Committee representation

This standard was prepared by the P5446 Committee. The membership of the committee was approved by the New Zealand Standards Approval Board and appointed by the New Zealand Standards Executive under the Standards and Accreditation Act 2015.

The committee consisted of representatives of the following nominating organisations:

Engineering New Zealand – Heavy Vehicle Engineers Group

Ia Ara Aotearoa Transporting New Zealand

Motor Trade Association

New Zealand Heavy Haulage Association

New Zealand Truck-Trailer Manufacturers Federation Inc.

Transpecs Ltd.

Waka Kotahi NZ Transport Agency

Acknowledgement

Standards New Zealand gratefully acknowledges the contribution of time and expertise from all those involved in developing this standard.

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DZ 5446:2023

New Zealand Standard

On Road Heavy Vehicle Towing Connections – Drawbeams and Drawbars

Superseding NZS 5446:2007

Contents

Appendix

Table

Figure

Referenced documents

Reference is made in this document to the following:

Joint Australian/New Zealand standards

AS/NZS 1554:- - - -	Structural steel welding
Part 1:2014	Welding of steel structures
Part 4:2014	Welding of high strength quenched and tempered steels
Part 5:2014	Welding of steel structures subject to high levels of fatigue loading
AS/NZS 1664:- - - -	Aluminium structures
Part 2:1997	Allowable design stress
AS/NZS 1665:2004	Welding of aluminium structures
AS/NZS 2980:2018	Qualification of welders for fusion welding of steels

International

EC/94/20:1994	Directive 94/20/EC of the European Parliament and of the Council of 30 May 1994 relating to the mechanical coupling devices of motor vehicles and their trailers and their attachment to those vehicles
ECE 55:2002	Regulation No 55. Uniform provisions concerning the approval of mechanical coupling components of combinations of vehicles
ISO 1102:2001	Commercial road vehicles – 50 mm drawbar eye – Interchangeability
ISO 8755:2001	Commercial road vehicles – 40 mm drawbar eye – Interchangeability
ISO 9001:2000	Quality management systems – Requirements
SAE J847	Trailer tow bar eye and pintle hook/coupler performance

Australian standards

AS 2213: - - - -	Commercial road vehicles – Mechanical connections between towing vehicles
Part 1:2001	Selection and marking of pin-type couplings and drawbar eyes
Part 2:2001	50 mm pin-type couplings and drawbar eyes
Part 3:1998	40 mm pin-type couplings and drawbar eyes
Part 4:1998	Strength test for pin-type couplings and drawbar eyes for rigid drawbars
Part 5:1998	Strength test for pin-type couplings and drawbar eyes for hinged drawbars
AS 3990:1993	Mechanical equipment – Steel work

British standards

BS AU 24a:1989	Specification for towing connections for trailers up to 5000 kg gross mass
BS AU 25:1964	Specification for towing hook for use between trailers of 5-14 tons gross weight and towing vehicle
BS AU 26:1964	Specification for towing jaw for use between trailers of 5 – 16 tons gross weight and towing vehicle
BS AU 27:1964	Specification for towing hook for use between trailers of 5 – 35 tons gross weight and towing vehicle
BS AU 28:1964	Specification for towing jaw for use between trailers of 5 – 35 tons gross weight and towing vehicle
BS AU 29:1964	Specification for drawbar eyes and for carriage pins for connections between trailers of 5 – 35 tons gross weight and towing vehicle

BS 5400: - - - -	Steel, concrete and composite bridges
Part 10:1980	Code of practice for fatigue
Part 10C:1980	Charts for classification of details for fatigue
BS 7608:2014 + A1:2015	Code of practice for fatigue design and assessment of steel structures

German standards

DIN 74051-1:1989	Mechanical connections between towing vehicles and trailers; automatic bolt coupling 40; dimensions and calculating data
DIN 74052-1:1989	Mechanical connections between towing vehicles and trailers; automatic bolt coupling 50; dimensions and calculating data
DIN 74053-1:1994	Mechanical connections between towing vehicles and trailers – 50 mm drawbar-eye – Part 1: With sleeve
DIN 74054-1:1989	Mechanical connections between towing vehicles and trailers; 40 mm drawbar-eye with sleeve

Other publications

Department of Infrastructure, Regional Development and Cities. *Vehicle standard (Australian Design Rule 62/02 Mechanical connections between vehicles)*. Canberra: Australian Government, 2007.

Robinson, B J. *TRL report 237 – Report on tyre adhesion values*. Crowthorne, UK: Transport Research Laboratory, 1997.

Websites

www.legislation.govt.nz

Latest revisions

The users of this standard should ensure that their copies of the above-mentioned New Zealand standards are the latest revisions. Amendments to referenced New Zealand and joint Australian/New Zealand standards can be found on www.standards.govt.nz.

Review of standards

Suggestions for improvement of this standard will be welcomed. They should be sent to the National Manager, Standards New Zealand, PO Box 1473, Wellington 6140.

Foreword

The main changes included in the 2007 revision from the original 1987 version of NZS 5446 (incorporating amendments from 1991) are:

(a) Components that have been approved by testing with a D value, or that have been tested and rated to a recognised standard, can be certified without the need for a full design check, provided this is done within the provisions of Appendix B. This is based on the development of new formulas to equate the testing of these components to the reference loads established by vehicle testing conducted in New Zealand during the development of the original 1987 standard;
(b) Some of the loading conditions have been clarified, in particular those relating to drawbeams and rigid drawbars. Provision is made for the vertical loads imposed on the drawbeam by rigid drawbars;
(c) The range of the table of longitudinal loadings is extended and more steps are provided;
(d) All design stresses are required to be in compliance with one of the referenced design standards;
(e) The list of parameters required for certification is extended to include the coupling D value. Other requirements such as the expiry date are clarified;
(f) In light of experience gained since the original standard was published, clauses dealing with repair are revised;
(g) An outline of the requirements for re-certifying towing connections is added;
(h) References to other standards are updated, as are clauses dealing with regulatory requirements;
(i) The formulas on simple trailer drawbar loadings in Appendix C have been further developed to recognise all of the loadings acting on the trailer during braking, along with other clarifications.

The 2023 revision builds on the work done by the previous committees and utilises work presented in the original commentary to the 1987 standard prepared by R Mackay.

The main changes included in the 2023 revision are:

(j) The name of the standard has been updated to make it clear it applies to on road vehicles only;
(k) Drawbar label requirements amended regarding turntable lock information;
(l) Definition for length of drawbar clarified;
(m) A revised figure 5;
(n) Clarification of tow-eye protection requirements;
(o) Minor amendments to reduced life calculations in Appendix B2 regrading;
(p) Amendments to Appendix D.

1 General

1.1 Scope

This standard establishes design, manufacture, installation, testing, maintenance, repair, and certification criteria necessary to ensure that a secure connection can be maintained between towing vehicles and drawbar trailers for use in heavy road vehicles in normal use on both sealed and unsealed roads.

Although primarily covering applications incorporating pin or hook couplings, this standard also applies to other types of couplings covering both rigid and hinged drawbars.

This standard includes the following components:

(a) Drawbeam;
(b) Drawbar;
(c) Couplings;
(d) Method of attachment to:
  (i) Towing vehicle chassis
  (ii) Main structural member of the trailer chassis or steering axle assembly.

1.2 Interpretation

For the purposes of this standard, the word ‘shall’ refers to practices that are mandatory for compliance with this standard, while the word ‘should’ refers to practices that are advised or recommended.

The terms ‘normative’ and ‘informative’ have been used in this standard to define the application of the Appendix to which they apply. A ‘normative’ appendix is an integral part of a standard while an ‘informative’ appendix is only for information and guidance.

1.3 Definitions

For the purposes of this standard the following definitions shall apply:

Certifier	A person appointed by the Director of Land Transport as a certifier for the purpose of land transport legislation
Centre axle trailer	See ‘simple trailer’
Certifying engineer	See ‘certifier’
Compliance certificate	A document approved by the Director of Land Transport and issued under land transport legislation
Coupling	That part of a vehicle that is specifically designed to enable it to be connected to another vehicle and does not include a structural member of the towing or towed vehicle
Design combination mass (DCM)	One of the following, as appropriate to the intended use of the vehicle: (a) Maximum sum of the axle loadings permitted by transport legislation for the towing and all towed vehicles in combination; (b) The sum of the gross vehicle mass of each vehicle in combination; or (c) The vehicle manufacturer’s gross combination mass (GCM) rating for a towing vehicle

Drawbar — An assembly of components that includes the trailer coupling connecting the trailer to the coupling of the towed vehicle, hinges (where applicable), and the structural and other related components between the trailer coupling and steering axle assembly or chassis

Drawbar attachment — The attachment between the drawbar and the trailer. This could be hinged or rigid as appropriate

Drawbeam — The part of the towing vehicle to which a coupling is fitted to enable a heavy trailer to be connected. It includes the structural and other related components between the towing vehicle coupling and the towing vehicle chassis, and the attached coupling

***D* value** — The *D* or D_C value is the theoretical reference value for the horizontal forces in the towing vehicle and the trailer.

For mechanical coupling devices and components not designed to support imposed vertical loads, the value is:

$$D = g\frac{T \times R}{T + R} kN \quad \text{(Eq. 1)}$$

For mechanical coupling devices and components for centre axle trailers, the value is:

$$D_c = g\frac{T \times C}{T + C} kN \quad \text{(Eq. 2)}$$

where

T is the technically permissible maximum mass of the towing vehicle, in tonnes. Where relevant, this includes the vertical load imposed by a centre axle trailer

R is the technically permissible maximum mass, in tonnes, of a trailer with drawbar free to move in a vertical plane

C is the mass, in tonnes, transmitted to the ground by the axle or axles of the centre axle trailer, when coupled to the towing vehicle and loaded to the technically permissible maximum mass

g is the acceleration due to gravity (assumed to be 9.81 m/s^2).

The *S* value is the vertical mass, in kilograms, imposed on the coupling, under static conditions, by the centre axle trailer, of technically permissible maximum mass.

The V value is the theoretical reference value of the amplitude of the vertical force imposed on the coupling by the centre axle trailer of technically permissible maximum mass greater than 3.5 tonnes.

$$V = \frac{a \times C \times X^2}{L^2} \quad \text{(Eq. 3)}$$

where

a is an equivalent vertical acceleration at the coupling depending on the type of suspension system of the rear axle of the towing vehicle for air suspension (or suspension systems with equivalent damping characteristics):

$$a = 1.8 \mathrm{m/s^2} \quad \text{(Eq. 4)}$$

for other types of suspension:

$$a = 2.4 \mathrm{m}/s^2 \quad \text{(Eq. 5)}$$

NOTE – If (X^2/L^2) is less than 1.0, then the value of at least 1.0 shall be used.

X is the length of the loading area of the trailer, in metres (see Figure 1)

L is the distance from the centre of the drawbar eye to the centre of the axle assembly, in metres (see Figure 1)

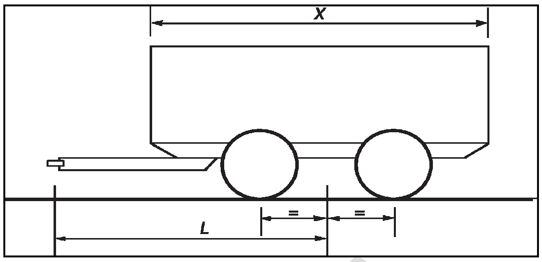

Figure 1 – Dimensions of the simple trailer

Gross combination mass (GCM) For a vehicle that is permitted to tow another vehicle, maximum permitted combined mass of the towing vehicle and any combination of attached trailers or vehicles, determined by the vehicle manufacturer and approved by the Director of Land Transport, or determined by the Director of Land Transport

Gross vehicle mass (GVM) The maximum permissible mass of a vehicle as specified by (GVM) the manufacturer of the vehicle, or by the Director of Land Transport where the manufacturer's rating is not available or is not appropriate

Heavy vehicle A vehicle with a GVM that exceeds 3500 kg

Maximum towed mass (MTM) The maximum permissible mass of all vehicles that may be towed behind a vehicle as determined by the manufacturer of the towing vehicle, and approved by the Director of Land Transport, or determined by the Director of Land Transport, or as limited by the certifying engineer. For the purpose of this standard, it is also the permitted trailer mass for a drawbar

Pole trailer A trailer that is attached to a towing vehicle by a telescoping or sliding pole, and is designed to support a common long load spanning between the trailer and the towing vehicle

Simple trailer A trailer with a rigid drawbar and having an axle or axles positioned close to the centre of gravity of the trailer, when uniformly loaded

Static roll threshold (SRT) The maximum level of steady turning lateral acceleration a vehicle can tolerate without rolling over, which is expressed as a proportion of '*g*' where '*g*' is the acceleration constant due to gravity (9.81 m/s^2)

Static vertical load The maximum vertical load transferred by a drawbar to the towing vehicle at the town coupling when stationary

1.4 Abbreviations

The following abbreviations are used in this standard.

DCM Design combination mass
FP Fatigue purposes (AS1554 welding category)
GCM Gross combination mass
GP General purposes (AS1554 welding category)
GVM Gross vehicle mass
MTM Maximum towed mass
SP Structural purposes (AS1554 welding category)
SRT Static roll threshold
VIN Vehicle identification number

2 Design

2.1 Design requirements – loading

The design of drawbeams and drawbars shall take into account both static (F_L) and dynamic (F_{FR}) loads in accordance with Table 1.

Table 1 – Design loads for specified MTM

Maximum towed mass	Longitudinal force F_L	Fatigue force range F_{FR}	Maximum towed mass	Longitudinal force F_L	Fatigue force range F_{FR}
(tonnes)	(kN)	(kN)	(tonnes)	(kN)	(kN)
3.5	55	55	22	232	196
4	64	64	23	238	199
5	80	80	24	244	202
6	90	90	25	250	205
7	100	100	26	252	208
8	110	110	27	254	211
9	120	120	28	256	214
10	130	130	29	258	217
11	140	137	30	260	220
12	150	144	31	262	223
13	160	151	32	264	226
14	170	158	33	266	229
15	180	165	34	268	232
16	188	170	35	270	235
17	196	175	36	272	238
18	204	180	37	274	241
19	212	185	38	276	244
20	220	190	39	278	247
21	226	193	40	280	250

2.2 Design stresses

The design stresses shall comply with Appendix A.

2.3 Components and assemblies with *D* values

A component or an assembly of components produced by manufacturers complying with ISO 9001, and having a *D* value, shall be selected according to the provisions of Appendix B.

2.4 Design considerations

2.4.1 *Eccentricities*

Eccentricities due to the layout, which may cause bending in members or their connections, shall be considered in the analysis of stresses (for example, the connection of the drawbar to the dolly, or where all members of the drawbar or drawbeam do not lie in the same horizontal plane, as this produces additional bending moments).

NOTE – The alignment of drawbar side arms with the hinge and tow-eye centres often results in secondary bending of those members.

2.4.2 *Stress concentrations*

In the design and manufacture of components, due account shall be taken of stress concentrations due to holes or sharp changes in section, or both, and appropriate factors applied.

2.4.3 *Rotating couplings*

Where one coupling can rotate, the mating coupling shall be fixed.

2.5 Construction materials

The construction materials shall be specified and the required mechanical properties detailed. Where alternative materials are used to those specified in Appendix A or where alternative processes such as shot peening are used, an equivalent level of safety shall be provided.

2.6 Brittle fracture

The possibility of a brittle fracture shall be considered in the design.

2.7 Bolted connections

All bolted connections shall comply with the following requirements:

(a) Bolts subject to dynamic loads predominantly in the axial direction shall be designed to BS 7608;

(b) Bolts subject predominantly to dynamic shear loads shall be designed to AS 3990 or BS 7608;

(c) Non-metric bolts, to a suitable, recognised standard (for example, an SAE International standard), may be substituted for metric bolts referred to in BS 7608 and AS 3990, provided they meet the loadings imposed in terms of the relevant standard.

3 Drawbeams

3.1 Design forces

Drawbeams shall comply with the allowable stress conditions defined by one of the standards listed in Appendix A when subjected independently to each of the applicable following four cases of design loading:

(a) Longitudinal force: A longitudinal force, F_L, in direct tension and compression, which in magnitude is the longitudinal force given in Table 1 for the specified MTM and applied to the coupling centre in a horizontal plane and parallel to the vehicle's longitudinal centre line;

NOTE – Static vertical rating for the drawbeam shall be included.

(b) Longitudinal fatigue force range: A longitudinal fatigue force range, F_{FR}, with magnitude as given in Table 1 for the specified MTM, and applied to the coupling centre in a horizontal plane and parallel to the vehicle's longitudinal centre line;

(c) Side force: A side force, F_S, equal in magnitude to 0.3 F_L, applied to the coupling centre in a horizontal plane at 90° to the longitudinal axis of the vehicle;

NOTE – This is a force to accommodate side loading from drawbars and turntable locks.

(d) Vertical force:

(i) Hinged drawbars: A vertical force, F_V, the greater of the static vertical load or 0.15 F_L, applied to the coupling centre in a vertical plane perpendicular to the longitudinal axis of the vehicle.

NOTE – This is a force to accommodate vertical loading from equipment on the drawbar and travel over crests and through troughs.

(ii) Rigid drawbars: In the case of any drawbeam intended to tow a trailer that may transfer any portion of the trailer weight or braking force vertically onto the towing vehicle, a vertical force, F_V, as defined in Appendix C.

If applicable, the static vertical rating of the drawbeam shall be noted on the compliance certificate and identification label.

3.2 Attachment

The drawbeam shall be adequately secured to the towing vehicle such that the structural section of the towing vehicle to which the drawbeam is attached is able to withstand the forces in 3.1 without exceeding the allowable design stresses in Appendix A.

3.3 Location

The drawbeam shall be positioned behind the rear wheels of the vehicle in accordance with the requirements of transport legislation.

3.4 Certification

A compliance certificate shall be issued following manufacture and installation of the drawbeam confirming compliance with this standard. Recertification shall be carried out in accordance with Appendix D.

3.5 Identification

3.5.1 *Labelling*

Each individual drawbeam shall be identified by indelible labelling to clearly identify:

(a) Person, company, or agency carrying out the certification;
(b) Certifier ID;
(c) Compliance certificate number;
(d) Vehicle identification number (VIN) or chassis number of the vehicle;
(e) Maximum towed mass;
(f) Permitted static vertical load;
(g) Coupling D value (minimum);
(h) Expiry date;
(i) NZS 5446.

The layout of the information on a drawbeam identification label should be as set out in Figure 2.

[NAME OF CERTIFYING AGENCY]	NZS 5446
Certifier ID	
Compliance certificate no.	
VIN/chassis no.	
Drawbeam maximum towed mass	
Permitted static vertical load	
Coupling D value (minimum)	
Expiry date	

Figure 2 – Example of a drawbeam identification label

3.5.2 *Label location*

The identification label should ideally be located on the drawbeam on the left-hand side in a low-stressed area and where it is protected from damage.

3.5.3 *Component identification*

It is recommended that each individual component that can be replaced should be marked with an identifier to enable all components to be traced during their life on the vehicle.

3.6 Welding

All steel welding shall comply with AS/NZS 1554 (category SP as a minimum, unless category FP is specified by the certifying engineer) and shall be carried out by operators qualified under AS/NZS 1554 in the appropriate position and technique.

Welding of aluminium shall comply with AS/NZS 1665 (to weld category B or better) and shall be carried out by operators qualified to AS/NZS 1665 in the appropriate position and technique.

3.7 Repair

3.7.1 *Deformed or fractured structures*

Deformed or fractured fabricated structures should only be repaired in accordance with the repair specification issued by the certifying engineer, provided the certifying engineer is satisfied that the fatigue life and structural strength can be adequately maintained or restored, having considered the operating conditions, spent life, and service history.

Repair of bolt-on components shall follow the directions of the component manufacturer.

3.7.2 *Certification*

Certification of repairs or modifications should be carried out by the person, company, or agency responsible for the original design and certification. Where this is impracticable, the certification of repairs or modifications shall be carried out by a person who fulfils the requirements of a certifying engineer.

3.7.3 *Welding*

All welding shall comply with 3.6.

3.7.4 *Examples*

Examples of couplings and drawbeam assembly are shown in Figure 3.

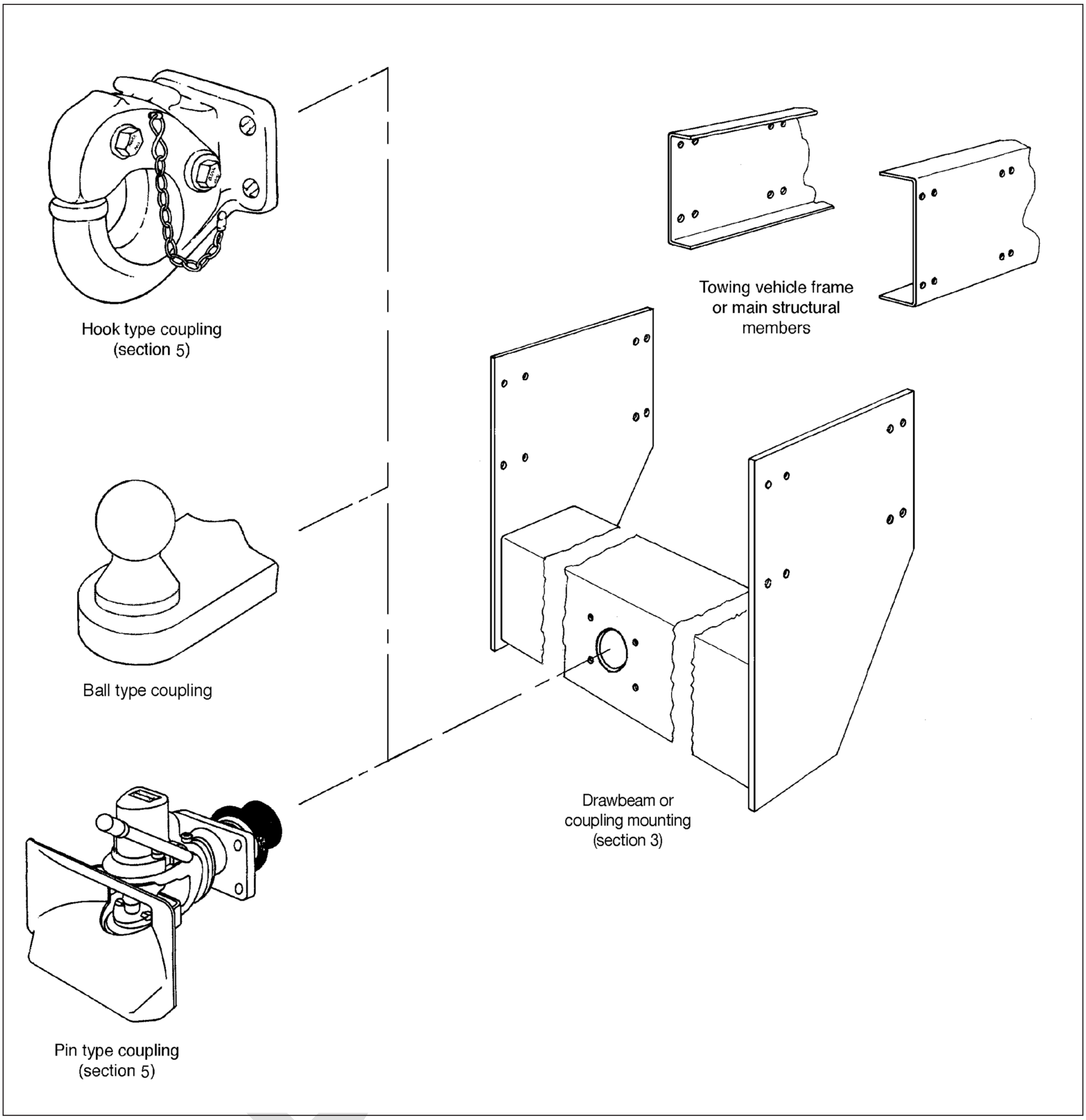

Figure 3 – Examples of couplings and drawbeam assembly

4 Drawbars

4.1 Design forces

Drawbars shall comply with the allowable stress conditions defined by one of the standards listed in Appendix A when subjected independently to each of the applicable following four cases of design loading:

(a) Longitudinal force: A longitudinal force F_L, in direct tension and compression, which in magnitude is the longitudinal force given in Table 1 for the specified MTM and applied to the coupling centre in a horizontal plane and parallel to the vehicle's longitudinal centre line;

NOTE – Any vertical loads or eccentricities induced in a drawbar or its attachments shall be included.

(b) Longitudinal fatigue force range: A longitudinal fatigue force range F_{FR}, with magnitude as given in Table 1 for the specified MTM, and applied to the coupling centre in a horizontal plane and parallel to the vehicle's longitudinal centreline;

NOTE – Any eccentricities induced in a drawbar or its attachments shall be included.

(c) Side force: A side force, F_S, as defined in Appendix E applied to the coupling centre in the horizontal plane at 90° to the longitudinal axis of the vehicle.

Drawbars fitted to trailers with turntable locks shall withstand a side force F_S of 0.15 times the MTM applied at 90° to the longitudinal axis at the coupling;

(d) Vertical force: In the case of a drawbar fitted to a trailer which may transfer any portion of the trailer weight or braking force vertically to the coupling, a vertical force, F_V, as specified in Appendix C, applied to the coupling centre in the vertical plane perpendicular to the longitudinal axis of the vehicle.

If applicable, the static vertical rating of the drawbar shall be noted on the compliance certificate and identification label.

4.2 Attachment

The drawbar shall be adequately secured to the trailer so that the attachment is able to withstand the forces in 4.1 without exceeding the allowable design stresses in Appendix A.

4.3 Articulation

For a hinged drawbar, the attachment shall have articulation compatible with the requirements of 5.4.3.

NOTE – Trailers with telescoping drawbars, with the tow coupling set to the correct height, are to achieve a minimum articulation of ± 5° vertically.

4.4 Certification

A compliance certificate shall be issued following manufacture and installation of the drawbar confirming compliance with this standard. Recertification shall be carried out in accordance with Appendix D.

4.5 Identification

4.5.1 *Labelling*

Each individual drawbar shall be identified by indelible labelling to clearly identify:

(a) Person, company, or agency carrying out the certification;
(b) Certifier ID;
(c) Compliance certificate number;
(d) VIN/chassis number of the vehicle;
(e) Maximum towed mass;
(f) Maximum static vertical load;
(g) Coupling *D* value (minimum);
(h) Drawbar length (Hinged drawbar: measured from hinge to coupling, Rigid drawbar: measured from front of the deck/body to coupling);
(i) When a turntable lock is fitted;
(j) Expiry date;
(k) NZS 5446.

The layout of the information on a drawbar ID label should be as set out in Figure 4.

[NAME OF CERTIFYING AGENCY]	NZS 5446
Certifier ID	
Compliance certificate no.	
VIN/chassis no.	
Drawbar maximum towed mass	
Maximum static vertical load	
Coupling D value (minimum)	
Drawbar length (in millimeters)	
Turntable lock fitted (if applicable)	
Expiry date	

Figure 4 – Recommended layout of drawbar identification label

4.5.2 *Label location*

The identification label should ideally be located on the drawbar on the left-hand side in a low-stressed area and where it is protected from damage.

4.5.3 *Component identification*

It is recommended that each individual component that can be replaced should be marked with an identifier to enable all components to be traced during their life on the vehicle.

4.6 Telescopic drawbars

The following requirements shall be met:

(a) A telescopic drawbar shall have end-stops or a secondary locking device designed to withstand the loads in 4.1(a), so as to prevent separation if the primary locking device fails;

(b) Where trailers are fitted with telescopic drawbars, the drawbars shall be designed to conform to the standard in all towing positions;

(c) Telescopic drawbars shall be fitted with one or more locking device(s), which shall each individually be capable of meeting the load requirements of 4.1(a); and

(d) Due allowance shall be made for wear in the design, and wear limits shall be stated on the compliance certificate.

4.7 Pole trailers

4.7.1 *Design*

The design of the drawbar for pole trailers is a special case and each case shall be considered on its merits, but, as a minimum, the loadings of 4.1(a) and 4.1(b) are to be applied with the MTM equal to tare mass.

4.7.2 *Steering force*

A side force F_S shall be applied as per 4.1(c), with the MTM equal to the applicable axle group laden mass.

4.7.3 *Additional vertical loads*

Consideration shall be given to the possibility of additional vertical loads being imposed by the payload transferring loads through the bolster or supports.

4.7.4 *Rigid single span*

For a pole trailer that carries its load as a rigid single span secured to both the towing vehicle and the pole trailer, the MTM of the drawbar shall be equal to or greater than the unladen mass of the pole trailer, and the identification label attached to the drawbar shall state that the MTM applies only when the trailer is unladen.

4.8 Additional design considerations

4.8.1 *Drawbar symmetry*

The drawbar should preferably be symmetrical in plan and side elevation.

4.8.2 *Drawbar slope*

With the vehicles on a level surface and in the fully laden condition, the drawbar should be level when connected to the towing vehicle. As a maximum limit, the slope of the drawbar shall not exceed 1 in 10 when vehicles are in the laden condition.

4.8.3 *Section change*

The section change between the coupling support and structural members shall be as gradual as practicable.

4.8.4 *Coupling protection*

Protection by mechanical means shall be incorporated into the drawbar design to prevent ground contact of the coupling tow-eye. Additional spring or stand support is recommended.

4.8.5 *Corrosion avoidance*

The design shall avoid sections capable of accumulating dirt, moisture, or material likely to cause corrosion.

4.9 Welding

4.9.1 *Compliance*

All steel welding shall comply with AS/NZS 1554 (category SP as a minimum unless category FP is specified by the certifying engineer) and shall be carried out by operators qualified under AS/NZS 1554 in the appropriate position and technique.

Welding of aluminium shall comply with AS/NZS 1665 (to weld category B or better) and shall be carried out by operators qualified to AS/NZS 1665 in the appropriate position and technique.

4.9.2 *Tow-eye shank welds*

All welds made on the tow-eye shank, including tack welds and welding of cover plates, shall be carried out according to the manufacturer's recommendations. If no specific recommendations are given then the procedure given in 4.9.3 shall be used.

4.9.3 *Tow-eye shank weld procedures*

Where no specific recommendations for welding of the tow-eye shank are given then the following weld procedure shall be used:

i. Pre-heat to 250°C.

ii. Hydrogen-controlled electrodes, dried according to the manufacturer's recommendations, or a hydrogen-controlled welding process, shall be used to make all welds, including tack welds and welds on cover plates and so on.

iii. Welding of the tow-eye shank shall be on the parallel section of the shank only, except a seal weld may be applied to the rear face of the shank.

iv. After welding, the tow-eye shall be protected by suitable means to ensure slow cooling from the welding temperatures.

v. If welding on the tow-eye shank is stopped and the temperature falls below 250°C, the component shall be raised to the preheat temperature before welding is recommenced.

4.9.4 *Visibility*

Wherever practicable, all welds shall be visible for inspection purposes.

4.10 Repair

4.10.1 *Deformed or fractured structures*

Deformed or fractured fabricated structures should only be repaired in accordance with the repair specification issued by the certifying engineer, provided the certifying engineer is satisfied that the fatigue life and structural strength can be adequately maintained or restored, having considered the operating conditions, spent life, and service history and the repair certified in accordance with this standard.

Repair of bolt-on components shall be according to the manufacturer's instructions.

4.10.2 *Tow-eye*

Where a replacement tow-eye is welded into a drawbar, the welding shall comply with 4.9.3, and the repair certified in accordance with this standard.

4.10.3 *Tow-eye bushes*

Tow-eye bushes shall be fitted in accordance with the manufacturer's instructions and shall not be retained by welding.

4.10.4 *Welding*

All welding shall comply with 4.9.1.

4.10.5 *Certification*

Certification of repairs or modifications should be carried out by the person, company, or agency responsible for the original design and certification. Where this is impracticable, the certification of repairs or modifications shall be carried out by a person who fulfils the requirements of a certifying engineer.

4.10.6 *Example*

An example of a drawbar and attachment is shown in Figure 5.

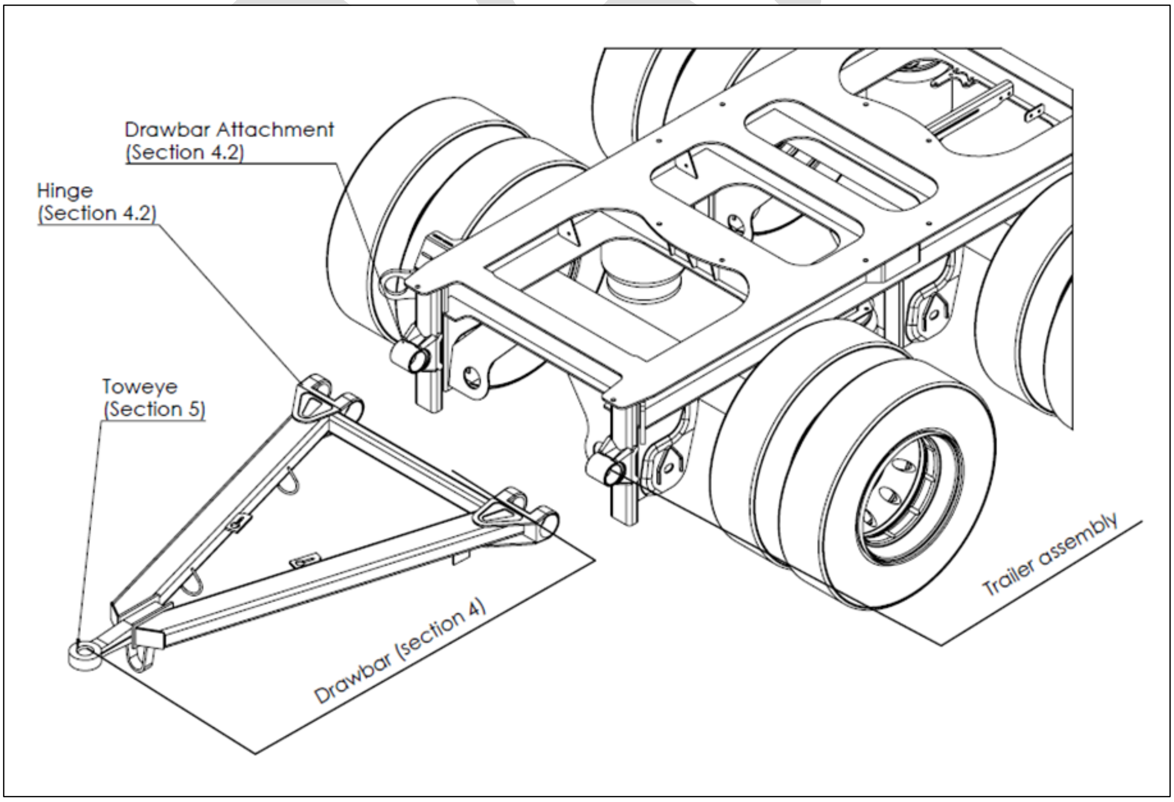

Figure 5 – Example drawbar and attachment

5 Couplings

5.1 Coupling standards

5.1.1 *General*

All couplings shall comply with one of the following standards:

(a) EC/94/20;

(b) ECE 55;

(c) DIN 74051-1 and 74054-1 (40 mm pin);

(d) DIN 74052-1 and 74053-1 (50 mm pin);

(e) ISO 1102 or ISO 8755;

(f) AS 2213.1, AS 2213.2, AS 2213.3, AS 2213.4, or AS 2213.5;

(g) BS AU 24a, 25, 26, 27, 28, and 29 or equivalent standards and be installed in accordance with the manufacturer's specifications;

(h) SAE J847 for hook-type couplings;

(i) ADR 62/02.

5.1.2 *Fastenings*

Manufacturers shall supply comprehensive installation instructions for the couplings that are intended to be used in New Zealand. If these are not available, components should not be used.

5.2 Capacity

5.2.1 *General*

Couplings shall be selected as per 5.2.1 and 5.2.2 as appropriate. See 2.3.

Note – Appendix B does not apply to couplings.

5.2.2 *Couplings with a D value*

Couplings with a *D* value that comply with EC/94/20 or ECE 55 and that are manufactured by a company recognised as meeting ISO 9001 shall have a minimum rating of:

$$DCM(tonnes) \times \frac{9.81}{4}(kN) \qquad \text{(Eq. 6)}$$

5.2.3 *Hook- (pintle-) type couplings*

Couplings designed to SAE J847 shall have a minimum rating of 90% of the $\frac{DCM}{4}$ provided that the manufacturer's rating capacity is not exceeded.

5.3 Vertical load capacity

Couplings for use with rigid drawbar trailers shall have a vertical load capacity as determined in 4.1(d).

5.4 Articulation

5.4.1 *Pin-type couplings*

The tow-eye shall be fixed in the drawbar and angular movement provided within the pin-type coupling. Clearance between a parallel pin of a pin-type coupling and the drawbar eye is not acceptable as a way of meeting the specified articulation angles. This requirement shall not apply to trailers where the drawbar is used only for steering the trailer (pole trailer).

5.4.2 *Hook- or pintle-type coupling*

Tow-eye rotation is acceptable in meeting the articulation angle requirements.

5.4.3 *Angular deflection*

The angular deflection shall be:

(a) Horizontal plane: at least ± 75° from the straight aft position;

(b) Vertical plane: at least ± 20° from the horizontal.

5.4.4 *Roll angle*

The roll angle shall be at least ± 25° around the longitudinal axis from a horizontal plane through the effective thrust point on the coupling pin or hook.

5.5 Coupling location

The coupling location shall be on the centre line of the vehicle and shall allow the drawbar articulation angles specified in 5.4.3.

5.6 Safety lock

The pin- or hook-type coupling shall incorporate at least one safety device to prevent accidental release of the coupling.

5.7 Maintenance and inspection

5.7.1 *General*

All couplings shall be maintained and inspected in accordance with the manufacturer's instructions.

5.7.2 *Control heads and safety locking devices*

Control heads and safety locking devices shall operate smoothly and effectively, and fastening shall be secure.

5.7.3 *Pin-type coupling mouths*

Coupling mouths shall only be repaired in accordance with the manufacturer's specifications.

5.7.4 *Coupling pins and towing hooks*

Coupling pins and towing hooks shall not be repaired or welded. If damaged, deformed, fractured, or worn at any one point exceeding 5% of the original dimensions, or the manufacturer's wear tolerance, whichever is less, the components shall be replaced.

5.7.5 *Yoke shafts*

As part of regular maintenance, the yoke shaft should be checked, especially if the coupling mouth or coupling pin has been damaged.

5.7.6 *Tow-eyes*

Tow-eyes shall not be repaired. If worn at any one point beyond 5% of the original dimension, or the manufacturer's wear tolerance, whichever is less, or if damaged, deformed, or fractured, the tow-eye shall be replaced.

APPENDIX A – Design stresses and design life

(Normative)

A1 Design stresses

Stresses in base metals, welds, and any other member associated with the drawbeam, drawbar, and attachments/connections for both static and dynamic (fatigue considerations), shall be limited to allowable stresses as given in the following standards:

AS 3990:1993	Mechanical equipment – Steelwork
BS 7608:2014 + A1:2015	Code of practice for fatigue design and assessment of steel structures
BS 5400.10:1980	Steel, concrete and composite bridges – Code of practice for fatigue or equivalent standards.
AS/NZS 1664: Part 2:1997	Aluminium structures – Allowable design stress

A2 Design life

For the dynamic condition, the fatigue force range given in Table 1 has been determined from testing and reference to BS 5400.10. The design stress at 2 x 10^6 cycles is recommended and calculated to two standard deviations. However, the certifying engineer is permitted to design for a lower or higher number of cycles. For most situations it is appropriate to assume one cycle per two kilometres, but consideration needs to be given to operating conditions.

For rigid drawbars, which may not be readily replaceable, an extended design life should be considered.

The design life and/or the design stress levels may be adjusted using an appropriate S–N curve from one of the approved design standards, in accordance with accepted fatigue design practice.

In applying AS 3990, category E is applicable for the sidearms, for many details, and end fittings (55 MPa stress range at 2 × 10^6 cycles). In applying BS 7608, Class G is often applicable (49 MPa stress range at 2 × 10^6 cycles).

NOTE – Welding adversely affects fatigue life more than most other fabrication processes. The use of alternative fatigue standards based on S_{min}/S_{max} is not appropriate.

A3 Certification period

As a parameter of the design life, distance travelled is a better measure than time. However, for practical and inspection purposes, time is the established and accepted format.

A certification period shall be established based on the information in A2. For instance, a drawbeam that is designed for 2 × 10^6 cycles (and where one cycle per 2 km is appropriate) with an anticipated annual distance covered of 400,000 km, will have a certification period of 10 years.

The expiry date of the certification period shall be specified on both the compliance certificate and the identification label.

APPENDIX B – Selection of structural components of drawbeams or drawbars that are tested and approved to an international standard

(Normative)

NOTE – Not to be used for coupling selection. See section 5.

B1 Minimum D value required

A component or an assembly of drawbeam or drawbar components that comply with EC/94/20 or ECE 55 and that are manufactured by a company recognised as meeting ISO 9001, shall be selected using one of the following:

B1.1 Components for expected life of 2×10^6 cycles

A component or an assembly of components marked with a *D* value that equals or exceeds the minimum rating required for the MTM selected from Table B1 can be certified for use up to 2×10^6 cycles.

Table B1 – Minimum *D* value required for a specified maximum towed mass

Maximum towed mass	Required D value (minimum)	Maximum towed mass	Required *D* value (minimum)
(tonnes)	(kN)	(tonnes)	(kN)
3.5	46	22	164
4	54	23	166
5	67	24	168
6	75	25	171
7	83	26	174
8	92	27	176
9	100	28	178
10	109	29	181
11	114	30	183
12	120	31	186
13	126	32	188
14	132	33	191
15	138	34	194
16	142	35	196
17	146	36	198
18	150	37	201
19	154	38	203
20	158	39	206
21	161	40	208

B1.2 Components with a shorter design life

A component or an assembly of components selected with a *D* value that is less than the minimum required by Table B1 for the appropriate MTM may be used, but shall be certified under the following conditions:

B1.2.1 Capacity

Any component or an assembly of components shall have a minimum rating of

$$DCM(tonnes) \times \frac{9.81}{4} (kN) \qquad \text{(Eq. 7)}$$

B1.2.3 Fabricated structures

Fabricated structures shall have their design life reduced as per the following calculation (derived from Equation 1 in section 4 of BS 7608) for detail class 'G' and two standard deviations:

$$\begin{aligned} N_1 &= Log^{-1}\{11.7526 - 2(0.1793) - 3.0 \times Log_{10}\,(S_r)\} \\ &= Log^{-1}\{11.3940 - 3Log_{10}(49.8 \times D_1/D_2\,)\} \end{aligned} \qquad \text{(Eq. 8)}$$

where

N_1 = New life in cycles

S_r = Applied stress range in MPa or N/mm^2

D_1 = *D* value for MTM at 2 × 10^6 cycles from Table B1

D_2 = D value of component selected

The life shall be stated on the compliance certificate in kilometres. For highway use, 1 cycle per 2 km is appropriate; however, severe duty and off highway applications are at the discretion of the certifying engineer.

B2 Example of reduced-life calculation for any component or assembly (drawbeam or drawbar) with a *D* value less than the minimum required in Table B1 for the maximum towed mass

Assumptions for design assessment are based on:

(a) Tested life of *D* value-rated components is 2 × 10^6 load cycles;

(b) Design life specified in NZS 5446 for a component or an assembly of components is 2 × 10^6 load cycles;

(c) Drawbar rating: If DCM/4 is the basis for a component or an assembly of components selection, then the design life is determined by the GVM of the trailer. The lower the trailer GVM, the longer the design life for a given drawbar;

(d) Drawbeam rating: DCM/4 shall be related to the heaviest trailer that can be towed for off highway operation, legal limits, and manufacturer's limits when determining the component or an assembly of component's life.

The test load rating is compared to the design loads in the standard based on a vehicle with a 44 tonne DCM.

Maximum *D* value is achieved when the trailer mass is equal to the truck mass (= DCM/4).

For example:

$$44{,}000\ kg \times \frac{9.81}{4} = 107.9\ kN$$

The fatigue test range for a D-rated component or an assembly of components is

$= \pm 0.6$ D

Therefore, the fatigue test range = 1.2 ´ D

= 1.2 ´ 107.9 kN

= 129.49 kN

If the component or an assembly of components is selected by DCM/4, then the selected item requires a D value of at least 107.9 kN. Therefore, the component or an assembly of components selected has the next higher D value, currently 120 kN.

Fatigue test load range 1.2 x 120 kN = 144 kN.

The maximum allowable trailer mass to truck mass in a combination is limited by transport legislation to a ratio of 1.5:1.

$$\text{So } MTM = \frac{44{,}000\ kg \times 1.5}{2.5} = 26{,}400\text{kg}$$

Under NZS 5446, the design fatigue load range for an MTM of 26,400 kg = 209 kN.

The component or an assembly of components selected above, with a *D* value of 120 kN, is tested to a fatigue load range of 144 kN.

However, from Table 1, the fatigue force range for the MTM is 209 kN. This is 1.45 times the test load range.

Stress increases in proportion to the increase in load. The life of a component or an assembly of components reduces as a consequence of stress increase.

Using BS 7608 and taking the life-limiting detail as class G to achieve a design life of 2 × 10^6 cycles, the maximum allowable stress range = 49.8 MPa.

When the load range is increased by 1.45 then service stress range is increased to 72.21 MPa.

A component or an assembly of components' expected life:

$$N = \text{Log}^{-1}\left(11.7526 - 2 \times 0.1793 - 3\text{Log } 72.21\right)$$

$$= 657{,}064 \text{ cycles}$$

$$\text{Service life} = 657{,}000 \text{ cycles} \times 2 \text{ km/cycle}$$

$$= 1.314 \times 10^6 \text{ km (based on 1 cycle per 2 km)}$$

Thus, this component or assembly of components with a *D* value of 120 kN shall be removed from service after 1,314,000 km or 657,000 stress cycles.

However, if a component or an assembly of components with a *D* value of 130 kN is selected, the fatigue test load range = 156 kN.

The ratio of fatigue-force range to test load range is then $\frac{209kN}{156\ kN} = 1.34 : 1$

Service stress range is then 1.34 x 49.8 MPa = 66.7 MPa.

Service life *N* = 834,700 cycles or 1.67 × 10^6 km.

For a component or an assembly of components with a *D* value of 190 kN, the fatigue test load range = 228 kN.

This exceeds the NZS 5446 fatigue load range of 209 kN, therefore the life is greater than 2 × 10^6 cycles.

B3 Adjustment

A component or an assembly of components rated using test loads other than the *D* value or the fatigue force range in Table 1 shall have their ratings adjusted to an equivalent of the *D* value or New Zealand reference loads.

This adjusted rating is then to be applied to the relevant sections of this standard.

B4 Testing

Testing carried out on heavy vehicle truck-and-trailer combinations in New Zealand has shown the towing forces to be unique to this country and, as such, need to be applied to the design and certification of these items fitted to our national fleet.

This standard will accept a tested component or an assembly of tested components that may have been tested to other design forces provided the ratings are adjusted to reflect the loadings measured in New Zealand.

Appendix C – Drawbars with vertical loadings

(Normative)

C1 Drawbars

For the drawbar of a trailer which may transfer any portion of the trailer weight or braking force vertically onto the towing vehicle (see Figure C1) the vertical force applied as a design load to the tow-eye shall be:

$$\mathrm{Fv} = 1.1\mathrm{g}\,\mathrm{M_c} + 0.8\,\mathrm{g}\,\mathrm{MTM} \times \frac{\mathrm{H}}{\mathrm{L}} - 0.8\,\mathrm{g}\,\mathrm{M_c}\,\mathrm{H_3}/\mathrm{L} \text{………(Eq. 9)}$$

where

M_a	= the static vertical mass on the centre axle set
M_C	= the static vertical mass on the coupling
MTM	= the maximum towed mass of the laden trailer (= M_a + M_c)
0.8	= the tyre adhesion factor
H	= the height of the combined centre of mass of the tare and payload
	= ((H_1 × tare mass + H_3 x payload mass) / MTM)
H_1	= the height of the centre of gravity of the tare mass of the trailer
H_2	= the height of the centre of gravity of the payload mass that matches the height X_1 used in the SRT calculator for the MTM
H_3	= the height of the coupling centre
Drawbar	= the length of the drawbar for the certification and is the length from the front of the deck or body to the centre of the tow-eye

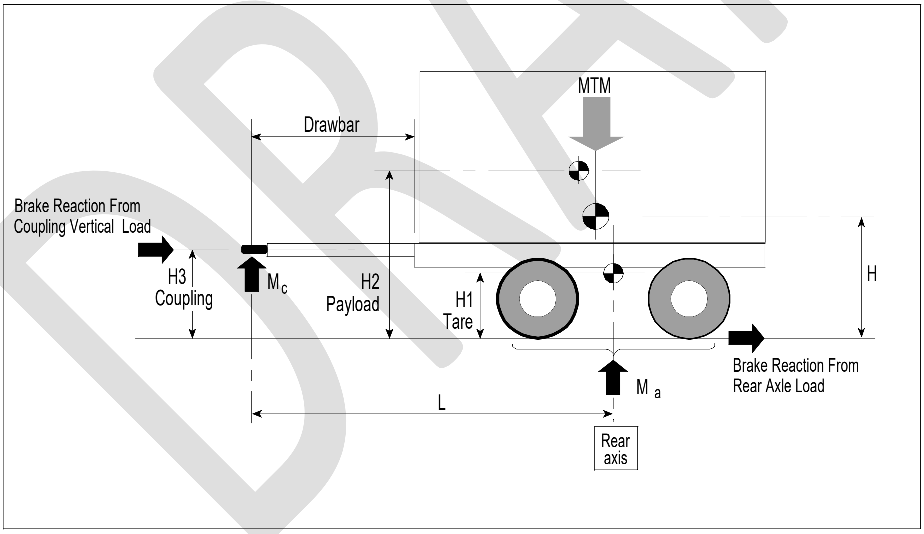

Figure C1 – Coupling forces for drawbeams with vertical loads

Note – See Appendix F notes for an explanation of changes.

C2 Drawbeams

For a drawbeam intended to tow trailers which may transfer any portion of the trailer weight or braking force vertically onto the towing vehicle, the vertical force applied as a design load shall be the greater value of:

F_v as calculated above, where known; otherwise:

$$F_V = 1.10\, g\, M_C + 0.35\, g\, MTM$$

Appendix D – Recertification

(Normative)

D1 Certifying engineer

The identity of the towing connection, and the details of its original certification, shall be established before it can be recertified.

Recertification of a towing connection should be carried out by the person, company, or agency responsible for the original design and certification. Where this is not practicable, the certifying engineer shall verify the design life in accordance with the requirements of this standard.

The certifying engineer shall establish, from records of the vehicle's road-use and in-service inspections, the remaining life based on the design life and spent life of the towing connection. The certifying engineer shall verify and shall establish the spent life from distance travelled records using one of the approved fatigue design standards.

The certifier shall undertake a thorough inspection of the towing connection and attachment to verify that the towing connection is in good condition, complies with this standard, and remains within 'safe tolerance', as defined in transport legislation.

The parameter recommended for equating loading cycles with distance travelled is one cycle per two kilometres. However, the operating conditions of the vehicle need to be taken into consideration.

Having verified the identity, existing certification, design, and remaining life of the towing connection, and that it remains within 'safe tolerance', the certifying engineer shall determine a new expiry date for the towing connection. This shall not be more than 20 years after the original certification unless it can be shown that the original design life has not been exceeded.

Appendix E – Side force on drawbars without turntable locks

(Normative)

E1 F_S side force to be applied to a drawbar

A tandem axle set and a tri-axle set are shown in Figure E1. The side force to be applied to a drawbar (see (4.1(c)) shall be determined by the following formula using the parameters shown for the applicable axle set:

For a single axle set: ……………………….(Eq. 10)

$$F_s = \frac{0.6 g \mu M_a}{2L} T$$

For a tandem axle set: $$F_s = \frac{0.6 g \mu M_a}{2L} \sqrt{D^2 + T^2}$$ …………. …….(Eq. 11)

For a tri-axle set: $$F_s = \frac{0.6 g \mu M_a \left(\left(2\sqrt{D^2 + T^2} \right) + T \right)}{6L}$$ …….. …….(Eq. 12)

Where

F_s	=	side force
G	=	the acceleration due to gravity
μ	=	coefficient of friction between tyres and road surface (for the purpose of this appendix, μ shall be taken as 1.0)
D	=	axle spacing
0.6	=	constant
M_a	=	mass on axle group under consideration
L	=	distance of the tow-eye from the turntable centre
T	=	mean track

NOTE –

(1) For a single axle bogie, D = 0.

(2) 0.6 = constant. This is to adjust from permanent deformation used in the 1987 standard to now comply with design stress in Appendix A.

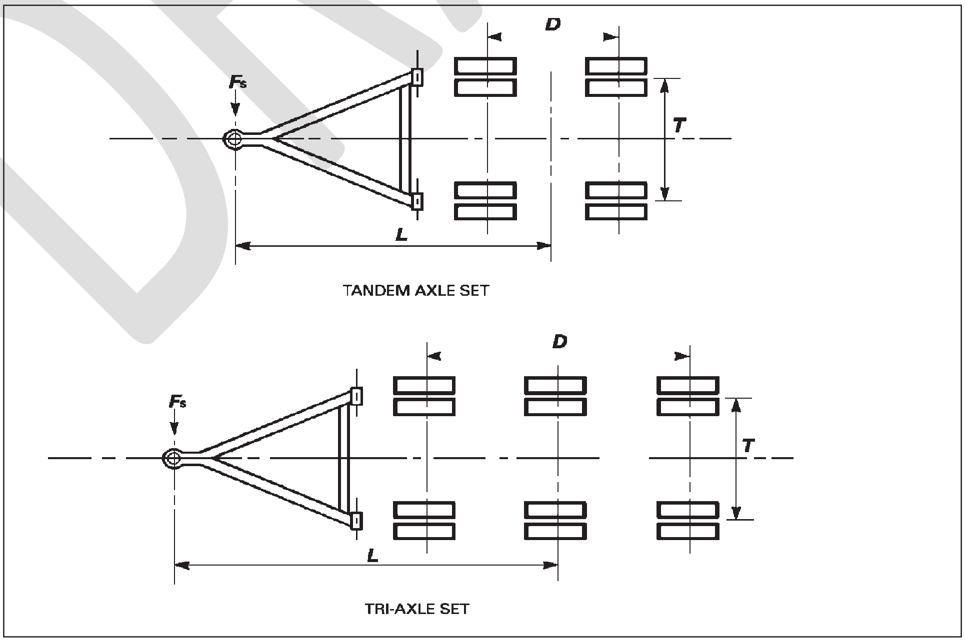

Figure E1 – Tandem axle set and tri-axle set

APPENDIX F – Explanatory notes on the 2007 and 2023 revisions of the standard

(Informative)

F1 Explanatory notes on the 2007 revision

F1.1 Establishing fatigue design requirements

To assist in establishing the fatigue design requirements, tape-recordings of drawbar forces were analysed by computer using the 'range mean pair' method. This counts the signal 'turning points' (maxima and minima), from which load histograms can be produced. A value of 20 occurrences per hour has been used to show the load or force levels likely to accrue over two million cycles in the expected lifetime of the drawbar. In many cases, the peak compressive loads exceeded the tensile load, but this was not exclusively so.

F1.2 Longitudinal drawbar forces on empty trailers

The longitudinal drawbar forces on empty trailers, while being less than those on the same trailer fully laden, were a considerably higher proportion of the empty trailer weight. This appears to come from the comparatively stiff suspension when empty. The concern is that, for example, a mismatched suspension on a fully laden trailer could result in loads higher than allowed for under the standard. Care should be taken to ensure that the components, the towing vehicle, and the trailer are suitable for their intended use.

F1.3 Transverse loads

The transverse loads that were recorded during normal driving were invariably low, while those during manoeuvring were generally a maximum of 10% to 12% of the gross trailer weight. The one exception occurred when the trailer was deliberately jack-knifed while tipping metal and the drawbar eye was bent.

F1.4 Maximum towed mass

The maximum towed mass is to be used in Table 1. Partial and empty running conditions were included in the data analysis, and therefore have been factored into the fatigue force range.

F2 Explanatory notes on the 2023 revision

F2.1 Updated formulas and diagram

The formulas and diagram in Appendix C have been updated to:

(a) Clarify the centre of gravity height;

(b) Reflect the practical tyre adhesion possible with current tyre–tarmac conditions (0.8) as per TRL Report 237 (Robinson, 1997);

(c) Recognise that the original formula was simplified by the original standard and does not allow the sum of horizontal loads to be zero to account for the difference of the inertia applied to the full MTM, but the brake reaction force at the ground is lower due to M_a being lower than the MTM;

(d) Recognise that the original standard included an arbitrary factor of 1.25 F_v to account for dynamic loadings at a time when the trailers were all built with mechanical suspension systems. With the common adoption of air suspension systems in the current fleet of simple trailers, this has been reduced to
1.1 F_v.