AS 7524:2018

Coupler and draw gear

Rolling Stock Standard

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RISSB wishes to acknowledge the positive contribution of subject matter experts in the development of this Standard. Their efforts ranged from membership of the Development Group through to individuals providing comment on a draft of the Standard during the open review.

I commend this Standard to the Australasian rail industry as it represents industry good practice and has been developed through a rigorous process.

Paul Daly
Chief Executive Officer
Rail Industry Safety and Standards Board

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Contents

Appendix Contents

1 Introduction

1.1 Purpose

This document describes requirements for coupler and drawgear used on rolling stock operating on Australian railways.

The main purpose of the requirements is to control hazards associated with train separation and to ensure operational compatibility in the coupling of rolling stock.

1.2 Scope

This document applies to new, modified and existing rolling stock.

This document covers automatic knuckle couplers, multi-function couplers, draw bars, articulated connectors and associated equipment such as draft gear and draft gear yokes.

Operation of rolling stock in regard to network safe working rules and route standards is not covered.

Rolling stock used on light rail, cane railway and monorail networks are not covered

1.3 Compliance

There are two types of control contained within Australian Standards developed by RISSB:

(a) Requirements.

(b) Recommendations.

Requirements – it is mandatory to follow all requirements to claim full compliance with the Standard.

Requirements are identified within the text by the term ‘shall’.

Recommendations – do not mention or exclude other possibilities but do offer the one that is preferred.

Recommendations are identified within the text by the term ‘should’.

Recommendations recognise that there could be limitations to the universal application of the control, i.e. the identified control cannot be able to be applied or other controls can be appropriate / better.

For compliance purposes, where a recommended control is not applied as written in the standard it could be incumbent on the adopter of the standard to demonstrate their actual method of controlling the risk as part of their WHS or Rail Safety National Law obligations. Similarly, it could also be incumbent on an adopter of the standard to demonstrate their method of controlling the risk to contracting entities, or interfacing organisations where the risk may be shared.

Controls in RISSB standards address known railway hazards as included in an appendix.

1.4 Referenced documents

1.4.1 Normative references

The following referenced documents are indispensable for the application of this Standard:

(a) AS 1444 Wrought alloy steels - Standard, hardenability (H) series and hardened and tempered to designated mechanical properties.

(b) AS 1544.2 Methods for impact tests on metals - Part 2: Charpy V-notch

(c) AS 2074 Cast steels.

(d) AS 7509 Dynamic behaviour.

(e) AS 7520 Body structural requirements.

(f) AAR Manual of Standards and Recommended Practices Section B, Section S and Section S Part III.

(g) Australian Design Rule 62/02 Mechanical connections between vehicles

1.4.2 Informative references

The following referenced documents are used by this Standard for information only:

(a) AS 4292 Railway safety management.

(b) AS 7501 Rolling stock certifications.

(c) AS 7504 Brake Blocks.

(d) AS 7521 Interior Crashworthiness

(e) EU Technical Specification for Interoperability of Trans-European High-Speed Rolling Stock, 2008.

(f) Field Manual of the AAR Interchange Rules.

1.5 Definitions

AAR: Association of American Railroads.

AAR Automatic Coupler: An automatic (knuckle) coupler based on the technical requirements of the AAR Manual of Standards and Recommended Practices section S3.

AAR E type or Horizontal Key Butt: A coupler butt for use with a standard horizontal connecting key and an AAR Y44AE Follower. This design is a flat buff face with a flat follower. The coupler fits to a standard Y40 or Y41 Yoke. Yoke standards: AAR Manual of Standards and Recommended Practices Section S3: S-141, S-142

Adaptor Coupling: A coupling that enables railway rolling stock with dissimilar coupling systems to be coupled together. Also known as a transition or emergency coupling.

Alignment Control: features on the end of the coupler that aid the alignment of coupler heads when on tangent track. Alignment control prevents the need for manual handling of couplers during train shunting on tangent track. Alignment control features also aid in raising train buff force required in jack knifing derailment.

Alignment Control Quad Shear: A locomotive coupler butt with twin pin lugs to meet a yoke with three pin lugs as shown in B3. This design uses a vertical pin loaded in shear at four points. The design loads the pin in both draw and buff. Alignment lugs on the side contact with sprung plungers in the yoke.

ANZR Butt: Australian New Zealand Railway coupler butt as shown in B1. This design is a vertical pin and cylindrical buff face with alignment lugs. The design uses a standard Y47 Vertical connecting pin and an ANZR Follower shown in B2. The coupler fits to a standard Y45AE Yoke. The Pin bore is usually bushed for wear.

ANZR Spherical Butt: Australia coupler butt for use with a standard Y47 Vertical connecting pin and an AAR Y46AE Follower. This design is a vertical pin and spherical buff face with alignment lugs. The coupler fits to a standard Y45AE Yoke.

ANZR Draft Gear Follower: A draft gear follower used with the ANZR cylindrical butt - see Figure B2.

Articulated Connector: Connects two adjacent rolling stock bodies allowing them to angle with respect to each other and the whole assembly is supported by a single bogie.

Automatic Coupler: A coupler that engages with a compatible coupler on adjacent rolling stock by the action of propelling the rolling stock together. Also known as auto coupler.

Automatic Knuckle Coupler: An automatic coupler based generally on the technical requirements of the AAR Manual of Standards and Recommended Practices.

Back-Up Coupling Device: A secondary device for preventing the separation in traffic of two coupled vehicles, which is in addition to the normal coupling system.

Buffer: A device used on the ends of vehicles to maintain vehicle separation in compression when couplings used are not capable of this. Typically, is sprung to absorb compressive shocks.

Buffer Lock: Entanglement of the buffers of adjacent rolling stock whilst traversing curves.

Butt: The draft gear end of an automatic knuckle coupler. Typical forms are the square butt (AAR Type E), spherical butt (AAR Type F) and the ANZR butt and quad sheer butt.

Cane Railway Network: A railway system dedicated to hauling harvested sugar cane from farms to a raw sugar factory, typically 610mm gauge.

CEMS: Crash Energy Management System. A system integrated into a vehicle body design for controlling the energy absorbed, deceleration and structural deformation during crashes, in particular collisions.

Chopper Coupling: A coupling system between rolling stock which consists of a central buffer with a mechanical hook that drops into a slot in the central buffer.

Continuous Drawgear: A drawgear arrangement where the non-coupling ends of the drawhooks at each end of a vehicle are directly connected to each other by one or more lengths of bar (often known as "middle bars"). Typically used only on heritage rolling stock.

Coupler Angling: The yaw angling that can occur between coupled couplers as a result of the coupler contours clearances.

Coupler Carrier: The underside structure on the striker supporting the vertical position and pitch angle of the coupler.

Coupler Contour: The coupler contour is the front profile of the coupler that allows couplers to connect. Standard contours such as the AAR 10A (AAR S-106, see figure c-1), F type (AAR S-117 figure C-2) and the 10A SR (figure C-3) work interchangeably. Other coupler contours such as the Willison couplers used in sugar cane railways do not connect.

Coupler Head: The front end of the coupler that contains the coupler mechanisms for locking and uncoupling. Component parts in the coupler head include knuckles, locks, lifters, kickers, throwers, and rotors. Multiple coupler head designs exist with the component parts being non-interchangeable for differing coupler head designs. Coupler head designs change with coupler profile, coupler load capacity, interlocking heads, slack control.

Coupler Height: The height measured from top of rail to the centre of the knuckle of an automatic coupler or to the horizontal centre line of the shank of a drawbar or other coupler type.

Coupler slack: The free longitudinal slack in coupler or drawbar connections. Most coupler slack occurs at the coupler contour with additional slack at the pin connection between pin draw engagement and buff engagement of pin or follower.

Coupler Swing: The vehicle dynamic requirements covered in AS7509 section 5.3 vehicle to vehicle clearance. The yaw angle or lateral reach required by the couplers between adjacent vehicles to safely negotiate curves and switches.

Dangerous Goods: Goods that are defined as dangerous in the Australian Dangerous Goods Code.

Draft Gear: Components which provide resilience in the connection of the coupling system to the structure of the rolling stock.

Draft Gear Follower: A steel block interposed between the butt end of an automatic knuckle coupler shank and the front working end of the draft gear that transmits compressive forces between the draft gear and vehicle body in draft and between the coupler and draft gear in buff. In some designs the butt of the coupler does not contact the follower directly in buff and the force is transmitted through the yoke pin and front member of the yoke.

Draft Gear Yoke: The component of automatic knuckle coupler-based drawgear connected to the coupler within which the draft gear resides. The purpose of the draft gear yoke is to support the draft gear and to transmit longitudinal draft and buff forces from the coupler to the draft gear pocket (via the draft gear and follower).

Drawbar: A rigid connection between two items of rolling stock. In most common rolling stock drawbar configurations, the connection is not intended to be separated in normal operation. Also known as semi-permanent or bar coupling.

Drawgear: A set of fittings used to connect railway rolling stock for the purpose of transmitting longitudinal forces between adjacent rolling stock; connection can be made manually or automatically.

Draw Hook and Screw Coupling: A coupling system between rolling stock which can accept only draft loads and relies on headstock buffers and / or beams to accept buffing loads.

F Type Coupler Butt: A coupler butt consistent with AAR Manual of Standards and Recommended Practices Section S3: S-110. Having an elongated cylindrical hole allowing coupler pitching to yoke pin of 7 degrees up and down.

Heavy Haul Trains: Trains of large mass and tractive effort where fatigue dominates wear in causing drawgear component replacement. The Recommended definition is trains over 15000 tons trains with over 1.8 MN tractive effort, trains with more than 1.2 MN of tractive effort in one location. Trains indexed with greater than 800 KN indexer force.

Interlocking Coupling Head: A coupling head arrangement that locks into the mating head and restrains their movement in all three directions; Generally made to the F type coupler contour of the AAR Manual of Standards and Recommended Practices Section S3, S-117.

Interlocking shelf: A feature with a horizontal ledge cast into the underside (bottom or single shelf) or top and underside (top and bottom, or double shelf) of automatic knuckle coupling heads to prevent vertical disengagement of mating couplers.

Jack Knifing: A derailment mode occurring in tangent track due to high in train buff forces and lateral instability of the coupler or drawbar.

Locomotive Rolling Stock: Self-propelled, non-passenger-carrying railway vehicles used for hauling other (typically freight or passenger) rolling stock.

Locomotive Butt: Only Used in light service. The Locomotive butt uses a vertical pin loaded in shear at two points. The design loads the pin in both draw and buff.

Modified F type contour: A coupler profile matching AAR F type profile S-117 but not including interlocking head features of the S-117 profile.

Modified Rolling Stock: Rolling stock where a change has been implemented that affects its compliance with the requirements in this standard.

Multi-Function Coupler: An automatic coupler which makes all connections between the rolling stock (mechanical, pneumatic and electrical) without human intervention, in contrast to automatic knuckle couplers which provide only the mechanical connection.

Multiple Unit Rolling Stock: A self-propelled set of vehicles, typically coupled internally by drawbar, formed as a train unit and able to couple with other similar units and be driven from one cab.

Offset Coupler: An automatic coupler where there is a vertical height difference between the centreline of the coupling head and the centreline of the coupler shank.

Open Access Network: A railway network where freight and passenger operators other than the network owner are able to operate.

Pin Carrier: A carrier plate under the draft pocket that supports the yoke and retains the connecting pin. The pin carrier can include lateral guidance for the yoke.

Quad Shear: A coupler butt with twin pin lugs to meet a yoke with three pin lugs. This design uses a vertical pin loaded in shear at four points. The design loads the pin in both draw and buff. A quad shear coupler butt has no alignment control features.

Rail Tank Cars: Freight rolling stock designed to carry bulk liquids or compressed gas.

REPOS: Road Environment Probability of Occurrence Spectrum, is a load spectrum for use in fatigue calculations. Available coupler force spectrum such as in AAR M-1001 is for longitudinal forces only and may need a dynamic factor for the pitching sway and vertical loads experienced on drawgear component in service.

Rotary Butt: A coupler butt for use with a vertical pin fitted to a collar. The collar fits a matching yoke. The Coupler pin hole can be either elongated like an F type coupler butt suiting interlocking coupler heads. Else the coupler pin hole can be cylindrical for a non-interlocking coupler. The coupler butt face is spherical with no alignment control. Multiple designs exist with some fitting the Y47AE follower and others with specific designs.

Rotary Collar: A component used with rotary couplers on tippler wagons. The collar fits around the coupler pin hole and within the rotary yoke permitting the wagon to tip over whilst still coupled in a train around centre line of the coupler height.

Rotary Coupler: An automatic knuckle coupler with a butt that can rotate inside the yoke. Is used on freight rolling stock, carrying bulk product, that is emptied by rotary dump unloading.

Rotary Yoke: Drawgear yokes designed for rotary couplers on tippler wagons. The yoke fits a yoke collar that pins to the coupler.

Road-Rail Vehicle: A vehicle that can travel on a road and can also travel on rail by use of a rail wheel guidance system.

Safety Plate: A third carrier plate used in AAR Standard draft pockets, ie S-243, S-244, S-245, S-247. The safety plate is used between the pin carrier and an end mounted Yoke Carrier.

Slack Control: Features on the coupler head that eliminate free slack from the coupler contour. These features have been added to 10A coupler contour that normally has 7/8 inch 22.2 mm of free slack. Typically, the features include a head mounted sprung plunger and sprung knuckle front face.

Sprung coupler Carrier: coupler carriers for use with interlocking couplers are sprung to give correct alignment of the coupler when uncoupled and allow sufficient inter vehicle vertical movement when coupled.

Standard Coupling Head: The coupling head fitted to the basic form of the automatic knuckle coupler (AAR Types E and F or equivalent coupler with a compatible coupler contour).

Striker: a casting or fabrication on rollingstock head stock that contains the coupler. The striker restricts coupler angling and coupler movement in the case of failed or broken draft gear.

Striker Clearance: The longitudinal distance between the coupler head and the rolling stock striker.

Train Dynamic Derailments: Derailment modes occurring on curves due to high accelerations on individual vehicles. Two modes occur, vehicle pitching and bogie pitching.

Track Machine: A flange wheeled vehicle used for infrastructure maintenance, construction and inspections. Separate to freight rolling stock (e.g. wagons used for carrying rail, sleepers, spoil, ballast etc) and Road-Rail Vehicles.

US-Type Locomotive Draft Gear: An all-rubber design of draft gear which has a shorter travel and uses a shorter draft gear pocket length (compared with freight rolling stock draft gear), as commonly fitted to North American locomotives. (Appendix A.18)

Vertical coupling instability: A derailment mode occurring in curved track due to high in train buff forces and pitching instability of the coupler or drawbar.

Vertical Key Butt: A coupler butt for use with a vertical connecting key and an AAR Y44AE Follower. Existing designs have insufficient key cross section for heavy service. This design is a flat buff face on the coupler with a flat follower in buff loading. The coupler fits a special matching key design Yoke.

Yoke Carrier: A carrier plate under the draft pocket that supports the yoke. The yoke carrier can include lateral guidance for the yoke. The yoke carrier can be positioned at the end of the yoke for pitch support or in the middle for easier coupler maintenance.

Yoke Pin: A pin connecting the coupler to the draft gear yoke.

2 Draw gear equipment and types

2.1 Automatic knuckle couplers

Automatic knuckle couplers on adjacent compatible rolling stock should automatically couple when the rolling stock are propelled together.

Modern locomotives have generally been fitted with automatic knuckle couplers in accordance with Figure A.18 in Appendix A and incorporating the following features or variations-

(a) no shelf or a bottom shelf;

(b) vertical yoke pin;

(c) top operation or bottom operation.

Passenger and freight rolling stock in Australia using automatic knuckle couplers have several variations, including:

(a) standard coupling head with no shelf, with single bottom shelf, or with top and bottom shelves; (see Appendix A.16 showing bottom shelf)

(b) interlocking coupling head (see Appendix A.2);

(c) different shank designs incorporating either a vertical yoke pin or a horizontal draft key (see Appendix A.3);

(d) Rotary couplers (see Appendix A.15).

On automatic knuckle couplers using a horizontal draft key, the integrity of the retainer pin assembly that is used to secure the draft key is critical to avoid separation of the coupler from the rolling stock in traffic. Refer to figure A3 in appendix A.

Automatic knuckle couplers with bushed holes for the yoke pin have been a general standard for Australian railways, couplers with unbushed holes are acceptable alternatives.

Refer to A16 in appendix A for draft gear parts.

2.2 Couplers contours

Standard couplers heads use a coupler contour compatible to coupling with the AAR 10A contour, S-106, (Appendix C.1). Coupler contours used in Australia include:

(a) 10A Profile (Appendix C.1)

(b) 10A Slack Reduced Profile (Appendix C.3)

(c) F Type Contour (Appendix C.2)

(d) the Modified F Type Contour

(e) the No. 5 contour

No 5-coupler contour is found on historical rollingstock.

The No 5 contour when connected to 10A compatible contours is pre-disposed to triggering lateral instability and jack knifing between vehicles under buff loads.

Coupler contour slack for the entire train needs to be minimised to prevent train dynamic derailments of wagon pitch or bogie pitch.

2.3 Chopper couplings

A general arrangement for chopper couplings is contained in Figure A.6 in Appendix A.

Chopper couplings should be of the single or double hook type. (Appendix A.6).

Chopper couplings are fitted only to heritage rolling stock but are still in use in parts of freight in New Zealand.

2.4 Draft Gear and draft gear yokes

Locomotives in Australia with automatic knuckle couplers have generally been fitted with draft gear yokes of the vertical yoke pin design.

The most common yoke in Australian and New Zealand rollingstock is an AAR Y45AE or forged equivalent yoke. AAR Manual of Standards and Recommended Practices Section S3: S-149.

Y45AE design yokes are used commonly with bushes in Australia. The use of bushed Y45AE yokes in heavy haul should be risk assessed by the operator to determine suitability.

2.5 Draw hooks and screw couplings

A draw hook and screw coupling system comprise a hook at the end of rollingstock and uses a screw adjustable link to join the draw hooks on adjacent rolling stock (see Figure A.5 in Appendix A).

In Australia, draw hooks and screw couplings are usually fitted only to heritage rolling stock.

For the draw hook coupling system, an alternative to the screw adjustable link is the three-link arrangement as well as other alternatives.

The arrangement of headstock buffers or beams shall avoid buffer lock between adjacent rolling stock whilst traversing curves.

2.6 Multi-function couplers

Multi-function couplers on adjacent rolling stock should automatically couple mechanically and pneumatically when compatible rolling stock are propelled together.

Multi-function couplers shall not couple electrically, except with compatible rolling stock.

Multi-function couplers shall not uncouple under anticipated service conditions unless the uncoupling mechanism is manually actuated.

See Figure A.4 in Appendix A for an example of a multi-function coupler

In Australia, multi-function couplers are typically fitted to the terminal ends of modern self-propelled passenger rolling stock.

2.7 Other coupler types

Other types of couplers can be used on existing locomotives in place of those described above.

Existing passenger rolling stock are sometimes fitted with variations on the automatic knuckle coupler that have been developed for specific applications that require reduced strength or dimensional spacing.

There are also various other types of couplers that can be used on existing rolling stock in place of those described above.

2.8 Rigid draw bars

Rigid drawbars are typically used to connect freight rolling stock where uncoupling in service is not required and it is desired to reduce train longitudinal slack and wagon weight through the elimination of the gap in the coupling interface (see Appendix A.7).

Most Australian applications of rigid drawbars use draft gear to reduce peak in train longitudinal forces.

2.9 Slackless drawbars

Slackless drawbars are typically used to connect freight rolling stock where uncoupling in service is not required and it is desired to reduce train longitudinal slack and wagon weight through the elimination of draft gear and the gap in the coupling interface (see Figure A.14).

Energy absorption during shunting impacts and train dynamics needs to be considered when using slackless drawbars on freight rolling stock.

2.10 Articulated connectors

Articulated connectors are used to couple two freight rolling stock bodies which share a common bogie (see Appendix A.13).

3 Rollingstock not fitted with AAR automatic couplers

Infrastructure Maintenance rolling stock in Australia are often fitted with non-AAR automatic couplers, which can restrict coupling to rolling stock which is similarly fitted.

Road-rail vehicles often use heavy-road vehicle-based couplings such as the following:

(a) 50 mm ball coupling - see Figure A.10 in Appendix A.

(b) pintle hook coupling - see Figure A.11 in Appendix A.

(c) automatic pin coupling - see Figure A.12 in Appendix A.

These heavy-road vehicles-based couplings are readily fitted to road-rail vehicles and allow trailers to go on road as well as rail.

Lighter track machines can also use these heavy-road vehicles-based couplings due to their off-the-shelf availability and low cost.

Drawbars of various forms using plain pinned connections at each end are common on infrastructure maintenance rolling stock.

These pinned end drawbars provide a simple bespoke connection between rail vehicles.

10A contour couplers of various forms, or adaptor couplings, are sometimes fitted/carried on track machines to allow them to be hauled by a locomotive.

4 Design

4.1 Automatic knuckle couplers

Rollingstock shall have automatic knuckle couplers fitted at both ends of the rollingstock.

Automatic knuckle couplers on new and modified and existing rollingstock shall have coupling contour compatible to the AAR, S-106 10A contour.

Acceptable Automatic knuckle coupler contours shall include: S-106 10A contour; S-117 F type coupler contour; 10A SR profile appendix C-3; Modified F-type contours.

The No 5 contour shall not be used in new or modified rollingstock.

No 5-coupler contour can only be used on historical rollingstock in trains under 500 tonnes.

Automatic knuckle couplers on new or modified rolling stock should have alignment control features. Rotary couplers are not required to have alignment control but should couple with fixed couplers that have alignment control features.

Automatic knuckle couplers on new or modified rolling stock should have a bottom interlocking shelf. Interlocking shelves prevent vertical movements between couplers leading to train separation.

Automatic knuckle couplers on new, modified and existing rolling stock shall have a 279 mm (11-inch) knuckle face. And interlocking bottom shelves shall not allow more than 140 mm of vertical offset between couplers.

Automatic knuckle coupler bottom shelfs should allow 102 mm of vertical offset between couplers. Vehicles with set height suspensions (air bag suspension) can have more restricted bottom shelf heights.

Passenger Rollingstock using automatic knuckle couplers should include slack control coupler heads. Train dynamic changes in longitudinal acceleration need to be minimised for passenger comfort.

Automatic knuckle coupler shall use a coupler head length of 254 or 304 mm. Coupler heads of 254 mm interchanged with 304 mm couplers shall be modified to match striker clearance and coupler line distance.

Interchange of 304 mm coupler heads for 254 mm coupler heads can require re-classification of the vehicle for the increased vehicle coupling line distance.

Automatic knuckle coupler shall use a coupler shank length to provide the correct striker to coupler head clearance for the operating draw gear. The striker clearance should be between the full travel of the draw gear and 13 mm greater than the drawgear full travel.

4.2 Interlocking Coupler Heads

Couplers with an interlocking coupler head shall use an AAR F type contour S-117.

Interlocking head couplers shall use an AAR F type butt or rotary F type butt allowing 7 degrees of coupler pitch angling.

The coupler length of interlocking head couplers shall be sufficient length to reach vertically between vehicles.

Interlocking head couplers shall be used with sprung coupler carriers. The design should be similar to AAR S-236 or S-238.

4.3 Dangerous good rolling stock couplers

Automatic Knuckle couplers on new or modified rail tank cars and dangerous goods cars shall have double interlock shelves to ensure vertical interlocking when coupled to older couplers with no interlock shelf.

Existing rail tank cars and dangerous good cars shall be fitted with double interlocking shelves when they are replaced or reach the wear limits.

4.4 Design for Derailments

All coupler designs shall be assessed for horizontal curve negotiation under AS 7509 section 5. Mitigation of the AS 7509 section 5 requirements can include coupler shank length.

All coupler designs should be assessed for lateral evaluation under AS 7509 section 10.

F type coupler butts and pin bores when fitted to a coupler or drawbar shall be assessed for vertical coupling instability under AS 7509 section 10.

Jack knife derailment risk shall be assessed for:

(a) couplers without alignment control via direct contact to a follower in buff to stabilize yaw movement. Specifically, locomotive butts, quad shear butts and quad shear alignment control butts: with coupler shank length and vehicle lateral suspension travel limits:

(b) total dynamic braking effort.

Coupler contour slack length shall be reduced for long train operations.

Trains with long total train coupler contour slack should be inspected after any emergency braking event for train dynamic derailments.

4.5 Offset couplers

Offset Automatic Knuckle Couplers shall be limited to a maximum of 40 mm.

Offset couplers heads cause increase pitching moments on drawgear. As a result, offset couplers increase fatigue on all drawgear components including adjacent rollingstock drawgear.

Offset couplers should not be used in Heavy Haul trains.

4.6 Coupler heights

Static coupler heights on rolling stock should not exceed the applicable range within the RIM interface standard. Appendix D gives an example of coupler height limits in service.

Coupler height must be met in all conditions from Wagon Tare Mass to solid spring condition and maximum to minimum wheel diameters.

4.7 Coupler operation

Automatic knuckle couplers shall meet the requirements of AAR M-211 section 7.1.

(a) The coupler knuckle shall rotate open by hand when unlocked.

(b) The coupler knuckle shall close and lock by hand.

(c) The Lock shall sit in a lock set position to allow uncoupling.

(d) The coupler shall provide anti creep protection to prevent accidental uncoupling.

Tippler vehicle couplers should require additional anti creep features.

5 Coupler strengths

Automatic Knuckle couplers can be made to meet general freight duty strength requirements or light duty / passenger duty strength requirements.

Heavy haul train operations should consider higher strength requirements to reduce fatigue. Where a heavy haul trains is over 15 000 tonnes or greater than 1.8 MN of total tractive effort or with greater than 1.2 MN of tractive effort in single train section or trains with indexation forces greater than 800 kN.

Light duty / passenger train operations shall be trains that are under 1000 tonnes; with less than 600 kN of tractive effort and not subject to indexer forces. Light duty vehicles can use passenger strength automatic knuckle couplers.

Coupler strengths shall be as specified in table 2. Vertical strengths are for a vertical load applied at the pulling line of drawbar mid-point and supported to the coupler carrier or striker or at the pin carrier as applicable to the draw gear design.

Connection Type	Knuckle Tension Yield	Knuckle Tension UTS	Coupler Tension Yield	Coupler Tension UTS	Coupler compression yield	Vertical yield
Multi-function coupler	n/a	n/a	800 kN	n/a	1500 kN	100 kN
Passenger drawbars			1500 kN		1500 kN	100 kN
Passenger auto-knuckle couplers	1500 kN	1880 kN	2200 kN	3000 kN	3000 kN	150 kN
Freight auto-knuckle couplers	1780 kN (2100)	2700 kN	3100 kN	4000 kN	4500 kN	220 kN
Freight drawbars	n/a	n/a		n/a		

Table 2- Coupler strengths

The strength of the shank transition in offset couplers shall exceed the overall strength of the coupler.

5.1 Testing

Testing should be in accordance with AAR M-211.

5.2 Fatigue

Fatigue assessment of drawgear when performed should:

(a) Be based on measured REPOS data that includes longitudinal and pitching load effects experienced by the relevant drawgear component

(b) Else be based on longitudinal REPOS plus 130% dynamic factor for pitching loads

(c) The REPOS spectrum shall cover all positions in the train

i. Note distributed power trains experience a peak REPOS at 1/3 of the train length

ii. Note indexer train REPOS maximums can occur as far as 2/3 of the train length

(d) Be based on surface finish relevant material data

(e) Be based on service performance in other train operations.

If REPOS data is not available the fatigue assessment should, as a minimum, be based on load spectra as per AAR Specification M-1001 in the Manual of Standards and Recommended Practices, Section C, Part II, Chapter 7.

Fatigue assessment of offset couplers should assume the worst location for longitudinal force alignment between the head centre line or the shank centreline.

Offset coupler fatigue shall assess buff load cycles.

An offset coupler fatigue design shall insure fatigue is more likely to occur in the coupler head than at the coupler shank transition.

New coupler shank offset designs for transition coupler shall be assessed for fatigue risk.

5.3 Back up coupling device

A back-up coupling device shall be provided between passenger rolling stock that do not have a brake that automatically applies if the rolling stock part in traffic.

The back-up coupling device (where required) shall have equivalent strength to that of the main coupling but with the exception that the backup coupling device need not withstand compressive forces.

A chain or wire rope sling is typically used as the back-up coupling device.

6 Draft gear, yoke, follower and pin

Draft gear for new and modified locomotives with automatic knuckle couplers should be either:

(a) locomotive specific draft gear, or

(b) comply with AAR Specifications M-901E or M-901G.

The draft gear yoke, follower and pin for new and modified rolling stock with automatic knuckle couplers should comply with the recommendations of the draft gear manufacturer.

Refer to Figure B2 in Appendix B for the draft gear follower to be used with the ANZR cylindrical butt on automatic knuckle couplers.

Draft gear for new and modified rolling stock fitted with automatic knuckle couplers should comply with AAR specifications M-901E or M-901G.

Second-hand or reconditioned draft gear for freight rolling stock fitted with automatic knuckle couplers should comply with AAR Standard M-901B.

Many non-AAR automatic coupler draw gear on infrastructure maintenance rolling stock have no draft gear due to the small number of vehicles typically being coupled together.

The draft gear yoke, follower and pin for new and modified infrastructure maintenance rolling stock fitted with AAR automatic couplers should comply with the recommendations of the draft gear manufacturer.

6.1 Yokes

Yokes strap rear radius shall be manufactured to AAR Standard S-139.

Freight vehicle yokes shall have a permanent set and ultimate load requirement matching AAR M-205 section 4. Permanent set shall be a minimum 3.33 MN and ultimate strength shall be a minimum of 4 MN.

New or modified freight rollingstock couplers should be fitted with AAR standard yoke S-149.

Drawbar connections may be fitted with a short yoke suited to shorten draft pack with reduced draft pack travel. Shorten yokes should be made with similar geometry as the S-149 Yoke.

New or modified locomotive couplers should use a B3 yoke design.

Standard coupler connecting pins should be to AAR S-116, 88.9 mm dia and 304 mm long. The RSO and the manufacture shall consult for correct pin measurements.

Coupler connecting pins should exceed the coupler tension ultimate strength. Coupler connecting pins loaded in compression and buff should exceed 115% of the coupler compressive yield requirements

Connecting Pins of inadequate strength shall be inspected at regular intervals set by the RSO and manufacture.

Enclosed yokes for a 625 mm draft pocket shall be 635 mm long (25 inches) as per AAR S-143.

Double shear bushed yokes should not be used in heavy haul trains.

6.2 Draft gear pockets

The Standard pocket for new and modified vehicles shall be 625.5 x 327 x 316.5 mm, as per any of the AAR S-243 to S-247. Refer to A17 in appendix A for draft gear pocket size diagram. Tolerances shall be as per AAR Specification S-254 in the Manual of Standards and Recommended Practices, Section C.

The draft gear striker shall permit the full coupler yaw angling in the neutral position.

The striker clearance to the coupler head shall be a minimum of 3 ¾ inches 95 mm for a standard draft gear AAR M-901 or similar with operation load deflection of 3 ¼ inches 82 mm, as per any of the AAR S-243 to S-247.

Vehicles with an interlocking head coupler shall use a sprung carrier as per AAR S-246 and S-247.

The standard draft pocket front stops shall be 222 mm apart, as per any of the AAR S-243 to S-247. Refer to A.17 in appendix A.

The standard draft pocket rear stops shall be 175 mm apart, as per any of the AAR S-243 to S-247. Refer to A.17 in appendix A.

The standard draft pocket should have a pin carrier, yoke carrier and a coupler carrier on the striker. Refer to A.17 in appendix A.

The standard draft pocket shall have two points of contact on the roof. One contact over pin, and second at the yoke rear restricting yoke pitching in the draft pocket. Refer to A.17 in appendix A.

The standard short draft pocket shall have front stops, rear stops, and side wall spacings as wells heights the same as the Standard draft pocket. The distance between front and rear stops shall be 236 mm. Refer to A.19 in appendix A.

Draft pocket tolerances shall be to AAR Standard S-254

Guiding yoke carriers shall not contact the draft gear at any point. For a standard AAR yoke the yoke strap guide faces shall be a minimum of 150 mm. For other yokes the strap guides shall give a 2 mm minimum clearance on both sides of the Yoke strap.

Yoke carriers for any applicable yokes shall not restrict the draft gear travel for the full travel in buff and draw plus additional travel of 6 mm in each direction to allow for wear in the draft pocket.

Guiding Pin carriers shall for a standard AAR yokes or shorten yokes shall have guide faces at a minimum of 222 mm. For other yokes the pin carrier guides shall give 2.5 mm minimum clearance on both sides of the Yoke strap.

New rollingstock standard draft pocket shall use replaceable hardened steel wear plates on the front and rear stops. Refer to A17 in appendix A. The front replaceable wear plates shall be at least 300mm in length.

New rollingstock standard draft pocket should use replaceable wear plates on all carrier’s roof contacts and side walls adjacent the follower and draft gear end. Refer to A17 in appendix A.

6.3 Rigid drawbars

The dimensions of the ends and shank of rigid drawbars on new and modified freight rolling stock fitted with draft gear yokes and draft gear should comply with the dimensions of an AAR Type 'F' coupler to Standards S-110 or S-112 with spherical butt ends.

6.4 Road-rail vehicle couplings

Couplings on new road-rail vehicles used for road operation only, or road and rail operation, shall comply with ADR 62/02.

6.5 Slackless drawbars

The design of the end assembly of a slackless drawbar on new and modified freight rolling stock should self-adjust for wear of components.

The design of slackless drawbars on new and modified freight rolling stock shall ensure that the drawbar does not bind during curving to permit compliance with AS 7509.

6.6 Articulated connectors

The assembly of an articulated connector on new and modified freight rolling stock should self-adjust for wear of components.

The minimum capacity for angular rotation of an articulated connector on new and modified freight rolling stock when installed shall be:

(a) Vertical plane (concave and convex): ±6°.

(b) Horizontal plane: ±17°.

(c) Roll: ±5°.

Articulated connectors strength shall comply with AS7520 Body Structural Requirements.

6.7 Draw gear design for operation

All draw gear in use shall not require persons to be between vehicles whilst the vehicles are unsecured, or are moving, except for where one of the vehicles is under 5 tonnes gross mass where a comprehensive risk assessment has produced a process that prevents uncontrolled movements of the coupling vehicles and does not permit persons to be in positions where surfaces close to under 0.5 m separation when coupling or coupled.

Any special limitations and the rated load capacity should be marked on drawbars and on or near non-AAR automatic couplers used for rail operations

7 Manufacturing standard

Material for new automatic knuckle couplers and new draft gear followers should be cast steel to one of the following:

(a) AAR Specification M-201 Grade E.

(b) AS 2074 Grade L6B-2 with the Charpy impact test at up to -40 degrees C to AS 1544, 3 tests required, average energy 27 J minimum, and no individual test less than 20 J.

(c) Manufacturers higher strength grades based on AAR M-201 Grade E with increased requirements for Yield and UTS tensile tests and impacts Charpy energies of 27 J minimum at -40 degrees C

New drawbars should either be cast steel as specified for couplers, forged steel as specified in forged yokes or fabricated hot rolled steel.

Material properties and test requirements for new fabricated drawbars should be at least equivalent to those specified in AAR Specification M-201.

Couplers, yokes and knuckles manufactured for Australia do not need to show annual or 6 monthly static testing proof tests as required in M-211 clause 3.2. Annual AAR M-216 knuckle fatigue testing are not needed on knuckles manufactured for Australia.

Periodic production tests required under M-211 clause 3.2.3 and internal solidity tests under clause 3.2.4 are required for Australian draw gear components.

Forged draw gear yokes should comply or exceed AAR specification M-211. Forged yokes should exhibit no solidity defects in critical areas and impact Charpy energies of 45 J minimum at -40 degrees C. Forged yokes should have no surface casting defects and superior surface roughness on all surfaces.

Material for new yoke pins should comply with one of the following:

(a) AAR Specification M-118;

(b) AS 1444/4140T;

(c) AS1444/4140U;

(d) AS 1444/X9931T.

(e) GB/T 3077 42CrMo

Couplers, yokes and knuckles manufactured for Australia do not need to show annual or 6 monthly static testing proof tests as required in M-211 clause 3.2. Annual AAR M-216 knuckle fatigue testing are not needed on knuckles manufactured for Australia.

Periodic production tests required under M-211 clause 3.2.3 and internal solidity tests under clause 3.2.4 are required for Australian draw gear components.

Automatic knuckle couplers not of a standard AAR Head design shall have sectioning cuts and critical zones as recommended by the manufacture. Severity levels of level 2 and critical surface zones shall apply to section volumes that would yield at 0.75 mm plastic set. Level 3 severity levels for volumes showing any yielding prior to the static testing ultimate failure.

Automatic knuckle couplers not of a standard AAR Head design shall be gauged in a similar manner to AAR coupler gauging but as recommended by the manufacture.

Other aspects of manufacture of draw gear cast components such as welding, thermal dressing, casting finish, markings, criteria for acceptance, purchaser's inspection, records and language should be as per AAR M-211.

8 Draft gear energy absorption

Energy absorption for new or reconditioned automatic knuckle coupler draft gear should be as prescribed in the AAR specifications MSRP Section B: M-901E; M-901G

AAR pocket draft gear for new single unit passenger rolling stock should have a minimum travel of 64 mm in both buff and draft;

AAR pocket draft gear for new single unit passenger rolling stock should have a preload of between 45 kN and 55 kN;

AAR pocket draft gear for new single unit passenger rolling stock should have a reaction force at the rated travel of a minimum 1000 kN.

The draft gear for new passenger multiple unit rolling stock should have the following minimum capacity:

(a) static spring capacity of not less than 540 kN in compression.

(b) dynamic spring capacity of not less than 14 kJ at a stroke of not less than 50 mm in compression.

Where compressive coupler loads in new passenger multiple unit rolling stock may exceed the capacity of the couplers and draft gear, an expendable energy-attenuating component should be incorporated into the load path between the coupler and the rolling stock body structure.

9 Coupling and uncoupling operation

It shall be possible to determine visually on automatic couplers whether the mechanisms are locked on the mating couplers or not.

The uncoupling mechanism on non-heritage locomotives shall be able to be operated from both sides of the locomotive.

Uncoupling mechanisms on automatic knuckle couplers fitted to new locomotives should be top operated and straight lift.

Uncoupling mechanisms on automatic couplers should operate without fouling any of the equipment mounted on the end of the locomotive.

The uncoupling mechanism on automatic knuckle couplers fitted to new passenger rolling stock should comply with the following:

(a) bottom operated;

(b) rotating handle type located on the left-hand side when facing the end of the rolling stock;

(c) handle located as near as practicable to the outside of the rolling stock and constructed so that rotation away from the rolling stock body and upwards, releases the coupler knuckle;

(d) provision of a device on the coupler release mechanism to prevent the accidental or unauthorised operation of the release mechanism and ensures the knuckle locking block is fully engaged.

For new and modified rolling stock the design of remote uncoupling activation devices (switches, buttons etc) shall prevent accidental initiation of an uncoupling of multi-function couplers.

For new rolling stock, the remote uncoupling activation of multi-function shall activate the rolling stock park brakes in the same operation.

For new rolling stock, the activation of the manual uncoupling feature (where fitted) on multi-function couplers shall not expose the operator to the release of stored energy from the coupler or associated systems during any time if the uncoupling activity.

10 Crashworthiness performance

For new and modified rolling stock fitted with automatic knuckle the following elements shall be utilised to improved crashworthiness performance during a collision or derailment:

(a) Automatic knuckle couplers should have a bottom interlocking shelf.

For new and modified rolling stock fitted with automatic knuckle couplers and multi-function couplers the following elements should be utilised to improved crashworthiness performance during a collision or derailment:

(a) alignment control features reduce the extent to which adjacent rolling stock can move out of line and thus reduce the propensity for jack-knifing;

(b) double shelves on automatic knuckle couplers and interlocking coupling heads assist in preventing uninitiated uncoupling and the subsequent over-riding of adjacent coupled rolling stock.

For new rolling stock, the collapse characteristics of the draw gear system shall be compatible with any CEMS for the vehicle body structure. Refer to AS 7520 for requirements on CEMS (Crash Energy Management Systems).

11 Recovery of failed vehicles

11.1 General

The requirements for carrying an adaptor coupling for potential recovery of failed vehicles shall be set by the Network Interface Requirements / Standards as defined by the Network Operator.

11.2 Adaptor couplings

Adaptor couplings used for the purpose of recovering failed vehicles shall be permanently marked for the life of the adaptor coupling with the following details:

(a) Maximum Capacity (kN).

(b) Type of Adaptor (e.g. AAR, S-106 10A to Type 10 Multifunction Coupler).

(c) Any limitations on rolling stock movement, arising from the use of the adaptor coupling system, shall be identified.

Where pneumatic connections are integrated into the function of the multifunction coupler head, the adaptor coupling shall incorporate equivalent pneumatic connections to match the multifunction coupler head.

11.3 Tow fixtures

Towing fixtures on freight rolling stock shall meet the requirements of AS 7520.

12 Action following incidents

Draw gear that has been subject to accident, incident or abnormal conditions likely to adversely affect them, shall have their integrity verified before continuing in service.

For automatic knuckle couplers, yokes and draft gear refer to the condemning criteria in the Field Manual of the AAR Interchange Rules.

13 Maintenance

13.1 General

Couplers and Drawgear should be maintained in accordance with the manufactures requirements.

Maintenance inspection intervals for couplers and drawgear which exceed manufactures requirements shall be assessed by a competent person with relevant qualifications and experience, considering the operating parameters and manufactures design parameters. The assessment shall clearly demonstrate that such intervals are safe. The information supporting an extended inspection interval shall be documented by a competent person.

Extended maintenance intervals couplers and drawgear shall be developed using a risk management framework of AS/NZS31000 or equivalent.

A formal process shall be in place which advises changes to operating conditions which impact on coupler and draft gear integrity relative to maintenance inspection intervals.

Competent personnel may perform visual inspections as per the manufactures guidelines without specialist training. Where non-destructive testing is required personnel shall meet the requirements of AS ISO9712 to perform Level 1 non-destructive testing.

Where no formal manufacturers' requirements are available for couplers fitted to legacy rolling stock, maintenance inspection intervals shall be developed in line with the above requirements.

Yoke Pins of inadequate strength compared to the strength of the coupler body shall be periodically verified by non-destructive testing at intervals developed using a risk management framework of AS/NZS31000 or equivalent.

13.2 Draw hooks

The integrity of draw hooks and screw couplings shall be periodically verified by non-destructive testing.

Non-destructive testing intervals shall be assessed by a competent person with relevant qualifications and experience, considering the rolling stock annual kilometres, operating parameters and the risk of draw hook or screw coupling failure. The assessment shall clearly demonstrate that such intervals are safe. The information supporting the non-destructive testing interval shall be documented by a competent person.

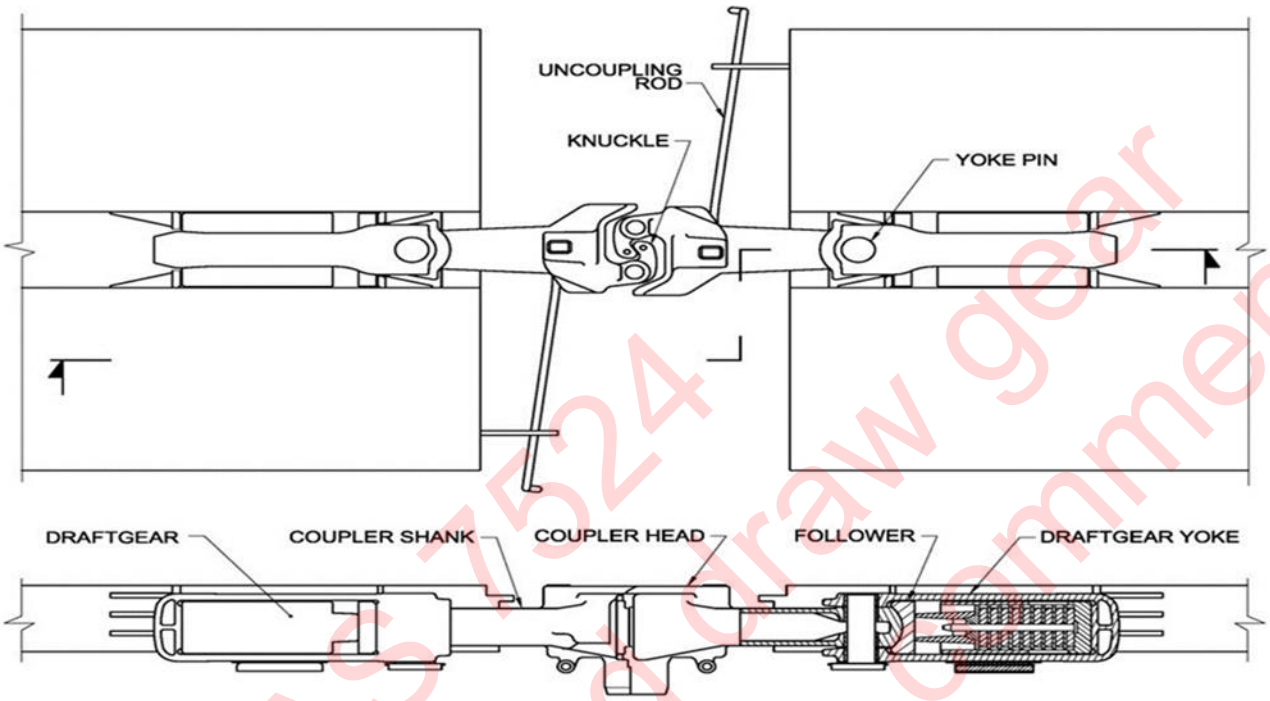
Non-destructive testing intervals shall be developed using a risk management framework of AS/NZS31000 or equivalent.

A formal process shall be in place which advises changes to operating conditions which impact on draw hook integrity relative to non-destructive testing intervals.

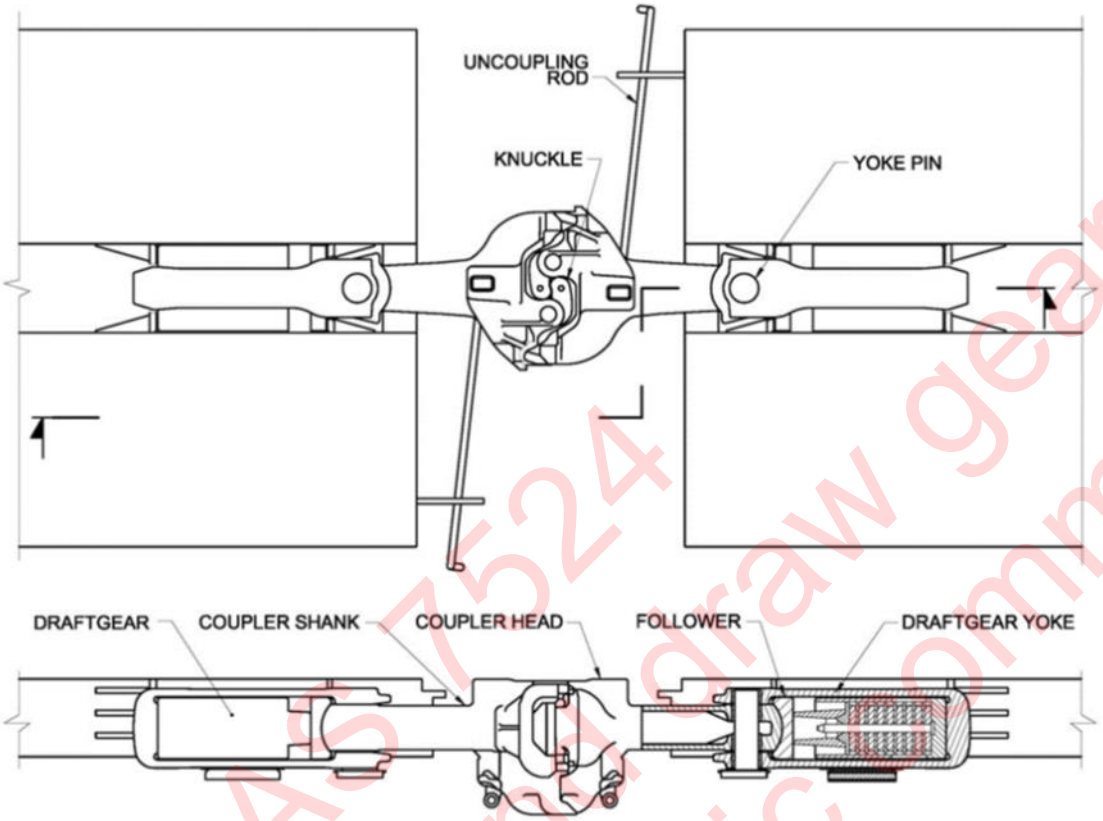
Personnel who perform non-destructive testing shall meet the requirements of AS ISO9712 to perform Level 1 non-destructive testing.

Appendix A Draw gear arrangement drawing

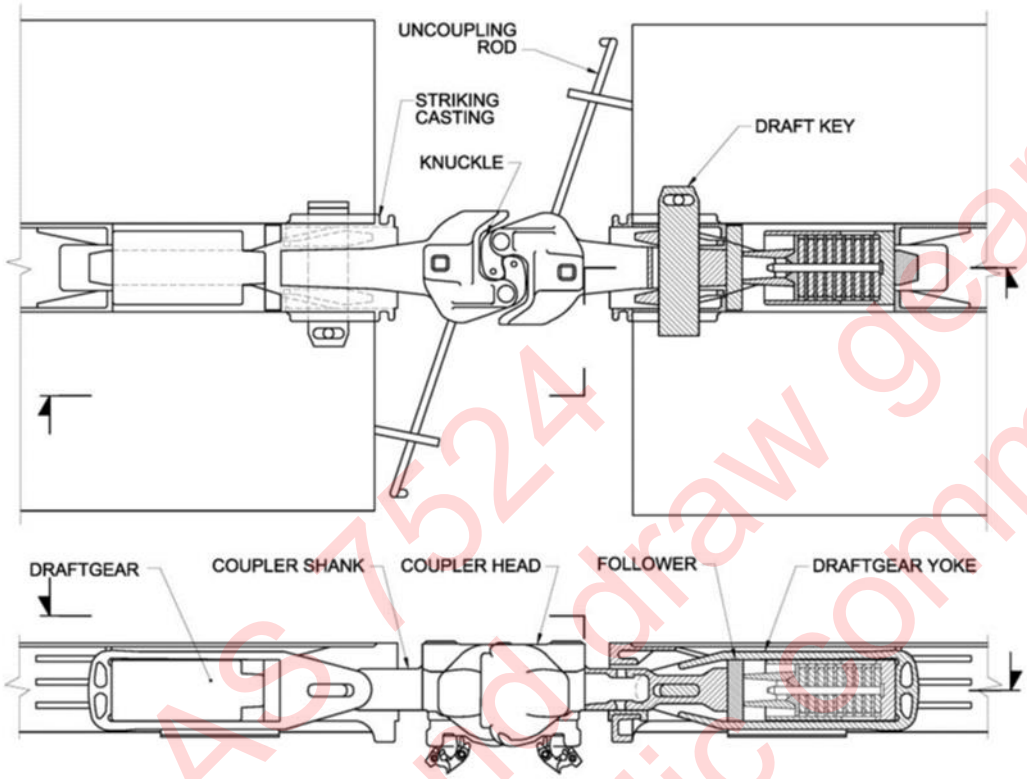
A.1 Automatic knuckle coupler



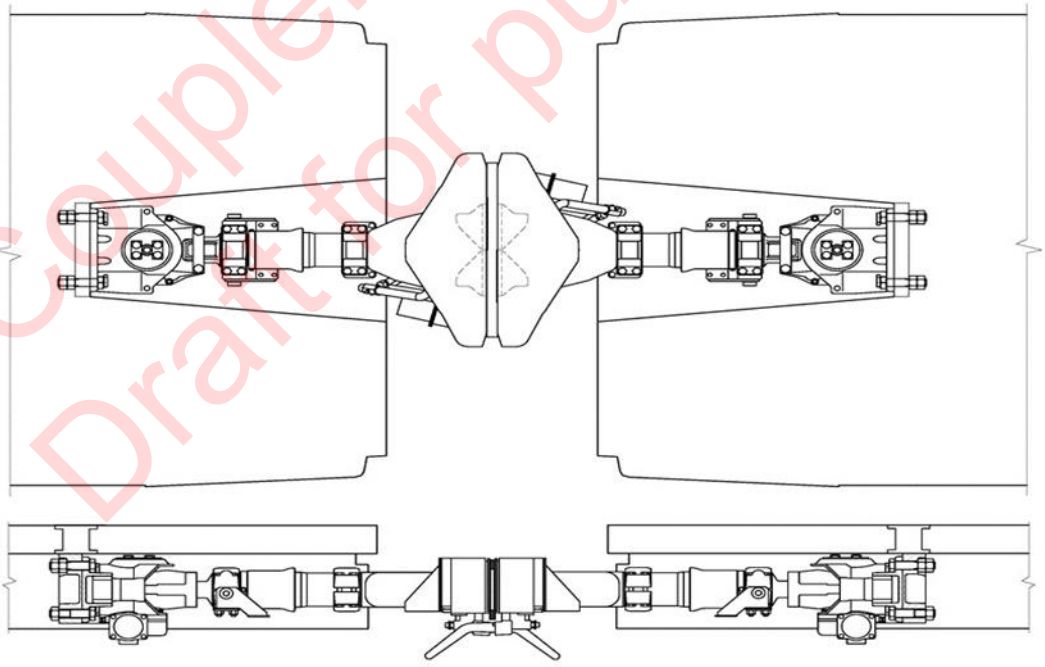
A.2 Automatic knuckle coupler with interlock



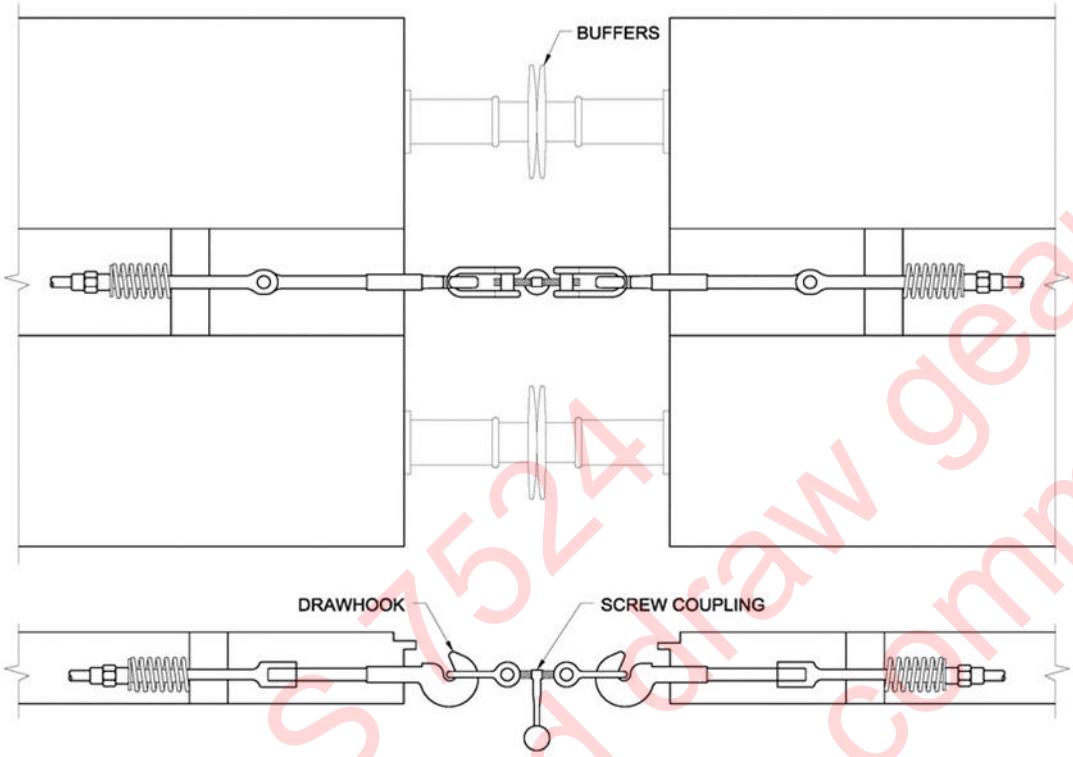
A.3 Bottom operated automatic knuckle coupler with bottom shelf and vertical yoke pin



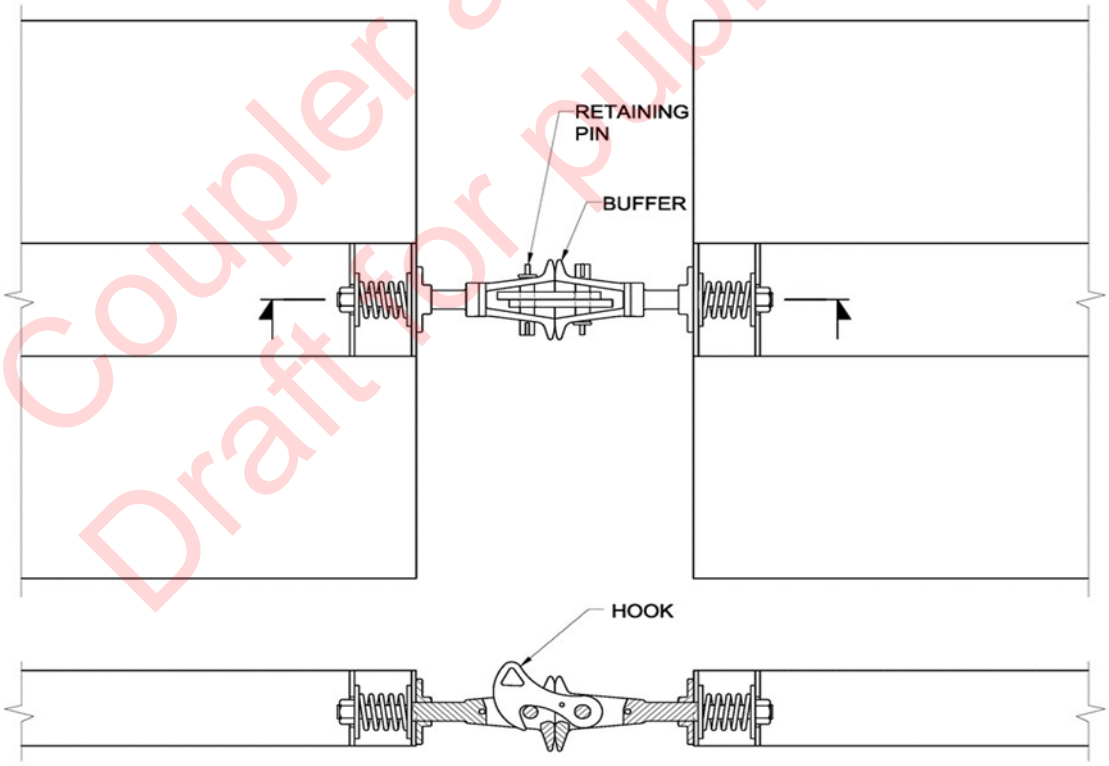
A.4 Automatic knuckle coupler with interlock



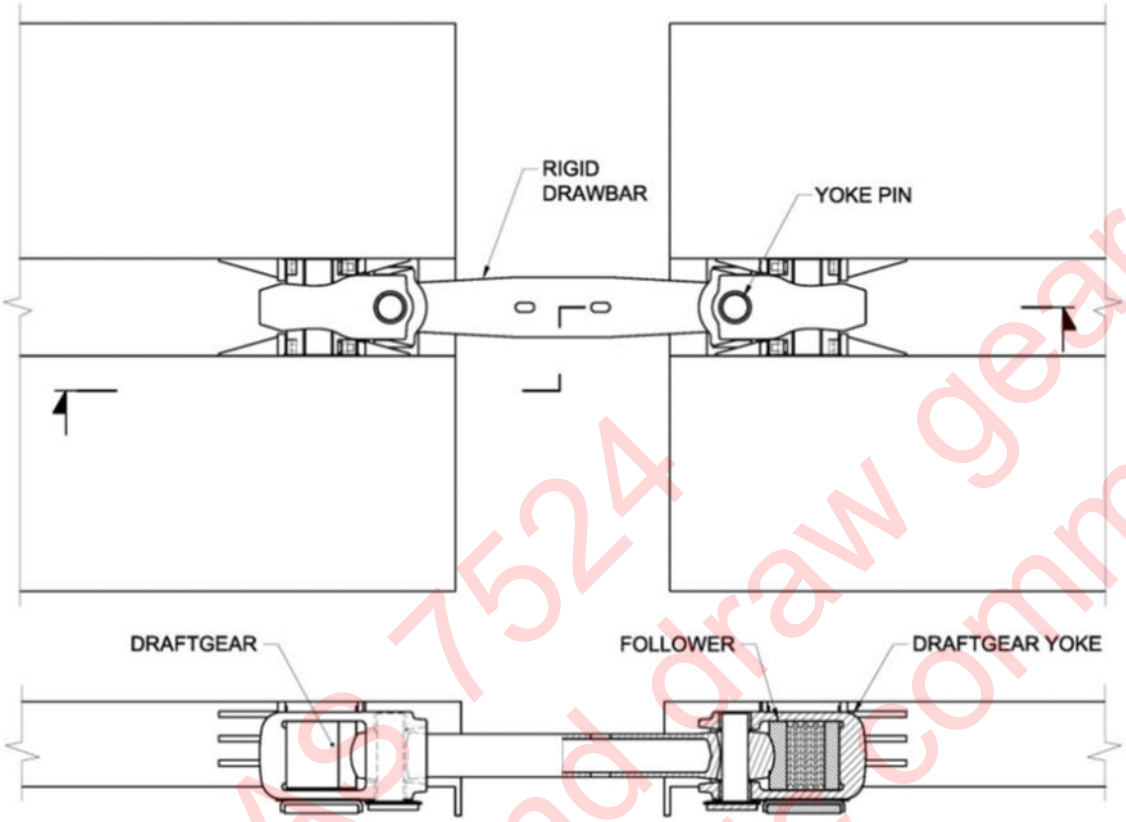
A.5 Automatic knuckle coupler with horizonal draft key



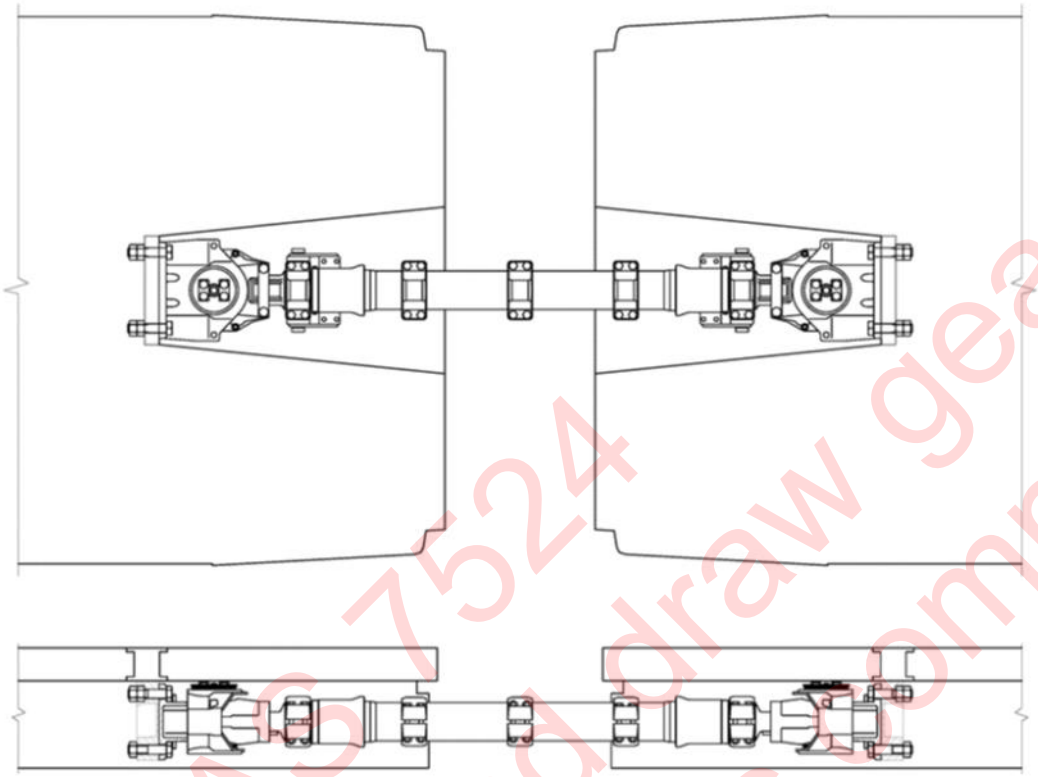
A.6 Multi-function coupler



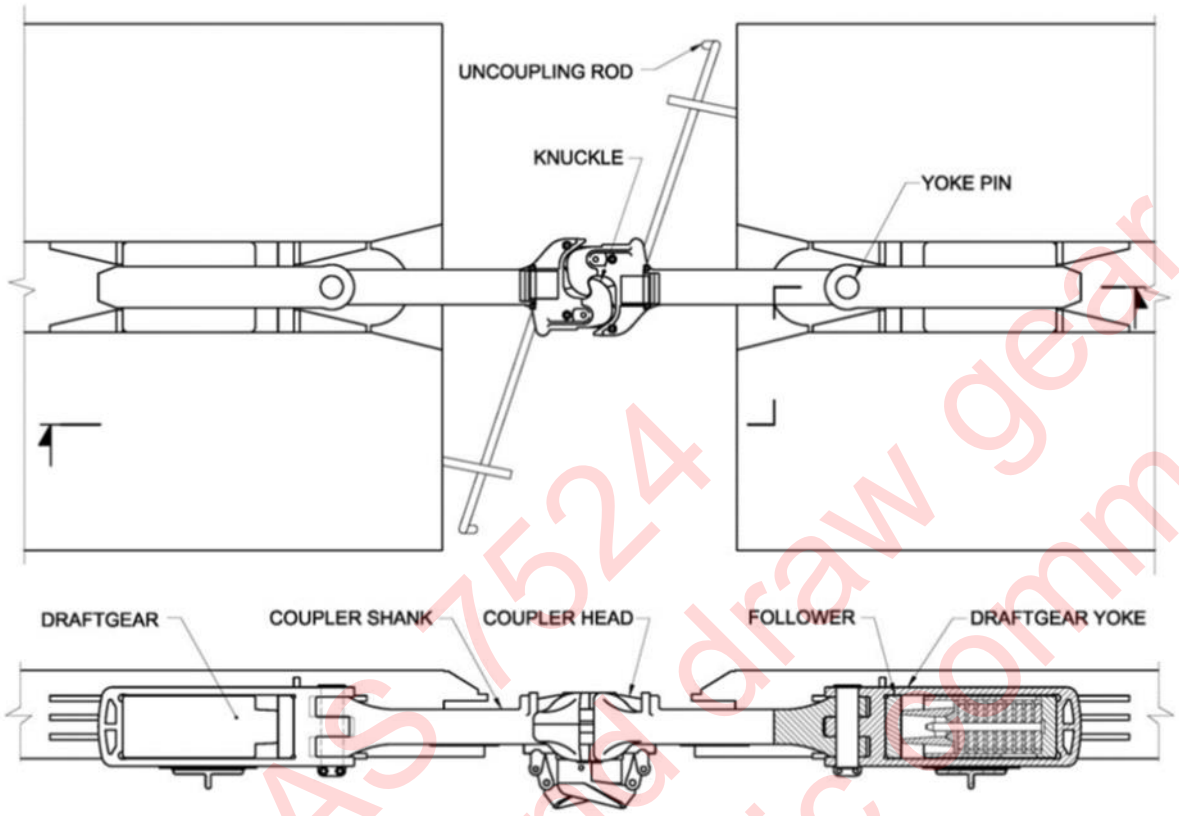
A.7 Draw hook and screw couplings



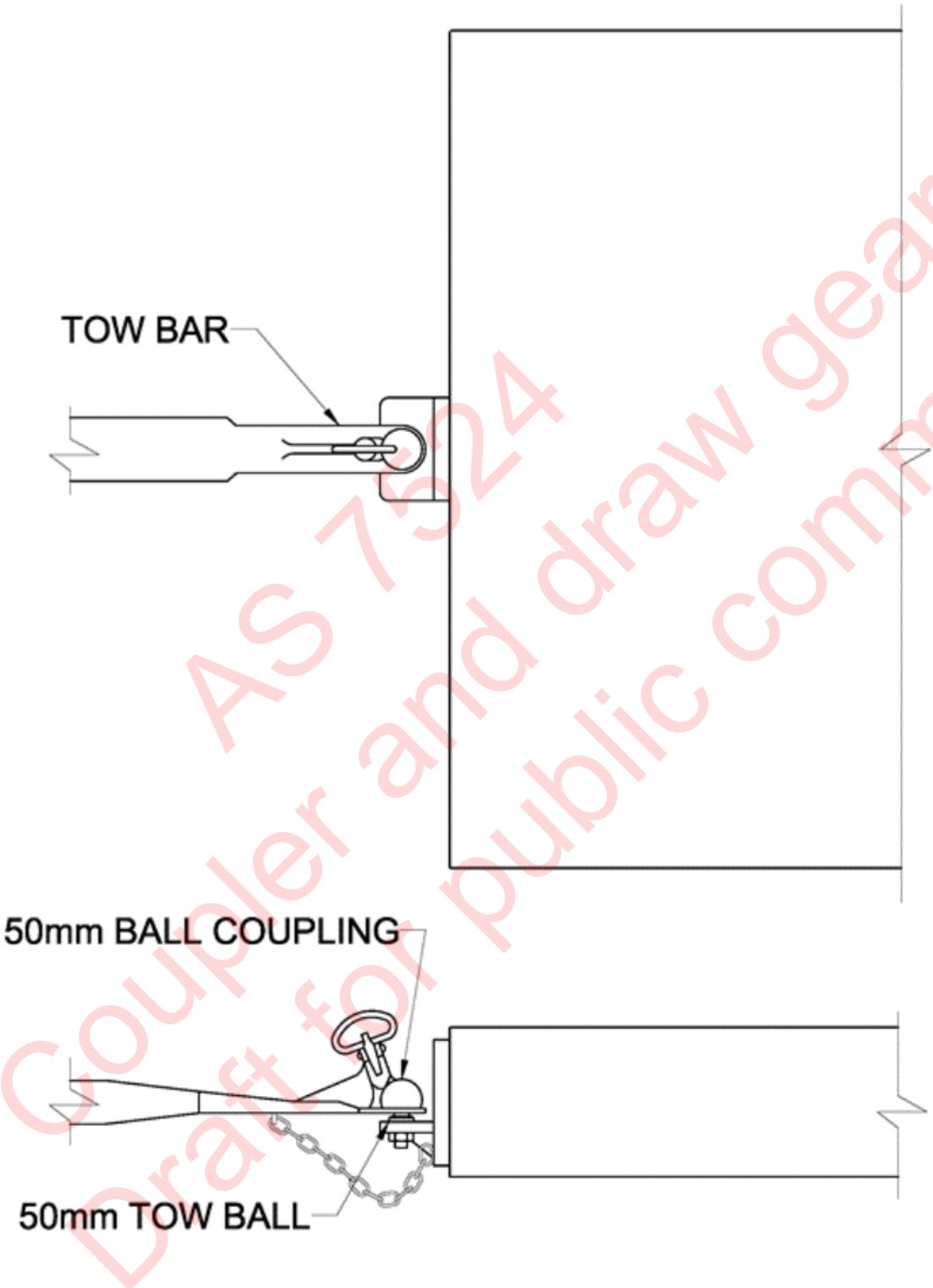
A.8 Solid drawbar split collar



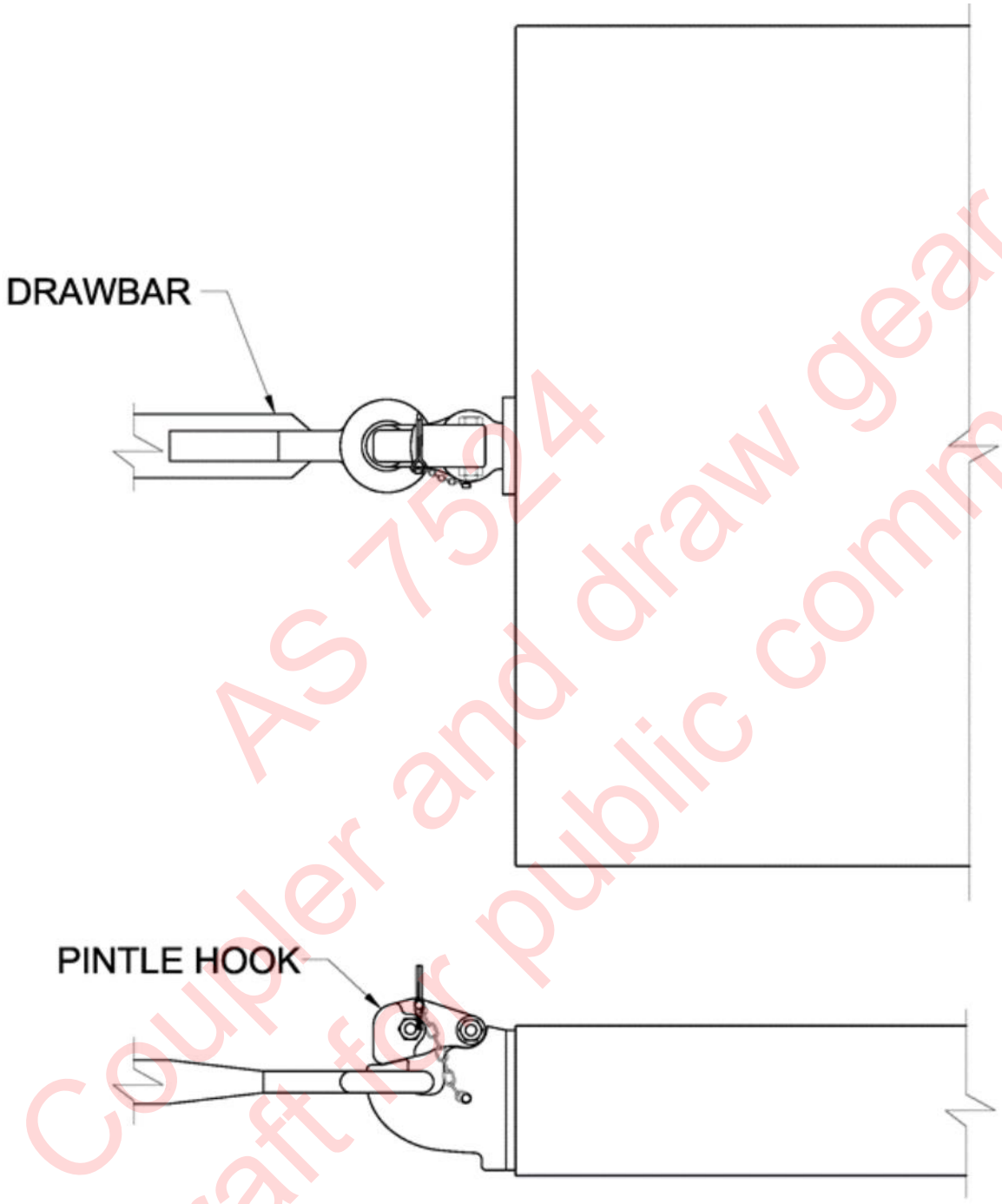
A.9 Fractional size coupler



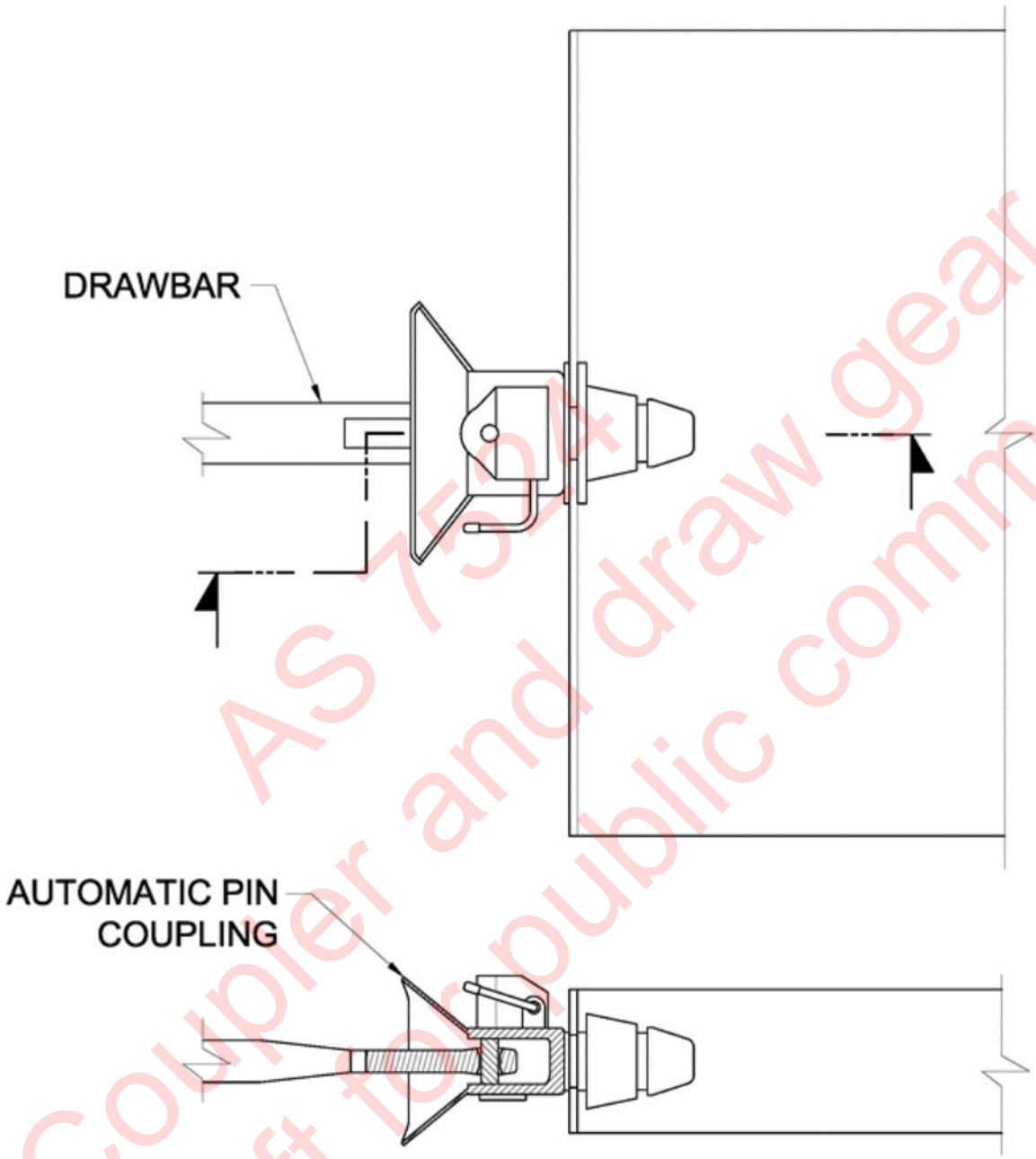
A.10 50mm Ball coupler



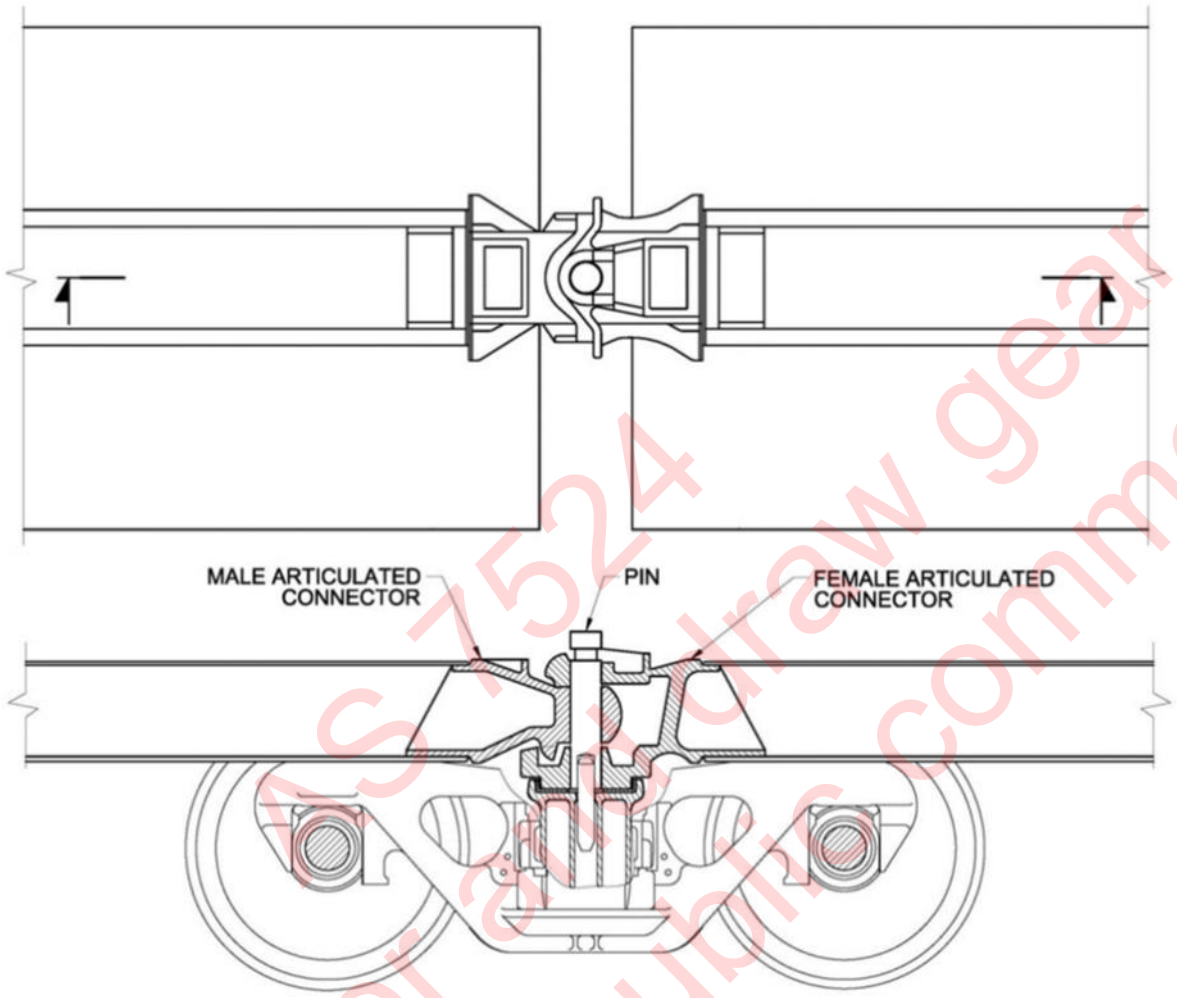
A.11 Pintle hook coupler



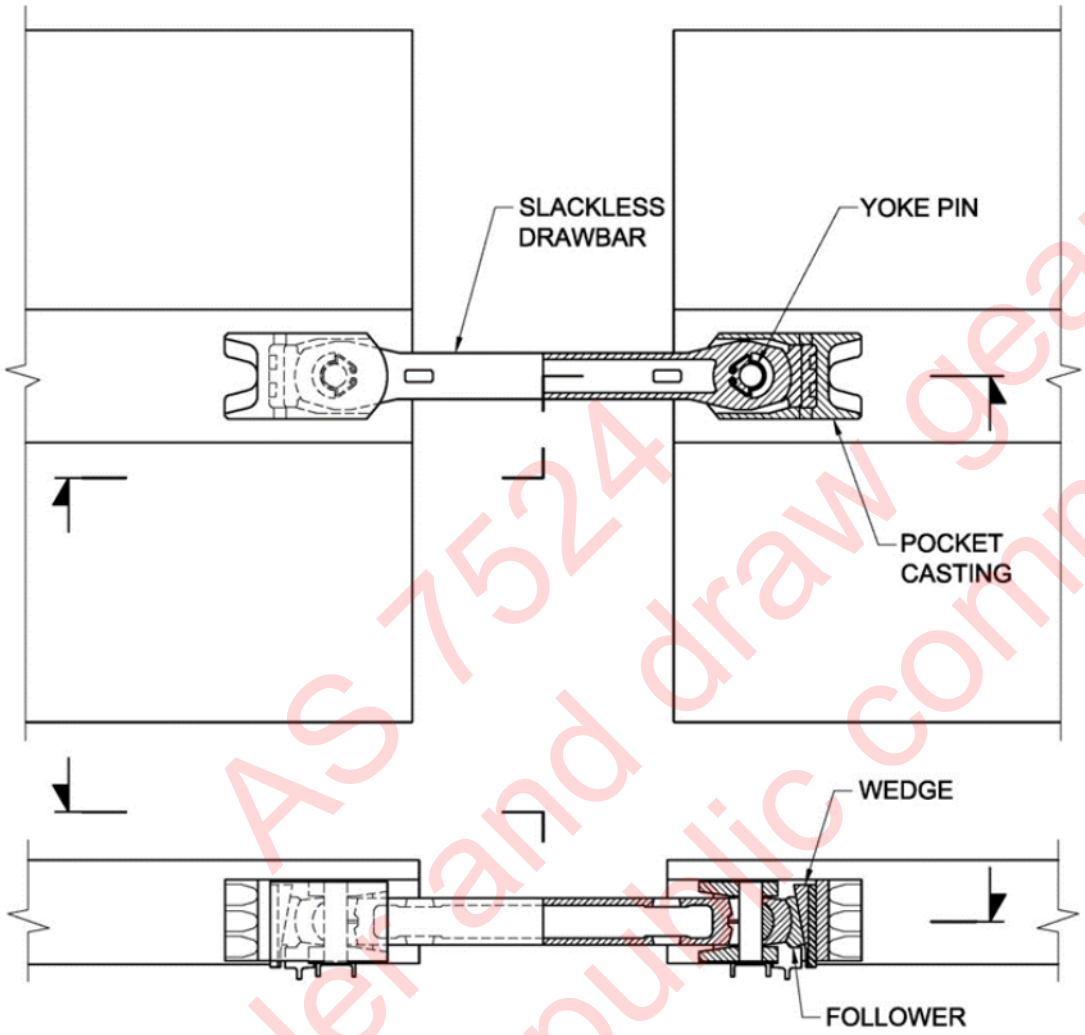
A.12 Automatic pin coupler



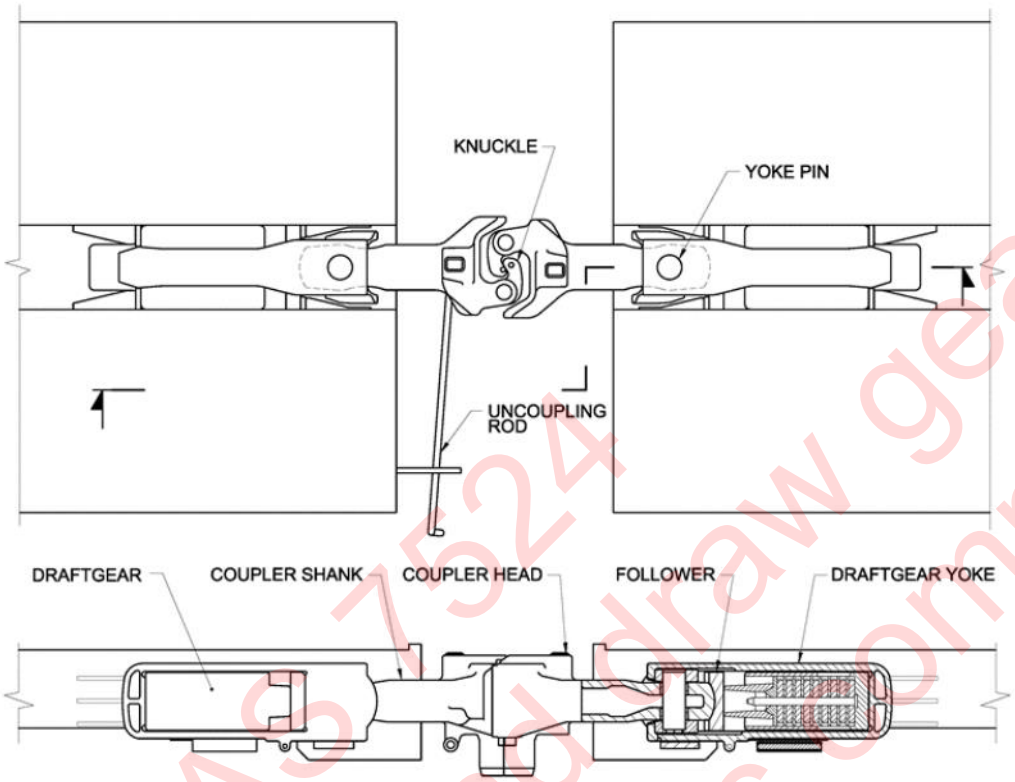
A.13 Articulated connector



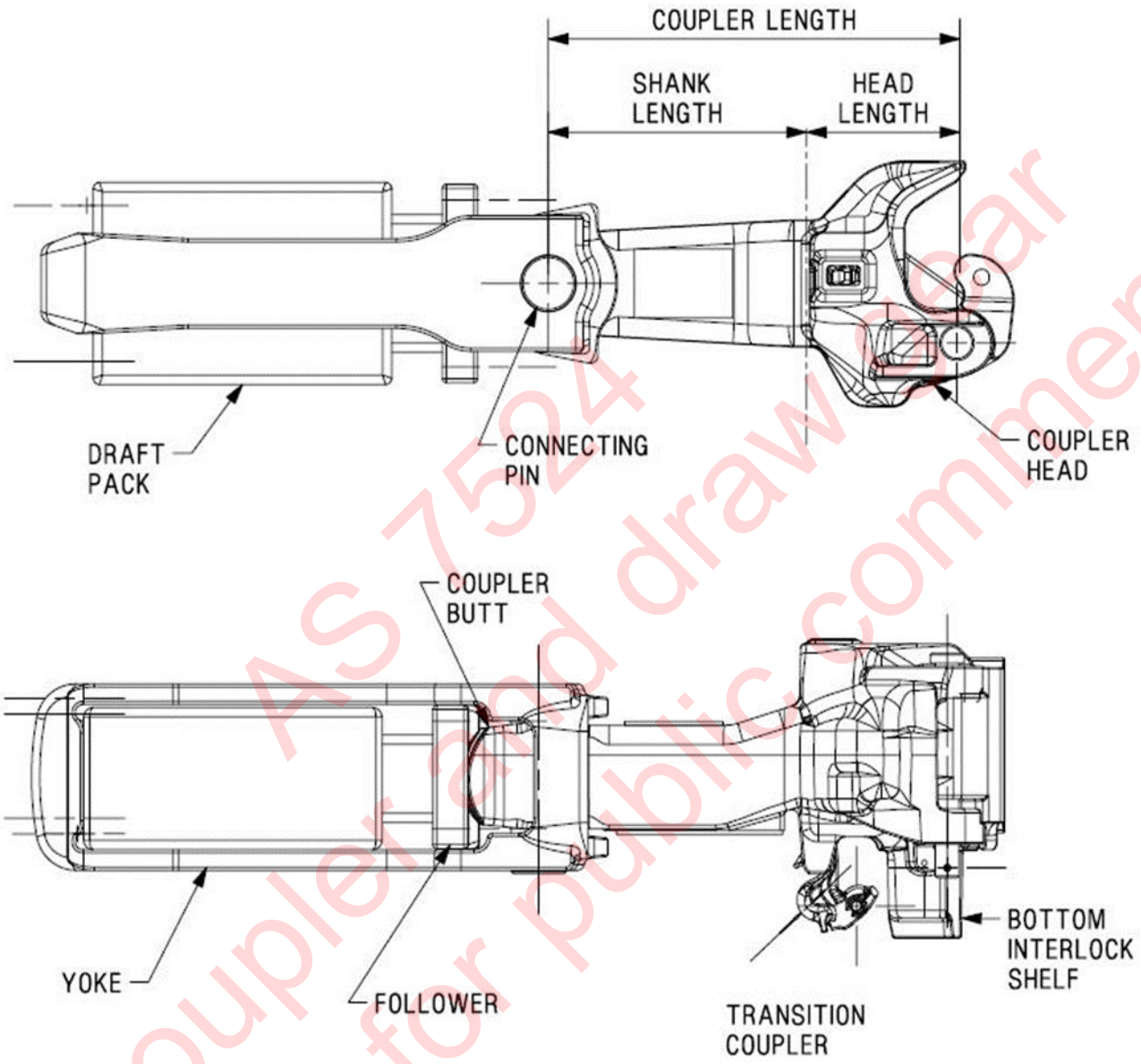
A.14 Slackless drawbar



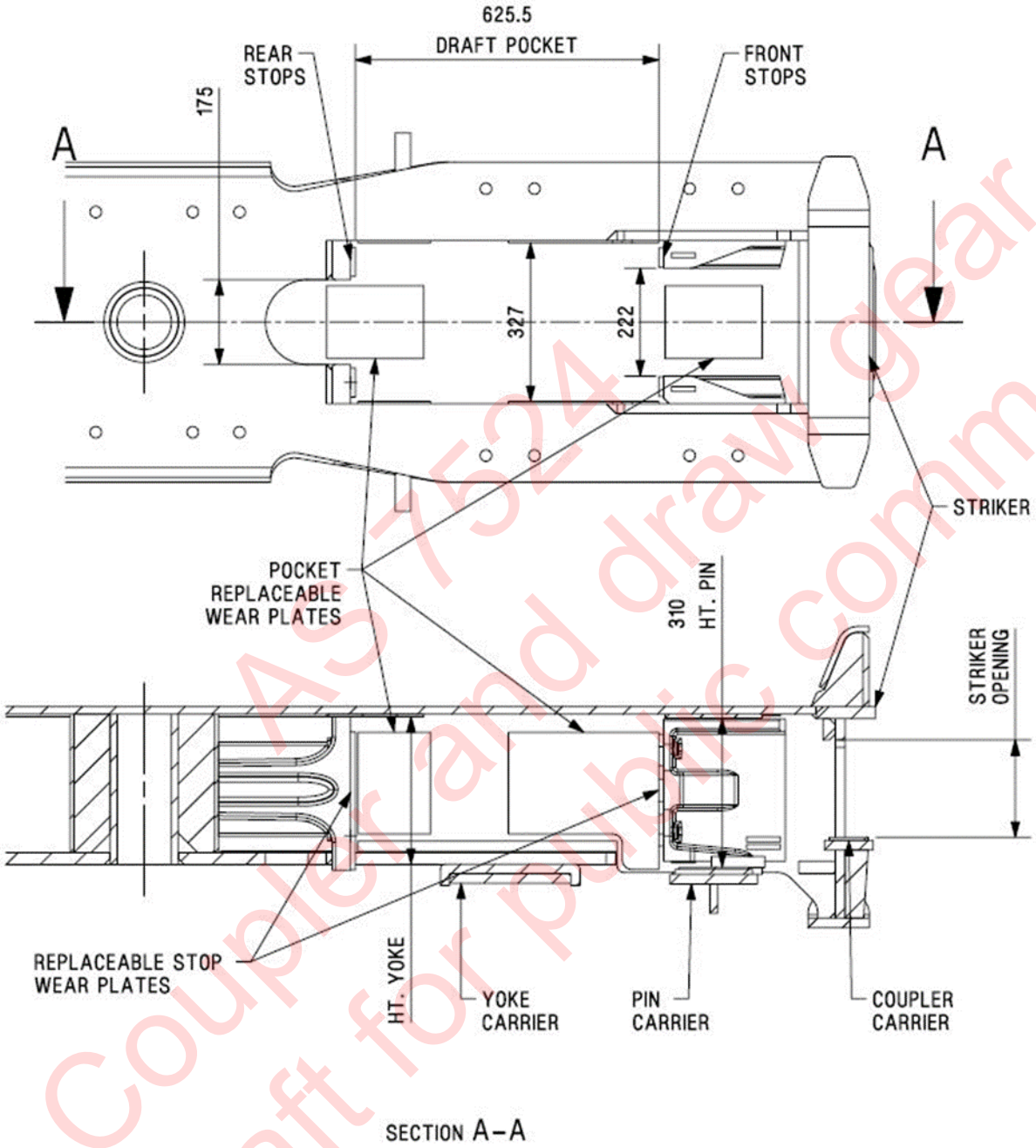
A.15 Rotary coupler



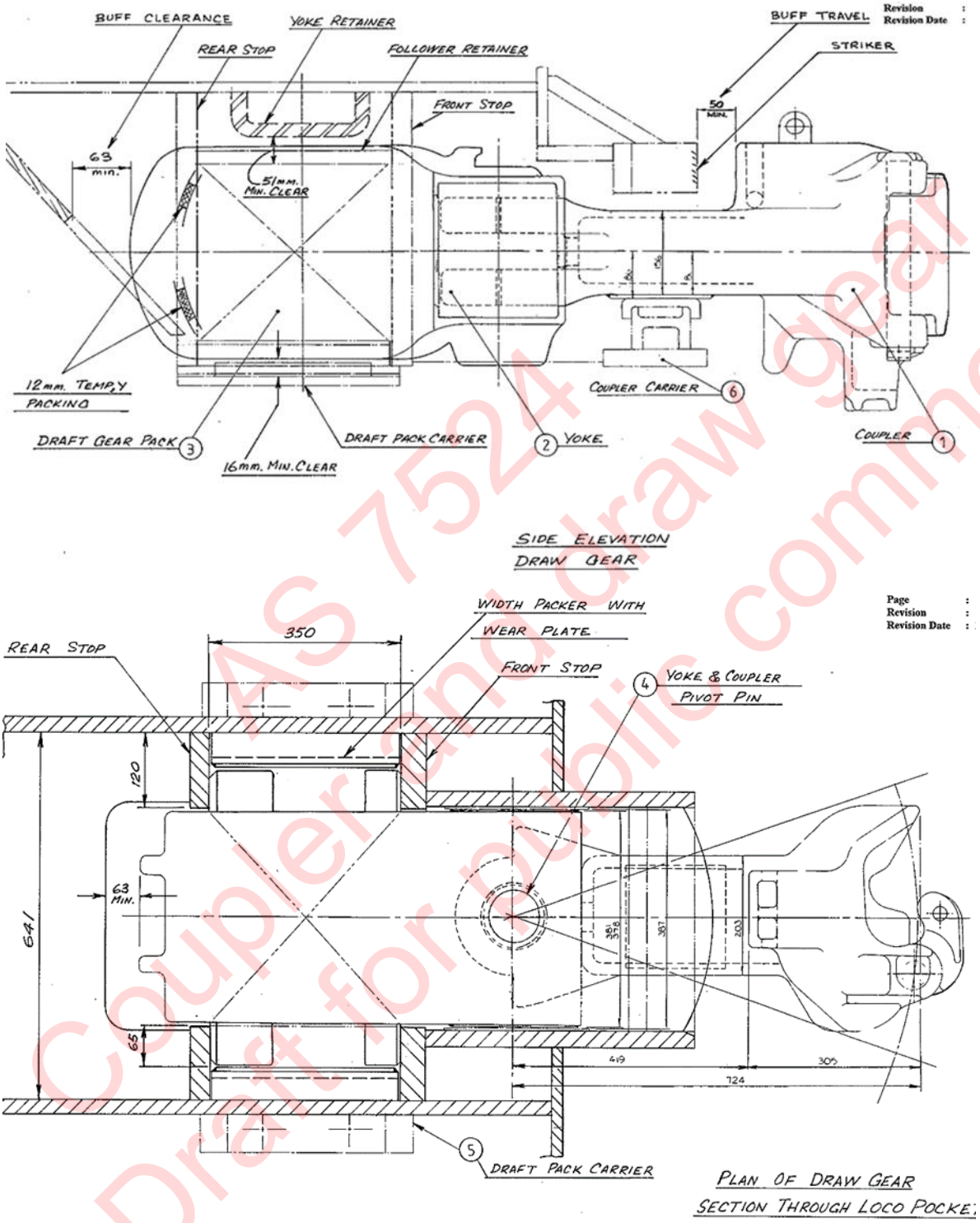
A.16 Draft gear parts

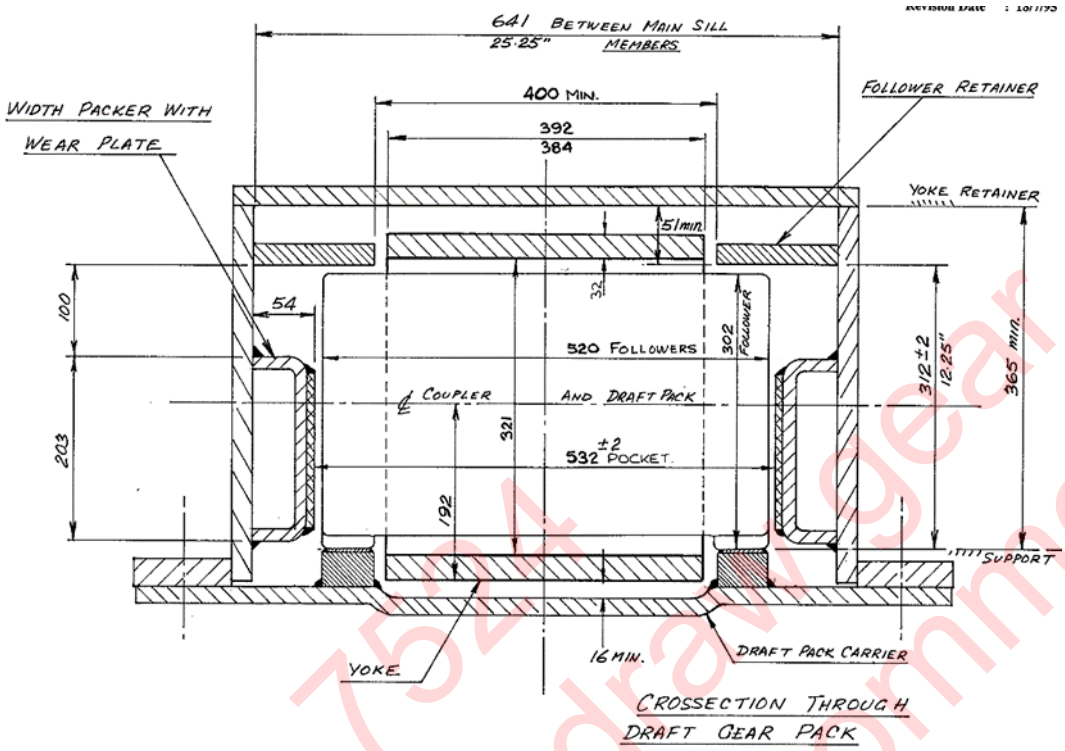


A.17 Pocket size

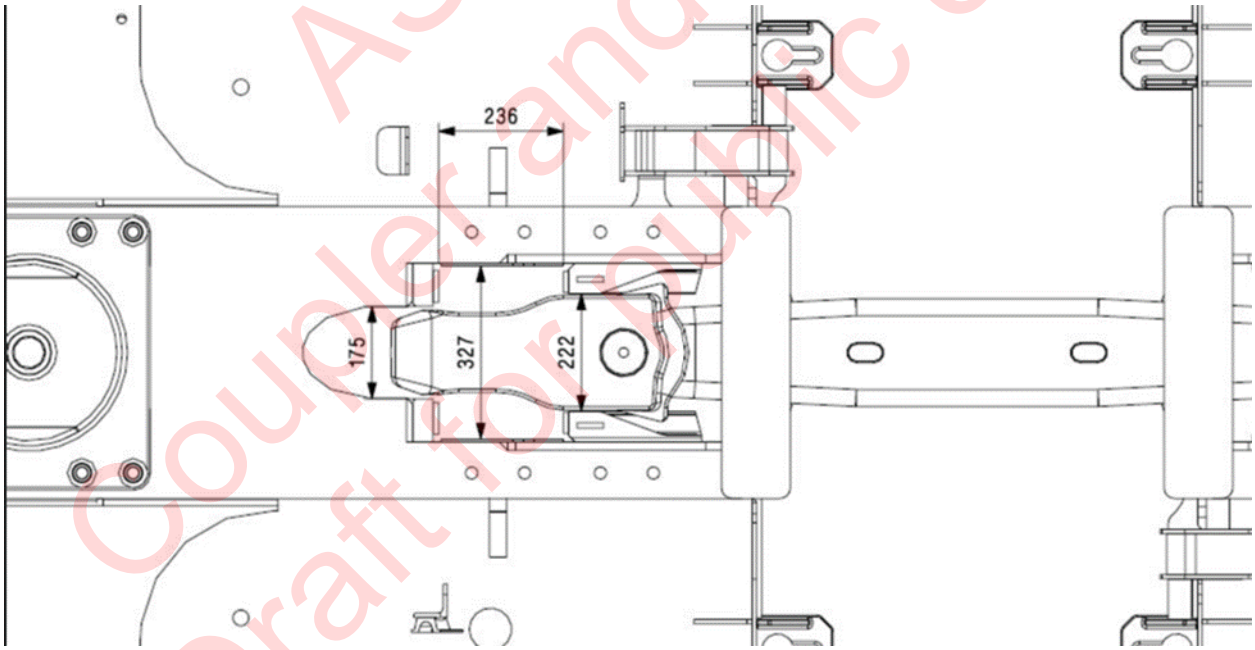


A.18 Locomotive coupler and draft pocket



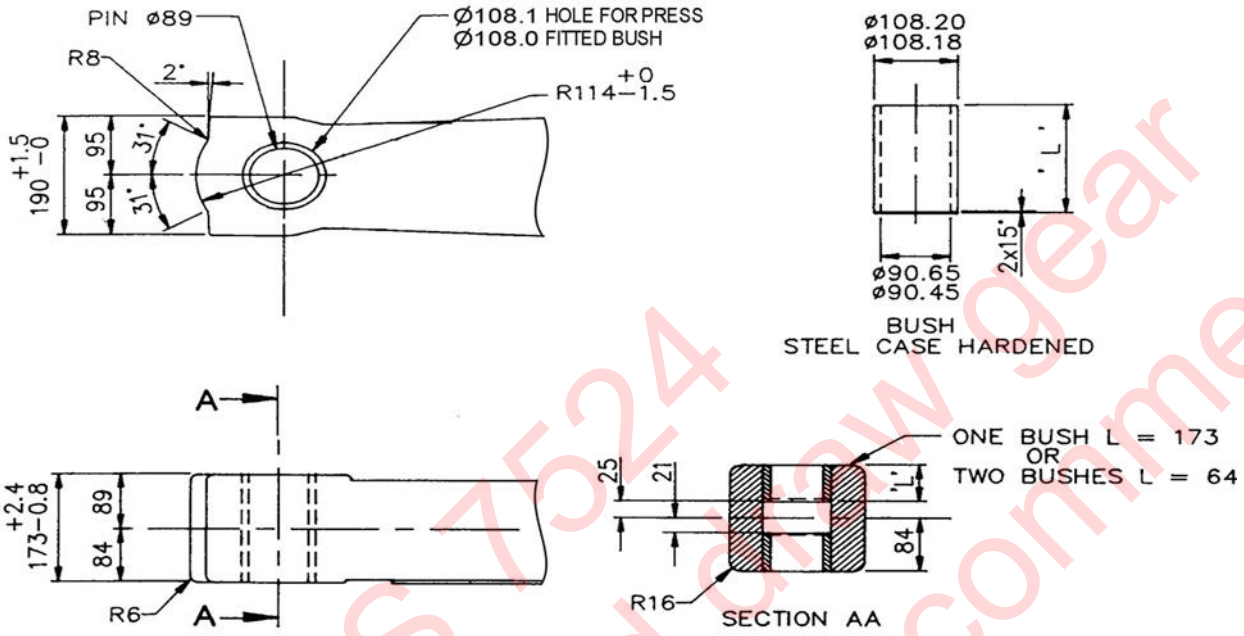


A.19 Short pocket

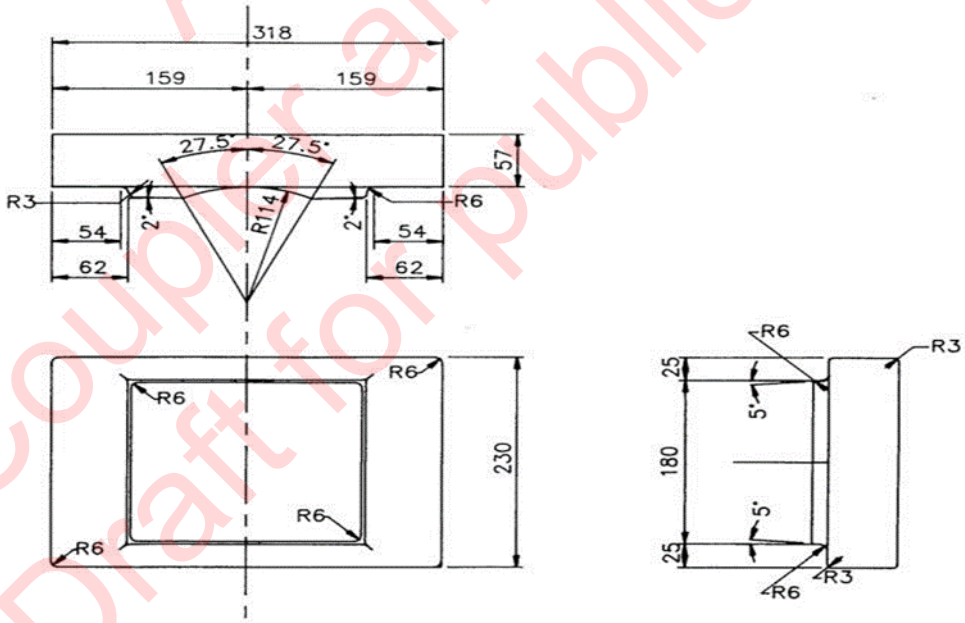


Appendix B Cylindrical butt and follower drawings

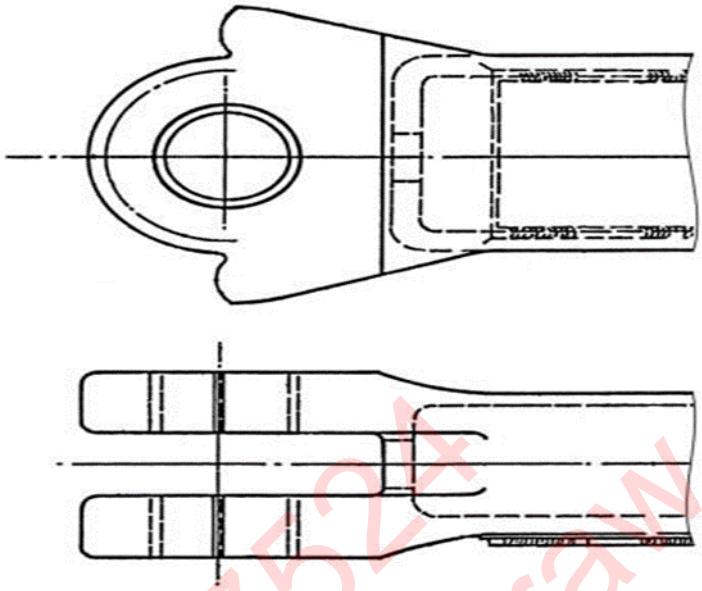
B.1 ANZR cylindrical butt coupler



B.2 ANZR draft gear follower

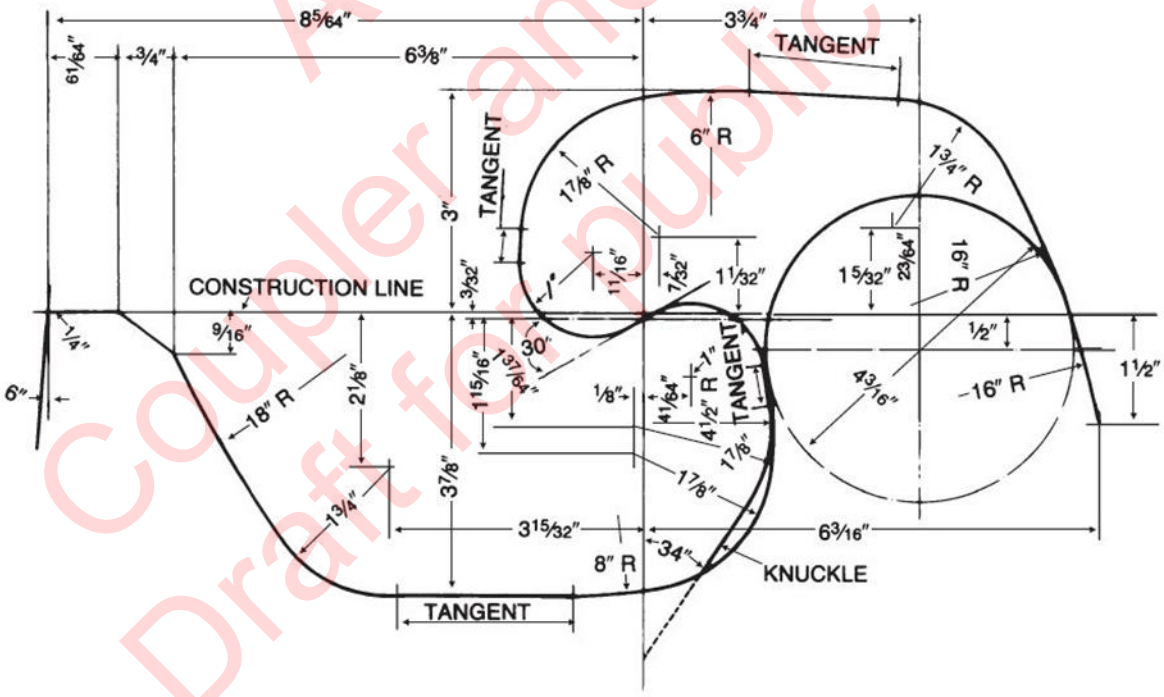


B.3 Slotted cylindrical butt with alignment control shoulders



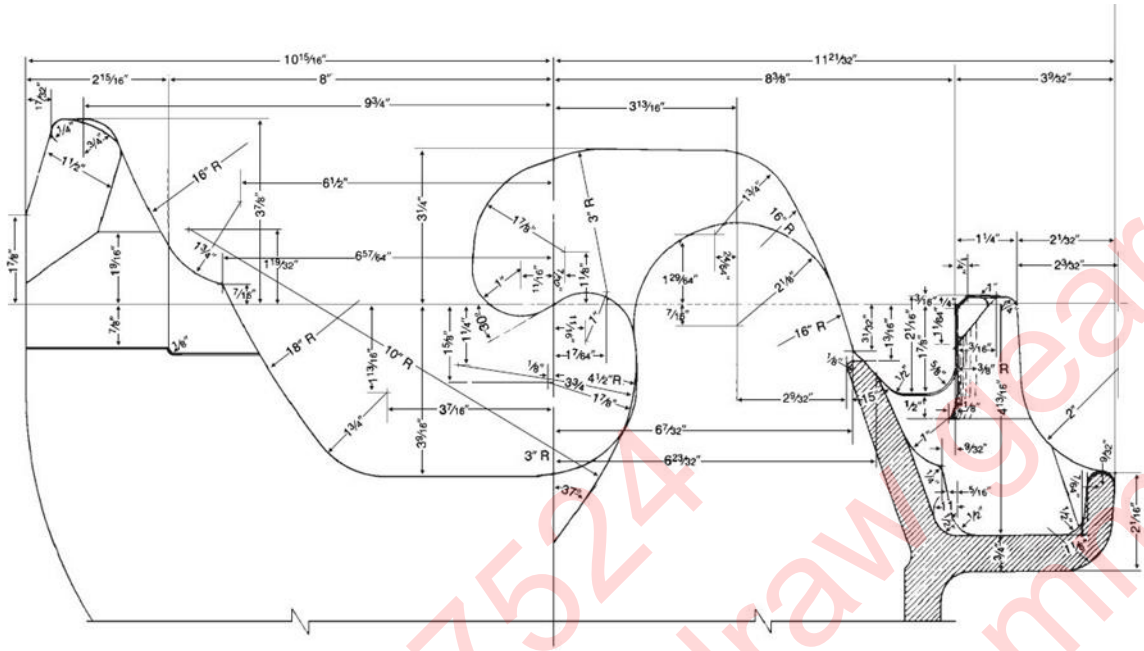
Appendix C Coupler contours

C.1 AAR: 10A contour-S-106

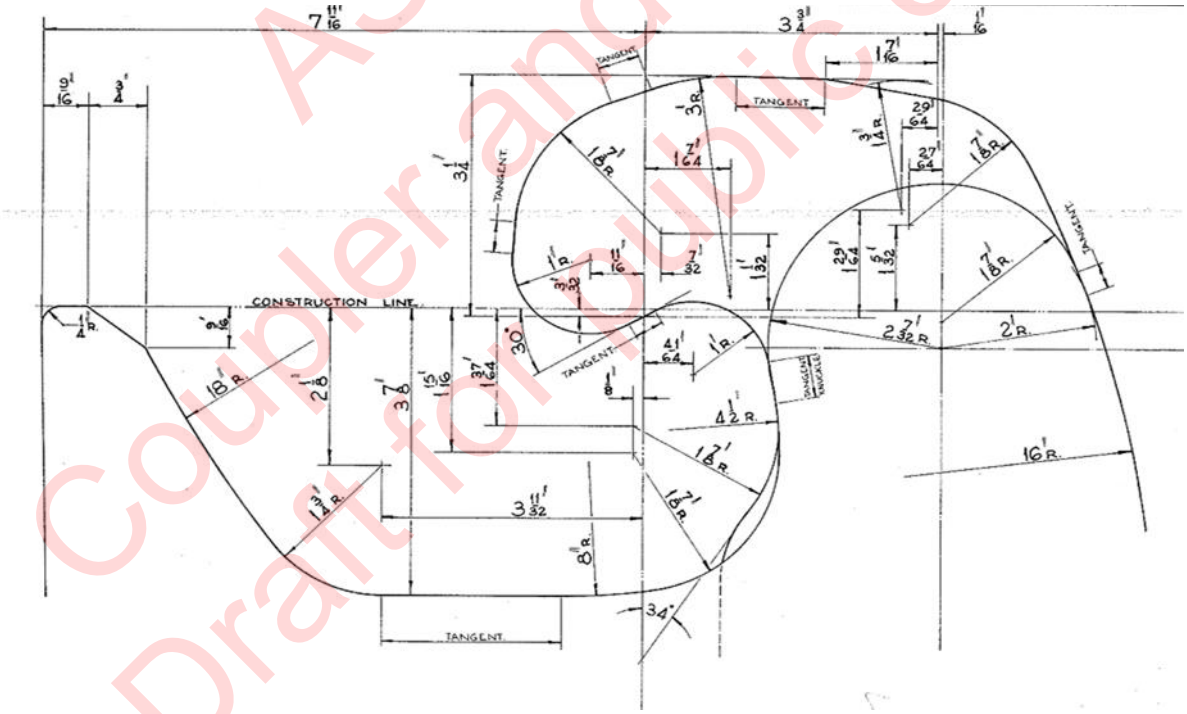


NO. 10A CONTOUR

C.2 AAR: F type contour- S-117



C.3 Australian common: 10A slack reduced contour



Appendix D Examples of coupler height limits in service

Network	Coupler height limits in service (mm)
Queensland narrow gauge	710-860
Western Australia narrow gauge	678-805
Tasmania narrow gauge	733-840
Victorian Network	780-915
Standard gauge	780-915
Narrow gauge	780-915

Appendix E Hazard table

Hazard Reference	Hazard	Section Addressing
5.4.1.5	Inadequate couplers, draft gear or structure strength which are unable to withstand train forces.	2.6, 4.1, 5, 7, 8, 13
5.4.1.46	Operating in a fault condition causing excessive wear and tear.	4.1, 6.1, 7, 8, 13
5.5.1.6	Incompatible couplers causing operational inflexibility.	2.1, 2.6, 4.1, 4.2
5.5.1.55	Couplers not fitted at both ends creating operational inflexibility.	2.1, 4.1
5.7.1.9	Derailment causing tunnels / bridges / overpasses / building structures to collapse onto trains.	2.1, 2.6, 4.1, 4.4, 5, 6, 7, 8, 10, 13
5.8.1.1	Trains parting causing the rear to run into the front	2.1, 2.6, 4.1, 4.4, 5, 6, 7, 8, 10, 13
5.8.1.9	Derailment causing side swipe by another train	2.1, 2.6, 4.1, 4.4, 5, 6, 7, 8, 10, 13
5.19.1.12	Coupler vertical or horizontal movement allowances being inadequate causing horizontal or vertical track curve	2.1, 2.6, 4.1, 4.2, 4.4, 5, 6, 7, 8, 10, 13
5.19.1.34	Large difference in coupling heights creating Quasi-static train forces	4.1, 4.6
5.35.1.6	Coupler or drawgear mechanical failure	2.1, 4.1, 4.4, 5, 6, 7, 8, 13
5.35.1.7	The uncoupling mechanism being accidently operated	2.1, 2.6, 4.1, 4.4, 4.7, 9
5.35.1.10	Being incorrectly coupled through inadequate training or competence	2.6, 4.1, 4.4, 4.7, 9
5.35.1.11	Being incorrectly coupled due to an indication of "coupled status"	2.6, 4.1, 4.4, 4.7, 9
5.36.1.7	Trains parting (Horizontal gap)	2.1, 2.6, 4.1, 4.4
5.40.1.3	Persons on tracks being crushed between wheels and rails	4.7, 9
5.40.1.14	Being crushed between couplers when (un)coupling vehicles	4.7, 9

Hazard Reference	Hazard	Section Addressing
5.40.1.15	Being crushed by uncoupling or centring mechanisms	4.7, 9
5.42.1.3	Mechanical / electrical failure of fuses, circuit breakers, RCD	2.6
5.42.1.9	Wiring etc not being fitted (Earthing)	2.6

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