final report

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Gas depelting at Peel Valley Exporters, Tamworth

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Executive summary

The first double head gas depelting (GDP) machine was installed and trialled at Peel Valley Exporters' (PVE) Tamworth site. Prior to the installation, this "beta" machine was tested at Auckland Meat Processors (AMP) in Auckland, New Zealand and achieved a high degree of success with the fore-leg configuration. It was anticipated that similar success could be obtained with Australian ovine. With the decision made to have the machine tested in PVE, the machine was modified to accommodate the existing plant layout.

At PVE, the machine was configured for the rear legs only, automatically injecting filtered air to separate the pelt in the hindquarter region. The purpose of relocating this machine was to determine the viability of the GDP as an alternative method of depelting Australian ovine and ultimately to improve the quality of the pelt.

Two production trials were conducted and over 3000 animals processed. Machine performance in terms of inserting the needle and inflating was about 98% successful on at least one leg, 68% on both legs. Though encouraging, this was not as high as the results obtained at AMP.

Results also show that pelt separation was not as effective as experienced with New Zealand sheep and lambs and the key learning outcome was to determine the region of the leg and layer beneath the pelt where injection should take place. Inadvertently, a decision to lower the injection target area had reduced the effectiveness of pelt separation.

Overall, the machine demonstrated the viability of the process with Australian lambs but future production installations must give due consideration to the specification of the machine and process.

Contents

1 Introduction

1.1 Background

The "beta" version of the gas-depelting machine incorporates several new features, such as improved sanitisation, sanitiser shielding, and safety features including shear pins and sensors to detect the position of the machine.

In earlier trials performed at Auckland Meat Processors (AMP), using the "alpha" prototype machine, pelts were examined by LASRA (the Leather and Shoe Research Authority (NZ)). Their findings concluded that there was statistically no more damage done to the gas de-pelted skin than when conventionally removed. Also, they found that the pelts which were gas de-pelted had less adhered flesh[1].

While this is positive, it should be noted that this was for a given inflation time and pressure, which is likely to vary for each plant. It can be expected that the lower the inflation pressure and the longer the inflation time, the better likelihood of high quality pelts.

Micro testing was performed on animals at AMP using the "alpha" machine. Findings were "acceptable, except for one sample", with bacterial loads dropping as the carcases were chilled[2]. The new "beta" machine has a modified cycle to aid in sanitising and prevention of material ingress.

These include:

- Sanitisation starts once the arms are back, not once the machine is home.
- Two nozzles are used at each sanitiser station.
- Sanitiser water temperature is monitored and machine stopped if temperature too low.

The machine also incorporated several features not present in the earlier prototype. The new features included:

- Better shielding of the sanitiser stations.
- A latching mechanism which directly linked the machine to the moving chain and the concomitant linear motor drive. The combination of which removed the requirement for synchronous drive between the machine and chain, and assorted mechanical components such as gearboxes, belts, pulleys and clutches.
- Sensors are used for better control.
- Additionally, the whole assembly was designed for easier assembly and maintenance.
- This machine was removed from the Auckland site, modified slightly and installed at Peel Valley Exporters' Tamworth site.

[1] Dr Tim Allsop and Dr Sue Cooper
[2] Daniel Mills

1.2 Aim

- Install and demonstrate the gas depelting machine on site in Australia.
- Determine the efficacy of the process.

2 Installation

2.1 Set-up

The set up between the two sites was significantly different, with the rear legs presented at Tamworth and the machine mounted inside the chain, above the belly (see figs 4&5). Positioning inside the chain was necessary due to the rub-bar arrangement at Peel Valley.

Peel Valley uses two styles of hook, with different means of mounting to the chain and different displacement away from the permanently mounted rub bar (see figs.1&2). Also, the hooks are relatively short, meaning that the hooves are not far from the chain (see fig. 3). As a result, the inductive hook sensor could not be used, and mounting the latching mechanism as designed was impossible. Also, variation in surface loading meant that the legs twisted to varying degrees, presenting at different orientations.

Figure 1. Tight hook.

Figure 2. Loose hook.

To enable the machine to be used, the PLC program code was modified to remove the requirement for the hook sensor. Also, the latching pawl (component which engages with the chain) was lengthened so the latch could work in the narrow gap between hook mounting bolts and hooves.

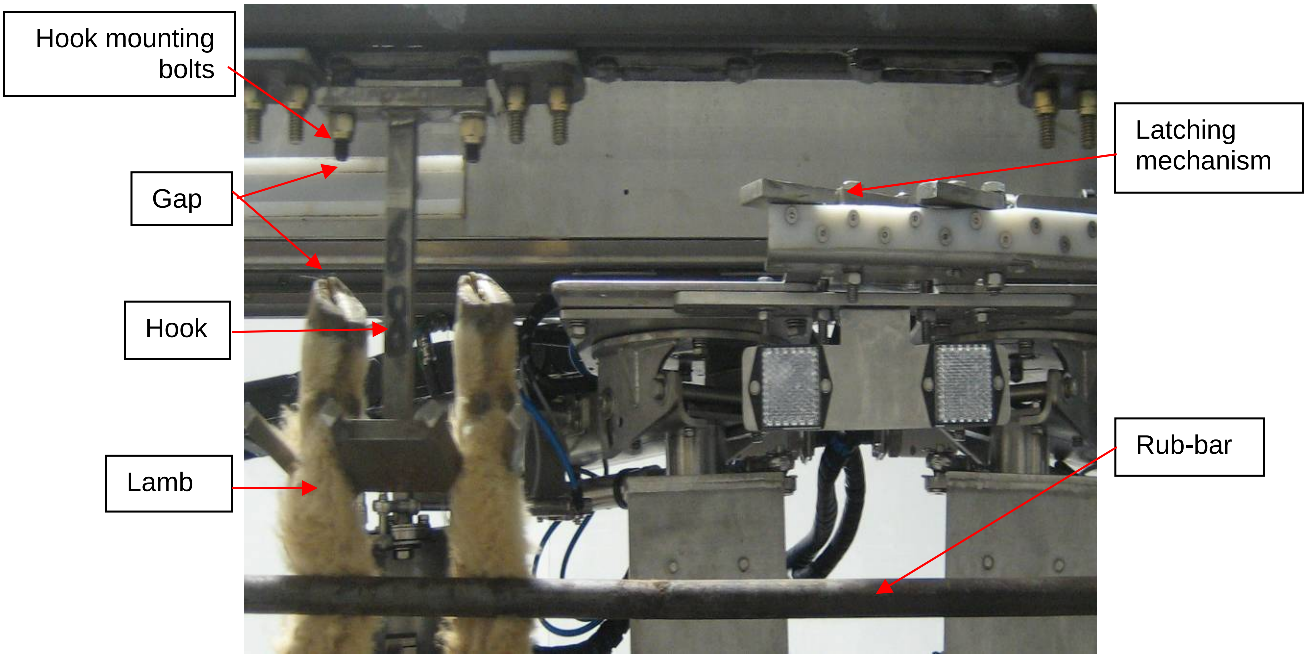

Figure 3. Latching position and gap.
NB: Hooves shown aren't as big and gnarled as some observed.

Framing was built locally, in Tamworth, for the mounting of the machine. The machine was mounted in an appropriate location immediately after the kill and stim and before the pizzle cut (see appendix). The machine was mounted at the most appropriate height and bolted in place. The control cabinet was mounted in the ceiling.

2.2 Installation

Various difficulties were experienced during installation. The first was the late arrival of the machine, though the time was used constructively to get the framing set up.

The second issue arose once the machine was powered, with it becoming obvious that somehow the PLC had a fatal malfunction. This necessitated replacing the unit and reprogramming.
At the time it seemed the 24V power supply was also faulty, however there turned out to be a short to earth in the wiring to the temperature monitor (this is unlikely to have caused the fault with the PLC, as it was wired to the 240V supply).

With these issues rectified, the tuning process was commenced, only to find an additional error, over-voltage to the linear motor controller. The over-voltage was corrected by the use of a high power resistor on the +72V line.

Tuning involved bringing the heads as close together as possible, mounting the latching mechanism to place the heads symmetrically about the hook, adjusting proximity and angle of the machine heads to the legs, and finally adjusting the aggressiveness (angle of approach) of the blades to the legs (see appendix).

The inflation time was determined by the frequency of animals, with the inflation limit sensor positioned to allow the return of the machine before the next animal to be processed. As the chain may stop mid-inflate, a timer was also used to limit the inflation time to approximately 3.5

seconds. Inflation pressure was reduced to approximately 4 bar, as this gave an inflated animal that could still be readily processed.

The temperature of the sanitising water was monitored, with the machine stopping if the temperature of the water dropped below 80°C and not restarting until the water was above this temperature.

In order to prevent the machine fouling on the inside face of the legs, which could result in a jam and broken shear pin, the heads were initially tuned so that the blades occasionally struck the rub-bar, which is also undesirable.

In an effort to counter these positional problems a stabiliser bracket was fitted to the rub-bar and the heads adjusted to suit. Then the location of the point of attack was lowered (by removing the "down-cut" motion of 40mm, leaving the blades in the lowered position).

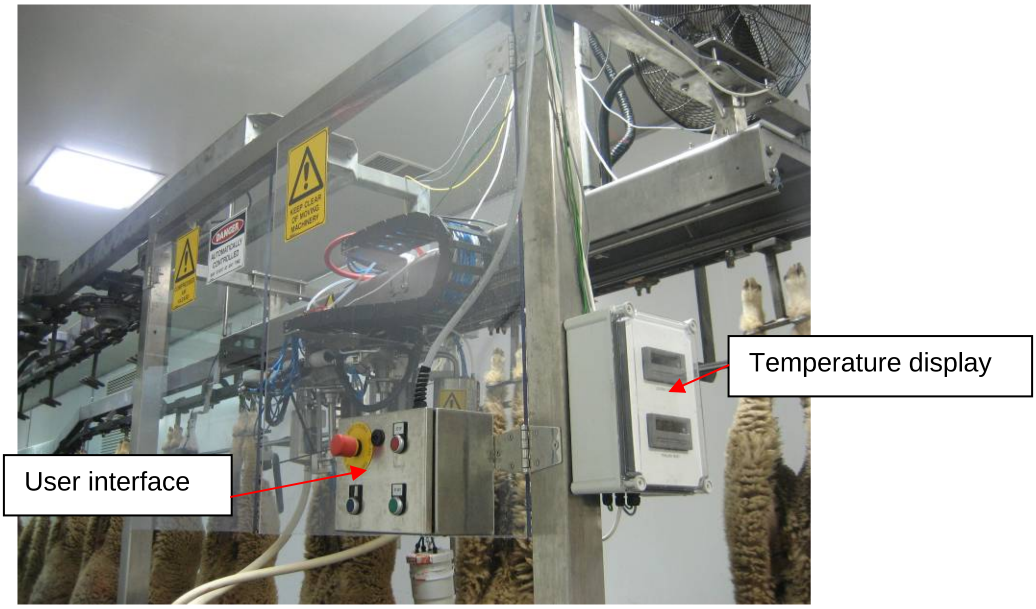

Figure 4. Installed machine view 1.

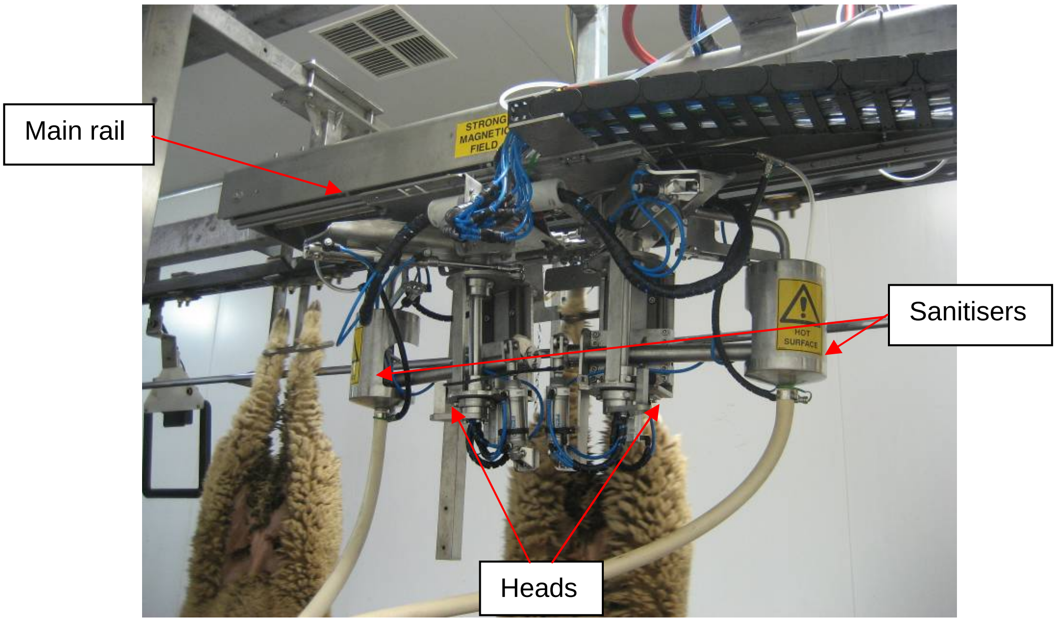

Figure 5. Installed machine view 2.

3 Experimental trials

Two trials were conducted.

1. Intended to prove the machine and used as a tuning and trial run. **30/1/2009**.

2. Supervised by AQIS, was used for tuning and proving of the machine on production runs. **24 – 26/4/2009**. Bacterial loading samples were taken by QA for analysis.

3.1 Test Procedure

Run the machine for a number of sheep and determine the hit rate. Hit rate is determined by successful inflation on the leading leg, trailing leg or both legs.

Test conditions:

1) Animals travel on continuous chain at 9 carcases / min.
2) Animals were mixed breed.
3) Machine operated automatically with supervision.
4) Observers: Ron Brooks (MLA Project Manager), PVE supervisors (John M^{c}Clusky, Michael Hope, Brian Ghananburgh (QA)).
5) Test conducted by Jason van Beurden, Christopher Lennox, Geoff Bates.

Observations / measurements:

- Process performance i.e. hit rate.
- Level of inflation – if this impairs further processes.
- Machine performance e.g. robustness, sanitising, repeatability, etc.

Reasons for failure are noted and are categorised as follows:

- Failure: behind leg — Blade passes behind leg and does not penetrate skin.
- Failure: in front of leg — Blade passes in front of leg and does not penetrate skin.
- Failure: insertion missed, blade fouled on bone — Blade hits leg, penetrates skin but doesn't rotate in as the blade is caught on bone.
- Failure: others — As noted.

Any feedback from the line is noted such as whether their process is made harder or easier, or if noticeable change to the product has occurred.

4 Results

Trial on 30/01/09

Notes:

- Whole machine moved back 10mm, heads tuned for angle, aggressiveness and position normal to the chain.
- New shear pins fitted. Leading shear pin replaced with bolt as keeps breaking when fouled in front of leg.

Table 1: 30/01/09 Hit rate

	Trailing	**Both**	**Leading**	**Total**
Success	46	71	16	133
Failure: Behind leg	2	3	12	17
Failure: In front of leg	4	6	4	14
Failure: Insertion Missed	0	0	0	0
Failure: Blade Fouled on bone	0	0	0	0
Failure: Other	11	5	31	47
Total	63	85	63	**148**
BOTH Legs Success Rate		**0.48**		
Individual Success Rate	**0.79**		**0.59**	
At least **ONE** leg successful				**0.90**

For 148 animals processed,

- 79% success on trailing leg (includes when both legs successful),
- 59% success on leading leg (includes when both legs successful),
- 48% success on both legs.
- 90% success on at least one leg.

Comments

- If leading head blade fouls in front of the leg, the machine stalls and requires a restart.
- Feedback from the line is all positive. The job is either easier or at least no more difficult for all processes down the line.
- The failures stated as "other" were where the blade hit, caught on the pelt (not bone), but could not penetrate skin. Blade may have been blunt.

Trial on 24-26/04/09

Notes:
- Rub bar bracket fitted.
- Heads tuned for angle, aggressiveness and position.
- Down cut removed from process to avoid clashes, effectively lowering the heads 40mm.

Table 2: 24-26 /04/09 Hit rate

	Trailing	Both	Leading	Total
Success	164	2,489	919	3572
Failure: Insertion Missed	923	67	168	1158
Total	1087	2556	1087	**3643**
BOTH Legs Success Rate		**0.68**		
INDIVIDUAL Success Rate	**0.73**		**0.94**	
At least **ONE** leg successful				**0.98**

For 3,643 animals processed over 3 days,
- 73% success on trailing leg (includes when both legs successful),
- 94% success on leading leg (includes when both legs successful),
- 68% success on both legs,
- 98% success on at least one leg.

Comments
- The cut is now in the edible region of the leg.
- Inflation does not seem beneficial. No positive feedback from the line.
- "Blown shoulders" evident.
- Possible slight improvement in appearance of rump fat and less evidence of blood on the surface, though this could not be verified and was debatable.

For further details, refer to Tamworth GDP Report 27 03 2009[3].

Swabs were taken by Peel Valley Exporter's Quality Assurance team during this trial. Bacterial loading tests were carried out by Symbio Alliance. Results were deemed acceptable according to PVE criteria (see appendix).
NB: Sampling process was not observed by IRL.

[3] G. Bates and C. Lennox

5 Discussion

The heads were mounted as close together as physically possible without clashing against each other. Unfortunately, due to the close hang-up between legs with the current hook geometry, this was not quite close enough to ensure definite contact with both legs. If the arms were able to swing past 90°, without fouling on the rub-bar, this limitation could be overcome, the blades would then approach the leg slightly to the rear at an angle. Additional tapped mounting holes in the head plate may be required to achieve this, as well as repositioning of the rub-bar. This would require the temporary removal of the head assemblies and head plates.

The temperature of the sanitising water was monitored, with the machine stopping if the temperature of the water dropped below 80°C, and not restarting until the water was above this temperature. As the chain speed was high, the machine had very little time to sanitise between animals. The direct result of this was that the machine stopped regularly to allow the sanitising water to achieve temperature.

With the variable position of the hooks relative to the rub-bar, the rub-bar was differentially loaded dependant on the various sized animals, which type of hook was occupied, and the number of animals on the chain – for instance day versus evening shift. The variable loading caused variation in the flexing of the rub-bar and position of the legs relative to the GDP machine, making repeatable results difficult.

Initially, in order to prevent the machine fouling on the inside face of the legs, which could result in a jam and broken shear pin, the heads were tuned so that the blades occasionally struck the rub-bar when it was under little load, this was also undesirable.

In an effort to counter these problems, first a stabiliser bracket was fitted, then the location of the point of attack was lowered by removing the “down-cut” motion of 40mm, leaving the blades in the lowered position (see fig. 6).

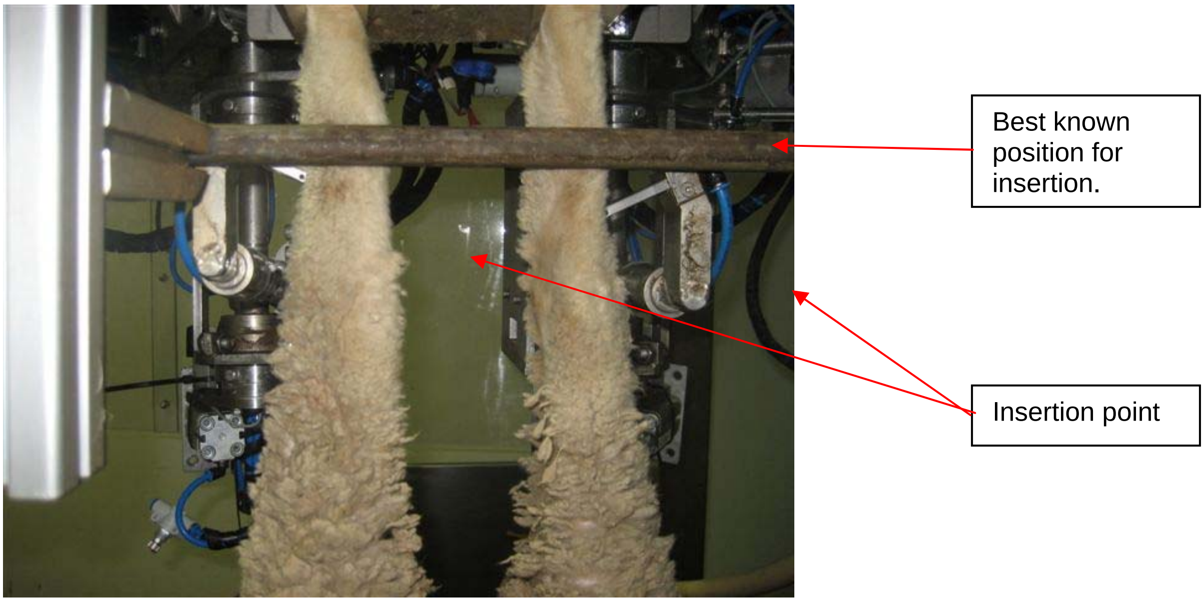

Figure 6. Blade insertion location.

These modifications improved the hit rate (see tables 1 & 2 for results). However, it seems that the low position means that the blade now tends to inflate tissues rather than separating the pelt from the carcase, also causing “blown shoulders”. No positive feedback was received from the line.

During initial set-up and trials at AMP this did not seem to be the case, with positive feed back (anecdotal only) from the line. At PVE the issue then was low hit rate and a high likelihood of fouling.

A possible solution would be a local modification of the rub-bar, with the rub-bar lowered approximately 50-70mm for the length of the machine. This would need to be rigidly braced near the home position of the machine and points along its length to provide a repeatable reference. Once this was done, the heads could operate at the upper position which may improve the separation of pelt from carcase. If the machine needed to operate above this position, modifications to the latching mount would also be required.

All bacterial testing indicates acceptable levels of contamination, generally no higher than normally occurs during processing. This indicates that the contribution from the GDP is minimal and that sanitisation measures are sufficient.

5.1 Benefits and Drawbacks

Trials at the New Zealand site included rear-leg gas-depelting using the “alpha” prototype, and fore-leg gas-depelting using the “beta” prototype which was later installed at PVE in Tamworth. During these trials anecdotal results showed that:

- The pelt was easier to remove. This was noted by the tunnel punchers.
- The finish was better – fewer tears in the fat resulted as did fewer blood spots, also the likelihood of cuts to the flesh at the groin was reduced with rear-leg GDP and under the forelegs with foreleg GDP.
- With foreleg inflation it was more difficult to perform the initial cut for Y-cut on animals that had short pelts when the fore-leg GDP was used. This was due to the pelt being under tension leaving no slack skin to grab. This would be the case with either an automated or manual inflation process.
- Some inflation of the fat was noted though this tended to disappear during chilling. There is no record of this occurring with manual GDP, though this does not mean it is absent.
- Blown shoulders were evident, whether this is due to GDP, the current pelt pulling process, or the current process exacerbated by GDP is unknown at this point. However there is apparently a lot of force applied when removing the pelt mechanically, this also leads to some damage to the pelt.
- Damage to the pelt was neither reduced nor increased through the use of rear-leg GDP as per LASRA report[1] (pelt analysis on foreleg GDP has not been done).

Similarly, during set-up trials at Tamworth anecdotal feed back was that:

- Over-inflation made the initial cuts difficult (as above).
- Other processes were not adversely influenced, some were said to be easier, though this was not objectively assessed.

Naturally, inflation occurs closest to the injection point first. With rear leg inflation this means the groin area, with fore-leg inflation it means around the brisket. From there the air percolates, generally along the belly and flanks, to the other end of the animal and up the other pair of legs. Surprisingly, air does not burst forth from the cut in the neck in either method, but is contained.

6 Conclusions

The “beta” version of the double head gas depelting (GDP) machine was successfully installed at Peel Valley Exporters’ (PVE) Tamworth site. Over a period of 3 months, the machine operated under supervision, completed two trials processing more than 3000 animals in a production scenario.

The key learning outcome of the depelting trials indicated an optimum position for inflation on the leg of the animal, in the bony section of hock closest to the hoof. By adjusting the injection blade lower to overcome the existing plant setup, it had caused the inflation to be less effective. Further work to remedy this situation is proposed in this report but would necessitate a change in the plant layout.

Machine performance results also indicated a lower insertion and injection success rate. Believed to be mainly due to physical constraints, both within the machine itself, and mating the machine to the chain, this is not insurmountable. Modifications made to the machine during the trial period did help to increase the rate. But it is envisaged that a more successful outcome could be attained if the chain was modified to suit the machine. It was understood this was not a viable proposition since the prototype machine was only installed for a short term.

7 References

Dr Tim Allsop and Dr Sue Cooper, “Evaluation of Lambskins from Gas Depelting Trials”, Leather and Shoe Research Authority (NZ) (LASRA), November 2007.

Daniel Mills, “Double Headed Ovine Gas Depelting (GDP) Microbiological Test Design”, DeviceWorks, Industrial Research Ltd, 5 November 7007.

G. Bates and C. Lennox, “Tamworth GDP Report 27 03 2009”, DeviceWorks, Industrial Research Ltd, March 2009.

8 Appendix

Gas-depelter nomenclature

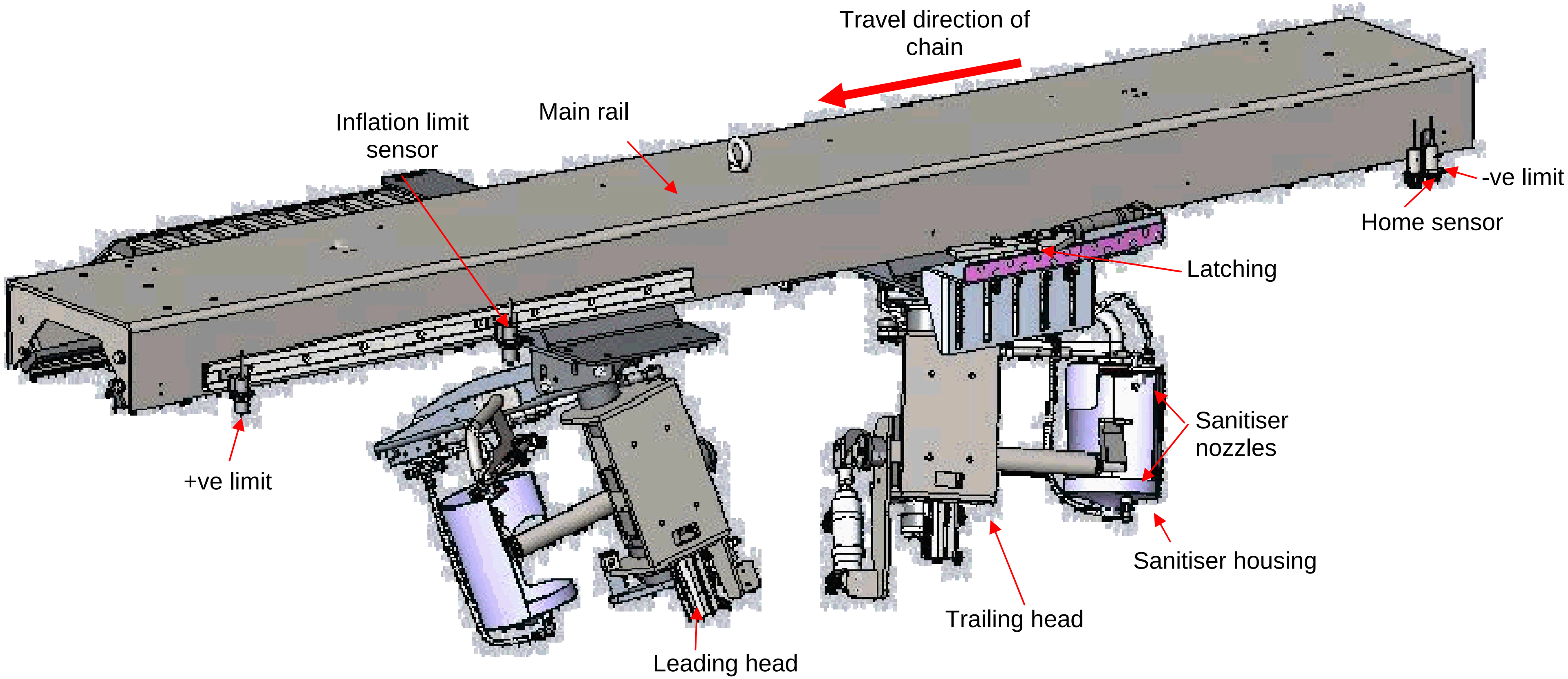

***Figure A1. Gas-depelter view 1, as seen from carcase side*.**

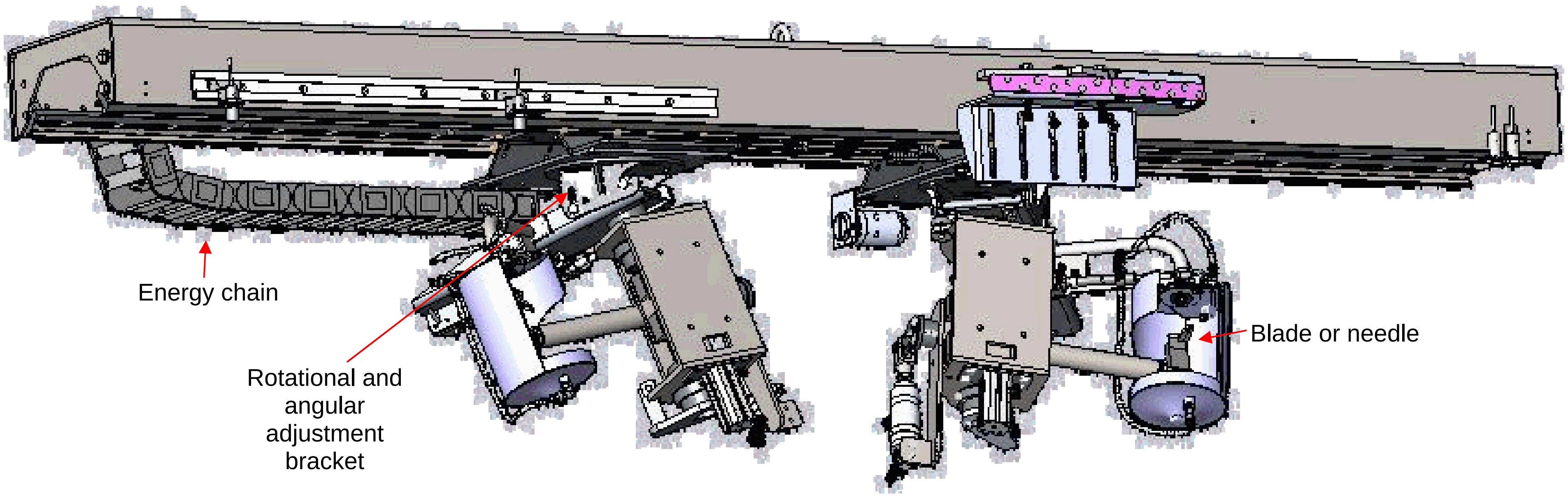

Figure A2. Gas-depelter view 2, as seen from carcase side.

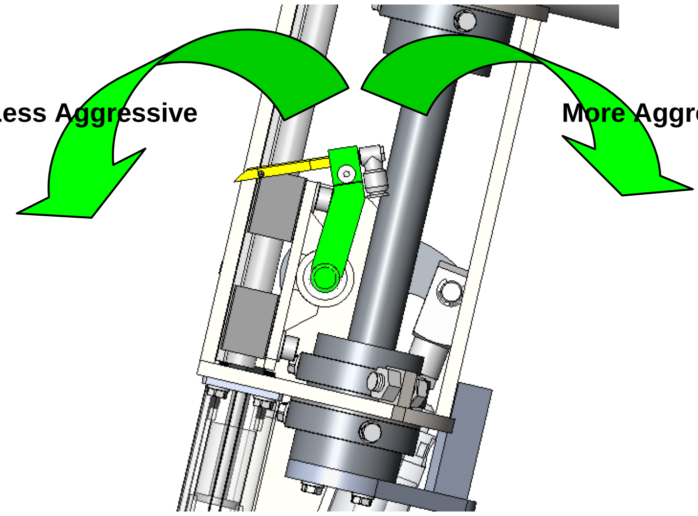

Figure A3. adjustment of blade angle (aggressiveness).
NB: Leading head shown.

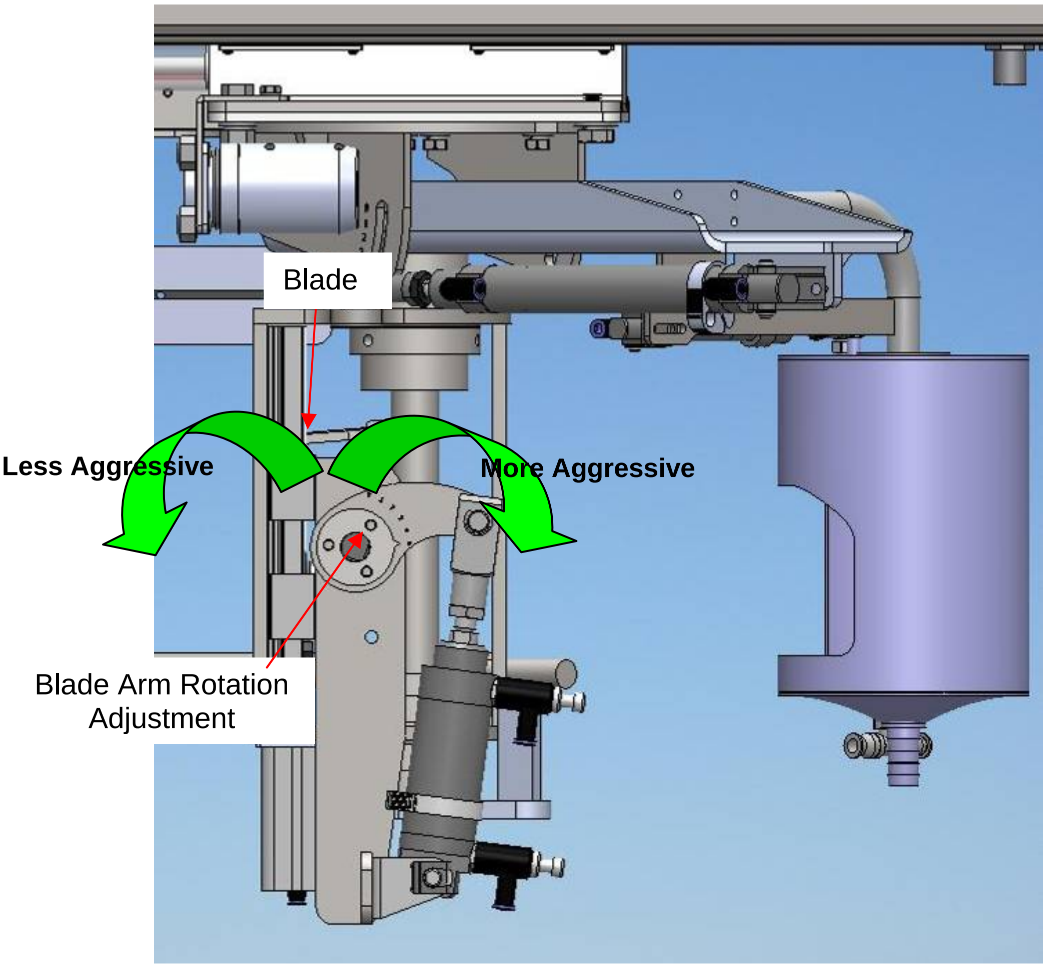

Figure A4. Adjustment of blade angle (aggressiveness).
NB: Trailing head shown.

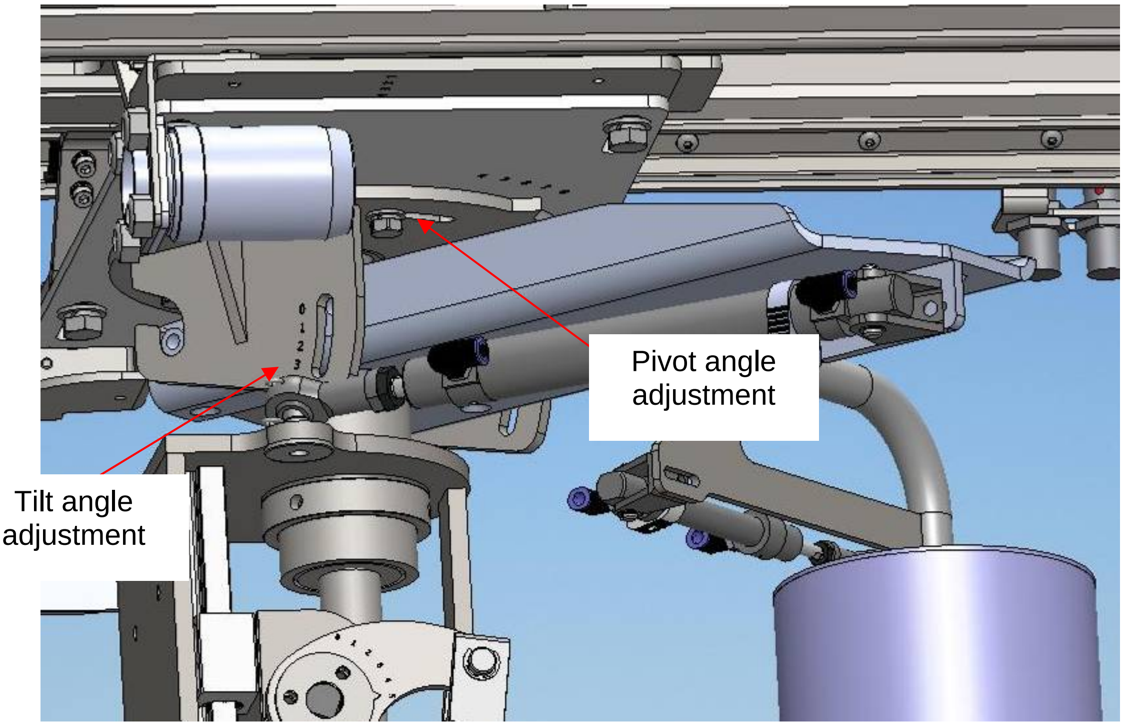

Figure A5. Adjustment of head angle.
NB: Tilt angle effects line of cut (while also effecting proximity to the chain), pivot angle effects end of motion position of arms when they swing in.

Site layout

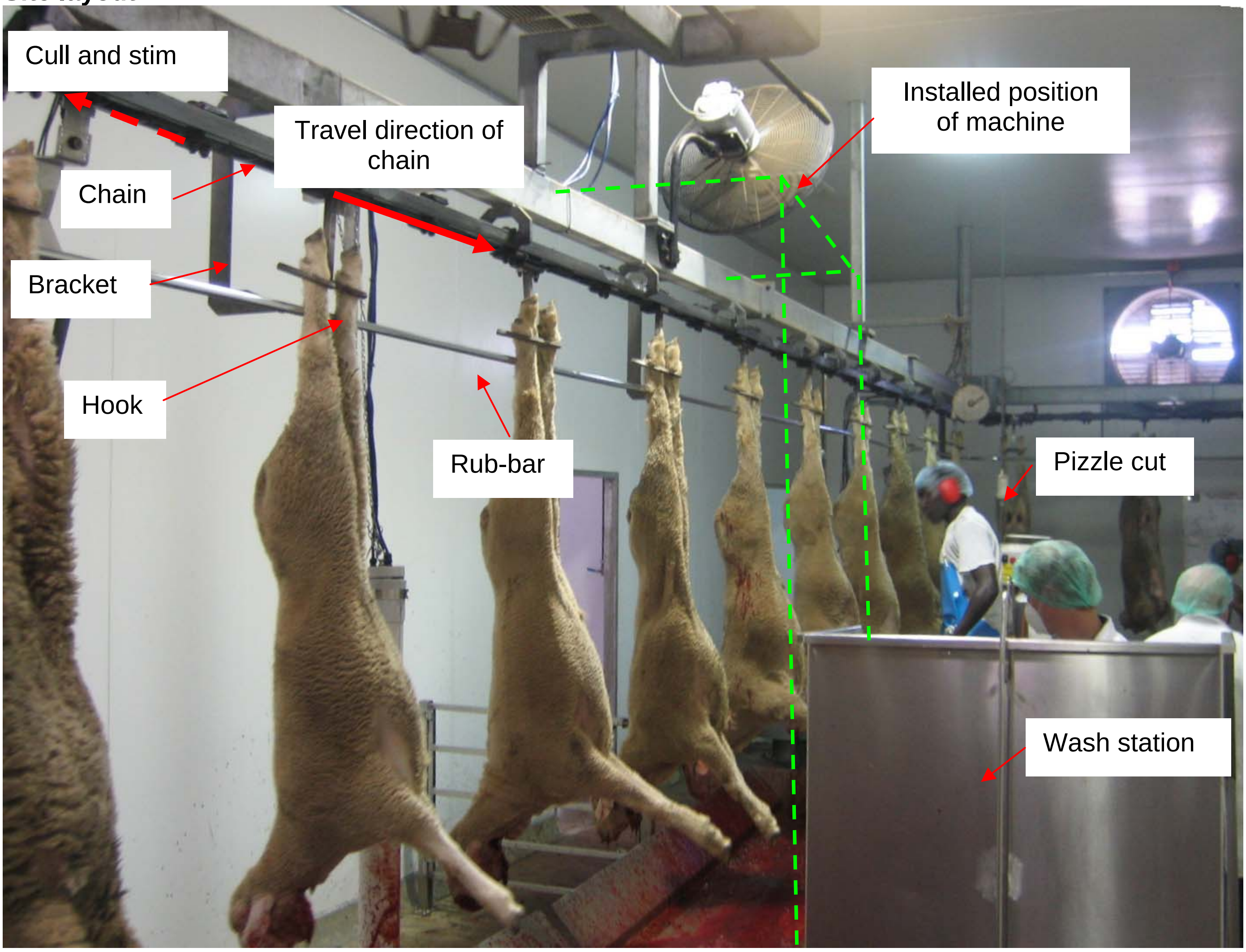

Figure A6. Peel Valley Exporters' Tamworth Site, machine location.

Figure A7. Peel Valley Exporters' Tamworth Site, machine location, machine in place.

Microbial contamination of carcases following gas de-pelting (PVE)

CERTIFICATE OF ANALYSIS

ANALYSIS PERFORMED FOR
Brian Ghananburgh
Peel Valley Exporters Pty Ltd
Phoenix Street
Tamworth NSW 2340

CERTIFICATE NO.: 72669
REVISION NO.: 00
ISSUE DATE: 12/03/09

SAMPLE INFORMATION
Description: Carcase Sponges
Date Received: 10/3/9
Testing Commenced: 10/3/9

CONDITIONS OF SAMPLE ON RECEIPT
Receipt Temperature: 3 °C (Surface Temperature taken by infra-red)
Storage Temperature: Less than 5 °C
Order No.: CO14879

RESULTS OF ANALYSIS ***Results pertain only to sample(s) analysed.***

Raw Meat (Carcase Sponge) 9/3/9 KD6/3/9

LAB CODE	Sample DESCRIPTION	SPC (CFU/cm2)	E coli (CFU/cm2)
72669-1	LAMB C1 10:35	13	<0.33
72669-2	LAMB C2 10:37	7	<0.33
72669-3	LAMB C3 10:40	3	<0.33
72669-4	LAMB C4 10:42	<3	<0.33
72669-5	LAMB C5 10:45	<3	<0.33
72669-6	LAMB C6 10:47	<3	<0.33
72669-7	LAMB C7 10:50	<3	<0.33
72669-8	LAMB C8 10:55	<3	<0.33
72669-9	LAMB C9 10:57	23	0.33
72669-10	LAMB C10 11:00	<3	<0.33
72669-11	LAMB C11 11:02	3	<0.33
72669-12	LAMB C12 11:05	3	<0.33
72669-13	LAMB C13 11:07	7	<0.33
72669-14	LAMB C14 11:10	<3	<0.33
72669-15	LAMB C15 11:15	<3	<0.33
72669-16	LAMB C16 11:17	3	<0.33
72669-17	LAMB C17 11:20	<3	<0.33
72669-18	LAMB C18 11:22	<3	<0.33
72669-19	LAMB C19 11:25	3	<0.33
72669-20	LAMB C20 11:27	3	<0.33
72669-21	LAMB C21 11:30	10	<0.33
72669-22	LAMB C22 11:35	<3	<0.33

HPC Holdings Pty Ltd trading as Symbio Alliance ABN 93 621 286 928
44 Brandl Street, Eight Mile Plains Q 4113
PO Box 4312, Eight Mile Plains Q 4113 Australia
Telephone +61 7 3340 5700 Facsimile + 61 7 3219 0333
Email admin@symbioalliance.com.au

Job Reference: 72669

LAB CODE	Sample DESCRIPTION	SPC (CFU/cm2)	*E coli* (CFU/cm2)
72669-23	LAMB C23 11:37	10	<0.33
72669-24	LAMB C24 11:40	<3	<0.33
72669-25	LAMB C25 11:42	<3	<0.33
72669-26	LAMB C26 11:45	3	<0.33
72669-27	LAMB C27 11:47	<3	<0.33
72669-28	LAMB C28 11:50	3	<0.33
72669-29	LAMB C29 11:52	7	<0.33

DEFINITIONS: **> = Greater than** **< = Less than** **CFU = Colony Forming Uints**
N.D. = Not Detected **- = Not Tested** **~ = Estimated Count**
MPN = Most Probable Number (Presumtive Result)

TEST PERFORMED

TestNo.	TEST	Method	REFERENCE
1	SPC	M2.5	AOAC990.12
2	Ecoli	M8.8	AOAC991.14

Dr Juliana Chiruta
Manager Microbiology

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■ 44 Brandl Street, Eight Mile Plains Q 4113
■ PO Box 4312, Eight Mile Plains Q 4113 Australia
■ Telephone +61 7 3340 5700 ■ Facsimile + 61 7 3219 0333
■ Email admin@symbioalliance.com.au

NB: The above certificate was transcribed from the original PDF.
Acceptability limits:
E-coli <1000 CFU/cm2
SPC / TPC <5 CFU/cm2

SPC = standard plate count (incubated on agar at 30°C-40°C for 2 days).
TPC = total plate count (growth medium, temperature and incubation period as stated for particular test).

Swabs were taken by Peel Valley Exporter’s Quality Assurance team, tests carried out by Symbio Alliance.

As stated earlier, the results are deemed acceptable by PVE.

Peel Valley Exporters Pty Ltd Disclaimer:

Peel valley Exporters Pty Ltd carried out micro swab tests on 29 carcases only. These tests were carried out to determine if in fact a verification trial would be conducted by this company. Please note that the 29 carcases tested were not a verification trial carried out by Peel Valley Exporters Pty Ltd, any verification trial carried out by this company would involve 150 randomly selected carcases per day over a 5 day period prior to and after the installation any new technology.
The swab tests taken or the Name Peel Valley Exporters Pty Ltd is not to be use as verification for the operational status of the Gas Pelt Removal system.