

Ergonomics of sheep handling equipment for shearing and crutching



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Project report

Ergonomics of sheep handling equipment for shearing and crutching

Project report

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By John Culvenor, Tom Mitchell & Michael Lawrance

Based on the work of the Australian Agricultural-Ergonomics Research Team at the University of Ballarat (Steve Cowley, John Culvenor, Jack Harvey, Michael Lawrance, Tom Mitchell, Warren Payne, David Stuart & Robyn Williams)

Contact Details:

VIOSH Australia
University of Ballarat
PO Box 663
Ballarat 3353
Telephone: 03-5327-9150
www.ballarat.edu.au

WorkCover NSW
GPO Box 5364
Sydney 2001
Telephone: 03-9370-5000
www.workcover.nsw.gov.au

Cover: Ralph Kelly at "Aldersyde South", Victoria
Cover Design: Stuart Murray

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Preface

Funded by WorkCover NSW (project 96-0094), the University of Ballarat recently undertook a research project that resulted in a set of resources regarding the "Ergonomics of sheep handling equipment for shearing and crutching".

The project documentation includes:

- Project Report
- Design Guide
- Checklists (extracted from the Design Guide)
- Equipment Catalogue

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The researchers acknowledge the assistance of the following:

- Manufacturers and distributors of sheep handling equipment.
- Shearing and crutching equipment users and owners.
- The shearing industry reference group.
- WorkCover NSW.

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Executive Summary

Shearing and crutching sheep is clearly a very demanding task and in many cases the work is undertaken using much the same methods that have been employed for most of this century. Two aspects of the task that make the job hazardous are the catching and dragging of the sheep, and the fully-flexed posture that the shearer adopts while doing the work. Equipment that holds the sheep off the floor, thereby removing the fully-flexed posture, has become popular for crutching. Sheep are delivered to the units in races in a way that on first appearance seems to remove the problems associated with the catch and drag from the traditional "catching pen". Similar concepts are being tried in sheep shearing but are not as widespread.

This project aimed to review the handlers that are used for shearing and crutching and prepare a set of guidelines that manufacturers could use when designing the equipment. Shearing and crutching machines throughout Australia were investigated by viewing them in operation where possible and speaking with owners and operators.

The design guide was developed and it was recommended that OHS regulatory authorities provide the guide to all manufacturers and designers of new technology and follow this with appropriate advice and other action where necessary. It was recommended that other material such as a catalogue of equipment reviewed and design checklists be promoted to people who may purchase or use these handlers. Furthermore it was recommended that this model of safety research and intervention be extended to other hazards in agriculture.

The conclusion of the project is that sheep handlers make a positive contribution to safety in the crutching of sheep. While the handlers address some of the greatest risks of the traditional method of crutching, namely the catching and dragging of sheep and the fully flexed posture, there are a number of improvements that could be made to the equipment. These are noted in the design guide that should be utilised by manufacturers. In the case of shearing, the handlers are less well developed but there would appear to be similar opportunities for their use to improve safety. In any work it is important that the hazards of new equipment and work processes be assessed and problems controlled. This is equally true of shearing and crutching where the introduction of new methods should be accompanied by a consideration of any new hazards such that problems can be addressed at an early stage.

1 Introduction

Within the agriculture sector, sheep shearers have the highest incidence of occupational injury and disease claims (150 compensation claims per 1000 workers per year) and manual handling is implicated in about 80% of these claims (Worksafe Australia 1995). It has been calculated that back injuries to shearers cost the Australian wool industry \$76.4 million per year or 15.9% of the labour cost of shearing (Bentley 1993). Therefore, in addition to addressing the personal costs borne by workers in the industry, it is imperative that the impact of worker injury on the cost of production be minimised in order for wool to be competitive and deliver an appropriate return to the wool grower.

Shearing and crutching are today often performed in much the same way as they have been for most of this century. However equipment generally known as “sheep handlers” are now becoming reasonably well used for crutching sheep and equipment is emerging for shearing sheep with some units now commercially available. Generally this new equipment holds the sheep in an elevated position and would seem at first impression to substantially address the stooping component of the traditional methods. Clearly the arrival of this equipment is changing the way crutching is performed and may in the future substantially influence the way shearing is carried out. The crutching systems range from single operator units installed inside shearing sheds to multiple operator mobile units popular for crutching sheep in-field especially in the pastoral areas of New South Wales, South Australia and Western Australia. In some instances the mobile crutching units are used for shearing, usually in locations remote from shearing shed facilities.

At this time it was prudent to conduct an assessment of the likely impact of the new technologies on occupational health and safety (OHS). For instance the *National Code of Practice for Manual Handling (NOHSC 1990)* emphasises that ‘Care should be taken to ensure that further risks to health and safety are not created by the application of control methods aimed at reduction of manual handling risks.’ (Clause 5.4).

Improvement at the design and manufacture stage represents an excellent opportunity to minimise occupational health and safety risks and for this reason an outcome of the research was a *Design Guide* for designers and manufacturers.

Together with good design, occupational health and safety risks can be influenced by the purchasing, operational and work system decisions of potential users of the equipment. Therefore a catalogue has been prepared to assist potential users of the equipment by providing a design checklist and a list of the equipment viewed during the research.

1.1 Aim

To reduce the level of injury among workers who operate, and will operate, new and emerging technologies for the shearing and crutching of sheep.

1.2 Objectives

1. To collaborate with sheep industry representatives and equipment manufacturers to enable evaluation of new and emerging wool harvesting technologies.
2. To undertake a *hazard identification* and *risk assessment* for new and emerging technologies for the shearing and crutching of sheep.
3. To produce *risk control* guidance notes for the safe design and operation of new and emerging technologies for the shearing and crutching of sheep in terms of the operator-machine interface, the associated environmental hygiene issues, and the work organisation factors.
4. To recommend specific design enhancements to reduce the risk associated with hazards identified for each equipment manufacturer participating in the research.
5. To provide a model for the integration of OHS in the design of agricultural machinery.

2 Methods

The research methodology was intended to answer the following research questions.

- What emerging technologies will have an influence on sheep shearing and crutching in the next three years?
- What risks do these emerging technologies impose on the operators?
- In terms of safety to the operator, what are the negative and positive design features of these emerging technologies?
- What design changes would reduce existing risks?

The methodology consisted of three parts:

1. hazard identification;
2. risk assessment; and
3. risk control.

The hazard identification phase included consultation with representatives of the wool harvesting industry to establish the range of equipment that is likely to influence the industry in the next three years. This was achieved by way of a survey (see Appendix A) of 33 individuals and representatives of the bodies listed below. This consultation was also used as a preliminary gauge of the range of hazards associated with the use of this equipment. Those invited to participate included representatives of:

State and National Farmer's Federations
Australian Workers' Union
Shearing and Rural Workers' Union
Shearing Contractors Association of Australia
Wool Mark Company

In the risk assessment phase, 28 crutching and 7 shearing technologies throughout Australia were reviewed. The equipment was observed in use where possible and discussions were had with operators who were present. Where equipment was not in use, the equipment was examined and discussions were had with the owner/operator regarding its operation and health and safety issues. Photographs and in some cases videotapes were taken for later viewing. The analysis was based on the ergonomic issues associated with the interface between the operator and the machine, the occupational hygiene issues of the working environment and the organization of work. Thus the three factors of interest were;

The operator machine interface. This is of central importance, but was considered within the context of;
The industrial and environmental hygiene issues; and
The work system issues related to the management of the tasks being considered.

Three researchers experienced in occupational health and safety undertook these visits. Checklists on manual handling (NOHSC 1990), occupational overuse syndrome (NOHSC 1996) and plant (HSOV undated) were applied. A detailed summary of each machine was made including its setup-configuration, typical uses, daily tally, operators, work organization, and occupational hygiene. A detailed summary of the task was made including an assessment of the sub-tasks such as the catch, handpiece, crutch/shear and release. Advantages and disadvantages with each machine were noted.

Manual handling issues in particular were analyzed by a researcher with clinical physiotherapy experience and the working postures associated with some machines were analyzed using biomechanical modeling using the University of Michigan 3D Static Strength Prediction Program. These issues are reported by Culvenor and Williams (1999).

The risk control phase consisted firstly of notifying individual manufacturers of what the research team saw as the main advantages and disadvantages of their equipment. Comment was invited regarding the feedback. Secondly a non-evaluative *Catalogue* of the equipment reviewed containing design checklists was produced to aid the purchase and operating decision of potential users. Thirdly, and the main aspect of the risk control phase, was the development of a *Design Guide* for designers and manufacturers of sheep handling equipment for shearing and crutching.

3 Results and Discussion

3.1 Hazard Identification

The survey, follow-up teleconference and subsequent investigation resulted in the list of machines that were ultimately reviewed shown in Table 1.

Table 1 Sheep Handlers Reviewed¹

Machine Type/Machine	Commercial Availability	Visit Date	State
Crutching: Rotating Cradle Systems			
Draffen Superior Sheep Handler	Yes	12 November 1997	Vic.
Hamilton Crutching Cradle	Yes	December 1997	NSW
Hawthorne Handler	Yes	4 March 1998	Vic.
Peak Handler (In-Yards)	Yes	15 January 1998	NSW.
PeakHandler (In-Shed)	Yes	December 1997	NSW
Rapid Sheep Handler	Yes	December 1997	NSW
Rentsch Revolution and Rentsch Animal Prompter	Yes	6 May 1998	Vic.
Ringer	Yes	3 March 1998	Vic.
Easy Farm Sheep Handler	Uncertain	December 1997	NSW
Crutching: Raised Race Systems			
Harrington Crutching Cradle & Raised Race	Yes	17 December 1997	Vic.
PeakCrutcha	Yes	December 1997	NSW
Home-Made Race and Crutching Cradle	No	17 March 1998	Vic.
Left-Hand/Right-Hand Modified Harrington Crutching Cradle	No	4 February 1998	Vic.
Modified Harrington Crutching Cradle with Under Race Release	No	4 February 1998	Vic.
Sheep Train	Uncertain	15 January 1998	NSW.
Crutching: Conveyor Systems			
VE Machine	Yes	2 & 3 March 1998	Vic.
VE Machine (Trailer-Mounted)	Yes	December 1997	NSW
Roberson Sheep and Goat Handler	Yes	December 1997	NSW
Langsford Sheep Handler	Yes	8 February 1998	WA
Crutching: Trailer Systems			
Dickenson Shearing/Crutching Trailer	Yes	8 February 1998	WA
Early Model Harrington Handler on Trailer	Yes	January 1998	Vic.
Harrington Three-Stand Crutching Trailer	Yes	15 January 1998	NSW
Harrington Three-Stand Crutching Trailer	Yes	12 January 1998	NSW.
Power Crutch Three-Stand Trailer	Yes	January 1998	WA
Swithenbank Three-Stand Crutching Trailer	Yes	January 1998	WA
Across the Board Five-Stand Crutching Trailer	No	15 January 1998	NSW
Across the Board Four-Stand Crutching Trailer	No	13 January 1998	NSW
Shearing Systems			
McShane Shearing Table	Yes	16 & 17 February 1998	Tas.
PeakShearer	Yes	Oct.-Nov. 1997	NSW
SLAMP	Yes	October 1997	WA
Bioclip	Emerging	Oct.-Nov. 1997	NSW
Godson/Overton	Emerging	Oct.-Nov. 1997	NSW
Chain Shear	Emerging	1 October 1997	WA
Lance Lines Electro-Immobilisation Schaefer Handler	Emerging	Oct.-Nov. 1997	SA

¹ Further machines that may be available but were not reviewed (many are listed in Kondinin Group 1990): Aussie Sheep Handler; Dwyer's Sheep Handler; Ezy-Sheephandler; Green Machine; Gun Crutch; Harrington Convey 2000; Hayes Sheep Handler; Hecton/Steer Handler; Jumbuck Crutching Cradle; Jumbuck Sheep & Goat Handler; Kurra Wirra; Murdoch Sheep Handler; Murray Handler; Murray Sheep Handler; Newbigging's Stock Handler; Newman No Drag System; Oatley Sheep & Goat Handler; Payne Sheep Handlers; Sunbeam; Thornton Sheep & Goat Handler

3.2 Risk Assessment (Fieldwork)

The equipment shown in Table 1 was reviewed in-field where possible. Table 2 summarizes the advantages and disadvantages (in terms of occupational health and safety) of the machines reviewed. The paper by Culvenor and Williams (1999) contains a more detailed discussion of the manual handling aspects of the risk assessment. The *Design Guide* also contains specific discussion of these design issues.

Table 2 Summary of Risk Assessment Issues

	Advantages	Disadvantages
General	<ul style="list-style-type: none"> • Less bending. • No catching and dragging. • Automatic handpiece switches. 	<ul style="list-style-type: none"> • Semi-stooping • Lateral flexion and twisting • Reaching for handpiece and other tools • Bending/forces associated with prompting sheep to feed into the unit • Handpiece tends to be close to operator's face/upper body • Increase in repetitive movements
Crutching: Rotating Cradle Systems	<ul style="list-style-type: none"> • Good sheep restraint • Sheep are released clear of operator • Sheep seeing way out aids feed 	<ul style="list-style-type: none"> • More difficult to incorporate adjustability. • More metal objects near handpiece increasing the chance of handpiece injury. • Force to rotate cradles.
Crutching: Raised Race Systems	<ul style="list-style-type: none"> • Simplicity – can incorporate adjustability • Use of decoy sheep to aid “feed” 	<ul style="list-style-type: none"> • Reach and force involved with loading sheep. • Sheep released striking operator/other operators/handpiece.
Crutching: Conveyor Systems	<ul style="list-style-type: none"> • Can do some work (e.g. dagging) without tipping sheep • One unit accommodates left and right handed operators 	<ul style="list-style-type: none"> • Access to sheep for crutching.
Crutching/Shearing : Trailer Systems	<ul style="list-style-type: none"> • Can be cooler than in shed (airflow, setup in shade, no sheep to create heat) 	<ul style="list-style-type: none"> • Dust • Heat/Cold and wind • Sun • Usually additional generator noise • Lack of amenities
Shearing Systems		<ul style="list-style-type: none"> • Some have underdeveloped methods of placing and removing the sheep from the unit. • More metal objects near handpiece increasing the chance of handpiece injury.

3.3 Risk Control

Manufacturers were given individual feedback about the advantages and disadvantages of their equipment. Two manufacturers responded in writing with comments that were subsequently taken into consideration and a further manufacturer telephoned and indicated that modifications were being made to address some issues that were highlighted.

The *Catalogue* and *Design Guide* were developed.

4 Conclusion

The new technologies for shearing and crutching that were reviewed have the potential to expose operators to less risk of manual handling injury than the conventional methods. There are a number of disadvantages associated with the new technologies, some of which can be generalized to most equipment such as:

- the tendency for operators to semi-stoop;
- the use of handpieces close to metal objects;
- the use of handpieces close to the face and upper body; and
- the lack of restraint of sheep legs that may result in the legs striking the handpiece or face/upper body.

It is concluded generally that the technologies available for crutching can make a useful impact on OHS performance. The *use* of crutching machines generally is therefore to be recommended provided that occupational hygiene and work organisation issues are managed in accordance with good occupational health and safety principles. While the use of the technologies are recommended, there are design issues that need to be addressed as noted above and in the *Design Guide* and these should be pursued. Associated with the use of handling equipment to assist with crutching is the tendency for the handpiece to be operated close to the upper body and face of the operator. In conjunction with the proximity to these parts of the body is the increase in potential for the handpiece to strike a metal object. Clearly the consequences of a handpiece lock-up while the handpiece is close to the upper body and face can be serious. Therefore along with the pursuit of good design of handling equipment for crutching should be some effort in the design of safe handpieces. At a very minimum this should include provision of a safety clutch and a pin drive as recommended by a recent Victorian WorkCover safety alert².

Regarding new technologies for shearing, there would seem to be opportunities for new technology to positively impact on the OHS issues associated with shearing, however the development of shearing technology is less well advanced and would seem to face much greater hurdles in terms of the practicality of removing the entire fleece. In this light, the further *development* of these technologies in a way that includes consideration of OHS is to be encouraged.

² VWA Alert 4/98 Revision 1 – September 1998 Shearing Equipment, available at <http://www.workcover.vic.gov.au>

5 Recommendations

1. That OHS regulatory authorities provide the *Design Guide* to all manufacturers and designers of new technology for shearing and crutching and advise same of their duties under relevant legislation.
2. That OHS regulatory authorities undertake a program of inspection of manufacturers and take action as necessary.
3. That information to assist the purchasing, operational and system of work decisions of potential equipment users (contractors and woolgrowers) be promoted by bodies such as farmers' federations, Farmsafe Australia, the Woolmark Company, unions, contractors' associations, rural suppliers, wool brokers, OHS regulatory authorities and bodies such as the Kondinin Group. The information may be appropriate for inclusion in the Managing Farm Safety package. The information drawn from this project that would seem most beneficial, in order, would be:
 - the checklists drawn from the *Design Guide*;
 - the catalogue (containing the above checklists); and
 - the *Design Guide*.
4. That comment on the *Design Guide* document be sought by WorkCover and revisions made for a future edition.
5. That other OHS issues associated with other classes of agricultural plant (e.g. grain handling and storage equipment; power take-off (PTO) driven equipment; hydraulic systems; tractors; etc) be addressed by adopting a similar model, that is:
 - identify a class of plant that is hazardous;
 - identify the scope of models/types of this plant in manufacture/use;
 - undertake a risk assessment by inspecting the plant in use;
 - develop guidance material for manufacturers of the plant;
 - promote guidance material to manufacturers;
 - promote purchasing and operational use information to users; and
 - undertake an inspection/regulatory program with manufacturers.
6. That WorkCover advise other bodies as appropriate of these recommendations and encourage their participation.

6 Impact Evaluation Recommendations

1. That the University of Ballarat prepare a survey of designers and manufacturers to be included with the distribution as per recommendation one. The survey will evaluate:
 - impressions of the design guide in terms of measures such as relevance, usefulness, applicability, practicality; and
 - intentions regarding modifications.

The University of Ballarat will analyse the survey results and report to WorkCover.

2. That the University of Ballarat prepare a survey of users in NSW (contractors and woolgrowers) to be included with the distribution as per recommendation three.

The University of Ballarat will analyse the survey results and report to WorkCover.

7 References

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National Occupational Health and Safety Commission 1990, *National Standard for Manual Handling and National Code of Practice for Manual Handling*, AGPS, Canberra.

National Occupational Health and Safety Commission 1996, *Guidance Note for the Prevention of Occupational Overuse Syndrome in the Manufacturing Industry* [NOHSC:3015(1996)], AGPS, Canberra.

Appendix A



University of Ballarat: New Crutching/Shearing Equipment Survey

Equipment Name t Please list the equipment that you know is currently used or might be available soon.	Current Use t If you know of anyone using the equipment please list their contact details	Manufacturer t How can we contact the manufacturer of this equipment?	OHS Issues t What OHS Issues do you think might be important with the use of this equipment?
1.			
2.			
3.			
4.			

Comments: Do you have any comments about OHS in general regarding the above equipment?

Questions? Contact the Research Team (Michael Lawrance, John Culvenor, Thomas Mitchell) on 03-5327-9150

Thankyou - Please Add Extra Pages for More Space