

SECTION 11

INTERMODAL EQUIPMENT

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11.1 SCOPE

- 11.1.1 This Section specifies the design and location requirements of securing devices and other special equipment required on rail vehicles for the transport of containers and road trailers in intermodal traffic. Also included are aspects of vehicle design specific to each class of traffic.
- 11.1.2 Design and construction of containers is specified in Section 14 of this Manual.
- 11.1.3 Special requirements for road trailers are included in this Section of the Manual at sub section 11.3.8.

11.2 SUPPORT AND SECUREMENT SYSTEMS FOR CONTAINERS

11.2.1 GENERAL REQUIREMENTS

- 11.2.1.1 The system shall provide longitudinal, lateral and vertical restraint at the four lowest corner fittings of the container.
- 11.2.1.2 The securement device may be permanently fixed in position on the vehicle or removable/adjustable. Devices fitted so as to provide for various lengths of containers must be capable of being retracted to be flush with the deck or removed and stowed on the vehicle.
- 11.2.1.3 Longitudinal and lateral restraint shall be provided by engagement with the aperture in the base of each bottom corner fitting, while vertical restraint is provided by a rotating spigot engaging the inner surface of the corner fitting base. This type is referred to hereafter as Internal Locking Devices.
- 11.2.1.4 A spigot engaging the aperture in the base of the bottom corner fittings without provision for vertical restraint may be used on vehicles where the vehicle structure provides substantial vertical engagement, eg well wagons.
- 11.2.1.5 Removable and retractable devices must be designed to be installed, removed, retracted and operated by one person without mechanical assistance or special tools.

11.2.2 INTERNAL LOCKING DEVICES

- 11.2.2.1 Internal locking devices may be fixed, retractable or removable.
- 11.2.2.2 Longitudinal and lateral restraint shall be provided by a spigot engaging the aperture in the base of each corner fitting.
- 11.2.2.3 Vertical restraint shall be provided by a rotating spigot engaging the inner upper surface of the base of each corner fitting.
- 11.2.2.4 The vertical restraint spigot shall be fitted with a positive locking mechanism to prevent accidental or unintentional disengagement.
- 11.2.2.5 Devices shall be designed to maintain adequate engagement and operating clearances under all conditions of wear and permissible manufacturing tolerances.
- 11.2.2.6 Retractable devices shall provide for the components providing support and restraint to be withdrawn below the level of the deck or support structure. These devices shall be fitted with a positive locking mechanism to hold them in the operating position.
- 11.2.2.7 Removable devices shall be attached to the deck or support structure in such a way as to prevent accidental disengagement. The method of attachment shall withstand the design loads specified in Clause 11.2.3.
- 11.2.2.8 Location dimensions and tolerances for Internal Locking Devices are given in Clause 11.2.4.1 and diagram 11.1.

11.2.3 DESIGN LOADS

- 11.2.3.1 When installed in the normal operating position, all securement devices shall withstand the design loads specified in Clause 11.2.3.4 without exceeding the yield stress of the material in any component.
- 11.2.3.2 The support structure and attachment system of each securement device shall also comply with the provisions of 11.2.3.1.
- 11.2.3.3 The following design loads shall be considered as applied to the securement devices in the manner and magnitude specified. Refer to Diagram 11.2.

11.2.3.4 Internal Locking Devices

Design loads for these devices shall be:

- (a) A horizontal longitudinal force of 630 kN applied independently to each end of the spigot providing horizontal restraint at a point 15 mm above the container seating surface.
- (b) A horizontal lateral force of 315 kN applied independently to each side of the spigot providing horizontal restraint at a point 15 mm above the container seating surface.
- (c) A vertical downward force of 560 kN applied to each end, independently, of the spigot providing horizontal restraint and to the container seating surface.
- (d) A vertical downward force of 315 kN applied to the centre of the rotating spigot providing vertical restraint. This force is to be applied with the spigot in both the locked and unlocked position.
- (e) A vertical upward force of 315 kN applied to the underside of the restraining face of the rotating spigot providing vertical restraint.

11.2.4 LOCATION AND TOLERANCES

11.2.4.1 Internal Locking Devices

- 11.2.4.1.1 Lateral and longitudinal spacing for these devices are shown on Diagram 11.1 to suit the various sizes of standard containers. Permissible variations in location dimensions are also shown.
- 11.2.4.1.2 Dimensions shown are to the centre lines of the spigots engaging the apertures in the base of the bottom corner fittings.
- 11.2.4.1.3 Under extreme conditions of cumulative tolerances on containers and corner fittings combined with rail vehicle variations it is theoretically possible for interference to occur between containers and securement devices. In view of the rarity of this occurring and the costs associated with more precise positioning, it is considered that tolerances closer than those specified cannot be justified.

11.2.4.2 Location on Vehicles

- 11.2.4.2.1 Lateral spacing of securing devices shall be symmetrical about the longitudinal centre line of the vehicle.
- 11.2.4.2.2 Longitudinal spacing and location shall provide adequate clearance between containers and handholds, handbrake mechanisms, support structures etc.
- 11.2.4.2.3 Where 'side loading' and similar systems are an optional consideration, spacing between adjacent containers shall provide clearance for lifting equipment.
- 11.2.4.2.4 Provision shall be made, where appropriate, for the carriage of insulated containers with external ('clip on') refrigeration units. Combinations of securing devices shall allow these containers to be positioned with the refrigeration unit adjacent to, but not protruding past, the vehicle headstock face.
- 11.2.4.2.5 For any combination of four securing devices located to restrain a standard container, the support surface of any device must lie within 5 mm of the plane through the support surfaces of the other three.

11.2.4.4 Rail Vehicle Requirements

- 11.2.4.4.1 In addition to the specific requirements included in this Section, container cars shall comply with all relevant and applicable design, dimensional and operating requirements specified elsewhere in this Manual.
- 11.2.4.4.2 The height above rail, at tare with new wheels, of the container support surface of securing devices shall not be greater than:
 - (a) 1070 mm for flat and skeletal type vehicles
 - (b) 300 mm for well type vehicles
- 11.2.4.4.3 That part of the vehicle structure supporting the securing devices shall be designed to accommodate the forces arising from the following accelerations when the vehicle is loaded to its maximum capacity:

- (a) 2 g longitudinally
- (b) 1 g laterally
- (c) 1 g vertically up
- (d) 1 g vertically down

The resultant forces in each case will be assumed to be taken by two (2) securing devices only. The support structure shall withstand these forces without exceeding the yield stress of the material in any component.

- 11.2.4.4.4 Within the area normally occupied by containers when the vehicle is loaded with the maximum number of containers, no part of the structure or attachments shall protrude above the plane through the container seating surfaces.
- 11.2.4.4.5 For vehicles without side sills, suitable boundary members shall be provided. The minimum width over boundary members, and side sills where fitted, shall be 2600 mm.
- 11.2.4.4.6 Diagram 11.3 shows a typical vehicle layout suitable for transporting dry freight and refrigerated containers of 12.2 m and 6.1 m nominal lengths.

11.3 TRAILER-ON-FLAT-CAR (TOFC) TRANSPORT

11.3.1 GENERAL REQUIREMENTS

- 11.3.1.1 Suitable road trailers may be transported with or without prime movers on flat cars. Trailers without prime movers can be carried on specially equipped or conventional general purpose flat cars. Trailers with prime movers attached can only be carried on general purpose flat cars.
- 11.3.1.2 Specially equipped TOFC flat cars shall be fitted with fixed or collapsible trailer hitches engaging the trailer king pin, wheel guides on the deck and bridging plates for drive on loading as specified in Clauses 11.3.2, 11.3.3 and 11.3.4.
- 11.3.1.3 Trailers carried on conventional general purpose flat cars shall be secured by lashing and the use of wheel chocks, as described in Clauses 11.3.6 and 11.3.7.
- 11.3.1.4 Trailers may be loaded by lifting or by the drive on method using side or end loading ramps or platforms. Special features required on road trailers for the lift on loading method are specified in Clause 11.3.8.
- 11.3.1.5 Typical layouts of specially equipped TOFC cars are given in diagrams 11.4 and 11.5.

11.3.2 SECURING HITCHES

- 11.3.2.1 Collapsible and fixed hitches, which support the trailer and engage the fifth wheel king pin, shall comply with AAR Specification M-928, latest revision, and have an Unconditional Certificate of Approval issued by the Specially Equipped Freight Car Committee of the Mechanical Division, Association of American Railroads.
- 11.3.2.2 The location of the hitch(es) on the vehicle deck is shown on diagrams 11.4 and 11.5.
- 11.3.2.3 Fixed hitches shall be used only on vehicles which are not capable of being loaded by the drive on method.

11.3.3 WHEEL GUIDES

- 11.3.3.1 Wheel guides shall be fitted to the vehicle deck, as shown on diagrams 11.6 and 11.7, to prevent lateral displacement of the trailer during transit and to assist in alignment during drive on loading.
- 11.3.3.2 The wheel guides may be external (outside the wheels) or internal (between the wheels). Internal guides are not suitable for trailers with single or wide-single tyres.
- 11.3.3.3 For external guides, the minimum distance between guides at the road wheel support surface shall be 2600 mm. The height shall be 150 mm minimum and 250 mm maximum. The inner face of the guides shall slope outwards as shown on diagram 11.6, but may be vertical up to 75 mm above the road wheel support surface. The height of the guides shall be reduced, and the distance between inner faces increased, within 500 mm of each end sill to accommodate bridging plates.
- 11.3.3.4 For internal guides the maximum distance over the outer faces shall be 1100 mm. The maximum height above the road wheel support surfaces shall be 130 mm. The outer face shall be preferably vertical, but the upper portion may slope inwards as shown on diagram 11.7. The height of the guides and the distance over the outer faces shall be reduced within 500 mm of the end of each guide section to assist in alignment. Guide sections must terminate no closer than 3000 mm to the centre of the trailer hitch on the approach side to permit raising and lowering of the hitch.

11.3.4 BRIDGING PLATES

- 11.3.4.1 Hinged bridge plates shall be fitted to each end of TOFC flat cars, diagonally opposite on the right hand side, when viewed from the end of the car as shown on diagrams 11.4, 11.5 and 11.8.
- 11.3.4.2 Bridge plates shall be a minimum of 700 mm wide and the length from the centre of the hinge to the outer end shall be 1250 mm for vehicles with standard draft gear and 1550 mm for vehicles fitted with end-of-car cushioning units or similar long travel draft equipment.
- 11.3.4.3 Bridge plates shall be designed to accommodate a moving loading of 50 kN, distributed over an area 200 mm long and 600 mm wide, without exceeding 2/3 of the minimum yield stress of the material.

- 11.3.4.4 The upper (drive on) surface shall be flat laterally and be of anti-skid material or coated with such a material. This surface shall be coloured yellow or bright orange for visibility by drivers during loading operations.
- 11.3.4.5 The hinge end of the bridge plates must be compatible with the standard hinge shown on diagram 11.8. The standard hinge is to be fixed to the top of the end sill of TOFC flat cars, as shown by M12 bolts or pin-rivet fasteners, with the nuts or collars below the deck.
- 11.3.4.6 The ends of the bridge plate shall be contoured to ensure contact between the ends of the plate and the vehicle deck when the deck height of the adjacent vehicle is 80 mm above or below the hinge end deck as shown on diagram 11.9. The hinge end shall incorporate steel pivot pins, 24 mm diameter, to engage the hinges.
- 11.3.4.7 Bridge plates shall be held in the upright position by a steel pin, 24 mm diameter, engaging a socket in or through the vehicle deck and attached to the bridge plate via a suitable bracket. The centre of the pin shall be 450 mm laterally from the centre of the bridge plate as shown on diagram 11.8. The locking pin assembly shall be designed so that it cannot be left in the unlocked position.
- 11.3.4.8 The centre line of the bridge plates shall be 950 mm from the longitudinal centre line of the vehicle.
- 11.3.4.9 All ferrous material shall be coated with an effective corrosion inhibitor. Where ferrous and non-ferrous materials are used a suitable insulating compound shall be applied between mating surfaces before assembly.
- 11.3.4.10 There shall be no sharp edges or corners in order to prevent damage or injury to trailers, tyres and loading personnel.
- 11.3.4.11 The standard vehicle hinge assembly is shown on diagram 11.8. Dimensions and tolerances shown shall be maintained. Hinge material shall be steel, AS 1204 Grade 250 minimum quality. The hinges shall be 285 mm centre to centre laterally, equally spaced about the bridge plate centre line; the centre of the hinge pin pivot shall be located between 50 and 100 mm from the face of the end sill.

11.3.5 RAIL VEHICLE REQUIREMENTS

- 11.3.5.1 In addition to specific requirements included in this section, TOFC cars shall comply with all other relevant and applicable requirements of this Manual.
- 11.3.5.2 The maximum deck height (road-wheel support surface) shall be 1070 mm.
- 11.3.5.3 Cars shall be equipped with securing hitches, guide rails and bridge plates as specified in Sections 11.3.2, 11.3.3 and 11.3.4 above.
- 11.3.5.4 The maximum protrusion above the road wheel support surface shall be 130 mm for a lateral distance of 550 mm each side of the longitudinal centre line. The support (running surface) shall be unobstructed laterally between 550 mm and 1300 mm from the longitudinal centre line. Portions of this surface may be raised longitudinally, if necessary, for operational requirements.
- 11.3.5.5 No part of the car structure, wheel guides or end sill attachments or fittings shall obstruct the operation of the bridge plates or prevent the bridge plates from seating fully on the deck.
- 11.3.5.6 Cars intended for lift-on operation only may be fitted with an above-deck handbrake at the end of the car. All other cars shall be fitted with a transverse handbrake, no portion of which shall protrude above deck level.
- 11.3.5.7 Diagram 11.4 shows a typical layout and minimum dimensions for a single trailer TOFC car. The hitch location allows for a trailer with the king pin in the rearmost position and an external nose mount refrigeration unit. The overall length provides for trailers up to 15.25 m (50 ft) in length, and is applicable to bogie and articulated vehicles.
- 11.3.5.8 Diagram 11.5 shows a typical layout and minimum dimensions for a TOFC car to carry two 12.2 m trailers.

11.3.6 WHEEL CHOCKS

- 11.3.6.1 Chocks shall be fitted to the rearmost wheels of trailers transported on rail vehicles without wheel guides. They shall be applied in pairs in front of and behind the wheels.
- 11.3.6.2 The tyre bearing surface of each chock shall be a minimum of 600 mm wide and contoured to ensure contact with the tyre tread. The contour may be straight or concave.
- 11.3.6.3 The dimension over the outer tyre bearing surfaces of each chock assembly shall be 2500 mm minimum, 2550 mm maximum.
- 11.3.6.4 The bottom surface of each chock shall be of anti-skid material to ensure high friction contact between the chock and the rail vehicle deck.
- 11.3.6.5 An easily-operated clamping mechanism shall be provided to pull each pair of chock assemblies tight against the trailer tyres and provide a downward force on the rail vehicle deck. The mechanism shall be preferably located outside the wheels for ease of access by loading staff.
- 11.3.6.6 Chock assemblies shall be designed and constructed to be readily installed and removed by two persons.

11.3.7 LASHING EQUIPMENT

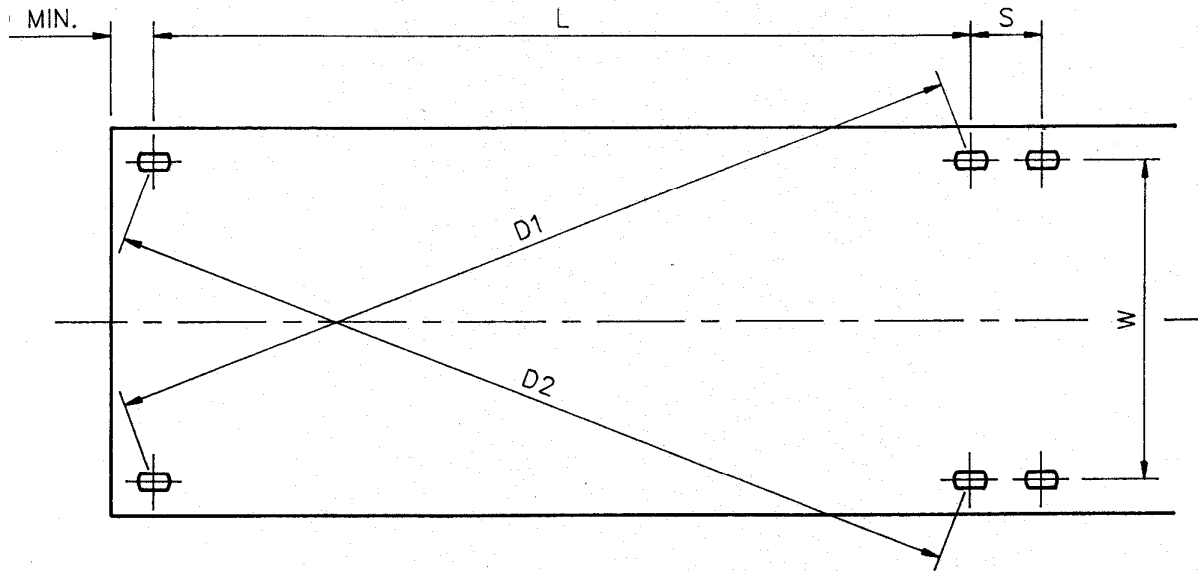
- 11.3.7.1 Trailers transported on conventional flat cars, with or without prime movers, shall be secured by lashing with chain assemblies.
- 11.3.7.2 When detached from the prime mover, trailers shall be supported at the king pin/skidplate location by a stand, the support face of which is 1170 mm above the deck and provides engagement with the king pin.
- 11.3.7.3 Trailer support legs are to be raised clear of the vehicle deck.
- 11.3.7.4 Front and rear of the trailer shall be secured against lateral movement by crossbracing with two (2) chain units installed diagonally as shown on diagrams 11.10 and 11.11.
- 11.3.7.5 Longitudinal restraint shall be provided by two (2) chains per side installed as shown on diagram 11.10 and incorporating elastic impact absorbing components.
- 11.3.7.6 The support stand shall be secured by rope lashing to the trailer (upper) and rail vehicle (lower) securing points.
- 11.3.7.7 Alternative longitudinal restraint may be provided by the use of six (6) ropes per side as shown on diagram 11.10. The sum of the safeworking loads of all longitudinal restraint devices (chains and/or ropes) shall be not less than 350 kN.
- 11.3.7.8 Chain assemblies shall have a minimum safe working load of two tonnes and terminate in 'D' shackles of equivalent strength. Length adjustment may be provided by turnbuckles or load binders.
- 11.3.7.9 When transported while attached to a prime mover, front diagonal chains cannot be applied. The rear of the prime mover is to be diagonally chained and the front secured by ropes.
- 11.3.7.10 Trailer lashing points are specified in Section 11.3.8.

11.3.8 ROAD TRAILER REQUIREMENTS

- 11.3.8.1 In addition to the specific requirements of this sub section, trailers shall comply with all relevant statutory rules and regulations, State and Federal, and be acceptable for registration for road use.
- 11.3.8.2 Trailers shall be fitted with brackets for lashing chain attachments and/or securing ropes, as required, located as shown on diagrams 11.10 and 11.11 and capable of withstanding a horizontal or vertical load of 40 kN.
- 11.3.8.3 Trailer support legs (landing gear) shall be capable of supporting the trailer without deformation when loaded to the maximum gross mass for rail transport as specified on the compliance plate.

- 11.3.8.4 The king pin and skid plate shall comply with AS 2175, "Fifth Wheel King Pins" and AS 2174 "Recommendations for Positions and Heights of Fifth Wheel for Articulated Vehicles".
- 11.3.8.5 For loading by Intermodal Lifting Equipment, trailers shall be fitted with lifting pads. Lifting forces will be applied to the underside of the trailer side frames at four (4) locations. Lifting pads shall provide a flat surface extending 200 mm in from the outer vertical face of the side frame and at least 1000 mm long. The flat vertical face shall be at least 50 mm high extending upwards from the bottom outer face of the side frame. Refer to diagram 11.12.
- 11.3.8.6 Lifting pads and the supporting cross members shall be capable of withstanding without permanent deformation the forces applied by lifting the trailer when loaded to the maximum gross load shown on the compliance plate.
- 11.3.8.7 Lifting pads shall be located symmetrically about the longitudinal and lateral centre lines of the trailer. All four (4) pads shall lie in the same horizontal plane. Pads shall be positioned longitudinally at a minimum of 5000 mm and 11000 mm maximum centre to centre. The optimum and recommended spacing is 7000 mm.
- 11.3.8.8 Lifting pads shall be painted or marked with a highly visible colour to enable easy identification by loading staff.
- 11.3.8.9 The trailer owner shall ensure that all load restraining equipment and devices are capable of withstanding the accelerations experienced in rail transport. For design purposes these accelerations shall be considered as:
- | | | |
|-----|--------------|-----|
| (a) | Longitudinal | 2 g |
| (b) | Vertical | 1 g |
| (c) | Lateral | 1 g |
- 11.3.8.10 The trailer road suspension system and underframe mounted equipment shall clear a protrusion 1100 mm wide and 180 mm high, located symmetrically about the longitudinal centre line of the rail vehicle, while fully loaded to the maximum shown on the compliance plate with worn road tyres.
- 11.3.8.1 The following dimensional limits apply to loaded trailers for 'lift on' loading:
- | | | |
|-----|--|---------|
| (a) | Maximum height from bottom of lifting pad to top of load | 3800 mm |
| (b) | Maximum width over load or trailer frame | 3000 mm |
| (c) | Maximum distance from front end of trailer to king pin | 1750 mm |
- 11.3.8.12 Trailers which comply with the provisions of this section for lift on loading by lift-truck or cranes shall be fitted with a compliance plate, supplied and installed by the owner. The plates shall be a minimum size of 150 mm x 50 mm, and shall be stamped or embossed with the following:
- "Complies with Section 11.3.8, ROA Manual
Maximum Gross Mass for Rail Transport - XX Tonnes
Issued 19YY"
- 'YY' is the year in which the trailer is certified to comply with this section.
- The compliance plate shall be fixed to the trailer side rail on the left hand side as near as practicable to the front.
- 11.3.8.13 The lifting pad on the arms of the lifting equipment shall have a contact surface not less than 150 mm wide and 750 mm long to reduce the risk of damage to the trailer lifting pads and supporting cross-members.

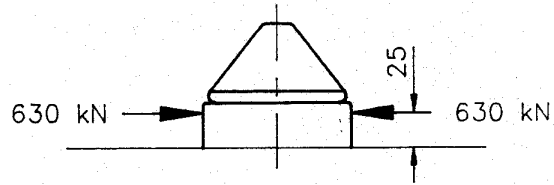
DIAGRAM 11-1
LOCATION DIMENSIONS
INTERNAL LOCKING DEVICES



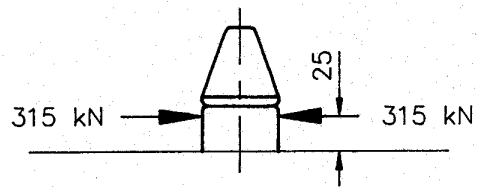
NOMINAL LENGTH OF CONTAINER ,m	L	W	D1-D2 OR D2-D1	S	
				EITHER	OR
12.20	11986±6	2261±2	10	510	280
9.13	8919±6	2261±2	8	510	280
6.10	5853±6	2261±2	8	510	280
3.05	2787±6	2261±2	6	510	280

NOTE: DIMENSION "S" : 510mm ALLOWS SUFFICIENT CLEARANCE BETWEEN CONTAINERS FOR TOP LIFTING EQUIPMENT WITH CENTREING GUIDES.
: 280mm MAINTAINS THE NOMINAL I.S.O. CLEARANCE OF 76mm BETWEEN ADJACENT CONTAINERS.

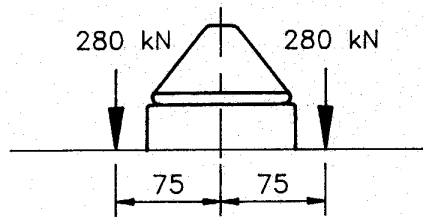
DIAGRAM 11-2
DESIGN LOADS
INTERNAL LOCKING DEVICES



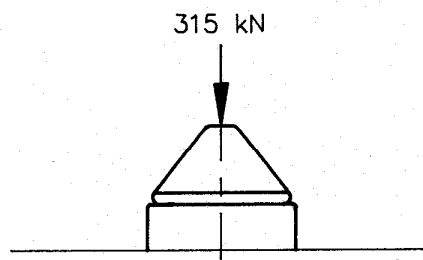
(a) LONGITUDINAL



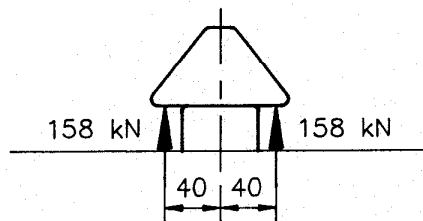
(b) LATERAL



(c) VERTICAL DOWN ON SUPPORT FACE



(d) VERTICAL DOWN ON SPIGOT



(e) VERTICAL UP ON SPIGOT

DIAGRAM 11-3

TYPICAL CONTAINER VEHICLE
LOCATION OF SECURING FITTINGS

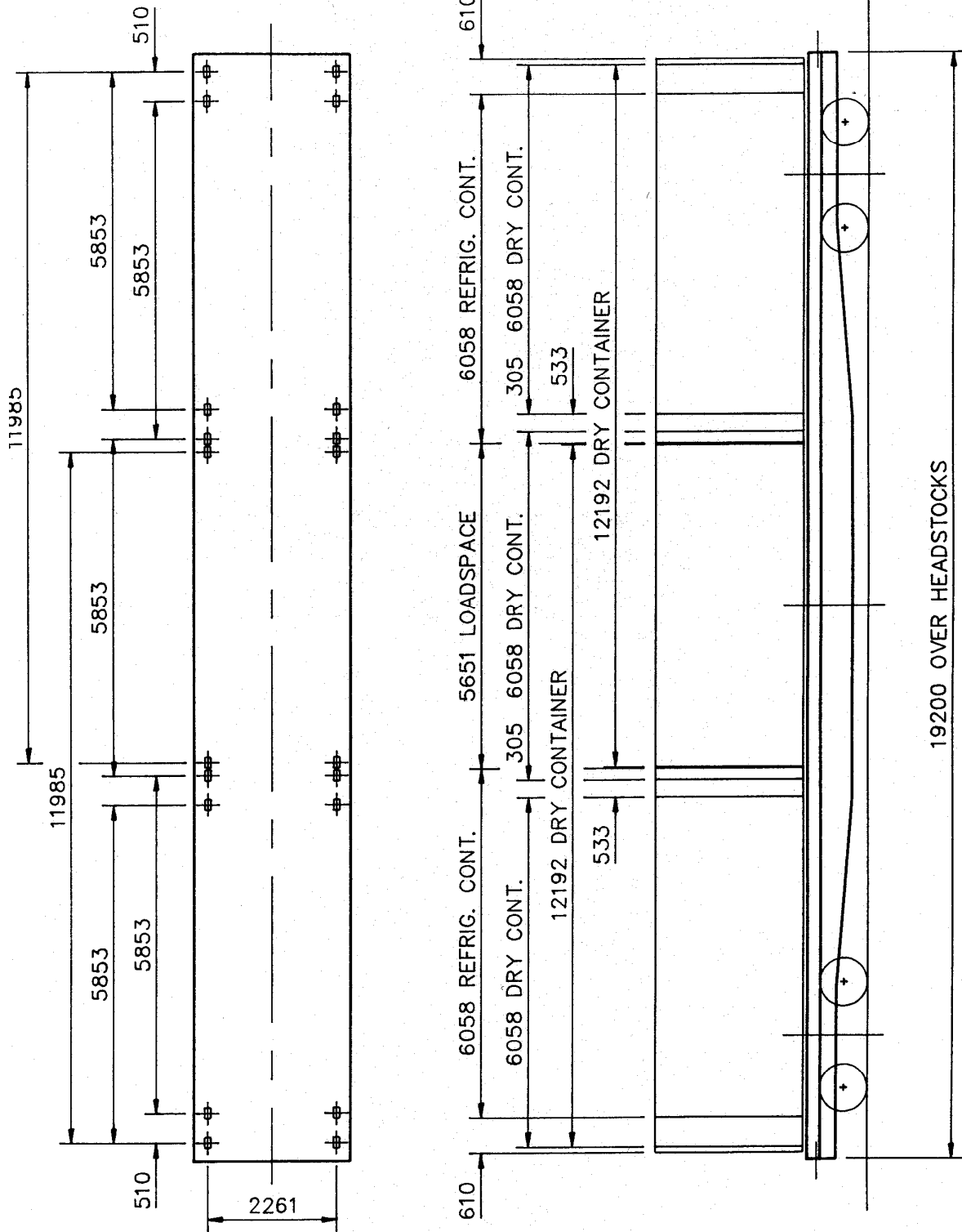


DIAGRAM 11-4
 TYPICAL TOFC FLAT CAR
 SINGLE TRAILER

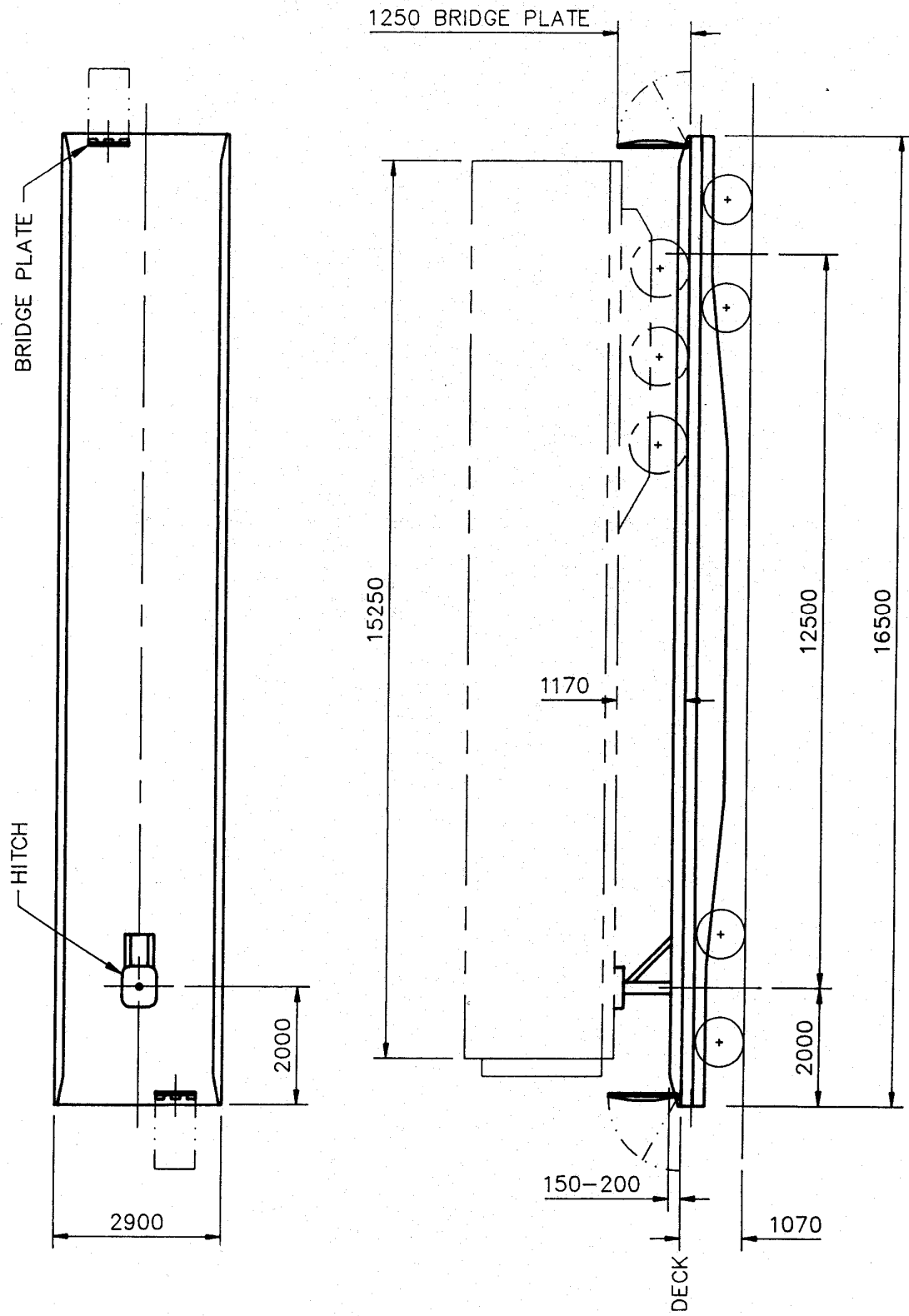


DIAGRAM 11-5

TYPICAL TOFC FLAT CAR
FOR TWO TRAILERS
1250 BRIDGE PLATE

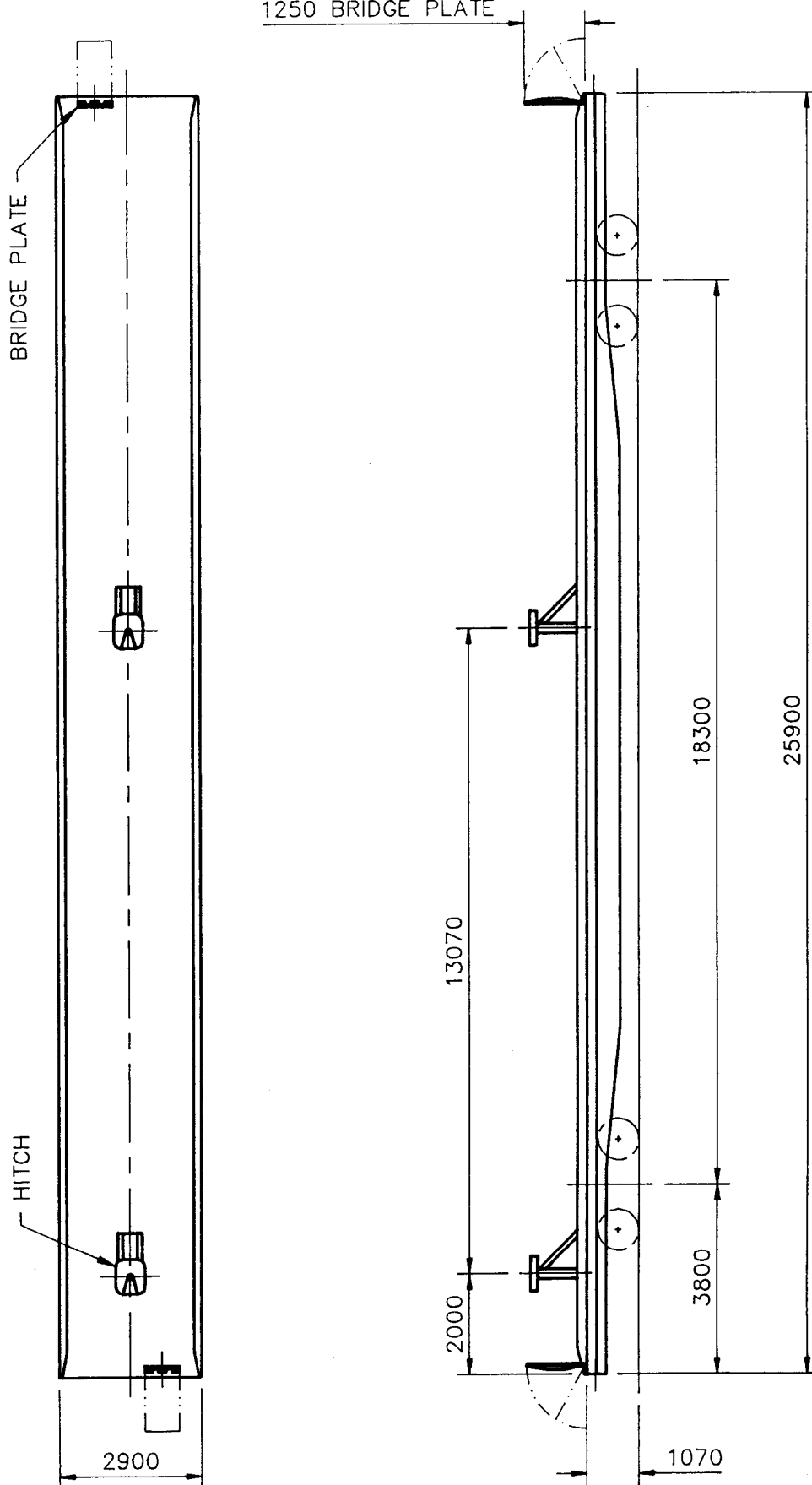


DIAGRAM 11-6
EXTERNAL WHEEL GUIDES

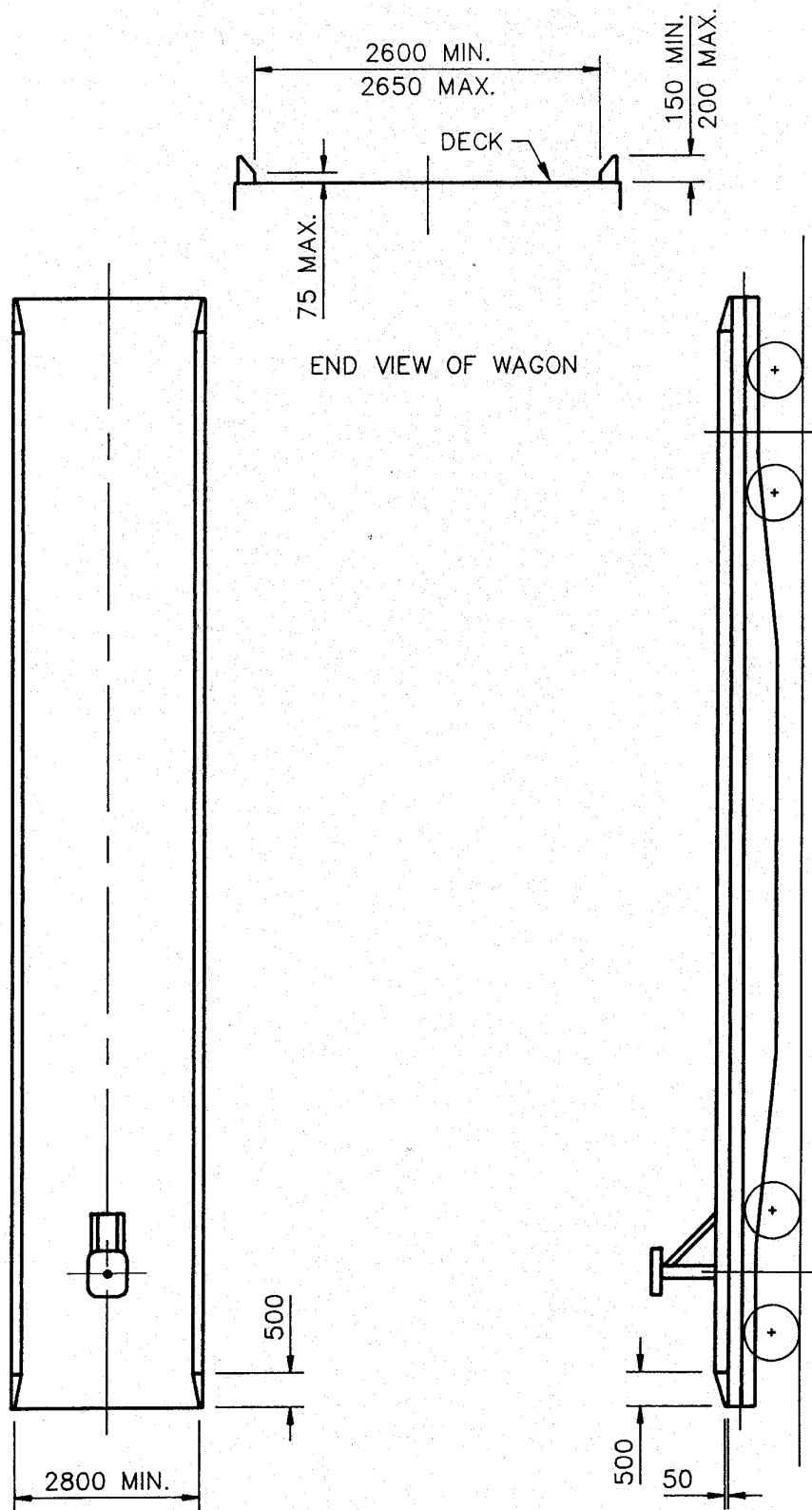


DIAGRAM 11-7
INTERNAL WHEEL GUIDES

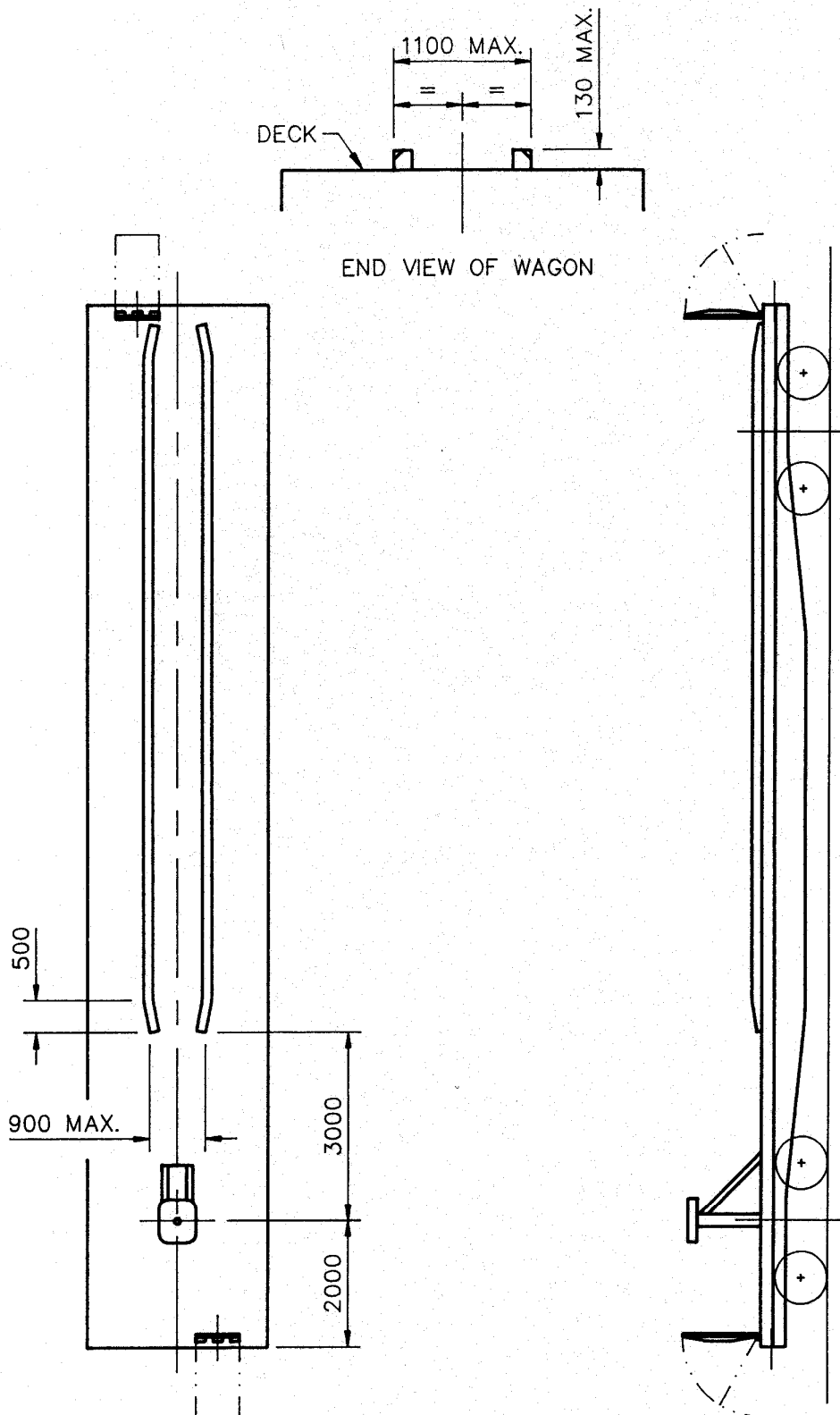


DIAGRAM 11-8

BRIDGING PLATE

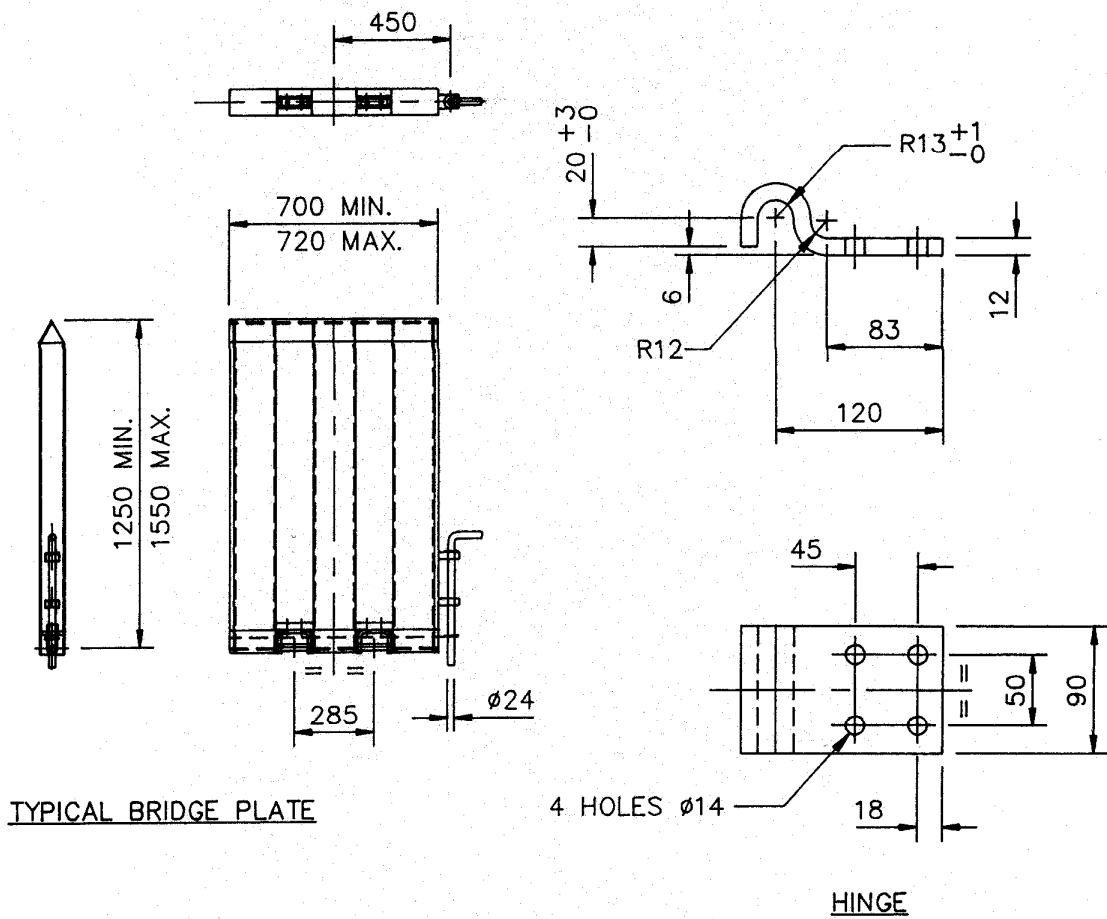
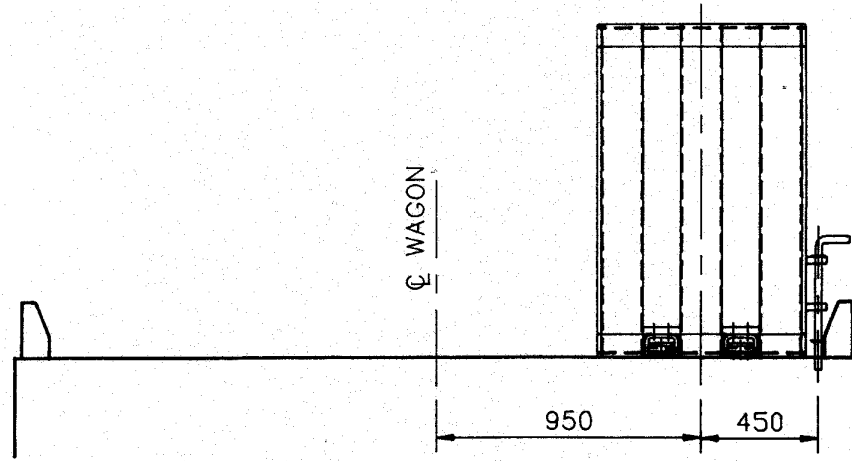


DIAGRAM 11-9

BRIDGE PLATE APPLICATION

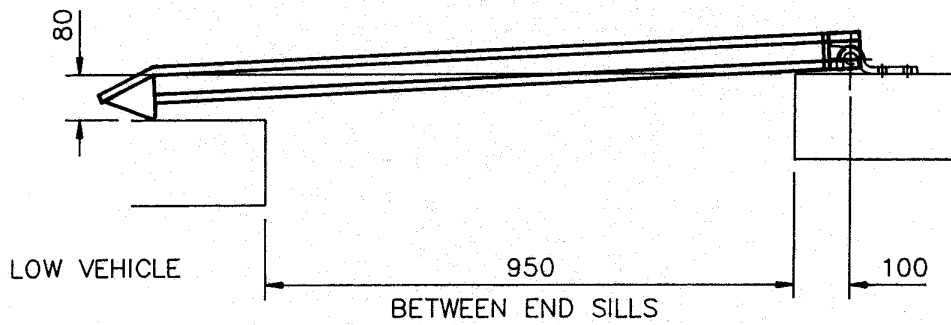
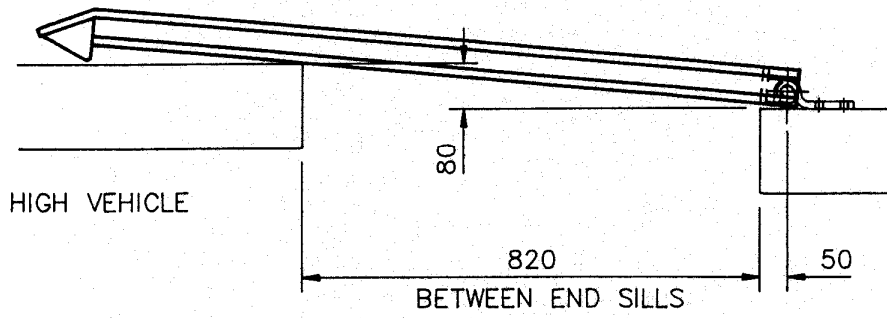


DIAGRAM 11-10

TRAILER SECUREMENT USING CHAIN ASSEMBLIES

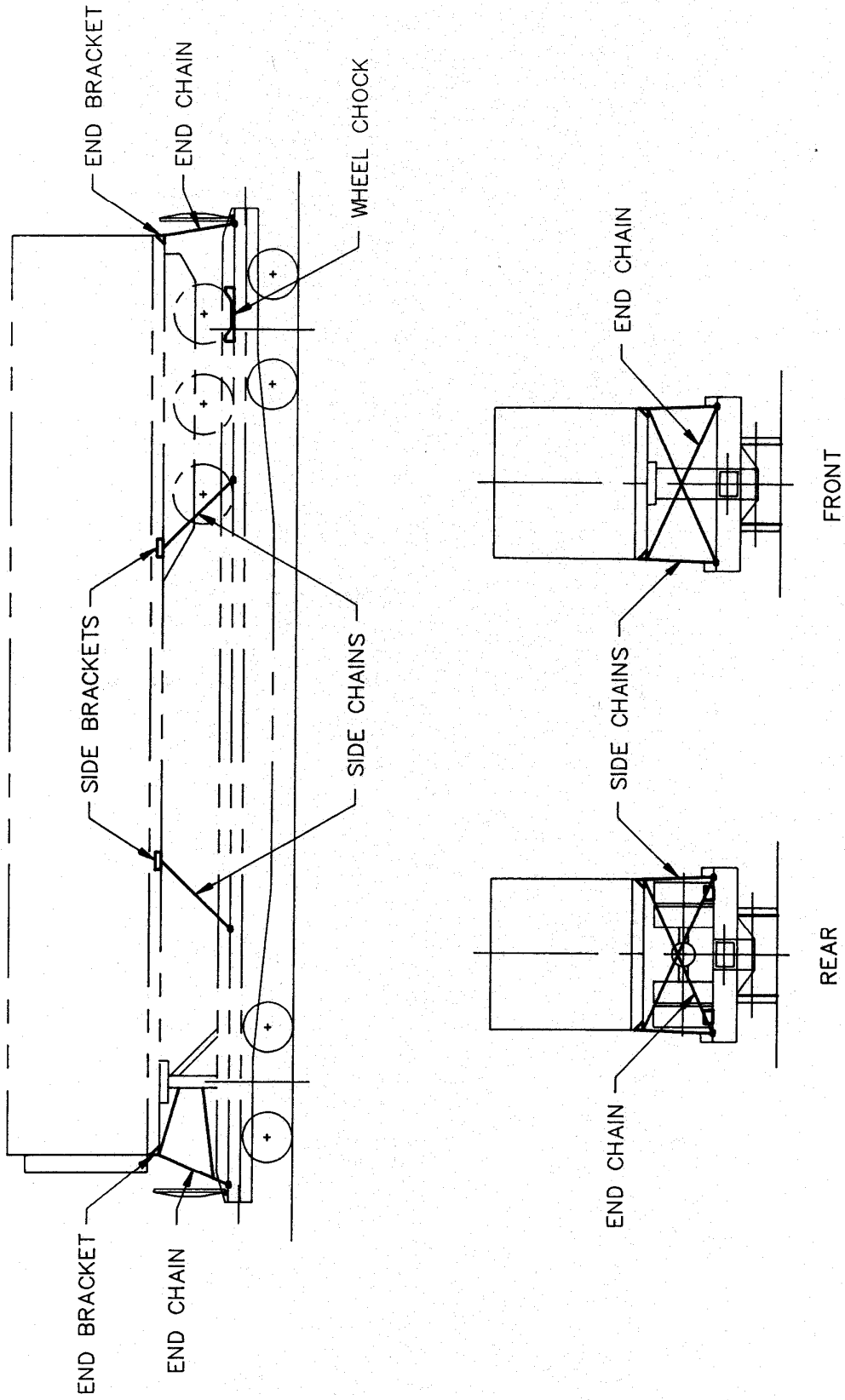


DIAGRAM 11-11

TRAILER SECUREMENT USING ROPES AND CHAINS

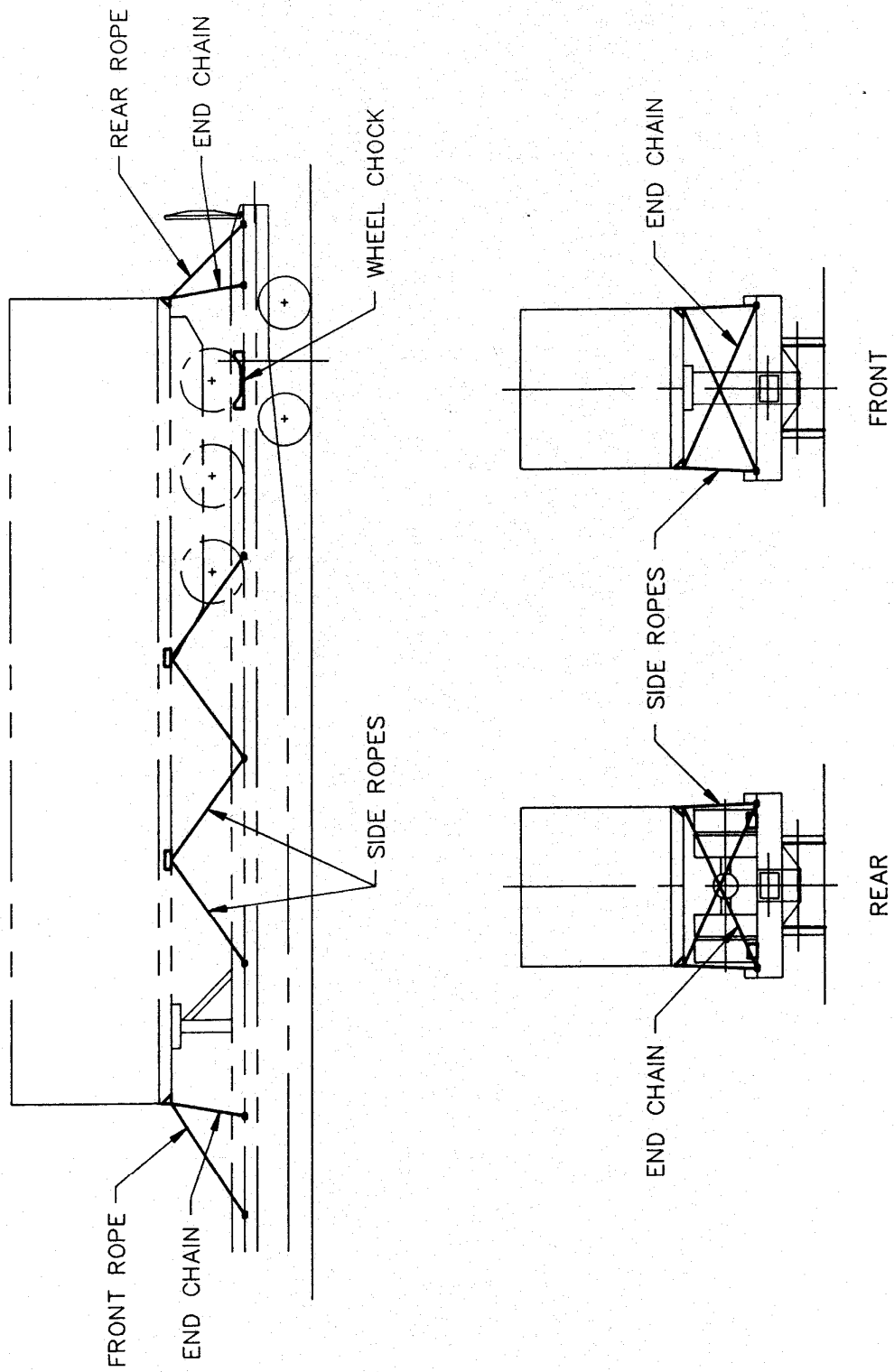
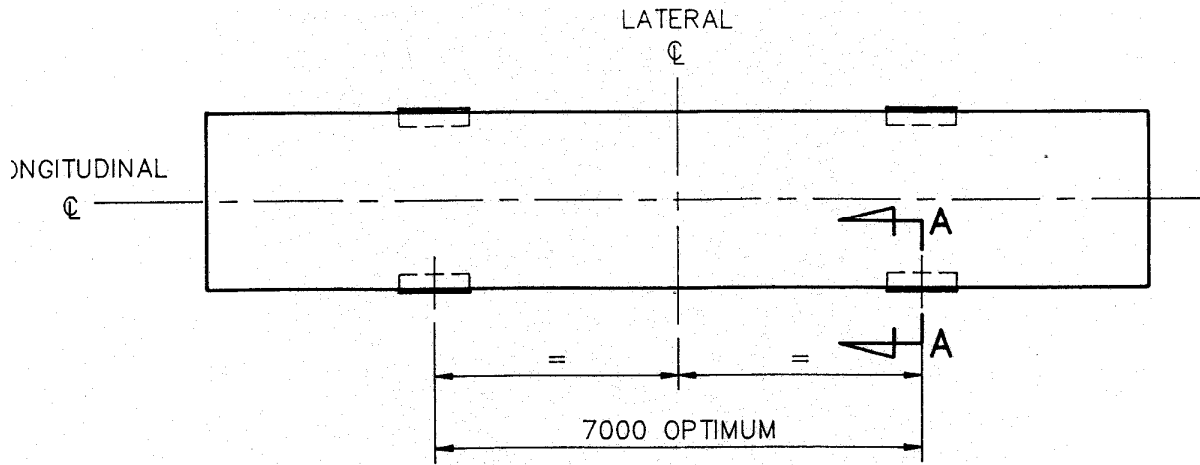


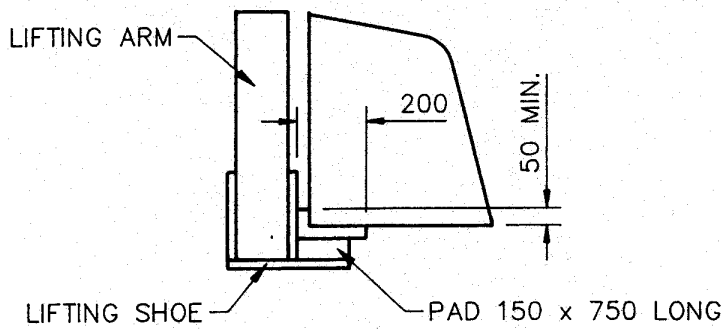
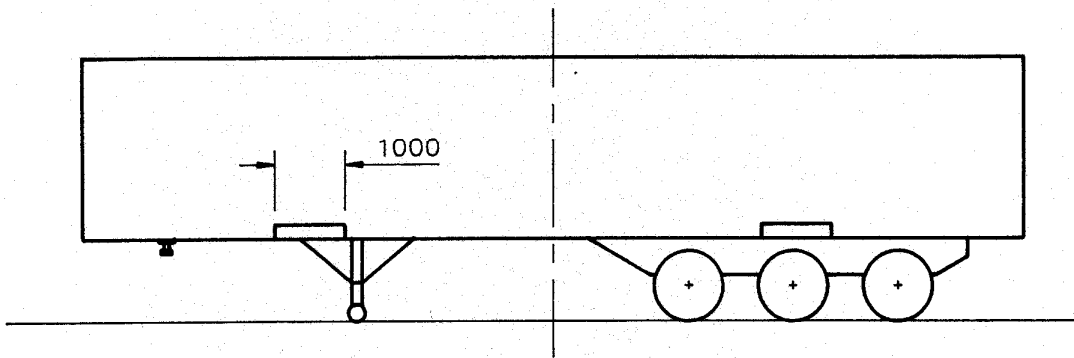
DIAGRAM 11-12

SEMI-TRAILER LIFTING PADS



5000 MINIMUM CENTRE TO CENTRE SPACING OF LIFTING ARMS

11000 MAXIMUM CENTRE TO CENTRE SPACING OF LIFTING ARMS



SECTION A-A TYPICAL LIFTING PAD SECTION