which a wheel loader can be operated.

It is also important to understand there may be assumptions and considerations applied by a manufacturer. These can include:

a) Linkage position used for calculating the rated load (typically racked work tool for bucket; level work tool for pallet fork & logging grapple),

b) Consideration of all relevant hydraulic functions (Lift, Tilt, Auxiliary etc) and over the entire range of motion of each function,

c) Assumptions made in relation to the compressibility of front tyres in determining tipping loads:

   - ‘Rigid Tire’ i.e. Front axle on blocks, or front tyres as incompressible steel wheels,
   - ‘Flexible Tire’ i.e. Modelling tire compression as a 3-dimensional spring – note that this may derate full turn static tipping loads in the order of 5-10% compared to a ‘rigid tyre’ model.

A comparison of the various application scenarios, international standards and associated commentary is provided in subsequent pages of this advisory notice.

For specific questions or queries, contact your manufacturer or supplier.

Copyright © 2021, CMEIG. All rights reserved.

BUCKET APPLICATIONS

Rated load for wheel loaders fitted with buckets is covered by the following standards:

- ***ISO 14397-1:2007 (Amd.1:2019)*** *Earth-moving machinery - Loaders and backhoe loaders - Part 1: Calculation of rated operating capacity and test method for verifying calculated tipping load, including Amendment 1*
- ***ISO 20474-3:2017*** *Earth moving machinery – Safety – Part 3: Requirements for loaders*.
- ***EN 474-3:2006*** *Earth-moving machinery – Safety – Part 3: Requirements for loaders.*

Additional notes:

- There are currently no Australian standards that cover rated loads for wheel loaders fitted with buckets.
- Both ***ISO 20474-3:2017*** and ***EN 474-3:2006*** refer to ***ISO 14397-1*** for rated operating capacity for wheel loaders fitted with buckets.
- The following standards have been withdrawn or cancelled:
    - ***AS 2954.1-1988*** *Earth-moving machinery – Rated loads and volumetric ratings – Rated operating load for crawler and wheel loaders.*
    - ***ISO 5998:1986*** *Earth-moving machinery; Rated operating load for crawler and wheel loader.*
    - ***SAE J818-2007*** *Rated Operating Load for Loaders*

A comparison of standards used to determine rated load for wheel loaders fitted with buckets is given in Table 1.

FORK APPLICATIONS

Rated load for wheel loaders fitted with forks is covered by the following standards:

- ***ISO 14397-1:2007 (Amd.1:2019)*** *Earth-moving machinery - Loaders and backhoe loaders - Part 1: Calculation of rated operating capacity and test method for verifying calculated tipping load, including Amendment 1*
- ***ISO 20474-3:2017*** *Earth moving machinery – Safety – Part 3: Requirements for loaders.*
- ***EN 474-3:2006*** *Earth-moving machinery – Safety – Part 3: Requirements for loaders*.
- ***SAE J1197-2011*** *Rated Operating Load for Loaders Equipped with Log or Material Forks without Vertical Mast*.

Additional notes:

- There are currently no Australian standards that cover rated loads for wheel loaders fitted with forks.
- Both ***ISO 20474-3:2017*** and ***EN 474-3:2006*** refer to ***ISO 14397-1*** for the method of calculation
- ***EN 474-3:2006*** specifies the fork length to be used for specific load ranges.

A comparison of the standards used to determine rated load for wheel loaders fitted with forks can be found in Table 2.

Copyright © 2021, CMEIG. All rights reserved.

LOG HANDLING APPLICATIONS

Rated loads for wheel loaders fitted with log grabs are covered by the following standards:

- ***ISO 14397-1:2007 (Amd.1:2019)*** *Earth-moving machinery - Loaders and backhoe loaders - Part 1: Calculation of rated operating capacity and test method for verifying calculated tipping load, including Amendment 1*
- ***ISO 20474-3:2017*** *Earth moving machinery – Safety – Part 3: Requirements for loaders*.
- ***EN 474-3:2006*** *Earth-moving machinery – Safety – Part 3: Requirements for loaders.*
- ***SAE J1197-2011*** *Rated Operating Load for Loaders Equipped with Log or Material Forks without Vertical Mast.*

Additional notes:

- There are currently no Australian standards pertaining to rated loads for wheel loaders fitted with log grabs.
- ***ISO 14397-1:2007 (Amd.1:2019)*** does not have a specific section for log handling per se, but the principles outlined can be applied to this application. Note that the standard requires a risk assessment to determine the k factor for derivate use of wheel loaders.
- Both ***ISO 20474-3:2017*** and ***EN 474-3:2006*** have a specific section for log handling, and refer to ***ISO 14397-1***for the method of calculation.

A comparison of the standards used to determine rated load for wheel loaders fitted with log grabs is given in Table 3.

HEAVY SINGLE OBJECT (HSO) – non-palletised load

Rated loads for wheel loaders in HSO applications (eg: large single blocks / quarry stone forks) are covered by the following standards:

- ***ISO 14397-1:2007 (Amd.1:2019)*** *Earth-moving machinery - Loaders and backhoe loaders - Part 1: Calculation of rated operating capacity and test method for verifying calculated tipping load, including Amendment 1*
- ***ISO 20474-3:2017*** *Earth moving machinery – Safety – Part 3: Requirements for loaders*.
- ***EN 474-3:2006*** *Earth-moving machinery – Safety – Part 3: Requirements for loaders.*

Additional notes:

- There are currently no Australian Standards pertaining to rated loads for wheel loaders in HSO applications.
- ***ISO 14397-1:2007*** (Amd.1:2019) has a number of additional requirements and constraints (eg: load fully rolled back).
- ***ISO 20474-3:2017*** and ***EN 474-3:2006*** refer to ***ISO 14397-1*** for the method of calculation, but provides a different stability factor for use in the calculation. ***EN 474-3:2006*** also specifies a different maximum speed.

A comparison of the standards used to determine rated load for wheel loaders fitted with log grabs is given in Table 4.

Copyright © 2021, CMEIG. All rights reserved.

LIFTING APPLICATIONS

Rated load for wheel loaders fitted with attachments used to lift freely suspended loads as a secondary function associated with the normal applications of the equipment (e.g. lifting and moving pipes, unloading construction equipment, manoeuvring accessories associated with the equipment) are covered by the following standards:

- ***AS 1418.8-2008*** *Cranes, hoists and winches – Special purpose appliances (Specifically refer to Section 5)*
- ***ISO 20474-3:2017*** *Earth moving machinery – Safety – Part 3: Requirements for loaders*.[1]
- ***EN 474-3:2006*** *Earth-moving machinery – Safety – Part 3: Requirements for loaders*.

Additional notes:

- The specific provision for Australia in relation to wheel loaders used to lift suspended loads is identified in Section 5 of ***AS 1418.8-2008***.
- There is currently no SAE standard that covers rated loads for wheel loaders used to lift freely suspended loads.

A comparison of the Standards used to determine rated loads for wheel loaders used to lift suspended loads is given in Table 5.

*****IMPORTANT***** The use of wheel loaders to lift suspended loads is highly regulated within Australia. Please refer to the detail in ***AS 1418.8, Section 5*** as well as the Occupational Health and Safety legislation applicable to your state or territory for further guidance.

[1] Note that ISO 20474-3:2017 should be read in conjunction with ISO 20474-1:2017 (Earth moving machinery – Safety – Part 1: General Requirements) guidance on *Object Handling*

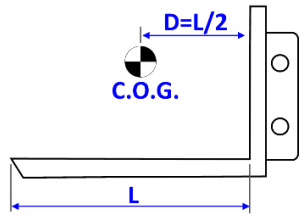
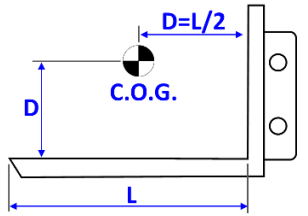
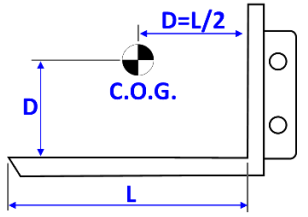
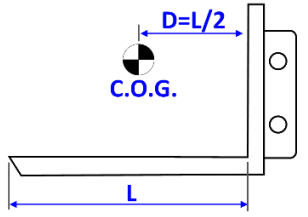
Copyright © 2021, CMEIG. All rights reserved.

Table 1 - Rated Loads for Bucket Applications

Standard	Terminology	Operating surface	Description	Max. travel speed	Load Centre of Gravity (C.O.G.) location
ISO 14397-1:2007 (Amd.1:2019)	Rated Operating Capacity	Hard, substantially smooth and level	**50%** of tipping load, or **100%** of hydraulic capacity (whichever is the lesser).	15 km/h	Centroid of ISO rated bucket volume
ISO 20474-3:2017	Rated Operating Capacity	Hard, substantially smooth and level	**50%** of tipping load, or **100%** of hydraulic capacity (whichever is the lesser).	15 km/h	Centroid of ISO rated bucket volume
EN 474-3:2006	Rated Operating Capacity	Hard, substantially smooth and level	**50%** of tipping load, or **100%** of hydraulic capacity (whichever is the lesser).	15 km/h	Centroid of ISO rated bucket volume

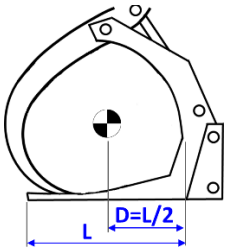
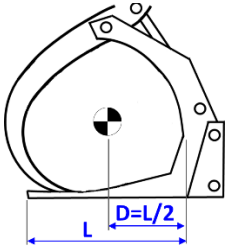
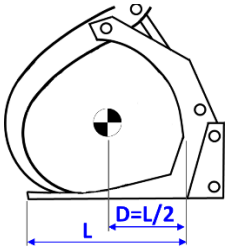
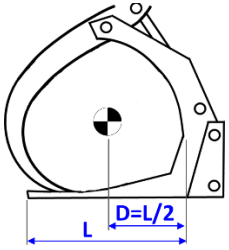
Copyright © 2021, CMEIG. All rights reserved.

Table 2 – Rated Loads for Fork Applications

<table>
<tr><th>Standard</th><th>Terminology</th><th>Operating surface</th><th>Description</th><th>Max. travel speed</th><th>Load Centre of Gravity (C.O.G.) location</th></tr>
<tr><td rowspan="2">ISO 14397-1:2007
(Amd.1:2019)</td><td rowspan="2">Rated Operating Capacity</td><td>Rough terrain</td><td>60% of tipping load, or
100% of hydraulic capacity
(whichever is the lesser).</td><td rowspan="2">15 km/h</td><td rowspan="2">Fork tynes horizontal
L = tyne length
  </td></tr>
<tr><td>Firm and level ground</td><td>80% of tipping load, or
100% of hydraulic capacity
(whichever is the lesser).</td></tr>
<tr><td rowspan="2">ISO 20474-3:2017</td><td rowspan="2">Rated Operating Capacity</td><td>Rough terrain</td><td>60% of tipping load, or
100% of hydraulic capacity
(whichever is the lesser).</td><td rowspan="2">15 km/h</td><td rowspan="2">Fork tynes horizontal
L = tyne length
  </td></tr>
<tr><td>Firm and level ground</td><td>80% of tipping load, or
100% of hydraulic capacity
(whichever is the lesser).</td></tr>
<tr><td rowspan="2">EN 474-3:2006</td><td rowspan="2">Rated Operating Capacity</td><td>Rough terrain</td><td>60% of tipping load, or
100% of hydraulic capacity
(whichever is the lesser).</td><td rowspan="2">15 km/h</td><td rowspan="2">Fork tynes horizontal
L = tyne length
 
<table><tr><th colspan="3">Load F (N)</th><th>D (mm)</th></tr><tr><td colspan="2">F ≤</td><td>10,000</td><td>400</td></tr><tr><td>10,000</td><td>< F ≤</td><td>50,000</td><td>500</td></tr><tr><td>50,000</td><td>< F ≤</td><td>100,000</td><td>600</td></tr><tr><td>100,000</td><td>< F ≤</td><td>200,000</td><td>900</td></tr><tr><td>200,000</td><td>< F</td><td></td><td>1200</td></tr></table></td></tr>
<tr><td>Firm and level ground</td><td>80% of tipping load, or
100% of hydraulic capacity
(whichever is the lesser).</td></tr>
<tr><td>SAE J1197-2011</td><td>Rated Operating Load</td><td>Hard, moderately smooth and level</td><td>50% of tipping load, or
100% of hydraulic capacity
(whichever is the lesser).</td><td>6 km/h</td><td>Fork tynes horizontal
L = tyne length
  </td></tr>
</table>

Copyright © 2021, CMEIG. All rights reserved.

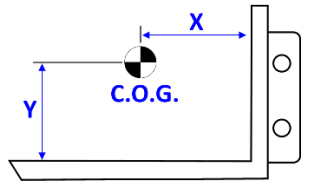
Table 3 – Rated Loads for Log Handling Applications

Standard	Terminology	Operating surface	Description	Max. travel speed	Load Centre of Gravity (C.O.G.) location
ISO 14397-1:2007 (Amd.1:2019) *Log Handling is not specifically mentioned.*	Rated Operating Capacity	Hard, substantially smooth and level	**50%** of tipping load, or **100%** of hydraulic capacity (whichever is the lesser).	15 km/h	Grab tynes must be horizontal with clamp closed L = grab tyne length 
ISO 20474-3:2017	Rated Operating Capacity	Rough terrain	**75%** of tipping load, or **100%** of hydraulic capacity (whichever is the lesser).	15 km/h	Grab tynes must be horizontal with clamp closed L = grab tyne length 
		Firm and level ground	**85%** of tipping load, or **100**% of hydraulic capacity (whichever is the lesser).		
EN 474-3:2006	Rated Operating Capacity	Rough terrain	**75%** of tipping load, or **100%** of hydraulic capacity (whichever is the lesser).	15 km/h	Grab tynes must be horizontal with clamp closed L = grab tyne length 
		Firm and level ground	**85%** of tipping load, or **100**% of hydraulic capacity (whichever is the lesser).		
SAE J1197:2011	Rated Operating Load	Hard, moderately smooth and level	**50%** of tipping load, or **100%** of hydraulic capacity (whichever is the lesser).	6 km/h	Grab tynes must be horizontal with clamp closed L = grab tyne length 

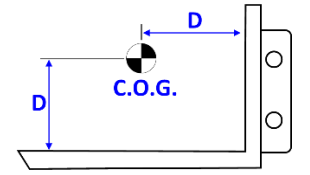
Copyright © 2021, CMEIG. All rights reserved.

Table 4 – Rated Loads for Heavy Single Object (HSO) Applications (non-palletised load)

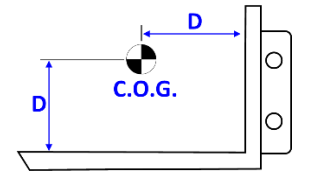
<table>
<tr><th>Standard</th><th>Terminology</th><th>Operating surface</th><th>Description</th><th>Max. travel speed</th><th>Load Centre of Gravity (C.O.G.) location</th></tr>
<tr><td>ISO 14397-1:2007
(Amd.1:2019)</td><td>Rated Operating Capacity</td><td>Firm and level ground</td><td>80% of tipping load, or
100% of hydraulic capacity
(whichever is the lesser).

Note : see Standard for additional requirements (eg: load fully rolled back; load as low as possible)</td><td>2 km/h</td><td> 

<table>
<tr><th>Load (kg)</th><th>X (mm)</th><th>Y (mm)</th></tr>
<tr><td><10,000</td><td>600</td><td>500</td></tr>
<tr><td>>10,000</td><td>900</td><td>800</td></tr>
</table></td></tr>
<tr><td>ISO 20474-3:2017</td><td>Rated Operating Capacity</td><td>Firm and level ground</td><td>80% of tipping load, or
100% of hydraulic capacity
(whichever is the lesser).

Note : see Standard for additional requirements (eg: load fully rolled back; load as low as possible)</td><td>2 km/h</td><td> 

<table>
<tr><th>Load F (N)</th><th>D (mm)</th></tr>
<tr><td>F < 100,000</td><td>600</td></tr>
<tr><td>100,000 – 200,000</td><td>900</td></tr>
<tr><td>F > 200,000</td><td>1200</td></tr>
</table></td></tr>
<tr><td>EN 474-3:2006</td><td>Rated Operating Capacity</td><td>Flat hard surface</td><td>80% of tipping load, or
100% of hydraulic capacity
(whichever is the lesser).

Note : see Standard for additional requirements (eg: load fully rolled back; load as low as possible)</td><td>10 km/h</td><td> 

<table>
<tr><th>Load F (N)</th><th>D (mm)</th></tr>
<tr><td>F < 100,000</td><td>600</td></tr>
<tr><td>100,000 – 200,000</td><td>900</td></tr>
<tr><td>F > 200,000</td><td>1200</td></tr>
</table></td></tr>
</table>

Copyright © 2021, CMEIG. All rights reserved.

Table 5 – Rated Loads for Lifting Applications

Standard	Terminology	Operating surface	Description	Max. travel speed	Permissible lift point locations	Load Centre of Gravity (C.O.G.) location
AS 1418.8-2008	Rated Capacity	As specified by manufacturer on load chart	**50%** of tipping load, or **87%**[2] of hydraulic capacity (whichever is the lesser).	As specified by manufacturer on load chart	Lifting lug located on the boom, bucket or coupler as specified by the manufacturer ***Caution**: AS 1418 stipulates additional mandatory requirements.*	Through lifting lug at maximum achievable reach
EN 474-3:2006	Rated Operating Capacity	Hard, substantially smooth and level	**50%** of tipping load, or **100%** of hydraulic capacity (whichever is the lesser).	15 km/h	As specified by the manufacturer	Through load hooking point at reaches as specified by the manufacturer

IMPORTANT: The use of wheel loaders to lift suspended loads is highly regulated within Australia. Refer to the detail in AS 1418.8 as well as the Occupational Health and Safety legislation applicable to your state or territory for further guidance.

[2] The exact clause within AS 1418.8 is as follows:

"**5.6 RATED HYDRAULIC CAPACITY**
The rated hydraulic lift capacity of earthmoving equipment shall be such that the rated capacity is not greater than 87% of the hydraulic capacity at maximum reach/radius."

While AS 1418.8 is ambiguous whether this applies to all earthmoving machines (including wheeled loaders), or only hydraulic excavators, CMEIG understands the source of the 87% in AS 1418.8 is the equivalent excavator standard ISO 10567 - *Earth-moving machinery — Hydraulic excavators — Lift capacity*. This identifies for rated hydraulic lift capacity of hydraulic excavators:

"**3.12 rated hydraulic lift capacity**
87% of the smaller of boom or arm hydraulic lift capacity at specific lift-point positions"

As shown in Table 5, the equivalent international standard to AS 1418.8 for wheel loaders standard specifies 100%.

CMEIG is currently engaged in a separate effort to address certain inconsistencies within AS 1418.8 including the aforementioned. However, in the interim, the figure of 87% of hydraulic capacity has been applied in Table 5.