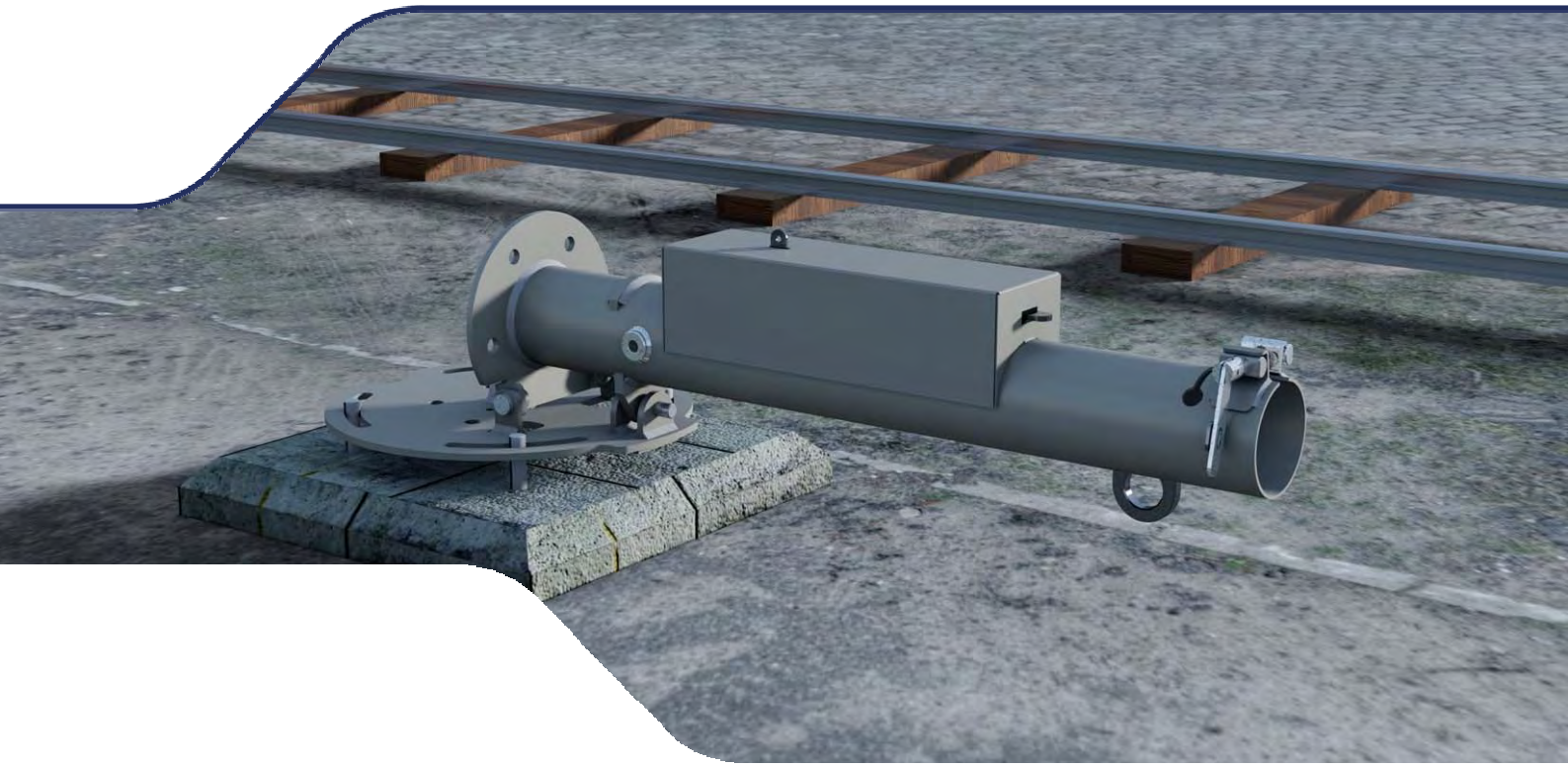
Standard Assisted Lift Trunnion



Operation & Maintenance Manual

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UNIPART DORMAN

INTELLIGENT ENGINEERING UNIQUE PEOPLE WORKING TOGETHER

Table of Contents

Document Control....2
Introduction....2
Safety....3
Dimensions....5
Description....7
Signal Lifting Force Data....8
Storage and Movement....9
Tooling....10
Foundation and Site Checks....10
Pre Installation Checks....11
Installation....12
Torque Loadings....14
Lowering the ALT to the Horizontal Position....14
Inserting the Post and Erecting the Signal....16
Electrical Connection....20
Signal Alignment....21
Signal Alignment....22
Post Installation Checks....26
Leaving the Signal/Trunnion in the Horizontal Position....26
Maintenance Activity....26
Signal Husbandry....27
Service and Repair....27
End of Life Disposal....27
Product Support....28
Product Labelling....28
Appendix A....29

Document Control

It is the reader's responsibility to ensure they have the correct version of this document. If in doubt, please contact Unipart Dorman to verify the current issue status.

Issue Number	Dated	Reason
1	Jan 2016	Initial Issue
2	Mar 2016	Incorporates new images and features as requested by customer
3	Jun 2016	Incorporates new safety warnings and updated drawings and images
4	Feb 2019	Improvement to Signal Sighting Procedure
5	Mar 2020	Revised Signal Alignment Section based upon customer feedback

Introduction

The Unipart Dorman Assisted Lift Trunnion (ALT) is a versatile yet simple signal mounting solution for installation in a wide variety of applications and only requires a spirit level, a tape measure, a sighting scope, a spanner, a torque wrench and two sockets to install and commission.

The ALT uses a progressive rate spring controlled by a fulcrum system which allows the force required to move the signal post from the horizontal to vertical to be equalised across the full range of movement such that it can be raised and lowered by a number of operatives.

The signal is designed to interface with most Unipart Dorman Lightweight and Classic Signals and can be used for a range of diverse equipment including Level Crossing Wig Wags. It is quickly installed onto 4 x 200mm M24 studs set in a standard foundation or screw pile system.

This document shall be deemed the 'Original Instructions' required by the Machinery Directive

Safety

Activities which may pose a hazard will have the following highlighters:

Activities identified as needing extra care are highlighted using the Caution Symbol

ACTIVITIES WHICH ARE OR HAVE THE POTENTIAL TO BE HAZARDOUS TO PERSONNEL AND/OR EQUIPMENT ARE HIGHLIGHTED WITH THE WARNING SYMBOL

The Unipart Dorman ALT has been designed using the principals shown in the Yellow Book (Engineering Safety Management) and has been subjected to extensive calculations and testing throughout its development. There is a Designers Risk Assessment detailed in the generic submission for approval to Network Rail and whilst comprehensive, it shall not be used as a substitute for a properly constituted and documented on-site assessment.

Before commencing assembly, any local safety requirements affecting the continued safe working environment of the signalling installation site and/or the working railway, either directly or indirectly should be carried out.

BEFORE THE COMMENCEMENT OF ANY ACTIVITY, ARRANGEMENTS SHALL BE APPLIED TO PROTECT THE WORKING RAILWAY.

It is the user's responsibility to ensure all necessary risk assessments, permissions to work and preparatory safety activities are correctly completed and adhered to throughout the installation and subsequent life of the signal.

This Operation and Maintenance document is designed to illustrate safe methods of work and highlight potential dangers to workers. It is a generic guide only and the content is not to be used to substitute or justify the omission of good engineering practices.

FAILURE TO ADHERE TO THE INSTRUCTIONS AND WARNINGS CONTAINED IN THIS PUBLICATION COULD CAUSE SERIOUS INJURY, ENDANGER LIFE AND/OR CAUSE CATASTROPHIC DAMAGE TO THE EQUIPMENT AND SURROUNDING INFRASTRUCTURE.

The weight of the ALT is clearly marked and installers should ensure that they have sufficient measures in place to ensure a safe lift. The marked weight is for the ALT only and does not include any pallet or packaging weight.

The ALT shall not be used for any purpose other than that described in the introduction above. If it is used for any other purpose, Unipart Dorman will not accept any responsibility for damage, injury or death caused by the activity.

All activity on the ALT and any associated head/post, both mechanical and electrical, must only be carried out by staff deemed competent in these fields by their employer. It is the user's sole responsibility to ensure that the apparatus is installed and/or maintained by competent staff. Where a specific competency is subject to periodic retest and certification, it should be valid throughout the time of the works.

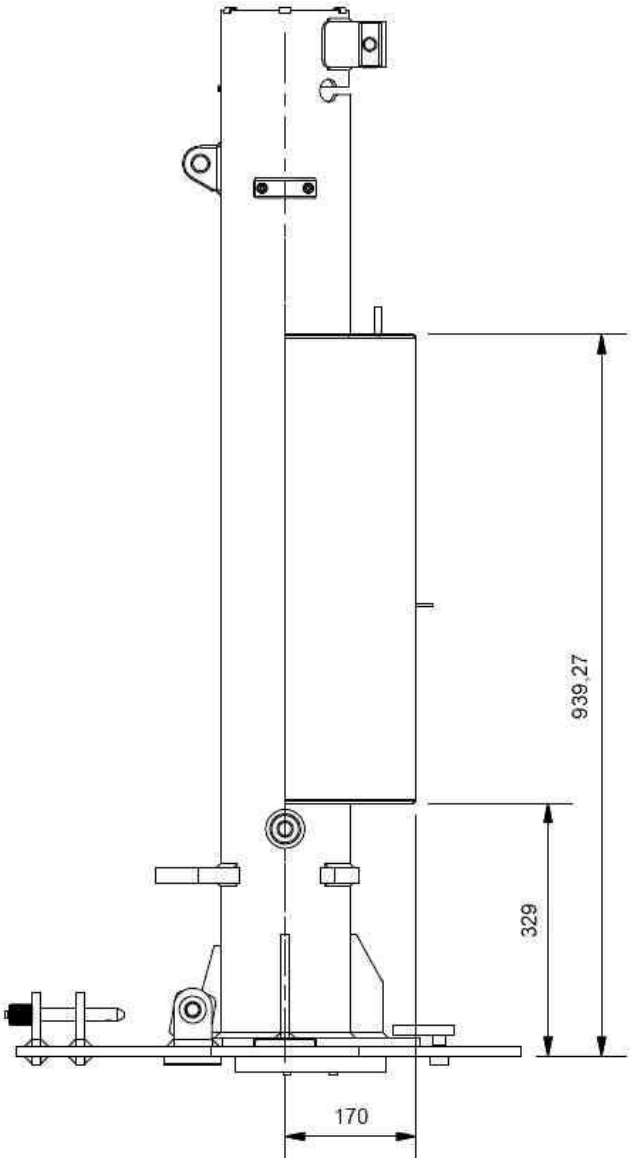
A copy of these instructions should be readily available. Anyone required to operate the ALT is to be fully conversant with them and deemed sufficiently competent (and where necessary properly certified) to undertake the task by their supervisory chain. The latest version of this document is available from Unipart Dorman using the contact details on the back page or by visiting:

http://www.unipartdorman.co.uk/assets/alt_ops_manual.pdf

Operating Safely

IF ANY DOUBT EXISTS ON THE SERVICEABILITY OF THE ALT, YOU ARE NOT SURE ABOUT ANY OF THE INSTRUCTIONS IN THIS DOCUMENT OR YOU ARE UNSURE OF THE CORRECT WAY TO USE THE ALT, YOU SHOULD STOP WORK AND CONTACT YOUR SUPERVISOR IMMEDIATELY AND IF NECESSARY CONTACT UNIPART DORMAN FOR SPECIALIST ADVICE USING THE DETAILS ON THE BACK PAGE

Dimensions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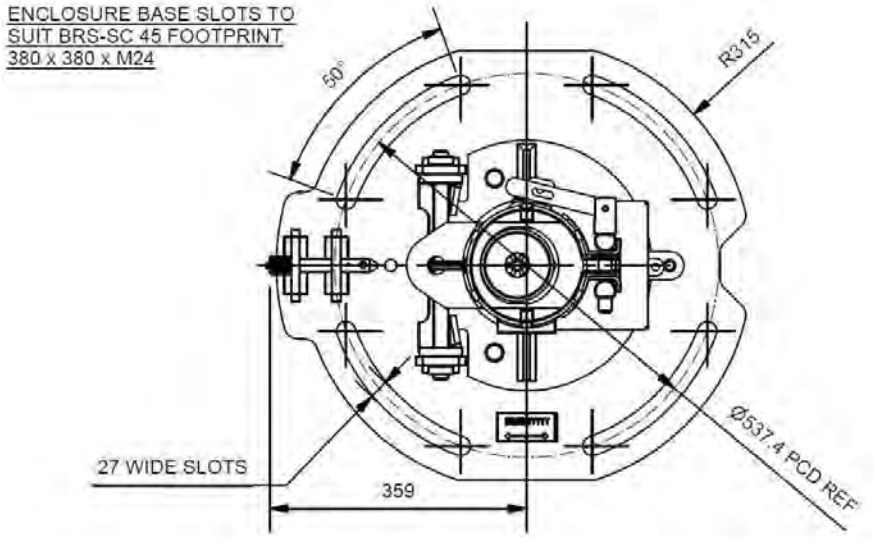
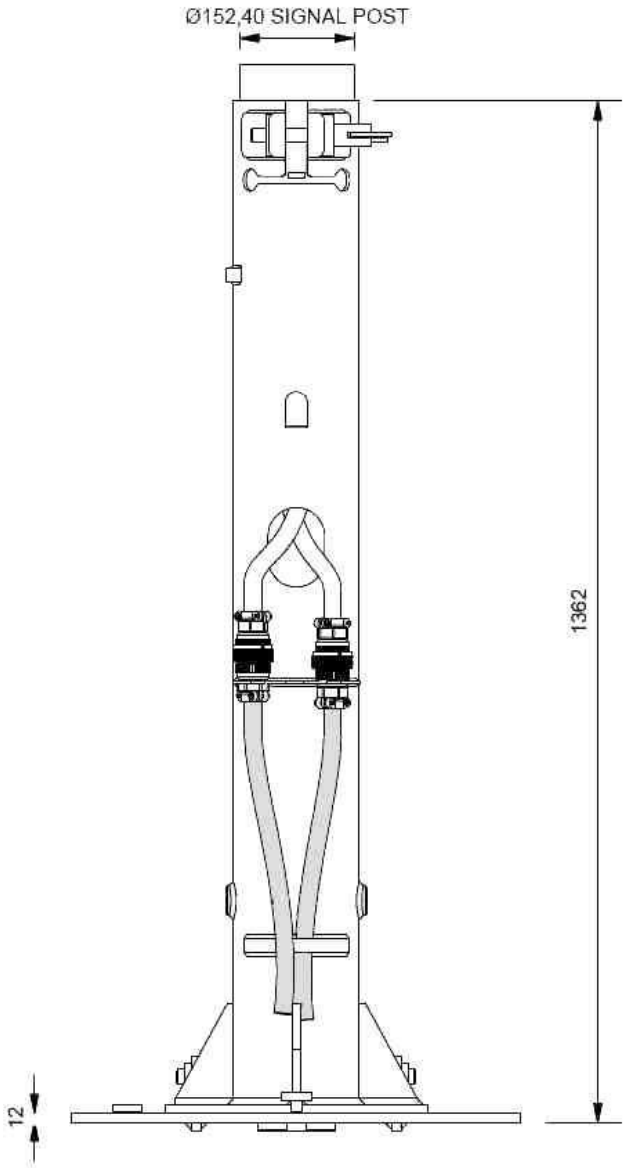

ENCLOSURE BASE SLOTS TO
SUIT BRS-SC 45 FOOTPRINT
380 x 380 x M24
50°
R315
27 WIDE SLOTS
359
Ø537.4 PCD REF


Ø152,40 SIGNAL POST
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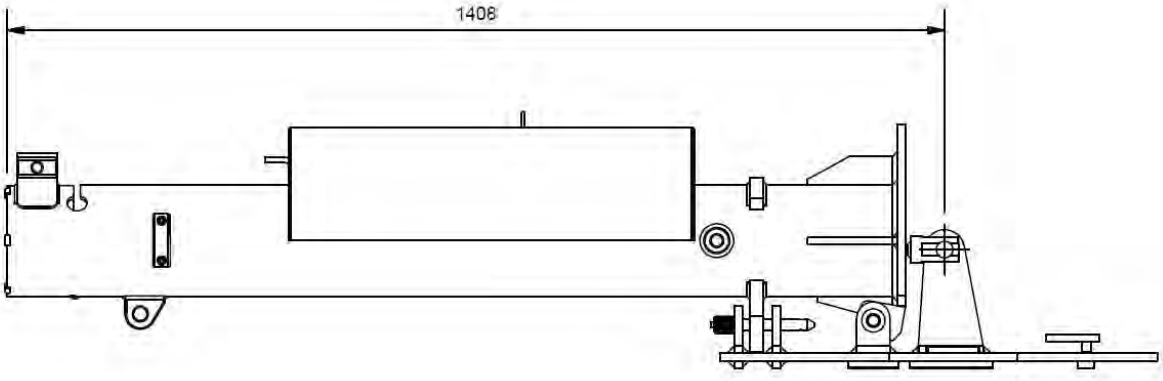
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Description

The Unipart Dorman ALT is a device designed to be used in the railway environment as a means of erecting a signal and then forming the support structure for that signal. It is constructed of 2 main sub-assemblies. The base plate, which is designed to suit a BRS-SC-45 footprint, is attached to a tubular unit at a main hinge and spring unit hinge point. The tubular section encloses the lift augmentation spring and its mountings, and has the lifting eye, post securing collar and electrical connection box as constituent parts. The 2 sub-assemblies share mountings for the hold down pin and brackets.

Once the signal head and post are inserted and the ALT is in its vertical position the two sub-assemblies are secured together using 4 x M24 bolts and this action forms the main mounting interface between the signal and the foundation.

Signal Lifting Force Data

The ALT system will support a wide range of Unipart Dorman signals as included within its F001, F002, and F003 submission, all available at varying heights as measured from the top of the rail head to the centre of the most restrictive aspect.

Each individual signal undergoes a set of structural calculations to confirm it complies with PAN/E/CE 0017 (Project Advice Note – Signal Structures – 'Form A' Guidance for Loading and Performance') and this, together with the restrictions on signal head configurations included within the generic F001, F002, and F003 submission delivers a robust system that mitigates the risk of the safe working load on the Signal Post and ALT Assembly being exceeded.

The ALT spring system is designed to provide assistance to personnel engaged in manually lifting or lowering the signal about the vertical position. To give some guidance on the force required to operate the ALT system and consequently the *suggested* amount of workers needed to complete the task safely, Unipart Dorman has produced lifting force graphs as shown in Appendix A.

It is impossible to determine the site conditions, capability of the persons engaged in the operation and other variables at each individual location. Consequently, the data shown in the Appendix is only provided to *assist* in the formulation of individual site risk assessments and method statements. Unipart Dorman does not accept any responsibility for any misuse of this guidance data which subsequently causes injury or damage

The graphs at Appendix A using the following fixed parameters to deliver consistency of data:

Calculation Parameters

- The three most common signal heads have been chosen for the calculations and graphs - Type 1 (standard 3 aspect mainline Colour Light Signal), Type 50 (standard 4 aspect mainline Colour Light Signal) and Type 100 (standard Banner Repeater).
- An example signal height of 5.1 metres from aspect centre to signal base has been used.
- All signal posts are fitted with a 4mm aluminium liner.
- The calculations include an example wind speed factor of 'not to exceed 26mph'.
- The dataset is based upon a 'standard' UK man who is 5ft 10inches (1.78m) tall and with average build.

(Please note that the parameters above were chosen as examples only and do not form any limitation on the signal type, height or liner which can be specified).

A data line has been plotted on the graphs showing the force required using 1, 2, 3 or 4 operators to raise and lower the signal.

The information used and shown in the graphs has been calculated in Newtons as the force required is applied through an arc. It is anticipated that during a lift, the operators will be moving closer to the pivot point as the signal is raised and further away whilst being lowered which causes the 'force required factor' to change as the signal post angle changes and this effect is displayed in the data shown on the graph.

Storage and Movement

The ALT is supplied on a standard pallet and may be stored in the open air. The fasteners used to secure the unit to the pallet should not be used as mounting hardware during installation and all packaging materials when removed should be disposed of in accordance with local regulations.

DO NOT ATTEMPT TO MOVE THE ALT FROM ITS VERTICAL POSITION TO THE HORIZONTAL WHEN INSTALLED ON THE SHIPPING PALLET AS THE FORCE REQUIRED WILL CAUSE IT TO TOPPLE AND POTENTIALLY INJURE THE OPERATOR OR DAMAGE THE UNIT.

Whilst the ALT can be stored in its open or horizontal position secured by the retaining pin, the amount of time it is stored in this condition shall not exceed 6 months. It is essential that the R pin or padlock is securely fitted into the retaining pin when the ALT is in the horizontal position.

It should be noted that the ALT weighs typically 73kg and if it is to be moved by anything other than mechanical means using the lifting eye provided, then the appropriate risk assessment should be undertaken by the user prior to manual handling.

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Exercise extreme care when handling in 3rd Rail and OLE areas even with isolation measures in place.

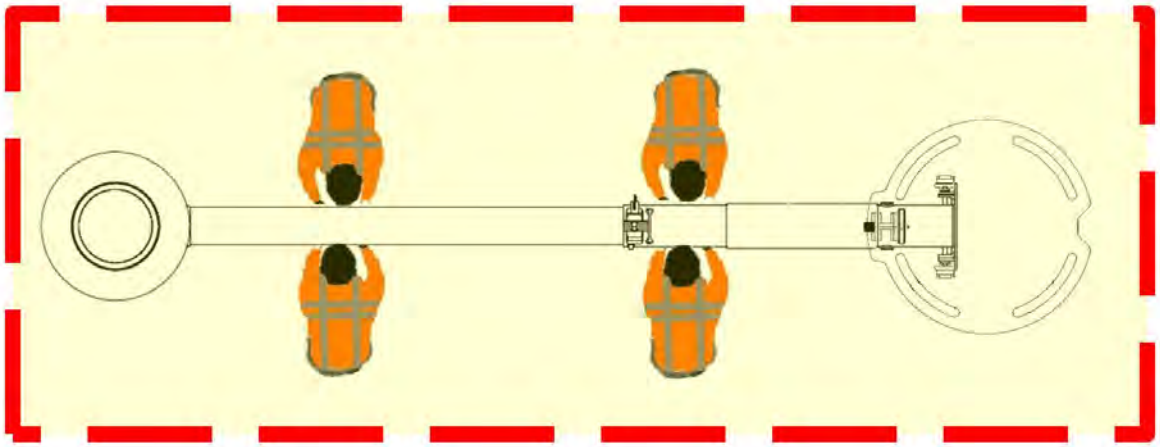
Tooling

With the exception of the sighting scope the only tools required are simple hand tools such as Torque Wrenches, 30mm and 36mm Sockets/Spanners. A spirit level and tape measure are required to prove that the foundation is prepared correctly prior to any installation activity.

Foundation and Site Checks

Foundations should be secure and clear of any obstructions with studs fitted as shown in the Pre Installation Checks below. The maximum recommended height between the top of the foundation and the surrounding terrain is 200mm.

A zone equivalent to the swept area of the signal being raised/lowered plus a reasonable margin either side to allow adequate footing for personnel engaged in the lift should be established. This zone should be firm and level with all hazards that could cause slips, trips or falls removed.



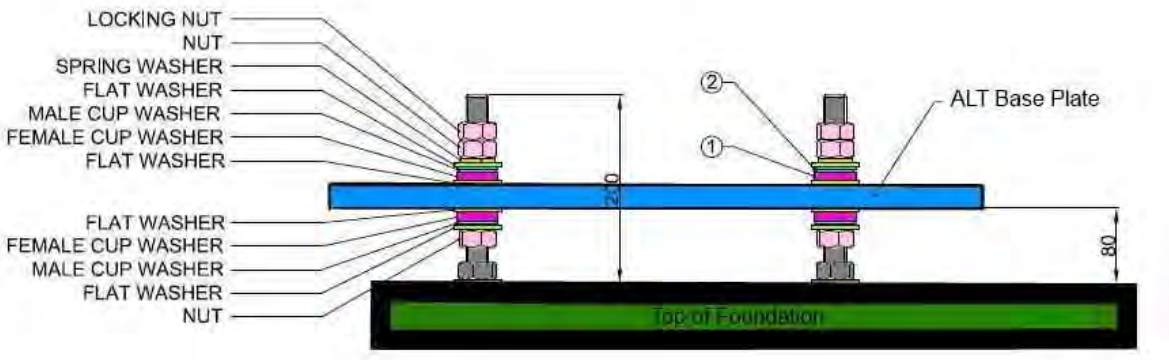
Example Safety Zone in place for lifting/lowering a signal

This image is for illustrative purposes only and does not represent the number, or placement of workers to enable a safe lift

During lifting and lowering all workers should stand to the side of the ALT/Post and never enter the swept area of the ALT/Post unless the unit is either secured in the horizontal using the locking pin or securely bolted down in the vertical position.

Pre Installation Checks

Prior to mounting the ALT a check shall be made with a spirit level to ensure that the foundation and therefore the top of all four mounting studs are level and at least 200mm of stud is available above the foundation top. The mounting studs should be clean, free of damage and lubricated. Mounting nuts and washers shall then be fitted strictly in the sequence shown below; ensuring that the distance between the bottom of the ALT base to the foundation top surface is >80mm.



The only mounting hardware supplied with the ALT is the cup washer set (item 1&2 on the illustration above. All other hardware is to be provided by the customer. Spare washer sets are available using the order detail below.

ITEM	PART No.	QTY	DESCRIPTION
1	B18.17227	8	M24 SPHERICAL WASHER DIN 6319 TYPE D FEMALE
2	B18.17228	8	M24 WASHER DIN 6319 TYPE C MALE

The signal and post should be checked for damage and any remaining transit packing materials should be removed and correctly disposed of. The ALT bore is to be free of debris and any other obstruction and the Post Clamp should be loosened to enable the post to be inserted.

If the signal is not to be commissioned immediately, the relevant out of use mask is to be fitted prior to lifting the post.

Where the ALT is to be installed in advance of the post and head installation it is preferable to leave it in the vertical position. However, if correctly secured using the retaining pin which is locked by the R pin or a standard padlock it can be left in the horizontal position for a period of **up to** six months.

It is possible to sight the complete signal without the head and post as described in the signal sighting section below.

Installation

IF ANY DOUBT EXISTS ON THE SERVICEABILITY OR OPERATION OF THE ALT AND/OR THE SIGNAL YOU SHOULD CONTACT UNIPART DORMAN IMMEDIATELY

It is assumed that the foundation for the particular signal has been installed and has been accepted by the person responsible for structures prior to commencement of the installation. The Pre-Installation checks shown above should be carried out immediately before fitting the ALT to the studs.

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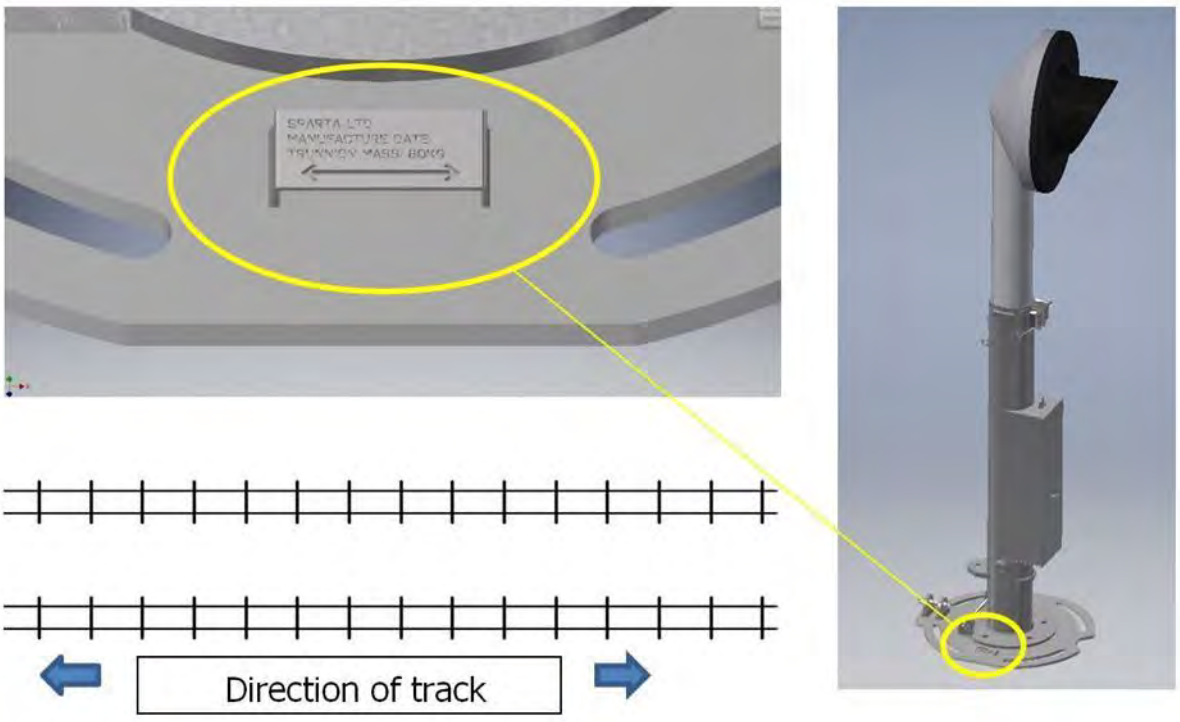
Lift the ALT into position onto the four 24mm studs taking care to align the arrow on the ALT Base parallel with the direction of the running rail. Then fit the remaining washers and nuts to secure it onto the studs.



Torque Loadings

	Nm	Lbf/Ft
M24 Mounting Nuts	195	143
M20 Trunnion Bolts	160	118
Padlocking Lever	**Hand tight Only**	-
Scope Fitment Screws	**Finger tight Only**	-

Lowering the ALT to the Horizontal Position

DO NOT REMOVE EITHER THE RETAINING PIN OR MOUNTING BOLTS WITHOUT FIRST ESTABLISHING CONTROL OF THE MOVABLE SECTION. SPRING FORCE IS APPLIED TO THE UNIT THROUGHOUT ITS RANGE. IF CONTROL IS LOST, THE UNIT MAY MOVE RAPIDLY TOWARDS THE VERTICAL CAUSING SERIOUS INJURY TO ANY OPERATORS IT MAY STRIKE AS IT DOES SO.

Before lowering the ALT a check should be made to ensure that the restraining pin and R pin are available, still attached by lanyard to the ALT base and that the base is secured correctly to the mounting studs. Remove the bolts and washers securing the tube section and retain.

A TRAP HAZARD EXISTS BETWEEN THE TUBE ASSEMBLY AND THE BASE WHEN IT IS IN OPERATION. ENSURE NO FOREIGN OBJECTS OR BODY PARTS ARE ALLOWED TO ENTER THIS AREA

A *minimum* of 2 people should then push the tube section over to the horizontal position where another operative secures it using the retaining pin and either a standard railway padlock or the supplied R Pin. (extra personnel may be required to assist when pushing against the spring resistance during this operation).

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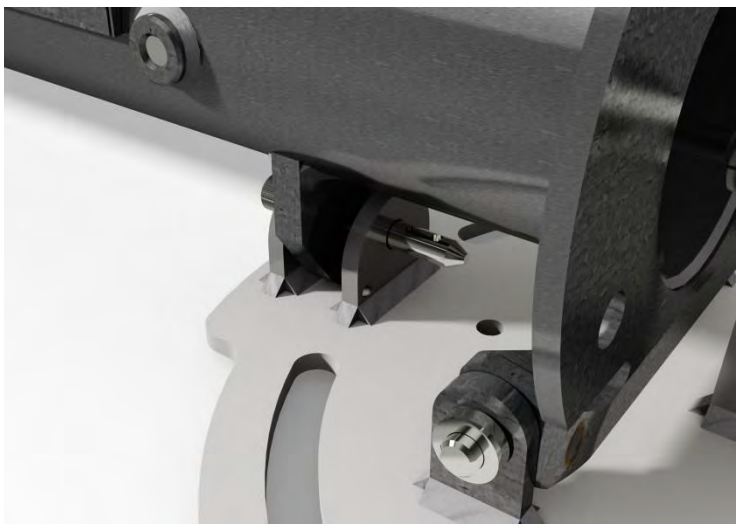
THE ALT IS NOT TO BE LEFT UNATTENDED/UNSUPPORTED WITH THE BOLTS REMOVED UNLESS IT IS IN THE HORIZONTAL POSITION AND THE RETAINING PIN IS FITTED CORRECTLY AND SECURED BY EITHER A PADLOCK OR R PIN



(R Pin/Padlock not shown for clarity)

MOVING THE TUBE ASSEMBLY SHOULD ONLY BE DONE FROM A POSITION THAT DOES NOT REQUIRE THE OPERATORS TO STAND DIRECTLY IN LINE WITH THE ARC THAT THE TUBE ASSEMBLY MOVES THROUGH.

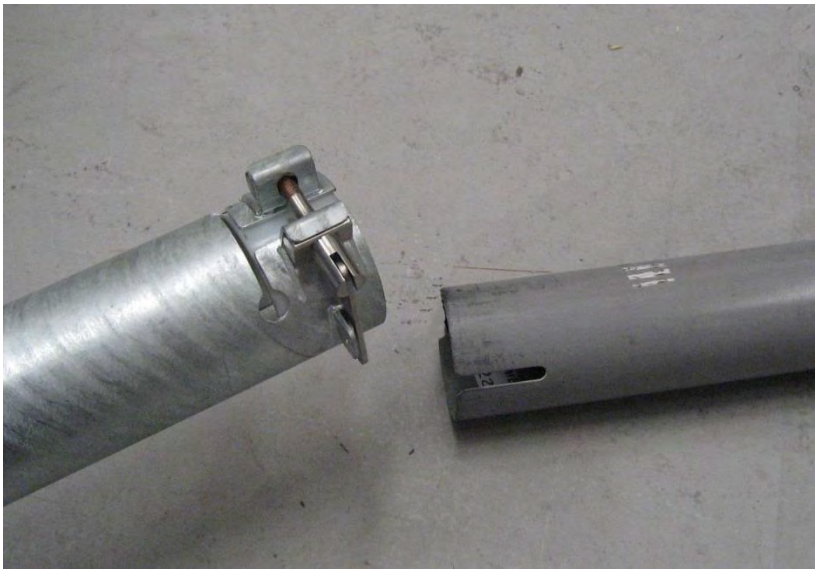
DO NOT LEAN OR STEP OVER A HORIZONTAL TUBE ASSEMBLY WHEN IT IS NOT SECURED BY THE RETAINING PIN WITH EITHER THE PADLOCK OR R PIN SECURELY FITTED

Inserting the Post and Erecting the Signal

LIFTING OPERATIONS SHOULD NOT BE UNDERTAKEN WHERE THE GUSTING WIND SPEED EXCEEDS 26 MILES PER HOUR (48 Km per Hour)

Any attempts to lift the signal post into a vertical ALT, or to lift a pre-assembled post and ALT onto a foundation may result in undetectable damage to the GRP post/signal assembly.

The bore of the ALT and the signal post should be checked for damage paying particular attention to the keyways on the post and the keys at the bottom of the ALT. Check the Plug Coupler and cable for damage, bent pins etc and any signs of moisture and then push them back into the bore of the post.



Undo the ALT Post Clamp, orientate the post correctly and slide it into the ALT until the keyways are engaged. The plug coupled cable is then routed out of the access hole on the GRP post and the hole in the ALT which passes into the connection box. Sufficient cable should be drawn through into the connection box to enable the plug coupler to be positioned onto the coupler retention bracket.

Check that the post cannot rotate in the ALT bore and that the painted witness mark (indicated below) on the post is level with the top of the ALT. Do not fully tighten the locking collar until the signal is in the vertical position to allow for any settling.

MOVING THE SIGNAL TO THE VERTICAL POSITION SHOULD ONLY BE DONE FROM A POSITION THAT DOES NOT REQUIRE THE OPERATOR(S) TO STAND DIRECTLY IN LINE WITH THE ARC THAT THE TUBE ASSEMBLY AND POST MOVES THROUGH.

Do not allow the signal to fall under its own weight. The spring is to provide assistance, not full support.

To raise the assembled signal and ALT, position an adequate number of workers around the sign and have them 'take the strain' to control any movement of the signal and remove the retaining pin from the base plate. Then the post can be lifted into the upright position using correct manual lifting technique augmented by the spring.

Lowering the signal is a reversal of this procedure.

IT IS VITAL THAT CONTROL OF THE MOVABLE SECTION AND HEAD/POST IS RETAINED AT ALL TIMES BY THE PERSONNEL CARRYING OUT THE LIFT/LOWER OPERATION. THE COMBINED WEIGHT OF THE HEAD/POST WILL OVERCOME THE SPRING FORCE IF CONTROL IS LOST AND CAUSE IT TO FREE FALL TO THE GROUND WITH POTENTIAL RISK TO LIFE.

As soon as the Signal and Tube Assembly is in the vertical position the latching cam should be rotated so it locks the two plates together as shown then all 4 bolts should be fitted to prevent uncontrolled signal movement due to wind action etc.

Do not rely on the latching device to provide adequate security. This is only achieved by fitting all four bolts to the base

Representative image only – Trunnion nuts and Tube bolts omitted for clarity

All mounting hardware should then be torque loaded to the values shown in the table in Section "Torque Loadings" above.

Finally, tighten the ALT collar until no movement can be detected in the spacer tube and secure with a padlock.

Electrical Connection

Align the keyway and lug inside the connector shells and turn the locking collar by hand until an audible 'click' is detected and the two indicator spots are aligned. (The spots may be of different colours; this is simply the preference of the manufacturer and does not affect the plug coupler's physical attributes)

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The Plug Couplers should connect easily and the use of handtools is discouraged. If the coupler cannot be fully engaged by hand, there may be a fault or mismatch in connection detail. This should be investigated as any attempt to force the connection may result in bent or broken pins/sockets which may require complete replacement of either the infrastructure cable or the signal module and cable

Once the connection is made the Plug Couplers should be stowed in the connection box as shown with the signal cable fitting into the recess in the mounting plate making sure the cable maintains a smooth bend radius. Spare signal cable can be tucked back into the post for stowage.

Close the connection box door ensuring the cable is central in the cut out at the base of the box making sure the cable is not damaged or pinched by the door. Secure the door with a padlock.

The ALT should be bonded to earth if required by the use of bonding straps. No specific earth bonding arrangements to the signalling elements are required by virtue of the double insulated design however a 17 mm through hole is provided on the base plate.

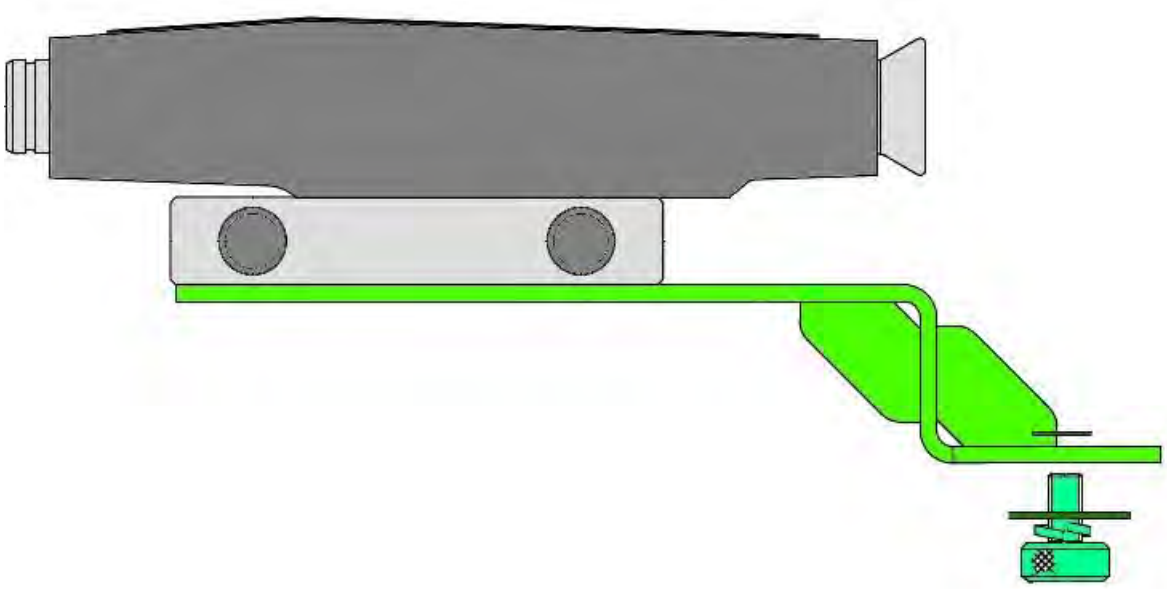
Signal Alignment

GREAT CARE SHOULD BE TAKEN TO ALIGN THE SIGNAL IN STRICT ADHERENCE TO THE SIGNAL SIGHTING FORM REQUIREMENTS

Detachable Alignment Scope

The Unipart Dorman Detachable Alignment Scope is an optical device that allows accurate signal alignment and is common to both variants of the CLS LITE. It is stored in a bespoke carrying box and should be returned to Unipart Dorman annually for an alignment verification check.

There is an adaptor bracket available that enable a suitable camera to be fitted to the scope. The camera and mount are subject to their own separate instruction sheets available on the Unipart Dorman website.



If the Scope lenses require any cleaning to be carried out, the only mediums approved are water and proprietary detergents.

Do not use any solvent based or abrasive cleaning material, as this may irreparably damage the lenses.

Ensure there is no grit etc. on the lens and then using a lint free cloth moistened with the water detergent solution, carefully wipe the lens clean before using a dry second cloth to remove any water spotting etc. and give a final buffing.

When the scope is moved from a cold to hot environment or vice versa there may occasionally be some temporary fogging of the internal lenses which will clear when the temperatures inside and outside the scope equalise.

Do not attempt to disassemble the scope to gain access to the internal lenses as this will disturb the optical alignment and the scope will need to be returned to

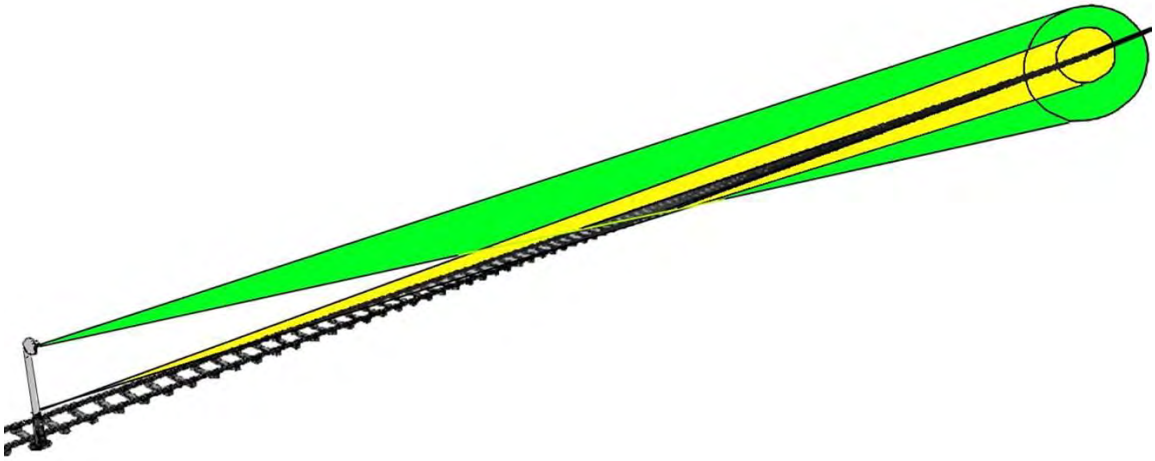
Signal Alignment

General Notes

The Signal Sighting Form (SSF) will provide the definitive, signal specific Alignment details and should always be consulted prior to commencement of work

The signal should not be aligned to a target board when using the Assisted Lift Trunnion. The beam profile allows the alignment activity to be done using the ALT mount as described below and to ensure accuracy, the signal shall be aligned to a point on the ground determined by the signal sighting form.

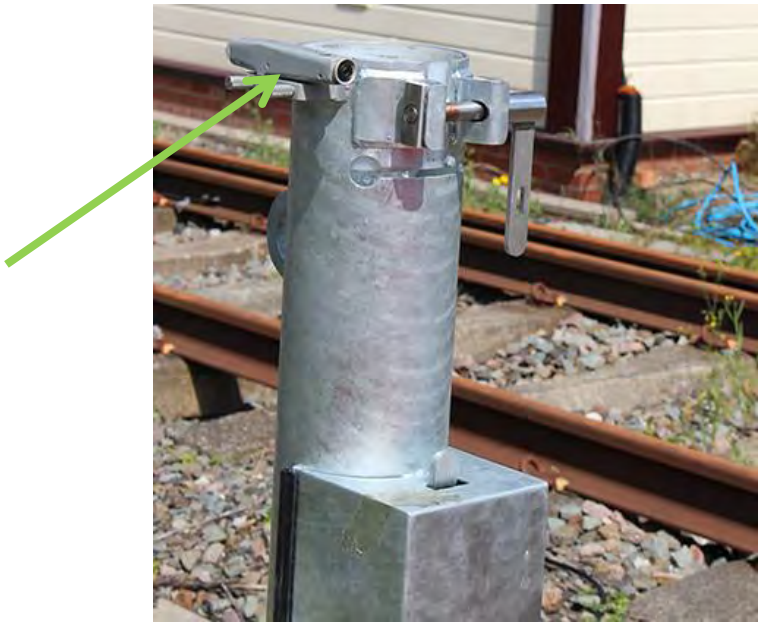
The illustration below shows a representation of the light beam shown in green and the Alignment scope field of view in yellow, converging at a point on the ground determined by the Signal Sighting Form



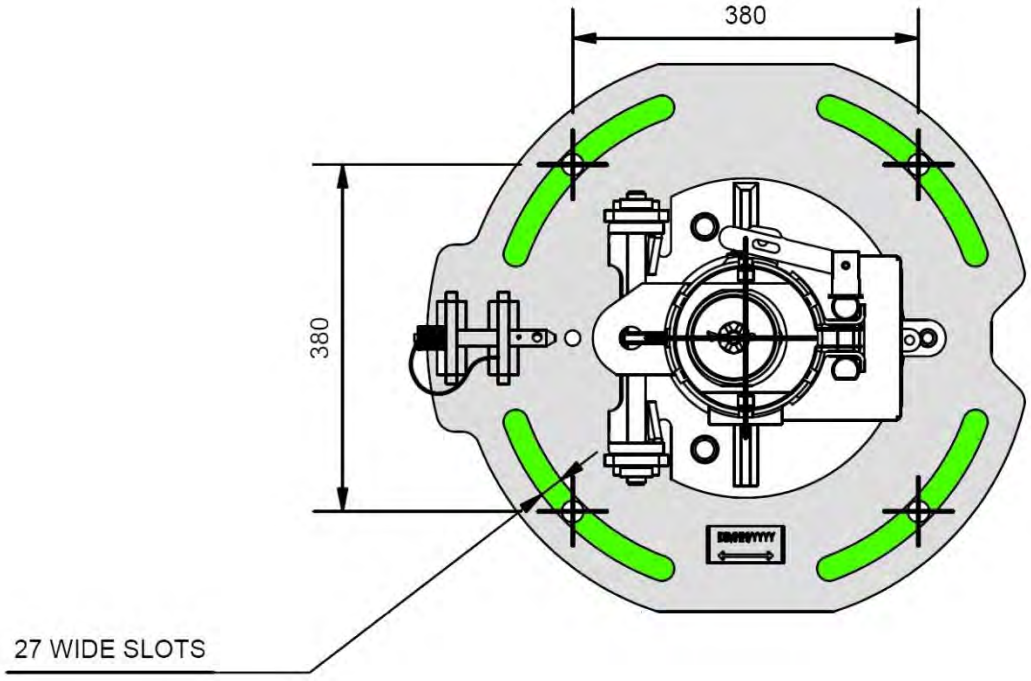
The signal shall be aligned to a point on the ground when sighted from the ALT

Fitting the Scope

The removable alignment scope unit should be fitted to the Trunnion by screwing the two knurled screws into the threaded holes as shown in the illustration below:



Using the alignment scope to provide visual cues, the signal is adjusted horizontally by rotating the base within the kidney slots and vertically by adjusting the angle of the ALT using the securing and adjustment nuts and the spherical washer sets shown in red.



The spherical washer sets are essential for the tilt adjustment and shall not be omitted

When the signal is aligned correctly to the point on the signal sighting form, ensure all the mounting nuts are correctly torque loaded in accordance with the ALT Manual and the alignment scope is removed and stored in its protective case.

If required, the adaptor plate and camera described in the Detachable Signal Alignment Scope section above can be fitted.

The arbitrary method of sighting to the AWS magnet shall not be used unless specifically authorised by the Signal Sighting Chair and correctly recorded on the latest version of the Signal Sighting Form

The Trunnion is capable of being sighted with or without the signal post installed; the post can then be fitted as and when required. When the signal is sighted as per the signal sighting form, ensure all the mounting nuts are correctly torque loaded and the sighting scope is removed and stored in its protective case.

When torque loaded to the correct value there shall be at least one full thread of the stud protruding past the top of the nut. If it is not possible to align the signal correctly and have all four nuts in safety as described plus the 80mm gap mandated in Section above, the foundation should be checked for misalignment or slippage.

BEFORE THE SIGNAL IS BROUGHT INTO USE, THE ALIGNMENT AND LOCKING DOWN OF THE HEAD SHALL BE VERIFIED AND WHERE MANDATED, A PHOTOGRAPH TAKEN OF THE SIGHTING PICTURE FOR RETENTION

Post Installation Checks

The Signal assembly has been designed for Plug and Play installation. Unipart Dorman recommends that the only test required is to have the signaller call on the aspects and ensure that the correct indications are displayed. This advice does not supersede any instructions issued by Network Rail.

Leaving the Signal/Trunnion in the Horizontal Position

If required the Signal/Trunnion can be installed and sighted and then to remove any confusion for drivers etc., it can be folded to its horizontal position and secured with the retaining pin. The retaining pin is drilled with a hole to enable the fitting of a standard RBK-221 padlock for added security.

The Signal/ALT shall not be locked in the horizontal position for any period exceeding 6 months. This is reset by raising the signal to the vertical position and then locking down again which reinitiates the 6 month count

Maintenance Activity

Both the ALT and iLS/CLS LITE signals are designed to be maintenance free. However, Network Rail may mandate some maintenance activity and this will be promulgated through the normal channels.


There is no provision to carry out any activity with the signal erected. Therefore it is to be lowered to the horizontal position using the instructions as shown in this manual.

Signal Husbandry

If the ALT/Signal requires any cleaning activity to be carried out, the only medium approved is water with the addition of proprietary soap based detergents if required .


Do not use any solvent based or abrasive cleaning material as this may irreparably damage the signal.

Service and Repair

The ALT, post/signal head and LED modules have no user maintainable elements (apart from general husbandry requirements). There are no spare parts available and the units are intended to be replaced completely should there be any failures.

End of Life Disposal

Wherever possible the electronic component parts and complete assemblies of the Unipart Dorman signal assembly are designed to be disposed of in accordance with the requirements of the latest version of the Waste Electronic and Electrical Equipment Regulations.

All other parts and assemblies are recyclable and end users should consult local and national regulations prior to disposal.

Please contact Unipart Dorman for full details of the procedure to be undertaken when a signal is permanently withdrawn from service for disposal.

Product Support

Unipart Dorman has developed a comprehensive support package including product awareness demonstrations for the complete lightweight signal range and this can be arranged by contacting Unipart Dorman using the details on the back page.

Product Labelling

The following safety label is applied to each ALT. Additional copies are available from Unipart Dorman quoting the part number B16.15560

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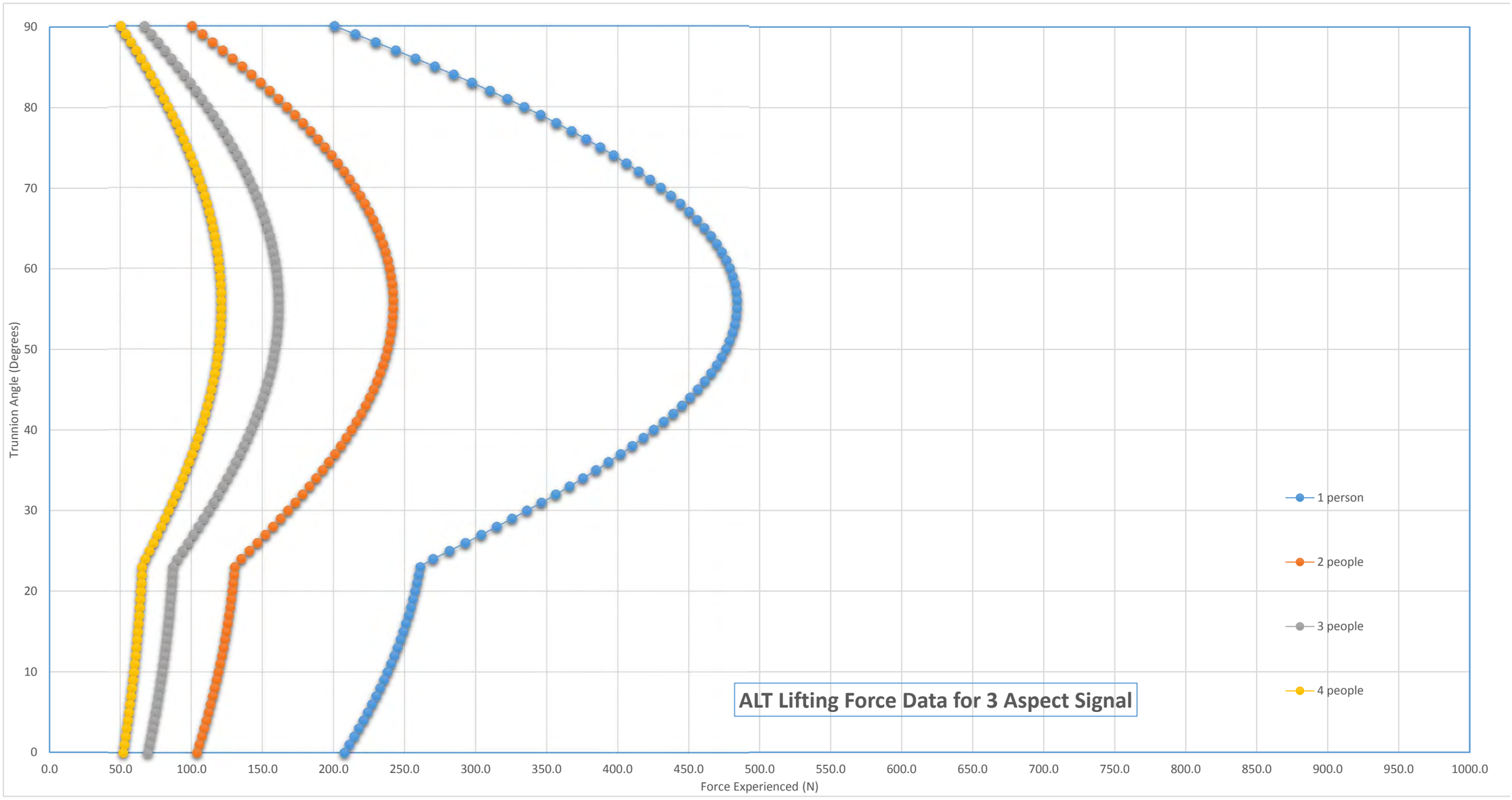
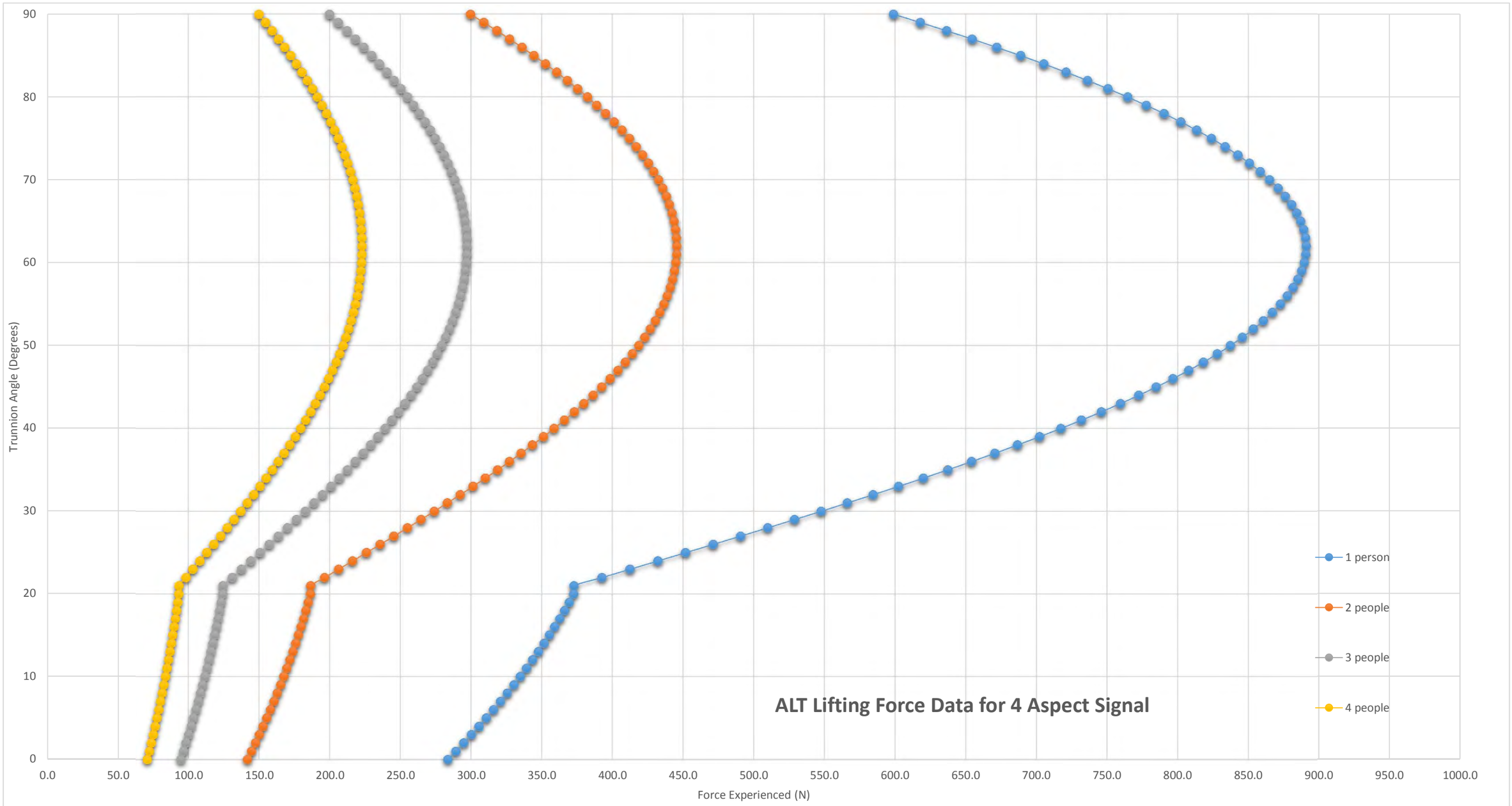
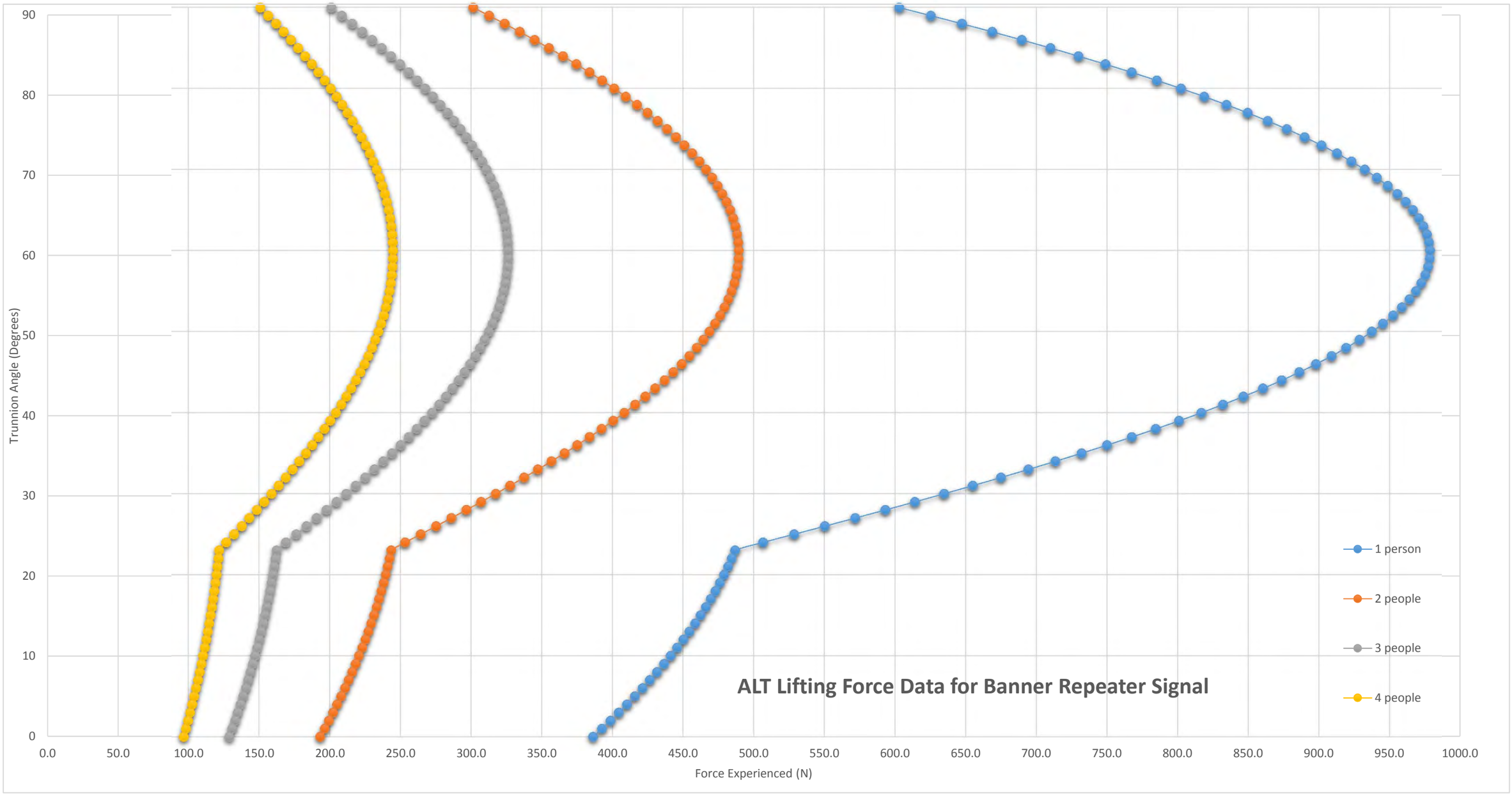
Appendix A

ALT/Signal Lifting Force Data

The data shown in this Appendix is provided to <u>assist</u> in the formulation of individual site risk assessments and method statements only. It is not to be used as a generic or definitive document in its own right and Unipart Dorman cannot accept any responsibility for any loss of life, injury or damage caused by its use as such.


ALT Lifting Force Data for 3 Aspect Signal
Trunnion Angle (Degrees)
Force Experienced (N)
0
10
20
30
40
50
60
70
80
90
0.0
50.0
100.0
150.0
200.0
250.0
300.0
350.0
400.0
450.0
500.0
550.0
600.0
650.0
700.0
750.0
800.0
850.0
900.0
950.0
1000.0
1 person
2 people
3 people
4 people


ALT Lifting Force Data for 4 Aspect Signal
Trunnion Angle (Degrees)
Force Experienced (N)
0
10
20
30
40
50
60
70
80
90
0.0
50.0
100.0
150.0
200.0
250.0
300.0
350.0
400.0
450.0
500.0
550.0
600.0
650.0
700.0
750.0
800.0
850.0
900.0
950.0
1000.0
1 person
2 people
3 people
4 people


ALT Lifting Force Data for Banner Repeater Signal
Trunnion Angle (Degrees)
Force Experienced (N)
0
10
20
30
40
50
60
70
80
90
0.0
50.0
100.0
150.0
200.0
250.0
300.0
350.0
400.0
450.0
500.0
550.0
600.0
650.0
700.0
750.0
800.0
850.0
900.0
950.0
1000.0
1 person
2 people
3 people
4 people

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