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**MOTORCYCLE PROTECTIVE CLOTHING:
FASHION OR FUNCTION?**

**Liz de Rome
LdeR Consulting,**

&

Guy Stanford,

Motorcycle Council of NSW

Sydney, Australia

**liz@lderconsulting.com.au
Telephone: 61 2 9550 2292
Po Box 48
Alexandria,
New South Wales, Australia 1435**

Motorcycle protective clothing -fashion or function?

Authors: **Liz de Rome & Guy Stanford**

Abstract

This is a report on a project to identify the features of effective motorcycle protective clothing and develop a process to ensure riders are able to make informed purchasing choices.

While clothing cannot prevent serious high impact injuries, there is evidence that perhaps half of all motorcycle injuries could have been reduced or prevented by the use of effective protective clothing.

Research based on crash investigation, injury studies and engineering has established standards for the features of effective motorcycle protective clothing. It has also provided objective tests as a means of verifying the protective performance of such clothing, however, this information has not filtered through to consumers nor been taken up by manufacturers.

Surveys indicated that riders' choice of clothing does not reflect awareness of the patterns of injury risk that are well known to researchers. Independent consumer tests in Europe have revealed that much of the clothing currently available will not provide the expected level of protection from injury in a crash.

While the standards for motorcycle protective clothing are only in force in Europe, their development has implication for the industry world wide. This presented an opportunity to encourage the local Australian motorcycle industry to develop a product safety assurance system for motorcycle clothing in order to remain competitive with European imports. The aim was to achieve a higher standard of protective clothing, consumer confidence and hence increased usage by riders who can be assured it is fit for the purpose.

Introduction

This paper is a report on a project to encourage use of motorcycle protective clothing. The project involved educating riders and the local motorcycle apparel industry as to the features of effective protective clothing. It identified a need for consumer protection advocacy and independent testing as a means of verifying the protective quality of products. It has resulted in the establishment of a process to achieve a product safety assurance system for motorcycle protective clothing.

In 2003, the Motor Accidents Authority of NSW (MAA) funded the development of a consumers guide to motorcycle protective clothing for the Motorcycle Council of NSW (de Rome, 2003). It was apparent at the time that riders' choice of clothing appeared to be driven more by comfort and convenience than by informed safety decisions.

Although patterns of relative risk of injury to different parts of the body were well known to crash researchers, this information did not appear to have filtered through to the rider community or to motorcycle magazines. In addition, most protective clothing reflected motorcycle racing images and was not appropriate in terms of fashion, style or convenience for commuters and general road riding.

A survey of riders established the types of clothing used. This was associated with factors such as the style of motorcycle, motorcycle club membership and whether they had ever crashed (de Rome et al, 2004).

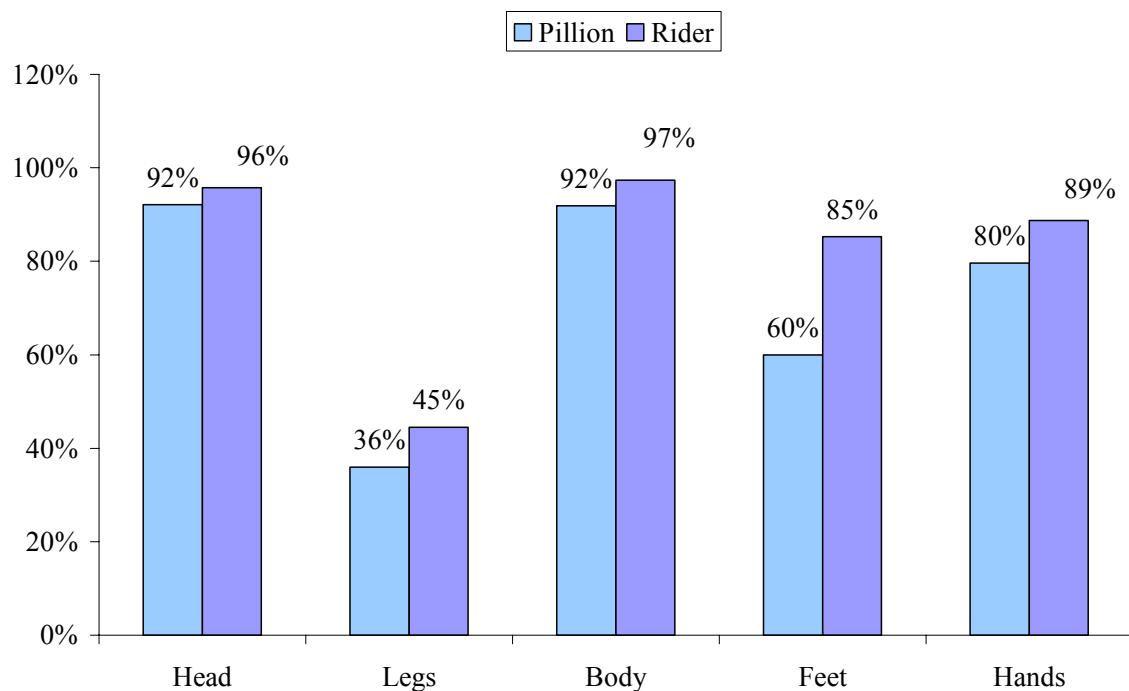
The project also included literature research and consultation with protective clothing experts from Europe. Standards for motorcycle protective clothing had recently come into force in Europe and provided the first objective tests of how specific products would perform under crash conditions.

The availability of these tests enabled consumer groups and magazines to objectively compare products for the first time. This has revealed significant failings in many well known brands. Consultations with key importers and manufacturers in Australia and New Zealand revealed a general lack of awareness of the existence of the European standards and of the implications for the local industry.

Rider usage of protective clothing

A survey of 796 motorcyclists in New South Wales conducted in 2002, found that while virtually all riders wear a helmet and motorcycle jacket, they were least likely to wear protective clothing on their legs.¹ Less than half (45%) of the riders normally wore motorcycle pants. The situation was markedly worse for their pillion passengers with only 36% wearing motorcycle pants (de Rome et al, 2004).

Figure 1. Riders and pillion passengers' usage of motorcycle protective clothing in New South Wales.



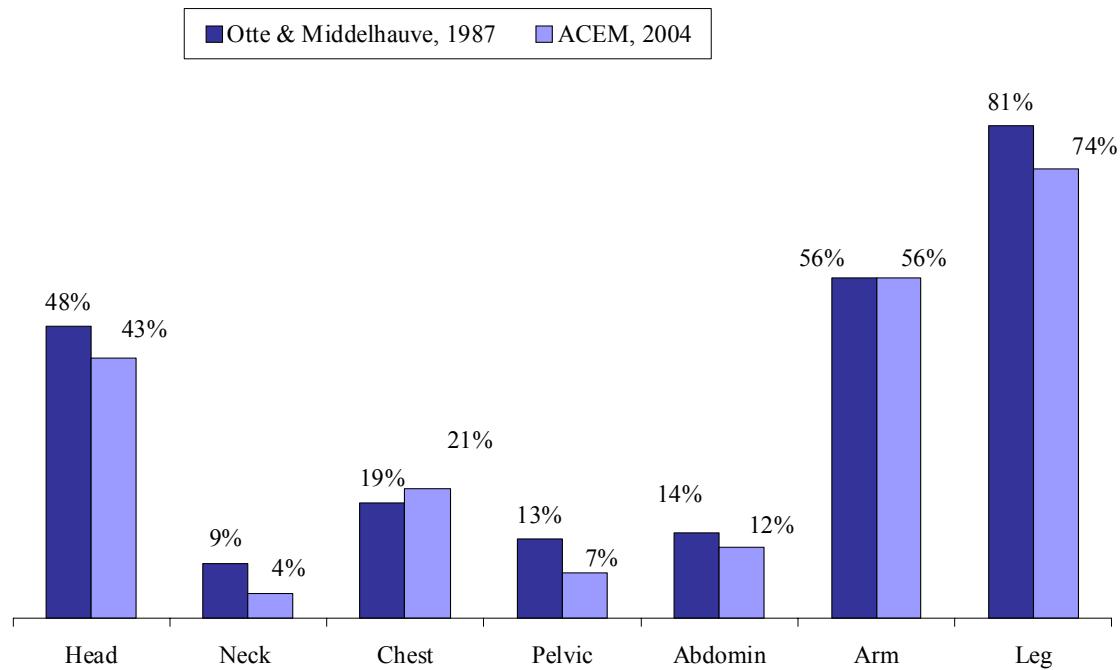
This pattern of rider usage of protective clothing was at odds with the relative risks of injury to each part of the body that has been documented by motorcycle crash research.

¹ Note: The wearing of an approved, properly fastened helmet is mandatory for motorcycle riders in all states of Australia.

In 1993, the European Experimental Vehicles Committee recognized that the legs are the area most frequently injured in a motorcycle crash (EEVC, 1993). Similar patterns of injury by body part have been documented by a range of crash studies studies in USA, UK and Germany (Hurt et al, 1981; Craig et al, 1983; Schuller et al, 1986; Otte & Middelhauve, 1987).

Figure 2 illustrates a comparison of the distribution of rider injuries in 1987 (Otte & Middelhauve) with that of the recent MAID Study (ACEM, 2004). It reveals a remarkably consistent pattern despite changes in vehicle and equipment safety in the intervening decades.

Figure 2. Motorcycle injury patterns 1987 vs 2004.



Although crash researchers have long recognized the legs as the area most at risk in motorcycle crashes, it is their legs that are least likely to be protected by riders. Could the lack of protection be due to a lack of information about relative injury risk rates or perhaps due to a lack of suitable products?

Almost two thirds (64%) of the respondents to the NSW survey were members of motorcycle clubs. This provided an opportunity to compare the protective clothing used by club members with that of non-members. It was hypothesized that the members of motorcycle clubs, being more involved in riding, and perhaps better informed than less committed riders, might be more likely to protect their legs.

Figure 3. Comparison of motorcycle club members and non members' use of protective clothing in New South Wales (de Rome et al, 2004).

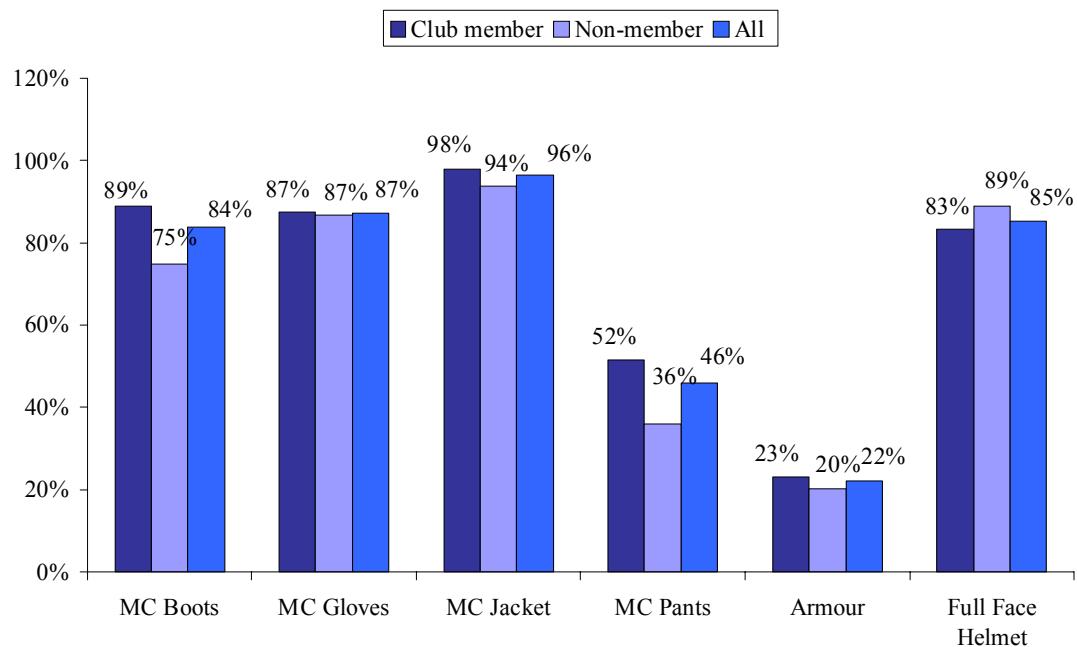


Figure 3 shows club members did have a higher level of usage of motorcycle boots (89% vs 75%) and motorcycle pants (52% vs 36%) than non-members. However as club membership tends to be associated with particular types of motorcycle and styles of riding, the higher usage rates may be simply a reflection of the types of motorcycles ridden rather than a higher level of safety consciousness.

Table 1 shows the proportion of riders using each type of protective clothing by the type of motorcycle that they rode.

Table1. Proportion of riders using motorcycle protective clothing by type of motorcycle (de Rome et al, 2004).

Type of motorcycle	MC Boots	MC Gloves	MC Jacket	MC Pants
Sports	86%	91%	98%	50%
Tourer	86%	86%	97%	49%
Cruiser	86%	83%	95%	33%
Trail	71%	71%	90%	38%
Scooter/ Commuter	41%	89%	81%	19%
All	84%	87%	96%	46%

It is apparent that those with sports or tourer style motorcycles were most likely to wear full riding gear including motorcycle pants. However this does not necessarily indicate that those riders have higher levels of concern for safety than the riders of other machines, it may be more a reflection of pragmatism, fashion or even just what is available in the market.

An informal review of advertisements for motorcycle apparel in Australia suggests that the motorcycle clothing market is segmented for different styles of road riding. Clothing that is promoted as providing injury protection tends to be styled in the image of the race track and is aimed at sports bike riders. Clothing that provides protection from the elements tends to be touring oriented. There is relatively little motorcycle protective clothing that is suitable in terms of fashion or convenience for general road riders, cruisers, commuters or scooter riders.

The function of motorcycle clothing

The findings of the survey led to a project to investigate the features of effective motorcycle protective clothing. The objective was twofold:

1. To encourage the use of protective clothing by providing riders with the resources to make informed purchasing decisions.
2. To provide guidance to the motorcycle clothing industry in terms of features of protection, so that these may be incorporated in different fashions or styles of gear.

Any discussion of motorcyclist clothing should first distinguish between the different purposes for which it may be worn. Motorcyclists' clothing may:

1. Prevent or minimise injury in the case of a crash,
2. Protect from the elements – wind, rain, cold and heat,
3. Draw the attention of other motorists (conspicuity),
4. Make a desired fashion statement.

Our focus is on protection from injury, although comfort and conspicuity are also safety issues for motorcyclists. Comfort in terms of protection from the elements is important in reducing fatigue, distraction and dehydration. The challenge for manufacturers is to provide protection from injury, as well as from the elements, without restricting ease of movement or creating stress fatigue.

The potential for clothing to increase a riders' visibility to other motorists is less well established. However it is an issue that every rider needs to consider as failure to see the motorcyclist was a factor for up to half of the drivers in motorcycle collisions (EEVC, 1993).

The issue of fashion is not entirely trivial. Motorcycle clothing can be very expensive and one of our objectives with this project is to try to help riders distinguish between clothing features that are just fashion and those that have some genuine protective merit.

Protective clothing generally includes gloves, boots, a long sleeved jacket and pants, or one piece suit, made of leather or other fabric with high abrasion and tear resistance. New materials, better manufacturing methods and improved quality controls are all having an effect on the end product. Most items, these days will also include some impact protectors to absorb or distribute force at specific impact points. Our discussion does not include helmets because they are mandatory in Australia and usage is very widely accepted.

The injury reduction benefits of motorcycle clothing

The injury reduction potential of motorcycle protective clothing has been well established for at least 30 years (Feldkamp, et al 1976; Zettas et al, 1979; Hurt, Ouellet & Wager, 1981; Schuller et al., 1982 & 1986; Otte & Middelhauve, 1987; Hell & Lob, 1993; Otte et al 2002; ACEM, 2004).

Over 20 years ago, Schuller reported that injured riders, who had been wearing leathers, spent on average 7 days less in hospital, and returned to work 20 days earlier than unprotected riders. The protected riders were 40% less likely to have suffered permanent physical defect. It was concluded that protective clothing can prevent or reduce 43% of injuries to soft tissue and 63% of deep and extensive injuries (Schuller et al, 1986). More recently, Otte found that impact protectors reduced the incidence of complex leg fractures and reported significant injury reduction for riders wearing high boots (Otte et al, 2002).

Most research has described the injury reduction benefits of protective clothing in relation to soft tissue injuries. Protective clothing has also been found to prevent or reduce injuries such as cuts and abrasions, exhaust pipe burns, friction burns and the stripping away of skin and muscle. Protective clothing may also reduce the risk of infection from wound contamination and consequent complications in the healing of severe injuries. (e.g. Schuller et al, 1986, Pegg & Mayze, (1983) Otte & Middelhauve, 1987; Hell & Lob, 1993).

There are, of course, limits to the extent that clothing can prevent injury, particularly in high impact crashes. However there is also evidence that most motorcycle crashes are not high impact.

The European Experimental Vehicles Committee's review of research into motorcycle accidents, found that the majority of motorcycle collisions take place at fairly low speeds, the average impact being at between 30 and 45 kilometers per hour (EEVC, 1993). According to the recent MAIDS (Motorcycle Accident In depth Study), 75% of all motorcycle crashes occur at speeds of 50 km/h or less (ACEM, 2004).

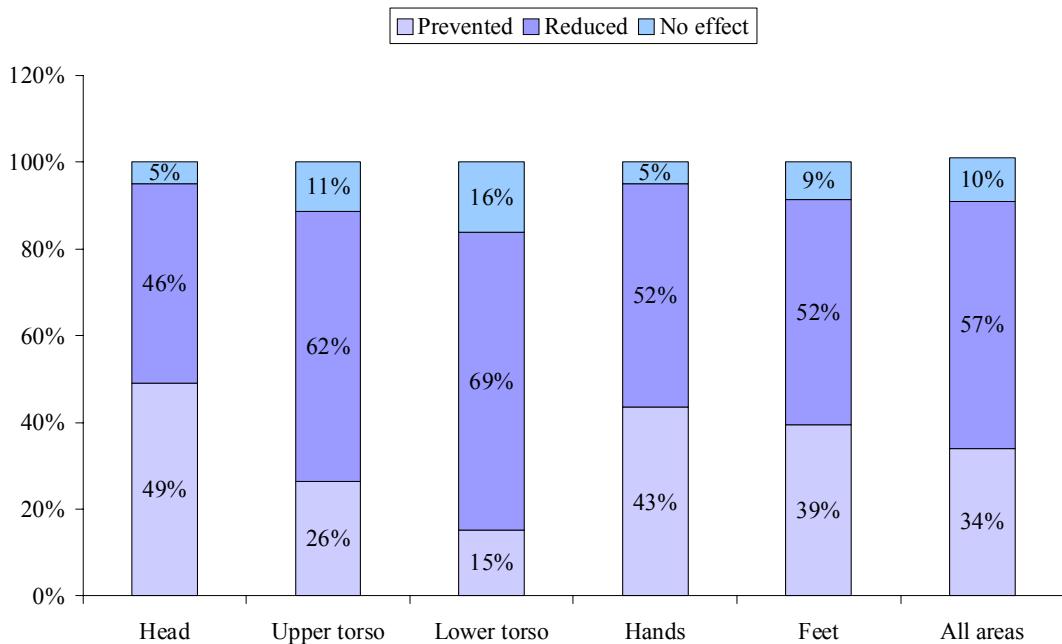
MAIDS reported that some 40% of riders tumbled, rolled or slid along the road from the point of the crash without any further impact with another object (ACEM, 2004). Overall, almost half (49%) of all the injuries recorded in MAIDS were rated to be minor or Level 1 on the Abbreviated Injury Scale (AIS 1).

Crashes where the rider slides along the road surface without impacting a fixed object are less likely to result in severe injuries and are the types of crashes where protective clothing can offer the greatest injury reduction (Hell & Lob, 1993, Otte et al, 1987).

Features of effective motorcycle protective clothing

The MAIDS investigators tried to establish whether clothing had reduced or prevented minor injuries such as cuts, gravel rash, friction burns etc. Figure 4 illustrates the proportion of riders considered to have been protected from minor injury by their clothing. The graph includes only those riders who were wearing protective clothing and sustained a direct impact that could have caused an injury to that part of the body. For example, the column for the upper torso indicates that clothing prevented superficial injury for more than a quarter (26%), and reduced injuries for over half (62%) of these riders. Only 11% or just over 1 in ten riders sustained injuries to the upper torso despite their clothing.

Figure 4. Riders protected from minor injury by clothing.



While such studies affirm the general benefits of protective clothing, they do not distinguish between the specific features of items that provided effective protection from those that failed.

Our review of the literature found little objective information that riders could apply in selecting protective clothing products. Riders are largely dependent on the advertising claims of manufacturers or product reviews by magazines. However until recently there was no means of providing an objective assessment of the likely protective performance of any product in a crash.

Standards for motorcycle protective clothing

The situation has now changed with the development of standards for motorcycle protective clothing in Europe. Under European law, any clothing claiming to provide protection from injury must be tested and labeled as complying with the relevant standard.

This is a general European law that requires standards for all safety equipment not just for motorcycle apparel. Under the directive, a product can only be described as “protective” if it provides protection from injury, the term cannot be applied to products that provide protection from the weather.

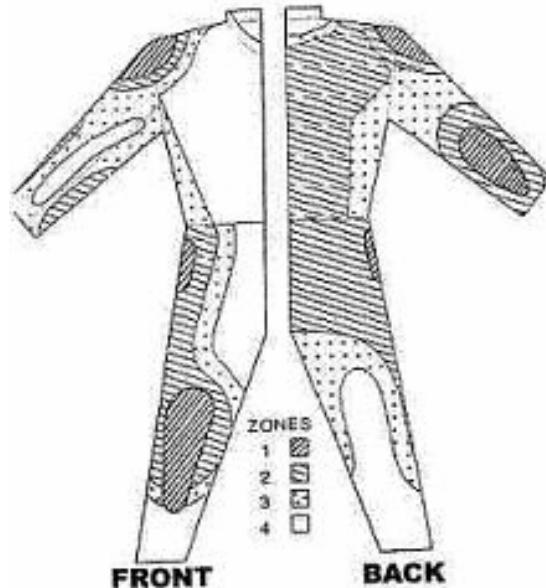
The European Directive on Personal Protective Equipment was made law in 1989, but it took some time for the standards for motorcycle clothing to be developed. The first standard to be issued for motorcycle gear was for impact protectors, which was released in 1997 (EN 1621-1). Standards have since been issued for gloves, boots, jackets and pants and back protectors. Each has a different number and clothing that complies must have been tested and labeled with the CE mark and the appropriate standards number.

The development of the Standards has provided objective tests for measuring the protective performance of motorcycle clothing products. The tests are largely based on the work of Roderick I. Woods who published a specification for motorcycle protective

clothing in which he defined the injury risk and protection requirements for each part of the body (Woods, 1996). See figure 5.

Figure 5. Injury risk zones (Woods, 1996)

- Zone 1 High - needs impact protectors & high abrasion resistance
- Zone 2. High - needs high abrasion resistance
- Zone 3. Moderate - moderate abrasion resistance
- Zone 4 Relatively low risk.



The Standards specify the test process and equipment upon which they must be performed. The tests measure performance in relation to:

1. Abrasion resistance to determine how long the material will last when being abraded against the road surface.
2. Burst strength to ensure that seams, fastenings and the material itself will not split open on impact.
3. Tear and cut resistance, required to ensure the material cannot be cut, penetrated or torn by sharp objects in a crash.
4. Impact resistance is required to slow down the rate of transfer of forces in an impact. Protection is required over specified high impact areas of the body and must remain in place during an impact.

Implications for other markets

While these standards are only enforceable in Europe, their development has significant implications for non-European markets. For the first time consumers have a means of objectively assessing how individual products would perform in the ultimate test of a crash. Applied by independent consumer organizations, the outcome has been to reveal serious failings in the safety performance of many of the products currently available in the European market.

For example, in one study of 18 leather suits tested by the British magazine "Ride" in August 2004, 7 of the suits scored 5 or less out of 10 for abrasion, 10 suits scored 5 or less on the burst test, 9 scored 5 or less on the impact test, 8 scored 5 or less on the tear test and 2 had zip failure (Crick, 2004 b).

None of these failings could have been reliably predicted by visual inspection or reliance on brand name. The results indicate that neither brand name nor cost can be used as indicators of protective quality. The most expensive suit from a world renowned company was rated second last in the rankings, whereas one of the cheapest suits was rated third best. Comparable tests of textile jackets, gloves and boots have also found the majority of those products do not perform well (Crick, 2004 a, 2004 c & 2005).

Similar independent tests have been conducted by consumer groups in the UK since the European Directive on Protective Personal Equipment was announced in 1989. From a comparison of such tests over the intervening period it is apparent that manufacturers have responded to calls for better protection. Most European manufacturers now include CE Standard impact protectors over the knees, hips, elbows and shoulders. Cotton padding or soft foam is no longer acceptable.

The abrasion resistance scores, particularly for textile jackets, have improved significantly over time as new materials and new methods of construction have emerged. However, quality of construction remains a weak point and many of the tested suits (leather and textile) continue to fail on seam strength and material burst resistance. The frustration is that the results suggest that in many cases only relatively minor adjustment to production methods could achieve compliance and produce protective products that are fit for the purpose.

The absence of any equivalent standards mean that motorcycle protective clothing can be sold in other markets without either a requirement, nor any means, to justify claims of providing protection from injury. Given the high level of failure of reputable European products when tested against the European standards, there is no reason to assume that products by other manufacturers would perform any better.

Increasing the usage of motorcycle protective clothing

A recent review of motorcycle safety strategies found that most include strategies for increasing the use of motorcycle protective clothing (de Rome, 2005). However it is evident from the current project that appropriate and verifiably effective clothing is not readily available for many riders.

There appears to be a lack of systematic connection between the three key areas of interest in motorcycle protective clothing (research, consumers and manufacturers).

Researchers with knowledge drawn from crash investigation, injury studies and engineering have made a good case for the safety value and features of effective motorcycle protective clothing. They have also provided the means of verifying the protective performance of such clothing, but this information has not filtered through to consumers nor been taken up by manufacturers.

It is perhaps unrealistic to expect the motorcycle apparel industry to take a lead in raising standards for their products in the absence of demand from their markets. Consumers have been largely uninformed and undemanding, perhaps because the major source of information for riders is through motorcycle magazines, which are dependent on advertising for their revenue.

In Australia and New Zealand a number of steps have been taken to address these issues. Web based consumer guides on motorcycle protective clothing have been developed to

enable riders to make more informed purchasing decisions and to demand assurances on the protective quality of the gear they buy (de Rome, 2002; de Rome, 2004).

Strategies have also been undertaken to inform the local motorcycle apparel industry about the existence of the European standards and the implications for the local industry.

The availability of the standards also has implications for traders' duty of care under Australian consumer protection law (Trade Practices Act, 1974). Under this law traders can be liable for goods that are not fit for the purpose for which they were sold.

As riders become better informed there is expected to be increased demand for CE marked European products and reduced demand for the products of other manufacturers. Anticipation of these events created an opportunity to encourage the local industry to develop a product safety assurance system in order to remain competitive.

An industry seminar was conducted for the key stakeholders to identify and address the implications for the Australian industry and rider community. Participants included all the key manufacturers, importers and retailers of motorcycle clothing, motorcycle groups and consumer protection and road safety agencies.

The outcome of the seminar was a general consensus to establish performance standards and a regulatory system for motorcycle protective clothing that would work in the best interests of riders and the industry.

A working party has been set up and is working on the establishment of an association for the motorcycle accessories industry, which will have carriage of the regulatory system. Key decisions under debate centre on the extent to which the European standards and their testing and labeling regime will be adopted or adapted for local application. The establishment of the system will also involve the resolution of a number of issues including the establishment of test facilities, making provision for imported as well as locally produced clothing, and mechanisms for monitoring and policing of compliance.

Conclusion

Motorcycle protective clothing cannot prevent major injuries in high impact crashes. At best, a rider's protective clothing may reduce or prevent soft tissue damage and the risk of infection and complications. The benefit of increased levels of motorcycle protective clothing usage is likely to be confined to reductions in the incidence of minor (AIS 1) level injuries. However the MAIDS research indicates that such injuries are a significant proportion (49%) of all injuries sustained by riders and were the only injuries sustained by over a third (36%) of all the riders involved in crashes (ACEM, 2004).

Our survey of riders showed that their usage of protective clothing does not reflect the higher relative risk of injury to their legs. Consumer education as to the benefits and features of effective motorcycle protective clothing is fundamental for riders to make informed choices.

The project also identified significant gaps in the market as appropriate protective clothing is not available for all styles of road riding. There is no point in encouraging riders to wear protective clothing if suitable products are not available. These findings have been presented as an opportunity for local industry to provide a wider range of fashion and style choices with credible levels of protection to meet the needs of all the different segments of the motorcycle market.

Finally consumer confidence in the protective performance of these products is essential if riders are to be encouraged to invest in protective motorcycle clothing. A quality assurance or standards system independently assessed or monitored by consumer protection agencies will be essential if that confidence is to be achieved.

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