

**Report on the Examination of Marks on
the Thumb of Mr Robin Bain seen in
Photographs A008 and A009**

A report prepared by

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Photographs A008 and A009**

My full name is **Kevan Arthur John Walsh**.

I have a Master of Science degree with first class honours in chemistry from the University of Waikato.

I am employed at the Mt Albert Science Centre of ESR. ESR is a Crown Research Institute and its functions include the provision of independent forensic testing and advice.

The forensic laboratories of ESR are accredited by the Laboratory Accreditation Board of the American Society of Crime Laboratory Directors.

I have been employed to carry out the analysis of items of forensic interest since 1983.

During this time I have gained experience in the examination of crime scenes, particularly crime scenes that have involved firearms.

I have attended post-mortem examinations of the victims of shootings.

I have previously given evidence in court on forensic examinations I have made in relation to shootings.

I am a member of the Association of Firearm and Tool Mark Examiners, which is an international organisation based in North America.

The results and conclusions provided in this report form my expert opinion, which is based on my scientific knowledge, experience and training.

I was asked to review photographs that had been taken of Mr Robin Bain to examine the marks seen on his thumb and to consider whether or not they could be marks created by him loading a cartridge into a rifle magazine.

Photographs of Mr Robin Bain's right hand

Two photographs were examined that showed marks on Mr Robin Bain's right hand. These photographs were labelled A009 and A008 and are shown in Figures 1 and 2.



Figure 1. Photograph A009 showing Mr Bain's right hand beside an upright rifle magazine.



Figure 2. Photograph A008 showing Mr Bain's right hand beside an upright rifle magazine.

Photograph A009 is a closer view than A008 and has been taken from a slightly different angle. These photographs appear to have been taken as general photographs to show the relative positions of items. Therefore there is no scale in the photograph that can be used to make measurements. These photographs are now being used to make comparisons (between the magazine and the marks on the thumb), which is a purpose for which they would not have been intended.



Figure 3. Cropped Photograph A009.



Figure 4. Cropped Photograph A008.

Figures 3 and 4 show cropped views of Photographs A009 and A008. The marks of interest have been labelled A and B. A further mark on the forefinger has been labelled C. I have not considered the significance of mark C.

Soot marks from loading the magazine

It has been proposed that the marks, particularly A and B, have resulted from the transfer of firearm residue from the lips at the top of the magazine to the thumb during the loading of a cartridge into the magazine. The lips of the magazine have been highlighted in yellow in Figure 5. Firearm residues can include the combustion products from the discharge of the cartridge and for the purposes of this discussion, can be considered to be soot.



Figure 5. A cropped photograph A008 depicting the magazine lips in yellow.

For the rifle exhibit 14, the magazine is positioned in a well at the bottom of the receiver of the rifle. The top of the magazine sits immediately behind and below the chamber. When a cartridge in the chamber is fired, the semi-automatic action of the rifle causes the fired cartridge case to be extracted from the chamber. Firing residues will also be released and these will be deposited on the nearby surfaces as soot.

Different people may load a magazine in different ways. One way is to hold the magazine in one hand and a cartridge in the other hand. The thumb can be used to push the cartridge down into the magazine (depressing the spring below the magazine follower) then slide the cartridge to the rear of the magazine where the cartridge becomes held in its loaded position. The sliding action of the thumb against the lips of the magazine creates an opportunity for any soot that is present on the lips to be transferred to the thumb. It is also possible to load the cartridge without transferring soot to the fingers or thumb.

On 13 August 2013 various experiments were conducted using the rifle exhibit 14 with the 5-shot and 10-shot magazines (exhibits 16 and 25). Shots were fired then various methods of reloading were conducted to study how marks from the magazine lips were produced on the thumb.

The series of photographs in Figure 6 (left to right) show how the cartridge can be loaded using the thumb. Some people might use a different angle of the thumb, for example, using the top of

the thumb to depress the cartridge then pushing the cartridge along the length of the thumb. In this position the rear of the magazine faces away from the person loading the magazine.



Figure 6. A sequence of photographs showing the loading of a cartridge into a magazine using the thumb at an angle to the magazine. The rear of the magazine is being held by the forefinger.

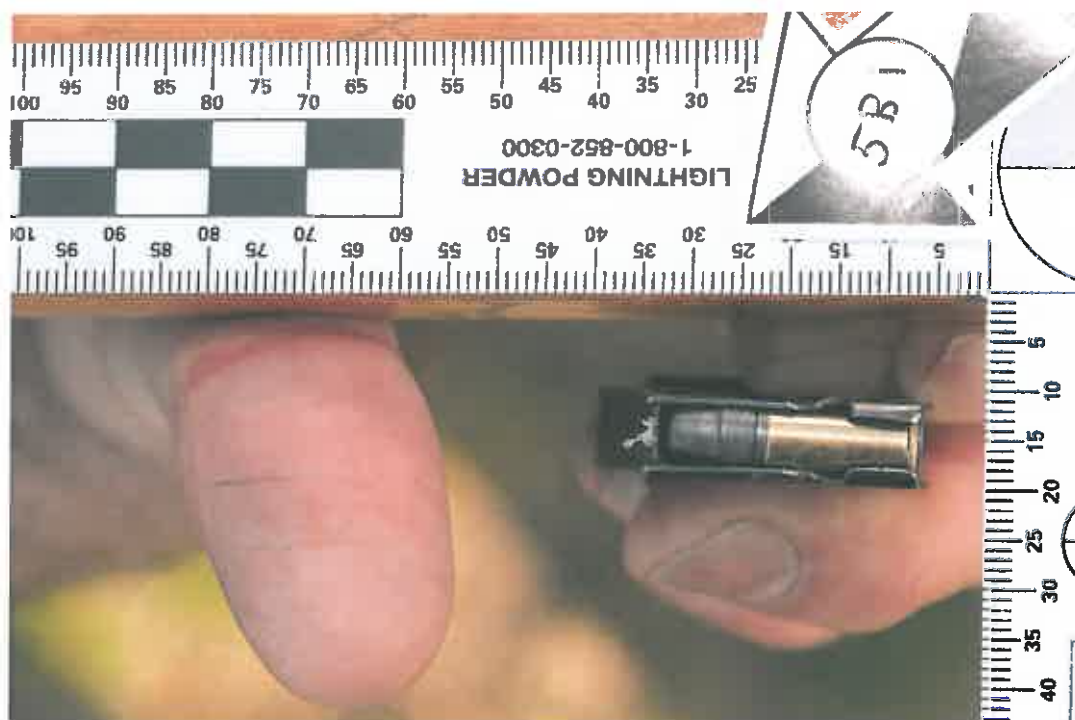


Figure 7. Soot marks left by loading a cartridge into the magazine in the manner shown in Figure 6.

An example of the soot transferred to the thumb can be seen in Figure 7. If a second cartridge is loaded, then another set of marks will be produced (see Figure 8). A fainter set of lines can be seen at an angle to the original set. The action of loading a cartridge wipes away the soot from the magazine lips, leaving less to be subsequently transferred. From the results of experiments made, it appears less likely that three loadings will leave three sets of marks. Figure 9 shows the result of a third loading where the previous two sets of loading marks have been wiped away. There are no visible soot marks on the thumb. This indicates that loading more than two cartridges will not necessarily leave a large number of marks.

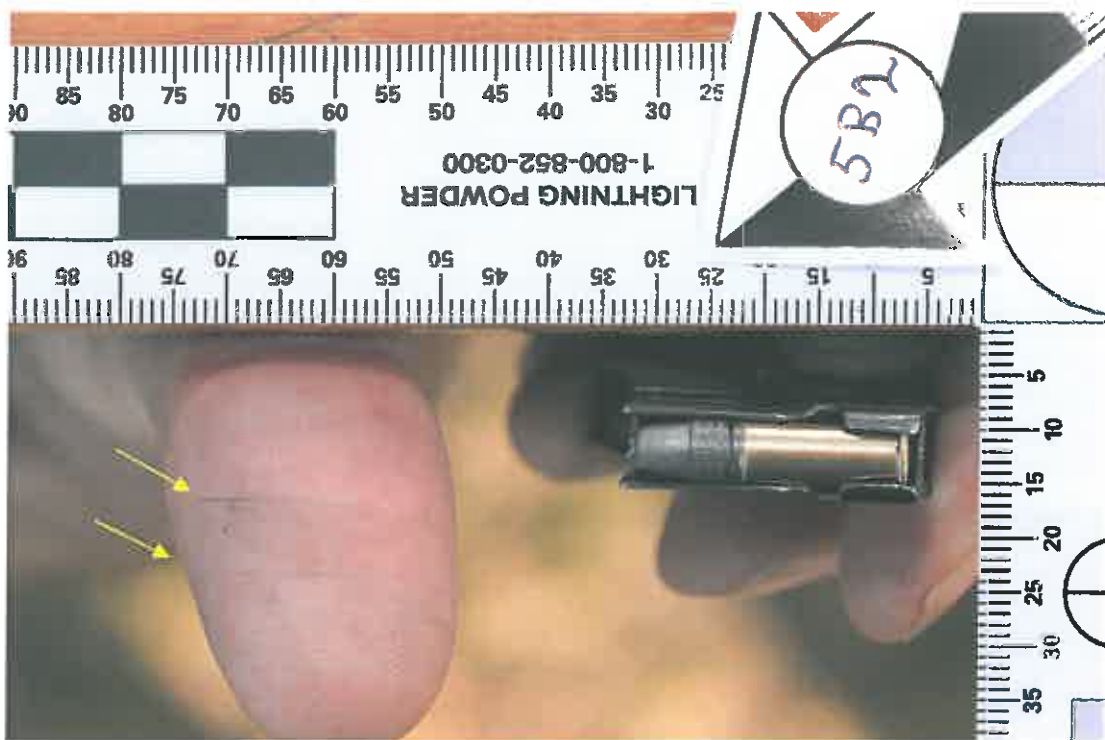


Figure 8. When a second cartridge is loaded another set of marks may be produced (arrowed).

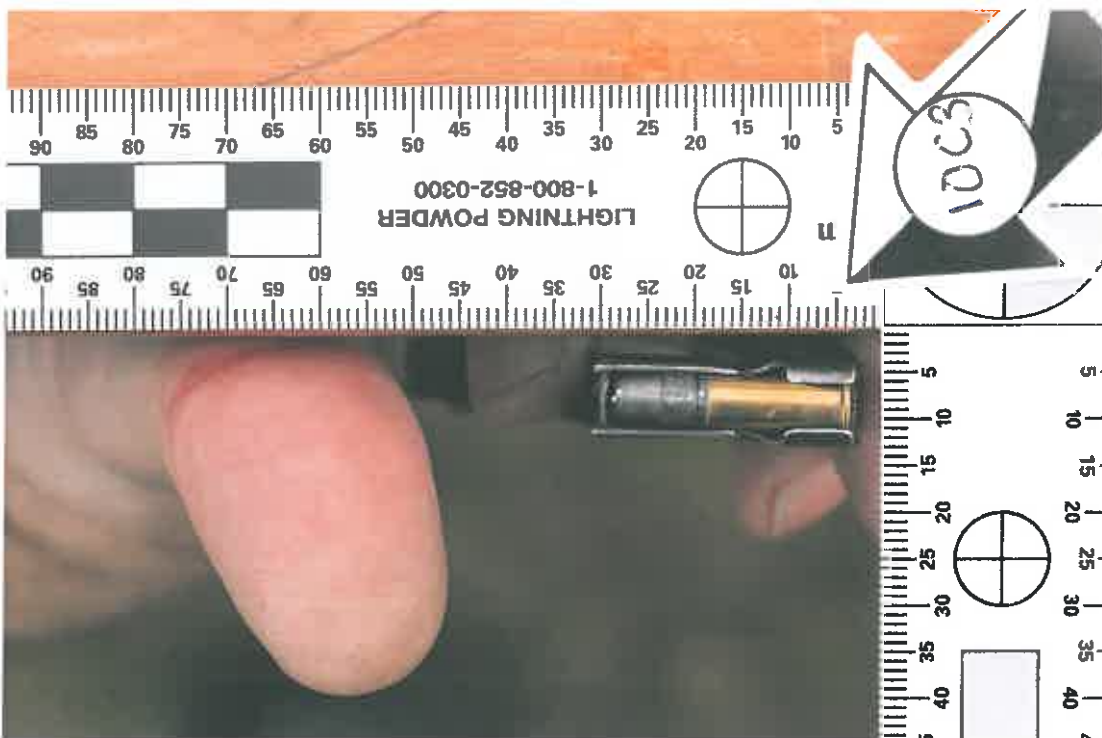


Figure 9. The thumb after loading a third cartridge (following two previous loadings and then cleaning of the thumb).

Characteristics of the soot marks made when loading the magazine

A series of tests were conducted to create soot marks on the thumb. These tests were made in a manner that would most likely lead to marks like those seen on Mr Robin Bain's thumb.

The following features were noted (e.g. see Figure 7);

1. Lines with a dark grey or black colour were produced.
2. Two lines are produced that are approximately parallel. However the gap between the lines could vary along their length, so they are not necessarily parallel. There was often observed a narrowing of the gap between the lines and a curvature to the lines at one end. This is possibly from initial contact of the thumb with the rear part of the magazine where the lips are slightly narrower and are not parallel but slightly angled such that they narrow towards the edge of the magazine.
3. The gap between the two lines was a good overlay to the lips of the top of the magazine. However the narrowing of the lips near the rear of the magazine meant that there could be significant variation of the gap between the lines depending on what part of the lips were in contact with the thumb.
4. The lines that are created are between about 12 and 25 millimetres (mm) long. The length of the lines can vary depending on how exaggerated the sliding action of the thumb is against the lips of the magazine.
5. One of the lines may be longer or shorter than the other.
6. Normal use resulted in the lines being typically made on the flat part of the pad of the thumb.
7. The width of the lines was variable. As measured as a proportion of the total width of the set of lines the individual lines were between approximately 2% and 12% of the total width of the set of two lines.
8. If more than one cartridge was loaded, then at least two sets of lines should be observed.
9. Wiping the thumb removes the lines.

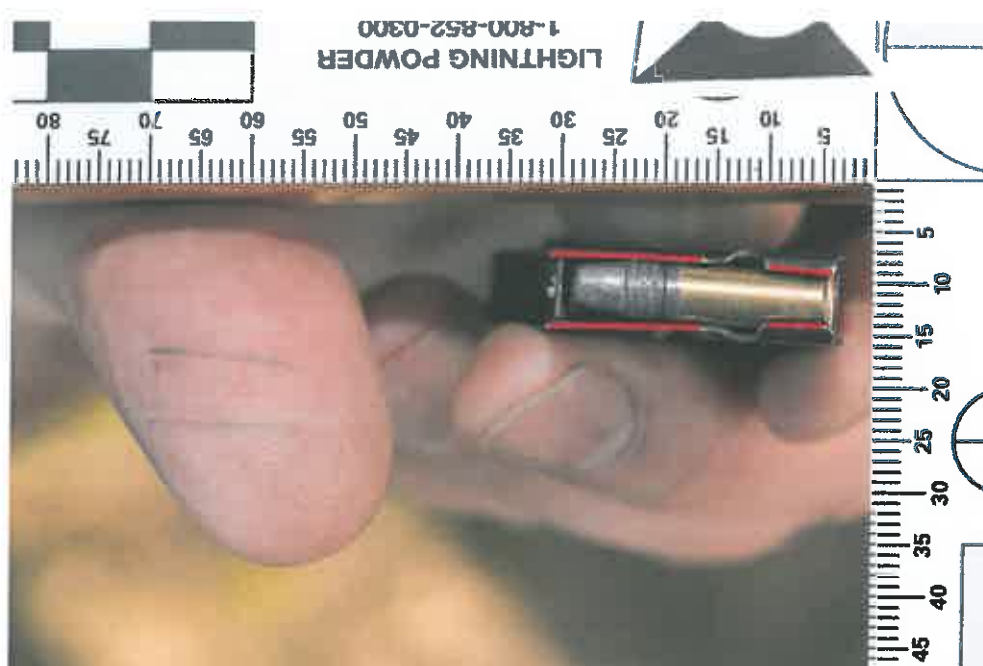


Figure 10. Red lines superimposed over the lips of the 5-shot magazine.

Comparison of the two magazines

There is a slight difference in the shape of the lips of the 5-shot and 10-shot magazines. However this difference is very small when compared to the inaccuracy of the comparisons with the photographs, so the impact of considering one magazine over another can be dismissed.

Figures 10 and 11 show lines superimposed on the lips of each magazine.

Figure 12 shows the two sets of lines superimposed on each other. Each set of lines has been scaled in size but the proportions kept the same. The difference observed is minimal. This means that comparisons can be made without the need to consider the 5-shot and 10-shot magazines separately.

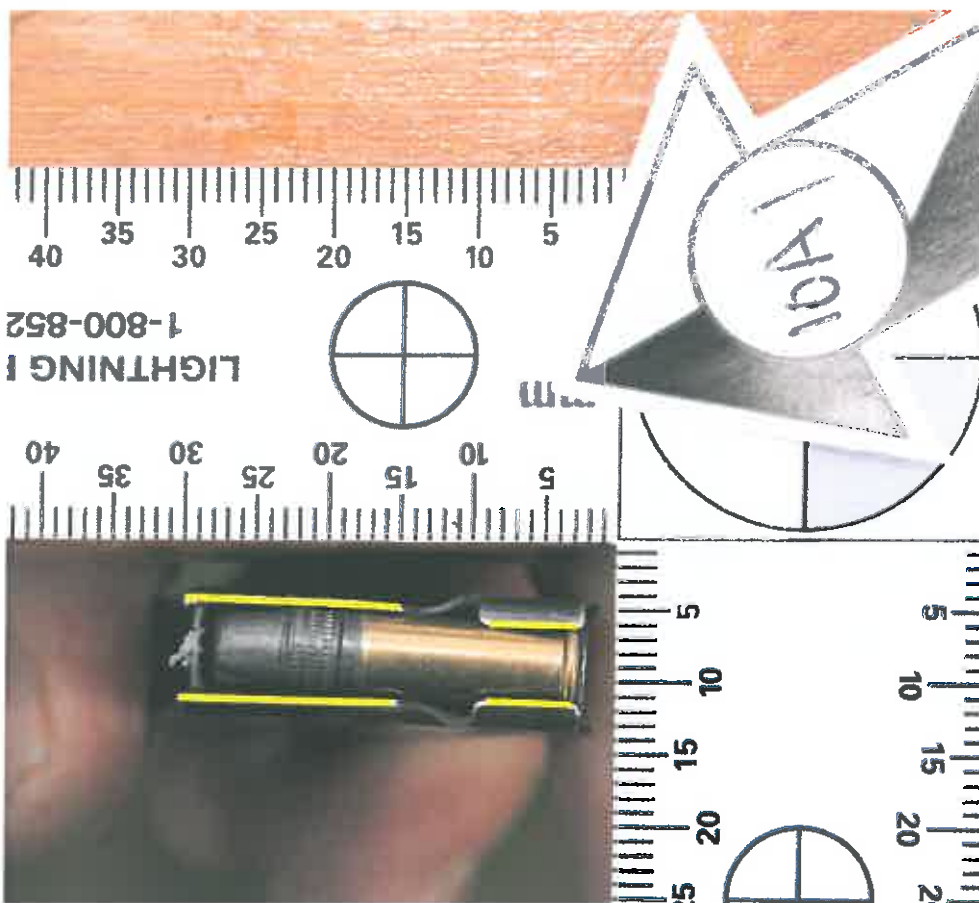


Figure 11. Yellow lines superimposed over the lips of the 10-shot magazine.

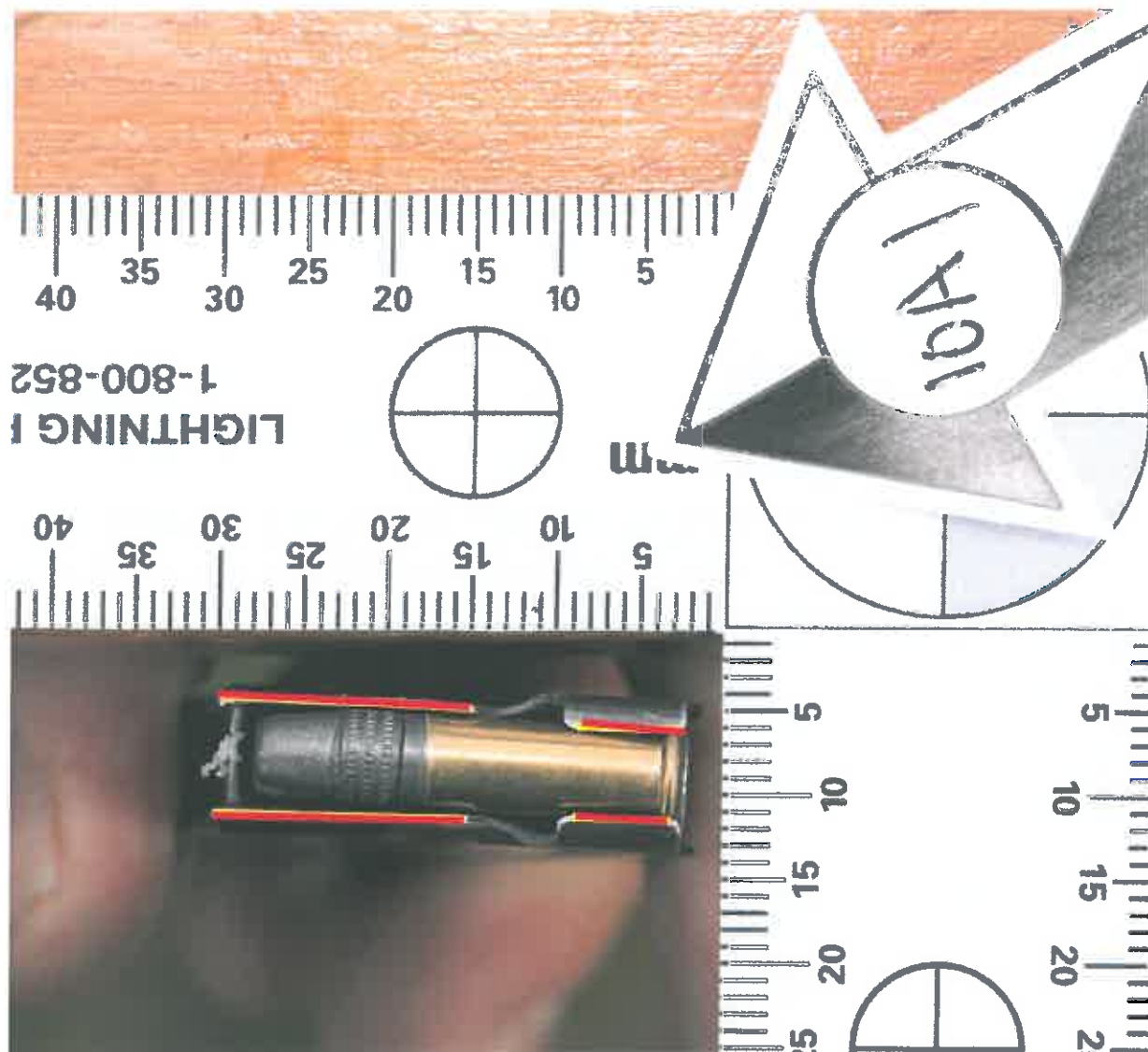


Figure 12. A double superimposition of the magazine lip lines of the 5-shot magazine (red lines) and the 10-shot magazine (yellow lines) over the 10-shot magazine. These sets of lines have been independently scaled to demonstrate the best fit.

Comparison of marks

To make an accurate comparison of two items within a photograph, a number of factors are important;

1. A scale is important to show that there is no proportional distortion along any length.
2. The lens chosen should optimise the view and not create any distortion.
3. The items of interest need to be in the same plane so that there is no distortion due to perspective.
4. The camera needs to be positioned at right angles to that plane and at an appropriate distance.

The photographs A009 and A008 have no scale.

The magazine can be seen in about the same area of the photograph as the marks on the thumbs.

The magazine, and in particular, the top of the magazine or lips of the top of the magazine is the only appropriate object to use to make measurements, or to directly compare.

However there is a perspective issue that arises because the top of the magazine is not in the same plane as the marks on the thumb. In both photographs (A008 and A009), the top of the magazine presents at an angle to the camera and this produces a distortion that is demonstrated in Figures 13 and 14. A set of lines representing the contact areas of the lips of the magazine seen in Figure 13 have been superimposed on the magazine lips in Figure 14. The proportions of the lines have been kept the same but the size and orientation has been changed to overlay the lines on the top of the magazine in Photograph A009. When overlaid, these lines extend beyond the extremities of the magazine which shows that there is significant distortion arising from perspective issues.

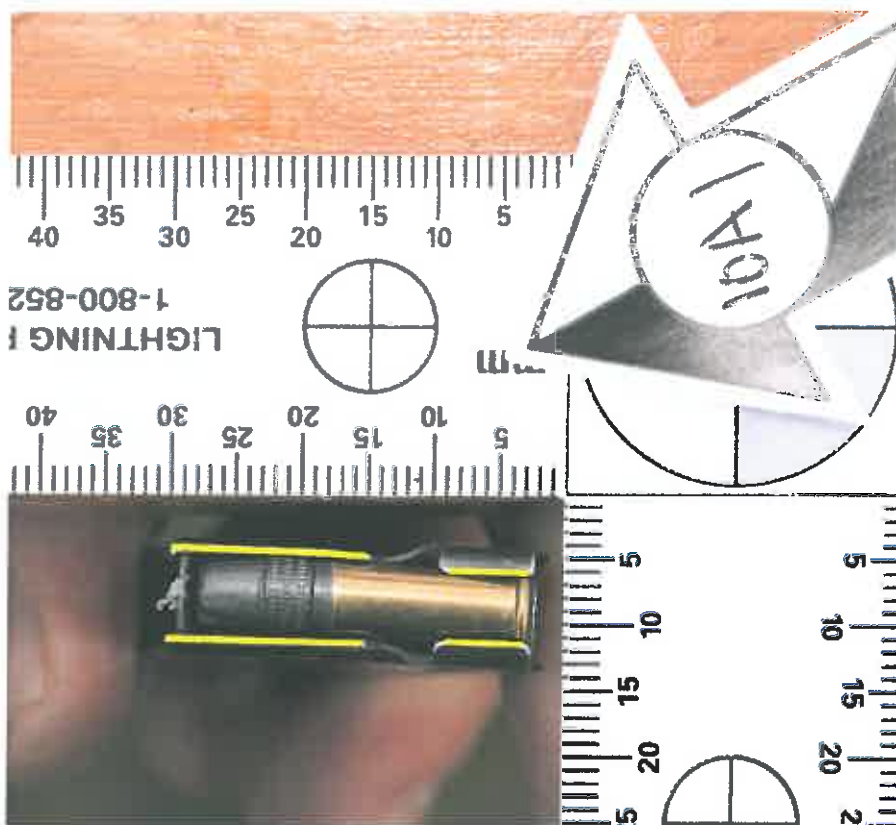


Figure 13. Yellow lines superimposed over the lips of the 10-shot magazine. These lines have been used in Figure 14.

In Photographs A009 and A008 (see Figures 3 and 4) it appears that the thumb is further away from the camera than the top of the magazine. This should also result in a perspective issue if the photographs are used to make measurements of the thumb and the top of the magazine. A measurement on the thumb should be smaller than for the top of the magazine. More directly, if marks A and B on the thumb were made by the magazine marks, then I would expect them to appear slightly smaller than the lips of the magazine as a result of perspective considerations.

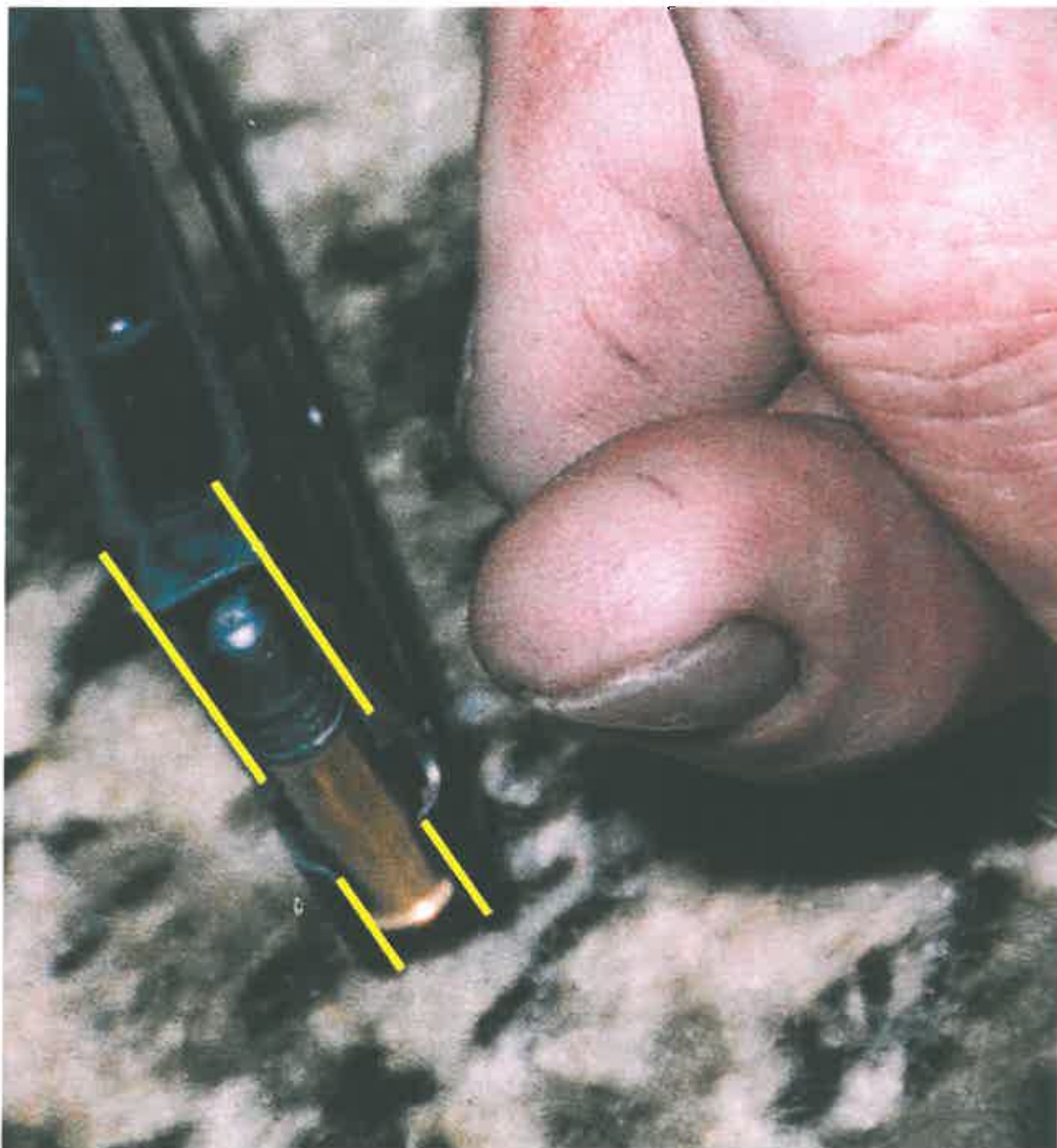


Figure 14. A cropped portion of photograph A009 with the magazine lip lines from Figure 13 superimposed over the top of the magazine. The proportions of the lines have been kept the same and when overlaid, these lines extend beyond the extremities of the magazine showing the distortion arising from perspective issues.

Are the marks on Mr Robin Bain's thumb magazine marks?

The marks on the thumb of Mr Robin Bain have been examined and compared in relation to the characteristics of the soot marks made when loading the magazine that were observed during experimentation.

1. Are the lines a dark-grey or black colour?

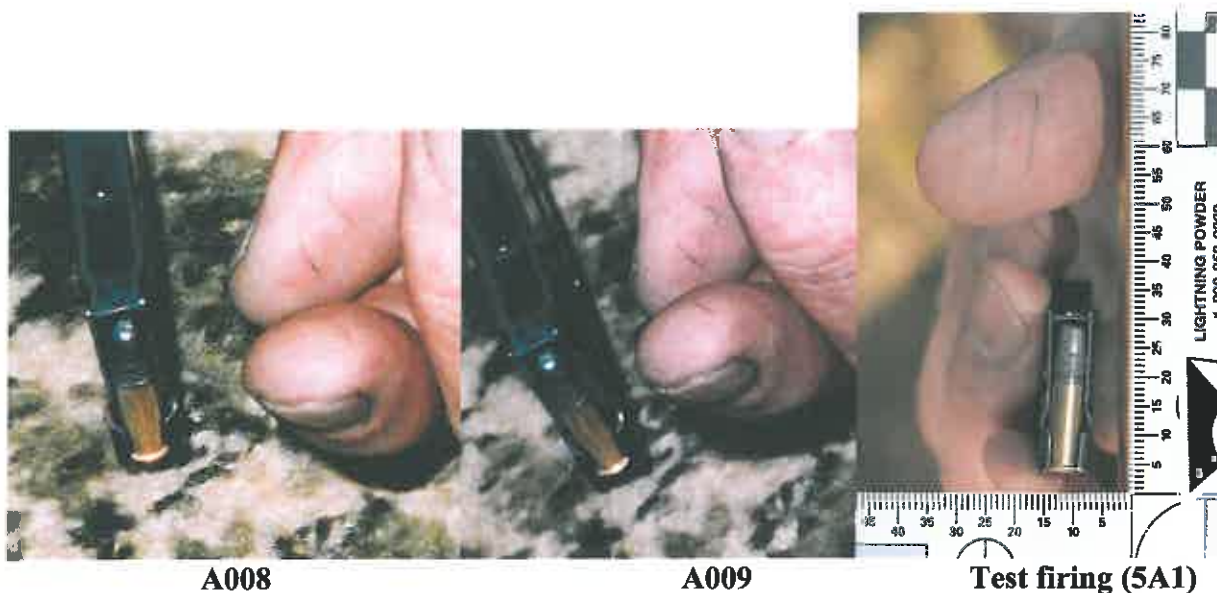


Figure 15. From left, Photograph A008, A009 and test firing (5A1).

Figure 15 shows two photographs of Mr Robin Bain's thumb and one of the photos from the test-firing experiments. Photographs A008 and A009 were taken using a flash and have no colour calibration cards in the view. These photographs were subsequently scanned into digital format. These factors make it difficult to carry out an objective colour determination. For example there is a significant colour difference apparent between photographs A008 and A009. Viewed subjectively, the photograph of the test-firing experimentation clearly shows a set of dark-grey or black lines. This is less apparent in photographs A008 and A009, where it could be subjectively judged that the lines appear to have a reddish colouration.

Similarly, in the tests conducted by Mr Tiffen et al, (see Figure 16) the marks on the thumbs caused by contact with the magazine have a dark-grey colouration compared to the marks seen in Photograph A008 seen at the centre of Figure 16.



IMG_6931



IMG_6950



IMG_6974



IMG_6955



A008



IMG_6962



IMG_6967



IMG_6959



IMG_6965

Figure 16. Photograph taken from the NZ Herald website on 27 July 2013, showing some of the results of tests conducted by Mr Tiffen, Mr Karam, Dr Sandiford, and Mr Munt, where cartridges were loaded into a magazine after shots had been fired.

2. Are the two lines approximately parallel?

The lines on the thumb of Mr Bain are not parallel. There is apparent curvature to part of one of the lines and that line is also angled to the other line. This is shown in Figure 17.

Photograph A008 was used to demonstrate the approximate fit of the set of lines to the lips of the magazine. Although this photograph was taken from further away than Photograph A009, the angle of the magazine as seen in Photograph A008 lends itself better to any comparison than Photograph A009 as the effect of perspective is less.



Figure 17. Left: overlay of lines on marks on Mr Robin Bain's thumb. Right: the lines displaced slightly to show the shape of the lines compared to the thumb marks.

A simple overlay of the lines formed from the shape of the marks on the thumb over the lips of the magazine is shown in Figure 18. With one line aligned with one of the lips the other line is angled and is not a good overlay of the opposite lip.

Test-firing experimentation showed that curved and non-parallel lines could be created from contact with the magazine lips upon loading. Loading the cartridge in the manner seen in Figure 6, sometimes created lines with curvature at the side of the thumb closest to the forefinger. In this manner the magazine was held with the rear of the magazine facing away from the body.

If the marks on Mr Robin Bain's thumb are the result of loading marks, and the curvature of the mark is due to contact with the narrower and angled lips near to the rear of the magazine, then the magazine would have been loaded with the rear of the magazine held towards the body. This position is easily obtained, but in my observation of people loading the magazine, this position seems generally unfavoured. With this orientation, any overlay of marks would need to be rotated 180 degrees as shown in Figure 19. In this rotation, the overlay is displaced and is a poor apparent fit to the lips of the magazine.

The marks created by Mr Tiffen et al (Figure 16) more often than not show generally parallel marks with no curvature. The general shape and appearance of those test marks appear to differ to the marks on Mr Bain's thumb.



Figure 18. Overlay of lines from the thumb onto the lips of the magazine.



Figure 19. Overlay of lines from the thumb onto the lips of the magazine.

3. Is the separation of the marks on the thumb consistent with the separation between the lips of the top of the magazine?

In either orientation shown in Figures 18 or 19, the overlay of the lines on top of the magazine lips is not well aligned. Either the marks on the thumb have not been made by the magazine and therefore an accurate overlay is not expected, or the marks on the thumb have been made by contact with the magazine and the poor overlay is the result of some effect such as perspective.

In Figures 18 and 19 the overlaid marks appear to have greater separation than the corresponding magazine marks. As discussed above, if the thumb marks are from contact with the magazine, then the positioning of the thumb further away from the camera should have meant that the thumb marks would appear smaller than the corresponding magazine lips, rather than appearing larger, which is what has been observed in Figures 18 and 19.

4. Is the length of the marks on the thumb consistent with those created by contact with a magazine?

From experiments that were conducted, the length of the marks caused by contact with the magazine lips were between about 12 and 25 mm long.

There is no scale in Photographs A008 or A009. However it is possible to approximately estimate the length of the marks using the magazine dimensions. The width of the 10-shot magazine shown in Photograph A008 is about 9.5mm. Using that as a scale and ignoring perspective effects, the length of Mark A on Mr Bain's thumb is approximately 6mm and Mark B is approximately 8mm long.

The marks on Mr Bain's thumb are therefore shorter than those observed from experimentation.

Figure 16 also shows that marks obtained from experimentation are much longer than the marks on Mr Bain's thumb.

However it is possible that a different orientation of the thumb with minimal sliding action of the thumb could produce shorter marks. Also, the marks can be wiped away, so a portion of the marks could have been wiped away to create an apparently shorter set of marks.

5. Is the location of the marks on the thumb consistent with loading a cartridge?

When a cartridge is loaded into the magazine, it requires considerable downwards pressure and this is most comfortably carried out by using the flat part of the pad of the thumb. Therefore, marks from loading a cartridge are typically seen on that part of the thumb. This is seen in Figures 7 and 16.

The location of the marks on Mr Bain's thumb can be seen in Figure 15. The edge of the thumbnail can be seen in Photographs A008 and A009, and it appears that the marks are located more towards the edge of the pad of the thumb.

During test-firing, an attempt was made to produce marks on the edge of the thumb rather than the centre of the pad of the thumb. It was noted by the person conducting the loading that this was awkward, uncomfortable and it was difficult to get purchase on the top of the cartridge. Nevertheless, marks could be created in this location (Figure 20) but they were less sooted and the apparent mark was partly the result of compression of the skin. Marks made in this manner were shorter in length. This can be seen in Figure 20.

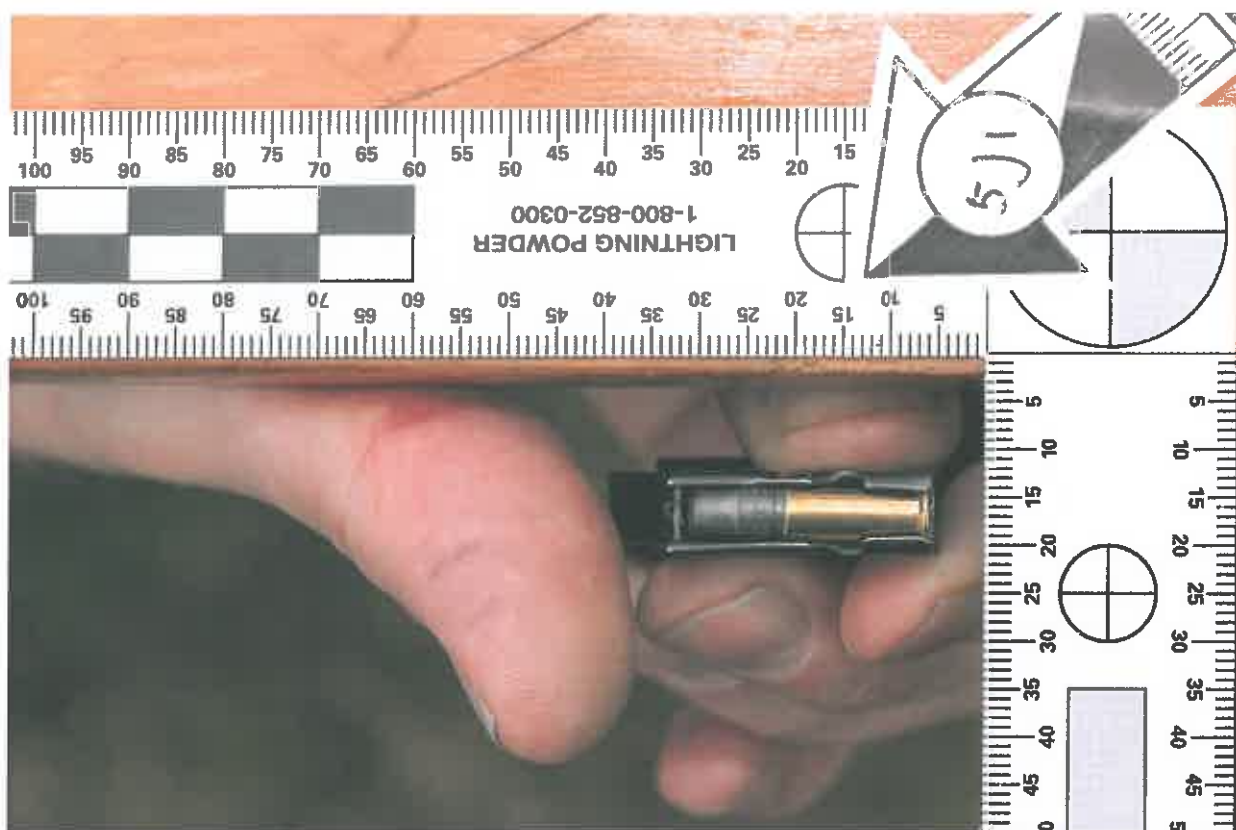


Figure 20. Marks made as a result of loading a cartridge using pressure on the side of the thumb.



Figure 21. A cropped area of Photograph A008.

6. Is the width of the marks on Mr Bain's thumb consistent with the marks created from loading a cartridge into the magazine?

The width of the marks produced during experimentation was variable. As measured as a proportion of the total width of the set of lines the individual lines were between about 2% and 12% of the total width of the set of two lines.

The marks on Mr Bain's thumb were approximately 5% and 9% of the total width of the set of two lines. Therefore they fell within the experimentally determined variation observed.

7. Is one set of lines expected from the circumstances of the shootings?

From the number of shots fired, it has been proposed that a number of cartridges would have needed to have been loaded into the magazines to continue firing.

Although it is possible to load rounds one at a time into the breech without using the magazine, this is cumbersome, slow and can be difficult.

Therefore it is likely that a number of cartridges were loaded into the magazine after some firing had occurred. This should result in multiple sets of magazine marks on the thumb.

Experimentation has shown that when two cartridges are loaded in succession, the thumb has two sets of marks resulting from contact with the lips of the magazine. This is shown in Figure 8 and is also probably the result of extra lines seen in at least one of the photographs in Figure 16. However the marks are less intense with the second loading and a third loading may not result in any marks being produced (see Figure 9).

In general two loadings may show part of, or all of, two sets of lines, but this may not be readily apparent. Furthermore the marks can be wiped away relatively easily, so the absence of multiple sets of marks does not necessarily exclude the possibility of multiple loading of the magazine.

Summary

1. Photographs A009 and A008 have been taken as general photographs to show the relative positions of items. Therefore there is no scale in the photograph that can be used to make measurements. These photographs are now being used to make comparisons (between the magazine and the marks on the thumb), which is a purpose for which they would not have been intended.
2. Subjectively, the photographs of the test-firing experimentation clearly show a set of dark-grey or black lines whereas the lines in Photographs A008 and A009 appear to have a reddish colouration.
3. The lines on the thumb of Mr Bain are not parallel and the line closest to the tip of the thumb is curved at one end. Although experimentation has shown that a curved line can be created which is not parallel to the other line, this appears to result from contact with the lips at the top of the magazine near the rear of the magazine. The lines on Mr

Bain's thumb did not give a good overlay of the relevant area of the lips of the magazine. However the orientation of the thumb in relation to the magazine means that an accurate comparison can not be made due to perspective differences. In general the lines on Mr Bain's thumb appear wider than the magazine lips.

4. The marks on Mr Bain's thumb are shorter than those typically observed during experimentation.
5. The marks on Mr Bain's thumb are not on the flat part of the pad of the thumb where loading marks are typically located. However they are not far removed from the common location and their apparent location nearer to the edge of the thumb may not be significant.
6. The width of the marks on Mr Bain's thumb fell within the experimentally determined variation.
7. If the marks on Mr Bain's thumb are the result of loading a cartridge, then the absence of other marks suggest that the loading was done after the marks from previous loadings had been wiped away.
8. The lack of appropriate scales and the orientation of the thumb in the photographs prevents a definitive conclusion as to whether the marks are the result of loading a magazine. The photographs had not been taken for the purpose of accurate comparison, so the absence of appropriate scales is not unexpected.
9. In my opinion although there appears to be a pair of lines on Mr Bain's thumb that could have resulted from loading a cartridge into a magazine, there is lacking an accurate correspondence of the features of the marks. In my opinion there is considerable doubt that the shape, dimensions and colour of the marks on Mr Bain's thumb are consistent with marks made as a result of loading a cartridge into a magazine.

K Walsh 2 October 2013

Kevan Arthur John Walsh