A116672

Inspection and Assessment of DVA Lifts

Department for Infrastructure

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1 Locksley Business Park, Montgomery Road, Belfast, BT6 9UP

Tel: +44 (0)28 9070 6000 Fax: +44 (0)28 9070 6050

Email: Website: www.**wyg**.com

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1.0 Executive Summary

Background

WYG Engineering (NI) Ltd. were commissioned by the Department for Infrastructure (DFI) on Friday 31st January 2020, to undertake an inspection and assessment of DVA lifts across all 15 MOT centres in Northern Ireland.

Inspections were carried out by Stephen Alford (WYG Director) CEng FIStructE MIEI, Keith Morrison (WYG Associate Director) CEng MIStructE MIEI, and John McConville (WYG Associate) CEng MIStructE.

53no. '*MAHA DUO +1 Irland (DVA)'* scissor lifts manufactured between 2011-2012 were installed throughout all MOT centres. Two new '*MAHA DUO CM 4.2 U'* lifts have recently been installed, one in Newbuildings and one in Boucher Road. All 53 original lifts were inspected across the 15 MOT test centres between the 3rd – 6th February 2020 (The two new lifts have not been inspected).

Key Observations

The following observations were made:

1. Cracking was observed in most of the welds securing each boss to the inner face of the rectangular hollow section (RHS) steel scissor legs.
2. In some instances, the cracking described in point 1 was observed to propagate into the underside of the RHS scissor legs. It was not possible to quantify the number of legs affected due to the presence of steel plates noted in point 4.
3. In some instances (30-40% of lifts), remedial welding has been undertaken around the boss, presumably as an to attempt to cease the propagation of the cracking noted in points 1 and 2.
4. In many instances, remedial works in the form of steel plates have been welded to the outer face and underside of the outer RHS scissor legs around the pivot. Where present, these plates prevented the inspection of the underside of the RHS legs and the potential presence of cracking as outlined in point 2.
5. At Boucher Road the new lift (Lift 5c) was in operation, while in lane 2 (Lift 2a) the original lift was still in operation. WYG understand that Lift 2a has undertaken fewer lifting cycles as it is sited at the end of the HGV lane.
6. At Newbuildings the new lift (Lift 4b) was installed but not yet in operation.
7. At Lisburn, two of the original lifts (5Aa and 5Ba), sited in the Vehicle Identity Check

(VIC) lanes, were in operation. WYG understand that these lifts have undertaken considerably fewer lifting cycles due to the frequency of the VIC testing. Neither lift appeared to exhibit any of the defects outlined in points 1-4.

Discussion

WYG believe that the defects outlined in points 1 and 2 are as a result of fatigue. WYG understand that the lifts have undertaken approximately 20,000 lifting cycles annually, which equates to approximately 150,000-160,000 cycles since their installation in 2011/2012. MAHA DUO operating instructions state:

"In its standard version, this product is designed for 22,000 load cycles based on EN 1493. The maximum period of normal use in relation to the possible product life expectancy shall be evaluated and scheduled by a qualified person during the annual safety inspection."

WYG are aware that the lifts supplied to DVA are non-standard, due to the inclusion of shaker plates, however we are unaware if MAHA have taken this into account within the lift design process, or if this impacts the product design load cycles. Nonetheless, based on the information available, the lifts have clearly undertaken significantly more than the 22,000 design load cycles. It should be noted that the lifts have a possible product life expectancy greater than 22,000 load cycles, however it is subject to annual evaluation. We understand inspections have been undertaken every six months by both MAHA and an independent inspector, which complies with the manufacturer's guidelines noted above.

WYG would recommend that all lifts exhibiting signs of fatigue are taken out of service and replaced. We would not advocate any short-term localised repairs due to the presence of fatigue in the scissor legs around the pivot. Consideration could however be given to replacement of the scissor legs, bearing bushes and pivots to bring the lifts temporarily back into service until new lifts are available. This is subject to all other parts of the scissor lifts being inspected, evaluated and certified by MAHA and an independent inspector as safe to use.

The new lifts at Belfast and Newbuildings can be used subject to commissioning by MAHA and inspections being undertaken in line with their recommendations. The existing lift 2a at Boucher Road and lifts 5Aa and 5Ba at Lisburn (VIC lanes) exhibited no apparent signs of fatigue around the boss and underside of the RHS scissor legs. Whilst likely to have exceeded the 22,000 design load cycles these lifts could remain operational subject to inspection, evaluation and certification by MAHA and an independent inspector that the lifts are still within their product life expectancy as outlined in the MAHA DUO operating instructions. Consideration should be given to scheduling these lifts for replacement alongside the others,

given they are likely to have exceeded their design load cycles.

Recommendations

1. Lifts exhibiting signs of fatigue are considered to be beyond their possible product life expectancy and should be replaced. No lift exhibiting signs of fatigue should be used.
2. Short term localised repairs to the scissor legs are not recommended due to presence of fatigue in the scissor legs around the pivot.
3. Consideration could be given to replacement of the scissor legs, bearing bushes and pivots to bring the lifts temporarily back into service until new lifts are available. This is subject to all replacement parts being supplied, fitted and warranted by MAHA, and all other parts of the scissor lifts being inspected, evaluated and certified by MAHA and an independent inspector as safe to use.

2.0 Introduction

WYG Engineering (NI) Ltd. were commissioned by the Department for Infrastructure (DFI) on Friday 31st January 2020, to undertake an inspection and assessment of DVA lifts across all 15 MOT centres in Northern Ireland.

Inspections were carried out by Stephen Alford (WYG Director) CEng FIStructE MIEI, Keith Morrison (WYG Associate Director) CEng MIStructE MIEI, and John McConville (WYG Associate) CEng MIStructE.

Inspections were carried out as follows:

DVA Centre	Inspection By	Date
Armagh	Stephen Alford	05/02/2020
Ballymena	Stephen Alford	04/02/2020
Belfast	Keith Morrison	05/02/2020
Coleraine	Stephen Alford	06/02/2020
Cookstown	John McConville	04/02/2020
Craigavon	Stephen Alford	05/02/2020
Downpatrick	Keith Morrison	04/02/2020
Enniskillen	Keith Morrison	05/02/2020
Larne	Stephen Alford	04/02/2020
Lisburn	John McConville	06/02/2020
Newbuildings	John McConville	04/02/2020
Mallusk	John McConville	06/02/2020
Newry	Keith Morrison	04/02/2020
Newtownards	John McConville	05/02/2020
Omagh	Keith Morrison	05/02/2020

53no. 'MAHA DUO +1 Irland (DVA)' scissor lifts manufactured between 2011-2012 were installed throughout all MOT centres. Two new 'MAHA DUO CM 4.2 U' lifts have recently been

installed, one in Newbuildings and one in Belfast. All 53 original lifts were inspected across the 15 MOT test centres between the 3rd – 6th February 2020. The two new lifts were given a cursory inspection only.

3.0 Inspection Regime

At each DVA centre, the number of testing lanes and scissor lifts were recorded. A photographic survey of each lift was undertaken. Observations of each lift were documented on inspection sheets. The record photographs and inspection sheets are included in Appendix A.

3.1 Photographic Survey

For each lift a suite of photographs was taken as follows:

- General overview
- Scissor Legs – Pivot Location
    - Left hand side (LHS) outer leg
    - LHS inner leg
    - Right hand side (RHS) inner leg
    - RHS outer leg

3.1.1 General Overview

The following typical photographs were taken of each lift:

Elevation looking from exit end towards entrance

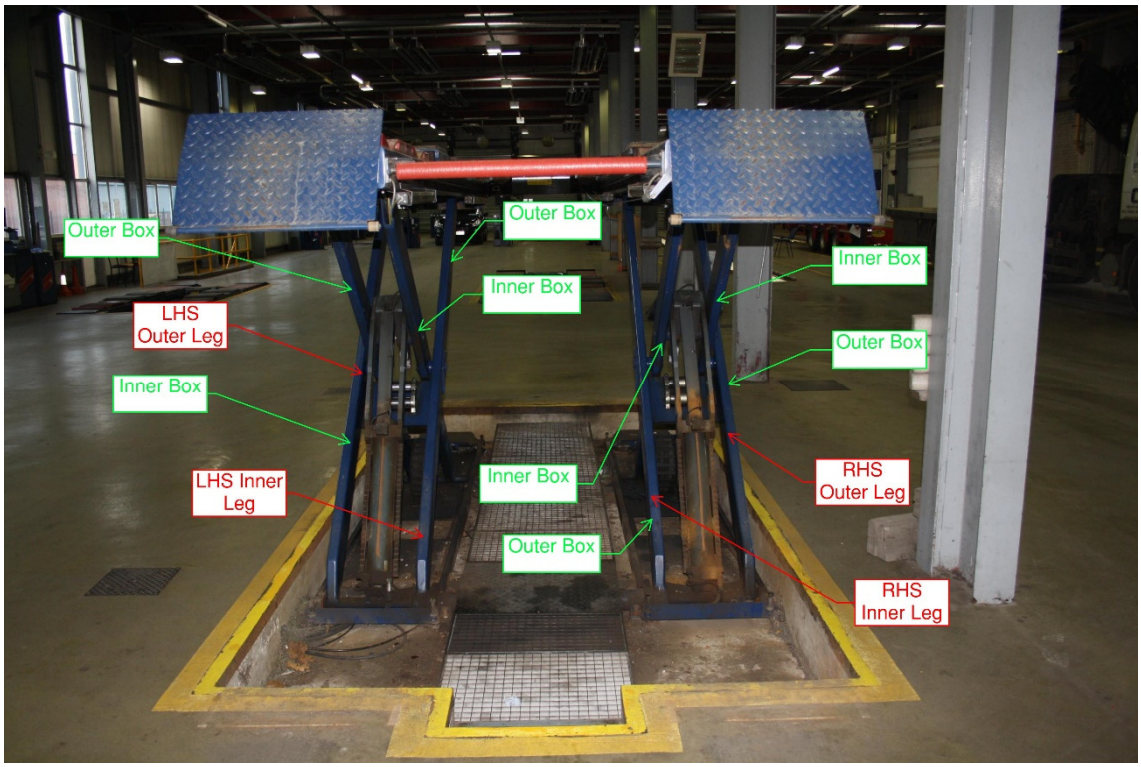
Side elevation

Elevation looking from entrance end towards exit

Lift ID plate

3.1.2 Scissor Legs

Each lift consists of 4 pairs of scissor legs. Each pair is made up of 2no. 150mm x 50mm x 8mm steel rectangular hollow box sections, referenced as follows:

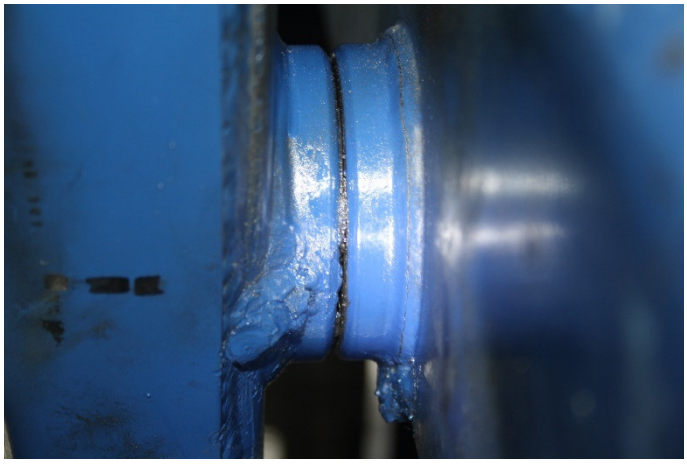


Lift viewed standing at exit looking towards entrance

Record photographs were taken of each scissor leg, showing views of the outer and inner steel box sections, and showing the bosses welded to the inside face of each steel box section at the pivot location. Example photographs as follows:

Typical outer box section – outside face

Typical outer box section – outside face with remedial steel plate



Typical pivot bosses – exit view

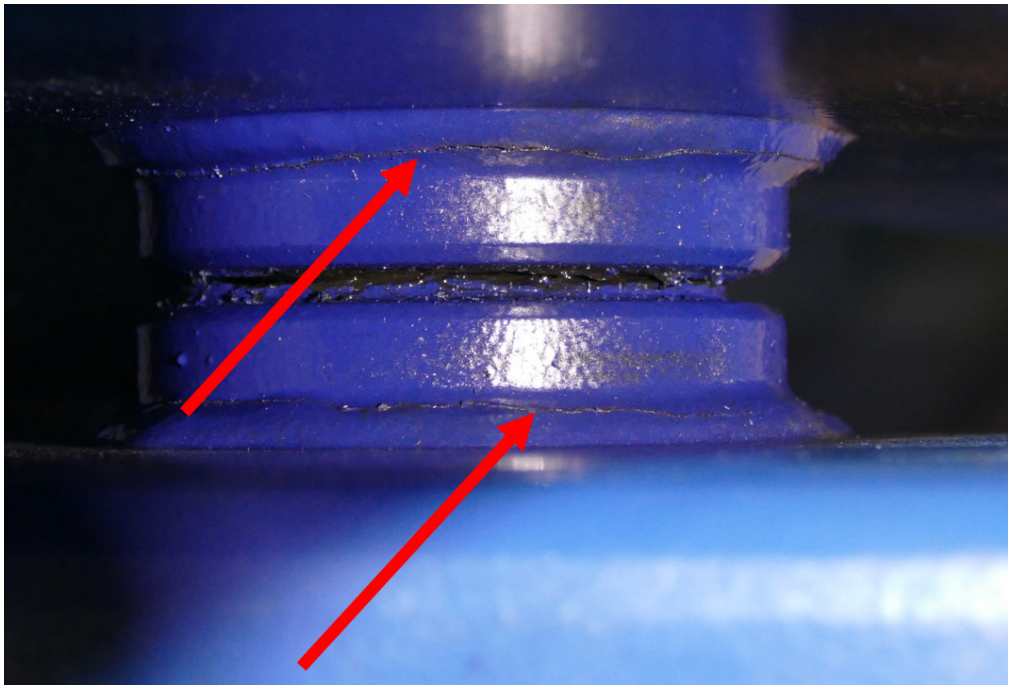
Typical inner box section – outside face

4.0 Observations

4.1 Typical Observations

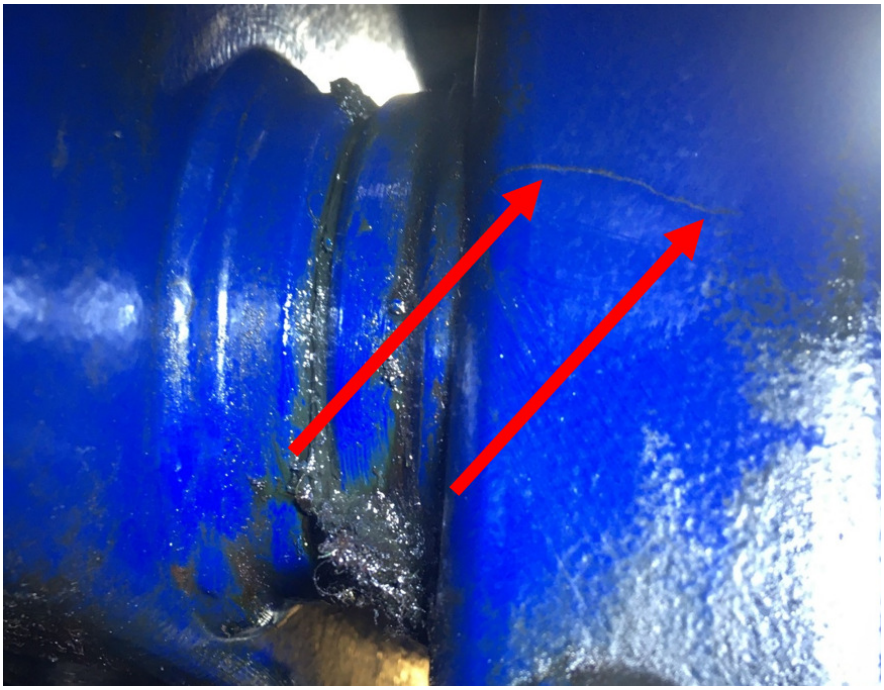
The following typical observations were made throughout all DVA centres:

8. Cracking was observed in most of the welds securing each boss to the inner face of the scissor legs box sections. This was observed in 94% of lifts.



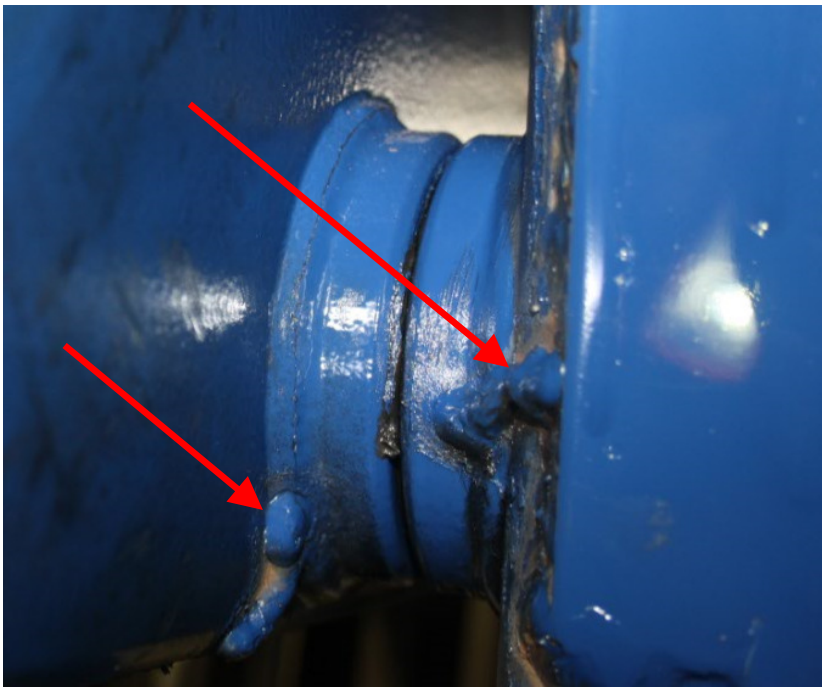
Typical cracking in boss

9. In some instances, the cracking described in point 1 was observed to propagate into the underside of the rectangular hollow section scissor legs. This was observed in 25% of lifts. However it was not possible to quantify the exact number of legs affected due to the presence of remedial steel plates, as discussed in point 4.



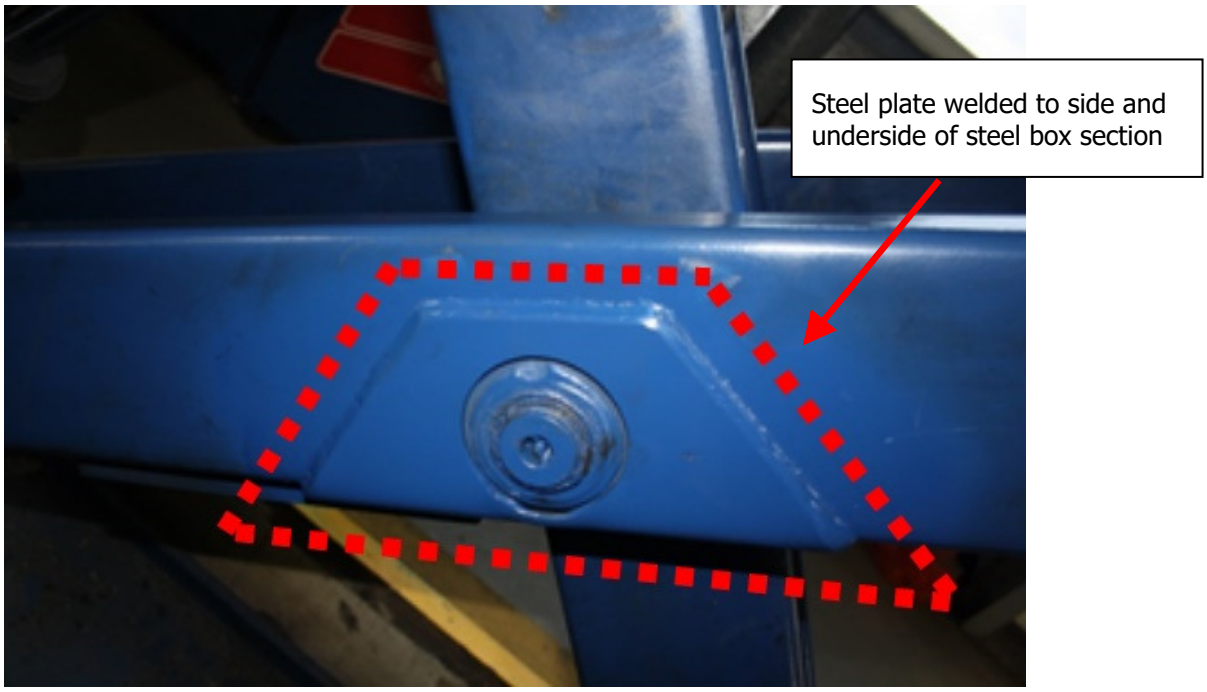
Cracking observed to underside of box section

10. In some instances, remedial welding has been undertaken around the boss, presumably as an to attempt to cease the propagation of the cracking noted in points 1 and 2. This was observed in 42% of lifts.



Localised site welding observed to boss

11. In many instances, remedial works in the form of steel plates have been recently welded to the outer face and underside of the scissor leg outer box. The steel plates are located at the position of the scissor leg pivot. This was observed in 68% of lifts.



Typical remedial steel plates welded to outer face of outer box section

4.2 Record of Typical Observations

The following table has been compiled to summarise the presence of the typical observations presented in section 3.1. Please note where cracking has been observed to propagate from the boss into the box section leg this has been recorded, however where remedial steel plates have been welded it was not always possible to confirm if cracking in the boss welds had progressed into the scissor legs. Detailed inspection sheets are included in Appendix A.

DVA Centre	Lift - Asset Tag	Lane Number	Cracking Observed in Boss Weld	Cracking Observed Propagating into Leg	Remedial Welding to Boss	Remedial Steel Plates
Armagh DVA	AHL2S406M	Lane 2	✓		✓	✓
Armagh DVA	AHL3S406M	Lane 3	✓	✓		✓
Ballymena DVA	BAL2S406M	Lane 2	✓	✓		
Ballymena DVA	BAL3S406M	Lane 3	✓	✓		
Ballymena DVA	BAL4S406M	Lane 4	✓	✓		
Belfast DVA	BTL2S309M	Lane 2				
Belfast DVA	BTL3S406M	Lane 3a	✓		✓	✓
Belfast DVA	BTL3S426M	Lane 3b	✓			✓
Belfast DVA	BTL3S446M	Lane 3c	✓		✓	✓
Belfast DVA	BTL5S406M	Lane 5a	✓			✓
Belfast DVA	BTL5S426M	Lane 5b	✓			✓
Belfast DVA	BTL5S446M* (new lift)	Lane 5c				
Coleraine DVA	CEL2S406M	Lane 2	✓			✓
Coleraine DVA	CEL3S406M	Lane 3	✓		✓	✓
Coleraine DVA	CEL4S406M	Lane 4	✓		✓	✓

DVA Centre	Lift - Asset Tag	Lane	Cracking Observed in Boss Weld	Cracking Observed Propagating into Leg	Remedial Welding to Boss	Remedial Steel Plates
Cookstown DVA	CKL3S406M	Lane 3	✓	✓	✓	✓
Cookstown DVA	CKL4S406M	Lane 4	✓		✓	✓
Cookstown DVA	CKL5S406M	Lane 5	✓		✓	✓
Craigavon DVA	CNL2S406M	Lane 2a	✓		✓	✓
Craigavon DVA	CNL2S426M	Lane 2b	✓		✓	✓
Craigavon DVA	CNL4S406M	Lane 4a	✓		✓	✓
Craigavon DVA	CNL4S426M	Lane 4b	✓		✓	✓
Downpatrick DVA	DKL2S406M	Lane 2	✓			✓
Downpatrick DVA	DKL3S406M	Lane 3	✓	✓		✓
Enniskillen DVA	ENL2S406M	Lane 2	✓		✓	✓
Enniskillen DVA	ENL3S406M	Lane 3	✓		✓	✓
Larne DVA	LEL2S406M	Lane 2	✓	✓		
Larne DVA	LEL3S406M	Lane 3a	✓			
Larne DVA	LEL3S415M	Lane 3b	✓			
Lisburn DVA	LNL2S406M	Lane 2	✓	✓		✓

DVA Centre	Lift - Asset Tag	Lane	Cracking Observed in Boss Weld	Cracking Observed Propagating into Leg	Remedial Welding to Boss	Remedial Steel Plates
Lisburn DVA	LNL3S406M	Lane 3	✓	✓		
Lisburn DVA	LNL4S406M	Lane 4	✓	✓		
Lisburn DVA-Vic	LNL5S117M	Lane 5Aa				
Lisburn DVA-Vic	LNL5S406M	Lane 5Ab				
Newbuildings DVA	LYL2S406M	Lane 2a	✓			
Newbuildings DVA	LYL2S426M	Lane 2b	✓			
Newbuildings DVA	LYL4S406M	Lane 4a	✓			
Newbuildings DVA	LYL4S426M* (new lift)	Lane 4b				
Mallusk DVA	MKL3S406M	Lane 3a	✓	✓	✓	✓
Mallusk DVA	MKL3S426M	Lane 3b	✓		✓	✓
Mallusk DVA	MKL5S406M	Lane 5a	✓		✓	✓
Mallusk DVA	MKL5S426M	Lane 5b	✓		✓	✓
Newry DVA	NYL2S406M	Lane 2	✓		✓	✓
Newry DVA	NYL3S406M	Lane 3	✓		✓	✓
Newry DVA	NYL4S406M	Lane 4	✓	✓		✓

DVA Centre	Lift - Asset Tag	Lane	Cracking Observed in Boss Weld	Cracking Observed Propagating into Leg	Remedial Welding to Boss	Remedial Steel Plates
Newtownards DVA	NSL2S406M	Lane 2a	✓			✓
Newtownards DVA	NSL2S426M	Lane 2b	✓			✓
Newtownards DVA	NSL3S406M	Lane 3	✓			✓
Newtownards DVA	NSL4S406M	Lane 4a	✓			✓
Newtownards DVA	NSL4S426M	Lane 4b	✓			✓
Newtownards DVA	NSL5S406M	Lane 5	✓			
Newtownards DVA	NSL6S406M	Lane 6	✓			
Newtownards DVA	NSL7S406M	Lane 7	✓			
Omagh DVA	OHL2S406M	Lane 2	✓	✓	✓	✓
Omagh DVA	OHL3S406M	Lane 3	✓		✓	✓

The percentage of each observation viewed across the lifts was as follows:

(The two new 2019 lifts have been discounted from the percentage calculation)

Observation	Total No. of lifts	No. of Lifts with Observation Present	Percentage
Cracking in Boss Weld	53	50	94%
Cracking Seen to Propagate into Leg	53	13	25%
Remedial Welding to Boss	53	22	42%
Remedial Steel Plates	53	36	68%

4.3 Other Observations

4.3.1 New Lifts

Two new lifts have recently been installed. One at Belfast (Lane 5c), and one at Newbuildings (Lane 4b). These new lifts are an updated model '*DUO CM 4.2 U*, manufactured in 2019. The lift in Belfast was in operation at the time of the site inspection. The lift in Newbuildings was awaiting commissioning and was not in use.

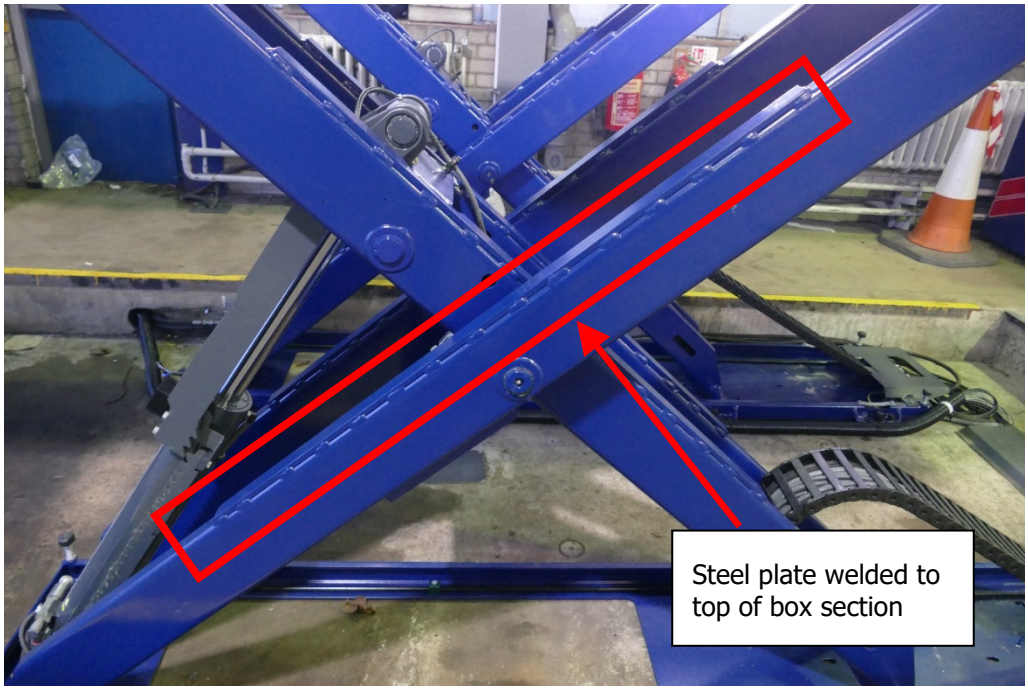
A cursory inspection of the new 2019 DUO CM 4.2U lifts highlighted a number of visible modifications over the 2011/2012 '*DUO + Irland (DVA)*' lifts, including:

- The addition of 1200mm long x 40mm wide by 10mm thick plates welded to the top of the 150mm x 50mm rectangular hollow section scissor legs over the pivot using hit and miss fillet welds.
- The fillet welds securing the bosses to the scissor legs also appeared to have a larger throat thickness. However this could not be measured due to the narrow gap between the scissor legs (approximately 30mm).

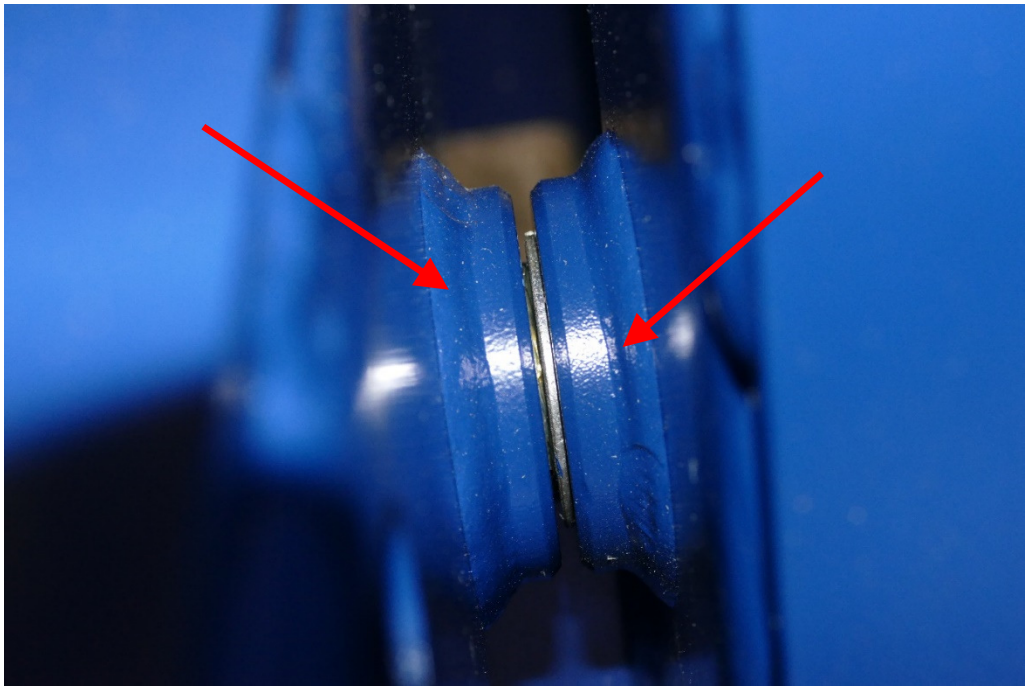
Other modifications may have been undertaken, however this would need to be confirmed with MAHA. WYG understand that the new lifts are also fitted with cycle counters, although this was not confirmed during the inspections.

Photographs illustrating these modifications are as follows:

New lift installed at Belfast



1200mm x 40mm x 10mm plate hit and miss welded to top of scissor legs



Larger weld around boss

4.3.2 Existing Lifts 'Belfast (Lane 2), Lisburn (Lane 5Aa) and Lisburn (Lane 5Ba)'

The existing lift (Lane 2) at Belfast and 2no. lifts at Lisburn (Lane 5Aa and 5Ba) exhibited none of the observations recorded in section 3.1. Belfast lift (Lane 2) is sited at the end of the HGV

testing lane. Lisburn lifts (Lane 5Aa and 5Ba) are sited in the Vehicle Identity Check (VIC) lanes.

5.0 Discussion

As noted in section 3.2, 94% of the 2011/2012 lifts exhibited cracking to the boss welds adjacent to the scissor leg pivots. In some instances, remedial works in the form of site welds to the boss welds, and site welding of steel plates to the outer scissor leg box sections has been undertaken. Cracks in the boss welds were observed to propagate into the scissor leg box sections in 25% of the lifts. However it should be noted that where remedial steel plates have been installed or remedial site welding undertaken, it was not always possible to confirm if cracking in the boss welds had progressed into the scissor legs.

As noted in section 3.3.2, existing lift (Lane 2) at Belfast and lifts at Lisburn (Lane 5Aa and 5Ba) exhibited none of the observations recorded in section 3.1. WYG understand that due to its location at the end of the HGV lane, Belfast lift (Lane 2) has undertaken fewer lifting cycles than the other lifts. This lift was still in operation at the time of inspection. Similarly, at Lisburn, two of the original lifts (Lane 5Aa and 5Ba), sited in the Vehicle Identity Check (VIC) lanes, were in operation. WYG understand that these lifts have undertaken considerably fewer lifting cycles due to the frequency of the VIC testing.

WYG believe that the defects outlined in section 3.1 points 1 and 2 are as a result of fatigue.

Section 7.0 of the MAHA DUO operating instructions (*document BA082901-en MAHA DUO CM Scissors Lift Original Operating Instructions*) states:

"In its standard version, this product is designed for 22,000 load cycles based on EN 1493. The maximum period of normal use in relation to the possible product life expectancy shall be evaluated and scheduled by a qualified person during the annual safety inspection."

Section 6.0 of the MAHA DUO operating instructions (*document BA082901-en MAHA DUO CM Scissors Lift Original Operating Instructions*) outlines the maintenance schedule for the lifts under normal workshop usage. This schedule requires inspection of the hydraulic system and sliding blocks every 3 months, hydraulic fluid every 6 months and a full general inspection every 12 months. The 12 monthly general inspection procedure states 'Check all components for damage', with no specific checks listed.

We note however in section 6.2 of the MAHA DUO operating instructions - Annual Inspection, *"the maintenance interval prescribed by the manufacturer is 12 (twelve) months. This*

maintenance interval refers to normal workshop usage. If the equipment is used more frequently or under severe operating conditions (e.g. outdoors), the interval must be reduced accordingly."

WYG understand that the lifts have undertaken approximately 20,000 lifting cycles annually, which equates to approximately 150,000-160,000 cycles since their installation in 2011/2012.

WYG are aware that the lifts supplied to DVA are non-standard, due to the inclusion of shaker plates, however we are unaware if MAHA have taken this into account within the lift design process, or if this impacts the product design load cycles. Nonetheless, based on the information available, the lifts have clearly undertaken significantly more than the 22,000 design load cycles. It should be noted that the lifts have a possible product life expectancy greater than 22,000 load cycles, however it is subject to annual evaluation (under normal workshop usage).

Given the significant load cycles, guidance should be sought from MAHA with regards to frequency of the evaluation and an appropriate maintenance schedule based on the actual usage / load cycles of each lift.

6.0 Recommendations

WYG would recommend that all lifts exhibiting signs of fatigue are taken out of service and replaced. We would not advocate any short-term localised repairs due to the presence of fatigue in the scissor legs around the pivot. Consideration could however be given to replacement of the scissor legs, bearing bushes and pivots to bring the lifts temporarily back into service until new lifts are available. This is subject to all other parts of the scissor lifts being inspected, evaluated and certified by MAHA and an independent inspector as safe to use.

The new lifts at Belfast and Newbuildings can be used subject to commissioning by MAHA and inspections being undertaken in line with their recommendations.

The existing lift (Lane 2) at Belfast and lifts at Lisburn (Lane 5Aa and 5Ba) exhibited no apparent signs of fatigue around the boss and underside of the scissor legs. Whilst likely to have exceeded the 22,000 design load cycles these lifts could remain operational subject to inspection, evaluation and certification by MAHA and an independent inspector that the lifts are still within their product life expectancy as outlined in the MAHA DUO operating

instructions. Consideration should be given to scheduling these lifts for replacement alongside the others, given they are likely to have exceeded their design load cycles.

7.0 Future Maintenance and Inspection

With regard to the future maintenance and inspection of the lifts, it is recommended that the maintenance schedule in section 6.0 of the MAHA DUO operating instructions be supplemented with a more specific list of items to be inspected as part of the general inspection. This should include inspection of the scissor leg boss welds and the underside of the scissor legs at the pivots.

Given the significant load cycles, guidance should be sought from MAHA with regards to frequency of the evaluation and an appropriate maintenance schedule based on the actual usage / load cycles of each lift.

WYG would also recommend that the general inspection of each lift should include an inspection by a Structural Engineer focusing primarily on the scissor legs and pivot.

In addition, WYG would recommend that cycle counters are added to all lifts, and that MAHA are requested to provide an estimated product life expectancy for new lifts, given as an estimated total number of load cycles based on the average load lifted. This would allow the number of cycles to be monitored and allow a lift replacement schedule to be developed.

Appendix A