

CHAMBER OF MINES OF SOUTH AFRICA

RESEARCH ORGANIZATION

REPORT

ON

THE USAGE OF SAFETY GLOVES IN THE GOLD MINING INDUSTRY

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## TECHNICAL SUMMARY

The safety departments of 31 mines were visited, and the data obtained was used to determine to what extent safety gloves were being used in the gold mining industry. The questionnaire requested, inter alia, the following figures from the mines visited:

- (a) Total labour force (Black and White, surface and underground).
- (b) Total number of safety gloves issued per month.
- (c) Types of work categories to which gloves were issued.
- (d) Types of gloves in current use,
- (e) Shortcomings or advantages of gloves in current use.

Trends that emerged were the following:

1. Safety departments on the different mines disagree about the usefulness of safety gloves, and various policies exist with respect to the number of gloves that are to be issued and to whom such issues are to be made. Accordingly mines may be divided into 3 categories:
  - (a) Those who feel that all underground workers should wear gloves (16,1%).
  - (b) Those who feel that only workers in certain specified job categories need to wear gloves (45,1%).
  - (c) Those who feel that gloves have little or no merit, and should only be issued at the request of workers (38,8%).
2. With respect to the shortcomings of gloves in current use, mines may be divided into 2 categories:
  - (a) Those who had no complaint against their gloves, and sought no alternatives (27%), and

- (b) Those mines who had complaints from their workers, and were constantly experimenting with different types of gloves for issueing to their workers (73%).

It further became clear that no consensus exists among personnel of different safety departments as to what the requirements of a glove should be.

The questionnaire also made enquiries into the extent to which the PVC dipped/nylon glove, designed by the Chamber of Mines' Research Services, had been accepted on the gold mines. It was found that this glove was only known to 55% of the mines visited.

## 1. INTRODUCTION

The frequency of occurrence of hand injuries amongst black workers of the gold mining industry has led to the introduction of various types of safety gloves by mine managements. These gloves were not always satisfactory nor very popular amongst the black labourers and the major reasons for this state of affairs can be summarised as follows:

- (a) Airtight, fully dipped PVC gloves are ill ventilated, ill drained and hot.
- (b) Natural fibre interior covering is susceptible to bacterial breakdown, becoming unhygienic and malodorous.
- (c) Gloves are ill-fitting, clumsy and uncomfortable.

It was felt that workers would be more willing to wear gloves if these complaints could be eliminated through the design of an improved glove. Consequently, the Chamber of Mines' Research Services was requested to design and develop an improved glove for general underground use. Such a glove, the nylon based PVC dipped glove, with only the palms and fingers dipped in PVC was designed and made available to the industry. Basically this glove meets such stringent requirements as adequate hand ventilation, comfort, durability and sufficient protection against minor accidents (cuts and bruises). Unfortunately, and probably due to a lack of advertising this glove had not received the general acclaim and acceptance expected. At a Research Advisory Committee meeting it was therefore decided that a survey should be done to determine to what extent this nylon PVC dipped glove was being used by the mines, and what the reasons were for using or not using it. A special enquiry was also made into the extent to which the new glove had been accepted by the industry.

## 2. METHOD

The survey took the form a personal interview with the safety officers of the 31 mines visited, and a questionnaire which they had to complete. (Appendix A).

Data concerning labour force, glove issues, costs of gloves and official mine policy concerning glove usage were obtained, and are presented in table form. From the interviews, personal opinions about the merits and demerits of various safety gloves were obtained. Glove turnover figures (Table 2) were arrived at by expressing the number of gloves issued per month as a percentage of the total number of black, underground workers on the mine. It is assumed that this figure indicates to what extent workers on a mine are using their gloves, since knowledge about actual underground events is not available. Some of the factors that would influence this figure and its interpretation are also listed in the tables, i.e. official mine policy concerning underground glove usage (Table 2) and the glove exchange system (Table 6).

Since this survey was started in September, 1977, present figures do not necessarily reflect the current situation.

### 3. RESULTS

- 3.1 All 31 mines issue protective gloves to their workers. Table 2 presents turnover (new issues per month) of gloves as a percentage of the underground black labour force. Turnover figures include issues to novices and surface labour, as well as issues to workers requiring new gloves.
- 3.2 A variety of special protective gloves are in use on the mines (Table 3). Not all mines indicated their consumption of such gloves.
- 3.3 Five mines had a policy of compulsory all round glove usage, 12 had no enforced glove usage, and 14 had a policy of semi-compulsory glove usage (compulsory only for certain work-categories) (Table 2). Furthermore, 17 mines were aware of the nylon/PVC dipped glove, and 14 did not know of its existence. Two mines were using the glove on a large scale.
- 3.4 Of the 31 mines interviewed, nine had no complaint against the fully dipped PVC glove presently in use, and expressed no desire to change. Table 4 lists those faults and complaints listed by the remaining 22 mines. Leather gloves were in

use on 12 of the mines. Five of these mines offered no complaint against their gloves, and the complaints of the remaining 7 mines are listed in Table 4.

#### 4. DISCUSSION

A major portion of all hospital admissions and dressing station cases (26.2% and 42.2% respectively) treated in the mining industry results from injury to the upper extremity (fingers and hands) (1). This is further illustrated by the fact that 67% of dressing station cases treated, resulted from injury to the upper extremity as a whole (fingers, hand and arm).

Hand and finger injuries, however, are not evenly distributed throughout underground populations, but are concentrated in certain work categories (see Table 5). It is apparent from this table that some work situations are more dangerous, and more likely to give rise to hand injuries. It is further worth noting that in spite of the different nature of activity of these work categories, hand, arm and finger injuries still constitute an average of 71.3% of dressing station cases and 43% of hospital admissions (2).

Previous research (3) indicated that the use of gloves by underground labourers significantly reduced the number of minor injuries. It is a fact, however, that the mere issuing of gloves does not ensure their being used, and thus neither the benefits that may be derived from such use. Factors influencing usage will be discussed in detail below.

##### 4.1 Glove turnover figures and mine policy

The glove turnover figure is arrived at in the following way: Size of underground black labour force is obtained, and the number of gloves issued per month: Issues per month are expressed as a percentage of underground black labour.

This method does not account for issues to surface labour, nor does it draw a distinction between issues to novices and to such labourers as require new gloves, having already been issued with a pair previously. Only total issues per month is considered. Nevertheless, since the method is the same for all mines, comparisons are valid.

From the survey it is clear that all mines had gloves made available to their workers. Special glove usage (Table 3) presents only 4% of total glove turnover, but it should be noted that such gloves are not subject to individual preference. Their use is not optional, but demanded by the various work situations. Each policy of glove issue (Table 2) has its own effect on glove usage, and these are discussed under the following headings: compulsory usage, non-compulsory usage and semi-compulsory usage.

#### Compulsory usage

Official policy on a mine may be 'compulsory usage of gloves for all workers', but actual use is nevertheless often determined by individual shift bosses and mine overseers. The five mines with this policy do show a higher average percentage glove turnover than that for the whole industry, i.e. 60,2% as opposed to 38,8%, indicating the effect of managerial attitudes on black workers.

#### Non-compulsory usage

The effect of management on black workers is quite clearly seen in this category. Supposedly, all workers are free to choose whether they wish to wear gloves or not - these mines all have the same official policy. The large range in glove turnover figures for this group - 75% highest, 13% lowest (Table 2) - should theoretically only be the result of like or dislike of wearing gloves amongst the workers. This is improbable, because of the similar nature of such gloves found on the various mines.

The following factors emerged as playing a role in glove turnover figures (apart from like or dislike of gloves):-

- (a) The particular attitude of the miner and shift boss in direct control of the black worker. Both groups of men (worker and supervisor) operate in the same working situation, and the example set by the supervisor is the most relevant influence.
- (b) The glove exchange system (Table 6). If a worker has to produce the worn out gloves before receiving a new pair,

consumption drops. The problem is that malodour often renders a glove unacceptable before it is actually worn out, and if a worker is not allowed to change the glove simply because it smells, he may elect to go without gloves. Although the average percentage turnover of gloves is higher for the free exchange group than for the controlled, the difference is rather small. This is so primarily because the glove exchange system is secondary in its effect to that of practical mine policy (point (a) above).

- (c) A worker may become aware of the fact that he needs gloves because of the nature of his work and working place, e.g. the dip of the stope, sharp rocks, working with rock-drill, or transporting and erecting timber.
- (d) Workers may during training be conditioned to the idea of wearing gloves. Mine 20, for instance, has no compulsory glove usage. Yet their turnover of gloves per month represents 75% of total underground black labour figure. The issue of gloves to all novices coupled with a training programme in which they are taught that everybody is expected to wear gloves, seems to have a strong and lasting influence on the workers. On the other hand, if mine management considers the use of gloves superfluous and only issues gloves on express request from individuals, very few workers are likely to wear gloves (see mines 16 and 29).

During discussions a number of mines revealed that they had recently changed from a policy of enforced glove usage to that of voluntary use. They claim that this shift in policy had no effect on injury figures, both hospital admissions and dressing station cases. They argued that if a worker had in training been taught to use gloves, it is wiser to let him decide for himself whether he wants to use them or not. A study of injury rates in relation to glove turnover figures would cast light onto the validity of this claim.



Semi-compulsory usage

This practice may also be referred to as 'enforced usage only for certain, specified categories'. As shown earlier, some work situations are more dangerous than others, and more likely to lead to injury. Mines with this policy indicated the following categories as being in need of gloves, (figures in brackets indicate the percentage response from 14 mines):-

1. Driller	(66)
2. Spanner	(66)
3. Borrers	(50)
4. Team leaders	(45)
5. Winch drivers	(55)
6. Loco drivers	(20)
7. Timber transport	(40)
8. Dashing and sweeping	(50)
9. Stonewall	(15)
10. P.T. and V.	(20)
11. Tips grizzly	(25)
12. Onsetter	( 4)
13. Underground transport belt	(10)
14. Haulage	( 4)

This list correlates well with Table 5, and indicates that the worker on the rock-face is most in need of gloves.

4.2 The Nylon/PVC dipped glove

Seventeen of the 31 mines visited were aware of the nylon/PVC dipped glove. Two of the 17 mines were using it on a large scale, and it was on trial at 5 mines. Of the remaining 10 mines, 5 had apparently done some testing and experimenting with the glove, but had opted against using it. The following are the major reasons why these 5 mines had decided against purchasing the nylon/PVC dipped glove:-

(a) No protection to knuckles

The opinion was expressed that a layer of nylon cloth is insufficient protection against the hazards of underground work.

There was, however, a certain amount of contradiction amongst these reports as to which workers needed more protection to their knuckles.

(b) Not durable enough

This complaint was again aimed at the new, nylon-only back, design of the glove. Apparently the cloth was just not strong enough for heavy duty underground labour. Again, this report is contradicted by various of the other mines involved, who actually seem to think the glove more durable. Further investigations indicated that several batches of gloves were manufactured using a mixed nylon/cotton material because the correct nylon cloth was not available.

(c) Too tight fitting

The nylon/PVC dipped glove was designed according to anthropometric data which should ensure that it would accurately fit 90% of Bantu mineworkers' hands. Unfortunately the anthropometric survey was done some 15 years ago and there is assurance that body dimensions have not changed in the interim. However, from this report it would seem as if black workers actually prefer loose fitting gloves. The difficulty they encounter in putting on and taking off these gloves when wet, seems to create a real resentment against the glove. This complaint has particular reference to workers in the stopes.

(d) Hot and malodorous

Because of excessive sweating on the palms of their hands, workers have apparently found the glove to be hot and inclined to malodour. Sweating of the palms also leads to an undesirable softening of the skin on their palms. If this complaint is levelled at the new glove then the fully-dipped PVC one must be totally unacceptable.

(e) Too expensive

The price of the nylon based PVC dipped glove is higher than the older types of glove but it has been shown that this is

compensated for by its lasting qualities.

These are the 5 major complaints against the glove, as supplied by the mines who had actually used it at some state. Complaints and opinions from the other 11 mines have not been accorded the same relevance. It must be noticed that rejection of this glove by these mines is not so much because of its bad points, but rather the availability of other types of gloves which, according to them, are more suitable. And further, the complaints as listed above may just as well derive from managerial opinions as from bona fide complaints from the black underground labourers.

#### 4.3 PVC gloves

The following are the opinions and complaints about the various types of PVC gloves in current use on the gold mining industry. Percentages in brackets refer to the frequency of occurrence of a complaint.

- |                                       |   |      |
|---------------------------------------|---|------|
| 1. Ill fitting and ill shaped         | } | (37) |
| 2. Uncomfortable because inflexible   |   |      |
| 3. Hot and ill ventilated             |   | (27) |
| 4. Malodorous                         |   | (45) |
| 5. Too short and small                |   | ( 5) |
| 6. Not durable to abrasion or tearing |   | (27) |
| 7. Not accepted by labourers          |   | (14) |
| 8. Clumsy - affording no grip         |   | (27) |
| 9. Pierces more easily than leather   |   | ( 5) |

Nine of the mines had no complaint against their gloves and were not experimenting with alternatives.

The majority of workers find gloves hot and uncomfortable. The frequency of this complaint shows that the various types of gloves in use on the mines suffer from similar defects, and that dislike of wearing gloves for the whole industry has a more or less single origin, i.e. discomfort.

Discomfort has its origin in the following:-

(a) Hot and ill ventilated

Because of high heat and humidity conditions underground, impermeable and close-fitting garments like gloves are necessarily unpopular. It is an unavoidable aspect of the use of protective clothing in underground situations, which can only to some extent be improved upon by better design and the correct choice of materials. Excessive perspiration of the hands leads to gloves becoming malodorous within a week of use - the major cause of the dislike workers have for wearing gloves.

(b) Clumsy, ill fitting and inflexible

That the average PVC glove was not designed to fit the hands of black mineworkers, was pointed out by van Graen et al (4). However, a major complaint against the PVC dipped/nylon glove was that it is too tight fitting and difficult to take off when wet. The glove had been designed to accurately fit 90% of the black mineworker's hands. This contradiction may be explained by the idea that for certain work categories a heavy, loose fitting glove is preferred. Such workers can insist on a glove that is easily removed only because clumsiness and inflexibility are of no consequence to their work. It is worth noting that mines who do use the PVC dipped/nylon glove did not consider it suitable for drilling crews and barrers. The problem of clumsiness relates to work involving the handling of materials, where protection from injury to the inside of the hand is required, and where flexibility is a feature to be desired.

(c) Pierce resistance

Primarily this complaint has reference to winch-drivers. Handling of steel cables presents the hazard of skin being pierced by thin strands of steel wire. Leather gloves, being more pierce-resistant than PVC, appear more suitable.

(d) Not durable to abrasion and tearing

A complaint from management, who desire durability as a cost-saving device. However, since malodour often prevents a glove being used in excess of 14 shifts, durability does not imply long life. Not all mines listed malodour as a complaint.

TABLE 1 EXTENT TO WHICH PVC DIPPED/NYLON GLOVE IS BEING USED

MINE	AWARE OF PVC DIPPED NYLON GLOVE	USING PVC DIPPED NYLON GLOVE
1	No	No
2	No	No
3	Yes	Yes
4	Yes	No
5	No	No
6	No	No
7	No	No
8	Yes	No
9	Yes	No
10	Yes	Yes
11	No	No
12	Yes	Yes
13	No	No
14	No	No
15	Yes	No
16	No	No
17	Yes	No
18	Yes	No
19	No	No
20	Yes	No
21	Yes	No
22	No	No
23	Yes	No
24	No	No
25	Yes	No
26	Yes	Yes
27	No	No
28	Yes	No
29	No	No
30	Yes	No
31	Yes	No

TABLE 2 GLOVE TURNOVER PER MONTH

MINE	U/G BLACK LABOUR FORCE	TURNOVER PER MONTH	TURNOVER AS % OF U/G BLACK LABOUR	POLICY OF USE
1	2 685	1 780	66	compulsory
2	11 370	3 500	31	non comp.
3	6 900	3 100	45	non comp.
4	8 337	4 000	48	non comp.
5	12 392	2 000	16	non comp.
6	4 080	1 000	25	semi comp.
7	9 400	2 000	21	non comp.
8	3 750	1 000	27	semi comp.
9	21 941	16 000	73	compulsory
10	14 598	8 000	55	semi comp.
11	4 296	2 000	47	semi comp.
12	9 000	6 200	69	compulsory
13	3 700	2 000	54	semi comp.
14	5 400	950	18	semi comp.
15	10 955	3 500	32	non comp.
16	6 500	1 000	15	non comp.
17	10 720	1 400	13	non comp.
18	5 756	1 125	20	semi comp.
19	7 733	4 820	62	compulsory
20	9 277	6 950	75	non comp.
21	7 362	2 500	34	semi comp.
22	5 089	1 759	35	semi comp.
23	10 567	3 000	28	non comp.
24	3 970	1 000	25	semi comp.
25	9 246	2 000	21.6	semi comp.
26	9 657	3 000	31.0	compulsory
27	5 445	6 500		semi comp.
28	28 801	8 000	27.7	semi comp.
29	13 826	1 220	8.8	non comp.
30	10 666	10 000	93.7	non comp.
31	8 000	4 000	50,0	semi comp.

av: Comp Group: 67,5  
av: Semi Comp Group: 34,0  
av: Non Comp Group: 32,4

TABLE 3 LIST OF SPECIAL GLOVES

MINE	TYPE OF GLOVE	PRICE (CENTS)	PAIRS USED/MONTH
1	Chrome leather	150	8
2	PVC long unpunched	167	20
3	Welding 8" cuff	215	50
4	Chrome leather	185	70
6	Wrist leather	70	12
	Rubber gauntlet	225	6
8	Chrome leather	150	20
9	Rubber 14" long	875	1
	8" chrome leather	234	2
	40cm plastochrome	130	200
	Superflex	110	600
10	Chamoise leather	105	10
	Chrome leather 6" cuff	222	40
	Electric rubber glove	205	50
13	Plastochrome	72	50
14	Chamoise	80	120
	Leather gauntlet	195	35
15	Chrome leather	151	177
	Gauntlet leather 24" long	300	35
	Chamoise leather	87	504
	Electrical leather	639	2
	Rubber elbow length	226	64
	Rubber gauntlets full length	240	14
	Acid resistant	236	2
	Asbestos	938	17
16	Long rubber	811	25
17	Werx	105	30
	Leather gauntlet	295	45
	Leather 64mm cuff	143	140
19	Gauntlet leather	299	24
	Acid resistant	236	17
	Rubber long	225	13
	Rubber shoulder length	239	4
	Electricians rubber	638	3
	Asbestos	937	2
	Chamoise	87	537
	Leather	150	20
20	Chrome leather	295	60
21	Leather	140	520
23	Chamoise	86	510
	Palm pads leather	110	200
	Chamoise wrist length	87	271
	Chrome leather	151	113



TABLE 3    continued

28	Leather gauntlet	172	388
	Leather elbow length	206	130
	Electrician	638	30
31	Chrome leather	202	500
	Rubber	360	200
	PVC elbow length	125	250

TABLE 4    COMPLAINTS AGAINST LEATHER AND PVC GLOVES

Complaints against leather gloves

1. stretches when wet;
2. palm wears through;
3. stitching weak;
4. ill-fitting;
5. hot, and
6. leather cracks after being wet.

Complaints against PVC gloves

1. ill-fitting;
2. inflexible;
3. hot, ill-ventilated;
4. malodorous;
5. not durable;
6. not accepted by workers, and
7. pierces more easily than leather.

TABLE 5    INJURY RATES (TO THE BODY) FOR DIFFERENT UNDERGROUND  
JOB CATEGORIES

JOB CATEGORY	MINOR INJURY RATE PER 100 PER MONTH	HOSPITAL ADMISSIONS RATE PER 100 PER YEAR
Drilling crews	16	18
Scrape winch operator	12	11
Other stope labour	7	9
Stope labour supervisor	11	16
Locomotive crew	6	14
All other labour	not given	4
Mine Average	8	9

TABLE 6      GLOVE EXCHANGE SYSTEMS

MINE	GLOVE EXCHANGE SYSTEM	GLOVE TURNOVER (PER MONTH) AS % OF U.G. LABOUR FORCE
1	Free Exchange	66
2	Free Exchange	31
3	Controlled	45
6	Free Exchange	25
7	Controlled	21
8	Free Exchange	27
9	Controlled	73
10	Controlled	55
11	Controlled	47
13	Controlled	54
14	Controlled	18
15	Free Exchange	32
16	Controlled	15
17	Free Exchange	13
19	Free Exchange	62
20	Free Exchange	75
23	Free Exchange	28
24	Free Exchange	25
25	Controlled	21.6
26	Controlled	31
27	Free Exchange	--
28	Controlled	28
29	Free Exchange	9
30	Free Exchange	94
31	Free Exchange	50

Av: Group of free exchange (14) : 41,3%

Av: Group with (11) controlled exchange : 37.1%

Mines above 30% turnover only:-

Av: Free Exchange : 58%(7)

Av: Controlled Exchange : 51%(6)

(figure in brackets is number of mines in group)

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APPENDIX A

EVALUATION OF PROTECTIVE GLOVES

A. MINE: \_\_\_\_\_ DATE: \_\_\_\_\_

MINE OFFICIAL,  
INTERVIEWED: \_\_\_\_\_ DESIGNATION: \_\_\_\_\_

B. LABOUR FORCE

	WHITE	BLACK
SURFACE		
U/G		
TOTAL		

C. Who decides on type of glove to purchase

\_\_\_\_\_  
\_\_\_\_\_

D. GLOVE INFORMATION

TYPE OF GLOVE USED	IDENTIFICATION NUMBER	SUPPLIER	NUMBER PRICE/PAIR	USED/MONTH	HOW LONG DO THEY LAST	WEAK POINTS OF GLOVES
(a)						
(b)						
(c)						
(d)						
(e)						
(f)						
(g)						

E. WORK CATEGORIES

GLOVES ISSUED TO WHAT WORK CATEGORIES	HOW MANY WORKERS EMPLOYED IN EACH WORK CATEGORY

F. Are you aware of the Nylon/PVC dipped glove?

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Are you making use of it

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If not, why

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General Comments:

REPORTERS a)  
b)