COMMISSION OF THE EUROPEAN COMMUNITIES

14th Report of the Mines Safety and Health Commission for the year 1976

BRUSSELS — LUXEMBOURG 1978

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* The report included as Annexes 6-10 were approved on 23 March 1977 by the MSHC, which directed that they be appended to this Report to ensure more rapid distribution.

1. Section I

INTRODUCTION

1.1.1. **As in previous years, the first part of the report gives a brief appreciation of the situation in the coal industries; the Mines Safety and Health Commission hopes that it will be possible in following reports to extend this to all extractive industries.**

1.1.2. Coal mining activities

As in the four previous reports, a number of statistics on activities in the coal mining sector are given below. These are based on the figures published by the Statistical Office of the European Communities on 14 January 1977 and on information supplied by the national mining authorities (see table which follows).

1.1.2. Coal production in 1976 was 3.6% lower than in the previous year, falling from 256.9 to 247.6 million tonnes. This restriction of production was accompanied by a reduction of about 5 million tonnes in available capacity as a result of the closure of 10 collieries. In this same context of adjustment to the trend of the coal market the number of miners employed underground was reduced by 3%, falling from 342.0 to 331.9 thousand. The reduction in manpower was severe in France and Belgium (5.9 and 5.4%) and less pronounced in the United Kingdom.

1.1.3. These figures should not, however, obscure the fact that the coal market has to some extent stabilized. The growth in stocks has sharply declined, for the increase between 1975 and 1976 was 2%, whereas stocks more than doubled between 1974 and 1975. Moreover, stocks held at coking plants, which had more than tripled in 1974/75, increased by only 38% in 1975/76. This may be explained by increased deliveries of coal (and lignite) to power stations in France and Germany as a result of government measures. The decline in quantities of coking coal delivered to coking plants and the stockpiling of an additional 5 million tonnes of coke underline the continuing crisis of the steel industry.

1.1.1.4. Within the same general upward trend, closure of certain collieries and increased mechanization and use of powered supports have improved productivity in Germany, France and Belgium, though in the United Kingdom there was a slight fall in output per manshift; for the community as a whole the latter remained at about 3.56 tonnes per manshift (U/G).

1.1.2. Overall figures for accidents below ground in coal mines

These figures could not be drawn up on the same basis both for the Community of Six and the United Kingdom as it has been impossible to ensure uniformity or even comparability of the statistics as a result of the shortage of staff within the Secretariat.

1.1.2.1. Community of Six

1.2. GENERAL ACTIVITIES OF THE MINES SAFETY AND HEALTH COMMISSION

1.2.1. Meetings held and salient events

1.2.1.1. The Mines Safety and Health Commission met on 6 May, 3 September and 2 December 1976, preparatory meetings of the Restricted Committee being held on the preceding days. An ad hoc Committee of the MHSC met on 18 February 1976. The working parties and their committees of experts met on 50 occasions (totalling 54 days). There were in addition 25 restricted meetings attended by only a few members. The total number of meetings including symposia was 83, extending over 89 days.

1.2.1.2. No appointment has been made to the post of principal administrator which has been vacant since 1971 and which was filled only from 15 August 1974 to 31 October 1975. The number of engineers acting as secretaries to the working parties has thus remained at three. As a result the extension of the responsibilities of the MSHC to all the extractive industries has been implemented more slowly than would otherwise have been the case.

1.2.1.3. At the end of the year the Chairman of the MSHC, Dr Hillery, left the Commission and the MSHC to take office as President of Ireland. His farewell message, which was sent to the MSHC at its meeting on 2 December 1976, was as follows.

"I regret that I am not able to be present to take leave of you as Chairman of the Mines Safety and Health Commission.

	Eur. 9	D	F	I	B	U.K.
Production (Mio t) 1974	242.6	101.5	22.9	0.004	8.1	109.2
" " 1975	256.9	99.2	22.4	0.002	7.5	127.8
" " 1976	247.7	96.4	21.9	0.002	7.2	122.1
Percentage change 1975/74	+5.9	-2.3	-2.1	-	-7.8	+17.0
Percentage cahnge 1976/75	-3.6	-2.8	-2.4	-	-3.2	- 4.5
Underground productivity - OMS in kg						
1975	3 559	4 062	2 761	-	2 426	3 493
1976	3 563	4 153	2 781	-	2 550	3 407
Percentage change 1975/76	+0.1	+2.2	+0.7	-	+5.1	-2.5
Underground workers on books (1 000)						
Average 1975	342.0	109.8	40.5	0.2	18.7	172.4
Average 1976	331.9	105.8	38.1	0.2	17.7	169.8
Percentage change 1975/76	-3.0	-3.6	-5.9	-	-5.4	-1.5
Number of working mines at the end of						
1975	331	46	29	-	14	242
1976	321	42	27	-	12	240
Capacity abandoned in 1976 (in Mio t)	4.48	3.4	0.46	-	0.3	0.320
Pithead coal stocks (1 000 t) at the						
end of 1975	26 248	9 290	5 494	9	806	10 617
1976	26 803	10 507	4 410	9	1 159	10 688
Percentage change 1975/76	+ 2.1	+13.1	-19.7	-	+43.8	+0.7
Coke stocks held at coking plants at						
the end of 1975	12 998	8 217	1 131	1 073	115	2 440
1976	17 951	12 460	1 500	900	100	2 960
Percentage change 1975/76	+38.1	+51.6	+32.6	-16.1	-13.0	+21.6
Percentage of output produced by						
mechanized means [1]						
Mechanized winning 1974	96.6	96.9	89.2	-	91.3	98.3
1975	97.3	97.9	89.9	-	95.9	93.3
1976	97.7	99.3	86.9	-	97.9	98.6
Powered supports 1974	80.0	75.7	40.6	-	54.8	94.4
1975	83.8	82.1	41.2	-	53.2	94.5
1976	86.9	84.6	41.7	-	56.5	96.5

Source: Eurostat statistical telegram 14.1.1977
1) Mining authorities

You are no doubt aware of the reasons for my early and somewhat sudden departure from the Commission of the European Communities, which has not left me time to take leave of a body for which I nonetheless have a high regard.

"Several of our meetings have been marked by the sad memory of miners killed in pit disasters and I was aware of the deep sympathy you felt both as fellow men and as fellow miners for the victims of these misfortunes, which the Mines Safety and Health Commission seeks to prevent but which remind us that your task will never be completed.

"We also met to say goodbye to departing members and I had the opportunity to establish a number of personal and very rewarding relationships.

"I have always been impressed by tne spirit of fellowship which unites you all - government representatives, employers and workers. I have been struck by the goodwill and sense of responsibility which characterize your collaboration in the study of complex problems, your confrontation of frequently differing points of view and your efforts, always in a spirit of cooperation and friendship, to seek solutions which will ensure greater safety for miners.

"As a doctor and a former Minister of Labour in Ireland, I appreciated your concern, your work and the results of that work and was pleased to see the Council of Ministers extend the responsibilities of the Mines Safety and Health Commission in 1974.

"Now that I myself am on the point of becoming a former member of the Mines Safety and Health Commission, I have pleasure in recalling and associating myself with the good wishes expressed by other departing members: may your work continue in the same spirit of friendly understanding and with the same success as in the past.

"I am pleased to note that the past and its achievements will be recalled at a conference to be held next year to commemorate the 20th anniversary of the Mines Safety and Health Commission.

"I hope that this conference will attest to your past successes and herald a future of fruitful cooperation".

1.2.2. Group accidents

1.2.2.1. The year 1976 saw three group accidents (i.e. accidents resulting in the death or injury with eight weeks'absence from work of at least five victims), Two of these accidents occurred in coal mines and were

immediately notified to the Secretariat of the MSHC. On 21 July 1976, a firedamp ignition in the Luisenthal colliery in the Saar resulted in severe burning of seven miners, of whom two died. On 30 September 1976 sixteen persons, who had volunteered to fight a fire at mine 5 of the Merlebach complex in the Lorraine Area, were killed by an explosion.

A further accident occurred at the Berwiller mine belonging to the Mines de Potasse d'Alsace on 18 July 1976: five persons died on falling down part of a shaft.

The MSHC discussed these accidents at its meetings on 3 September and 2 December 1976. They will be further studied in 1977, but the MSHC has delegated the work on the two coal mining accidents to the appropriate working parties. It has instructed the Working Parties on "Ventilation and Firedamp" and "Rescue Arrangements, Mine Fires and Underground Combustion" to study the relevant aspects of the Luisenthal and Merlebach accidents respectively.

1.2.2.2. The MSHC has also completed its study of the following accidents: the collapse of the Calonne-Ricouart tip which on 26 August 1975 caused the death of six local residents, the firedamp and dust explosion at Lens-Liévin (Nord/Pas-de-Calais Area, France), which occurred on 27 December 1974 and resulted in 42 fatalities, the explosion at the Houghton-Main colliery in the United Kingdom, which resulted in the death of five persons and severe injury of a sixth, on 12 June 1975.

On 6 May and 3 September 1976, after studying these two accidents and that at Luisenthal, the MSHC issued the Working Party on Ventilation and Firedamp with a new remit extending the terms of reference handed down on 11 July 1975.

The MSHC instructed the Working Party on Ventilation and Firedamp:

"1. to study all the aspects of the accidents which occurred at Lens-Liévin, Houghton-Main and Luisenthal which might be interesting and important for preventing firedamp explosions and firedamp ignitions and in particular to propose measures which can be taken to control the emission of firedamp.

- coming from old workings and cul-de-sacs, both those abandoned temporarily and those abandoned permanently;
- in cul-de-sacs workings, account should be taken of the dust make, stoppages of work and stoppage of auxiliary ventilation as well as the length and nature of the ducting for the auxiliary ventilation;

2. to study the utility of automatic monitoring of auxiliary ventilation (air velocity etc.) and of automatic monitoring of CH_4 (by instruments installed on coal-getting and heading machines and including electrical cut-out or alarm indication devices);

3. to compare national legislations designed to avoid the risk of sparking in auxiliary fans, with a view to possible harmonization."

1.2.2.3. Section III contains reports on the three group accidents.

1.2.3. Decisions of the Mines Safety and Health Commission

1.2.3.1. At its meeting on 6 May 1976 the MSHC, on the basis of the opinion submitted by the Working Party on Rescue Arrangements, Mine Fires and Underground Combustion (see Chapter 2.1.), approved a first report on filter self-rescuers for use in European Community coal mines - Part I: minimum design requirements and testing procedures (Doc.694/7/76). It submitted this report to the Governments as a proposal for the improvement of safety in coal mines, specifying that these minimum requirements could be exceeded in certain countries whose regulations were already more stringent. The report made no recommendation as to the need for such filters.
The document has already been published as Annex X to the 13th Report in the interests of speedy distribution.

1.2.3.2. At its meeting on 3 September 1976 the MSHC, on the basis of a report by its Working Party on Flammable Dists (see Chapter 2.4.), approved a "Recommendation on the application of dust binding by hygroscopic salts as a means of combatting coal dust explosions" (Doc. 735/3/76). It submitted this recommendation to the Governments of the Member States as a proposal for the improvement of safety in coal mines in pursuance of Article 1 of its terms of reference with a view to further action in accordance with Article 4.
This document is appended as Annex V.

1.2.4. Extension of the responsibilities of the Mines Safety and Health Commission

1.2.4.1. On 11 July 1975 the MSHC had decided to set up an ad hoc Committee to advise on the organization of the working parties in the light of the extension of its responsibilities to all extractive industries, and

bearing in mind the difficult staffing situation in the Secretariat which indicated the need to establish priorities (section 1.2.4. of the 13th Report).

1.2.4.2. This ad hoc Committee, which was composed exclusively of the government representatives, met on 18 February 1976 and sumbitted proposals to the MSHC (Doc. 929/76).

1.2.4.3. These proposals were considered by the MSHC on 6 May 1976 and the following decisions were taken (Doc. 2523/76, section 11)[1].

1.2.4.3.1. None of the remits already issued to the working parties would be abandoned as they already derived from a choice of priorities, but a decision would be taken on the order in which the tasks should be carried out, taking account of the staff available to the Secretariat.

1.2.4.3.2. Most of the previous recommendations and work of the MSHC can be of relevance to the "other than coal" mining industry and can be applied as they stand in these industries.
The chairmen of the working parties will, if necessary with the help of a small committee, decide which of the three hundred recommendations or opinions can usefully be applied to these industries either in the form of regulations or on an informational basis.

1.2.4.3.3. Priority topics specific to certain extractive industries other than coal mining which require early consideration.
Some of these topics can be dealt with by the existing Working Parties.
The MSHC consequently instructed its Working Parties as follows.

1.2.4.3.3.1. The Working Party on Roof Control [2] will extend its activities to cover the following areas:

- stability of cavities, in particular cavities produced by drilling and dissolving of salt deposits;
- mining under the sea, under lagoons and close to old flooded workings (the Indian disaster in 1975);

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1) Certain decisions were postponed, being finalized on 23 March 1977 (Doc. 1249/77, section 2).

2) To be known henceforth as the Working Party on Strata Control and Stability of Ground (Decision taken on 23 March 1977).

- stability of high faces in quarries and workings of lignite and other loose materials, as well as stability of tips;
- effect of frost (Greenland)

1.2.4.3.3.2. The Working Party on Ventilation and Firedamp [1] will extend its activities to cover the following areas:
- problems connected with the use of diesel engines;
- shotfiring fumes in underground mines.

1.2.4.3.3.3. The Working Party on Health in Mines will extend its studies of the problem of noise, respirable dust, climate, temperature and ionizing radiation in the coal industry to include all the extractive industries.

1.2.4.3.3.4. The Working Party on Winding Engines, Ropes and Shaft Guides will extend its work in the following areas to embrace all the extractive industries: "all guided systems for the conveyance of men and meterials in shafts and roadways (including diesel trolleys for overhead monorails and floormounted guided systems) and aerial suspended systems".

1.2.4.3.3.5. The Working Party on Mechanization will extend its study of "all problems connected with non-guided transport systems" to all the extractive industries.

1.2.4.3.4. The MSHC decided that:

1.2.4.3.4.1. a Working Party on Petroleum, Gas and other Materials extracted by Borehole would be set up;

1.2.4.3.4.2. The new types of explosive (gels,slurries) and blasting techniques justified the establishment of a new Working Party. In view of the excessive workload of the Secretariat, a preparatory study would be carried out by an expert : Mr Goffard, Principal Explosives Inspector in Belgium.

1.2.4.3.5. The MSHC decided to merge the Working Parties "Effects of Working hours on Safety at Work" and "Psychological and Sociological Factors affecting Safety".

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1) To be known henceforth as the Working Party on Ventilation, Firedamp and other Mine Gases (Decision taken on 23 March 1977).

1.2.4.3.6. The MSHC did not approve the proposal by the ad hoc Committee that the Working Parties on "Flammable Dusts" and "Ventilation and Firedamp" should be merged in view of the distinctive character of the remits of these Working Parties.

1.2.4.3.7. The MSHC emphasised the need to ensure that the Working Parties on "Psychological and Physiological Factors affecting Safety, including Time at Work" and "Health in Mines" became fully operational.

1.2.5. The MSHC took note of the current status of the research programme on safety in mines drawn up by the Health and Safety Directorate of the Directorate-General for Employment and Social Affairs, and approved by the Commission on 21 December 1976 [1]. The programme will run for five years from 1977 with a budget of 7.5 million European units of Account. It covers most of the subjects dealt with by the MSHC Working Parties and may contribute to the solution of the problems with which they are concerned. The research findings will be notified to the MSHC so that they can be analyzed and taken into account either in regulations or in operating practice.

1.2.6. On 2 December 1976 the MSHC began its scrutiny of a proposal for a Council Directive on safety signs at the workplace. This proposal had been drawn up by the competent Commission departments and had been discussed on 26 November 1976 by the ECSC Consultative Committe, which had not approved the immediate application of the Directive to the coal and steel industries. It requested that the MSHC and the Steel Industry Safety and Health Commission should be consulted and proposed that the coal and steel industries be added to the list of industries to which this instrument did not apply.
The MSHC instructed a select study group to scrutinize this proposal for a Directive.

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1) Official Journal C 10 of 14 January 1977

1.2. Dissemination of information. International trade union conference (ICFTU and WCL) on safety and health in mines.

The conference was held on 16, 17 and 18 March 1976 in Punta Ala (near Follonica) in the Grossetto mining area (Italy). This is the first non-coalmining area in which a MSHC conference has been held since the terms of reference of the MSHC were enlarged to cover all the extractive industries.

The conference was attended by 71 miners'representatives from the Member States. Papers were read on the socio-economic situation in the Grossetto area and on technical aspects of the four Solmine surface pyrite mines and the mines in process of being developed (to meet the demand for suphuric acid and with a view to the possible use of sponge iron in the steel industry). Visits to these mines were arranged. An account was given of the work of the MSHC, and in particular of those aspects which are of relevance to extractive industries other than coal mining, and of the prospective ECSC research programmes (Article 55) aimed at the prevention of accidents and illnesses in coal and iron ore mines. The main points raised related to:

a) environmental factors, and in particular high temperatures and dust levels, where there was a need for common methods of evaluation and establishment of limit values;
   and
b) enabling the trade union organizations to make a greater contribution to accident prevention.

1.2. The safety campaigns inthe various mining areas continued with financial assistance from the Commission.

1.2.9. 20th Anniversary of the establishment of the MSHC

The occasion will be marked by a conference, to be held in the New Theatre in Luxembourg, on 22 and 23 November 1977.

2. Section II

ACTIVITIES OF THE WORKING PARTIES

2.1. Chapter A. - Rescue Arrangements, Mine fires and Underground Combustion

2.1.1. The Working Party held 4 plenary meetings on 25 March, 2 July and 22 November 1976 in Luxembourg and on 12 October in Essen (Germany). Meetings of the Committees of Experts were held as follows:

- Conveyor belts : 5 meetings of which 5 were plenary (being attended by about 15 experts);
- Fire-resistant fluids: 5 meetings of which 2 were plenary and 3 for medical experts only (3 to 5 experts);
- Stabilisation of ventilation in the event of fire below ground: 3 meetings, of which 1 was plenary;
- Filter self-rescuers (anti-CO masks): 6 meetings of which 4 were plenary (5 to 9 experts);

i.e. a total of 25 meetings, of which 16 were plenary.

2.1.2. The Working Party and its Committees of Experts continued the work described in the 13th Report in pursuance of the terms of reference set out in Annex II.

2.1.3. Certain aspects of this work were completed in 1976, the reports of the Committees of Experts having being scrutinized by the Working Party, but the relevant documents were not considered and approved by the MSHC until 23 March 1977.
In the interest of more rapid distribution, the MSHC has agreed that these documents should be appended as annexes to the 14th Report for the year 1976.
The documents in question are as follows.

2.1.3.1. A report entitled "Notes for guidance on the measures to be taken to stabilize ventilation in the event of open fires underground (except in shafts)". It bears the document number 3354/6/74 and is appended as Annex IX to the present 14th Report. It constitutes a supplement to the document "Practical conclusions on the application of the theory of stabilisation of ventilation approved by the MSHC on 10 October 1968 (Annex III to the 6th Report). It is intended for the use of mining engineers and reviews the results of the work carried out since 1960

on the basis of the Budryk theory by the Committe of Experts on Ventilation, a brief account of which is given in Doc. 708/3/74 by Messrs Champagnac and Stenuit (available in f, d, and e from the Secretariat).
This document was not unanimously accepted at the meeting of the MSHC on 5 May 1976 as a proposal for submission to the governments in pursuance of Article 1 of the terms of reference of the MSHC, but was appoved on 23 March 1977 as an important information report.

2.1.3.2. Ninth Report on Mine Rescue Services, Organization, Personnel and Apparatus Available, giving the position as at 1 January 1976.
Although the MSHC had intended this report to be bi-annual, it has not been published since 1972 (the fifth annual Report of the MSHC). Together with the list of specialists in borehole rescue work and of equipment available for the drilling of large-diameter holes to rescue trapped miners, which was published as Annex VI to the 13th Report, the present simplified form of this document (Annex VI to the 14th Report) provides a tangible basis for one of the aspects of liaison between the rescue services of the Community countries as prescribed by Article 7 of the terms of reference of the MSHC. Such liaison is maintained within the Working Party and more specifically within the Committee of Experts on Rescue and through the numeroux contacts established between the heads of the rescue stations.

2.1.3.3. A report entitled 'Memorandum on the Neutralization of Mine Fires by the Injection of Nitrogen'.
This technique, which is mentioned in the 13th Report (2.1.3.5.) was applied for the first time in Germany in December 1974. It is of particular relevance to the safety of rescue brigadesmen attempting to seal off a fire area by means of stoppings. The document may serve as a guide during advance studies of the measures to be taken in the event of open fires underground, and is appended to the present Report as Annex VIII [1].

2.1.3.4. Report on the use of filter self-rescuers, Part II: Maintenance and Training (See Annex VII to the present Report) [1].

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1) Approved by the MSHC on 23 March 1977.

This report was approved by the Working Party on 22 November 1976. It follows on from Part I, which was published as Annex X of the 13th Report. It is a summary of current practice in the Member States which use self-rescuers, but, like the preceding part, it contains no recommendation as to the need to use such filters. With regard to the training of miners in wearing the apparatus, the report takes account of the conditions of darkness, dust clouds, smoke and heat which were encountered in the Houghton-Main accident (12 June 1975).
The Working Party will follow up Part II with a third part which will assess the likely future developments with regard to the use of the existing self-rescuer or another type of device.

2.1.4. On 2 July and 22 November the Working Party was informed of the progress made by the Committee of Experts on Fire-resistant Conveyor Belts and Other Long Items of Plant.

2.1.4.1. On 29 April the Committee of Experts visited the Trémonia experimental mine to observe the various fire-resistance tests and the electrical resistance test (mentioned in the 13th Report, section 2.1.4.). It arranged for comparative tests to be carried out at the Cerchar, the INIEX, the Trémonia experimental mine and the N.C.B. on four similar samples of four types of belt.
The purpose of this work is to carry out a further study of the comparability of the different tests and to find a suitable quality control test, i.e. a test which can be carried out simply and rapidly to give results comparable with the two approval tests adopted by the MSHC (Annex VI to the 12th Report).

2.1.4.2. The Working Party decided to instruct a small Committee of Experts, which met on 13 May 1976, to study the health hazards associated with gases and vapours which are generated during the combustion of plastic materials (conveyor, belts, ducting, etc.) and which might not be absorbed by the anti-CO self-rescuer.

2.1.4.3. It approved a request for Community financial assistance for work on the development of a flammability test for conveyor belts with steel carcasses.

2.1.5 The Working Party also began work on the problem of withdrawal of men from production faces served by long roadways. This subject is discussed

in a German document by Mr Funkemeyer, available in e, f, d. (Doc 4341/76).

2.1.6. Progress has been made in the work on harmonization of flammability and toxicity tests for fire-resistant fluids. After analysis of a questionnaire on incidents involving lubricants, it was decided that a study should be made of their flammability. (previous work dealt mainly with fluids used for power transmission).

2.2. Chapter B - Winding Engines, Ropes and Shaft Guides

2.2.1. The Working Party met on 9 and 10 February 1976 in Germany, on 27, 28 and 29 April in Sweden and on 9, 10 and 11 November in Poland. Its eight member Committee of Experts on Winding Engines and Safety in Shafts held two meetings in Luxembourg, on 25 February and 15 October 1976. There have thus been three plenary and two select meetings i.e. five meetings covering a total of ten days.

2.2.2.1. In Germany the Working Party visited the shaft of the Grimberg potash mine, which is equipped with an eight-rope winder. The installation has a winding capacity of 1 250 tonnes hour from a depth of 540 m and uses 38 tonne skips (25 tonnes payload, winding speed 15.5 m/sec). Its electronic control system dates from 1971. The Working Party was particularly interested in the control devices on this installation, especially the braking system.
A visit was also made to the Achenbach shaft of the Grund lead and zinc mine, whose winding installation was equipped as early as 1973 with a digital speed controller and electronic control system.

2.2.2.2. In Sweden the Working Party saw winding engines in nine metal mines in the centre of the country. The installations are equipped with electrotechnical devices for partial or total electronic control. The Working Party took a particular interest in the problems involved in determining the factor of safety to be applied to the winding ropes of multi-rope winders, in compensation for differences in tension between the ropes, in the digital automatic speed controller, and in the automatic control of shaft station operations e.g. automatic interlocking of the pit-bottom shaft gates. The Working Party visited the premises of the ASEA, which provided the electronic apparatus, and of Atlas COPCO, which supplied the pneumatic and hydraulic equipment.

2.2.2.3. In Poland the Working Party visited a rock-salt mine at Wieliczke, the institute of mechanical engineering, machinery used for preparation and automation in the school of mines and metallurgy at Crcow, the Sierzy coal mine and the Chief Mining Institute (G.I.G.) at Katowice with its ropeworks and test facilities.
The latest developments of the Polish apparatus for electromagnetic rope testing were studied. Note was taken of the capacity and limitations of this instrument for fault detection with a view to determining discard criteria for ropes, especially of locked-coil construction.

2.2.2.4. These visits enabled the Working Party to acquire a corpus of documentation and information which will greatly facilitate its work on harmonizing rope and winder regulations.

2.2.3. The Working Party set up a Committee of Experts to work towards harmonization of safety measures relating to winders and shaft equipment. It took note of the available documents listed below:

- 722/76 on braking systems (Dr Arnold, Federal Republic of Germany);
- 1089/76 on rope breaking loads (ISO);
- 2368/75 on winding rope breaking loads (Professor de Crombrugghe, Belgium);
- 445/76 on shaft winding safety precautions (Dr Arnold, Federal Republic of Germany).

2.3. Chapter C - Electricity

2.3.1. The Working Party held plenary meetings on 14 and 15 January, 24 and 25 March, 9 July, 6 and 7 October and 4 and 5 November 1976. In addition, two meetings of experts were held on 28 April and 10 June (five experts) and a preparatory meeting (seven experts) took place on 14 June 1976, i.e. a total of five plenary meetings and three select meetings covering 12 days.

2.3.2. The Working Party continued the work on harmonization begun in 1974 and described in the 12th and 13th Reports. This work comprised:

- the draft Directive on the approximation of the laws of the Member States concerning electrical apparatus for use in potentially explosive atmospheres in gassy mines (Doc. 1411/9/75);
- adaptation of the CENELEC draft European Standards, Edition 1, No 50 014-50 020 to render them applicable to gassy mines, with a

view to their attachment to the draft Directive and adoption by the Council as harmonized Community standards.

2.3.3. As in previous years, this work was continued in collaboration with representatives both of Directorate-General XI, in the context of elimination of barriers to trade, and of CENELEC. For its work on harmonizing the design of electrical apparatus, the Working Party had, as early as the beginning of 1974, obtained the assistance of representatives of the governments, users, manufacturers and testing stations (see Annex III).

2.3.4. In general terms the Working Party approved the CENELEC draft European Standards mentioned in 2.3.2. above, subject to a number of amendments and additions to the following standards [1].

2.3.4.1. EN 50 014 and 50 018 - general requirements and type of protection 'd'. The modifications relate to:

2.3.4.2.1. the use of insulating materials (especially plactics) in flameproof enclosures;

2.3.4.2.2. certification of flameproof enclosures which are tested empty, i.e. without the apparatus which is to be placed inside them;

2.3.4.2.3. the use of non-metallic flameproof enclosures, i.e. enclosures of ceramic or plastic materials;

2.3.4.2.4. type 'd' switchgear, plugs, sockets and lampholders for type 'e' luminaires;

2.3.4.2.5. the introduction of particle-proof testing for certain flameproof enclosures (this is the most controversial point on which a decision is still to be taken by the Working Party);

2.3.4.2.6. intrinsically safe electrical systems (as no CENELEC standard exists, the Working Party has instructed a Committee of Experts to draw up standards on the basis of a British draft).

2.3.5.1. Final decisions are still to be taken on the distinctive Community mark and distinctive marking and the form of certificates for the purposes of Articles 8,9,10, and 13 of the draft Directive mentioned in 2.3.2. above. These points will be considered in consultation with

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1) The decisions on these amendments and additions have not yet been taken by the Working Party.

the experts who are concerned with the same aspects of the 'surface' Directive [1] in Directorate-General XI of the Commission in Brussels.

2.3.5.2. With regard to Article 9 of the draft Directive mentioned in 2.3.2. above, the Working Party will also consider the question of making certification documents available to manufacturers.

2.3.6. A progress report was made to the MSHC on 2 December 1976 (document available - 3820/76).

2.3.7. **At an early date, the Working Party hopes to complete adaptation** of the draft CENELEC European Standards to gassy mines and to begin work on the second part of its remit, which relates to harmonization of rules covering the installation and use of electrical apparatus below ground. A preparatory study subsidized by the Commission of the European Communities will be carried out by the NCB.

2.4. Chapter D - Flammable Dusts

2.4.1. The Working Party met on 27 February, 17 June and 29 November in Luxembourg and visited the Silverwood colliery and the experimental gallery of the SMRE (Safety in Mines Research Establishment) in the United Kingdom on 6 and 7 October 1976. A restricted meeting was held in **Luxembourg** on 14 May and on 25 and 26 May 1976 a group of four experts visited the Minister Achenbach colliery and the Tremonia experimental mine in Germany.
In total four plenary meetings covering five days were held and two restricted meetings covering three days i.e. six meetings and eight days.

2.4.2. As is stated in the corresponding section of the 13th Report, the Working Party was instructed by the MSHC to study the Lens-Liévin accident and subsequently to propose 'standardized measures for the most effective control of dust explosions in coal mines'.

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1) Council Directive 76/117/EEC of 18 December 1975, OJ L 24 p. 45 et seq of 30 January 1976 on the approximation of the laws of the Member States concerning electrical equipment for use in potentially explosive atmospheres (other than in mines susceptible to firedamp) and pertinent specific Directives.

2.4.2.1. It first prepared a 'Recommendation on the application of dust binding by hygroscopic salts as a means of combatting coal dust explosions'.
It made use of the 'Information report on procedures for neutralizing dust using salts pastes, powders and flakes' approved by the MSHC on 21 January 1974 (Annex VI to the 11th Report). This document was updated and the recommendation was drafted by an editorial committee. On 25 May it visited the Minister Achenbach colliery in Lünen-Brambauer, where it observed the application of salt pastes in a particularly dusty inclined cross-cut and the use of salt powders in a conveyor incline through which 7 500 tonnes was transported per day.
The recommendation includes an explanatory memorandum comparing the effectiveness of this method of protection against dust explosions with that of stone dusting and water spraying, describing the advantages and disadvantages of the technique, the method of use and the cases in which the technique is not justified and its use is not recommended. The principles and methods of application are described in an annex.

The recommendation was approved by the MSHC on 3 September 1976 and was submitted to the Governments of the Member States in pursuance of Article 1 of its terms of reference for further action in accordance with Article 4.
The document is appended as Annex V to the present Report.

2.4.2.2. The Working Party then began the drafting of a recommendation on the use of water barriers [1].

2.4.2.3. On 6 October the Working Party visited the Silverwood colliery at Rotherhan in the United Kingdom to see a district in hard coal with a low dust make, where salt flakes are applied to the gate road floors and stone dust to the rest of the roadway perimeter.

2.5. Chapter E - Common Accident Statistics

2.5.1. The analysis of the expert's report, which was mentioned in the 11th, 12th and 13th Reports, could not be carried out in 1976 because of staffing difficulties in the Secretariat (see 1.2.1.2.). The study is available as document number 932/76 "Development of serious accidents and fatalities in the United Kingdom and the Community of Six from

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1) Approved by the MSHC on 5 July 1977 (document available - 3512/4/76).

1958 to 1974". The purpose of the document is to facilitate the compilation of common accident statistics by bringing into line the statistics for the Community of Six and the United Kingdom. The main differences of approach lie in the definition of the serious accident and the classification of accidents under the various headings: falls of ground, haulage and transport, etc.

2.5.2. **For 1976, the United Kingdom has been able to complete its accident statistics on the same basis as the Community of Six. This has enabled some comparisons with the U.K. accident experience to be made and some differences which have emerged are to be studied by this Working Party in 1978.**

2.6. Chapter F - Health in Mines

2.6.1. For the same reasons as mentioned above, the Working Party was unable to meet in 1976.

2.7. Chapter G - Working Parties on "Psychological and Sociological Factors Affecting Safety" and "Effects on Safety of Hours Worked", merged to form a single Working party on **Human Factors.**

2.7.1. The Working Party met on 10 March 1976.

2.7.2. It discussed the position with regard to safety training in the Community coal mining industry (Doc. 935/76 for the Federal Republic of Germany, Doc. 1337/76 for Belgium, Doc. 3989/75 for France, Doc. 3990/75 for Italy).
It was decided that an outline table would be drawn up. In addition, a study will be carried out by national experts with financial assistance from the Commission of the European Communities [1].

2.7.3. Participation of workers in accident prevention, the rôle of their representatives in relation to the inspectorates and in particular their rôle in accident enquiries will be considered by the Working Party and discussed at symposia to be held in Belgium for workers' safety representatives from the mining industry[2].

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1) To be completed by the end of 1977.

2) Arranged for the spring of 1978.

2.8. Chapter H - Ventilation and Firedamp

2.8.1. The Working Party met in Luxembourg on 26 February, 21 May and 17 November 1976 and visited mines near Stoke-on -Trent and Nottingham (United Kingdom) on 14 and 15 September 1976.
A four-member Committee of Expers on harmonization of specifications and testing procedures for firedamp monitoring instruments met on 21 June, 15 October and 12 December 1976.
Four plenary meetings and three select meetings were thus held, covering a total of eight days.

2.8.2. On 26 February the Working Party continued its study of the accidents which occurred at Lens-Lévin on 27 December 1974 and at Houghton-Main on 12 June 1975. It took note of the remit which it had received in this connection from MSHC on 6 May 1976 and which has already been mentioned in Section 1.2.2.2. above.

2.8.2.1. In pursuance of this remit it drew up a document on the control of firedampemission from sealed-off areas, to be submitted to the MSHC in 1977. This document discusses two methods used in specific situations, one being employed in the United Kingdom and involving the use of pressure chambers (document available - 3965/75) and the other being practised in the Federal Republic of Germany and consisting in low-concentration gas drainage from the sealed-off area (document available 4258/1/76).

2.8.2.2. Further to the above-mentioned remit, the Working Party began a study of firedamp control in dead-end workings. It collected and compared the pertinent regulations, the results being summarized in a synopsis prepared by the Secretariat.

2.8.2.3. On 14 and 15 September 1976 the Working Party, in the course of its work of these questions, visited the Wolstanton colliery near Stoke-on-Trent (pressure chambers) and the Rufford colliery near Nottingham (recirculation to face advance headings with an exhaust fan and continuous automatic monitoring of firedamp concentrations). The two visits are described in Doc. 4234/76 and Doc. 4322/76 (available in English only).

2.8.3. The Working Party also studied the attendant circumstances and causes of a firedamp ignition which occurred at the Luisenthal colliery on 21 July 1976 as a result of which seven miners suffered severe burns, two of them dying. The lessons to be drawn from this accident overlap

with those derived from the Lens-Liévin and Houghton-Main accidents and with the additional points to be included in the Working Party's remit, viz. length and type of auxiliary ventilation ducting, automatic firedamp monitoring and alarm systems on heading machines and power loaders.

2.8.4. The Working Party carried out an initial study of the Merlebach explosion (16 fatalities, 30 September 1976).

2.8.5. The Working Party completed its 'Interim Information Report on Ignition of Firedamp by Power Loaders and Heading Machines'. Although the MSHC approved this cocument in 1977 [1] it directed that it should be appended to this Report (as Annex VIII) to ensure rapid distribution. In addition to its documentary contents the report recommends that work be undertaken or continued on a number of projects, mostly at the development stage.
A second report will be drawn up on the progress of the work in hand and will include new technical proposals for submission to the Governments.

2.8.6 The danger of firedamp ignition below armoured conveyors was mentionned in the 12th and 13th Reports (2.8.3.3.), and a progress report has been drawn up on research in this field (document available-3740/75).
A list of recommended precautions against this hazard will be submitted to the MSHC at the end of 1977.

2.8.7. Use of diesel engines in mines: problems of the toxicity of exhaust gases and of the prevention of explosion and fire.
At the end of the year, the outside expert responsible for the study financed by the Commission of the European Communities submitted a report on the first phase of his work (Doc. 4706/1/76 -40 pages + 160 page appendix).
The Working Party will acquaint itself with this document in 1977.
As a second stage, the expert has been instructed to draw up proposals for uniform rules.

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1) Approved by the MSHC on 23 March 1977 and submitted to the Governments of the Member States as a proposal in pursuance of Article 1 of its terms of reference, for information pursuant to Article 3 and for further action in accordance with Article 4.

2.8.8. Firedamp (CH_4) monitoring instruments

On 21 June a group of four experts began work on harmonization of specifications and testing procedures for these instruments, beginning with hand-held methano-meters.
A reference document, available under No. 3074/75, reviews these specifications and procedures.
Three meetings have been devoted to this subject. It is anticipated that the report on hand-held methanometers will be completed by the end of 1977.

2.9. Chapter I - Mechanization

2.9.1. Meetings of the full Working Party were held on 19 February, 29 March, 14 October and 23 November 1976 and a select committee of 4 experts met on 5 February and 14 April 1976. There were thus 4 plenary meetings and 2 select meetings, covering a total of 6 days.

2.9.2. As stated in the 13th Report, after the study of accidents occurring in the various countries, priority was given to drafting a first report on safety techniques in winning areas.
The activities of the Working Party in 1976 consisted in a scrutiny, now virtually completed, of this initial document, which was drawn up at the end of 1975
In the proposals which the MSHC will submit to the Governments, close collaboration between manufacturers and users is recommended. The document contains as exhaustive a list as possible of proposed measures relating to direct prevention (design, protection against environmental factors etc), indirect prevention (lighting, communications etc.), information, operating instructions, supervision and training.

2.10. Chapter J - Roof Control

2.10.1. The Working Party met in Luxembourg on 3 March, 17 September and 30 November 1976 and a small committee of experts held preparatory meetings on 2 March, 26 October and 29 November. Three plenary meetings and 3 select meetings were thus held, covering a total of 6 days.

2.10.2. The Working Party drew up a paper on "Strata reinforcement by bolting, dowelling and injection techniques in European coal mines".
This 120 page document describes the techniques in question and summarizes the most important parameters determining the effectiveness of these methods of strata reinforement at the face and in roadways, which supplement the measures taken at the planning stage with a view to ensuring improved ground stability. It describes the application of the method in specific situations encountered in the various mining countries of the Community and in conclusion lists the research to be undertaken in order to ensure that the lowest possible level of risk to the safety and health of operators is associated with the application of these techniques [1].

2.10.3. On 6 May the Working Party submitted to the MSHC a study on the effect of powered supports on the rate of serious accidents and fatalities caused by falls of ground or falling meterial in the United Kingdom, where 94% of coal production is obtained in faces equipped with such supports.
It has undertaken a revision of this report in accordance with the instructions of the MSHC to the effect that the study was to be extended to all the Community mining countries and was to be supplemented with data on the accident rate per shift worked below ground and if possible per shift worked at the face, as well as on the risks involved in the handling and transport of powered supports. The trends quoted were also to be substantiated by tests of statistical significance.

2.10.4. The Working Party continued discussion of the "First report of the National Committee on steep seam working in British coal mines" (document available - 1408/75) which was drawn up following the accident which occurred at the Seafield colliery (Scotland) on 10 May 1973.

2.10.5. The small Committee of Experts on Rock Mechanics which had begun work in 1973 resumed its activities and decided to review the research undertaken with financial assistance from the Commission of the European Communities under the supervision of the Directorate-General for Energy. It will try to determine the practical applications of the research findings, whether the projects in question are completed or

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1) Approved with certain proposals to the Governments on 5 July 1977 (document available - 1612/4/75).

still in progress, and to draw up simplified records of the results for dissemination by the MSHC.

2.11. Chapter K - Petroleum, Gas and other Materials extracted by Borehole

2.11.1. The first meeting of the Working Party was held on 30 November 1976. At this initial stage, only the government representatives were present.

2.11.2. There was a wide-ranging exchange of views on:

- the delimitation of the areas for which the MSHC is competent;
- relations with existing organizations concerned with all or part of the field in question (London Conference, European Diving Technology Committee etc);
- the individual interests of the various Member States.

2.11.3. It was decided that the Working Party would give priority to the risk of group accidents e.g. those resulting from blowouts, with the attendant hazards of explosion or fire associated with the use of electricity.

2.11.4. The most frequent causes of accidents involving individuals will be determined on the basis of accident statistics to be provided by each country.

2.11.5. Each country was also requested to provide its basic instruments regulating drilling and production activities together with a description of methods of personnel training at all levels.

2.11.6. A study is also to be made of health and hygiene aspects deriving from the particular characteristics of the working environment (noise, climate, lighting, etc.).

2.11.7. The government representative will meet gain in June 1977 and the Working Party will then be expanded to its normal composition to include representatives of the employers and workers.

2.11.8. Throughout the year the Secretariat remained in close contact with the European Diving Technology Committee, who met in Luxembourg on 25th June and in Amsterdam 11th November. The frequency of accident to divers remains high, and to help reduce this the E.D.T.C. drew up a 58 page document "Guidance Notes for Safe Diving". In accordance with a decision of the Mines Safety and Health Commission, the Commission

of the European Communities helped with the publication and distribution of this document [1] now available in English, French, German and Italian on application to the Secretariat of the MSHC. The two organisations will continue their co-operation in this field.

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1) Published March 1977

3. SECTION III

STUDIES OF GROUP ACCIDENTS

These accidents are listed in section 1.2.2.

3.1. Luisenthal accident (Saar)

3.1.1. This accident occurred on 21 July 1976 and was discussed by the MSHC at its meetings on 3 September and 2 December 1976.

3.1.2. The accident was caused by a firedamp ignition as a result of which seven miners suffered severe burns; two of them dying. The ignition occurred at the roadhead in a 1000 m rise heading driven in an inclined seam having an angle of dip of 4-14°. The seam was more than 2m thick and had a conglomerate roof. The drivage was being carried out by a selective heading machine at a rate of 10 m per shift. Main ventilation was by forcing ducts with an exhaust duct at the drivage face.

3.1.3. The flame was propagated over a distance of 40 m from the heading face.

3.1.4. While the final conclusions of the enquiry are not yet available, the accident was probably caused by a roof layer of firedamp emitted from a blower which the heading machine had just uncovered in the floor; Pick on conglomerate frictional sparking may have been the source of ignition.

3.1.5. Following the Lens-Liévin, Houghton-Main and Luisenthal accidents, the MSHC gave the Working Party on Ventilation and Firedamp with a new remit, which is quoted in section 1.2.2.2. The aspects of this new remit which are of relevance to the Luisenthal accident are the length and nature of auxiliary ventilation ducting, mentioned at the end of section 1, and section 2: "to study the utility of automatic monitoring of auxiliary ventilation (air velocity etc.) and of automatic monitoring of CH_4 (by instruments installed on coal-getting and heading machines and including electrical cut-out or alarm indication devices)".

3.2. Merlebach accident (Lorraine Area)

3.2.1. The accident occurred on 30 September 1976 at mine No 5 in the Lorraine coalfield. It resulted in the deaths of sixteen persons when an explosion

occurred as they were trying to extinguish a fire.

3.2.2. The accident was discussed by the MSHC on 2 December 1976 and will be further discussed in 1977 by the Working Party on Rescue Arrangements, Mine Fires and Underground Combustion, which will consider the implications for fire prevention and fire fighting.

3.2.3. As the conclusions of the enquiry and the results of the study by the above Working Party are not yet available, the present Report contains only a few details of the circumstances attending this accident. A more detailed description will be given in the next Report.

3.2.4.1. The accident occurred on the 1036 m level in a production face situated in a steep seam 3,50 thick, having a angle of dip of 60°.
The production district was a new one. A central raise lined with steel segments was used for loading out the coal produced in two units, each 400 m long, which were worked to the rise in horizontal slices 5 m high with multiple attack hand-winning and hydraulic stowing.

3.2.4.2. A fire was discovered on a level with the return end of the armoured conveyor near the foot of the rise heading serving as a return airway from the southern unit of the face in seam 2A.
The alert was quickly given and workers began to apply water to the fire. The fire nonetheless spread, a roof fall having created a passage between the rise heading in seam 2A and that in an adjacent seam. The production workers were withdrawn from the face and replaced by a team of rescue brigadesmen and volunteers.
It was these persons who were caught in a violent explosion at about 18,30 hours as it was blocking the head of the central raise, in order to seal off the face by filling it with stowing material passed through the rise heading serving the northern unit.

3.2.4.3. The district, comprising six faces in total serviced from the 1036 m level, was abandoned and sealed off by means of stoppings and hydraulic stowing from the return level at 826 m.
This operation was completed on 20 October 1976.

3.3. Accident at Berwiller, belonging to the Mines de Potasse d'Alsace

3.3.1. This accident occurred on 18 June 1976 and was discussed by the MSHC on 2 December 1976 on the basis of Doc. 3818/76 supplied by the French government representatives.

3.3.2. The following sets out the main circumstances attending this accident.

A group of five men including an engineer, a foreman and an overman descended into the sump below the level of the normal pit-bottom shaft station in order to prepare for cutting of the tails of the rope guides at the weights. At about 15.15 hours they descended in a shaft inspection cage to a platform at a level 20 m below the normal lower landing and then continued down on ladders to other platforms to arrive at the lowest platform 40 m below the level of the normal shaft station. This platform gave way and the five men fell into the water-filled sump some 60 m below. When the banksman received no news of the five men he asked a deputy who was below ground to investigate. The latter heard cries for help and gave the alarm at 18.30 hours. The cries for help came from the engineer, who died during the rescue operations. The platform was located a few meters below another platform which sealed off the shaft, and was thus in an area where the air was not renewed and was particularly hot, humid and saline. Very severe corrosion was found on the iron girders which had supported the platform.

SECTION IV

Joint statistics of underground accidents in coal mines

4.1. **For reasons of economy it had been decided to discontinue publication of the statistical tables 1a, 1b, 2a, 2b by country and by coalfield. By the unanimous request of the members of the Mines Safety and Health Commission these tables will now be included, but on a national basis. All delegations indicated that these were of considerable value in the study of accident statistics.**

4.2. At the end of this chapter there are the usual tables A and B (frequency rates of fatal accidents and serious injuries for each country and the Community of the Six. since 1958) C (groupe accidents) and D (recapitulation: Community of the Six and the United Kingdom). **Tables 1a,1b,2a,2b are included for each of the Community Countries with summaries for the Community of Six and the full Community. (Excluding the coal mines of Ireland and the independantly licensed mines of the United Kingdom.**

4.3. It will be noted that the United Kingdom has compiled its 1976 statistical tables on mine accidents in the same way as the countries in the Community of the Six.

However, in the interests of continuity in comparing accident levels over a period, we shall continue to consider the Community of the Six and United Kingdom separately, since the only long term comparison which can be made is for fatalities.

4.4. Analysis of the statistics

4.4.1. Community of the Six

Casualties resulting in an absence from work of 4 - 20 days: 30 643 for 301.1 million hours worked, i.e. a frequency rate of 101.77 (1975: 33 985 casualties, a rate of 106.67) i.e. a 4.8% decrease (significant).

Casualties resulting in an absence from work of 21 - 56 days 13 923, frequency rate 46.24 1975: 15 554 a rate of 48.50) i.e. a 4.8% decrease (statistically significant)

Casualties resulting in absence from work of more than 56 days: 4 491 frequency rate 14.92 (1975: 4 795, a rate of 15.05) i.e. a 0.8% decrease (not statistically significant).

Fatalities; 125 (including 16 in a group accident), frequency rate of 0.415 (1975: 110 fatalities without groupe accidents, frequency rate 0.345) i.e. a 20 % increase.

Without the 16 fatalities in the group accident the frequency rates are 0.362 and 0.345 respectively, i.e. a 4.9% increase (not statistically significant at 95% certainty level).

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1) Footnote: **The Secretariat of the Mines Safety and Health Commission hold accident statistics for the principal coalfields of the Community of Six, and these will be sent on request.**

4.4.2. United Kingdom (286.5 million hours worked)

Casualties - 4 - 20 days:	28 669	- rate 100.07
Casualties -21 - 56 days:	10 815	- rate 37.75
Casualties mere than 56 days:	2 407	- rate 8.40
Fatalities :	45	- rate 0.157

Discounting the group accidents (1975 - 55 fatalities; rate 0.181 including 5 in 1 group accident) - 15.2% decrease (statistically significant)

Without the 5 fatalities in 1975, the rates are 0.157 and 0.165 respectively, i.e. a 5% reduction (not statistically significant)

4.4.3. Accident levels over a period in the Community of the Six.

In 4.4.1. it was noted that the rate of casualties resulting in absences of 4-20 days and 21-56 days had decreased in 1976 compared with 1975. As the table below shows, there has been a steady decrease since 1973, and between 1971 and 1976 the decrease is of the order of 10% for absences of 4-20 days and 21-56 days which is highly significant.

For absences of more than 56 days comparisons can be made back to 1958. As shown in Table A, the frequency rate levelled off between 1958 (13.55) and 1967 (13.246) increased from then until 1973 (16.77) and subsequently decreased steadily by very significant proportions.

Lastly, Table B shows that the fatalities rate fell from 0.610 in 1958 to 0.415 in 1976, a very significant decrease of 47%. There has been **a regular decrease since 1958, apart from** fatalities in groupe accidents. Over the past 10 years the decrease has been slight and insignificant.

The decrease is most marked for falls of ground, viz. from 0.253 in 1958 to 0,07 in 1976. This decrease has been regular over the 18 year period. On the other hand, the decrease has levelled off over the past few years for the whole of lines 2 and 3, viz. haulage and transport, and movement of personnel. There is a significant increase in the accident rates for the whole of lines 4 and 5, viz. machinery, handling, of tools and supports, and falling objects. It is because of this increase that the Working Party on Mechanisation was set up.

Accident levels since 1971 (Community of the Six)

	1971	1972	1973	1974	1975	1976
4 - 20 days - actual	47 203	40 376	37 384	34 797	33 985	30 643
Frequency rate	113,96	109,31	112,77	110,97	106,67	101,77
increase/decrease on previous year (%)	-	-4 (s)	+3,17 (s)	-1,6 (s)	-3,9 (s)	-4,8 (s)
21-56 days - actual	21 116	18 531	17 325	15 875	15 454	13 923
Frequency rate	50,98	50,17	52,26	50,62	48,5	46,24
increase/decrease on previous year (%)	-	-1,59	+4,17 (s)	-3 (s)	-4,2 (s)	-4,8 (s)
more than 56 days - actual	6 249	5 763	5 560	5 054	4 795	4 791
Frequency rate	15,09	15,60	16,77	16,12	15,05	14,92
increase/decrease on previous year (%)	-	+3,4 (s)	+ 7 (s)	-4 (s)	-6,7 (s)	-0,8 (s)
Fatalities total actual	182	147	137	143	110	125
Frequency rate	0,440	0,399	0,413	0,456	0,345	0,415
increase/decrease on previous year (%)	-	-10	+3,9	+10,4	-24	+20
Actual without group-accident (actual group accident)	162 (3)	141 (1)	128 (1)	96 (2)	110 (0)	109 (1)
Frequency rate	0,391	0,382	0,385	0,307	0,345	0,362
increase/decrease on previous year (%)	-	-2,3	+1%	-21 (s)	+12	+4,9

(s) significant variation

A. Comparative Table of numbers of persons incapacitated by underground accidents for eight weeks or longer

years 1958- 1976 per '000,000 man-hours (frequency)

GERMANY	1958	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977
1) Falls of ground	4,843	4,779	4,886	4,797	4,682	4,663	4,894	4,732	4,721	4,524	4,618	4,736	4,321	4,354	4,20	4,30	4,08	3,69	3,47	
2) Haulage and transport	2,550	2,569	2,445	2.458	2,501	2,433	2,385	2,411	2,067	1,913	1,994	2,195	2,007	1,724	1,81	1,80	1,68	2,16	1,89	
3) Movement of personnel	2,497	2,463	2,348	2,512	2,608	2,646	2,744	3,032	2,852	2,974	3,300	3,399	3,370	3,246	3,48	3,98	4,15	3,37	3,58	
4) Machinery, handling of tools and supports	0,767	0,914	0,920	0,867	1,046	1,213	1,242	1,234	1,244	1,124	1,396	1,291	1,382	1,597	1,38	1,61	1,58	2,16	1,85	
5) Falling objects	2,537	2,719	2,738	2,945	3,077	3,038	3,242	3,344	3,272	3,642	3,773	4,036	4,166	3,313	3,49	3,49	3,37	2,97	2,92	
6) Explosives	0,015	0,011	0,010	0,009	0,008	0,006	0,006	0,005	0,005	0,017	0,011	0,007	0,008	-	-	-	0,01	-	0,01	
7) Explosions of firedamp or coal dust	0,011	0,016	-	0,002	0,123	0,010	-	0,014	0,013	-	0,004	0,004	-	0,012	-	-	-	-	0,02	
8) Sudden outbursts of firedamp, suffocation by natural gases	-	-	-	-	-	-	-	0,005	-	0,003	-	-	-	-	-	-	-	-	-	
9) Underground combustion and fires	-	-	0,003	0,002	-	-	-	-	-	-	0,004	-	-	-	-	-	-	-	-	
10) Inrushes of water	0,004	-	-	-	-	0,004	-	-	-	-	-	-	-	-	-	-	-	-	-	
11) Electricity	0,010	0,014	0,012	0,014	0,006	0,012	0,009	0,002	0,010	0,006	0,011	0,026	0,012	0,008	0,01	0,005	-	0,009	0,01	
12) Other causes	0,487	0,522	0,457	0,503	0,488	0,473	0,477	0,354	0,414	0,396	0,429	0,402	0,532	0,632	0,96	0,99	0,52	0,32	0,40	
TOTAL	13,721	14,007	13,819	14,109	14,539	14,499	14,999	15,133	14,598	14,599	15,540	16,096	15,798	14,886	15,31	16,19	15,40	14,69	14,16	
BELGIUM	1958	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977
1) Falls of ground	5,911	4,294	4,324	4,071	4,439	4,432	4,417	3,574	3,568	3,850	3,676	5,075	4,673	3,989	4,6	4,02	3,99	2,79	2,77	
2) Haulage and transport	4,132	2,979	2,709	2,770	3,331	3,565	3,419	2,866	3,269	2,960	3,220	3,169	3,018	3,365	2,8	3,33	2,43	2,39	2,98	
3) Movement of personnel	1,354	0,998	1,008	1,062	1,136	1,066	0,961	0,771	0,936	0,903	1,122	1,186	1,144	1,496	1,3	1,41	1,70	1,29	1,06	
4) Machinery, handling of tools and supports	2,804	2,085	2,386	2,097	2,461	2,414	2,310	2,126	2,146	2,265	1,903	2,353	1,801	2,469	1,7	2,58	2,18	1,66	1,81	
5) Falling objects	0,414	0,371	0,354	0,301	0,445	0,547	0,397	0,292	0,349	0,459	0,358	1,244	1,242	1,870	1,5	1,44	1,84	1,46	1,63	
6) Explosives	0,027	0,007	0,032	0,018	-	0,019	0,018	-	0,013	0,056	0,049	-	-	0,025	0,03	-	-	-	0,03	
7) Explosions of firedamp or coal dust	-	-	-	-	-	-	0,009	0,031	-	-	-	0,019	-	-	-	-	-	-	-	
8) Sudden outbursts of firedamp, suffocation by natural gases	0,011	-	-	-	-	-	-	-	0,013	-	-	-	-	-	-	-	-	-	-	
9) Underground combustion and fires	-	-	-	-	-	-	-	0,021	-	-	-	-	-	-	-	-	-	-	-	
10) Inrushes of water	-	-	-	-	0,010	-	-	-	-	-	-	-	-	0,025	-	-	-	-	-	
11) Electricity	0,011	-	0,016	0,018	0,010	0,009	-	0,010	0,015	-	0,016	0,019	-	-	-	0,03	0,03	0,03	-	
12) Other causes	0,260	0,255	0,260	0,301	0,351	0,198	0,268	0,333	0,362	0,278	0,228	0,175	0,195	0,324	0,2	0,36	0,41	0,06	0,17	
TOTAL	14,924	10,989	11,089	10,638	12,161	12,250	11,799	10,024	10,669	10,771	10,572	13,240	12,097	13,563	12,13	13,16	12,61	9,71	10,47	

A. Comparative Table of numbers of persons incapacitated
by underground accidents for eight weeks or longer
years 1958-1976 per '000,000 man-hours (frequency)

FRANCE.*	1958	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977
1) Falls of ground	5,027	4,665	4,744	4,416	4,222	4,177	4,308	3,941	3,927	3,634	4,162	4,044	3,761	3,721	3,79	4,38	4,52	3,75	3,82	
2) Haulage and transport	1,980	1,695	1,920	2,106	2,196	2,364	2,278	2,153	1,858	1,918	1,946	1,556	1,666	1,959	1,89	2,37	2,36	2,63	2,53	
3) Movement of personnel	1,505	1,118	2,873	2,334	2,458	2,368	2,383	2,087	2,239	2,174	2,815	3,226	3,372	3,667	4,51	4,79	4,11	4,29	4,81	
4) Machinery, handling of tools and supports	0,914	1,022	1,621	2,523	2,991	3,096	3,042	2,272	2,639	2,773	3,016	3,070	3,332	2,373	2,63	2,84	2,98	2,94	3,17	
5) Falling objects	1,890	2,187	1,893	2,292	2,073	2,278	2,074	1,839	1,785	2,114	2,386	2,537	2,515	4,566	4,96	5,00	5,12	4,11	4,11	
6) Explosives	0,043	0,051	0,031	0,017	0,051	0,009	0,013	0,037	0,010	0,011	-	0,050	0,016	-	0,02	-	-	0,03	-	
7) Explosions of firedamp or coal dust	0,047	0,088	-	-	0,004	-	-	-	0,029	-	-	-	0,087	-	-	-	0,08	-	-	
8) Sudden outbursts of firedamp, suffocation by natural gases	0,004	-	-	-	-	-	-	-	-	0,005	-	-	-	-	-	-	-	0,01	-	
9) Underground combustion and fires	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0,01	0,03	0,01	0,01	
10) Inrushes of water	-	-	-	-	-	-	0,018	-	0,005	-	0,006	-	0,032	-	0,01	0,04	-	-	-	
11) Electricity	0,014	-	0,004	0,029	0,004	0,014	0,009	0,014	-	0,005	0,006	0,014	0,024	0,009	0,01	-	9,01	0,03	0,03	
12) Other causes	2,956	2,768	0,793	0,362	0,240	0,354	0,227	0,174	0,200	0,185	0,233	0,291	0,294	0,314	0,43	0,67	0,63	0,64	0,49	
TOTAL	14,380	13,594	13,909	14,079	14,239	14,660	14,347	12,517	12,692	12,819	14,570	14,788	15,099	16,609	18,24	20,09	19,85	18,44	18,97	

ITALY[1]	1958	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977
1) Falls of ground	1,355	1,378	1,808	-	0,792	0,366	0,893	5,572	6,360	5,580	0,182	3,656	-	5,958	2,20	-	-	-	-	
2) Haulage and transport	1,335	0,984	1,205	0,676	1,847	1,465	1,787	-	0,707	0,797	0,812	-	-	3,404	-	-	-	-	-	
3) Movement of personnel	0,668	0,394	1,005	1,578	1,056	0,732	1,787	-	0,707	1,594	0,812	1,462	-	1,702	-	3,25	-	-	-	
4) Machinery, handling of tools and supports	1,169	0,984	0,603	0,902	1,584	1,465	3,127	7,164	7,067	13,552	7,304	8,043	6,896	2,553	-	-	-	4,00	-	
5) Falling objects	1,169	1,698	1,808	2,029	2,375	3,296	3,574	0,796	-	6,377	6,493	3,656	-	1,702	-	-	1,64	-	-	
6) Explosives	0,167	-	-	0,225	-	0,366	-	-	-	-	-	-	-	-	-	-	-	-	-	
7) Explosions of firedamp or coal dust	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
8) Sudden outburst of firedamp, suffocation by natural gases	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
9) Underground combustion and fires	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
10) Inrushes of water	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
11) Electricity	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
12) Other causes	0,334	0,591	0,603	0,451	-	-	-	1,592	3,360	3,189	0,812	-	5,172	0,851	-	-	-	-	-	
TOTAL	6,197	6,299	7,032	5,861	7,654	7,690	11,168	15,124	18,201	31,089	17,043	16,817	12,068	16,170	2,20	3,25	1,64	4,00	-	

* Including Provence as from 1970.

1) Production stopped since 1976

A. Comparative Table of numbers of persons incapacitated by underground accidents for eight weeks or longer

years 1958- 1976 per '000,000 man-hours (frequency)

NETHERLANDS[1]	1958	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977
1) Falls of ground	1,326	1,464	1,305	1,829	2,238	1,742	2,017	1,923	1,688	2,466	2,450	2,737	2,634	2,528	2,06	4,219	1,041	-		
2) Haulage and transport	1,511	1,562	1,898	1,924	2,590	1,826	1,952	2,808	2,621	1,866	2,407	2,562	2,634	1,820	2,19	2,443	2,603	-		
3) Movement of personnel	0,324	0,386	0,187	0,514	0,580	0,630	0,472	0,774	0,605	0,766	1,160	1,165	0,905	0,404	1,03	0,888	0,521	-		
4) Machinery, handling of tools and supports	0,617	0,402	0,780	0,915	1,015	1,050	1,094	1,282	2,066	0,833	1,031	1,689	1,894	3,033	1,81	1,554	4,686	-		
5) Falling objects	0,401	0,515	0,492	0,819	0,642	0,630	0,923	0,862	0,958	0,866	1,590	1,106	0,659	1,213	1,55	0,888	1,562	-		
6) Explosives	-	-	-	-	-	-	0,021	-	-	-	-	-	-	-	-	-	-	-		
7) Explosions of firedamp or coal dust	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
8) Sudden outbursts of firedamp, suffocation by natural gases	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
9) Underground combustion and fires	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
10) Inrushes of water	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
11) Electricity	-	-	-	-	0,021	-	0,021	-	-	-	-	-	-	-	-	-	-	-		
12) Other causes	0,262	0,161	0,390	0,210	0,497	0,147	0,129	0,088	0,353	0,700	0,301	0,116	0,165	0,202	0,52	0,666	-	-		
TOTAL	4,441	4,490	5,051	6,212	7,583	6,025	6,629	7,737	8,291	7,497	8,939	9,375	8,891	9,201	9,15	10,659	10,413			

COMMUNITY (IV)	1958	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977
1) Falls of ground	4,846	4,490	4,571	4,434	4,387	4,337	4,509	4,215	4,186	4,060	4,261	4,492	4,135	4,109	4,08	4,29	4,15	3,61	3,48	
2) Haulage and transport	2,602	2,347	2,310	2,371	2,521	2,520	2,346	2,416	2,173	2,037	2,139	2,118	2,016	1,953	1,93	2,11	1,91	2,28	2,14	
3) Movement of personnel	2,003	1,823	2,185	2,185	2,282	2,261	2,326	2,364	2,320	2,354	2,795	3,023	3,084	3,117	3,47	3,88	3,89	3,38	3,62	
4) Machinery, handling of tools and supports	1,098	1,064	1,264	1,423	1,712	1,818	1,848	1,773	1,815	1,790	1,945	1,865	2,011	1,876	1,75	2,01	1,98	2,29	2,15	
5) Falling objects	1,962	2,161	2,105	2,353	2,375	2,406	2,442	2,415	2,362	2,638	2,858	3,185	3,308	3,506	3,62	3,63	3,62	3,08	3,08	
6) Explosives	0,023	0,020	0,017	0,012	0,018	0,010	0,011	0,013	0,007	0,019	0,015	0,019	0,011	0,002	0,008	-	0,01	0,006	0,01	
7) Explosions of firedamp or coal dust	0,017	0,030	0,010	0,001	0,071	0,006	0,001	0,011	0,016	-	0,002	0,004	0,025	0,007	-	-	0,02	-	0,01	
8) Sudden outbursts of firedamp, suffocation by natural gases	0,002	-	-	-	-	-	-	0,002	0,001	0,003	-	-	-	-	-	-	-	0,003	-	
9) Underground combustion and fires	-	-	0,002	0,001	-	-	-	0,002	-	-	0,002	-	-	-	-	0,003	0,01	0,003	0,003	
10) Inrushes of water	0,002	-	-	-	0,001	0,002	0,003	-	0,001	-	0,002	-	0,009	0,002	0,003	0,009	-	-	-	
11) Electricity	0,010	0,008	0,010	0,018	0,007	0,012	0,008	0,006	0,007	0,005	0,010	0,021	0,014	0,007	0,008	0,006	0,01	0,016	0,01	
12) Other causes	0,985	1,012	0,513	0,428	0,404	0,390	0,364	0,289	0,354	0,337	0,341	0,333	0,434	0,509	0,73	0,84	0,53	0,37	0,40	
TOTAL	13,551	12,954	12,986	13,227	13,781	13,781	13,861	13,506	13,242	13,246	14,370	15,160	15,047	15,088	15,60	16,77	16,12	15,05	14,92	

1) Production stopped since 1975

B. Underground accidents resulting in death within eight weeks

years 1958- 1976

per '000,000 man-hours (frequency)

GERMANY	1958	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977
1) Falls of ground	0,268	0,290	0,263	0,216	0,280	0,260	0,200	0,184	0,197	0,206	0,148	0,192	0,113	0,147	0,10	0,08	0,12	0,12	0,06	
2) Haulage and transport	0,179	0,169	0,182	0,196	0,149	0,178	0,300	0,191	0,175	0,150	0,126	0,143	0,128	0,103	0,16	0,13	0,07	0,12	0,10	
3) Movement of personnel	0,094	0,097	0,070	0,086	0,059	0,089	0,071	0,070	0,094	0,076	0,079	0,056	0,058	0,032	0,06	0,06	0,06	0,06	0,07	
4) Machinery, handling of tools and supports	0,010	0,027	0,012	0,027	0,037	0,019	0,028	0,025	0,030	0,020	0,014	0,034	0,031	0,032	0,03	0,02	0,02	0,05	0,03	
5) Falling objects	0,065	0,041	0,039	0,065	0,072	0,072	0,054	0,058	0,048	0,063	0,051	0,049	0,035	0,047	0,06	0,02	0,04	0,05	0,05	
6) Explosives	0,009	0,003	0,003	-	0,004	-	0,002	-	-	-	0,004	-	-	-	-	-	-	-	0,005	
7) Explosions of firedamp or coal dust	0,011	0,012	-	-	0,660	0,002	0,002	0,019	0,056	-	0,061	-	-	0,008	-	-	-	-	0,01	
8) Sudden outbursts of firedamp, suffocation by natural gases	0,005	0,003	0,002	0,004	0,002	-	-	0,002	0,002	0,007	-	0,004	-	0,008	0,004	0,005	-	-	0,01	
9) Underground combustion and fires	-	0,003	-	0,002	-	0,006	0,009	0,005	-	-	-	-	-	-	-	-	-	-	-	
10) Inrushes of water	-	0,003	0,002	-	-	0,004	-	-	-	-	-	-	0,012	-	-	-	-	-	-	
11) Electricity	0,022	0,008	0,002	0,005	0,010	0,002	0,004	0,005	-	0,003	0,004	0,004	0,004	-	0,004	0,005	-	-	0,005	
12) Other causes	0,025	0,025	0,036	0,049	0,049	0,025	0,017	0,023	0,027	0,017	0,022	0,022	0,027	0,083	0,04	0,09	0,03	0,005	0,03	
TOTAL	0,687	0,680	0,611	0,651	1,344	0,657	0,587	0,582	0,629	0,542	0,509	0,504	0,408	0,460	0,46	0,420	0,34	0,41	0,377	

BELGIUM	1958	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977
1) Falls of ground	0,223	0,213	0,299	0,266	0,246	0,264	0,222	0,239	0,324	0,264	0,179	0,214	0,268	0,100	0,08	0,21	0,06	0,03	0,07	
2) Haulage and transport	0,101	0,124	0,157	0,168	0,142	0,245	0,166	0,166	0,187	0,180	0,114	0,097	0,170	0,125	0,18	0,21	0,06	0,16	0,03	
3) Movement of personnel	0,011	0,027	0,008	0,035	0,010	0,057	0,028	0,011	0,025	-	0,033	-	-	0,049	0,03	-	0,03	-	0,07	
4) Machinery, handling of tools and supports	0,005	0,014	0,016	0,027	0,047	-	0,018	0,052	0,025	0,028	0,065	-	-	0,025	-	0,03	-	0,09	0,03	
5) Falling objects	0,016	-	0,008	-	0,010	0,019	0,018	-	-	-	0,016	-	-	-	0,03	-	0,03	-	0,03	
6) Explosives	0,011	0,014	-	-	-	-	-	-	-	-	0,016	-	-	-	-	-	-	-	-	
7) Explosions of firedamp or coal dust	-	-	0,016	-	-	-	-	0,011	-	-	-	-	-	-	-	-	-	-	-	
8) Sudden outbursts of firedamp, suffocation by natural gases	0,016	0,014	-	-	0,047	-	-	0,041	0,013	-	-	-	-	0,025	0,18	0,06	-	-	-	
9) Underground combustion and fires	-	0,007	-	-	-	-	-	0,011	-	-	-	-	-	-	-	-	-	-	-	
10) Inrushes of water	0,011	-	-	0,044	0,047	0,019	-	-	-	-	-	-	-	-	-	-	-	-	-	
11) Electricity	0,021	-	0,024	-	-	0,009	0,009	0,011	-	0,014	0,033	0,019	0,024	-	-	-	-	-	-	
12) Other causes	0,005	-	0,008	0,009	0,019	0,028	0,009	-	0,013	0,042	-	-	-	-	0,03	0,03	-	-	-	
TOTAL	0,420	0,413	0,536	0,549	0,568	0,641	0,471	0,542	0,587	0,528	0,456	0,330	0,462	0,324	0,53	0,54	0,20	0,29	0,24	

B. Underground accidents resulting in death within eight weeks

years 1958-1976

per '000,000 man-hours (frequency)

FRANCE *	1958	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977
1) Falls of ground	0,235	0,192	0,186	0,219	0,167	0,120	0,127	0,164	0,214	0,159	0,177	0,149	0,143	0,117	0,07	0,20	0,11	0,06	0,09	
2) Haulage and transport	0,115	0,085	0,082	0,122	0,077	0,121	0,141	0,052	0,126	0,088	0,101	0,186	0,127	0,108	0,08	0,07	0,12	0,07	0,10	
3) Movement of personnel	0,007	0,018	0,027	0,008	0,043	0,009	0,009	0,042	0,024	0,016	0,025	0,014	0,016	0,072	0,01	0,01	0,01	0,03	0,03	
4) Machinery, handling of tools and supports	0,018	0,040	0,016	0,008	0,030	0,009	0,036	0,009	0,015	0,016	0,006	-	0,032	0,027	-	0,02	0,03	-	0,10	
5) Falling objects	0,025	0,007	0,004	0,017	0,030	0,009	0,018	0,019	0,015	0,011	0,031	0,014	0,016	0,045	-	0,04	0,03	0,03	0,03	
6) Explosives	-	0,026	-	-	-	0,005	0,005	0,009	0,005	0,005	0,006	-	0,108	0,018	-	-	-	-	0,01	
7) Explosions of firedamp or coal dust	0,115	0,121	-	-	0,004	-	-	0,155	-	-	0,038	-	0,127	-	-	-	0,58	-	0,23	
8) Sudden outbursts of firedamp, suffocation by natural gases	0,043	0,026	0,019	0,004	-	0,019	0,009	-	0,005	0,027	0,019	0,007	-	0,072	-	0,01	-	-	-	
9) Underground combustion and fires	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0,01	-	0,01	-	-	
10) Inrushes of water	-	-	-	0,004	-	-	-	0,005	-	0,005	-	-	0,016	-	0,01	-	-	-	-	
11) Electricity	-	0,011	0,012	-	0,009	0,024	-	-	0,010	-	-	0,007	-	-	-	-	-	-	-	
12) Other causes	0,036	0,029	0,008	-	0,009	0,014	0,014	-	0,005	0,005	-	0,007	-	0,009	0,03	-	-	-	-	
TOTAL	0,594	0,555	0,354	0,382	0,369	0,330	0,359	0,455	0,419	0,332	0,403	0,384	0,484	0,468	0,21	0,37	0,89	0,18	0,60	
ITALY[1]	1958	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977
1) Falls of ground	0,167	-	0,201	0,225	-	0,366	-	-	-	-	-	-	-	-	2,20	-	-	-	-	
2) Haulage and transport	-	0,197	-	-	-	-	-	-	-	0,797	-	-	-	-	-	-	-	-	-	
3) Movement of personnel	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
4) Machinery, handling of tools and supports	-	-	-	-	-	-	-	-	-	0,797	-	-	-	-	-	-	-	-	-	
5) Falling objects	-	0,197	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
6) Explosives	0,501	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
7) Explosions of firedamp or coal dust	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
8) Sudden outbursts of firedamp, suffocation by natural gases	0,167	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
9) Underground combustion and fires	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
10) Inrushes of water	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
11) Electricity	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
12) Other causes	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
TOTAL	0,835	0,394	0,201	0,226	-	0,366	-	-	-	1,594	-	-	-	-	2,20	-	-	-	-	

* Including Provence as from 1970.

1) Production stopped since 1976

B. Underground accidents resulting in death within eight weeks

years 1958- 1976

per '000,000 man-hours (frequency)

NETHERLANDS [1]	1958	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977
1) Falls of ground	0,262	0,064	0,034	0,114	0,062	0,084	0,043	0,044	0,050	0,100	0,172	0,058	0,082	0,101	-	-	-	-	-	
2) Haulage and transport	0,077	0,145	0,067	0,095	0,062	0,105	0,172	0,177	0,126	-	0,086	-	0,165	-	0,26	-	-	-	-	
3) Movement of personnel	-	-	-	-	-	-	-	-	-	-	-	0,058	-	-	-	-	-	-	-	
4) Machinery, handling of tools and supports	0,015	0,016	-	-	0,041	-	-	0,022	-	0,067	-	0,117	-	-	-	-	-	-	-	
5) Falling objects	-	0,016	-	-	-	-	0,043	-	-	-	0,043	-	-	-	-	-	0,521	-	-	
6) Explosives	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
7) Explosions of firedamp or coal dust	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
8) Sudden outbursts of firedamp, suffocation by natural gases	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
9) Underground combustion and fires	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
10) Inrushes of water	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
11) Electricity	-	-	-	0,019	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
12) Other causes	-	-	0,017	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
TOTAL	0,355	0,241	0,119	0,229	0,166	0,189	0,258	0,243	0,176	0,167	0,301	0,233	0,247	0,101	0,26	-	0,521			

COMMUNITY	1958	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977
1) Falls of ground	0,253	0,242	0,235	0,217	0,234	0,217	0,175	0,177	0,208	0,192	0,160	0,176	0,135	0,133	0,092	0,13	0,11	0,10	0,07	
2) Haulage and transport	0,147	0,141	0,146	0,168	0,124	0,167	0,178	0,149	0,160	0,128	0,115	0,145	0,132	0,104	0,141	0,12	0,08	0,11	0,09	
3) Movement of personnel	0,057	0,063	0,047	0,056	0,045	0,060	0,045	0,051	0,060	0,044	0,054	0,038	0,039	0,043	0,043	0,04	0,05	0,047	0,06	
4) Machinery, handling of tools and supports	0,011	0,028	0,012	0,021	0,037	0,013	0,030	0,024	0,023	0,024	0,017	0,023	0,027	0,029	0,019	0,02	0,02	0,047	0,05	
5) Falling objects	0,043	0,027	0,024	0,041	0,062	0,046	0,037	0,037	0,030	0,036	0,040	0,031	0,025	0,041	0,038	0,02	0,04	0,038	0,04	
6) Explosives	0,009	0,010	0,002	-	0,002	0,001	0,002	0,002	0,001	0,002	0,006	-	0,002	0,005	-	-	-	-	0,006	
7) Explosions of firedamp or coal dust	0,032	0,036	0,002	-	0,375	0,001	0,001	0,053	0,030	-	0,044	-	0,037	0,005	-	-	0,13	-	0,06	
8) Sudden outbursts of firedamp, suffocation by natural gases	0,016	0,010	0,006	0,003	0,007	0,005	0,002	0,006	0,004	0,012	0,006	0,004	-	0,027	0,022	0,012	-	-	0,006	
9) Underground combustion and fires	-	0,003	-	0,001	-	0,003	0,005	0,005	-	-	-	-	-	-	0,003	-	-	-	-	
10) Inrushes of water	0,002	0,002	0,001	0,006	0,005	0,005	-	0,001	-	0,002	-	-	0,011	-	0,003	0,003	-	-	-	
11) Electricity	0,016	0,007	0,007	0,004	0,008	0,008	0,003	0,004	0,003	0,004	0,006	0,006	0,004	-	0,003	0,003	-	-	0,003	
12) Other causes	0,023	0,021	0,024	0,029	0,032	0,021	0,014	0,013	0,017	0,015	0,012	0,015	0,016	0,053	0,035	0,06	0,02	0,003	0,02	
TOTAL	0,610	0,590	0,507	0,546	0,932	0,547	0,492	0,522	0,536	0,457	0,460	0,438	0,429	0,440	0,399	0,413	0,456	0,35	0,42	

1) Production stopped since 1975

C. Comparative Table of underground group accidents (see (1) below)
years 1960–1976

CAUSES	1960			1961			1962			1963			1964			1965			1966			1967			1968			1969			1970			1971			1972			1973			1974			1975			1976			1977			1978			1979		
	N	a	b	N	a	b	N	a	b	N	a	b	N	a	b	N	a	b	N	a	b	N	a	b	N	a	b	N	a	b	N	a	b	N	a	b	N	a	b	N	a	b	N	a	b	N	a	b	N	a	b	N	a	b	N	a	b
1) Falls of ground	2	2	10	1	-	7	3	3	18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	6	-	-	-	2	-	12	-	-	-	2	-	9	1	1	5	-	-	-									
2) Haulage and transport	-	-	-	-	-	-	-	-	-	-	-	-	2	5	14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-									
3) Movement of personnel	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-									
4) Machinery, handing of tools and supports	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-									
5) Falling objects	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-									
6) Explosives	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-									
7) Explosions of firedamp or coal dust	-	-	-	-	-	-	3	62	338	-	-	-	-	-	-	3	4	41	3	11	21	-	-	-	1	-	17	-	-	-	1	11	16	-	-	-	-	-	-	-	-	-	1	5	42	-	-	-	1	-	18						
8) Sudden outbursts of firedamp, suffocation by natural gases	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	8	-	-	-	-	-	-	-	-	-	-	-	-									
9) Underground combustion and fires	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-									
10) Inrushes of water	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-									
11) Electricity	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-									
12) Ohter causes	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-									
TOTAL	2	2	10	1	-	7	6	65	356	-	-	-	2	5	14	3	4	41	3	11	21	-	-	-	1	-	17	2	-	11	1	11	16	3	-	20	-	-	-	2	-	9	2	6	47	-	-	-									

(1) Accidents involving more than five casualties of type (a).
(N) Number of groups accidents.
(a) Casualties were unable to resume work below ground for at least eight weeks.
(b) Casualties died within eight weeks.

REPARTITION :

I960 - I97I	Germany			Belgium			France			United Kingdom		
	N	a	b	N	a	b	N	a	b	N	a	b
I960	2	2	I0	-	-	-	-	-	-	-	-	-
I96I	-	-	-	-	-	-	1	-	7	-	-	-
I962	4	63	344	1	2	6	1	-	6	-	-	-
I964	2	5	I4	-	-	-	-	-	-	-	-	-
I965	I	4	8	2	-	33	-	-	-	-	-	-
I966	2	5	2I	I	6	-	-	-	-	-	-	-
I968	I	-	I7	-	-	-	-	-	-	-	-	-
I969	-	-	-	-	-	-	2	-	11	-	-	-
I970	-	-	-	-	-	-	1	11	16	-	-	-
I97I	2	-	12	-	-	-	1	-	8	-	-	-

I973 -	Germany			Belgium			France			United Kingdom		
	N	a	b	N	a	b	N	a	b	N	a	b
I973	2	-	9	-	-	-	-	-	-	-	-	-
I974	I	I	5	-	-	-	I	5	42	-	-	-
I976	-	-	-	-	-	-	I	-	I6	-	-	-

D. RECAPITULATION : COMMUNITY OF THE SIX

Year	Extraction (1)	Underground o.m.s. (kg.)	Million man-hours worked	Fatalities	Serious injuries (4) (disablement for 8 weeks or over	Fatalities per m. tons	Serious injuries (4) per m. tons	Fatalities per m. man-hours	Serious injuries per m. man-hours
1958	252 278	1 634	1 260	770	17 074	3,052	67,68	0,610	13,551
1959	240 602	1 788	1 122	622	14 539	2,585	60,43	0,590	12,950
1960	239 967	1 958	1 037	526	13 459	2,192	56,09	0,507	12,986
1961	235 848	2 100	962	527	12 720	2,235	53,93	0,548	13,227
1962	233 233	2 229	901	840 (3) 541 (4)	12 418	3,602 (3) 2,320 (4)	53,24	0,932 (3) 0,600 (4)	13,781
1963	229 769	2 331	849	465	11 686	2,024	50,86	0,547	13,761
1964	235 007	2 395	841	411	11 726	1,749	49,89	0,493	13,860
1965	224 249	2 461	784	410	10 595	1,828	47,25	0,522	13,506
1966	210 189	2 611	698	374	9 247	1,779	43,99	0,536	13,242
1967	189 484	2 824	587	269	7 781	1,420	41,06	0,457	13,246
1968	181 016	3 065	522	240	7 501	1,326	41,44	0,460	14,370
1969	176 749	3 265	476	209	7 222	1,181	40,82	0,438	15,160
1970	170 355	3 442	438	188	6 591	1,104	38,69	0,429	15,047
1971	164 910	3 514	414	182	6 249	1,104	37,89	0,440	15,088
1972	151 809	3 659	369	147	5 763	1,033	26,34	0,399	15,60
1973	139 700	3 755	332	137	5 560	0,981	39,80	0,413	16,77
1974	133 300	3 742	313	143	5 054	1,073	37,91	0,456	16,12
1975	129 100	3 632	319	110	4 795	0,852	37,14	0,35	15,05
1976	125 600	3 710	301	125	4 491	0,995	35,76	0,415	14,92
1977									
1978									

(1) Net extraction, slurry and dust.
(2) Incl. Luisenthal explosion.
(3) Excl. Luisenthal explosion.
(4) Casualties were unable to resume work for at least eight weeks.

UNITED KINGDOM

1973	130 200	3 598	306	74	490	0,568	3,76	0,242	1,60
1974	109 200	3 260	268	37	417	0,339	3,82	0,138	1,555
1975	127 700	3 493	303	55	522	0,431	4,09	0,181	1,722
1976	122 100	3 407	287	45	2 407(1) 444	0,369	19,71(1) 3,64	0,157	8,387 (1) 1,536
1977									
1978									

Note : It is only possible to compare the figgers in table 1 (Community of the Six) with those in table 2, by refering to the explanatory notes in Section IV, paragraphe 4.2.

1) Statistical tables for 1976 following the system of classification used in the Community of Six.

MINES SAFETY AND HEALTH COMMISSION

Common Statistics on victims of accidents underground in coal mines

DETAILED BREAKDOWN OF ACCIDENT VICTIMS ACCORDING TO CAUSE AND SITE OF ACCIDENT AND PERIOD OF INCAPACITY

(absolute figures)

Table 1a

COUNTRY FEDERAL REPUBLIC OF GERMANY
COAL-FIELD

YEAR 1976
MAN-HOURS WORKED (1) 204 101 641

CAUSES OF ACCIDENTS / SITE OF THE ACCIDENT / Period of incapacity	Production faces 1					Headings excluding shafts and staple-pits 2					Shafts and staple-pits 3					Other places 4					Total of accidents underground 5					Group accidents (3) 6		
	4 to 20 days (2)	21 to 56 days (2)	> 56 days (2)	Fatal accidents	total	4 to 20 days (2)	21 to 56 days (2)	> 56 days (2)	Fatal accidents	total	4 to 20 days (2)	21 to 56 days (2)	> 56 days (2)	Fatal accidents	total	4 to 20 days (2)	21 to 56 days (2)	> 56 days (2)	Fatal accidents	total	4 to 20 days (2)	21 to 56 days (2)	> 56 days (2)	Fatal accidents	total	56 days (2)	Fatal accidents	total
I. FALLS OF GROUNDS AND ROCKS	2033	1234	409	7	3683	1389	634	256	5	2284	8	3	4	-	15	239	150	39	1	429	3669	2021	708	13	6411	-	-	-
II. TRANSPORT, TOTAL	165	163	121	2	451	64	50	40	3	157	42	44	47	3	136	252	290	170	12	732	523	547	386	20	1476	-	-	-
a) Continuous Transport	67	80	74	2	223	17	20	15	3	55	3	3	2	-	8	17	11	8	1	37	104	114	99	6	323	-	-	-
b) Discontinuous Transport	98	83	47	-	228	47	30	25	-	102	39	41	45	3	128	235	279	170	11	695	419	433	287	14	1153	-	-	-
III. FALLS AND MOVEMENT OF THE VICTIM, TOTAL	1556	1123	272	3	2954	996	553	147	1	1697	174	168	53	7	402	1214	791	258	3	2296	3940	2635	730	14	7319	-	-	-
a) while moving about the mine	20	14	6	-	40	10	8	2	-	20	6	6	-	1	13	17	14	7	-	38	53	42	15	1	111	-	-	-
b) in the course of other activities	1536	1109	266	3	2914	986	545	145	1	1677	168	162	53	6	389	1197	777	251	3	2228	3887	2593	715	13	7208	-	-	-
IV. MACHINES, TOOLS AND SUPPORTS TOTAL	1060	723	223	6	2012	470	302	94	1	867	38	21	6	-	65	358	210	55	-	623	1926	1256	378	7	3567	-	-	-
a) Machines	166	148	61	3	378	69	53	33	1	156	11	9	4	-	24	62	60	19	-	141	308	270	117	4	699	-	-	-
b) Tools	333	162	32	-	527	244	123	27	-	394	23	11	2	-	36	238	102	19	-	359	838	398	80	-	1316	-	-	-
c) Supports	561	413	130	3	1107	157	126	34	-	317	4	1	-	-	5	58	48	17	-	123	780	588	181	3	1552	-	-	-
V. FALLS OF OBJECTS	1481	976	320	3	2780	643	306	127	1	1077	102	44	24	2	172	628	363	126	4	1121	2854	1689	597	10	5150	-	-	-
VI. EXPLOSIVES	1	-	1	-	2	1	-	2	1	4	-	-	-	-	-	-	-	-	-	-	2	-	3	1	6	-	-	-
VII. IGNITIONS OR EXPLOSIONS OF FIREDAMP AND COAL DUST	-	-	-	-	-	-	1	4	2	7	-	-	-	-	-	-	-	-	-	-	-	1	4	2	7	-	-	-
VIII. OUTBURSTS OF GAS, DE-OXYGENATION, SUFFOCATION OR POISONING BY NATURAL GASES (CO_2, CH_4, CO, H_2S), TOTAL	-	-	-	-	-	1	1	-	2	4	-	-	-	-	-	2	-	-	-	2	3	1	-	2	6	-	-	-
a) Outbursts of Gas	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
b) De-oxygenation and Poisoning by natural Gases	-	-	-	-	-	1	1	-	2	4	-	-	-	-	-	2	-	-	-	2	3	1	-	2	6	-	-	-
IX. HEATINGS OR FIRES	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	1	1	-	-	-	1	-	-	-
X. INRUSHES	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
XI. ELECTRICITY	-	1	-	-	1	3	2	1	-	6	-	-	-	1	1	6	3	1	-	10	9	6	2	1	18	-	-	-
XII. OTHER CAUSES	125	54	25	5	208	73	41	11	1	126	17	8	3	-	28	138	67	43	1	249	352	170	82	7	611	-	-	-
TOTAL	6420	4274	1371	26	2091	3640	1890	682	17	6229	381	288	137	13	819	2838	1874	700	21	5433	13279	8326	2890	77	24572	-	-	-

(1) Number of hours worked by pit staff and employees of contractor firms who belong to a miners' social insurance scheme.
(2) Accidents involving more than five casualties (i.e who either died or were unable to resume work underground for at least eight weeks)
(3) Calendar days

MINES SAFETY AND HEALTH COMMISSION

Common Statistics on victims of accidents underground in coal mines

DETAILED BREAKDOWN OF ACCIDENT VICTIMS ACCORDING TO CAUSE AND SITE OF ACCIDENT AND PERIOD OF INCAPACITY

(frequency rates)

Table 1b

COUNTRY FEDERAL REPUBLIC OF GERMANY
COAL-FIELD

YEAR 1976
MAN-HOURS WORKED (1) 204 101 641

SITE OF THE ACCIDENT / CAUSES OF ACCIDENTS — Period of incapacity	Production faces 1					Headings excluding shafts and staple-pits 2					Shafts and staple-pits 3					Other places 4					Total of accidents underground 5					Group accidents (2) 6		
	4 to 20 days (3)	21 to 56 days (3)	> 56 days (3)	Fatal accidents	total	4 to 20 days (3)	21 to 56 days (3)	> 56 days (3)	Fatal accidents	total	4 to 20 days (3)	21 to 56 days (3)	> 56 days (3)	Fatal accidents	total	4 to 20 days (3)	21 to 56 days (3)	> 56 days (3)	Fatal accidents	total	4 to 20 days (3)	21 to 56 days (3)	> 56 days (3)	Fatal accidents	total	56 days (3)	Fatal accidents	total
I. FALLS OF GROUNDS AND ROCKS	9,96	6,05	2,00	0,03	18,04	6,81	3,11	1,25	0,02	11,19	0,04	0,01	0,02	-	0,07	1,17	0,73	0,19	-	2,10	17,98	9,90	3,47	0,06	31,41	-	-	-
II. TRANSPORT, TOTAL	0,81	0,80	0,59	0,01	2,21	0,31	0,24	0,20	0,01	0,77	0,21	0,22	0,23	0,01	0,67	1,23	1,42	0,87	0,06	3,59	2,56	2,68	1,89	0,10	7,23	-	-	-
a) Continuous Transport	0,33	0,39	0,36	0,01	1,09	0,08	0,10	0,07	0,01	0,27	0,01	0,01	0,01	-	0,04	0,08	0,05	0,04	-	0,18	0,51	0,56	0,49	0,03	1,59	-	-	-
b) Discontinuous Transport	0,48	0,41	0,23	-	1,12	0,23	0,15	0,12	-	0,50	0,19	0,20	0,22	0,01	0,63	1,15	1,3	0,83	0,05	3,41	2,05	2,12	1,41	0,07	5,65	-	-	-
III. FALLS AND MOVEMENT OF THE VICTIM, TOTAL	7,62	5,50	1,33	0,01	14,47	4,88	2,71	0,72	-	8,31	0,85	0,32	0,26	0,03	1,97	5,95	3,88	1,26	0,01	11,10	19,30	12,91	3,58	0,07	35,86	-	-	-
a) while moving about the mine	0,10	0,07	0,03	-	0,20	0,05	0,04	0,01	-	0,10	0,03	0,03	*	-	0,06	0,08	0,07	0,03	-	0,19	0,26	0,21	0,07	-	0,54	-	-	-
b) in the course of other activities	7,52	5,43	1,30	0,01	14,28	9,83	2,67	0,71	*	8,22	0,82	0,79	0,26	0,03	1,91	5,86	3,81	1,23	0,01	10,92	19,04	12,70	3,50	0,06	35,32	-	-	-
IV. MACHINES, TOOLS AND SUPPORTS TOTAL	5,19	3,54	1,09	0,03	9,86	2,30	1,48	0,46	-	4,25	0,19	0,10	0,03	-	0,32	1,75	1,03	0,27	*	3,05	9,44	6,15	1,85	0,03	17,48	*	-	-
a) Machines	0,81	0,73	0,30	0,01	1,85	0,34	0,26	0,16	-	0,76	0,05	0,04	0,02	-	0,12	0,30	0,29	0,09	*	0,69	1,51	1,32	0,57	0,02	3,42	-	-	-
b) Tools	1,63	0,79	0,16	-	2,58	1,20	0,60	0,13	-	1,93	0,11	0,05	0,01	-	0,18	1,17	0,50	0,09	-	1,76	4,11	1,95	0,39	-	6,45	-	-	-
c) Supports	2,75	2,02	0,64	0,01	5,42	0,77	0,62	0,17	-	1,55	0,02	-		-	0,02	0,28	0,24	0,08	*	0,60	3,82	2,88	0,89	0,01	7,60	-	-	-
V. FALLS OF OBJECTS	7,26	4,78	1,57	1,01	13,62	3,15	1,50	0,62	-	5,28	0,50	0,22	-	0,01	0,84	3,08	1,78	0,62	0,02	5,49	13,98	8,28	2,93	0,05	25,23	*	-	-
VI. EXPLOSIVES	-	-	-	-	0,01	-	-	0,01	-	0,02	-	-	0,12	-	-	-	-	-	-	-	0,01	-	0,01	-	0,03	-	-	-
VII. IGNITIONS OR EXPLOSIONS OF FIREDAMP AND COAL DUST	-	-	-	-	-	-	-	0,02	0,01	0,03	-	-	-	-	-	-	-	-	-	-	-	-	0,02	0,01	0,03	-	-	-
VIII. OUTBURSTS OF GAS, DE-OXYGENATION, SUFFOCATION OR POISONING BY NATURAL GASES (CO_2, CH_4, CO, H_2S), TOTAL	-	-	-	-	-	-	-	-	0,01	0,02	-	-	-	-	-	0,01	-	-	-	0,01	0,01	-	-	0,01	0,03	-	-	-
a) Outbursts of Gas	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
b) De-oxygenation and Poisoning by natural Gases	-	-	-	-	-	-	-	-	0,01	0,02	-	-	-	-	-	0,01	-	-	-	0,01	0,01	*	-	0,01	0,03	-	-	-
IX. HEATINGS OR FIRES	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
X. INRUSHES	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
XI. ELECTRICITY	-	-	-	-	-	0,01	0,01	-	-	0,03	-	-	-	-	-	0,03	0,01	-	-	0,05	0,04	0,03	0,01	-	0,09	-	-	-
XII. OTHER CAUSES	0,61	0,26	0,12	0,02	1,02	0,36	0,20	0,05	-	0,62	0,08	0,04	0,01	-	0,14	0,68	0,33	0,21	*	1,22	1,72	0,83	0,40	0,03	2,99	-	-	-
TOTAL	13,45	20,94	6,72	0,13	59,24	17,83	9,26	3,34	0,08	30,52	1,87	1,41	0,67	0,06	4,01	13,90	9,18	3,43	0,10	26,62	65,06	40,79	14,16	0,38	20,39	-	-	-

(1) Number of hours worked by pit staff and employees of contractor firms who belong to a miners' social insurance scheme.
(2) Accidents involving more than five casualties (i.e. who either died or were unable to resume work underground for at least eight weeks).
(3) Calendar days.

MINES AFETY AND HEALTH COMMISSION

Common Statistics on victims of accidents underground in coal mines

Table 2a

DETAILED BREAKDOWN OF VICTIMS ACCORDING TO LOCATION AND NATURE OF INJURY AND PERIOD OF INCAPACITY

(absolute figures)

COUNTRY FEDERAL REPUBLIC OF GERMANY
COAL-FIELD

YEAR 1976
MAN-HOURS WORKED (1) 204 101 641

NATURE OF THE INJURY	Amputations and enucleations 1			Fractures with or without dislocation 2			Luxations, twist and sprains 3			Concussion and internal injury 4			Open wounds contusion and muscular abrasions 5			Burns and harmful effects of electricity and radiation 6			Poisoning and suffocation 7			Multiple injuries of those not specified (2) 8			TOTAL 9				
PERIOD OF INCAPACITY	> 56 days (5)	Fatal accidents	total	> 56 days (5)	Fatal accidents	total	> 56 days (5)	Fatal accidents	total	> 56 days (5)	Fatal accidents	total	> 56 days (5)	Fatal accidents	total	> 56 days (5)	Fatal accidents	total	> 56 days (5)	Fatal accidents	total	> 56 days (5)	Fatal accidents	total	4 to 20 days (5)	21 to 56 days (5)	> 56 days (5)	Fatal accidents	total
LOCATION OF THE INJURY																													
I. Head and neck	-	-	0,01	0,24	0,12	1,24	0,01	-	0,08	0,11	-	0,69	0,37	0,01	11,21	-	-	0,07				-	-	0,05	0,54	2,94	0,73	0,14	13,36
II. Eyes	-	-	0,01							0,01	-	0,01	0,24	-	3,13	0,02	-	0,24				-	-	0,07	2,69	0,49	0,27	-	3,45
III. Trunk	-	-	-	0,79	0,05	2,15	0,03	-	0,53	0,01	-	0,05	0,29	0,02	7,17	0,01	-	0,15				-	-	0,13	5,37	3,58	1,14	0,09	10,18
IV. Upper limbs (excluding the hands) (3)	0,01	-	0,01	0,75	-	1,39	0,08	-	0,76				0,45	-	11,64	0,03	-	0,21				-	-	0,06	9,29	3,45	1,32	-	14,07
V. Hands	0,30	-	0,64	2,78	-	13,08	0,20	-	1,10				1,47	-	30,76	0,02	-	0,18				-	-	0,05	21,77	19,45	4,78	-	46,00
VI. Lower limbs (excluding feet) (4)	0,02	-	0,02	1,69	0,01	2,08	0,48	-	2,20				1,06	-	11,80	0,01	-	0,16				0,05	-	0,12	8,00	5,06	3,31	0,01	16,38
VII. Feet	0,02	-	0,05	1,44	-	3,79	0,32	-	3,55				0,49	-	7,70	-	-	0,04				-	-	0,03	7,66	5,23	2,27	-	15,16
VIII. Multiple locations	-	-	-	0,11	0,04	0,19	0,04	-	0,25	-	0,02	0,04	0,15	0,01	1,18	0,03	0,01	0,09				-	0,03	0,04	0,72	0,59	0,33	0,12	1,76
IX. Not specified																-	-	-	-	0,01	0,02	-	-	-	0,01	-	-	0,01	0,02
TOTAL	0,35	-	0,96	7,80	0,23	23,90	1,17	0,01	8,48	0,14	0,03	0,79	4,51	0,04	84,58	0,13	0,01	1,10	-	0,01	0,02	0,07	0,03	0,56	65,06	40,79	14,16	0,38	120,39

(1) Number of hours worked by pit staff and employees of contractor firms who belong to a miner's social insurance scheme.
(2) Including complications.
(3) The shoulders and the wrists are included under „upper limbs"
(4) The hips and the ankles are included under „Lower limbs"
(5) Calender days.

MINES AFETY AND HEALTH COMMISSION

Common Statistics on victims of accidents underground in coal mines

Table 2b

DETAILED BREAKDOWN OF VICTIMS ACCORDING TO LOCATION AND NATURE OF INJURY AND PERIOD OF INCAPACITY

(Frequency rates)

COUNTRY FEDERAL REPUBLIC OF GERMANY
COAL-FIELD

YEAR 1976
MAN-HOURS WORKED (1) 204 101 641

NATURE OF THE INJURY	Amputations and enucleations 1			Fractures with or without dislocation 2			Luxations, twist and sprains 3			Concussion and internal injury 4			Open wounds contusion and muscular abrasions 5			Burns and harmful effects of electricity and radiation 6			Poisoning and suffocation 7			Multiple injuries of those not specified (2) 8			TOTAL 9				
PERIOD OF INCAPACITY	> 56 days (3)	Fatal accidents	total	> 56 days (3)	Fatal accidents	total	> 56 days (3)	Fatal accidents	total	> 56 days (3)	Fatal accidents	total	> 56 days (3)	Fatal accidents	total	> 56 days (5)	Fatal accidents	total	> 56 days (5)	Fatal accidents	total	> 56 days (5)	Fatal accidents	total	4 to 20 days (3)	21 to 56 days (3)	> 56 days (3)	Fatal accidents	total
LOCATION OF THE INJURY																													
I. Head and neck	-	-	2	48	25	254	3	-	17	23	1	140	75	2	2287	-	-	15				1	-	11	1947	601	150	28	2726
II. Eyes	-	-	2							2	-	2	49	-	638	4	-	48				1	-	15	549	100	56	-	705
III. Trunk	-	-	-	162	10	438	6	1	109	3	1	11	59	5	1463	2	-	30				1	1	27	1097	730	233	18	2078
IV. Upper limbs (excluding the hands) (3)	2	-	3	153	-	283	17	-	156				91	-	2376	6	-	42				1	-	12	1897	705	270	-	2872
V. Hands	61	-	172	568	-	2669	41	-	224				300	-	6278	4	1	36				1	-	10	4444	3969	975	1	9389
VI. Lower limbs (excluding feet) (4)	4	-	4	345	3	424	97	-	449				217	-	2409	3	-	32				9	-	25	1632	1033	675	3	3343
VII. Feet	5	-	11	294	-	773	65	-	725				99	-	1571	1	-	9				-	-	6	1564	1067	464	-	3095
VIII. Multiple locations	-	1	1	22	8	38	9	1	51	-	5	8	30	2	241	6	2	12				-	6	9	147	121	67	25	360
IX. Not specified																-	-	-	-	2	4	-	-	-	2	-	-	2	4
TOTAL	72	1	195	1592	46	4879	238	2	1731	28	7	161	920	9	17263	26	3	224	-	2	4	14	7	115	13279	8326	2890	77	24572

(1) Number of hours worked by pit staff and employees of contractor firms who belong to a miner's social insurance scheme.
(2) Including complications.
(3) The shoulders and the wrists are included under „upper limbs".
(4) The hips and the ankles are included under „Lower limbs".
(5) Calender days.

MINES SAFETY AND HEALTH COMMISSION

Common Statistics on victims of accidents underground in coal mines

DETAILED BREAKDOWN OF ACCIDENT VICTIMS ACCORDING TO CAUSE AND SITE OF ACCIDENT AND PERIOD OF INCAPACITY

(absolute figures)

Table 1a

COUNTRY BELGIUM
COAL-FIELD

YEAR 1976
MAN-HOURS WORKED (1) 28 158 264

CAUSES OF ACCIDENTS / SITE OF THE ACCIDENT / Period of incapacity	Production faces 1					Headings excluding shafts and staple-pits 2					Shafts and staple-pits 3					Other places 4					Total of accidents underground 5					Group accidents (2) 6		
	4 to 20 days (3)	21 to 56 days (3)	> 56 days (3)	Fatal accidents	total	4 to 20 days (3)	21 to 56 days (3)	> 56 days (3)	Fatal accidents	total	4 to 20 days (3)	21 to 56 days (3)	> 56 days (3)	Fatal accidents	total	4 to 20 days (3)	21 to 56 days (3)	> 56 days (3)	Fatal accidents	total	4 to 20 days (3)	21 to 56 days (3)	> 56 days (3)	Fatal accidents	total	56 days (3)	Fatal accidents	total
I. FALLS OF GROUNDS AND ROCKS	2029	276	51	1	2357	764	91	24	1	880	18	2	0	0	20	152	14	3	0	169	2963	383	78	2	3426			
II. TRANSPORT, TOTAL	137	35	13	0	185	242	58	37	0	337	54	18	11	1	84	194	41	23	0	258	627	152	84	1	864			
a) Continuous Transport	129	2	12	0	173	71	22	9	0	102	0	0	0	1	1	40	10	0	0	50	240	64	21	1	326			
b) Discontinuous Transport	8	3	1	0	12	171	36	28	0	235	54	18	11	0	83	154	31	23	0	208	387	88	63	0	538			
III. FALLS AND MOVEMENT OF THE VICTIM, TOTAL	228	30	4	0	262	345	62	11	2	420	87	17	6	0	110	287	61	9	0	357	947	170	30	2	1149			
a) while moving about the mine	33	6	1	0	40	57	13	3	0	73	12	6	2	0	20	56	7	1	0	64	158	32	7	0	197			
b) in the course of other activities	195	24	3	0	222	288	49	8	2	347	75	11	4	0	90	231	54	8	0	293	789	138	23	2	952			
IV. MACHINES, TOOLS AND SUPPORTS TOTAL	807	168	38	1	1014	466	74	8	0	548	34	3	1	0	38	200	24	4	0	228	1507	269	51	1	1828			
a) Machines	54	16	5	0	75	39	11	2	0	52	1	1	0	0	2	15	3	1	0	19	109	31	8	0	148			
b) Tools	171	23	1	0	195	160	15	0	0	175	21	1	1	0	23	72	7	2	0	81	424	46	4	0	474			
c) Supports	582	129	32	1	744	267	48	6	0	321	12	1	0	0	13	113	14	1	0	128	974	192	39	1	1206			
V. FALLS OF OBJECTS	535	89	23	1	648	568	79	13	0	660	72	11	3	0	86	316	64	7	0	387	1491	243	46	1	1781			
VI. EXPLOSIVES	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1			
VII. IGNITIONS OR EXPLOSIONS OF FIREDAMP AND COAL DUST	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1			
VIII. OUTBURSTS OF GAS, DE-OXYGENATION, SUFFOCATION OR POISONING BY NATURAL GASES (CO_2, CH_4, CO, H_2S), TOTAL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0			
a) Outbursts of Gas	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0			
b) De-oxygenation and Poisoning by natural Gases	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0			
IX. HEATINGS OR FIRES	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0			
X. INRUSHES	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0			
XI. ELECTRICITY	1	0	0	0	1	1	0	0	0	1	0	0	0	0	0	3	1	0	0	4	5	1	0	0	6			
XII. OTHER CAUSES	95	9	1	0	105	76	3	2	0	81	14	1	0	0	15	71	8	2	0	81	256	21	5	0	282			
TOTAL	3832	607	130	3	4572	2462	368	96	3	2929	279	52	21	1	353	1223	213	48	0	1484	7796	1240	295	7	9338			

(1) Number of hours worked by pit staff and employees of contractor firms who belong to a miners' social insurance scheme.
(2) Accidents involving more than five casualties (i.e. who either died or were unable to resume work underground for at least eight weeks).
(3) Calendar days.

MINES SAFETY AND HEALTH COMMISSION

Common Statistics on victims of accidents underground in coal mines

DETAILED BREAKDOWN OF ACCIDENT VICTIMS ACCORDING TO CAUSE AND SITE OF ACCIDENT AND PERIOD OF INCAPACITY

(frequency rates)

Table 1b

COUNTRY BELGIUM
COAL-FIELD

YEAR 1976
MAN-HOURS WORKED (1) 28 158 264

CAUSES OF ACCIDENTS / Period of incapacity	Production faces 1					Headings excluding shafts and staple-pits 2					Shafts and staple-pits 3					Other places 4					Total of accidents underground 5					Group accidents (2) 6		
	4 to 20 days (3)	21 to 56 days (3)	> 56 days (3)	Fatal accidents	total	4 to 20 days (3)	21 to 56 days (3)	> 56 days (3)	Fatal accidents	total	4 to 20 days (3)	21 to 56 days (3)	> 56 days (3)	Fatal accidents	total	4 to 20 days (3)	21 to 56 days (3)	> 56 days (3)	Fatal accidents	total	4 to 20 days (3)	21 to 56 days (3)	> 56 days (3)	Fatal accidents	total	56 days (3)	Fatal accidents	total
I. FALLS OF GROUNDS AND ROCKS	72,05	9,80	1,81	0,03	83,70	27,13	3,23	0,85	0,03	31,25	0,63	0,07	0,00	0,00	0,71	5,39	0,49	0,10	0,00	6,00	105,22	13,60	2,77	0,07	121,66			
II. TRANSPORT, TOTAL	4,86	1,24	0,46	0,00	6,57	8,59	2,05	1,31	0,00	11,96	1,91	0,63	0,39	0,03	2,98	6,88	1,45	0,81	0,00	9,16	22,26	5,39	2,98	0,03	30,68			
a) Continuous Transport	4,58	1,13	0,42	0,00	6,14	2,52	0,78	0,31	0,00	3,62	0,00	0,00	0,00	0,03	0,03	1,42	0,35	0,00	0,00	1,77	8,52	2,27	0,74	0,03	11,57			
b) Discontinuous Transport	0,28	0,10	0,03	0,00	0,42	6,07	1,27	0,99	0,00	8,34	1,91	0,63	0,39	0,00	2,94	5,46	1,10	0,81	0,00	7,38	13,74	3,12	2,23	0,00	19,10			
III. FALLS AND MOVEMENT OF THE VICTIM, TOTAL	8,09	1,06	0,14	0,00	9,30	12,25	2,20	0,39	0,07	14,91	3,08	0,60	0,21	0,00	3,90	10,19	2,16	0,31	0,00	12,67	33,63	6,03	1,06	0,07	40,80			
a) while moving about the mine	1,17	0,21	0,03	0,00	1,42	2,02	0,46	0,10	0,00	2,59	0,42	0,21	0,07	0,00	0,71	1,98	0,24	0,03	0,00	2,27	5,61	1,13	0,24	0,00	6,99			
b) in the course of other activities	6,92	0,85	0,10	0,00	7,88	10,22	1,74	0,28	0,07	12,32	2,66	0,39	0,14	0,00	3,19	8,20	1,91	0,28	0,00	10,40	28,02	4,90	0,81	0,07	33,80			
IV. MACHINES, TOOLS AND SUPPORTS TOTAL	28,65	5,96	1,34	0,03	36,01	16,54	2,62	0,28	0,00	19,46	1,20	0,10	0,03	0,00	1,34	7,10	0,85	0,14	0,00	8,09	53,51	9,55	1,81	0,03	64,91			
a) Machines	1,91	0,56	0,17	0,00	2,66	1,38	0,39	0,07	0,00	1,84	0,03	0,03	0,00	0,00	0,07	0,53	0,10	0,03	0,00	0,67	3,87	1,10	0,28	0,00	5,25			
b) Tools	6,07	0,81	0,03	0,00	6,92	5,68	0,53	0,00	0,00	6,21	0,74	0,03	0,03	0,00	0,81	2,55	0,24	0,07	0,00	2,87	15,05	1,63	0,14	0,00	16,83			
c) Supports	20,66	4,58	1,13	0,03	26,42	9,48	1,70	0,21	0,00	11,39	0,42	0,03	0,00	0,00	0,46	4,01	0,49	0,03	0,00	4,54	34,59	6,81	1,38	0,03	42,82			
V. FALLS OF OBJECTS	18,99	3,16	0,81	0,03	23,01	20,17	2,80	0,46	0,00	23,43	2,55	0,39	0,10	0,00	3,05	11,22	2,27	0,24	0,00	13,74	52,95	8,62	1,63	0,03	63,24			
VI. EXPLOSIVES	0	0	0	0	0	0,00	0,00	0,03	0,00	0,03	0	0	0	0	0	0	0	0	0	0	0,00	0,00	0,03	0,00	0,03			
VII. IGNITIONS OR EXPLOSIONS OF FIREDAMP AND COAL DUST	0	0	0	0	0	0,00	0,03	0,00	0,00	0,03	0	0	0	0	0	0	0	0	0	0	0,00	0,03	0,00	0,00	0,03			
VIII. OUTBURSTS OF GAS, DE-OXYGENATION, SUFFOCATION OR POISONING BY NATURAL GASES (CO_2, CH_4, CO, H_2S), TOTAL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0			
a) Outbursts of Gas	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0			
b) De-oxygenation and Poisoning by natural Gases	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0			
IX. HEATINGS OR FIRES	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0			
X. INRUSHES	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0			
XI. ELECTRICITY	0,03	0,00	0,00	0,00	0,03	0,03	0,00	0,00	0,00	0,03	0	0	0	0	0	0,10	0,03	0,00	0,00	0,14	0,17	0,03	0,00	0,00	0,21			
XII. OTHER CAUSES	3,37	0,31	0,03	0,00	3,72	2,69	0,10	0,07	0,00	2,87	0,49	0,03	0,00	0,00	0,53	2,52	0,28	0,07	0,00	2,87	9,09	0,74	0,17	0,00	10,01			
TOTAL	136,08	21,55	4,61	0,10	162,36	87,43	13,06	3,40	0,10	104,01	9,90	1,84	0,74	0,03	12,53	48,43	7,56	1,70	0,00	52,70	276,86	44,03	10,47	0,24	331,62			

(1) Number of hours worked by pit staff and employees of contractor firms who belong to a miners' social insurance scheme.
(2) Accidents involving more than five casualties (i.e. who either died or were unable to resume work underground for at least eight weeks).
(3) Calendar days.

MINES AFETY AND HEALTH COMMISSION

Common Statistics on victims of accidents underground in coal mines

Table 2a

DETAILED BREAKDOWN OF VICTIMS ACCORDING TO LOCATION AND NATURE OF INJURY AND PERIOD OF INCAPACITY

(absolute figures)

COUNTRY BELGIUM
COAL-FIELD

YEAR 1976
MAN-HOURS WORKED (1) 28 158 264

NATURE OF THE INJURY	Amputations and enucleations 1			Fractures with or without dislocation 2			Luxations, twist and sprains 3			Concussion and internal injury 4			Open wounds contusion and muscular abrasions 5			Burns and harmful effects of electricity and radiation 6			Poisoning and suffocation 7			Multiple injuries of those not specified (2) 8			TOTAL 9				
PERIOD OF INCAPACITY	> 56 days (5)	Fatal accidents	total	> 56 days (5)	Fatal accidents	total	> 56 days (5)	Fatal accidents	total	> 56 days (5)	Fatal accidents	total	> 56 days (5)	Fatal accidents	total	> 56 days (5)	Fatal accidents	total	> 56 days (5)	Fatal accidents	total	> 56 days (5)	Fatal accidents	total	4 to 20 days (5)	21 to 56 days (5)	> 56 days (5)	Fatal accidents	total
LOCATION OF THE INJURY																													
I. Head and neck	-	-	-	7	5	12	-	-	-	-	-	-	10	-	10	-	-	-				-	1	1	-	-	17	6	23
II. Eyes	-	-	-							-	-	-	2	-	2	-	-	-				-	-	-	-	-	2	-	2
III. Trunk	-	-	-	18	-	18	1	-	1	-	-	-	9	-	9	-	-	-				2	-	2	-	-	30	-	30
IV. Upper limbs (excluding the hands) (3)	2	-	2	16	-	16	-	-	-				10	-	10	-	-	-				-	-	-	-	-	28	-	28
V. Hands	14	-	14	38	-	38	2	-	2				38	-	38	1	-	1				2	-	2	-	-	95	-	95
VI. Lower limbs (excluding feet) (4)	-	-	-	30	-	30	-	-	-				34	-	34	-	-	-				4	-	4	-	-	68	-	68
VII. Feet	3	-	3	23	-	23	1	-	1				18	-	18	-	-	-				-	-	-	-	-	45	-	45
VIII. Multiple locations	-	-	-	6	-	6	-	-	-	-	-	-	4	-	4	-	-	-				-	1	1	-	-	10	1	11
IX. Not specified																-	-	-	-	-	-	-	-	-	-	-	-	-	-
TOTAL	19	-	19	138	5	143	4	-	4	-	-	-	125	-	125	1	-	1	-	-	-	8	2	10	-	-	295	7	302

(1) Number of hours worked by pit staff and employees of contractor firms who belong to a miner's social insurance scheme.
(2) Including complications.
(3) The shoulders and the wrists are included under „upper limbs".
(4) The hips and the ankles are included under „Lower limbs".
(5) Calender days.

MINES AFETY AND HEALTH COMMISSION

Common Statistics on victims of accidents underground in coal mines

Table 2b

DETAILED BREAKDOWN OF VICTIMS ACCORDING TO LOCATION AND NATURE OF INJURY AND PERIOD OF INCAPACITY

(Frequency rates)

COUNTRY BELGIUM
COAL-FIELD

YEAR 1976
MAN-HOURS WORKED (1) 28 158 264

NATURE OF THE INJURY	Amputations and enucleations 1			Fractures with or without dislocation 2			Luxations, twist and sprains 3			Concussion and internal injury 4			Open wounds contusion and muscular abrasions 5			Burns and harmful effects of electricity and radiation 6			Poisoning and suffocation 7			Multiple injuries of those not specified (2) 8			TOTAL 9				
PERIOD OF INCAPACITY	> 56 days (5)	Fatal accidents	total	> 56 days (5)	Fatal accidents	total	> 56 days (5)	Fatal accidents	total	> 56 days (5)	Fatal accidents	total	> 56 days (5)	Fatal accidents	total	> 56 days (5)	Fatal accidents	total	> 56 days (5)	Fatal accidents	total	> 56 days (5)	Fatal accidents	total	4 to 20 days (5)	21 to 56 days (5)	> 56 days (5)	Fatal accidents	total
LOCATION OF THE INJURY																													
I. Head and neck	0,0	0,0	0,0	0,2	0,1	0,4	0,0	0,0	0,0	0,0	0,0	0,0	0,3	0,0	0,3	0,0	0,0	0,0				0,0	0,0	0,0	0,0	0,0	0,6	0,2	0,8
II. Eyes	0,0	0,0	0,0							0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0				0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
III. Trunk	0,0	0,0	0,0	0,6	0,0	0,6	0,0	0,0	0,0	0,0	0,0	0,0	0,3	0,0	0,3	0,0	0,0	0,0				0,0	0,0	0,0	0,0	0,0	0,1	0,0	1,0
IV. Upper limbs (excluding the hands) (3)	0,0	0,0	0,0	0,5	0,0	0,5	0,0	0,0	0,0				0,3	0,0	0,3	0,0	0,0	0,0				0,0	0,0	0,0	0,9	0,0	0,0	0,0	0,9
V. Hands	0,4	0,0	0,4	1,3	0,0	1,3	0,0	0,0	0,0				1,3	0,0	1,3	0,0	0,0	0,0				0,0	0,0	0,0	0,0	0,0	3,3	0,0	3,3
VI. Lower limbs (excluding feet) (4)	0,0	0,0	0,0	1,0	0,0	1,0	0,0	0,0	0,0				1,2	0,0	1,2	0,0	0,0	0,0				0,1	0,0	0,1	0,0	0,0	2,4	0,0	2,4
VII Feet	0,1	0,0	0,1	0,8	0,0	0,8	0,0	0,0	0,0				0,6	0,0	0,6	0,0	0,0	0,0				0,0	0,0	0,0	0,0	0,0	1,5	0,0	1,5
VIII. Multiple locations	0,0	0,0	0,0	0,2	0,0	0,2	0,0	0,0	0,0	0,0	0,0	0,0	0,1	0,0	0,1	0,0	0,0	0,0				0,0	0,0	0,0	0,0	0,0	0,3	0,0	0,3
IX. Not specified																0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
TOTAL	0,6	0,0	0,6	4,9	0,1	5,0	0,1	0,0	0,1	0,0	0,0	0,0	4,4	0,0	4,4	0,0	0,0	0,0	0,0	0,0	0,0	0,2	0,0	0,3	0,0	0,0	10,4	0,2	10,7

(1) Number of hours worked by pit staff and employees of contractor firms who belong to a miner's social insurance scheme.
(2) Including complications.
(3) The shoulders and the wrists are included under „upper limbs"
(4) The hips and the ankles are included under „Lower limbs".
(5) Calender days.

MINES SAFETY AND HEALTH COMMISSION

Common Statistics on victims of accidents underground in coal mines

DETAILED BREAKDOWN OF ACCIDENT VICTIMS ACCORDING TO CAUSE AND SITE OF ACCIDENT AND PERIOD OF INCAPACITY

(absolute figures)

Table 1a

COUNTRY FRANCE
COAL-FIELD

YEAR 1976
MAN-HOURS WORKED (1) 68 832 991

CAUSES OF ACCIDENTS / SITE OF THE ACCIDENT / Period of incapacity	Production faces 1					Headings excluding shafts and staple-pits 2					Shafts and staple-pits 3					Other places 4					Total of accidents underground 5					Group accidents (2) 6		
	4 to 20 days (3)	21 to 56 days (3)	> 56 days (3)	Fatal accidents	total	4 to 20 days (3)	21 to 56 days (3)	> 56 days (3)	Fatal accidents	total	4 to 20 days (3)	21 to 56 days (3)	> 56 days (3)	Fatal accidents	total	4 to 20 days (3)	21 to 56 days (3)	> 56 days (3)	Fatal accidents	total	4 to 20 days (3)	21 to 56 days (3)	> 56 days (3)	Fatal accidents	total	56 days (3)	Fatal accidents	total
I. FALLS OF GROUNDS AND ROCKS	1398	566	173	3	2140	552	215	66	2	835	7	1	1	0	9	191	73	23	1	288	2148	855	263	6	3272	0	0	0
II. TRANSPORT, TOTAL	108	67	37	1	213	88	38	40	3	169	17	14	7	0	38	180	164	90	3	437	393	283	174	7	857	0	0	0
a) Continuous Transport	59	44	28	0	131	29	9	15	0	53	0	1	0	0	1	24	18	10	0	52	112	72	53	0	237	0	0	0
b) Discontinuous Transport	49	23	9	1	82	59	29	25	3	116	17	13	7	0	37	156	146	80	3	385	281	211	121	7	620	0	0	0
III. FALLS AND MOVEMENT OF THE VICTIM, TOTAL	978	494	102	0	1574	551	267	61	0	879	58	29	11	1	99	859	534	157	1	1551	2446	1324	331	2	4103	0	0	0
a) while moving about the mine	388	163	49	0	600	274	110	28	0	412	43	20	7	1	71	515	303	96	0	914	1220	596	180	1	1997	0	0	0
b) in the course of other activities	590	331	53	0	974	277	157	33	0	467	15	9	4	0	28	344	231	61	1	637	1226	728	151	1	2106	0	0	0
IV. MACHINES, TOOLS AND SUPPORTS TOTAL	1047	449	122	5	1623	466	173	45	1	685	11	16	6	0	33	402	177	48	1	628	1926	818	218	7	2969	0	0	0
a) Machines	89	43	23	5	160	42	17	12	1	72	1	0	4	0	5	40	12	9	1	62	172	75	45	7	299	0	0	0
b) Tools	451	145	41	0	636	278	90	17	0	385	8	10	2	0	20	199	88	15	0	302	936	333	75	0	1344	0	0	0
c) Supports	506	261	58	0	826	146	66	16	0	228	2	6	0	0	8	163	77	24	0	264	818	410	98	0	1326	0	0	0
V. FALLS OF OBJECTS	868	368	109	1	1346	516	181	59	0	756	37	23	6	1	67	676	405	109	0	1190	2097	977	283	2	3359	0	0	0
VI. EXPLOSIVES	1	1	0	1	3	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	2	1	0	1	4	0	0	0
VII. IGNITIONS OR EXPLOSIONS OF FIREDAMP AND COAL DUST	0	1	0	16	17	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	2	0	16	18	0	16	16
VIII. OUTBURSTS OF GAS, DE-OXYGENATION, SUFFOCATION OR POISONING BY NATURAL GASES (CO_2, CH_4, CO, H_2S), TOTAL	0	0	0	0	0	2	0	0	0	2	0	0	0	0	0	4	0	0	0	4	6	0	0	0	6	0	0	0
a) Outbursts of Gas	0	0	0	0	0	2	0	0	0	2	0	0	0	0	0	0	0	0	0	0	2	0	0	0	2	0	0	0
b) De-oxygenation and Poisoning by natural Gases	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	4	4	0	0	0	4	0	0	0
IX. HEATINGS OR FIRES	9	2	0	0	11	3	0	0	0	3	1	0	1	0	2	6	0	0	0	6	19	2	1	0	22	0	0	0
X. INRUSHES	4	0	0	0	4	1	0	0	0	1	0	0	0	0	0	1	0	0	0	1	6	0	0	0	6	0	0	0
XI. ELECTRICITY	0	0	1	0	1	0	2	0	0	2	3	0	0	0	3	2	2	1	0	5	5	4	2	0	11	0	0	0
XII. OTHER CAUSES	158	29	11	0	198	137	18	5	0	160	23	9	4	0	36	202	35	14	0	251	520	91	34	0	645	0	0	0
TOTAL	4571	1977	555	27	7130	2317	894	276	6	3493	157	92	36	2	287	2523	1391	442	6	4362	9568	4357	1306	41	15272	0	16	16

(1) Number of hours worked by pit staff and employees of contractor firms who belong to a miners' social insurance scheme
(2) Accidents involving more than five casualties (i.e. who either died or were unable to resume work underground for at least eight weeks)
(3) Calendar days.

MINES SAFETY AND HEALTH COMMISSION

Common Statistics on victims of accidents underground in coal mines

DETAILED BREAKDOWN OF ACCIDENT VICTIMS ACCORDING TO CAUSE AND SITE OF ACCIDENT AND PERIOD OF INCAPACITY

(frequency rates)

Table 1b

COUNTRY FRANCE
COAL-FIELD

YEAR 1976
MAN-HOURS WORKED (1) 68 832 991

CAUSES OF ACCIDENTS / Period of incapacity	Production faces 1					Headings excluding shafts and staple-pits. 2					Shafts and staple-pits 3					Other places 4					Total of accidents underground 5					Group accidents (3) 6		
	4 to 20 days (3)	21 to 56 days (3)	> 56 days (3)	Fatal accidents	total	4 to 20 days (3)	21 to 56 days (3)	> 56 days (3)	Fatal accidents	total	4 to 20 days (3)	21 to 56 days (3)	> 56 days (3)	Fatal accidents	total	4 to 20 days (3)	21 to 56 days (3)	> 56 days (3)	Fatal accidents	total	4 to 20 days (3)	21 to 56 days (3)	> 56 days (3)	Fatal accidents	total	56 days (3)	Fatal accidents	total
I. FALLS OF GROUNDS AND ROCKS	20,31	8,22	2,51	0,04	31,09	8,02	3,12	0,96	0,03	12,13	0,10	0,01	0,01	0,00	0,13	2.77	1,06	0,33	0,01	4,18	31,21	12,42	3,82	0,09	47,54	0,00	0,00	0,00
II. TRANSPORT, TOTAL	1,57	0,97	0,54	0,01	3,09	1,28	0,55	0,58	0,04	2,46	0,25	0,20	0,10	0,00	0,55	2,62	2,39	1,31	0,04	6,35	5,71	4,11	2,53	0,10	12,45	0,00	0,00	0,00
a) Continuous Transport	0,86	0,64	0,41	0,00	1,90	0,42	0,13	0,22	0;00	0,77	0,00	0,01	0,00	0,00	0,01	0,35	0,26	0,15	0,00	0,76	1,63	1,05	0,77	0,00	3,44	0,00	0,00	0,00
b) Discontinuous Transport	0,71	0,33	0,13	0,01	1,19	0,86	0,42	0,36	0,04	1,69	0,25	0,19	0,10	0,00	0,54	2,27	2,12	1,16	0,04	5.59	4,08	3,07	1,76	0,10	9,01	0,00	0,00	0,00
III. FALLS AND MOVEMENT OF THE VICTIM, TOTAL	4,21	7,18	1,48	0,00	22,87	8,00	3,88	0,89	0,00	12,77	0,84	0,42	0,16	0,01	1,44	12,48	7,76	2,28	0,01	22,53	35,54	19.23	4,81	0,03	59,61	0,00	0,00	0,00
a) while moving about the mine	5.64	2,37	0,71	0,00	8,72	3,98	1,60	0,41	0,00	5,99	0,62	0,29	0,10	0,01	1,03	7,48	4,40	1,39	0,00	13,28	17,72	8.66	2,62	0,01	29,01	0,00	0,00	0,00
b) in the course of other activities	8.57	4,81	0,77	0,00	14,15	4,02	2,28	0,48	0,00	6,78	0,22	0,13	0,06	0,00	0,41	5,00	3,36	0,89	0,01	9,25	17,81	10,58	2,19	0,01	30,60	0,00	0,00	0,00
IV. MACHINES, TOOLS AND SUPPORTS TOTAL	15,21	6,52	1,77	0,07	23,58	6,77	2,51	0,65	0,01	9,85	0,16	0,23	0,09	0,00	0,48	5,84	2,57	0,70	0,01	9,12	27,98	11,88	3,17	0,10	43,13	0,00	0,00	0,00
a) Machines	1,29	0,62	0,33	0,07	2,32	0,61	0,25	0,17	0,01	1,05	0,01	0,00	0,06	0,00	0,07	0,58	0,17	0,13	0,01	0,90	2,50	1,09	0,65	0,10	4,34	0,00	0,00	0,00
b) Tools	6,55	2,11	0,60	0,00	9,24	4,04	1,31	0,25	0,00	5,59	0,12	0,15	0,03	0,00	0,29	2,89	1,28	0,22	0,00	4,39	13,60	4,84	1,09	0,00	19,53	0,00	0,00	0,00
c) Supports	7,35	3,79	0,84	0,00	12,00	2,12	0,96	0,23	0,00	3,31	0,03	0,09	0,00	0,00	0,12	2,37	1,12	0,35	0,00	3,84	11,88	5,96	1,42	0,00	19,26,	0,00	0,00	0,00
V FALLS OF OBJECTS	12,61	5,35	1,58	0,01	19,55	7,50	2,63	0,86	0,00	10,98	0,54	0,33	0,09	0,01	0,97	9,82	5,88	1,58	0,00	17,29	30,47	14,19	4,11	0,03	48,80	0,00	0,00	0,00
VI. EXPLOSIVES	0,01	0,01	0,00	0,01	0,04	0,01	0,00	0,00	0,00	0,01	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,03	0,01	0,00	0,01	0,06	0,00	0,00	0,00
VII. IGNITIONS OR EXPLOSIONS OF FIREDAMP AND COAL DUST	0,00	0,01	0,00	0,23	0,25	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,01	0,00	0,03	0,00	0,23	0,26	0,00	0,23	0,23
VIII. OUTBURSTS OF GAS, DE-OXYGENATION, SUFFOCATION OR POISONING BY NATURAL GASES (CO_2, CH_4, CO, H_2S), TOTAL	0,00	0,00	0,00	0,00	0,00	0,03	0,00	0,00	0,00	0,03	0,00	0,00	0,00	0,00	0,00	0,06	0,00	0,00	0,00	0,06	0,09	0,00	0,00	0,00	0,09	0,00	0,00	0,00
a) Outbursts of Gas	0,00	0,00	0,00	0,00	0,00	0,03	0,00	0,00	0,00	0,03	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,03	0,00	0,00	0,00	0,03	0,00	0,00	0,00
b) De-oxygenation and Poisoning by natural Gases	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,06	0,06	0,00	0,00	0,00	0,06	0,00	0,00	0,00
IX. HEATINGS OR FIRES	0,13	0,03	0,00	0,00	0,16	0,04	0,00	0,00	0,00	0,04	0,01	0,00	0,01	0,00	0,03	0,09	0,00	0,00	0,00	0,09	0,28	0,03	0,01	0,00	0,32	0,00	0,00	0,00
X INRUSHES	0,06	0,00	0,00	0,00	0,06	0,01	0,00	0,00	0,00	0,01	0,00	0,00	0,00	0,00	0,00	0,01	0,00	0,00	0,00	0,01	0,09	0,00	0,00	0,00	0,09	0,00	0,00	0,00
XI. ELECTRICITY	0,00	0,00	0,01	0,00	0,01	0,00	0,03	0,00	0,00	0,03	0,04	0,00	0,00	0,00	0,04	0,03	0,03	0,01	0,00	0,07	0,07	0,06	0,03	0,00	0,16	0,00	0,00	0,00
XII. OTHER CAUSES	2,30	0,42	0,16	0,00	2,88	1,99	0,26	0,07	0,00	2,32	0,33	0,13	0,06	0,00	0,52	2,93	0,51	0,20	0,00	3,65	7,55	1,32	0,49	0,00	9,37	0,00	0,00	0,00
TOTAL	66,41	28,72	8,06	0,39	3,58	33,66	12,99	4,01	0,09	50,75	2,28	1,34	0,52	0,03	4,17	36,65	20,21	6,42	0,09	63,37	139,00	63,30	18,97	0,60	221,87	0,00	0,00	0,00

(1) Number of hours worked by pit staff and employees of contractor firms who belong to a miners' social insurance scheme.
(2) Accidents involving more than five casualties (i e who either died or were unable to resume work underground for at least eight weeks)
(3) Calendar days

MINES AFETY AND HEALTH COMMISSION

Common Statistics on victims of accidents underground in coal mines

Table 2a

DETAILED BREAKDOWN OF VICTIMS ACCORDING TO LOCATION AND NATURE OF INJURY AND PERIOD OF INCAPACITY

(absolute figures)

COUNTRY FRANCE
COAL-FIELD

YEAR 1976
MAN-HOURS WORKED (1) 68 832 991

NATURE OF THE INJURY	Amputations and enucleations 1			Fractures with or without dislocation 2			Luxations, twist and sprains 3			Concussion and internal injury 4			Open wounds contusion and muscular abrasions 5			Burns and harmful effects of electricity and radiation 6			Poisoning and suffocation 7			Multiple injuries of those not specified (2) 8			TOTAL 9				
PERIOD OF INCAPACITY	> 56 days (5)	Fatal accidents	total	> 56 days (5)	Fatal accidents	total	> 56 days (5)	Fatal accidents	total	> 56 days (5)	Fatal accidents	total	> 56 days (5)	Fatal accidents	total	> 56 days (5)	Fatal accidents	total	> 56 days (5)	Fatal accidents	total	> 56 days (5)	Fatal accidents	total	4 to 20 days (6)	21 to 56 days (5)	> 56 days (5)	Fatal accidents	total
LOCATION OF THE INJURY																													
I. Head and neck	1	0	1	21	7	28	0	0	0	3	0	3	40	1	41	0	0	0				1	0	1	847	218	66	8	1140
II. Eyes	0	0	0							1	0	1	15	0	15	0	0	0				0	0	0	815	47	16	0	878
III. Trunk	0	0	0	32	3	35	51	0	51	6	1	7	36	1	37	0	0	0				3	0	3	1315	771	129	5	2219
IV. Upper limbs (excluding the hands) (3)	2	0	2	53	0	53	17	0	17				58	0	58	0	0	0				6	0	6	1255	379	136	0	1770
V. Hands	34	0	34	215	0	215	5	0	5				124	0	124	0	0	0				0	0	0	2652	1548	378	0	4578
VI. Lower limbs (excluding feet) (4)	3	0	3	142	0	142	71	0	71				160	0	160	1	0	1				4	0	4	1498	778	381	0	2657
VII. Feet	3	0	3	92	0	92	4	0	4				35	0	35	0	0	0				0	0	0	788	403	134	0	1325
VIII. Multiple locations	0	0	0	8	5	13	0	0	0	1	0	1	28	1	29	0	16	16				22	5	27	367	196	59	27	649
IX. Not specified																6	0	6	1	0	1	1	0	1	31	17	8	0	56
TOTAL	43	0	43	563	15	578	148	0	148	11	1	12	496	3	499	7	16	23	1	0	1	37	5	42	9568	4357	1306	40	15272

(1) Number of hours worked by pit staff and employees of contractor firms who belong to a miner's social insurance scheme.
(2) including complications.
(3) The shoulders and the wrists are included under „upper limbs".
(4) The hips and the ankles are included under „Lower limbs".
(5) Calender days.

MINES AFETY AND HEALTH COMMISSION

Common Statistics on victims of accidents underground in coal mines

Table 2b

DETAILED BREAKDOWN OF VICTIMS ACCORDING TO LOCATION AND NATURE OF INJURY AND PERIOD OF INCAPACITY

(Frequency rates)

COUNTRY FRANCE
COAL-FIELD

YEAR 1976
MAN-HOURS WORKED (1) 68 832 991

NATURE OF THE INJURY	Amputations and enucleations 1			Fractures with or without dislocation 2			Luxations, twist and sprains 3			Concussion and internal injury 4			Open wounds contusion and muscular abrasions 5			Burns and harmful effects of electricity and radiation 6			Poisoning and suffocation 7			Multiple injuries of those not specified (2) 8			TOTAL 9				
PERIOD OF INCAPACITY	> 56 days (3)	Fatal accidents	total	> 56 days (3)	Fatal accidents	total	> 56 days (3)	Fatal accidents	total	> 56 days (3)	Fatal accidents	total	> 56 days (3)	Fatal accidents	total	> 56 days (5)	Fatal accidents	total	> 56 days (5)	Fatal accidents	total	> 56 days (5)	Fatal accidents	total	4 to 20 days (3)	21 to 56 days (3)	> 56 days (3)	Fatal accidents	total
LOCATION OF THE INJURY																													
I. Head and neck	0,01	0,00	0,01	0,31	0,10	0,39	0,00	0,00	0,00	0,04	0,00	0,04	0,58	0,01	0,58	0,00	0,00	0,00				0,01	0,00	0,00	12,31	3,17	0,96	0,13	16,56
II. Eyes	0,00	0,00	0,00							0,01	0,00	0,01	0,22	0,00	0,19	0,00	0,00	0,00				0,00	0,00	0,00	11,84	0,68	0,23	0,00	12,76
III. Trunk	0,00	0,00	0,00	0,46	0,04	0,48	0,74	0,00	0,73	0,09	0,01	0,09	0,52	0,01	0,49	0,00	0,00	0,00				0,04	0,00	0,04	19,10	11,20	1,86	0,07	32,24
IV. Upper limbs (excluding the hands) (3)	0,03	0,00	0,03	0,77	0,00	0,73	0,25	0,00	0,25				0,84	0,00	0,77	0,00	0,00	0,00				0,09	0,00	0,09	18,23	5,51	1,98	0,00	25,71
V. Hands	0,49	0,00	0,45	3,12	0,00	2,93	0,07	0,00	0,07				1,80	0,00	0,76	0,00	0,00	0,00				0,00	0,00	0,00	38,53	22,49	5,49	0,00	66,51
VI. Lower limbs (excluding feet) (4)	0,04	0,00	0,03	2,06	0,00	1,93	1,03	0,00	1,00				2,32	0,00	2,27	0,01	0,00	0,00				0,06	0,00	0,06	21,76	11,50	5,54	0,00	38,60
VII. Feet	0,04	0,00	0,04	1,34	0,00	1,28	0,06	0,00	0,06				0,51	0,00	0,46	0,00	0,00	0,00				0,00	0,00	0,00	11,45	5,85	1,95	0,00	19,25
VIII. Multiple locations	0,00	0,00	0,00	0,12	0,07	0,19	0,00	0,00	0,00	0,01	0,00	0,00	0,41	0,01	0,42	0,00	0,23	0,23				0,32	0,07	0,33	5,33	2,85	0,86	0,39	9,43
IX. Not specified																0,00	0,00	0,00	0,01	0,00	0,01	0,01	0,00	0,01	0,45	0,25	0,12	0,00	0,81
TOTAL	0,62	0,00	0,57	8,18	0,22	7,93	2,15	0,00	2,11	0,16	0,01	0,15	7,29	0,04	7,03	0,01	0,23	0,23	0,01	0,00	0,01	0,54	0,07	0,54	139,00	63,30	8,97	0,60	221,87

(1) Number of hours worked by pit staff and employees of contractor firms who belong to a miner's social insurance scheme.
(2) Including complications.
(3) The shoulders and the wrists are included under „upper limbs".
(4) The hips and the ankles are included under „Lower limbs".
(5) Calender days.

MINES SAFETY AND HEALTH COMMISSION

Common Statistics on victims of accidents underground in coal mines

DETAILED BREAKDOWN OF ACCIDENT VICTIMS ACCORDING TO CAUSE AND SITE OF ACCIDENT AND PERIOD OF INCAPACITY

(absolute figures)

Table 1a

COUNTRY UNITED KINGDOM
COAL-FIELD

YEAR 31.12.76
MAN-HOURS WORKED (1) 286 504 770

SITE OF THE ACCIDENT / Period of incapacity / CAUSES OF ACCIDENTS	Production faces 1					Headings excluding shafts and staple-pits 2					Shafts and staple-pits 3					Other places 4					Total of accidents underground 5					Group accidents (2) 6		
	4 to 20 days (3)	21 to 56 days (3)	> 56 days (3)	Fatal accidents	total	4 to 20 days (3)	21 to 56 days (3)	> 56 days (3)	Fatal accidents	total	4 to 20 days (3)	21 to 56 days (3)	> 56 days (3)	Fatal accidents	total	4 to 20 days (3)	21 to 56 days (3)	> 56 days (3)	Fatal accidents	total	4 to 20 days (3)	21 to 56 days (3)	> 56 days (3)	Fatal accidents	total	56 days (3)	Fatal accidents	total
I. FALLS OF GROUNDS AND ROCKS	3043	1121	224	12	4400	725	260	64	1	1050	1	1	0	0	2	725	265	66	1	1057	4494	1647	354	14	6 509			
II. TRANSPORT, TOTAL	1148	480	131	4	1763	299	113	32	1	445	23	14	12	0	49	2598	1118	344	12	4072	4068	1725	519	17	6 329			
a) Continuous Transport	76	47	24	1	148	26	18	8	1	53	0	0	0	0	0	165	80	25	0	270	267	145	57	2	471			
b) Discontinuous Transport	1072	433	107	3	1615	273	95	24	0	392	23	14	12	0	49	2433	1038	319	12	3802	3801	1580	462	15	5 858			
III. FALLS AND MOVEMENT OF THE VICTIM, TOTAL	1221	486	91	0	1798	663	240	59	0	962	0	0	0	0	0	5452	2105	490	6	8053	7336	2831	640	6	10 813			
a) while moving about the mine	309	123	17	0	449	170	63	14	0	247	0	0	0	0	0	2793	1059	240	1	4093	3272	1245	271	1	4 789			
b) in the course of other activities	912	363	74	0	1349	493	177	45	0	715	0	0	0	0	0	2659	1046	250	5	3690	4064	1586	369	5	6 024			
IV. MACHINES, TOOLS AND SUPPORTS TOTAL	2434	718	176	1	3329	650	238	37	2	927	9	5	0	0	14	1819	607	101	0	2527	4912	1568	314	3	6 797			
a) Machines	400	128	38	1	567	67	30	6	2	105	0	0	0	0	0	130	43	7	0	180	597	201	51	3	852			
b) Tools	200	49	14	0	263	53	21	3	0	77	4	1	0	0	5	342	135	16	0	493	599	206	33	0	838			
c) Supports	1834	541	124	0	2499	530	187	28	0	745	5	4	0	0	9	1347	429	78	0	1854	3716	1161	230	0	5 107			
V. FALLS OF OBJECTS	1539	621	121	0	2281	366	140	17	0	523	8	2	0	0	10	1272	508	100	0	1880	3185	1271	238	0	4 694			
VI. EXPLOSIVES	39	6	2	1	48	6	1	2	0	9	0	0	0	0	0	30	9	0	0	39	75	16	4	1	96			
VII. IGNITIONS OR EXPLOSIONS OF FIREDAMP AND COAL DUST	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0			
VIII. OUTBURSTS OF GAS, DE-OXYGENATION, SUFFOCATION OR POISONING BY NATURAL GASES (CO_2, CH_4, CO, H_2S), TOTAL	2	0	0	0	2	0	0	0	0	0	0	0	0	0	0	2	1	0	0	3	4	1	0	0	5			
a) Outbursts of Gas	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	2	2	0	0	0	2			
b) De-oxygenation and Poisoning by natural Gases																					2	1			3			
IX. HEATINGS OR FIRES	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	2	2	0	0	0	2			
X. INRUSHES	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	1	1	0	0	2			
XI. ELECTRICITY	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	7	2	2	2	13	8	2	2	2	14			
XII. OTHER CAUSES	1052	384	80	0	1516	417	177	35	0	629	29	6	1	1	37	3086	1186	220	1	4493	4584	1753	336	2	6 675			
TOTAL	10479	3817	825	18	15139	3126	1169	246	4	4545	70	28	13	1	112	14994	5801	1323	22	22140	28669	10815	2407	45	41 936			

(1) Number of hours worked by pit staff and employees of contractor firms who belong to a miners' social insurance scheme.
(2) Accidents involving more than five casualties (i.e. who either died or were unable to resume work underground for at least eight weeks).
(3) Calendar days.

MINES SAFETY AND HEALTH COMMISSION

Common Statistics on victims of accidents underground in coal mines

DETAILED BREAKDOWN OF ACCIDENT VICTIMS ACCORDING TO CAUSE AND SITE OF ACCIDENT AND PERIOD OF INCAPACITY

(frequency rates)

Table 1b

COUNTRY UNITED-KINGDOM
COAL-FIELD

YEAR 31.12.1976
MAN-HOURS WORKED (1) 286 504 770

CAUSES OF ACCIDENTS / SITE OF THE ACCIDENT / Period of incapacity	Production faces 1					Headings excluding shafts and staple-pits 2					Shafts and staple-pits 3					Other places 4					Total of accidents underground 5					Group accidents (2) 6		
	4 to 20 days (3)	21 to 56 days (3)	> 56 days (3)	Fatal accidents	total	4 to 20 days (3)	21 to 56 days (3)	> 56 days (3)	Fatal accidents	total	4 to 20 days (3)	21 to 56 days (3)	> 56 days (3)	Fatal accidents	total	4 to 20 days (3)	21 to 56 days (3)	> 56 days (3)	Fatal accidents	total	4 to 20 days (3)	21 to 56 days (3)	> 56 days (3)	Fatal accidents	total	56 days (3)	Fatal accidents	total
I. FALLS OF GROUNDS AND ROCKS	10.62	3.91	0.78	0.04	15.35	2.53	0.90	0.22	0.00	3.66	0.00	0.00	0.00	0.00	0.00	2.53	0.92	0.23	0.00	3.68	15.68	5.74	1.23	0.04	22.71			
II. TRANSPORT, TOTAL	4.00	1.67	0.45	0.01	6.15	1.04	0.39	0.11	0.00	1.55	0.08	0.04	0.04	0.00	0.17	9.06	3.90	1.20	0.04	14.21	14.19	6.02	1.81	0.05	22.09			
a) Continuous Transport	0.26	0.16	0.08	0.00	0.51	0.09	0.06	0.02	0.00	0.18	0.00	0.00	0.00	0.00	0.00	0.57	0.27	0.08	0.00	0.94	0.93	0.50	0.19	0.00	1.64			
b) Discontinuous Transport	3,74	1.51	0.37	0.01	5.63	0.95	0.33	0.08	0.00	1.36	0.08	0.04	0.04	0.00	0.17	8.49	3.62	1.11	0.04	13.27	13.26	5.51	1.61	0.05	20.44			
III. FALLS AND MOVEMENT OF THE VICTIM, TOTAL	4.26	1.69	0.31	0.00	6.27	2.31	0.83	0.20	0.00	3.35	0.00	0.00	0.00	0.00	0.00	19.02	7.34	1.71	0.02	28.10	25.60	9.88	2.23	0.02	37.73			
a) while moving about the mine	1.07	0.42	0.05	0.00	1.56	0.59	0.21	0.04	0.00	0.86	0.00	0.00	0.00	0.00	0.00	9.74	3.69	0.83	0.00	14.28	11.41	4.34	0.94	0.00	16.71			
b) in the course of other activities	3.18	1.26	0.25	0.00	4.70	1.72	0.61	0.15	0.00	2.49	0.00	0.00	0.00	0.00	0.00	9.27	3.65	0.87	0.01	13.82	14.18	5.53	1.28	0.01	21.02			
IV. MACHINES, TOOLS AND SUPPORTS TOTAL	8.49	2.50	0.61	0.00	11.61	2.26	0.83	0.12	0.00	3.23	0.03	0.01	0.00	0.00	0.04	6.34	2.11	0.35	0.00	8.81	17.14	5.47	1.09	0.01	23.72			
a) Machines	1.39	0.44	0.13	0.00	1.97	0.23	0.10	0.02	0.00	0.36	0.00	0.00	0.00	0.00	0.00	0.45	0.15	0.02	0.00	0.62	2.08	0.70	0.17	0.01	2.97			
b) Tools	0.69	0.17	0.04	0.00	0.91	0.18	0.07	0.01	0.00	0.26	0.01	0.00	0.00	0.00	0.01	1.19	0.47	0.05	0.00	1.72	2.09	0.71	0.11	0.00	2.92			
c) Supports	6.40	1.88	0.43	0.00	8.72	1.84	0.65	0.09	0.00	2.60	0.01	0,01	0.00	0.00	0.03	4.70	1.49	0.27	0.00	6.47	12.96	4.05	0.80	0.00	17.82			
V. FALLS OF OBJECTS	5.37	2.16	0.42	0.00	7.96	1.27	0.48	0.05	0.00	1.82	0.02	0.00	0.00	0.00	0.03	4.43	1.77	0.34	0.00	6.56	11.11	4.43	0.83	0.00	16.38			
VI. EXPLOSIVES	0.13	0.02	0.00	0.00	0.16	0.02	0.00	0.00	0.00	0.03	0.00	0.00	0.00	0.00	0.00	0.10	0.03	0.00	0.00	0.13	0.26	0.05	0.01	0.00	0.33			
VII. IGNITIONS OR EXPLOSIONS OF FIREDAMP AND COAL DUST	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00			
VIII. OUTBURSTS OF GAS, DE-OXYGENATION, SUFFOCATION OR POISONING BY NATURAL GASES (CO_2, CH_4, CO, H_2S), TOTAL	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.00	0.00	0.00	0.01			
a) Outbursts of Gas																												
b) De-oxygenation and Poisoning by natural Gases																												
IX. HEATINGS OR FIRES	0.00	0.00	0.00	0.00	0,00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00			
X. INRUSHES	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00			
XI. ELECTRICITY	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.04	0.02	0.00	0.00	0.00	0.04			
XII. OTHER CAUSES	3.67	1.34	0.27	0.00	5.29	1.45	0.61	0.12	0.00	2.19	0.10	0.02	0.00	0.00	0.12	10.77	4.13	0.76	0.00	15.68	15.99	6.11	1.17	0.00	23.29			
TOTAL	36.57	13.32	2.87	0.06	52.83	10.90	4.07	0.85	0.01	15.86	0.24	0.09	0.04	0.00	0.39	52.32	20.24	4.61	0.07	77.26	100.05	37.74	8.40	0.15	146.35			

(1) Number of hours worked by pit staff and employees of contractor firms who belong to a miners' social insurance scheme.
(2) Accidents involving more than five casualties (i.e. who either died or were unable to resume work underground for at least eight weeks).
(3) Calendar days.

MINES AFETY AND HEALTH COMMISSION

Common Statistics on victims of accidents underground in coal mines

Table 2a

DETAILED BREAKDOWN OF VICTIMS ACCORDING TO LOCATION AND NATURE OF INJURY AND PERIOD OF INCAPACITY

(absolute figures)

COUNTRY UNITED-KINGDOM

COAL-FIELD

YEAR 31.12.1976

MAN-HOURS WORKED (1) 286 504 770

NATURE OF THE INJURY	Amputations and enucleations 1			Fractures with or without dislocation 2			Luxations, twist and sprains 3			Concussion and internal injury 4			Open wounds contusion and muscular abrasions 5			Burns and harmful effects of electricity and radiation 6			Poisoning and suffocation 7			Multiple injuries of those not specified (2) 8			TOTAL 9				
PERIOD OF INCAPACITY	> 56 days (5)	Fatal accidents	total	> 56 days (5)	Fatal accidents	total	> 56 days (5)	Fatal accidents	total	> 56 days (5)	Fatal accidents	total	> 56 days (5)	Fatal accidents	total	> 56 days (5)	Fatal accidents	total	> 56 days (5)	Fatal accidents	total	> 56 days (5)	Fatal accidents	total	4 to 20 days (5)	21 to 56 days (5)	> 56 days (5)	Fatal accidents	total
LOCATION OF THE INJURY																													
I. Head and neck	0	0	0	7	7	53	14	1	190	0	0	0	68	0	1916	0	0	4				0	1	3	1625	443	89	9	2166
II. Eyes	0	0	0							0	0	0	20	0	730	1	0	7				17	0	738	1255	182	38	0	1475
III. Trunk	0	0	0	24	0	70	380	2	7133	0	0	0	111	0	2661	1	0	8				1	4	9	6764	2594	517	6	9881
IV. Upper limbs (excluding the hands) (3)	3	0	5	54	0	138	41	0	852				92	0	2283	0	0	10				1	0	10	2369	738	191	0	3298
V. Hands	32	0	82	66	0	477	12	0	288				326	0	8713	2	2	22				2	0	33	6330	2843	440	2	9615
VI. Lower limbs (excluding feet) (4)	4	0	4	162	0	239	262	0	3862				232	0	4905	1	0	10				3	1	20	6148	2227	664	1	9040
VII. Feet	6	0	10	37	0	168	8	0	222				98	0	2322	0	0	2				0	0	5	1815	765	149	0	2729
VIII. Multiple locations	2	0	5	28	2	75	95	0	1144	0	0	0	153	1	2123	2	0	9				4	2	16	2279	804	284	5	3372
IX. Not specified																14	0	65	0	8	10	21	14	285	227	76	35	22	360
TOTAL	47	0	106	378	9	1220	812	3	13691	0	0	0	1100	1	25633	21	2	137	0	8	10	49	22	1119	28669	10815	2407	45	41936

(1) Number of hours worked by pit staff and employees of contractor firms who belong to a miner's social insurance scheme.
(2) Including complications.
(3) The shoulders and the wrists are included under „upper limbs".
(4) The hips and the ankles are included under „Lower limbs".
(5) Calender days.

MINES AFETY AND HEALTH COMMISSION

Common Statistics on victims of accidents underground in coal mines

Table 2b

DETAILED BREAKDOWN OF VICTIMS ACCORDING TO LOCATION AND NATURE OF INJURY AND PERIOD OF INCAPACITY

(Frequency rates)

COUNTRY UNITED-KINGDOM
COAL-FIELD

YEAR 31.12.1976
MAN-HOURS WORKED (1) 286 504 770

NATURE OF THE INJURY	Amputations and enucleations 1			Fractures with or without dislocation 2			Luxations, twist and sprains 3			Concussion and internal injury 4			Open wounds contusion and muscular abrasions 5			Burns and harmful effects of electricity and radiation 6			Poisoning and suffocation 7			Multiple injuries of those not specified (2) 8			TOTAL 9				
PERIOD OF INCAPACITY	> 56 days (3)	Fatal accidents	total	> 56 days (3)	Fatal accidents	total	> 56 days (3)	Fatal accidents	total	> 56 days (3)	Fatal accidents	total	> 56 days (3)	Fatal accidents	total	> 56 days (5)	Fatal accidents	total	> 56 days (5)	Fatal accidents	total	> 56 days (5)	Fatal accidents	total	4 to 20 days (3)	21 to 56 days (3)	> 56 days (3)	Fatal accidents	total
LOCATION OF THE INJURY																													
I. Head and neck	0,00	0,00	0,00	0,02	0,02	0,18	0,04	0,00	0,66	0,00	0,00	0,00	0,23	0,00	6,68	0,00	0,00	0,01				0,00	0,00	0,01	5,67	1,54	0,31	0,03	7,55
II. Eyes	0,00	0,00	0,00							0,00	0,00	0,00	0,06	0,00	2,54	0,00	0,00	0,02				0,05	0,00	2,57	4,37	0,63	0,13	0,00	5,14
III. Trunk	0,00	0,00	0,00	0,08	0,00	0,24	1,32	0,00	24,89	0,00	0,00	0,00	0,38	0,00	9,28	0,00	0,00	0,02				0,00	0,01	0,03	23,60	9,05	1,80	0,02	34,48
IV. Upper limbs (excluding the hands) (4)	0,01	0,00	0,01	0,18	0,00	0,48	0,14	0,00	2,97				0,32	0,00	7,96	0,00	0,00	0,03				0,00	0,00	0,03	8,26	2,57	0,66	0,00	11,51
V. Hands	0,11	0,00	0,28	0,23	0,00	1,66	0,04	0,00	1,00				1,13	0,00	30,40	0,00	0,00	0,07				0,00	0,00	0,11	22,09	9,92	1,53	0,00	33,55
VI. Lower limbs (excluding feet) (5)	0,01	0,00	0,01	0,56	0,00	0,83	0,91	0,00	13,47				0,80	0,00	17,11	0,00	0,00	0,03				0,01	0,00	0,06	21,45	7,77	2,31	0,00	31,54
VII. Feet	0,02	0,00	0,03	0,12	0,00	0,58	0,02	0,00	0,77				0,34	0,00	8,10	0,00	0,00	0,00				0,00	0,00	0,01	6,33	2,66	0,52	0,00	9,52
VIII. Multiple locations	0,00	0,00	0,01	0,09	0,00	0,26	0,33	0,00	3,99	0,00	0,00	0,00	0,53	0,00	7,40	0,00	0,00	0,03				0,01	0,00	0,05	7,95	2,80	0,99	0,01	11,76
IX. Not specified																0,04	0,00	0,22	0,00	0,02	0,03	0,07	0,04	0,99	0,79	0,26	0,12	0,07	1,25
TOTAL	0,16	0,00	0,36	1,31	0,03	4,25	2,83	0,01	47,78	0,00	0,00	0,00	3,83	0,00	89,52	0,07	0,00	0,47	0,00	0,02	0,03	0,17	0,07	3,90	100,05	37,74	8,40	0,15	146,35

(1) Number of hours worked by pit staff and employees of contractor firms who belong to a miner's social insurance scheme.
(2) Including complications.
(3) The shoulders and the wrists are included under „upper limbs".
(4) The hips and the ankles are included under „Lower limbs".
(5) Calender days.

MINES SAFETY AND HEALTH COMMISSION

Common Statistics on victims of accidents underground in coal mines

DETAILED BREAKDOWN OF ACCIDENT VICTIMS ACCORDING TO CAUSE AND SITE OF ACCIDENT AND PERIOD OF INCAPACITY

(absolute figures)

Table 1a

COUNTRY COMMUNITY (VI)
COAL-FIELD

YEAR 1976
MAN-HOURS WORKED (1) 301 092 896

CAUSES OF ACCIDENTS / SITE OF THE ACCIDENT / Period of incapacity	Production faces 1					Headings excluding shafts and staple-pits 2					Shafts and staple-pits 3					Other places 4					Total of accidents underground 5					Group accidents (2) 6		
	4 to 20 days (3)	21 to 56 days (3)	> 56 days (3)	Fatal accidents	total	4 to 20 days (3)	21 to 56 days (3)	> 56 days (3)	Fatal accidents	total	4 to 20 days (3)	21 to 56 days (3)	> 56 days (3)	Fatal accidents	total	4 to 20 days (3)	21 to 56 days (3)	> 56 days (3)	Fatal accidents	total	4 to 20 days (3)	21 to 56 days (3)	> 56 days (3)	Fatal accidents	total	56 days (3)	Fatal accidents	total
I. FALLS OF GROUNDS AND ROCKS	5460	2076	633	11	8180	2705	940	346	8	3999	33	6	5	-	44	582	237	65	2	886	8780	3259	1049	21	13 109			
II. TRANSPORT, TOTAL	410	265	171	3	849	394	146	117	6	663	113	76	65	4	258	626	495	291	15	1427	1543	982	644	28	3 197			
a) Continuous Transport	255	156	114	2	527	117	51	39	3	210	3	4	2	1	10	81	39	18	1	139	456	250	173	7	886			
b) Discontinuous Transport	155	109	57	1	322	277	95	78	3	453	110	72	63	3	248	545	456	273	14	1288	1087	732	471	21	2 311			
III. FALLS AND MOVEMENT OF THE VICTIM, TOTAL	2762	1647	378	3	4790	1892	882	219	3	2996	319	214	70	8	611	2360	1386	424	4	4174	7333	4129	1091	18	12 571			
a) while moving about the mine	441	183	56	-	680	341	131	33	-	505	61	32	9	2	104	588	324	104	-	1016	1431	670	202	2	2 305			
b) in the course of other activities	2321	1464	322	3	4110	1551	751	186	3	2491	258	182	61	6	507	1772	1062	320	4	3158	5902	3459	889	16	10 266			
IV. MACHINES, TOOLS AND SUPPORTS TOTAL	2914	1340	383	12	4649	1402	549	147	2	2100	83	40	13	-	136	960	411	107	1	1479	5359	2343	647	15	8 364			
a) Machines	309	207	89	8	613	150	81	47	2	280	13	10	8	-	31	117	75	29	1	222	589	376	170	11	1 146			
b) Tools	955	330	74	-	1358	682	228	44	-	954	52	22	5	-	79	509	197	36	-	742	2198	777	159	-	3 134			
c) Supports	1649	803	220	4	2677	570	240	56	-	866	18	8	-	-	26	334	139	42	-	515	2572	1190	318	4	4 084			
V. FALLS OF OBJECTS	2884	1433	452	5	4774	1727	566	199	1	2493	211	78	33	3	325	1620	832	242	4	2698	6442	2909	926	13	10 290			
VI. EXPLOSIVES	2	1	1	1	5	2	-	3	1	6	-	-	-	-	-	-	-	-	-	-	4	1	4	2	11			
VII. IGNITIONS OR EXPLOSIONS OF FIREDAMP AND COAL DUST	-	1	-	16	17	-	2	4	2	8	-	-	-	-	-	-	1	-	-	1	-	4	4	18	26	-	16	16
VIII. OUTBURSTS OF GAS, DE-OXYGENATION, SUFFOCATION OR POISONING BY NATURAL GASES (CO_2, CH_4, CO, H_2S), TOTAL	-	-	-	-	-	3	1	-	2	6	-	-	-	-	-	6	-	-	-	6	9	1	-	2	12			
a) Outbursts of Gas	-	-	-	-	-	2	-	-	-	2	-	-	-	-	-	-	-	-	-	-	2	-	-	-	2			
b) De-oxygenation and Poisoning by natural Gases	-	-	-	-	-	1	1	-	2	4	-	-	-	-	-	6	-	-	-	6	7	1	-	2	10			
IX. HEATINGS OR FIRES	9	2	-	-	11	3	-	-	-	3	1	-	1	-	2	7	-	-	-	7	20	2	1	-	23			
X. INRUSHES	4	-	-	-	4	1	-	-	-	1	-	-	-	-	-	1	-	-	-	1	6	-	-	-	6			
XI. ELECTRICITY	1	1	1	-	3	4	4	1	-	9	3	-	-	1	4	11	6	2	-	19	19	11	4	1	35			
XII OTHER CAUSES	377	92	37	5	511	286	62	18	1	367	54	18	7	-	79	411	110	59	1	581	1128	282	121	7	1 538			
TOTAL	14823	6858	2056	56	23793	8419	3152	1054	26	12651	817	432	194	16	1459	6584	3478	1190	27	11279	30643	13923	4491	125	49 182	-	16	16

(1) Number of hours worked by pit staff and employees of contractor firms who belong to a miners' social insurance scheme.
(2) Accidents involving more than five casualties (i e who either died or were unable to resume work underground for at least eight weeks).
(3) Calendar days

MINES SAFETY AND HEALTH COMMISSION

Common Statistics on victims of accidents underground in coal mines

DETAILED BREAKDOWN OF ACCIDENT VICTIMS ACCORDING TO CAUSE AND SITE OF ACCIDENT AND PERIOD OF INCAPACITY

(frequency rates)

Table 1b

COUNTRY COMMUNITY (VI)
COAL-FIELD

YEAR 1976
MAN-HOURS WORKED (1) 301 092 896

CAUSES OF ACCIDENTS / SITE OF THE ACCIDENT / Period of incapacity	Production faces 1					Headings excluding shafts and staple-pits 2					Shafts and staple-pits 3					Other places 4					Total of accidents underground 5					Group accidents (2) 6		
	4 to 20 days (3)	21 to 56 days (3)	> 56 days (3)	Fatal accidents	total	4 to 20 days (3)	21 to 56 days (3)	> 56 days (3)	Fatal accidents	total	4 to 20 days (3)	21 to 56 days (3)	> 56 days (3)	Fatal accidents	total	4 to 20 days (3)	21 to 56 days (3)	> 56 days (3)	Fatal accidents	total	4 to 20 days (3)	21 to 56 days (3)	> 56 days (3)	Fatal accidents	total	56 days (3)	Fatal accidents	total
I. FALLS OF GROUNDS AND ROCKS	18,13	6,89	2,10	0,04	27,17	8,98	3,12	1,15	0,03	13,28	0,11	0,02	0,02	-	0,15	1,93	0,79	0,22	0,006	2,94	29,16	10,82	3,48	0,07	43,54			
II. TRANSPORT, TOTAL	1,36	0,88	0,57	0,01	2,82	1,31	0,48	0,39	0,02	2,20	0,38	0,25	0,22	0,01	0,86	2,08	1,64	0,97	0,05	4,74	5,12	3,26	2,14	0,09	10,62			
a) Continuous Transport	0,85	0,52	0,38	0,006	1,75	0,39	0,17	0,13	0,01	0,70	0,01	0,01	0,006	0,003	0,03	0,27	0,13	0,06	0,003	0,46	1,51	0,83	0,57	0,02	2,94			
b) Discontinuous Transport	0,51	0,36	0,19	0,003	1,07	0,92	0,31	0,26	0,01	1,50	0,37	0,24	0,21	0,01	0,82	1,81	1,51	0,91	0,05	4,28	3,61	2,43	1,56	0,07	7,68			
III. FALLS AND MOVEMENT OF THE VICTIM, TOTAL	9,17	5,47	1,26	0,01	15,91	6,28	2,93	0,73	0,01	9,95	1,06	0,71	0,23	0,03	2,03	7,84	4,60	1,41	0,01	13,86	24,35	13,71	3,62	0,06	41,75			
a) while moving about the mine	1,46	0,61	0,19	-	2,26	1,13	0,44	0,11	-	1,68	0,20	0,11	0,03	0,006	0,35	1,95	1,08	0,35	-	3,37	4,75	2,23	0,67	0,006	7,66			
b) in the course of other activities	7,71	4,86	1,07	0,01	13,65	5,15	2,49	0,62	0,01	8,27	0,86	0,60	0,20	0,02	1,68	5,89	3,52	1,06	0,01	10,49	19,60	11,48	2,95	0,05	34,09			
IV. MACHINES, TOOLS AND SUPPORTS TOTAL	9,68	4,45	1,27	0,04	15,44	4,66	1,82	0,49	0,006	6,97	0,28	0,13	0,04	-	0,45	3,19	1,37	0,36	0,003	4,91	17,80	7,78	2,15	0,05	27,78			
a) Machines	1,03	0,69	0,30	0,03	2,04	0,50	0,27	0,16	0,006	0,93	0,04	0,03	0,03	-	0,10	0,39	0,25	0,10	0,003	0,74	1,96	1,25	0,56	0,04	3,81			
b) Tools	3,17	1,10	0,25	-	4,51	2,27	0,76	0,15	-	3,17	0,17	0,07	0,02	-	0,26	1,69	0,65	0,12	-	2,46	7,30	2,58	0,53	-	10,41			
c) Supports	5,48	2,66	0,73	0,01	8,89	1,89	0,80	0,18	-	2,87	0,06	0,03	-	-	0,09	1,11	0,46	0,14	-	1,71	8,54	3,95	1,06	0,01	13,56			
V. FALLS OF OBJECTS	9,58	4,65	1,50	0,02	15,86	5,74	1,88	0,66	0,003	8,28	0,70	0,26	0,11	0,009	1,08	5,38	2,76	0,80	0,01	8,96	21,40	9,66	3,08	0,04	34,18			
VI. EXPLOSIVES	0,006	0,003	0,003	0,003	0,02	0,006	-	0,009	0,003	0,02	-	-	-	-	-	-	-	-	-	-	0,01	0,003	0,01	0,006	0,04			
VII. IGNITIONS OR EXPLOSIONS OF FIREDAMP AND COAL DUST	-	0,003	-	0,05	0,06	-	0,006	0,01	0,006	0,03	-	-	-	-	-	-	0,03	-	-	0,003	-	0,01	0,01	0,06	0,09	-	0,05	0,05
VIII. OUTBURSTS OF GAS, DE-OXYGENATION, SUFFOCATION OR POISONING BY NATURAL GASES (CO_2, CH_4, CO, H_2S), TOTAL	-	-	-	-	-	0,009	0,003	-	0,006	0,02	-	-	-	-	-	0,02	-	-	-	0,02	0,03	0,003	-	0,006	0,04			
a) Outbursts of Gas	-	-	-	-	-	0,006	-	-	-	0,006	-	-	-	-	-	-	-	-	-	-	0,006	-	-	-	0,006			
b) De-oxygenation and Poisoning by natural Gases	-	-	-	-	-	0,003	0,003	-	0,006	0,01	-	-	-	-	-	0,02	-	-	-	0,02	0,02	0,003	-	0,006	0,03			
IX. HEATINGS OR FIRES	0,03	0,006	-	-	0,04	0,009	-	-	-	0,009	0,003	-	0,003	-	0,006	0,02	-	-	-	0,02	0,07	0,006	0,003	-	0,08			
X. INRUSHES	0,01	-	-	-	0,01	0,003	-	-	-	0,003	-	-	-	-	-	0,003	-	-	-	0,003	0,02	-	-	-	0,02			
XI. ELECTRICITY	0,003	0,003	0,003	-	0,009	0,01	0,01	0,003	-	0,03	0,009	-	-	0,003	0,01	0,04	0,02	0,006	-	0,06	0,06	0,04	0,01	0,003	0,12			
XII. OTHER CAUSES	1,25	0,31	0,12	0,02	1,70	0,95	0,21	0,06	0,003	1,22	0,18	0,06	0,02	-	0,26	1,37	0,37	0,20	0,003	1,93	3,75	0,94	0,40	0,02	5,11			
TOTAL	49,23	22,78	6,83	0,19	79,02	27,96	10,47	3,50	0,09	42,02	2,71	1,43	0,64	0,05	4,85	21,87	11,55	3,95	0,09	37,46	101,77	46,24	14,92	0,42	163,34	--	0,05	0,05

(1) Number of hours worked by pit staff and employees of contractor firms who belong to a miners' social insurance scheme.
(2) Accidents involving more than five casualties (i.e. who either died or were unable to resume work underground for at least eight weeks).
(3) Calendar days

MINES AFETY AND HEALTH COMMISSION

Common Statistics on victims of accidents underground in coal mines

Table 2a

DETAILED BREAKDOWN OF VICTIMS ACCORDING TO LOCATION AND NATURE OF INJURY AND PERIOD OF INCAPACITY

(absolute figures)

COUNTRY COMMUNITY (VI)
COAL-FIELD

YEAR 1976
MAN-HOURS WORKED (1) 301 092 896

NATURE OF THE INJURY	Amputations and enucleations 1			Fractures with or without dislocation 2			Luxations, twist and sprains 3			Concussion and internal injury 4			Open wounds contusion and muscular abrasions 5			Burns and harmful effects of electricity and radiation 6			Poisoning and suffocation 7			Multiple injuries of those not specified (2) 8			TOTAL 9				
PERIOD OF INCAPACITY	> 56 days (3)	Fatal accidents	total	> 56 days (3)	Fatal accidents	total	> 56 days (3)	Fatal accidents	total	> 56 days (3)	Fatal accidents	total	> 56 days (3)	Fatal accidents	total	> 56 days (5)	Fatal accidents	total	> 56 days (5)	Fatal accidents	total	> 56 days (5)	Fatal accidents	total	4 to 20 days (5)	21 to 56 days (5)	> 56 days (5)	Fatal accidents	total
LOCATION OF THE INJURY																													
I. Head and neck	1	-	3	76	37	294	3	-	17	26	1	143	125	3	2338	-	-	15				2	1	14	2894	819	233	42	3888
II. Eyes	-	-	2							3	-	3	66	-	655	4	-	48				1	-	15	1364	147	74	-	1585
III. Trunk	-	-	-	212	13	491	58	1	161	9	2	18	94	6	1509	2	-	30				6	1	32	2412	1501	391	23	4327
IV. Upper limbs (excluding the hands) (3)	6	-	7	222	-	352	34	-	173				159	-	2444	6	-	42				7	-	18	3152	1084	434	-	4670
V. Hands	109	-	220	821	-	2922	48	-	931				462	-	6440	5	1	37				3	-	12	7096	5517	1448	1	14062
VI. Lower limbs (excluding feet) (4)	7	-	7	517	3	596	168	-	520				411	-	2603	4	-	33				17	-	33	3130	1811	1124	3	6068
VII. Feet	11	-	17	409	-	888	70	-	730				152	-	1624	1	-	9				-	-	6	2352	1470	643	-	4465
VIII. Multiple locations	-	1	1	36	13	57	9	1	51	1	5	9	62	3	274	6	18	28				22	12	37	514	317	136	53	1020
IX. Not specified																-	-	-	1	2	5	1	-	1	33	17	8	2	60
TOTAL	134	1	280	2293	66	5600	390	2	1883	39	8	173	1547	12	17893	28	19	242	1	2	5	59	14	167	22847	12683	4491	125	40146

(1) Number of hours worked by pit staff and employees of contractor firms who belong to a miner's social insurance scheme.
(2) Including complications.
(3) The shoulders and the wrists are included under „upper limbs".
(4) The hips and the ankles are included under „Lower limbs".
(5) Calender days.

MINES AFETY AND HEALTH COMMISSION

Common Statistics on victims of accidents underground in coal mines

Table 2b

DETAILED BREAKDOWN OF VICTIMS ACCORDING TO LOCATION AND NATURE OF INJURY AND PERIOD OF INCAPACITY

(Frequency rates)

COUNTRY COMMUNITY (VI)
COAL-FIELD

YEAR 1976
MAN-HOURS WORKED (1) 301 092 896

NATURE OF THE INJURY	Amputations and enucleations 1			Fractures with or without dislocation 2			Luxations, twist and sprains 3			Concussion and internal injury 4			Open wounds contusion and muscular abrasions 5			Burns and harmful effects of electricity and radiation 6			Poisoning and suffocation 7			Multiple injuries of those not specified (2) 8			TOTAL 9				
PERIOD OF INCAPACITY	> 56 days (5)	Fatal accidents	total	> 56 days (5)	Fatal accidents	total	> 56 days (5)	Fatal accidents	total	> 56 days (5)	Fatal accidents	total	> 56 days (5)	Fatal accidents	total	> 56 days (5)	Fatal accidents	total	> 56 days (5)	Fatal accidents	total	> 56 days (5)	Fatal accidents	total	4 to 20 days (5)	21 to 56 days (5)	> 56 days (5)	Fatal accidents	total
LOCATION OF THE INJURY																													
I. Head and neck	-	-	0,01	0,25	0,12	0,98	0,01	-	0,06	0,09	-	0,47	0,42	0,01	7,76	-	-	0,05				-	-	0,05	9,61	2,72	0,77	0,139	12,91
II. Eyes	-	-	-							0,01	-	0,01	0,22	-	2,18	0,01	-	0,16				1	-	0,05	4,53	0,49	0,25	-	5,26
III. Trunk	-	-	-	0,70	0,04	1,63	0,19	-	0,53	0,03	-	0,06	0,31	0,02	5,01	-	-	0,10				0,02	-	0,11	8,01	4,99	1,30	0,076	14,37
IV. Upper limbs (excluding the hands) (3)	0,02	-	0,02	0,74	-	1,17	0,11	-	0,57				0,53	-	8,12	0,02	-	0,14				0,02	-	0,06	10,47	3,60	1,44	-	15,51
V. Hands	0,36	-	0,73	2,73	-	9,70	0,16	-	2,76				1,53	-	21,39	0,02	-	0,12				0,01	-	0,04	23,57	18,32	4,81	0,003	46,70
VI. Lower limbs (excluding feet) (4)	0,02	-	0,02	1,72	0,01	1,98	0,56	-	1,73				1,36	-	8,64	0,01	-	0,11				0,06	-	0,11	10,40	6,01	3,73	0,009	20,15
VII. Feet	0,04	-	0,06	1,36	-	2,95	0,23	-	2,42				0,50	-	5,39	-	-	0,03				-	-	0,02	7,81	4,88	2,14	-	14,83
VIII. Multiple locations	-	-	-	0,12	0,04	0,19	0,03	-	0,17	-	0,02	0,03	0,21	0,01	0,91	0,02	0,06	0,09				0,07	0,04	0,12	1,71	1,05	0,45	0,176	3,39
IX. Not specified																-	-	-	-	-	0,02	-	-	-	0,11	0,06	0,03	0,006	0,20
TOTAL	0,45	-	0,93	7,62	0,22	18,60	1,30	-	6,25	0,13	0,03	0,57	5,14	0,04	59,43	0,09	0,06	0,80	-	-	0,02	0,20	0,05	0,55	75,88	42,12	14,92	0,415	133,33

(1) Number of hours worked by pit staff and employees of contractor firms who belong to a miner's social insurance scheme.
(2) Including complications
(3) The shoulders and the wrists are included under „upper limbs".
(4) The hips and the ankles are included under „Lower limbs".
(5) Calender days.

MINES SAFETY AND HEALTH COMMISSION

Common Statistics on victims of accidents underground in coal mines

DETAILED BREAKDOWN OF ACCIDENT VICTIMS ACCORDING TO CAUSE AND SITE OF ACCIDENT AND PERIOD OF INCAPACITY

(absolute figures)

Table 1a

COUNTRY COMMUNITY (IX)
COAL-FIELD

YEAR 1976
MAN-HOURS WORKED (1) 587 597 666

CAUSES OF ACCIDENTS / Period of incapacity	Production faces 1					Headings excluding shafts and staple-pits 2					Shafts and staple-pits 3					Other places 4					Total of accidents underground 5					Group accidents (2) 6		
	4 to 20 days (3)	21 to 56 days (3)	> 56 days (3)	Fatal accidents	total	4 to 20 days (3)	21 to 56 days (3)	> 56 days (3)	Fatal accidents	total	4 to 20 days (3)	21 to 56 days (3)	> 56 days (3)	Fatal accidents	total	4 to 20 days (3)	21 to 56 days (3)	> 56 days (3)	Fatal accidents	total	4 to 20 days (3)	21 to 56 days (3)	> 56 days (3)	Fatal accidents	total	56 days (3)	Fatal accidents	total
I. FALLS OF GROUNDS AND ROCKS	8503	3197	857	23	12580	3430	1200	410	9	5049	34	7	5	-	46	1307	502	131	3	1943	13274	4906	1403	35	19618			
II. TRANSPORT, TOTAL	1558	745	302	7	2612	693	259	149	7	1108	136	90	77	4	307	3224	1613	635	27	5499	5611	2707	1163	45	9526			
a) Continuous Transport	331	203	138	3	675	143	69	47	4	263	3	4	2	1	10	246	119	43	1	409	723	395	230	9	1357			
b) Discontinuous Transport	1227	542	164	4	1937	550	190	102	3	845	133	86	75	3	297	2978	1494	592	26	5090	4888	2312	933	36	8169			
III. FALLS AND MOVEMENT OF THE VICTIM, TOTAL	3983	2133	469	3	6588	2555	1122	278	3	3958	319	214	70	8	611	7812	3491	914	10	12227	14669	6960	1731	24	23384			
a) while moving about the mine	750	306	73	-	1129	511	194	47	-	752	61	32	9	2	104	3381	1383	344	1	5109	4703	1915	473	3	7094			
b) in the course of other activities	3233	1827	396	3	5459	2044	928	231	3	3206	258	182	61	6	507	4431	2108	570	9	7118	9966	5045	1258	21	16290			
IV. MACHINES, TOOLS AND SUPPORTS TOTAL	5348	2058	559	13	7978	2052	787	184	4	3027	92	45	13	-	150	2779	1018	208	1	4006	10271	3911	961	18	15161			
a) Machines	709	335	127	9	1180	217	111	53	4	385	13	10	8	-	31	247	118	36	1	402	1186	577	221	14	1998			
b) Tools	1155	379	88	-	1621	735	249	47	-	1031	56	23	5	-	84	851	332	52	-	1235	2797	983	192	-	3972			
c) Supports	3483	1344	344	4	5176	1100	427	84	-	1611	23	12	-	-	35	1681	568	120	-	2369	6288	2351	548	4	9191			
V. FALLS OF OBJECTS	4423	2054	573	5	7055	2093	706	216	1	3016	219	80	33	3	335	2892	1340	342	4	4578	9627	4180	1164	13	14984			
VI. EXPLOSIVES	41	7	3	2	53	8	1	5	1	15	-	-	-	-	-	30	9	-	-	39	79	17	8	3	107			
VII. IGNITIONS OR EXPLOSIONS OF FIREDAMP AND COAL DUST	-	1	-	16	17	-	2	4	2	8	-	-	-	-	-	-	1	-	-	1	-	4	4	18	26	-	16	16
VIII. OUTBURSTS OF GAS, DE-OXYGENATION, SUFFOCATION OR POISONING BY NATURAL GASES (CO_2, CH_4, CO, H_2S), TOTAL	2	-	-	-	2	3	1	-	2	6	-	-	-	-	-	8	1	-	-	9	13	2	-	2	17			
a) Outbursts of Gas	-	-	-	-	-	2	-	-	-	2	-	-	-	-	-	2	-	-	-	2	4	-	-	-	4			
b) De-oxygenation and Poisoning by natural Gases	2	-	-	-	2	1	1	-	2	4	-	-	-	-	-	6	1	-	-	1	9	2	-	2	13			
IX. HEATINGS OR FIRES	9	2	-	-	11	3	-	-	-	3	1	-	1	-	2	9	-	-	-	9	22	2	1	-	25			
X. INRUSHES	4	1	-	-	5	1	-	-	-	1	-	-	-	-	-	2	-	-	-	2	7	1	-	-	8			
XI. ELECTRICITY	2	1	1	-	4	4	4	1	-	9	3	-	-	1	4	18	8	4	2	32	27	13	6	3	49			
XII. OTHER CAUSES	1429	476	117	5	2027	703	239	53	1	996	83	24	8	1	116	3497	1296	279	2	5074	5712	2035	457	9	8213			
TOTAL	25302	10675	2881	74	38932	11545	4321	1300	30	17196	887	460	207	17	1571	21578	9279	2513	49	33419	59312	24738	6898	170	91118			

(1) Number of hours worked by pit staff and employees of contractor firms who belong to a miners' social insurance scheme.
(2) Accidents involving more than five casualties (i.e. who either died or were unable to resume work underground for at least eight weeks)
(3) Calendar days.

MINES SAFETY AND HEALTH COMMISSION

Common Statistics on victims of accidents underground in coal mines

DETAILED BREAKDOWN OF ACCIDENT VICTIMS ACCORDING TO CAUSE AND SITE OF ACCIDENT AND PERIOD OF INCAPACITY

(frequency rates)

Table 1b

COUNTRY COMMUNITY (IX)
COAL-FIELD

YEAR 1976
MAN-HOURS WORKED (1) 587 597 666

CAUSES OF ACCIDENTS / Period of incapacity	Production faces 1					Headings excluding shafts and staple-pits 2					Shafts and staple-pits 3					Other places 4					Total of accidents underground 5					Group accidents (2) 6		
	4 to 20 days (3)	21 to 56 days (3)	> 56 days (3)	Fatal accidents	total	4 to 20 days (3)	21 to 56 days (3)	> 56 days (3)	Fatal accidents	total	4 to 20 days (3)	21 to 56 days (3)	> 56 days (3)	Fatal accidents	total	4 to 20 days (3)	21 to 56 days (3)	> 56 days (3)	Fatal accidents	total	4 to 20 days (3)	21 to 56 days (3)	> 56 days (3)	Fatal accidents	total	56 days (3)	Fatal accidents	total
I. FALLS OF GROUNDS AND ROCKS	14,47	5,44	1,46	0,04	21,41	5,84	2,04	0,70	0,02	8,59	0,06	0,01	-	-	0,08	2,22	0,85	0,22	-	3,31	22,59	8,35	2,39	0,06	33,39			
II. TRANSPORT, TOTAL	2,65	1,27	0,51	0,01	4,44	1,18	0,44	0,25	0,01	1,89	0,23	0,15	0,13	-	0,52	5,49	2,74	1,08	0,04	9,36	0,55	4,61	1,98	0,08	16,21			
a) Continuous Transport	0,56	0,35	0,23	-	1,15	0,24	0,12	0,08	-	0,45	--	-	-	-	0,02	0,42	0,20	0,07	-	0,70	1,23	0,67	0,39	0,02	2,31			
b) Discontinuous Transport	2,09	0,92	0,28	-	3,29	0,94	0,34	0,17	-	1,44	0,23	0,15	0,13	-	0,50	5,07	2,54	1,01	0,04	8,66	8,32	3,93	1,59	0,06	13,90			
III. FALLS AND MOVEMENT OF THE VICTIM, TOTAL	6,78	3,63	0,80	-	11,21	4,35	1,91	0,47	-	6,74	0,54	0,36	0,12	0,01	1,04	13,29	5,94	1,56	0,02	20,81	24,96	11,84	2,95	0,04	39,80			
a) while moving about the mine	1,28	0,52	0,12	-	1,92	0,87	0,33	0,08	-	1,28	0,10	0,05	0,02	-	0,18	5,75	2,35	0,59	-	8,69	8,00	3,26	0,80	-	12,07			
b) in the course of other activities	5,50	3,11	0,67	-	9,29	3,48	1,58	0,39	-	5,46	0,44	0,31	0,10	0,01	0,86	7,54	3,59	0,97	0,02	12,11	16,96	8,59	2,14	0,04	27,72			
IV. MACHINES, TOOLS AND SUPPORTS TOTAL	9,10	3,50	0,95	0,02	13,58	3,49	1,34	0,31	-	5,15	0,16	0,08	0,02	-	0,26	4,73	1,73	0,35	-	6,82	17,48	6,66	1,64	0,03	25,80			
a) Machines	1,21	0,57	0,22	0,02	2,01	0,37	0,19	0,09	-	0,66	0,02	0,02	0,01	-	0,05	0,42	0,20	0,06	-	0,68	2,02	0,98	0,38	0,02	3,40			
b) Tools	1,97	0,64	0,15	-	2,76	1,25	0,42	0,08	-	1,75	0,10	0,04	0,01	-	0,14	1,45	0,57	0,09	-	2,10	4,76	1,67	0,33	-	6,76			
c) Supports	5,93	2,29	0,59	-	8,81	1,87	0,73	0,14	-	2,74	0,04	0,02	-	-	0,06	2,86	0,97	0,20	-	4,03	10,70	4,00	0,93	0,01	15,64			
V. FALLS OF OBJECTS	7,53	3,50	0,98	-	12,01	3,56	1,20	0,37	-	5,13	0,37	0,14	0,06	-	0,57	4,92	2,28	0,58	-	7,79	16,38	7,11	1,98	0,02	25,50			
VI. EXPLOSIVES	0,07	0,01	-	-	0,09	0,01	-	-	-	0,03	-	-	-	-	-	0,05	0,02	-	-	0,07	0,13	0,03	0,01	-	0,18			
VII. IGNITIONS OR EXPLOSIONS OF FIREDAMP AND COAL DUST	-	-	-	0,03	0,03	-	-	-	-	0,01	-	-	-	-	-	-	-	-	-	-	-	-	-	0,03	0,04	-	0,03	0,03
VIII. OUTBURSTS OF GAS, DE-OXYGENATION, SUFFOCATION OR POISONING BY NATURAL GASES (CO_2, CH_4, CO, H_2S), TOTAL	-	-	-	-	-	-	-	-	-	0,01	-	-	-	-	-	0,01	-	-	-	0,02	0,02	-	-	-	0,03			
a) Outbursts of Gas	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-			
b) De-oxygenation and Poisoning by natural Gases	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0,01	-	-	-	-	0,02	-	-	-	0,02			
IX. HEATINGS OR FIRES	0,02	-	-	-	0,02	-	-	-	-	-	-	-	-	-	-	0,02	-	-	-	0,02	0,04	-	-	-	0,04			
X. INRUSHES	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0,01	-	-	-	0,01			
XI. ELECTRICITY	-	-	-	-	-	-	-	-	-	0,02	-	-	-	-	-	0,03	0,01	-	-	0,05	0,05	0,02	0,01	-	0,08			
XII. OTHER CAUSES	2,43	0,81	0,20	-	3,45	1,20	0,41	0,09	-	1,70	0,14	0,04	0,01	-	0,20	5,95	2,21	0,47	-	8,64	9,72	3,46	0,78	0,02	13,98			
TOTAL	43,06	18,17	4,90	0,13	66,26	19,65	7,35	2,21	0,05	29,26	1,51	0,78	0,35	0,03	2,67	36,72	15,79	4,28	0,08	56,87	100,94	42,10	11,74	0,30	155,07	--	0,03	0,03

(1) Number of hours worked by pit staff and employees of contractor firms who belong to a miners' social insurance scheme.
(2) Accidents involving more than five casualties (i.e. who either died or were unable to resume work underground for at least eight weeks).
(3) Calendar days.

MINES AFETY AND HEALTH COMMISSION

Common Statistics on victims of accidents underground in coal mines

Table 2a

DETAILED BREAKDOWN OF VICTIMS ACCORDING TO LOCATION AND NATURE OF INJURY AND PERIOD OF INCAPACITY

(absolute figures)

COUNTRY COMMUNITY (IX)
COAL-FIELD

YEAR 1976
MAN-HOURS WORKED (1) 587 597 666

NATURE OF THE INJURY	Amputations and enucleations 1			Fractures with or without dislocation 2			Luxations, twist and sprains 3			Concussion and internal injury 4			Open wounds contusion and muscular abrasions 5			Burns and harmful effects of electricity and radiation 6			Poisoning and suffocation 7			Multiple injuries of those not specified (2) 8			TOTAL 9				
PERIOD OF INCAPACITY	> 56 days (3)	Fatal accidents	total	> 56 days (3)	Fatal accidents	total	> 56 days (3)	Fatal accidents	total	> 56 days (3)	Fatal accidents	total	> 56 days (3)	Fatal accidents	total	> 56 days (5)	Fatal accidents	total	> 56 days (5)	Fatal accidents	total	> 56 days (5)	Fatal accidents	total	4 to 20 days (3)	21 to 56 days (3)	> 56 days (3)	Fatal accidents	total
LOCATION OF THE INJURY																													
I. Head and neck	1	-	3	83	44	347	17	1	207	26	1	143	193	3	4254	-	-	19				2	2	17	4519	1262	322	51	6054
II. Eyes	-	-	2							3	-	3	86	-	1385	5	-	55				18	-	753	2619	329	112	-	3060
III. Trunk	-	-	-	236	13	561	438	3	7294	9	2	18	205	6	4170	3	-	38				7	5	41	9176	4095	898	29	14208
IV. Upper limbs (excluding the hands) (4)	9	-	12	276	-	490	75	-	1025				251	-	4727	6	-	52				8	-	28	5521	1822	625	-	7968
V. Hands	141	-	302	887	-	3399	60	-	1119				788	-	15153	7	3	59				5	-	45	13426	8360	1888	3	23677
VI. Lower limbs (excluding feet) (5)	11	-	11	679	3	835	430	-	4382				643	-	7508	5	-	43				20	1	53	9278	4038	1788	4	15108
VII. Feet	17	-	27	446	-	1056	78	-	952				250	-	3946	1	-	11				-	-	11	4167	2235	792	-	7194
VIII. Multiple locations	2	1	6	64	15	132	104	1	1195	1	5	9	215	4	2397	8	18	37				26	14	53	2793	1121	420	58	4392
IX. Not specified																14	-	65	1	10	15	22	14	286	260	93	43	24	420
TOTAL	181	1	386	2871	75	6820	1202	5	15574	39	8	173	2647	13	43546	49	21	379	1	10	15	108	36	1286	51759	23555	6898	170	82082

(1) Number of hours worked by pit staff and employees of contractor firms who belong to a miner's social insurance scheme.
(2) Including complications.
(3) The shoulders and the wrists are included under „upper limbs".
(4) The hips and the ankles are included under „Lower limbs".
(5) Calender days.

MINES AFETY AND HEALTH COMMISSION

Common Statistics on victims of accidents underground in coal mines

Table 2b

DETAILED BREAKDOWN OF VICTIMS ACCORDING TO LOCATION AND NATURE OF INJURY AND PERIOD OF INCAPACITY

(Frequency rates)

COUNTRY COMMUNITY (IX)
COAL-FIELD

YEAR 1976
MAN-HOURS WORKED (1) 587 597 666

NATURE OF THE INJURY	Amputations and enucleations 1			Fractures with or without dislocation 2			Luxations, twist and sprains 3			Concussion and internal injury 4			Open wounds contusion and muscular abrasions 5			Burns and harmful effects of electricity and radiation 6			Poisoning and suffocation 7			Multiple injuries of those not specified (2) 8			TOTAL 9				
PERIOD OF INCAPACITY	> 56 days (5)	Fatal accidents	total	> 56 days (5)	Fatal accidents	total	> 56 days (5)	Fatal accidents	total	> 56 days (5)	Fatal accidents	total	> 56 days (5)	Fatal accidents	total	> 56 days (5)	Fatal accidents	total	> 56 days (5)	Fatal accidents	total	> 56 days (5)	Fatal accidents	total	4 to 20 days (5)	21 to 56 days (5)	> 56 days (5)	Fatal accidents	total
LOCATION OF THE INJURY																													
I. Head and neck	-	-	-	0,14	0,07	0,59	0 03	-	0,35	0,04	-	0,24	0,33	-	7.24	-	-	0,03				-	-	0,03	7,69	2,15	0,55	0,086	10,30
II. Eyes	-	-	-							-	-	-	0,15	-	2,36	-	-	0,09				0,03	-	1,28	4,46	0,56	0,19	-	5,21
III. Trunk	-	-	-	0,40	0,02	0,95	0,75	-	12,41	0,02	-	0,03	0,35	0,01	7,10	-	-	0,06				0,01	-	0,07	15,62	6,97	1,55	0,049	24,18
IV. Upper limbs (excluding the hands) (3)	0,02	-	0,02	0,47	-	0,83	0,13	-	1,74				0,43	-	8,04	0,01	-	0,08				0,01	-	0,05	9,40	3,10	1,06	-	13,56
V. Hands	0,24	-	0,51	1,51	-	5,78	0.10	-	1,90				1,34	-	25,79	0,01	-	0,10				-	-	0,08	22,54	14,23	3,21	0,005	40,29
VI. Lower limbs (excluding feet) (4)	0,02	-	0,02	1,16	-	1,42	0,73	-	7,46				1,09	-	12,78	-	-	0,07				0,03	-	0,09	15,79	6,87	3,04	0,006	25,71
VII. Feet	0,03	-	0,05	0,76	-	1,80	0,13	-	1,62				0,43	-	6,72	-	-	0,02				-	-	0,02	7,09	3,80	1,35	-	12,24
VIII. Multiple locations	-	-	0,01	0,11	0,03	0,22	0,18	-	2,03	-	-	0,02	0,37	-	4,08	0,01	0,03	0,06				0,04	0,02	0,09	4,75	1,91	0,71	0,098	7,47
IX. Not specified																0,02	-	0,11	-	0,02	0,03	0,04	0,02	0,49	0,44	0,16	0,07	0,040	0,71
TOTAL	0,31	-	0,66	4,55	0,13	11,61	2,05	-	26,50	0,07	0,01	0,29	4,50	0,02	74,11	0,08	0,04	0,64	-	0,02	0,03	0,18	0,06	2,19	87,67	39,99	11,74	0,289	139,69

(1) Number of hours worked by pit staff and employees of contractor firms who belong to a miner's social insurance scheme.
(2) Including complications.
(3) The shoulders and the wrists are included under „upper limbs"
(4) The hips and the ankles are included under „Lower limbs".
(5) Calender days.

ANNEXES

LIST OF ANNEXES

ANNEX I

TERMS OF REFERENCE AND RULES OF PROCEDURE OF THE MINES SAFETY COMMISSION

(Decisions from the Council of Ministers of 9 July 1957, 11 March 1965 and 27 June 1974)

COUNCIL OF MINISTERS

DECISION

of 9 July 1957

concerning the terms of reference and rules of procedure of the Mines Safety Commission

Having taken note of the Recommendations adopted by the Conference on Safety in Coalmines and of the proposals submitted by the High Authority in connection with the Conference's final Report, which afford a working basis for the improvement of safety in coalmines, and

having regard to their Decisions at the Council's 36th and 42nd sessions on September 6, 1956 and on May 9 and 10, 1957, setting up the Mines Safety Commission,

THE REPRESENTATIVES OF THE GOVERNMENTS OF THE MEMBER STATES MEETING AT THE SPECIAL COUNCIL OF MINISTERS,

- hereby lay down that the terms of reference of the aforesaid Commission shall be as follows:

1. The Commission shall follow developments regarding safety in coalmines, including those regarding the safety regulations instituted by the public authorities, and assemble the necessary information concerning progress and practical results obtained, more especially in the matter of accident prevention.

   To secure the necessary information, the Commission shall apply to the Governments concerned.

   The Commission shall evaluate the information in its possession and submit to the Governments proposals for the improvement of safety in coalmines.

2. The Commission shall help the High Authority to work out a method of compiling intercomparable accident statistics.

3. The Commission shall ensure the prompt forwarding to the quarters directly concerned (including in particular mines inspectorates and employers' and workers' associations) of relevant information assembled by it.

4. The Commission shall ascertain, by regular contact with the Governments, what action is being taken to implement the proposals of the Conference on Safety in Coalmines, and such proposals as it may itself draw up.

5. The Commission shall propose such study and research as it deems most indicated for the improvement of safety, with notes as to the way in which these can best be effected.

6. The Commission shall facilitate the exchange of information and experience among persons responsible for safety matters, and propose appropriate measures for this purpose (e.g. organization of study sessions, establishment of documentation services).

7. The Commission shall propose appropriate measures for ensuring the necessary liaison among the rescue services of the Community countries.

8. The Commission shall submit annually to the Council of Ministers and the High Authority a Report on its activities and on developments regarding safety in coalmines in the different member States. In this connection, it shall in particular examine the statistics compiled on accidents and incidents in coalmines.

- The Representatives of the Governments further lay down that the rules of procedure of the Commission shall be those set forth in the Annex to the present Decision.

- The Representatives of the Governments trust that the High Authority will arrange for the Commission to start work at the earliest possible moment.

This Decision was adopted by the Council at its forty-fourth session, on July 9, 1957.

For the Council,

J. REY

President.

RULES OF PROCEDURE

of the Mines Safety Commission

CHAIRMAN

Article 1

The Chairman of the Mines Safety Commission shall be a Member of the High Authority of the European Coal and Steel Community.

Article 2

The Chairman shall conduct the work of the Commission in accordance with these Rules of Procedure.

MEMBERS

Article 3 (1)

The Commission shall consist of 36 members appointed by the Governments; each country shall have four members, of whom two shall be representatives of that country's Governments, one of the employers and one of the workers.

Each Government shall send in writing to the Chairman a nominal roll of the members appointed by it. It shall notify the Chairman of all changes in this.

Each Government may appoint for any particular meeting of the Commission one or two advisers, whose names it shall send to the Chairman.

I.L.O. PARTICIPATION

Article 4

Representatives of the International Labour Organization shall be invited to attend the proceedings of the Commission in a consultative capacity.

ORGANIZATION

(a) Restricted Committee

Article 5

A Restricted Committee shall be set up, to consist of Governments representatives on the Commission.

Article 6

The Chairman of the Commission shall act as Chairman of the Restricted Committee.

Article 7

The function of the Restricted Committee shall be to ensure permanent liaison among the Governments of the member States and between them and the Commission, more especially for the purpose of exchanging relevant information. The Restricted Committee shall see to the preparation of the Commission's activities.

Article 8 (1)

The Restricted Committee shall be convened by the Chairman.

The Chairman shall be required to convene it when asked to do so by the representatives of five or more Governments.

(b) Working Parties

Article 9

The Commission of the Restricted Committee may set up Working Parties of experts to consider specific technical matters.

Article 10

The Working Parties shall decide their own modus operandi.

Article 11

The Restricted Committee shall be given reports by the Working Parties on the results of their proceedings, which it shall submit to the Commission with the comments of its members.

In the event of differences of opinion within the Working Parties, the views expressed shall be given, together with the names of those expressing them.

SECRETARIAT

Article 12 (1)

The High Authority shall be responsible for the secretarial arrangements in connection with the work of the Commission, the Restricted Committee and the Working Parties.

These arrangements shall be under the charge of a High Authority staff member appointed to act as Secretary.

All documents shall be in the six official languages of the Community.

WORKING PROCEDURE

Article 13

The Chairman shall fix the agenda and the dates of meetings after consultation with the members of the Restricted Committee.

Article 14 (1)

The Chairman shall allow to speak any member of the Commission or representative of the International Labour Organization asking to do so.

The Chairman may allow advisers to speak.

Article 15

The members of the High Authority shall have the right to attend meetings of the Commission and of the Restricted Committee, and to speak there.

The Chairman may bring with him advisers, whom he may allow to speak.

Article 16

Where the Commission or the Restricted Committee deems it desirable to obtain information concerning the various aspects of safety in coalmines, it shall request this from the Governments of the member States.

Article 17 (1)

24 members shall constitute a quorum. Conclusions shall be adopted by majority of the members present.

Proposals by the Commission under 1,3 of its terms of reference shall, however, require a vote in favour by two-thirds of the members present, and by not less than nineteen members in all.

Any dissenting opinions shall be brought to the attention of the Governments should the members expressing them so request.

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(1) Amended having regard to decision of the Council of the European Communities of 1 January 1973 (Official Journal of the European Communities L2 of 1 January 1973).

THE COUNCIL

DECISION *(1)*

of March 11, 1965

of the Representatives of the Governments of the Member States assembled in the Special Council of Ministers to modify the decision of July 9, 1957

concerning the terms of reference and rules of procedure of the Mines Safety Commission

THE REPRESENTATIVES OF THE GOVERNMENTS OF THE MEMBER STATES ASSEMBLED IN THE SPECIAL COUNCIL OF MINISTERS -

having regard to the decision of July 9, 1957 regarding the terms of reference and rules of procedure of the Mines Safety Commission, and

having regard to the High Authority's proposal of January 7, 1964, and

seeing that this decision in no way affects Article 118 of the Treaty setting up the European Economic Commununity,

DECIDE:

Article 1

The terms of reference of the Mines Safety Commission laid down by the decision of July 9, 1957 are replaced by the provisions in the annex.

Article 2

The provisions of Article 17 of the rules of procedure annexed to the Decision of July 9, 1957 are replaced by the following provisions:

"Should the Mines Safety Commission or the Restricted Committee consider it desirable to receive information regarding the various fields for which it is responsible, it shall apply to the Governments of the member States."

This decision was adopted by the Council at its one-hundredth session, on March 11, 1965.

For the Council

M. MAURICE-BOKANOWSKI

President

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(1) See "Journal officiel de la Communauté européenne du charbon et de l'acier" no. 46 of 22nd March 1965.

ANNEX

TERMS OF REFERENCE FOR THE MINES SAFETY COMMISSION

1. The Commission shall follow developments regarding safety and measures to avoid at working-points conditions which represent a danger to health in coalmines, including to this end the safety regulations instituted by the public authorities and assemble the necessary information concerning progress and practical results obtained.

   To secure the necessary information, the Commission shall apply to the Governments concerned.

   The Commission shall evaluate the information in its possession and submit to the Governments proposals for the improvement of safety and health conditions in coalmines.

2. The Commission shall help the High Authority to work out a method of compiling intercomparable statistics on accidents and damage to health attributable to vocational activities in coalmines.

3. The Commission shall ensure the prompt forwarding to the quarters directly concerned (including in particular mines inspectorates and employers' and workers' associations) of relevant information assembled by it.

4. The Commission shall ascertain, by regular contact with the Governments, what action is being taken to implement the proposals of the Conference on Safety in Coalmines, and such proposals as it may itself draw up.

5. The Commission shall propose such study and research as it deems most indicated for the improvement of safety, and of healthy working conditions in coalmines, with notes as to the way in which these can be effected.

6. The Commission shall facilitate the exchange of information and experience among persons responsible for safety matters and the maintenance of healthy working conditions, and propose appropriate measures for this purpose (e.g. organization of study sessions, establishment of documentation services).

7. The Commission shall propose appropriate measures for ensuring the necessary liaison among the rescue services of the Community countries.

8. The Commission shall submit annually to the Council of Ministers and the High Autority a Report on its activities and on developments regarding safety and protection of health in coalmines in the different member States. In this connection, it shall in particular examine the statistics compiled in these fields.

COUNCIL DECISION

of 27 June 1974

on the extension of the responsibilities of the Mines Safety and Health Commission to all mineral-extracting industries

(74/326/EEC)

THE COUNCIL OF THE EUROPEAN COMMUNITIES,

Having regard to the Treaty establishing the European Economic Community, and in particular Article 145 thereof;

Having regard to the draft of the Commission;

Having regard to the Opinion of the European Parliament (1);

Having regard to the Opinion of the Economic and Social Committee;

Whereas the representatives of the Governments of the Member States meeting within the special Council of Ministers, by Decision of 9 and 10 May 1957, set up a Mines Safety and Health Commission whose terms of reference as laid down by Decision of 9 July 1957 (2) of the representatives of the Governments of the Member States meeting within the Special Council of Ministers, amended by Decision of 11 March 1965 (3) are to follow developments in safety and in the prevention of occupational risks to health in coal mines and to draw up proposals appropriate for the improvement of safety and health in coal mines;

Whereas this body has proved to be an effective and suitable instrument for safeguarding the health and safety of workers in coal mines;

Whereas problems of safety similar to those in coal mines also exist in other mineral-extracting industries;

Whereas the prevention of occupational accidents and diseases, as well as occupational hygiene, are among the objectives of the Treaty establishing the European Economic Community;

Whereas the Council resolution of 21 January 1974 (4) concerning a social action programme envisages an action programme for workers which aims *inter alia* at improvement in safety and health conditions at work;

Whereas the Safety and Health Commission should be assigned the task of extending to all mineral-extracting industries the preventive action which has hitherto been confined to coal mines;

Whereas the representatives of the Governments of the Member States meeting within the Council agreed to assign this task to the Safety and Health Commission,

HAS DECIDED AS FOLLOWS:

Article 1

1. Preventive action against risks of accident and occupational risks to the safety and health of workers in all mineral-extracting industries except simple excavation, excluding the protection of the health of workers against the dangers arising from ionizing radiations which is subject to special regulations pursuant to the Treaty establishing the European Atomic Energy Community shall be the responsibility of the Mines Safety and Health Commission within the terms of reference laid down by Decision of 11 March 1965 of the representatives of the Governments of the Member States meeting within the special Council of Ministers.

2. Mineral-extracting industries shall be taken to mean the activities of prospecting and of extraction in the strict sense of the word as well as of preparation of extracted materials for sale (crushing, screening, washing), but not the processing of such extracted materials.

3. Simple excavation shall be taken to mean work whose purpose is not the extraction of materials for use.

(1) OJ No C 40, 8. 4. 1974, p. 64.
(2) OJ No 28, 31. 8. 1957, p. 487/57.
(3) OJ No 46, 22. 3. 1965, p. 698/65.
(4) OJ No C 13, 12. 2. 1974, p. 1.

Article 2

1. This Decision shall enter into force on the fifth day following its publication in the *Official Journal of the European Communities*.

2. It shall apply :

— to the underground activities of the mineral-extracting industries : as from the day laid down in paragraph 1 ;

— to the other activities of the mineral-extracting industries : as from 1 January 1976.

Done at Luxembourg, 27 June 1974.

For the Council

The President

K. GSCHEIDLE

ANNEX II

TERMS OF REFERENCE OF THE VARIOUS WORKING PARTIES OF THE MINES SAFETY AND HEALTH COMMISSION

(as at 31.12.1976)

I - Working Party on Electrification - Chairman Mr Stassen

Terms of reference

1. Comparing adopted safety and accident prevention provisions relating to:
   (a) electric shock,
   (b) fire hazard,
   (c) explosion hazard.

2. Ascertaining the present position in Community countries with regard to safety regulations on underground electrical networks of low and medium voltage (up to 1 100 V) and feeder cables for movable equipment, with due regard to the specifications for the said cables.

3. Reporting on steps to be taken when work has to be carried out on electrical equipment under voltage.

4. Studying the construction of high-tension cables (of up to 6 000 V) used underground, and protective equipment.

5. Study of the problem of stray currents.

6. Periodic reports on oil-powered contactors used in gassy environments.

7. To follow the development of techniques designed to eliminate entirely the production of sparks on electrical contact lines (battery motors excluded).

8. Investigation of the use of remote-control circuits in automated mining operations.

9. The Mines Safety and Health Commission instructs the Working Party on Electricity:

   1(i) to take due note of the results of the work of the CENELEC Committee of Experts entrusted with harmonizing the rules covering the design of electrical equipment for use in explosive atmosphere;

   (ii) to examine the draft directive of the Commission of the European Communities dealing with the co-ordination in Member States of legislation on electrical equipment to be used in explosive atmosphere;

   2 to propose, if appropriate, modifications to the above documents to make them applicable to coal mines in countries of the European Community;

   3 to suggest the means by which harmonization of the certification procedures and reciprocal acceptance of the test methods and test certificates could be achieved;

   4 to compare the rules covering installation and use of underground electrical equipment now current in each to the Community countries, particularly in respect of the dangers of firedamp ignition; to ensure that the rules are uniform or to examine the equivalence of certain rules, so that such equipment can be used without modification in all the Community countries.

II - Working Party on Rescue Arrangements, Fires and Underground Combustion- Chairman Mr Coenders

A. General terms of reference

(Art. 7 of the Terms of Reference of the Mines Safety and Health Commission)

Exchange of experience between the Community countries and the United Kingdom on:

1. Rescue operations and action against spontaneous combustion, heatings and fires on the occasion of accidents or other events underground requiring the assistance of rescue teams, from which useful lessons have been learned:

2. Organization of rescue operations underground and the presentation of reports every two years;

3. The prevention of spontaneous combustion, heatings and fire outbreaks underground, the fighting and control of spontaneous combustion, heatings and fires, and reopening sealed-off workings.

B. Special terms of reference

1. Comparison of practical arrangements of rescue operations existing in the Community countries and the United Kingdom and possibly the drafting of a standard plan of procedure for the Community as a whole.

2. Exchange of experience and practical knowledge in the following fields:

   (a) methods and apparatus for the early detection of combustion, heatings and pit fires,
   (b) CO self-rescuers,
   (c) Oxygen deficiency warning devices,
   (d) Fires in long plant,
   (e) Sealing off abandoned workings,
   (f) Specifications and testing conditions for fire-resistant fluids for mechanical power transmission.

3. Condensed comparative survey of new regulations and guidelines promulgated by the mining authorities of member countries and the United Kingdom on rescue arrangements, first aid and fire fighting and prevention.

C. Analysis of results (partial or overall) of research projects at present in progress so as to:

1. Improve borehole rescue techniques,

2. Define the standards to which flameproof clothing should conform.

D. Studies to be completed by the Group of Experts on Budryk's theory on the following subjects:

1. Extent of instability of diagonal ventilation roadways,

2. Effects of a fire on workings with descensional ventilation,

3. Resources to be applied to combat the danger of explosion during firefighting.

III - Working Party on Winding Ropes and Shaft Guides: Chairman Mr Martens

Terms of reference

1. Follow-up of progress made in the testing of winding ropes by means of appropri-

ate instruments in order to obtain information concerning its application in the mines of the Community and the United Kingdom.

2. Testing of couplings for circular and flattened winding ropes.

3. Arrangements for the installation and inspection of capels.

4. Testing of guides for winding cages in drafts and guide mechanisms for cable haulage in roadways.

5. Maintenance required to ensure safe operation of winding ropes and balance ropes.

6. Use of studies on the dynamic behaviour of shaft and roadway ropes.

7. Exchange of views on the properties operating conditions and strength of winding ropes of particular interest.

8. Discussion on accidents involving winding and hauling ropes and their couplings, which could provide new information.

IV - Working Party on Mining Accident Statistics: Chairman Mr Koch

Terms of reference

In order to enable the Mines Safety and Health Commission to draw conclusions on accident prevention, the frequency of underground accidents in the Community coal mines should be examined, with the following objectives:

1. To decide on suitable mathematical statistical systems,

2. To evaluate, with their aid, chronological differences in frequency together with differences from country to country or coalfield to coalfield.

V - Working Party on Combustible Dusts: Chairman Mr Delacote

Terms of reference

Taking into account the mechanism of dust combustion and of flame propagation and the various factors which may influence this, including the fact that methane is frequently involved in this phenomenon, the working party is instructed to carry out a study of precautions against dust combustion, in particular:

(a) dust neutralization (dust control in situ, stone dusting, spraying, dust fixation by means of spreading salts and coagulating pastes, etc.), this study to include the comparative analysis of the regulations and instructions applied in the Community countries and the United Kingdom, along with the methods of application of the different processes,

(d) dust barriers of various types to halt dust explosions, mixed dust-methane explosions and pure methane explosions.

The working party may make any suggestions for research work considered necessary to advance the knowledge of the phenomena studied and to promote safety in these fields.

VI - Working Party on Health in Coal Mines: Chairman Mr Wilson

Studying, from the standpoint of technical prevention and industrial medicine, the prevention of environmental risks to the health of workers in coal mines.

1. General directives concerning airborne dust control methods where powered supports, underground crushers, coal cutting and getting and roadway drivage machinery is used.
2. Dust measurement (methods, frequency, measuring points, conclusions to be drawn etc.) and where necessary establishing a scale of comparison of the various methods employed.
3. Establishment of airborne dust thresholds. Definition of categories of permissible dustiness. Steps to be taken when faced with various categories of dustiness.
4. Medical problems:

   (a) Among the medical problems involved in the control of ambient health hazards to coal mine workers, priority must be given to the study of the following factors:
   climate, noise, vibration, lighting, gas, etc.

   (b) The Secretariat is to be instructed:
   (i) to set up a medical consultative committee,
   (ii) comparison of the provisions in force in the various countries concerning the organization of company medical services: selection and training of doctors, relations between medical services and technical departments and a list of the tasks and functions of industrial medicine,
   (iii) a draft scheme to standardize pre-recruitment medical examinations, periodic checks and checks in special instances,
   (iv) a draft scheme for a minimum degree of standardization in the detection of disorders and in the radiological supervison of workers as regards pneumoconiosis prevention,
   (v) a draft scheme for standards and criteria in workings in which miners already suffering from a deterioration in pulmonary function do not run the risk of this deterioration progressing further.

VII -Working Party on Effects of Working Time on Safety at Work, especially in Difficult or Unhealthy Conditions.

In suspension.

VIII-Working Party on Psychological and Sociological Factors affecting Safety: Chairman Mr Schnase

Terms of reference

1. Community safety campaigns.
2. Recommendation on the employment of foreign and young workers.
3. Practical measures for the prevention of accidents, taking into account psychological and sociological factors.

IX - Working Party on Ventilation and Mine Gas - Chairman Mr Carver

A. General terms of reference

The Working Party on Ventilation and Mine Gas will examine general problems of ventilation, particularly where prevention of firedamp explosions is concerned and other means or measures should be applied in order to suppress or control firedamp.

In addition to the study of firedamp explosions occurring in the Community and the United Kingdom, aatention will also be devoted to usable results of research in the field of firedamp outbursts, in particular where maximum permissible levels in ventilation air of firedamp and other poisomous gases are concerned, and the advance estimation of firedamp emission before a working is started.

Attention will also be devoted to appropriate speeds for the flow of ventilation air, measures to be taken in the event of deceleration of the flow of air, measures for the stabilization of ventilation and the means and procedures for monitoring ventilation.

B. Special terms of reference

1.1. to study all the aspects of the accidents which occurred at Lens-Liévin, Houghton-Main and Luisenthal which might be interesting and important for preventing firedamp explosions and firedamp ignitions and in particular to propose measures which can be taken to control the emission of firedamp

- coming from old workings and cul-de-sacs, both those abandoned temporarily and those abandoned permanently;

- in cul-de-sac workings, account should be taken of the dust make, stoppages of work, and stoppage of auxiliary ventilation as well as: the length and nature of the ducting for tne auxiliary ventilation;

1.2. to study the utility of automatic monitoring of auxiliary ventilation (air velocity etc..) and of automatic monitroing of CH_4 (by instruments installed on coal-getting and heading machines and including electrical call-out or alarm indication devices).

1.3. to compare national legislation designed to avoid the risk of sparking in auxiliary fans, with the ultimate aim of harmonising these.

2. Preparation of a report or interim report on "Methane under conveyors".

3. Preparation of a report on "Ignitions of firedamp by power loaders and heading machines".

4. Preparation of a report on use of CH_4 monitoring instruments in the Community Countries.

5. Preparation of a report on "Heavy gas emissions".

6. Preparation of a report on "Effects of firedamp on the risk of explosion with coal-dusts (in collaboration with the Working Party on "Flammable Dusts").

7. Drafting of uniform requirements and test specifications for CH_4 monitoring instruments.
(see point 5 of the agenda)

8. Preparation of a report on "Use of diesel engines underground in mines".

9. Drafting conclusions concerning 'Outbursts'.

X - Working Party on 'Mechanization' - Chairman Mr. Medaets

Taking into consideration current techniques in winning and roadway dring, linings and roadway conveyors, the working party is instructed to study particular ways of preventing accidents connected with mechanization.

In particular, it is to :

a) compile a schedule for machinery manufacturers of the minimum work safety requirements for mechanical protection of machines and equipment;

b) study safety provisions such as: visual and acoustic signalling, operating controls and in particular the ability to stop machines from any point on the face or roadway, taking account of modern means of telecommunication and remote control, electrical protection of motors in the event of overloading or jamming of equipment, lighting, etc.

XI - Working Party on 'Roof control' - Chairman Mr. Carver

The Working Party is instructed to examine, by exchanging experience and evaluating the results of research, whether it is possible to draw up measures or practical directives for the prevention of falls of ground, taking into account the individual features of coal measures and workings.

1. In particular: In the interest of better roof control, particularly within the context of working schedules, it will study:

   a) general measures to be taken into consideration in avoiding falls of ground, in the light of the type of measures and conditions of working, e.g. sequence of working the seams, features of the working areas (length, speed of advance, etc.), type and characteristics of the lining;

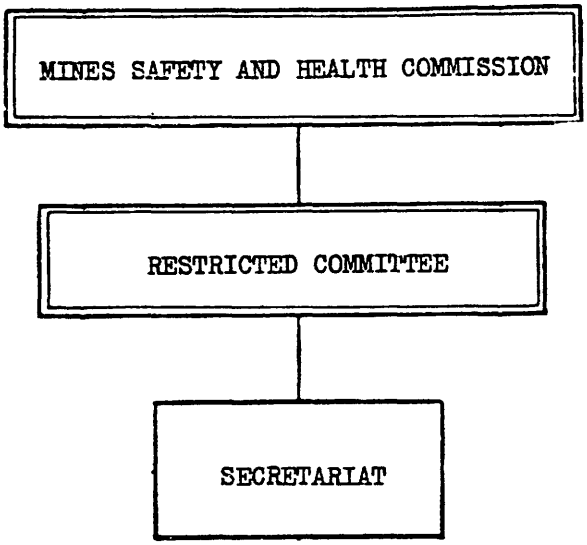
   b) specific measures to deal with individual difficulties which may or may not foreseeably arise in the long term, such as disturbance zones, protective banks, working of a face at right-angles to the end of an old seam, etc.

   c) specific measures to be taken when starting off a face in order to prevent abrupt subsidence of the roof.

2. It will also compare mining regulations on support and draw up minimum roof control requirements, taking into account the characteristics of the various faces (overall seam thickness, dip, dead rock .....).

ANNEX III

COMPOSITION OF THE MINES SAFETY AND HEALTH COMMISSION AND ITS WORKING PARTIES



W O R K I N G P A R T I E S

C	Ventilation and Firedamp	I	Mechanization
D	Winding ropes and Shaft guides Winding engines and winches	K	Petrol and Gas
E	Roof Control	L	Combustible dusts
F	Electrification	M	Health in coal mines
G	Psychological and sociological factors affecting safety	N	Rescue arrangement, mine fires and underground combustion
H	Effects on Working Time on Safety at Work	O	Common statistics of accidents

COMMITTEE OF EXPERTS

C 1 Experts on Firedamp Measuring Instruments

D 1 Winding ropes
D 2 Winding engines

E 1 Rock mechanics

G 1 Community safety compaigns

N 1 Stabilization of ventilation
N 2 Fire resistant fluids
N 3 Long-slame flam-resistant conveyor installations
N 4 Self-rescuers

A. MINES SAFETY AND HEALTH COMMISSION

FEDERAL REPUBLIC OF GERMANY

Government Representatives

- Ministerialrat Dr. Ing. R. LINTZEN, Referat III A 1, Bundesministerium für Wirtschaft - 5300 BONN

- Dipl.-Ing. K. HORNEFFER, Bundesministerium für Arbeit und Sozialordnung - 5300 BONN

Employer's Representative

- Bergwerkdirektor, Bergass a.D. Vorsitzender des Genossenschaftsvorstandes der Bergbauberufsgenossenschaft H. HARNISCH - Lücklemberg, Paul Geissler Weg 9 - 4600 DORTMUND

Workers' Representative

- E. STEBEL, Leiter des Sachgebiets Arbeitsschutz, IG Bergbau und Energie, 4630 BOCHUM, Alte Hattingerstrasse, 19.

Technical Advisers

- Dipl.-Ing. A. COENDERS, Präsident des Landesoberbergamts Nordrhein-Westfalen - 4600 DORTMUND, Goebenstrasse 25-27.

- Berghauptmann G. SEYL, Leiter des Oberbergamts für das Saarland und das Land Rheinland-Pfalz, 6600 SAARBRUECKEN, Am Staden, 17.

BELGIUM

Government Representatives

- M. J. MEDAETS, Directeur-Generaal der mijnen, Ministerie van Economische Zaken, rue de Mot,30 - B 1040 BRUSSEL

- M. J. STASSEN, Inspecteur général des mines, 49, rue des Augustins - B 4040 LIEGE

Employer's Representative

- M. G. DEGUELDRE, Directeur de l'Institut d'Hygiène des Mines 22, Hovermarkt - B 3500 HASSELT.

Workers' Representative

- M. S. CANTARELLI, Centrale des Mineurs du Hainaut, Bd. Devreux 36-38, B - 6000 CHARLEROI

Technical Adviser

- M. E. VANDENDRIESSCHE, Secrétaire général de la Centrale des francs-mineurs 26-32, avenue d'Auderghem - BRUXELLES 4

FRANCE

Government Representatives

- M. L. KOCH, Ingénieur en chef des mines, Direction des Mines Ministère de l'Industrie, du Commerce et de l'Artisanat 99, rue de Grenelle - 75 PARIS 7e

- M. B. SCHNELL, Ingénieur général des mines, Conseil général des Mines - Ministère de l'Industrie et de la Recherche 5, rue Barbet de Jouy - 75007 PARIS

Employer's Representative

- M. F. POT, Directeur général des services techniques des Charbonnages de France, 9 avenue Percier - 75 Paris 8e.

Workers' Representative

- M. A. VAN DE WALLE, Fédération des Mineurs - C. F. T. C. 21, rue Diderot - 62300 LENS

Technical Adviser

- M. St. NOWAK, 4 rue Charcot - 62300 LENS

ITALY

Government Representative

- Prof. Dott. Ing. A. GALATI, Ministero dell'industria e commercio Direzione generale delle miniere, Serv. Sicurezza mineraria, via Veneto 33 - 00100 ROMA.

Employers' Representative

- Prof. M. CARTA, Istituto arte mineraria della facoltà d'ingegneria - Piazza d'Armi - CAGLIARI (Sardegna).

Workers' Representative

- Dott. G. CRAVIOTTO, Segretario generale della Federestrattive, Via Isonzo 42 - ROMA.

Technical Advisers

- Comm. Dott. R. PURPURA, Direttore generale del ministero del lavoro e riposo, Via Aiaccio 14 - 00198 ROMA

- Dott. C. MICHELAZZI, Ispettore generale del ministero del Lavoro e della previdenza sociale, Via Flavia 6 - ROMA.

LUXEMBOURG

Government Representative

- M. A. SCHUSTER, Ingénieur-Directeur du Travail et des Mines, Inspection du Travail et des Mines, 2, rue des Girondins LUXEMBOURG.

Employer's Representative

- M. E. SCHMIT, Ingénieur en chef, Administration Centrale, ARBED B.P. 1802 - LUXEMBOURG

NETHERLANDS

Government Representatives

- Ir. J.W. DE KORVER, Inspecteur-generaal der mijnen, Staatstoezicht op de mijnen, Apollolaan 9, HEERLEN (L).

- Ir. Th. M. JANSEN, Inspecteur der mijnen, Staatstoezicht op de mijnen, Apollolaan 9 - HEERLEN.

Employer's Representative

- M. J.M. WEIJERS, Vice-vorzitter van de Nederlandse Katholieke Mijnwerkersbond, Seringenstraat, 9, Passart-Zuid.

UNITED-KINGDOM

Government Representatives

- Mr. L.D. RHYDDERCH, Chief Inspector of Mines and Quarries, Health and Safety Executive, Regina House, 259/269 Old Marylebone Road LONDON NW1.5RR.

- Mr. J.A. MARSHALL, Assistant Secretary, Health and Safety Executive Safety and General Branch C, Regina House 259/269 Old Marylebone Road, LONDON NW1.5RR

Employers' Representative

- Mr. B. GODDARD, Director of mining environment, National Coal Board, The Lodge, South Parade - DONCASTER Yorkshire

Workers' Representative

- Mr. Mc GAHEY, Vice-President of the National Union of Mineworkers 5, Hillside Crescent, EDINBURGH Scotland.

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ANNEX IV

OFFICIAL REGULATIONS DRAWN UP IN 1975 AND 1976

OFFICIAL REGULATIONS DRAWN UP IN 1975 AND 1976

In 1975 and 1976, the various Community countries issued the following official regulations with regard to safety and health in coalmines. It should be noted that, in some countries, these regulations also apply to surface mines and quarries.

FEDERAL REPUBLIC OF GERMANY

I. Rhineland-Westphalia

- Opinion of contracting firms in the mining industry in the light of the Administrative order on an industrial safety and works medical service of 28.2.1975.
- Guideline for the handling of dangerous materials of 6.2.1975.
- Use of insulating foam in underground mines of 11.12.1975
- Electrical properties of water barriers of 11.12.1975.
- Materials for intermediate gear of 16.6.1975.
- Hoisting ropes in highly stressed mine hoists of 4.7.1975.
- Shaft signalling plants of 29.12.1975.
- Guidelines for machine-driven floor-mounted trackways of 26.3.1975.
- Guideline for fixed methane measuring equipment of 24.6.1975.
- Rules governing abandoned mine workings of 8.1.1975.
- Guidelines for the filling and capping of ventilation air shafts of 2.9.1975.
- Utilisation of mine surveying work by land registry offices of 11.12.1975.
- Inspection of records by insurance companies of 13.1.1975.
- Mines supervision and mining industry cooperative association of 23.1.1975.
- Waste disposal of 7.4.1975.

Acts, administrative orders and decrees issued by the Federal Government and the Land Nordrhein-Westfalen with special significance for the mining industry :

A. Federal Government

- Young Workers Protection Act (revised) of 15.4.1976 (BGBl. I p. 965).

- Order for the Vocational Training of Mine Mechanics of 30.6.1976 (BGBl. I p. 1733).

- Federal Construction Law Amendment Act of 18.8.1976 (BGBl I p. 2221).

- Second General Set of Administrative Regulations implementing Title XI - Central Register of Trades - of the Industrial Code of 7.5.1976 (supplement to Federal Gazette no. 62 of 30.3.1976).

- Explosive Materials Act of 13.9.1976 (BGBl I p. 2737)

- Wildlife and Countryside Protection Act of 20.12.1976 (BGBl. I p. 3574).

B. Land Nordrhein-Westfalen

- Second Order amending the order on the supervision of by-product recovery and processing plants by the mining authorities of 7.5.1976 (GV. NW. p. 190).

- Second "Land" Building Regulations Amendment Act of 15.7.1976 (GV. NW. p. 264)

- Administrative order issued by the Chief Mines Inspectorate of Nordrhein-Westfalen on 16.7.1976 amending the administrative order on an industrial safety and works medical service.

- Administrative order issued by the Chief Mines Inspectorate of Nordrhein-Westfalen on 10.12.1976 amending the administrative order on lignite mines.

- Noise protection measures of 17.5.1976.

- Guidelines for the handling of dangerous materials of 20.7.1976.

- Guidelines on fire precautions in the coalmining industry of 25.10.1976.

- Instructions for the implementation of BVOE of 5.7.1976.

- Design regulations for small diesel locomotives of 8.6.1976.

- Guidelines for the use of parallel connection firing apparatus of 4.11.1976.

- Guidelines for explosives stores in mines in underground other than coalmines of 22.12.1976.

- Rockfall guidelines of 9.4.1976.

- CH_4 exception guidelines of 30.4.1976.

- Guidelines for hand-held explosimeters of 12.5.1976.

- Guidelines for portable methane (CH_4) monitoring devices of 16.6.1976.

- Guidelines on outbursts of gas of 6.8.1976.

- Guidelines for fixed carbon monoxide (CO) monitoring devices of 18.8.1976.

- Guidelines for stability tests of 4.3.1976.

- Collaboration between mining authority and water authorities of 23.11.1976.

- Safety regulations for surveying work of 10.3.1976.

- Training of industrial safety experts of 19.5.1976.

Medical aid plan of 15.10.1976.

Approval procedure for coking plants of 12.3.1976.

Central register of trades of 9.12.1976.

II. Saar

Administrative Order issued by the Chief Mines Inspectorate for the Saarland and Rhineland-Palatinate on 21.3.1975 on exploration and geophysical prospection.

Administrative Order issued by the Chief Mines Inspectorate for the Saarland and Rhineland-Palatinate on 1.6.1976 on coalmines.

Directive issued by the Chief Mines Inspectorate for the Saarland and Rhineland-Palatinate on 15.9.1976 on fire-fighting in underground coalmines.

Regulation issued by the Chief Mines Inspectorate for the Saarland and Rhineland-Palatinate on 15.9.1976 on fire prevention in underground coalmines.

Directive issued by the Chief Mines Inspectorate for the Saarland and Rhineland-Palatinate on 20.10.1976 on the destruction of explosives.

Directive issued by the Chief Mines Inspectorate for the Saarland and Rhineland-Palatinate on 7.12.1976 on the establishment and management of explosives stores in underground non-coal mines.

Directive issued by the Chief Mines Inspectorate for the Saarland and Rhineland-Palatinate on 30.12.1976 on the specifications relating to stonedust and the testing of dusts.

FRANCE

- Instructions on the prevention of pneumoconiosis and silicosis in coalmines,

- Regulation on the protection of workers in mines and quarries employing electrical apparatus,

- Instructions on teh control of flammable dusts in mines for the extraction of solid mineral fuels.

UNITED KINGDOM

- The Mines and Quarries (Metrication) Regulations 1976 which substitute metric measurements for imperial measurements in certain parts of the Mines and

Quarries Act 1954 and in

(i) The Coal and Other Mines (Height of Travelling Roads) Regulations 1956;

(ii) The Coal and Other Mines (Ventilation) Regulations 1956;

(iii) The Coal Mines (Clearance in Transport Roads) Regulations 1959.

- The Coal Mines (Precautions against Inflammable Dust) Temporary Provisions Regulations 1976 were made to allow a modified sampling procedure for the long periods of summer holiday.

- The Fire Certificates (Special Premises) Regulations 1976 which provide for the inspection and issue of Certificates to buildings at the surface of mines.

ANNEX V

R E C O M M E N D A T I O N

on the application of dust binding by hygroscopic salts as a means of combatting coal dust explosions

adopted by the Mines Safety and Health Commission on 3.9.1976 and submitted to the governments of Member States in accordance with Article 1 of its terms of reference for action in accordance with Article 4

1. Introduction

On 23 November 1970 the Mines Safety and Health Commission instructed the Working Party on Flammable Dusts to study protective measures against dust inflammations and explosions, in particular:

- neutralization of dusts (in situ dust suppression, stone dusting, spraying, dust binding by salts and coagulating pastes, powders etc.), this study to comprise comparative analysis of the regulations applying in the Member States and the United Kingdom, and of the ways in which the various procedures are applied;

- water barriers of varying designs for halting dust explosions, hybrid explosions of dust and firedamp and pure firedamp explosions.

In accordance with a proposal of the Working Party on Health, in situ dust suppression, considered a priority measure, was dealt with in the 'Recommendation embodying directives on means of suppressing dust concentrations in underground workings', published in the 8th Report of the Mines Safety and Health Commission, Annex VI, June 1971, while the Working Party on Flammable Dusts drew up the following three information reports, which were adopted by the Mines Safety and Health Commission on 22 January 1974 and 3 May 1974 and annexed to the 11th Report of the Mines Safety and Health Commission (Annexes VI, VII and VIII):

1. Information report on procedures for neutralizing dusts using salt pastes, powders and flakes.

2. Information report on water barriers for containing dust explosions underground, as used in the Federal Republic of Germany.

3. Report on triggered barriers and recommendations for their use underground.

The first report deals with one of the ways of neutralizing or binding dusts and describes the experience gathered in Germany and the Netherlands in the application of this procedure, which was made a statutory requirement following the results of a number of conclusive full-scale tests.*

In the report, the Mines Safety and Health Commission discusses the advantages and disadvantages of this new procedure, with the aim of assisting the appropriate bodies to select the most effective procedure for each application. It takes the view that dust binding using hygroscopic salts is an effective way of neutralizing inflammable dusts, that it can be used along with other methods already adopted, and that other countries could make use of it.

Following the experience gathered in several Member States, the Mines Safety and Health Commission considers it appropriate to submit immediately to governments the present recommendation on dust binding by means of hygroscopic salts, with the objective of preventing dust explosions, without waiting until a recommendation on barriers, (the ultimate means necessary to stop an explosion), is finalized.

* See points 5 and 6 of the References on p. 8 of this document.

The principle of the action of hygroscopic salts and the application thereof in mines are listed in Annex VI of the 11th Report and summarized in the Annex to this recommendation. It may simply be stated here that pastes, powders and flakes of the hygroscopic salts $CaCl_2$ and $MgCl_2$, distributed on the roof, sides and floor of roadways, combine with the dampness in the air in the mine to form an agglutinating solution which retains the dust.

This action is continuous and long-term, the dust being retained as long as enough of the saline binder is present. In a roadway with a low dust make, it may remain effective for several months, whereas in a roadway with a high dust make, experience has shown that it may be necessary to renew the saline compound once per month, or even more often.

With the non-continuous stone dust method, a layer of coal dust may be deposited between applications. This layer varies in thickness according to the dust make and, in certain circumstances, even a very thin layer of 0.1 mm may be enough to propagate an explosion. In order to provide adequate protection against explosions, stone-dusting has thus to be carried out at appropriate intervals. Trials are planned in the U.K. and U.S.A. with continuous stone-dusting; these will be followed with interest.*

Compared with spraying with water alone, the solution of hygroscopic salts has the advantage that it does not evaporate, the duration of its effectiveness depending solely on the quantity of dust to be bound.

The dust binding method therefore constitutes a positive step forward in protection against coal-dust explosions. Its application is particularly advisable wherever appreciable quantities of coal-dust are produced, e.g. by coal winning and conveying operations, and deposited on the roadway roof, sides, and floor by the ventilating current. This applies particularly to gateroads and other belt conveyor roads and to transfer and loading points. It would

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* Long-term tests on the stone-dust method are currently being carried out in the U.S.A., and in the U.K. The results are awaited with interest.

theoretically apply to coalfaces, and in the immediate vicinity thereof, but the technique cannot be employed here for practical reasons.

In addition to its effectiveness against explosions, the procedure has other advantages:

a) a retarding effect on timber fire when the salts are applied to mine timber, particularly when the wood has been impregnated in advance with a saline solution;

b) a beneficial effect on health, the environment and the climate since the penetration into the lungs of fine dust and particularly in the irritation due to coarse dust, are considerably reduced, and visibility is much improved. The humidity is also reduced.

However, the procedure does have certain disadvantages which are described in the preceding report (Annex VI of the 11th Report), the most important being corrosion and in particular the effects thereof on electrical installations. Following a report by the Working Party on Electricity, these effects were described in a 'Policy statement on the deleterious effects of dust-binding processes using saline pastes and powders upon electrical plant underground', (9th Report of the Mines Safety and Health Commission, Annex IX - July 1972).

This question is covered in the information report, Annex VI to the 11th Report, in which the Mines Safety and Health Commission lists the measures which can be taken to reduce these deleterious effects, and in which it takes the view that these disadvantages should not be regarded as an obstacle, given the good results in the suppression of the inflammable dust.

The application of salts may occasion inconvenience to personnel, either during the spreading of the powder, or by making the floor slippery. These disadvantages can be minimized by certain precautions (Annex VI to the 11th Report). The method of use, amply explained

in the information report, is summarized in the Annex, both for the treatment of the floor by flakes and for the treatment of the roof and sides by paste or powder, or by a combination of these saline products. However, an effective neutralization of dust in those cases where salts are used is obtained either :-

a) by treating the entire periphery of the roadway with a binding agent;

   or

b) by treating the floor with a dust binding agent (generally flakes) and using the stone-dusting process for the sides and the roof, allowing for the fundamental limitations of the latter process as mentioned.

When the dust binding process is used on the entire periphery of a roadway, use must be made of water barriers and not of stone dust barriers. As stone dust and coal dust alike are rendered indispersable by pastes and powders, stone dust barriers become largely ineffective.(1)

In addition, dust binding need not be used for explosion prevention purposes:

- in permanently very wet mine workings or sections of roadways (either naturally or artificially wet).

- where protection against explosions can be maintained effectively by stone dusting.

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(1) At the moment, there is insufficient experience on the aglomerating effect of the hygroscopic salts, on water-proof stonedust used in certain countries in stonedust barriers.

Furthermore, dust binding by hygroscopic salts is not recommended in the following cases:

- in very steep workings, because these can be particularly slippery;

- in faces and in the immediate vicinity of the face if there is any particularly sensitive equipment in these zones;

- in the immediate vicinity of the trolley wires in trolley loco roads and of the load-bearings and haulage elements of overhead monorails, as well as rope haulage.

3. Recommendation

1) The Mines Safety and Health Commission recommends the proper application of hygroscopic salts as a protection against dust explosions, particularly in places where coal dust makes are likely to be high.

2) The Mines Safety and Health Commission considers that stone dusting, whether applied over the whole periphery of roadways or in combination with dust binding on the floor is a suitable alternative provided it is regularly and properly applied. Particular attention is drawn to the danger when a layer of coal dust forms on stone dust (even a thin layer).

3) The recommendation does not apply to naturally and constantly wet mines and does not preclude water spraying at certain points in the mine.

References:

1. Dust consolidation.

Approved manner of consolidating dust on the floor of a road and rendering it indispersable.

2. Merkblatt für die Anwendung des Chlorcalcium-Montan-Pulvers.

Published by the Hauptstelle für Staub- und Silikosebekämpfung (dust and silicosis prevention centre) of the Steinkohlenbergbauverein, Essen. August 1967 edition.

3. Hamm: "Untersuchung des Staubbindevermögens hygroskopischer Salzpasten zur Staubbekämpfung im Steinkohlenbergbau", Berichte der Versuchsgrubengesellschaft, issue 13, 1969.

4. W.Externbrink: "Betriebserfahrungen bei der Staubbekämpfung mit festen hygroskopischen Salzen", Glückauf 1970, issue 21, pages 1020/26.

5. Lutte technique contre les poussières dans les mines - deuxième programme "Versuchsgrubengesellschaft mbH - Dortmund" - 31.12.1968 (Doc. No 816/69).

6. Reports of the Tests carried out at the above Test mine (Versuchsgrubengesellschaft).

ANNEX

1. Principle of dust binding with hygroscopic salts

The principle of dust binding is that the dust generated during operations is thoroughly moistened with water to ensure that it remains indispersable. In order to prevent evaporation, aqueous solutions of highly hygroscopic salts such as calcium chloride ($CaCl_2$) or magnesium chloride ($MgCl_2$) are used. A surface active substance (wetting agent) is added to these solutions since coal dust usually cannot be sufficiently moistened by water or saline solutions alone.

These saline solutions crystallize at relative humidities of less than 40%. Above 40% (which covers climatic conditions in the West European coal industry) the concentration of the saline solutions is determined by the prevailing air humidity and temperature. It is conditioned by absorption of water from the airstream or by evaporation as the case may be.

The dust which settles on the roofs, sides and floors of roadways is constantly moistened by this saline solution which contains wetting agents. The thickness of the layer of moistened dust increases as long as sufficient wetting agent solution can reach the surface and is thus available to bind the dust that is constantly being produced. Dust binding ceases when the dust make is too great for the solution available and blowing causes the dust to disperse. A further application is then necessary.

An information report on the type and composition of dust binding agents has already been published*.

Dust binding capacity is variable and decreases:

- as the proportion of fine particles in the dust make increases;
- as the proportion of dirt in the dust decreases;
- with certain types of coal dust.

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* 11th Report of the Mines Safety and Health Commission (1973, Annex VI).

2. Application of dust binding agents

Treatment of the floor

Salt flakes are the most suitable binding agents for treating the floor. They can be applied manually (with a shovel) or mechanically.

Care should be taken to ensure that small coal and dust accumulations are first removed from the floor. The salt flakes can with advantage be applied to existing layers of stone dust in order to make the surface less slippery. This particularly applies to inclined workings.

Treatment of roof and sides

Salt paste and powder are both suitable for binding dust on the roof and sides. For further details reference should be made to the information report mentioned * in paragraph 1. on p. 2 of this report.

Combined applications

Paste, powder and flakes can be used individually or in combination. When paste and powder are applied sufficient saline substance generally falls on to the floor to make any special treatment of the floor unnecessary, unless special sources of dust are present (transfer points, loading points, airlocks). Flakes can be used for any additional floor treatment which may prove necessary. Flakes on their own are suitable only for treatment of the floor and possibly the bottom part of roadway sides.

Effective dust neutralization is achieved:

a) by treating the whole roadway periphery with dust binding agents;

b) by treating the floor with binding agents (usually flakes) and by applying stone dust to the roof and sides. Stone-dusting, however, is subject to the basic reservations expressed in item 2. of the Recommendations (Para. 3. 2. p. 7).

ANNEX VI

NINTH REPORT

on

Mine Rescue Services, Organization, Personnel, Apparatus available, and recent developments for rescue work in irrespirable atmospheres, giving the position in Member States of the Community as at 31.12.1975

(Adopted by the Mines Safety and Health Commission on 23rd. March 1977 in accordance with Articles 3 and 6 of its Terms of Reference)

MINE RESCUE SERVICES

1. Main coordinating Agencies:

	Address of Agency	Telephone No.
Allemagne (Germany)	Haupstelle für das Grubensrettungswesen:	
	Essen	0201/21866
	Aachen	0241/71089
	Friedrichsthal (Saar)	06897/8015
Belgique (Belgium)	Coördinatiecentrum, Reddingswezen, Kempische Steenweg 555, B 3500 Hasselt	011/22/28/87
France (France)	Monsieur J. Cretin, Belle Roche Rescue Centre, F 57 Merlebach, Lorraine.	87/04/19/95
	Monsieur G. Rogez, Rescue Centre Nord-Pas-de-Calais, Rue Notre Dame, F 62 Lens.	21/28/24/31
Irlande (Ireland)	Rescue Services based on individual mines (Rescue Superintendant)	See Mine Telephone Nos.
Royaume-Uni (United Kingdom)	J. Blunt Esq., N.C.B., The Lodge, South Parade, Doncaster, Yorkshire, England.	0302/66611
	B. Goddard Esq., N.C.B., The Lodge, South Parade, Doncaster, Yorkshire, England.	0302/66611
	H.M. Inspector of Mines & Quarries, Health and Safety Executive, Millbank, London, SW1P 4QL. (Mr. Carver: Mr. Rhydderch)	01/211/3000

	ALLEMAGNE (Germany)	BELGIQUE (Belgium)	FRANCE (France)	IRLANDE (Ireland)	ROYAUME-UNI (United Kingdom)
2. Number of Central Rescue Stations: (This list includes only those that are manned 24 hours/day)	5	4	2	none	25
3. Number of Local Rescue Stations:	105	6	35	none	1
4. Number of fully-trained full time rescue personnel: a) coal mines	207	none	none	none	251
b) other mines	none	none	none	none	none
5. Number of fully-trained part-time personnel: a) coal mines	4 191	436	1213	none	2404
b) other mines	748	-	-	70	120

	ALLEMAGNE (Germany)	BELGIQUE (Belgium)	FRANCE (France)	IRLANDE (Ireland)	ROYAUME-UNI (United Kingdom)
6. Total number of workers on books; men employed underground:					
a) coal mines	122,300	20,549	46,452	250	192,000
b) other mines	5,500	-	-	775	3,166
7. Fully self-contained breathing apparatus with operational life of <u>two hours or more</u>:					
a) type of apparatus	Draeger * & Auer	Draeger * & Fenzy	Draeger * & Fenzy	Caa *	Siebe Gorman * Aerorlox Proto
b) Number available	2540	303	828	54	1350
c) Gas supplied	oxygen	oxygen	oxygen	oxygen	Compressed oxygen and liquid oxygen
d) Rated operational life/minutes	120-240 minutes	120-240 minutes	120-240 minutes	120 minutes	120 minutes

* The Secretariat of the Mines Safety and Health Commission hold details of the numbers of apparatus of each particular type. These can be provided on demand.

	ALLEMAGNE (Germany)	BELGIQUE (Belgium)	FRANCE (France)	IRLANDE (Ireland)	ROYAUME-UNI (United Kingdom)
8. Number of emergencies in last 2 years in which Rescue Apparatus was used: (excluding practices)					
a) coal mines - no. in total:	128	1	32	none	18
for saving life:	none	none	2	none	1
to seal off Districts:	23	1	19	none	6
other instances:	105	none	11	none	11
b) other mines - no. in total:	10	none	2	3	none

	ALLEMAGNE (Germany)	BELGIQUE (Belgium)	FRANCE (France)	IRLANDE (Ireland)	ROYAUME-UNI (United Kingdom)
9. Use of Filter Self-rescuers:					
a) coal mines - no. in use:	126,000	6,200	none		250,000
type of apparatus:	Draeger & Auer	Draeger & Auer	-	Draeger & MSA	MSA
b) if in use in other mines:	yes	no	-	yes (36)	yes

PRINCIPAL CHANGES.

Reports from Rescue Stations

	ALLEMAGNE (Germany)	BELGIQUE (Belgium)	FRANCE (France)	IRLANDE (Ireland)	ROYAUME-UNI (United Kingdom)
1. Changes occurring since 1970 in Organizational Procedure:	No changes in Organizational Procedure.	New instructions to directors of rescue stations allowing greater latitude in drawing up 3-year organizational plans.	Introduction of radio for calling out rescue workers from their homes in the Lorraine.	Each of the four large metal mines has 2 rescue teams available co-ordinated by a Mines Rescue Superintendant.	No changes in organizational procedure since 1970.
2. Changes since 1970 in Operational Procedure:	No changes in Operational Procedure. The VHF radio alarm system has benn extended to all mines.	The organizational plans allow for the mines to have greater responsibility for rescue service cover than hitherto. Radio call out of rescue workers in the near future.	-	Fire and Rescue Regulations enacted in 1972 which require teams to have regular practices. These services are available to all mines.	The organization of individual Rescue Stations has been linked to form a fully integrated National Service.

	ALLEMAGNE	BELGIQUE	FRANCE	IRLANDE	ROYAUME-UNI
3. Changes in Type of Apparatus:	Replacement of the Draeger BG 160A apparatus by the Draeger BG 174 apparatus, having 240 minutes operational life.	Replacement of the Draeger BG 160A by the Draeger BG 174 apparatus, having 240 minutes operational life.	Introduction of 652 Fenzy 66 giving 45 minutes of protection in oxygen deficient atmospheres. Introduction of Draeger BG 172 and 174 apparatus with 240 minute life.	The mine opertors are Canadian based companies and have adopted the McCaa type apparatus.	No changes in apparatus in use; development of compressed oxygen rescue apparatus and escape apparatus has continued.
4. Changes since 1970 in types of Fire, Combustion or Explosion experience:	The following procedures have been introduced and extended : -Hydromechanical Hard-stem stoppings (also over great distances) -The use of Nitrogen to reduce the risk of explosion -Pressure balancing to reduce the rate of spontaneous combustion or fire.	No change noted in this period.	Detection of heatings by multi-directional UNOR apparatus with compressors.	No changes in fire, combustion or explosion experience noted.	One exlosion (Houghton Main). Several spontaneous combustion fires of various magnitudes including one at a Potash mine.

ANNEX VII

The Use of Filter Self Rescuers in European Coal Mines

PART II. Maintenance and Training

(Adopted by the Mines Safety and Health Commission as an important information report in accordance with Articles 3 and 6 of its Terms of reference on 23rd. March 1977)

TABLE OF CONTENTS

1. Current Regulations and Instructions in EEC countries

At present only the U.K., Belgium and the Federal Republic of Germany have official regulations or instructions on maintainance, servicing and checking of self-rescuers in the field and schemes for the instruction of personnel in their use.

The relevant documents in the U.K. are the NCB Notes of Guidance on Self-Rescuers comprising :

- NGSR/9 - Maintainance, Withdrawal and Replacement Procedures.
- NGSR/5 and NGSR/12 - Training in the Use of Self-Rescuers (covering the Type 265 and Type 275 respectively).
- NGSR/6 and NGSR/13 - Description of the Type 265 and Type 275 Self-Rescuers.
- NGSR/8 and NGSR/14 - Care and Maintainance of Self-Rescuer Training Models.

In Belgium the relevant instructions are contained in

- The Royal Decree dated 2nd December 1957 : approval, provision, daily inspection and maintainance of self-rescuers ; initial training.
- The Circulars of the Director General of Mines Nos. 106, 106 bis, 106 ter and 106 quater : conditions of approval for self-rescuers, daily checking and maintainance, initial training of personnel.
  - Directives for the training of instructors in the use of filter self-rescuers.
  - Directives for the training of personnel in the use of filter self-rescuers.
  - Directives for the cleaning and disinfection of the training model filter self-rescuers.

In Germany, the relevant documents are the following regulations :

- Guidelines for the Construction, Testing and Assessment of Self-Rescuers.

- Scheme for Instruction in the Use, Checking and Maintainance of Filter Self-Rescuers (FSR-Plan).

- Instructions for the various types of self-rescuer.

2. Maintainance and Checking

2.1. General

The aim of maintainance is to ensure that the miner underground is always supplied with a self-rescuer which is effective.
To achieve this the following tests may be required :

(i) Type Acceptance Test (see Part I of this report)
(ii) A Production Quality Control Test
(iii) A Warranty Test
(iv) Serviceability Test (Extension of carrying life)
(v) Checks at the mine :

Daily inspection
Periodic weighing
General serviceability assessment

2.2. Responsible Persons and Testing Laboratories

2.2.1 At the Mine

It is important that the responsibility for routine checking and maintainance of self-rescuers be clearly defined :

In Belgium, the U.K. and Germany, the manager of the mine, or his appointee, is responsible for the checking and maintainance of self-rescuers. In the U.K. overall supervision is undertaken by staff at a central point. In the Federal Republic of Germany and in Belgium, technicians are specially appointed at the mine for checking and maintainance.

2.2.2 Testing Laboratories

The above mentioned tests - with the exception of work done at the mines - are carried out by the following establishments in their respective countries :

In the United Kingdom :
NCB Scottish Laboratory, Edinburgh.

In Belgium :

Institut National des Industries Extractives (INIEX), Division de Pâturages.

In Germany :

Hauptstelle für das Grubenrettungswesen, Essen.

The Hauptstelle für das Grubenrettungswesen in Hohenpeissenberg (Type approval only)

2.3. Maintainance at the Mine

2.3.1. Daily servicing

Similar servicing procedures exist in all member states. When self-rescuers are returned at the end of the shift, a visual inspection is carried out. Those that are obviously damaged are replaced immediately from stock. There are minor differences in the system from one coal field to another.

2.3.2. Weighing

Regular weighing of filter self-rescuers is used to check whether a rescuer has absorbed moisture from the atmosphere. Absorption of moisture will reduce the effective life of the rescuer and indicates faulty sealing of the rescuer case. An early detection of moisture pick up enables the seals to be repaired. The frequency of regular weighing is dictated by local circumstances, but shall not be less than quarterly.

Periodic weighing is not essential with vacuum-sealed filter self-rescuers, as the loss of vacuum will be indicated by the opening of the case. For safety reasons the rescuers should still be weighed at least once a quarter.

2.3.3. Withdrawal from service

In Germany self-rescuers that have gained more than 12 g. in weight because of absorption of moisture are withdrawn from service. The Belgian practice is similar to that in Germany and it is intended to introduce the same requirement in the U.K. when new type filter self-rescuers (275) come into service, to replace the present regeneration procedures.

In Germany and Belgium the dustiness is taken into account in the points system for the routine re-licensing the rescuer after 4 years in the field.

In Britain if a rescuer is found to have more than 4 g. of loose reagent fines in the bottom of the case it is removed from service and replaced.

2.4. Replacement of Self-Rescuers

2.4.1. In the United Kingdom :

In the United Kingdom the testing and replacement of self-rescuers in service do not follow a rigid system ; it is regarded as desirable to replace all self-rescuers over a period of about 8 years. The replacement does not, however, follow a strictly chronological order but is based on continual assessment of the performance of self-rescuers in the field, spot checks and periodic sampling and testing. This may mean that some self-rescuers are replaced before 8 years have elapsed.

2.4.2. In Germany :

In Germany it is accepted that a self-rescuer has a carrying life of at least 4 years without any significant deterioration of its performance. After this time all self-rescuer production series must be tested in a Central Testing Laboratory * to see whether they are suitable for further use. The assessment is based on a points system which takes into account the general condition of the rescuer, the dustiness of the filter, the breathing resistance and the CO-slip. According to the points value obtained the rescuers may either continue in service for a further year or 9 months (followed by a resample), 6 months definitive life or immediately be withdrawn. For the above tests a 1% sample is taken. If the warranty performance only has to be checked, a 0,5 % sample of the series is sufficient. The system is described in detail in the annex.

2.4.3. In Belgium :

In Belgium the German rules have been adopted except that for warranty testing a 1% sample is taken (not 0,5 %).

2.4.4. Reserve Stocks

In the U.K., Belgium and in Germany, self-rescuers withdrawn from service are replaced either from reserve stocks held for the purpose or from current production. The reserve stocks are subjected to periodic checks. Reserve rescuers are weighed and examined before reissue.

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* (The Hauptstelle für das Grubenrettungswesen, Essen-Kray)

The actual carrying life of a self-rescuer in service cannot be predicted with certainty in spite of much accumulated experience to date. It depends on a number of factors including the quality of the rescuer when new and the conditions it meets in daily use. The replacement of self-rescuers, therefore, is always based on the results of check tests described above.

3. Training

3.1. Introduction

In addition to the technical quality of the filter self-rescuers the training of personnel in their use is of paramount importance. Experience has shown that a rescue system is successful only when all men are well trained in the use of self-rescuers and keep them always ready to hand. The aim of the training is to ensure that miners know when, how and where a self-rescuer can and should be worn and that they are aware of its effective life. They must be able to open and don their self-rescuers in complete darkness and in unfavourable conditions.

To this end the training course must explain the purpose, construction, operation, handling and use of filter self-rescuers. It must also cover the possible production of toxic gases by mine fires and explosions and their effect on man. Special mention should be made of the fact that a self-rescuer will get hot in atmospheres containing high concentrations of carbon monoxide. The correct behaviour when wearing the rescuer during escapes must be stressed. To get the necessary dexterity and "the feel" of the self-rescuer an exercise session is necessary. The training must stress that - in order to save lives - the rescuer must always be ready to hand and therefore it should be carried on the person at all times. At the end of the training a test should be carried out to make sure that all men can open, don and wear their filter self-rescuer correctly in the dark.

3.2. Responsible Persons

In the U.K., in Germany and in Belgium at every colliery a person is nominated by the manager to be responsible for the carrying out and supervision of training of pit personnel in the use of self-rescuers. Additional personnel is provided to assist with the instruction and training.

The person in charge is responsible both for the initial training of new employees and for the refresher training of all underground personnel.

3.3. Training of Personnel employed underground at the mine

3.3.1. General

It is advisable that training is carried out in small groups; the number in each group being dependent on local circumstances. An adequate number of practice self-rescuers should be available. The importance of carrying the self-rescuer on the person at all times should be emphasized.

3.3.2. Initial Training

The initial training for new entrants into the industry should include an explanation of the function, use and the limitations of the filter self-rescuer, together with a practical demonstration of the procedures for opening, donning and wearing. A practice session and exercise wearing a self-rescuer must be included, and on completion of the training, every participant should be given a booklet describing the use of the rescuer.

3.3.3. Refresher Training

Refresher training of personnel in the use of filter self-rescuers is to be given at intervals not exceeding 2 years. Its main purpose is to give men practice in opening and donning the rescuer and to familiarise them with the feel and the breathing resistance of the rescuer in the wearing position when walking and crawling.

3.4. Special Training

In Belgium[+], Germany and the United Kingdom all persons not normally employed below ground, who wish to go underground and who have not attended a training course in the use of self-rescuers, shall be given a demonstration and instruction in the use of rescuers before going underground.

+) In Belgium this rule is not applied to weekend visitors who are not employed in coalmining'.

3.5. Training of Instructors and Maintainance Personnel

In Belgium, Germany and in the United Kingdom training of self rescuer instructors is the responsibility of the Rescue Service. The training syllabus is practically identical in all three countries. Copies of the Training Instructions are attached as Appendices. The number of instructors required depends on the organisation and size of the colliery.

The training of self-rescuer maintainance men proceeds along similar lines in the three countries, where the responsible centres are the Centrale de Sauvetage, the Hauptstelle für das Grubnerettungswesen, and the NCB Scientific Control (Area or Regional Scientist).

3.6. Training Aids

Suitable aids and equipment are necessary. The most important item is the training model self-rescuer which enables the opening, fitting and wearing of a self-rescuer to be simulated. The training models must be so constructed that they differ as little as possible from the normal rescuer, and are easy to clean and disinfect.

Other useful aids to training are films, slide/sound tape combinations, and instruction booklets. They are used in all member countries. The aids employed should have the approval of the competent establishments.

Annex VIII

MEMORANDUM

on

THE NEUTRALIZATION OF MINE FIRES BY THE INJECTION OF NITROGEN

(Adopted by the Mines Safety and Health Commission on 23rd March 1977 as an important information report in accordance with Articles 3 and 6 of its Terms of Reference)

Introduction

The Working Party on Mine Rescue Arrangements of the Steinkohlenbergbauverein decided to prepare this memorandum after several mine fires had been successfully controlled in 1974 and 1975 by the injection of gaseous nitrogen, and a considerable decrease was effected by this method in the risks associated with the control of mine fires. The memorandum's primary aim is to enable collieries to prepare themselves for the application of this method; at the same time it was intended to serve as a record of the practical experience gained.

The task of drafting the memorandum was undertaken by a working party composed of a number of experts employed by collieries and the Central Office for Rescue Arrangements, (under the direction of the colliery general manager, Dr. G. Lange). The contents were agreed with the Landesoberbergamt NW (North Rhine-Westphalia Chief Mines Inspectorate), to which we are indebted for a number of valuable suggestions.

The memorandum should be viewed as a first attempt to set out in concise form the essential facts relating to the use of gaseous nitrogen below ground. A revised version will be issued should additional information become available.

Central Office for
Rescue Arrangements

MEMORANDUM
on the neutralization of mine fires by the injection of nitrogen

Memorandum
on the neutralization of mine fires by the injection of nitrogen

1. General information

1.1. Aim and present state of development of the neutralization procedure

The neutralization of inflammable or explosible gas mixtures in tanks and pipes is common practice in coking plants, refineries and the chemical industry, the flows of inert gas required varying in size. For the neutralization of underground workings, however, substantially larger flows of inert gas are required per unit of time. There is an international bibliography on the control of mine fires by means of inert gas [7.1.]. In the Federal Republic of Germany six mine fires were recently neutralized with nitrogen; account was taken in writing this memorandum of the knowledge thereby gained.

The neutralization procedure was first used in the Ruhr in 1967, to limit a combustion zone at the Graf Moltke colliery. The aim was to enable a mine rescue team to be sent in safely (to move stoppings forward) by introducing non-explosible gas mixtures into the combustion zone. It had only limited success, since the output of the inert gas generator (fuel oil burner) used at that time was insufficient. As only 15 m^3 of inert gas could be produced per minute, several weeks were needed due to the leakiness of the stopping in order to eliminate the risk of explosion in the combustion zone. It was learned from this experience, however, that flows of inert gas of some 50 m^3/min. are required if the neutralization procedure is to be successfully carried out in sealed areas of the workings.

Annex 7.1. Bibliography.

For open fires inert gas flows of more than 100 m^3/min. are considered necessary.

The injection of nitrogen into workings can be considered

a) in order to convert explosible gas mixtures into non-explosible gas mixtures;

b) in order to reduce the supply of oxygen to concealed fires so that the fire abates;

c) in addition, to extinguish open timber and belt-conveyor fires and other open fires, and to cool the atmosphere for access to sealed-off combustion zones (improvement of conditions to enable mine rescue teams to be sent in).

This memorandum is concerned solely with the use of nitrogen as an inert gas, as it is as present only with this gas that the procedure is likely to succeed. The procedure entails the evaporation above - ground of nitrogen delivered in liquid form and its transport through pipelines in a gaseous state to its places of use underground.

1.2. Purpose of the memorandum

The purpose of the memorandum is to explain in detail exactly how the neutralization procedure should be organized and carried out. It indicates also the security measures to be taken when handling nitrogen for the generation of inert gas mixtures in underground workings.

The memorandum contains the following basic information:

a) the physical characteristics of nitrogen;
b) the delivery of nitrogen;
c) the procurement of evaporators;
d) the energy requirements of evaporators;
e) transport to the place of use of the liquid nitrogen;
f) injection into the mines of the gaseous nitrogen;
g) security measures to be taken during the neutralization procedure;
h) monitoring of the procedure's success.

1.3. Physical characteristics of nitrogen

Nitrogen is a non-poisonous, odourless, colourless gas with an asphyxiating effect through the displacement of oxygen. When used to neutralize concealed fires, nitrogen normally forms no chemical compounds so that no poisonous nitrogen compounds are likely to occur.

With open fires, small NO and NO_2 concentrations can occur at temperatures of 1000°C. These concentrations can be detected with test tubes (Dräger and Auer).

As the mine rescue team wears oxygen breathing apparatus on the return side, there is no increased risk if these gases occur.

Conversion of liquid quantities into gas quantities

1	kg N_2 liquid = 1.25 l = 0.8 m^3	N_2 gaseous at 0°C/760 torr
1.25	kg N_2 liquid = 1.55 l = 1.0 m^3	N_2 gaseous at 0°C/760 torr

Molecular weight :	28.01
Melting point :	-210°C
Density, liquid, at boiling point :	0.81 kg/l
Boiling point :	-195.82°C
Density, gaseous, in terms of air = 1	0.97
Density, gaseous :	1.25 kg/m^3 at 0°C/760 torr
Evaporation heat :	198.2 J/g
Critical temperature :	146.9°C
Critical pressure :	33.84 (bar)
Specific heat at 20°C :	1.038 J/g degrees
Heat conductivity at 0°C :	240 µW/cm degrees

For the evaporation, and heating to around 5°C, of 1 kg of liquid nitrogen, the energy requirement determined in practice is approx. 630 x 10^3 joules (150 kcal).

1.4. Example of neutralization using nitrogen

The following considerations are based on the example of a face with a working length along the strike of 1 000 m, a length of 200 m and a seam thickness of 2 m, worked by caving.

The cavity volume (area mined) is 400 000 m^3, without regard to the filling factor of the caved goaf.

Two roadways, each with a sectional area remaining of 10 m^2, account for an additional volume of 20 000 m^3, so that the theoretical total cavity to be filled is 420 000 m^3.

Since it is not known with any precision how great or variable is the filling factor of the caved goaf, and the need must also be anticipated for several complete changes of "air", the total nitrogen requirements can be many times the quantity calculated.

However, the quantity of nitrogen required also results from the assignment :

to eliminate the risk of explosion, as much nitrogen must be supplied as will cause the oxygen level to fall to e.g. <12 Vol.% O_2.
If substantial H_2 concentrations are present, the oxygen level must be lowered to <5.0 %. If, in order to control a concealed fire, the oxygen content must be lowered still further, the necessary quantity of nitrogen will of course be greater than in the case of neutralization intended to prevent the risk of explosion.

For the delivery of, e.g., 420 000 m^3 of nitrogen, about 28 tank trucks of liquid nitrogen are required, each containing 15 000 m^3 of gaseous nitrogen.

Supposing a nitrogen requirement of 6 000 m^3/h (100 m^3/min), a complete filling process (without flushing) will take 70 hours, i.e. each tank truck load will be used up after two and a half hours.

1.5 Conditions for use of the neutralization procedure

In neutralizing combustion zones, the most important condition is to ensure that the area to be neutralized is as tightly sealed off as possible, on one side at least, from the other workings, in order to keep the nitrogen requirement to a minimum.

For the sealing-off process the rules should be observed of Section 5 of the 'Richtlinien für den Brandschutz unter Tage auf den Steinkohlenbergwerken im Oberbergamtsbezirk Dortmund' (Conditions for Fire Protection Underground in the Collieries of the Dortmund Chief Mines Inspectorate Area) of 9.5.1963, or the 'Vorschriften und Richtlinien für die Brandbekämpfung unter Tage auf Steinkohlengruben' (Rules and Regulations for the Control of Mine Fires Underground) of the Saarbrücken Chief Mines Inspectorate of 4.11.1965.

The more airtight the sealing, the more quickly the neutralization procedure will be completed. It can be seen from Annex 7.2 that to control a concealed fire ($O_2 < 1$ Vol.%) the leakage air flow over the source of the fire may be 3 m^3/min with an available 50 m^3/min of nitrogen; to control an open fire ($O_2 < 12$ Vol.%), the air current, with an available 50 m^3/min of nitrogen, must not exceed 45 m^3/min.

A further important condition for the use of the nitrogen neutralization procedure is the availability of sufficient energy for the evaporation of the nitrogen delivered in liquid form.

The energy required to produce 100 m^3 of gaseous nitrogen per minute is shown in the following table :

Form	Unit	Requirement at 100 m^3/min N_2
Saturated steam (5.5 atmospheric excess pressure)	t/h	1.8
Fuel oil	kg/h	88.6
Propane	Nm^3/h	39.2
Electricity	kW	876.1

Another important condition is the presence of a system of pipes running from above ground to the planned feed point of the inert gas, and whose cross-sections and compressive strength are adapted to the quantities of nitrogen required.

2. Delivery of nitrogen and evaporators

2.1. Time required for the delivery of nitrogen and evaporators

Previous experience in emergency cases has shown that on working days a maximum of 12 hours are required for the delivery and complete operational installation above ground of the neutralization equipment. This time may be exceeded on Sundays and holidays. Within this period the measures described under point 3.2 must be taken below ground, in adddition to the sealing on at least one side.

The names of suppliers for nitrogen, evaporators and other equipment are given in Annex 7.9 (7.9.1 and 7.9.2).

2.2. Supply of the evaporators with energy from an outside source

If insufficient steam or hot water from an outside source is

available where the evaporators are installed, steam locomotives (see Annex 7.3) may be used for that purpose. Several colliery-owned steam locomotives are at present available in the Ruhr. Provided a siding is available at the place of operation, these locomotives can run on Federal Railway lines under their own steam; if not permitted to do so, they can be towed to the place of operation by Federal Railway locomotives.

If no siding is available, the locomotive may be loaded onto a Federal Railway low loader and driven to its destination by road. Details on ordering low loaders in accordance with the intended application are provided by the Essen Federal Railways Directorate.

Annex 7.3 gives further information on the locomotives of the various mining companies and the offices which should be contacted with a view to ordering.

2.3. Facilities for steam locomotive operation

If steam locomotives are installed to generate steam, a water connection (hydrant) must be available near the locomotive. A wagon containing suitable steam coal must also be made available for firing the locomotive (see Annex 7.5.1.).

A small conveyor belt should be provided for feeding the steam locomotive with coal from the wagon.

3. Technical data

3.1 Surface operation

3.1.1. Space requirements of tank trucks

For driving the suppliers' tank trucks to the pithead area well-made approach roads are necessary.

The tank trucks have a total weight of 38 t (about 10 t axle load) and a length of 15 m.

A clear passage should be provided for the tank trucks as they frequently have limited manoeuvrability. For safety reasons there should always be a full tank truck at the colliery, or a storage tank should be installed.

3.1.2. Site for evaporators and tanks

The site for the complete evaporating plant should be paved. If the equipment is to be installed in series, a length of some 80 - 100 m is required. The site should be such that waste gases from the vehicles or the mobile evaporator cannot enter the downcast shaft.

Barriers and warning notices should be erected to ensure that no unauthorized persons enter the area when the plant is in use.

A water outlet must be available for the heat transfer arising from steam or hot water operation of the nitrogen evaporators.

The site of the device for regulating the nitrogen feed should if possible be connected by telephone or radio to the surface staff in charge of the operation and by pit telephone to the stand-to area below ground. If necessary, a local battery telephone should be installed.

3.1.3. Connection to the shaft mains

The evaporators are first set up by the nitrogen suppliers. The colliery then provides the power supply if necessary, and the transfer from the tank trucks to the storage tanks or evaporators is effected with tombac hoses. Only then are the evaporators connected to the nitrogen manifold.

The nitrogen manifold is suitably connected to the shaft main with a flexible hose.

If several evaporators are used, the gaseous nitrogen is similarly conveyed to the nitrogen manifold by means of hoses. In this case it is advisable to provide a nozzle with the appropriate

number of hose connection-points at the beginning of the nitrogen manifold (see Annex 7.4).

The nitrogen line running to the shaft must be so laid that manoeuvring vehicles etc., cannot cause it to kink. Pipe or cable conduits can be used for this purpose. A measuring section with a nominal diameter of 150 mm must be suitably placed in the nitrogen line (the recording measuring devices if possible in a heated room).

In one case neutralization was possible only by laying an F hose pipe, about 600 m long and with a nominal diameter of 150 mm through a shaft. The names of suppliers should be listed in the Emergency procedures.

3.1.4. Measuring technique at the surface

The temperature, volume and pressure of the nitrogen flow should be monitored.

Monitoring of the temperature is necessary to ensure that the latter does not fall below +5°C, as there is otherwise - particularly in the shaft pipe - a risk of ice formation and thus of excessive weights. The pressure must be monitored to ensure that a specific operating pressure, dependent on the pipelines used, is not exceeded (excess-pressure or pressure-limiting valves).

Compressed-air line	- maximum operating pressure 10 bars
Water pipes, "DIN Berg", heavy construction	- maximum operating pressure 25 bars
Gas drainage pipe	- maximum operating pressure 4 bars

Measurement of the volume is necessary to permit appropriate regulation of the nitrogen flow. The measuring device for the injection of inert gas described in Annex 7.5 has shown itself to be efficient during operations at the Osterfeld/Sterkrade and Schlägel and Eisen collieries.

A temperature measuring device is recommended which gives an alarm when temperatures exceed or fall below the threshold values set.

3.2. Operation underground

3.2.1. Shaft mains and lines in other underground workings up to the feed point

For the injection of nitrogen for the neutralization procedure, a line of the largest diameter possible should be used due to pressure losses both underground and in the shaft. Its minimum nominal diameter should be 100 mm, and it should have no cross-sectional constrictions. Consideration should be given to whether air, gas-drainage, fresh-water lines or rising mains could be made available or whether hoses should be laid. If necessary, pneumatic stowing pipes or the cooling water lines of air conditioning plants can also be used.

It must be borne in mind here that water and compressed air must always be available in the area concerned for mine rescue purposes (fire extinguishing, sealing). In this connection it must also be verified whether the mine rescue team can be supplied with compressed air and water via rapidly laid C-hoses in order to release the compressed-air or water pipes themselves for the neutralization procedure.

A general idea of the amount of nitrogen conveyed through lines of varying diameter, length and pressure is given in Annexes 7.6.1 and 7.6.2; For more precise figures see Annexes 7.6.3 and 7.6.3./Text.

3.2.2. Leakage tests and flushing of lines with nitrogen or combustion gases.

After a suitable pipe has been chosen, and connected to the nitrogen manifold at the surface through to a point where the nitrogen is injected, a clear passage through the pipe must first be ensured by checking all stopcocks, slide and other valves to see that they are open.

When this has been done, the line should be closed via the slide valves at a safely accessible spot as near as possible to the feed point, and tested for leaks.

It has proved advisable during this procedure, as well as for the subsequent flushing, to employ the hookup scheme used in Annex 7.7. A manometer should be installed between slide valves 1 and 4, If the leakage test has been successfully completed with slide valves 1 and 4 closed, slide valve 4 is opened and the pipe from the surface to the point of insertion of the three-way pipe flushed with nitrogen with slide valve 4 in the open and slide valve 1 in the closed position.

This must always be done when no extra oxygen may be conveyed to the nitrogen feed point. The effectiveness of this flushing should be monitored with a hand-held oxygen meter.

It must next be considered whether it is also necessary to evacuate the oxygen in the pipe laid from the point of insertion of the three-way piece to the nitrogen feed point. This must always be done when the pipe has a large dead volume, and additional oxygen could increase the risk of explosion. With slide valves 1 and 4 closed, and valves 2 and 3 open, the pipe is then filled with fumes using a suitable fan. When this has been done (test with a hand-held CO measuring device or by taking a gas sample), slide valve 3 is closed, slide valve 1 opened and the nitrogen fed from the surface in the required volume (cf Annex 7.7).

Such a three-way pipe must if necessary incorporate adapter pieces for the existing pipe diameters and the fan.

If, however, the nitrogen is fed through a stopping on the return side, against the direction of the ventilation, the use of the fan jet to flush the pipe with fumes is usually unnecessary, as the differential pressure of the mine ventilation should then be adequate for the clearing process.

4; Monitoring of the neutralization procedure

To enable the success of the neutralization procedure to be monitored, the composition of the fumes must be ascertained by sampling as frequently as possible at a suitable point. This must be done by remote sampling when the risk of explosion exists to avoid unnecessary sampling operations.

The gas pump GF 26 of Maihak AG has proved its efficiency for such remote sampling; its monoflex hose pipes enable the gas flow to be conveyed over great distances, continuously or intermittently, to, e.g., the stand-by room, where the gas samples can be taken (see Annex 7.11).

Additional information can be obtained from hand measurements for CO, CO_2, CH_4 and O_2, using hand-held meters.

5. Assessment of the success of the neutralization procedure

The success of the neutralization procedure can be assessed from the hand measurements, or from the analysis of the gas samples which should be taken at suitable points, if necessary by remote sampling.

Judgement is based on the particular aim of the procedure : if the aim is to lessen the risk of explosion, it is generally sufficient to plot the analysis values in explosion triangles and note the tendency shown. Assessment of the course of the fire

with the aid of the Graham ratio is no longer possible due to the presence of N_2.

In controlling concealed fires, an assessment can be made from the oxygen level of the undiluted combustion gases, which should if possible be < 1 Vol.% O_2. The CO production per minute is a further yardstick. However, it must be borne in mind that neutralization by nitrogen has an initial flushing effect as regards CO, depending on the size of the cavity being filled. This effect can lead to an increase in the CO quantities found in the ventilating current over fairly long periods of time. The N_2 supply should accordingly be regulated to avoid to high CO, and if necessary CH_4, CO_2 and H_2 concentrations in the air flow.

6. Safety

6.1. Tank trucks

Liquid nitrogen may be transferred from tank trucks only when the vehicle is parked on level ground (§ 20 VBG 61). Before the fuel lines are attached, the vehicles must be secured against movement, (§ 37 (2) VBG 61)*

6.2. Surface storage tanks for liquid nitrogen

The location of a liquid nitrogen storage tank must be such that it does not restrict the width of escape and transport routes on the site (§7 (1) VBG 61).

The storage tank must be securely positioned and readily accessible on all sides (§ 8 (1) VBG 61).

Particular dangers can occur through electrostatic charges in areas where there is an explosion hazard, and in the area around the upcast shafts (§ 14 (1) VBG 61).

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* List of Safety Regulations of Industrial Cooperative Associations.

A storage tank may be filled with the liquid phase to only 95 % capacity.

Only containers approved by the TÜV (Technical Control Board) may be used.

6.3. Manometers

Only safety manometers may be used, marked with an S on the dial. Safety manometers are so made that in the event of damage persons standing in front of the window indicator cannot be injured by gas or splinters (section 16 VBG 61). Lines should therefore not be closed by means of the slide valves before cessation of the neutralization procedure.

6.4. Pipe and hose lines

Pipe and hose lines must be suitable for the pressures and temperatures required (section 10 (1) VBG 61). The pressure ratings may not be exceeded, even for brief periods.

The pipelines must be so laid as to eliminate dangerous vibrations or distortions (section 12 (11) VBG 61).

Pipe and hose lines must be designed in accordance with the pressures and temperatures.

The characteristics of plastic pipelines and hoses laid underground or in areas at the surface where there is a risk of explosion must satisfy the relevant regulations of the Mines Inspectorate. Electrostatic charges must be reliably prevented, and insulating points by-passed by metal conduction.

If blowoff, air exhaust or stress-relieving lines are planned at the surface, the discharge point of the gases released must be such that persons are not endangered (section 11 (1) VBG 61). It must also be possible to relieve the stress on filling lines so

that the gas emerging entails no hazards to persons (section 19 (3) VBG 61).

6.5. Valve system

The design and material of the valves used must be suited to their particular purpose (liquid or gaseous nitrogen, operating pressure and temperature) (sections 10 and 17 (1) VBG 61).

Spindles must be secured against unscrewing (section 17 (2) VBG 61).

It must be possible to operate all valves from a secure position (section 8 (1) VBG 61).

6.6. Evaporators

Evaporators must be so erected as not to narrow escape and transport routes in the area of the operating buildings (section 7 (1) VBG 61).

No unauthorized pressures may occur in evaporators.

6.7. Operating instructions

The leakage test should be conducted with a maximum 1.1-fold operating pressure.

The inert gas plant may be operated only by persons

a) conversant with the safety regulations and with the surface operation of the plant, and

b) who have been informed of the particular risks involved in handling liquid and gaseous nitrogen, and of the measures to be taken in case of accidents or malfunctions.

When transferring liquid nitrogen, operating personnel must wear protective gloves and goggles. The liquid should on no account be allowed to splash onto human skin.

Breathing apparatus must be available.

The danger area around the inert gas plant must be temporarily cordoned off and signposted. It may be entered only by the operating and supervisory personnel (section 34 (6) VBG 61). Suitable warning notices should be posted (section 37 (3) VBG 61). The danger area is deemed to be the zone in which the splashing of liquid nitrogen is possible.

6.8. Danger of asphyxiation underground

Before starting the neutralization procedure (injecting nitrogen) it must be ensured that no-one is in the area to be washed with nitrogen. Exceptions to this rule are members of the mine rescue team wearing oxygen breathing apparatus.

If there is a fear of a nitrogen delivery line being destroyed, there is also a risk of asphyxiation in these areas when low air currents are present. Annex 7.8 shows that a nitrogen flow of no more than 17 % of the volume of the air current should be discharged in underground workings if the 0_2 level of the air is to be at least 18 %. Underground workings thus at risk should be monitored for 0_2 deficiency.

6.9. First aid

Persons whose skin has come into contact with liquid nitrogen should be treated as suffering from burns. The parts of the body affected should be covered with sterilized cloths. The victim must drink as much as possible (tea, water) and then be taken immediately to hospital.

Frost-bitten extremities may be recognized from their whitish-grey colour and the subsequent formation of blisters. In serious cases the extremity becomes as hard as a board and brittle.

Persons who have fallen unconscious in a nitrogen-rich atmosphere must be removed at once from the danger area and revived. A doctor should be called.

Essen, March 1976.

Annex 7.1

Bibliography

Possibility of using inert gas to suppress mine fires

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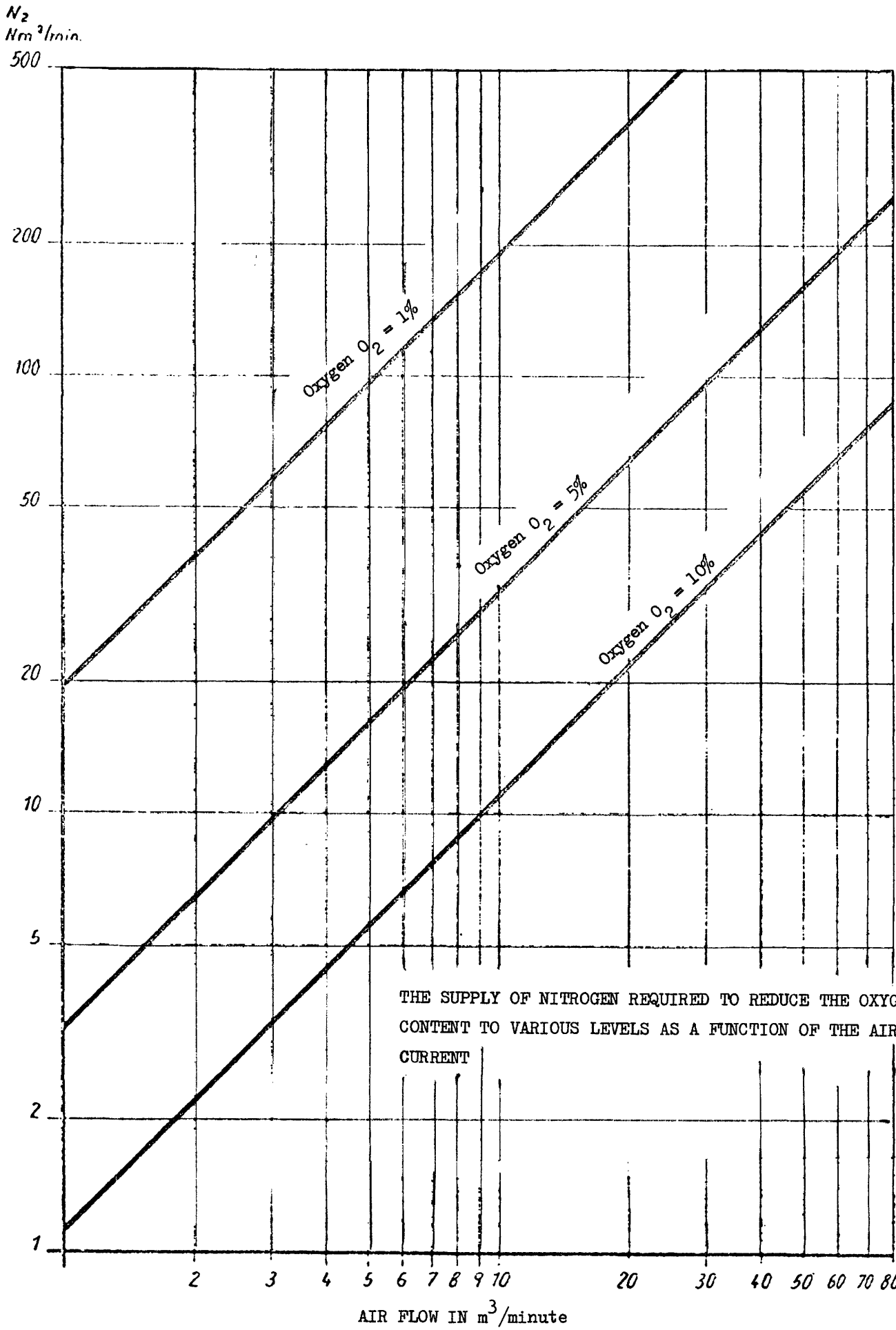
Annex 7.2

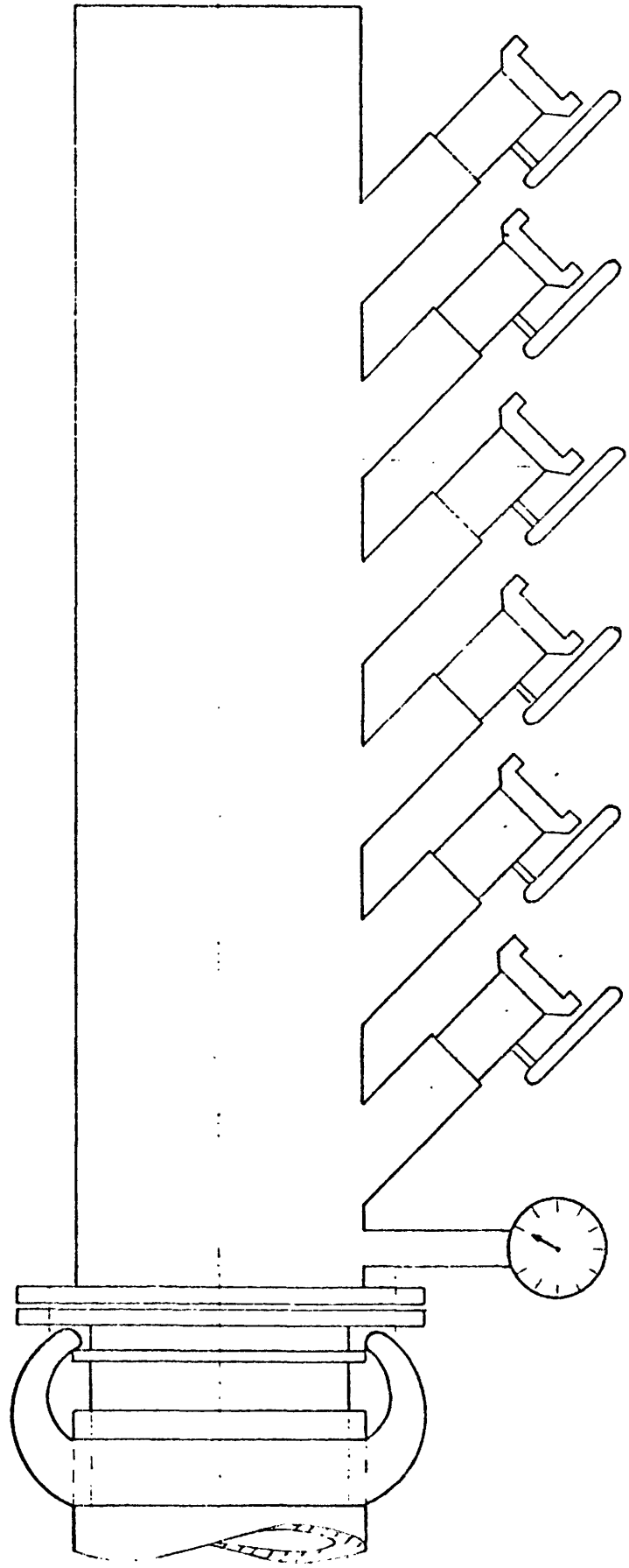


THE SUPPLY OF NITROGEN REQUIRED TO REDUCE THE OXYGEN CONTENT TO VARIOUS LEVELS AS A FUNCTION OF THE AIR CURRENT

SEAM LOCOMOTIVES AVAILABLE FOR PRODUCTION OF STEAM

Locations	Number	Steam production	Weight	Addresses
Niederberg Mine	2	2 t/h	80 t	Herr. Soring 916 - 330
Rhineland Mine	1	2 t/h	50 t	Herr. Neumann 915 - 4320
Achenbach Mines	1	2 t/h	80 t —	Zentrale 962 - 1 Herr Henkelbach 962 - 7408 Herr Biederbach 962 - 7357
Konigsborn Mine	2	2 t/h	70 t	Herr Büffler 973 - 565 930-6245 Herr Cornelius 945 - 880
Saarland	8	2 t/h	50 t	Herr Müller 06897-2035

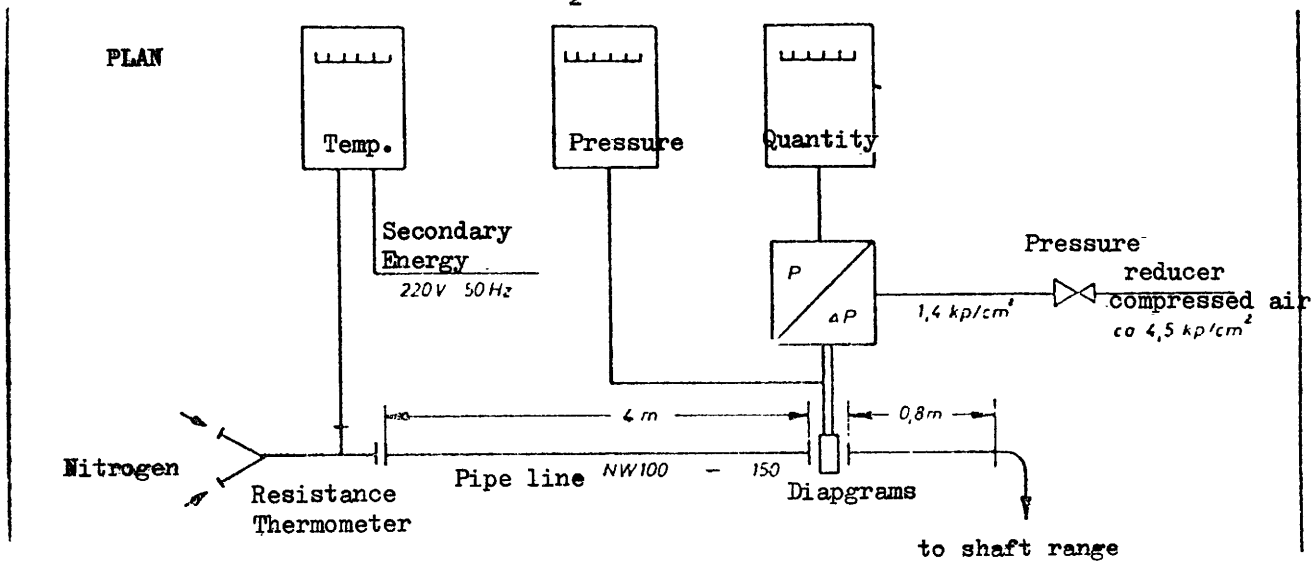
Annex 7.4



OUTLET MANIFOLD FOR FLEXIBLE HOSES OF TYPE NW 100 FROM EVAPORATORS

Annex 7.5

Arragements for measuring the parameters relative to the flows of N_2 for injection



Description of Apparatus

1. Gas flow measurement

Throttle: Single orifice diaphram
External diameter = 100 mm, Internal = 81.7 mm

Transducer: Pneumatic transformer of effective pressure for differential pressure; Type WRM - KG Range 0 - 3,600 mm. Water Gange Flow 0,2 - 1 kg. per cm_2

2. Flow recorder — Pneumatic recorder "unicourbe" (single line) with recording unit type IC Ekhardt range 0,2 - 1 kg/cm^2, and 0 - 100 m^3/min.

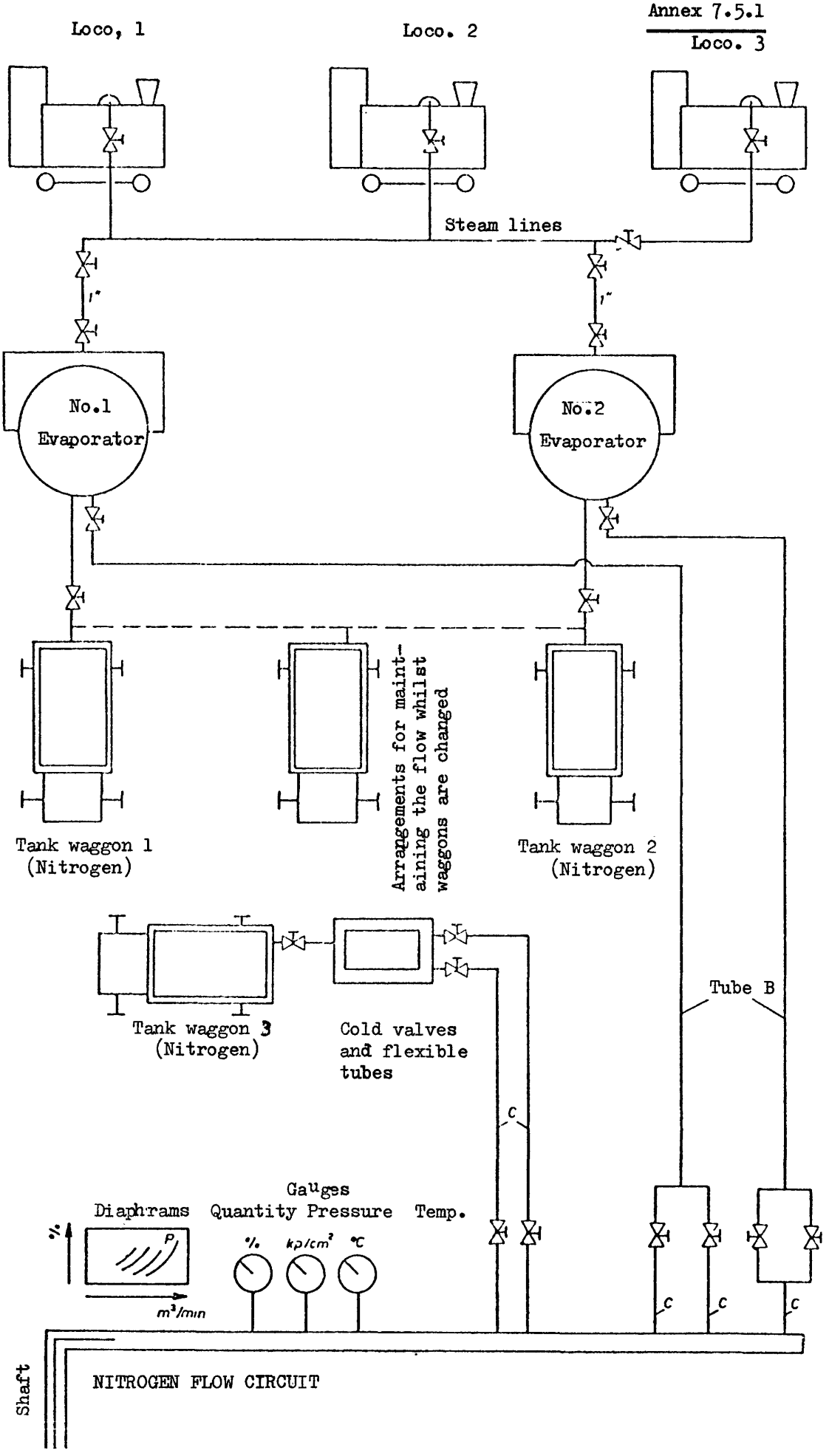
Pressure — Pen recorder of the elastic tube type: markgtted by I.C. Eckhardt with a pressure range 0 - 10 kg/cm^2.

3. Temperature Measurement

Thermometer — Resistance thermometer 100 ohm at 0°C Type Degussa, length 100 mm.

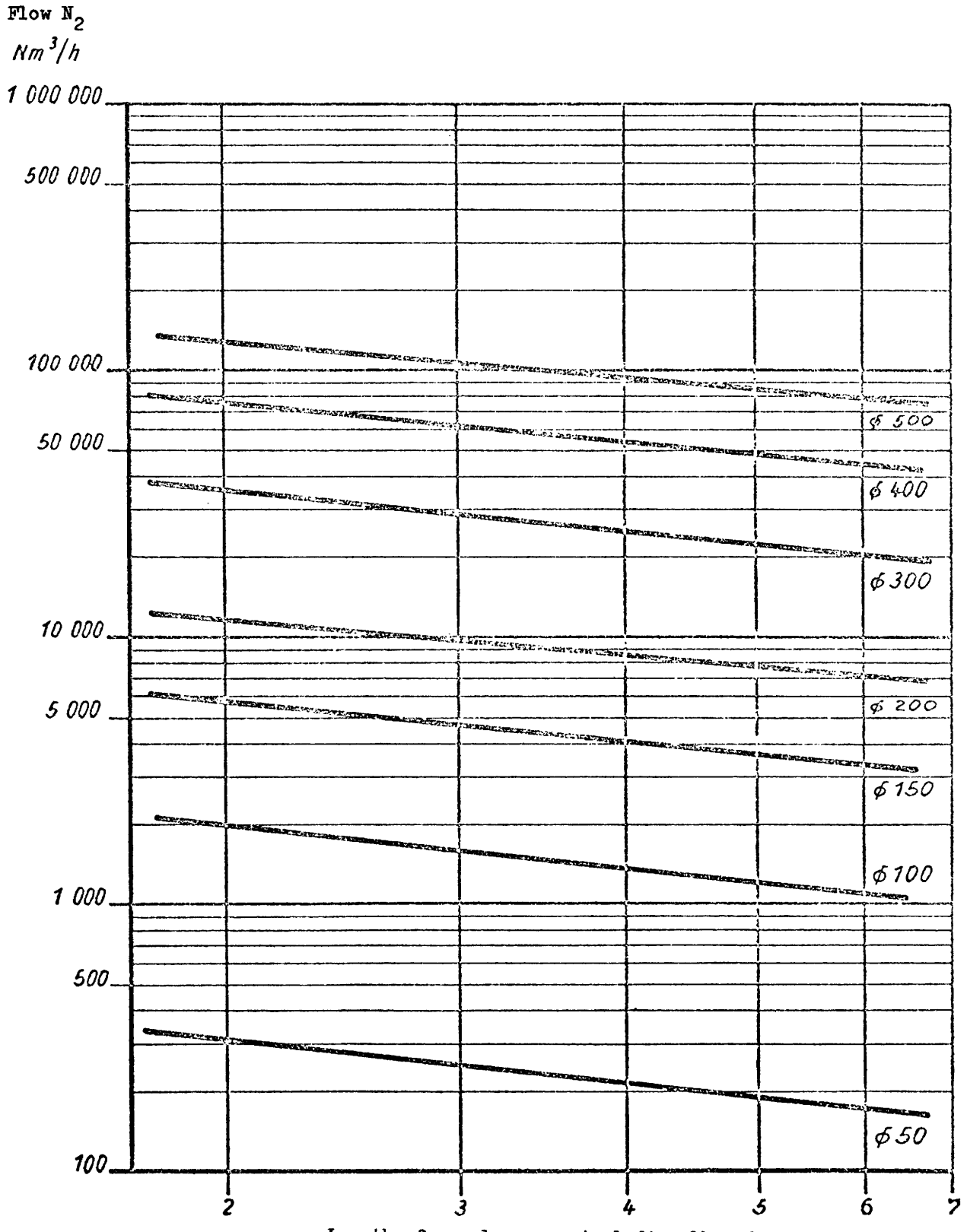
Recorder — Including compensator as marketted by Joens: Range - 20/0/+60°C with tappings and adjustments for all ranges (zero correction will be required).

Annex 7.5.1


Loco, 1
Loco. 2
Loco. 3
Steam lines
1"
1"
No.1 Evaporator
No.2 Evaporator
Tank waggon 1 (Nitrogen)
Arrangements for maintaining the flow whilst waggons are changed
Tank waggon 2 (Nitrogen)
Tank waggon 3 (Nitrogen)
Cold valves and flexible tubes
Tube B
C
Gauges
Diaphrams
Quantity
Pressure
Temp.
%
kp/cm²
°C
P
m³/min
Shaft
NITROGEN FLOW CIRCUIT

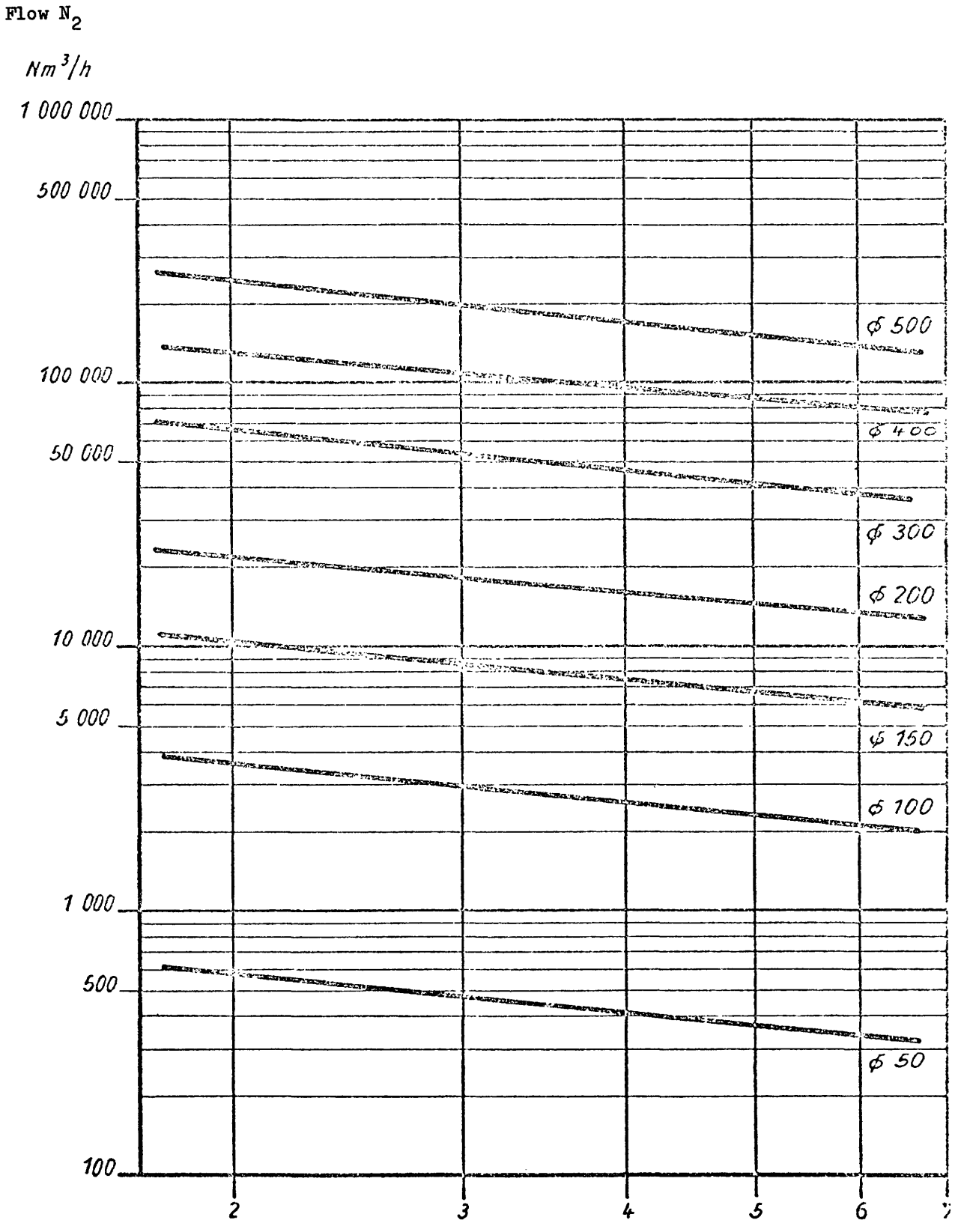
Annex 7.6

FLOW of N_2 WHEN THE PRESSURE IS 5 ATMOSPHERES



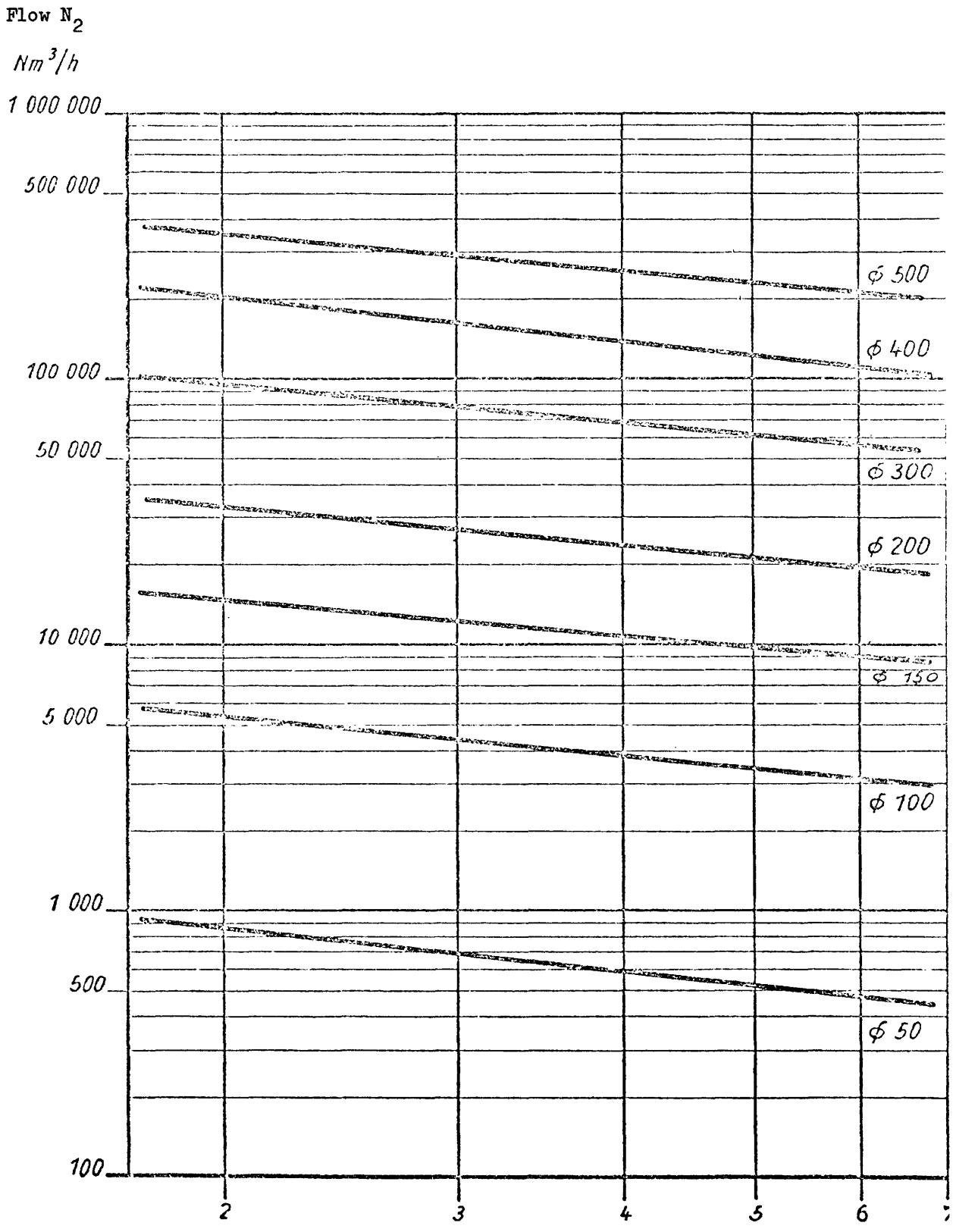
Annex 7.6.1

FLOW OF N_2 WHEN THE PRESSURE IS 10ATMOSPHERES

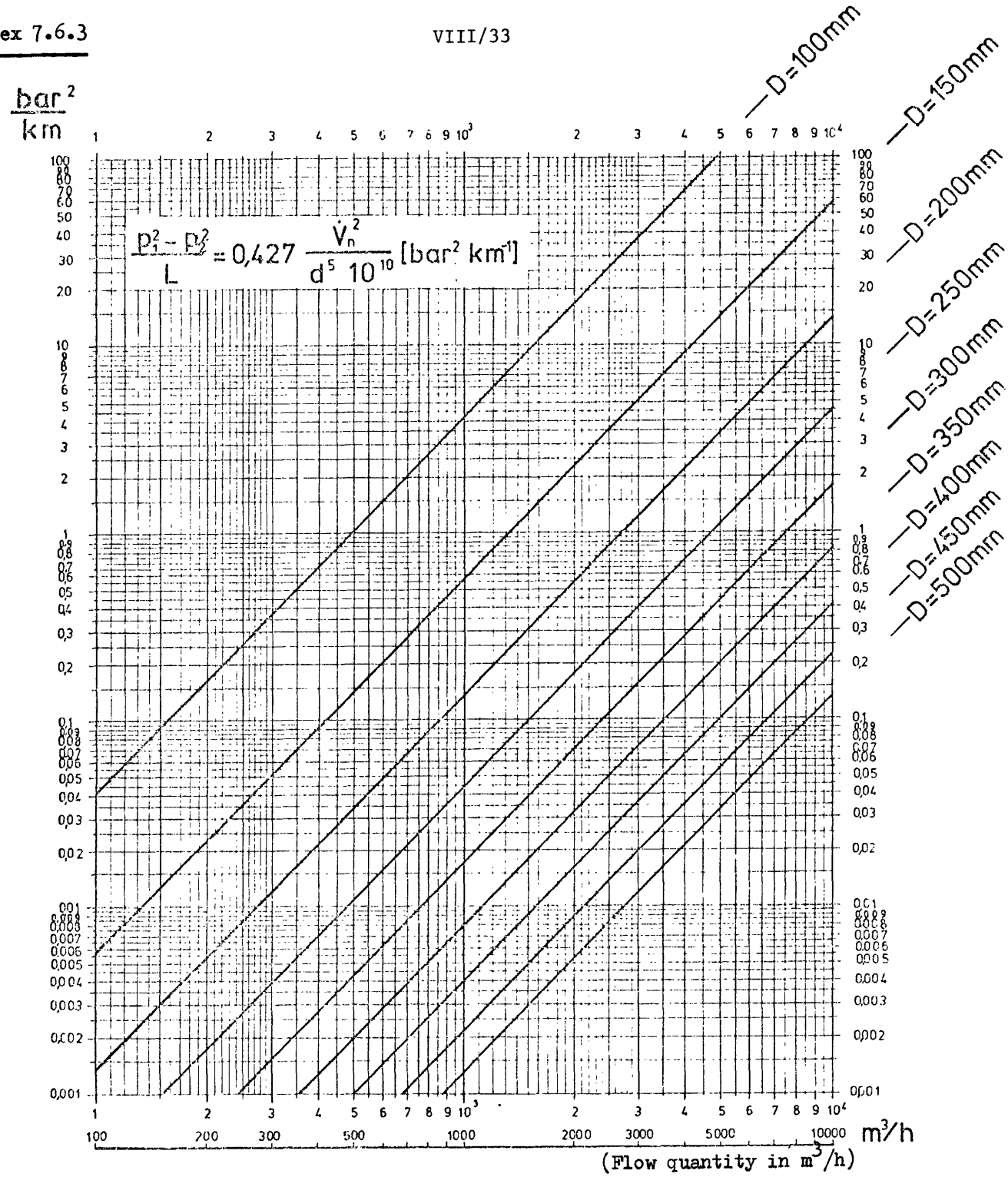


Annex 7.6.2.

FLOW OF N_2 WHEN THE PRESSURE IS 15 ATMOSPHERES



Length of supply range including 1 km of shaft range



PRESSURE DROP IN HORIZONTAL PIPES

Assumed values: Isothermic Curve = 10°C Friction Coefficient = 0,025

Compressability K = 1 Density = 1.251 kg/m³

Annex 7.6.3/Text

Calculation of the pressure-flow diagram for the movement of Nitrogen in horizontal pipes

The formula for calculating the loss of pressure of substances which are compressible following a change of state and neglecting the acceleration factor is:

$$p_1^2 - p_2^2 = \lambda K \frac{L \cdot w_n \cdot \rho \cdot p_n}{d} \quad N\,m^{-2}$$

λ = coefficient of friction of gas in tubes
K = compression index
L = length of pipes in metres
w_n = velocity in metres per second
ρ_n = density of the gas in kg/m^3
p_1, p_2 = absolute pressure of the gas at injection into ranges (1) and at the end of the range (2) in m^2
d = diameter of the tube in metres
index n = factor to correct the differences between normal conditions of temperature and pressure

Practical units

Pressure p in bars
Length L in Km
Normal pressure $p_n = 1{,}0133$ bars

with $w_n = \frac{\dot{V}_n \cdot 4}{d^2\ \pi \cdot 3600}$

V_n = flow in m^3/hr at mean gas temperature of

$\vartheta_1 = 10°\ C\ (T_1 = 283\ K)$

$$\dot{V}_1 = \dot{V}_n \frac{T_1}{T_n} = \dot{V}_n \cdot \frac{283}{273} = 1.037\ \dot{V}_n$$

which gives

$$p_1^2 - p_2^2 = 13{,}64 \frac{\lambda \cdot K \cdot L \cdot \rho_n \cdot \dot{V}_n^2}{D^5 \cdot 10^{10}} \quad bar^2$$

Application of this formula to the nitrogen ranges

Compressibility index K for nitrogen up to 10 bar is approximatively 1 and thus may be neglected

Coefficient of friction = f (Re, d/k)
Re = Reynolds number
k = Roughness in mm. K as a basis say, 0,5 mm

For intermediate diameters the factor d/k lies between 100 and 800. In this range and for Reynolds numbers $>$ 400 000, the coefficient of friction is no longer a function of d/k.

Values of Re
Examples for the movement of Nitrogen

V_n = 3000 m^3/h
d = 0,1 m which gives Re = 801,000
V_n = 5000 m^3/h
d = 0,2 m which gives Re = 667,000
V_n = 6000 m^3/h
d = 0,4 m which gives Re = 400 000

With a hydraulic flow in a rough walled tube the relationship between d and k the friction coefficients for different diameters of pipe are given:

Roughness K = 0,5 mm

d	d/k	λ
150	300	0,026
200	400	0,024
300	600	0,022
400	800	0,020

taking λ = 0,025
and K = 0,025
ϱ_n = 1 251 kg/m^3 for N_2

The equation for loss of pressure becomes

$$\frac{p_1^2 - p_2^2}{L} = 0{,}427 \frac{\dot{V}_n^2}{d^5 \cdot 10^{10}} \quad \left[bar^2\ km^{-1}\right]$$

p_1, p_2 in bars
V_1 in m^3/hr
d in m
L in km

Examples

Example 1

Given: $d = 250$ mm
$L = 3500$ m $= 3{,}5$ km
$V_n = 3000$ m^3/h

open end
$p_2 = 1{,}13$ bar (850 torr)

To find the initial pressure p_1

$$\frac{p_1^2 - p_2^2}{L} = 0{,}4 \text{ bar}^2 \cdot \text{km}^{-1} \quad \text{(see diagram)}$$

$$p_1^2 - p_2^2 = 3{,}5 \cdot 0{,}4 = 1{,}4$$

$$p_1^2 = 1{,}4 + p_2^2 = 1{,}4 + 1{,}28 = 2{,}68$$

$$p_1 = \sqrt{2{,}68} = 1{,}64 \text{ bar}$$

Result: loss of pressure = 0,51 bar

Example 2

Given: pressure at the evaporator
diameter of the pipes
length of the pipes
outlet pressure
inlet pressure

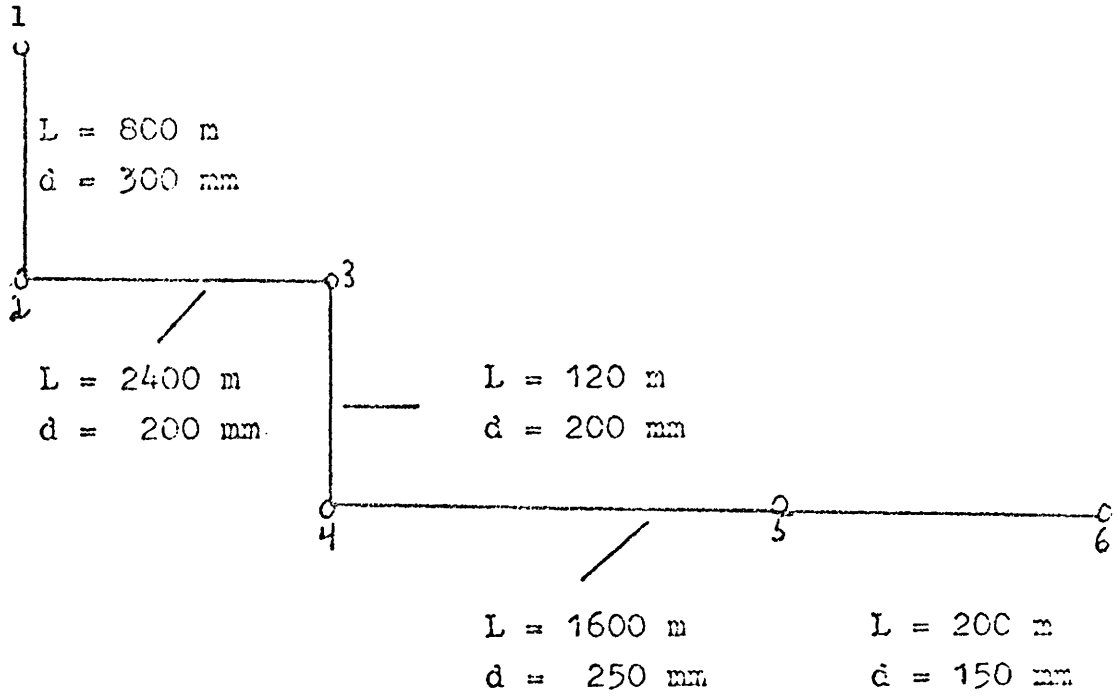
Unknown: flow V_n

$$\frac{p_1^2 - p_2^2}{L} = \frac{36 - 1{,}32}{3{,}6} = 9{,}63 \ \frac{\text{bar}^2}{\text{km}}$$

Result following the diagram $V_n = 4200$ m^3/hr

Example 3

Given:



Flow V_n = 3000 m^3/hr

Unknown; pressure at the evaporator.

The increase in pressure due to the differences in level is virtually negligible (due to increase in surrounding air pressure)

Section of the pipe 5 - 6

p_6 = 1,16 bar (local ambiant pressure)

Calculation of p_5 for V_n = 3000 m^3/hr

following the diagram:

$$\frac{p_5^2 - p_6^2}{L} = 5{,}1 \quad \frac{bar^2}{km}$$

$$p_5^2 = L \cdot 5{,}1 + p_6^2$$

$$= 0{,}2 \cdot 5{,}1 + 1{,}35 = \underline{2{,}37 \text{ bar}^2}$$

Section of the pipe 4 - 5

Following the diagram:

$$\frac{p_4^2 - p_5^2}{L} = 0,4 \quad \frac{bar^2}{km}$$

$$p_4^2 = L \cdot 0,4 + p_5^2$$

$$= 1,6 \cdot 0,4 + 2,37 = \underline{3,01 \text{ bar}^2}$$

Section of the pipe 3 - 4

Following the diagram:

$$\frac{p_3^2 - p_4^2}{L} = 1,20 \quad \frac{bar^2}{km}$$

$$p_3^2 - p_4^2 = L \cdot 1,20 = 0,12 \cdot 1,20 = 0,144 \text{ bar}^2$$

$$p_3^2 = 0,144 + p_4^2 = 0,144 + 3,01 = \underline{3,15 \text{ bar}^2}$$

Section of the pipe 2 - 3

Following the diagram;

$$\frac{p_2^2 - p_3^3}{L} = 1,20 \quad \frac{bar^2}{km}$$

$$p_2^2 - p_3^2 = 2,4 \cdot 1,20 = 2,88 \text{ bar}^2$$

$$p_2^2 = 2,88 + 3,15 = \underline{6,03 \text{ bar}^2}$$

Section of the pipe 1 - 2

Following the diagram:

$$\frac{p_1^2 - p_2^2}{L} = 0,16 \quad \frac{bar^2}{km}$$

$$p_1^2 - p_2^2 = L \cdot 0,16 = 0,8 \cdot 0,16 = 0,13$$

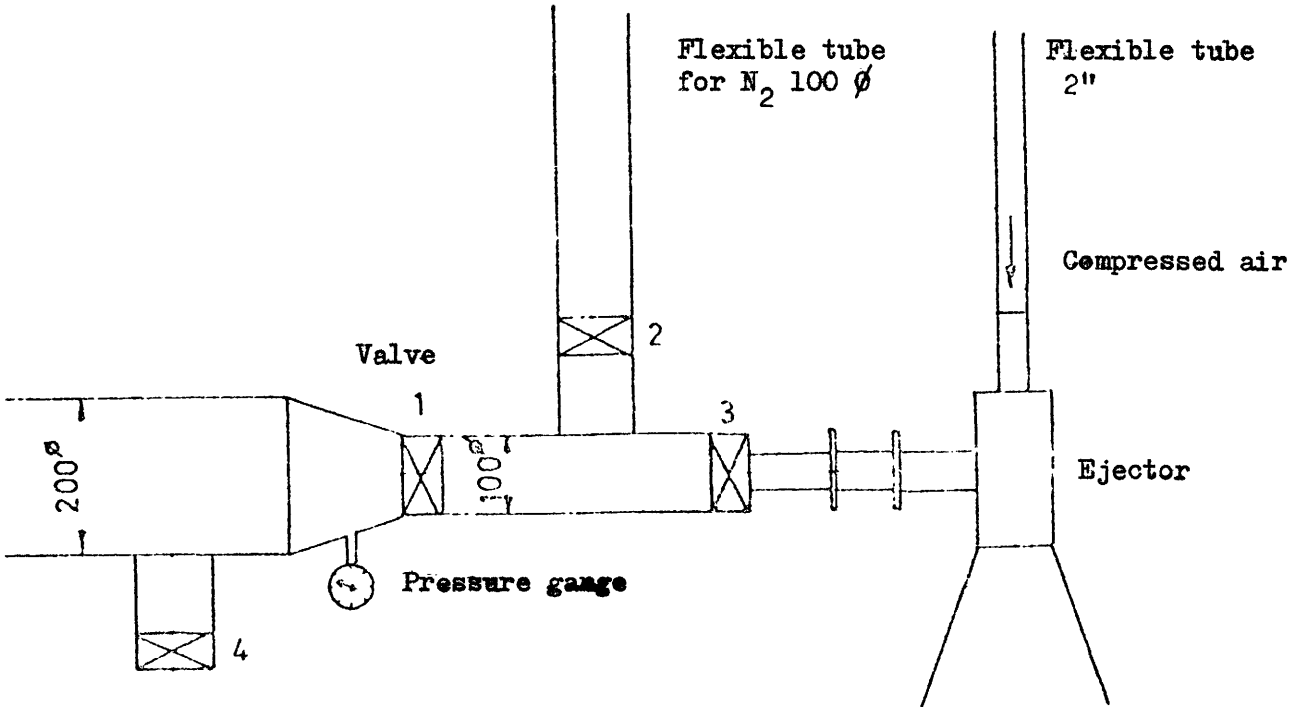
$$p_1^2 = 0,13 + p_2^2 = 0,13 + 6,03 = 6,16$$

$$p_1 = 2,48 \text{ bar}$$

$$p_1 - p_6 = 2,48 - 1,16 = \underline{1,32 \text{ bar}}$$

Result: pressure at the evaporator 1,32 bar

Annex 7.7



Starting Position: Valves in 100 ø, 1, 2, 3 and 4 closed

Before Starting: Valve 4 open, 1, 2 and 3 closed

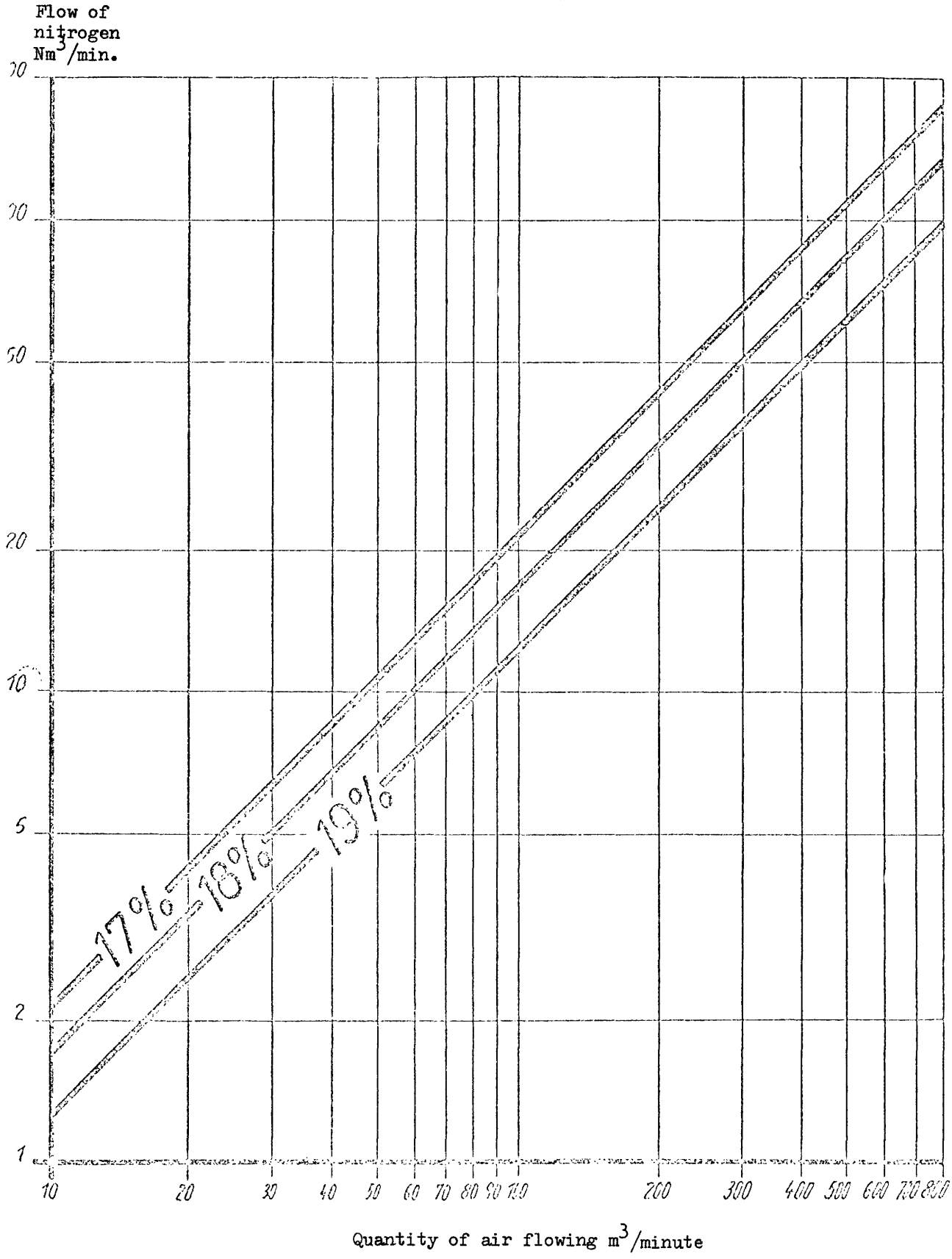
At the N_2 delivery: Close Valve 4; open 2 and 3

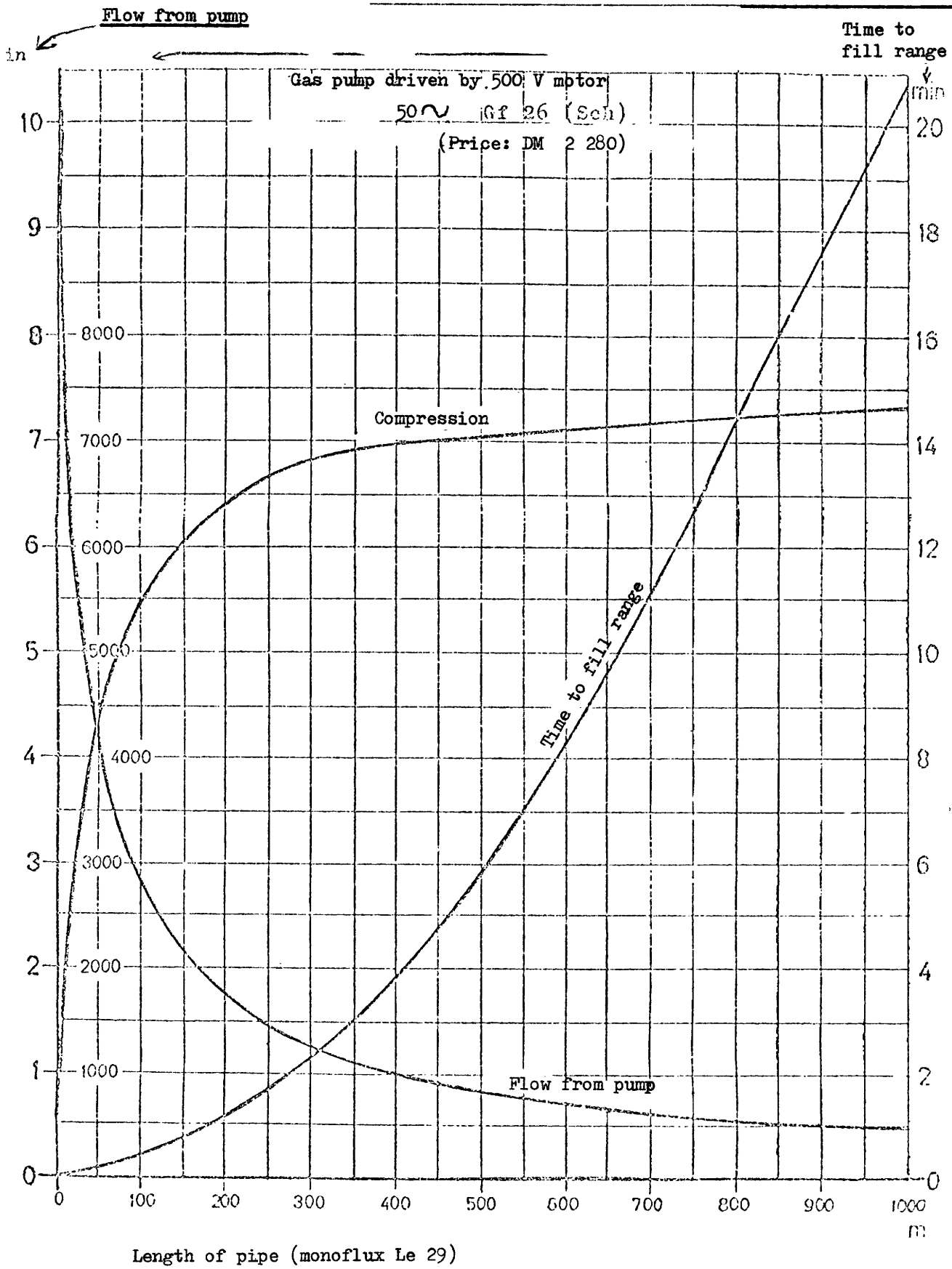
Switch on Ejector as soon as the N_2 arrives. When the incendive gases arrive, close valve 3 and open valve 1.

Schematic arrangment of the equipment for clearing pipes and injector of Nitrogen

Annex 7.8

Curve showing the danger of asphyxiation caused by the injection of Nitrogen into various quantities of air flowing underground. - 17, 18, 19% oxygen





	Flow from pump type Gas CF 26	50 063

Annex IX

Notes for guidance on the measures to be taken to stabilise ventilation in the event of open fires underground (Except in shafts)

(Adopted by the Mines Safety and Health Commission as an important report in accordance with Articles 3 and 6 of the mandate of the Mines Safety and Health Commission)

Notes for guidance on the measures to be taken to stabilise ventilation in the event of open fires underground (Except in shafts)

Adopted by the Mines Safety and Health Commission on 23rd March 1977 as an important report in accordance with Articles 3 and 6 of the mandate of the Mines Safety and Health Commission

The Mines Safety and Health Commission believes that these measures which have been proved in many countries, (with or without the use of computers applied to the control of ventilation underground), should be known to all those responsible persons listed in the Introduction.

Given the multiplicity of circumstances which are possible, the person responsible for the rescue operations remains free to chose the most appropriate measures in the actual case concerned; the immediate measure of choking the ventilation should be carefully considered and where necessary carried out on the orders of the persons made responsible in the individual countries.

This summary is complementary to the Document "Practical conclusions on the application of the theory of stabilisation of ventilation" which was approved by the Mines Safety and Health Commission on 10th October 1976 and published as Annex III of its Sixth Report.

Doc. No 708/3/74 referred to in the Introduction is a 150 page text prepared by Messrs. Stenuit and Champagnac, summarising the work of a Committee of Experts which has studied problems associated with the stabilisation of the ventilation in the event of a fire occurring underground, on the basis of the Budryk Theory. This document is available on request, from the Secretariat of the Mines Safety and Health Commission.

Summary of the measures to be taken to stabilize ventilation in the event of open fires underground (except in shafts)

INTRODUCTION

This document is for the use of engineers and other specialists in fires, rescue and ventilation who have adequate knowledge of the subject and who are familiar with doc. 708/3/74, the results of which are summarized here together with some general measures to be taken in the event of fires.(Doc. 708/3/4 deals with the "Stabilization of ventilation in the underground workings of gassy and other mines, particularly in the event of open fires").

It consists of three parts :

1. Initial measures
2. Subsequent measures
3. Implementation of such measures

1. Part one : Initial measures in the event of an open fire

1.1. General measures

1.1.1. Alert the supervisory staff underground and the mine management even if the fire seems to be a small one.

1.1.2. Evacuate all staff whose safety is threatened or is liable to be threatened if the fire develops.

1.1.3. Organize a direct attack on the seat of the fire.

1.1.4. The following measures should be taken in the fire zone as the situation requires :

a) Determine whether the following should remain operational or should be cut :

- electric power
- compressed air lines
- firedamp drainage pipes

b) Make preparations, with a view to rapid execution in case of need, for :

- cutting off the electric power
- isolating the compressed air lines
- isolating the firedamp drainage pipes.

1.1.5. In all cases, no initial measures affecting ventilation should be taken other than those listed below under 1.2.1.1. Any attempt at regulating ventilation, especially by means of the main ventilators, booster fans, and auxiliary fans must only be carried out after thorough investigation of the consequences, and orders from the person responsable for the ventilation.

1.2. Measures for stabilizing ventilation

Generally speaking, these measures involve the use of ventilation regulators. If doors are not installed for this purpose, regulators may be made by stretching brattice sheeting across the roadway or other suitable devices :

1.2.1. If the roadway containing the fire is an ASCENSIONALLY ventilated airway

1.2.1.1. In all cases, whether the air velocity is high or low, the initial operation most likely to be effective is the reduction of the ventilation in the roadway on the intake side of the fire to approximately that which appertained prior to the fire.

The purposes of this reduction are ;

- to prevent any increase in the flow of air to the fire caused by the action of the fire itself ;

- to prevent the aeromotive force of the fire (which is in harmony with the ventilation in ascensional airways) from causing reversal of ventilation in adjacent parallel branches or in diagonal branches of the ventilation network.

1.2.1.2. Once the necessary regulators have been installed, the airflow in the roadway where the fire is located should be continuously monitored so that it is not reduced to such an extent that combustion fumes, and firedamp in gassy mines, can accumulate.

Maintaining the airflow through the roadway affected by the fire at the same level as before the fire amounts to keeping the apparent resistance of the branch on fire virtually constant, thus neutralizing the disturbing effect of the fire on the rest of the network.

1.2.2. If the roadway containing the fire is a HORIZONTALLY or DESCENSIONALLY ventilated airway

No initial measures should be taken other than those specified in an instruction for stabilizing the ventilation.

Such contingency plans are always useful, and indeed necessary for the danger points. The requirements are as follows :

- advance studies
- continuous updating
- suitable distribution to properly trained personnel.

Such instructions will make provision for continuous monitoring of the airflows affected by the measures which they prescribe, e.g. the opening or closing of one or more air doors, or the installation of regulators.

§ 3.3 is also of relevance to the points discussed in the previous two paragraphs.

2. Part two : Subsequent measures

2.1. General measures

2.1.1. Check that the initial measures have been correctly taken and obtain the most accurate information possible on the situation.

2.1.2. Collect and send underground all equipment required for gathering additional information, firefighting and if necessary rescue.

2.1.3. Alert the ventilation computer centre if the network is stored in a memory or can be fed back into a simulator.

2.2. Assessment of the stability of the ventilation

The Budryk method offers the following possibilities :

2.2.1. The topographical plan can be used to evaluate the strength and direction of the aeromotive forces of the fire. Alternatively, standard diagrams of the air circuit can be used for this purpose, if they include the necessary details (i.e. length and inclination of the raodways), in association with the appropriate graphs taken from Doc. No. 708/3/74. The method also makes it possible for the ventilation department to calculate the worst possible effects of the fire, on the basis of this information.

2.2.2. Using the Standard Diagram of the ventilation network, the "Principal circuit"* of the fire can be recognised, and a "Closed circuit or Budryk" diagram can be established which gives details of all the roads in the vicinity, the main roads, and leakage paths in a simplified form.

2.2.3. Without waiting for the results from the computer centre, the method can give the probable qualitative effects of the fire and can establish the limits of the inner "unsafe zone" which may have to be abandoned, (perhaps in stages), and an outer "safe zone" in which the ventilation should be stable.

2.2.3.1. At this stage, the method allows consideration of which are the simplest and the most effective measures which can be taken, to minimize the effects of the fire whilst constantly maintaining the relationship $\frac{hi}{he} < \frac{Ri}{Re}$ (defined in Doc. No 708/3/74 and on page 7 of this document).

Amongst these steps are :

a) increasing the resistance of the main "internal" circuit (which always includes the branch where the fire is burning),
b) reducing the resistance of the "internal" parallel circuits,
c) reducing the resistance of the main external circuit,
d) increasing the resistance of the external parallel circuits,

e) increasing the aeromotive force of the main ventilators,

f) reducing the aeromotive force of the fans in the parallel circuits.

In this assessment, serious attention should always be paid to the diagonal branches or sections of the networks; i.e. those which are liable to be unstable due to variation in the resistance of other branches of the network or to slight variations in the balance between normal aeromotive forces; (e.g. those of multiple main ventilators, or main ventilators and booster fans, or between booster fans).

It should be noted that the principles on which the rules for stabilising ventilation are based are the same whether the disturbance is caused by a fire that occurs in an ascensional or a descensional ventilated airway.

All stabilisation measures other than the installation of regulators in the branch on fire, and in particular blocking of laterals,* tend to increase the airflow in the branch on fire and consequently to fan the fire.

Great caution must therefore be exercised in blocking the flow of laterals*, and allowance must be made for the increase in airflow over the fire which will result unless adjustable regulators are installed in the branch on fire.

2.2.3.2. Details of the measures projected from the investigation outlined above are sent to the computer centre so that a test can be carried out of their effectiveness either in isolation or in combination. The order of priority is included.

2.2.3.3. Without waiting for the results from the computer centre, (a) a plan of attack on the fire, (b) a rescue plan if required, and (c) a plan for ventilation stabilisation, perhaps in stages, are established.

2.2.3.4. As soon as the results from the computer centre are received, revised plans are drawn up with any necessary corrections.

3. Part three : Implementation of the measures outlined in parts 1 and 2

3.1. In view of the diversity of management organizations in each coalfield and even in each mine, the management of individual mines should appoint the staff responsible for implementing the various measures to stabilize the ventilation outlined in Parts 1 and 2.

* The term "lateral" is defined in Doc. 708/3/74, para 1 page 48 etc. Broadly speaking it is a circuit in parallel with the branch in which the fire has occurred.

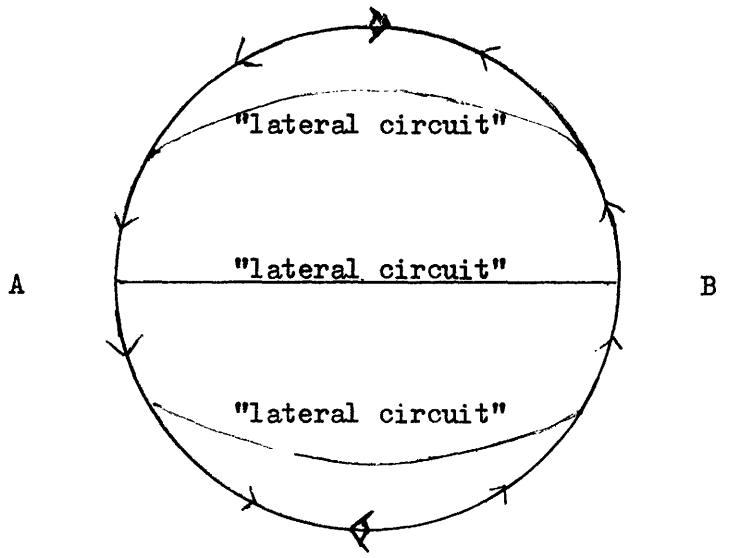
3.2. The complexity of many ventilation networks results in difficulty in selecting the measures to be taken and therefore the personnel concerned should be suitably trained.

3.3. The factors of instability in the vicinity of a fire may cause accumulations of firedamp or explosive combustion fumes to be driven towards the seat of the fire by reversal of the ventilation in one or more of the local circuits. It is for this reason that the ventilation must be stabilized.

3.4. In diagonal airways, unfortunately, there are no simple rules for stabilizing ventilation and thus prior study should be made of each individual case. All personnel responsible for implementing stabilization measures should be fully informed of the possible effects of a fire and the risk of changes in the quantity and direction of ventilation in the various circuits, arising from the aeromotive force of a fire in diverse localities.

* The main circuit of an internal aeromotive force (for example caused by a fire) is the circuit constituted in the first part by the normal intake airway from the Surface as far as the Source of this force (i.e. the fire), and in the second part, by the normal return airway from the Source (i.e. the fire) to the Surface. It follows from this that the whole principal air circuit passes by the Surface and thus by the main fan.

he (aeromotive force of the fan)



hi (aeromotive force of the fire)

** The outer "safe" zone includes all the main airways and lateral circuits on the opposite side to the fire (aeromotive force hi) in relation to a roadway A – B which the direction of ventilation is unlikely to change.

*** The inner "unsafe" zone includes all the roadways situated on the other side of roadway A – B.

$$\frac{hi}{he} = \frac{\text{aeromotive force of the fire}}{\text{aeromotive force of the fan(s)}}$$

$$\frac{\mathcal{R}i}{\mathcal{R}e} = \frac{\text{Resistance of the inner "unsafe" zone}}{\text{Resistance of the outer "safe" zone}}$$

ANNEX X

FIRST REPORT ON IGNITIONS OF FIREDAMP BY POWER LOADERS AND HEADING MACHINES

(Adopted by the MSHC on 23 March 1977 and submitted to the Governments of the Member States as a proposal following Article 1 of its terms of reference, as information following Article 3 and for implementation and follow-up in accordance with Article 4 of those terms of reference)

1. INTRODUCTION

1.1. During the meeting held on 26 March 1971, the MSHC gave the Working Party on "Ventilation and Firedamp"[1] among other things, the following terms of reference: "The Working Party on "Ventilation and Firedamp" will examine general problems of ventilation, particularly where prevention of firedamp is concerned and other means or measures which should be applied in order to suppress or control firedamp" (See 12th Report of the MSHC, Annex III, page 6).

1.2. Following those terms of reference the Working Party on "Ventilation and Firedamp" presents the following First Report.

1.3. Certain problems still have to be solved and further research is in hand to reduce the risk of ignition of methane by power loaders or heading machines. In spite of the fact that the information is not yet complete, there is great interest in this work.

1.4. The recent CH_4 ignition in a development heading of the Luisenthal mine (Saar coalfield) emphasizes the importance of the problem.

1.5. The documents from which this report is compiled are listed in Appendix III.

1.6. The MSHC adopted this report on its meeting held on 23 March 1977, and submits it to the Governments of the Member States.
The MSHC draws the attention of Governments to points 10.1, 10.2 and 10.3 in accordance with the provisions of Article 1 of its terms of reference.
Pursuant of Article 3 of these terms of reference the MSHC requests forwarding of this report to the quarters directly concerned.

1.7. The MSHC instructed the Working Party on "Ventilation, firedamp and other mine gases" to continue the work on this subject and to keep in touch with the research and studies in progress in this field and to submit a second report in due course containing further proposals to the Governments.

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1) The name of this Working Party was changed by the MSHC at its meeting held on 23 March 1977.

2. Statistics on ignitions

2.1. Reports on frictional ignitions which had accurred in their countries have been received from Germany, Belgium and the United Kingdom. For France it had previously been reported that during the last 10 years no ignition had occurred at power loaders in that country.

2.2. The report from Germany[1] covered the period 1 January 1970 to 30 June 1975 and listed 10 ignitions.

2.3. The report from Belgium[2] described two ignitions both of which occurred on the same face within a period of 8 days.

2.4. The United Kingdom[3] covered a 10 year period from 1965 to 1974 and listed a total of 137 frictional ignitions of gas at power loaders and 14 frictional ignitions at heading machines.

2.5. In the United Kingdom the manager is required to report every ignition however slight and however short a duration to the Inspectorate.[4]
Of the 63 ignitions that occurred between 1970 and 1974, the longest time recorded was one which lasted for 25 minutes. Three were said to have lasted less than one minute, 21 lasted only a few seconds and 19 were described as only momentary.

2.6. A summary of the ignitions reported in the various member countries is given in tables I and II overleaf.

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1) Doc. n° 3072/75
2) Doc. n° 3073/75
3) Doc. n° 3738/75
4) Compulsary in the other countries also

TABLE I

Number of ignitions by face Power Loader

Type of Machine[1]	10 Years U.K. 1965-74	5½ Years Germany 1.1.70 - 30.6.75	Belgium	Total
Conventional shearers	83	4	2	89
Thin Seam shearers	5	-	-	5
Fixed outboard arm shearers	2	-	-	2
Ranging drum shearers	9	-	-	9
Single ended conveyor mounted trepanners	8	-	-	8
Double ended conveyor mounted trepanners	18	-	-	18
Floor mounted trepanners	5	-	-	5
Trepan shearers	6	-	-	6
Multi jib cutters	1	-	-	1
Ploughs	-	4	-	4
Total	137	8	2	147

1) The proportion of machines (or production obtained by) the various types of machines is given below

a) For the U.K. 70 % of the machines were shearers
23 % were trepanners
7% were ploughs.

b) FR of Germany (proportion of production obtained) 75 % by ploughs
25 % by shearers

c) Belgium (proportion of production obtained) 90 % by ploughs
10 % by shearers

TABLE II

Number of ignitions by Heading Machines

Type of Machines	U.K. (10 years)	Germany ($5\frac{1}{2}$ years)	Belgium	Total
Coal Heading Machines	10	-	-	10
Roadheading Machines	3	1	-	4
Dintheaders	1	-	-	1
Total	14	1	-	15

Total of igntions by face Power Loaders and Heading Machines

Both types of machines (total of tables I and II)	151	9[1)]	2	162

1) Note: The tenth ignition reported by Germany was caused by a defective Shoe Brake on the main driving unit of a face conveyor

2.7. Of the 162 ignitions at face power loaders and heading machines, not one propagated into an explosion and no one was injured.

2.8. Following the period for which statistics are given, a further ignition at a heading machine occurred at the Luisenthal mine in the Saar Coalfield, on 21 July 1976. 2 men were killed and 5 injured.

3. Machine Design

3.1. Seventy two per cent of all ignitions reported at face power loaders occurred at shearer loader machines. The majority of these occurred in the United Kingdom where for the 10 year period reviewed 70 % of all face power loading machines were shearers. For ignitions at trepanners it must be realised that, in general, these machines work in thinner seams and in more adverse geological conditions.

3.2. Half the ignitions on face power loaders in Germany occurred at ploughs whereas non occurred at ploughs in the United Kingdom where over the 10 year period only 7% of the total number of power loaders in use were ploughs.

4. Igniting Source

All the ignitions at shearer loaders were attributed to picks striking hard material in the roof or floor, intrusions in the seam or when cutting through faulted ground. Of the four ignitions at ploughs, two occurred when the plough blades cut into quartzitic intrusions in the roof and two when the plough left its guidance causing heating of chips or surfaces.

5. Pick Speed

5.1. Analysis of 63 ignitions which occurred in the United Kingdom between 1970 and 1974 showed that about 70 % occurred at pick speeds of between 210 and 240 metres per minute. For the two ignitions in Belgium the pick speed was given as between 230 and 250 metres per minute.

5.2. Although research work has shown that the liability for ignitions increases with pick speed, the statistical analysis cannot verify this as no figures are given as to the pick speeds of all the power loaders in use.

6. Ventilation

6.1. In the United Kingdom, 53 % of the ignitions occurred when cutting with the ventilation although 67 % of the cutting is done in this direction. In Belgium both ignitions occurred when cutting towards the main gate,against the ventilation.

6.2. Local ventilation round the cutting picks is important. In the United Kingdom a device known as a hollow shaft ventilation has been designed for shearers. In 80 % of the ignitions between 1970 and 1974 either no hollow shaft ventilation had been fitted or it was not operating at the time of the ignition. In Germany venturi nozzles have been used to rectify the lack of adequate ventilation at the cutting point.

6.3. In the United Kingdom local ventilation devices, either small hydraulically operated fans or compressed air operated venturi devices are used in conjunction with heading machines. These devices are mounted on the machine such that they direct a jet of air to the cutting point. They may also be interlocked with the power to the machine so that the machine can work only if the ventilation device is operating.

7. Source of CH_4

7.1. In Belgium both ignitions occurred due to the trailing drum cutting into the floor where floor breaks issuing considerable quantities of CH_4 were found later.

7.2. In two cases in Germany, CH_4 under the face conveyor was thought to be the main source.[1)]

8. Work carried out in member countries on ignitions at power loaders and heading machines.

8.1. A research project is currently being carried out in Germany at the WBK in Bochum. No reports on this project have been submitted.

8.2. In the United Kingdom a co-ordinating committee on frictional ignitions was formed in 1966. The committee has representatives from the National Coal Board, the Mines and Quarries Inspectorate, the Mining Research and Development Establishment (MRDE), the Safety in Mines Research Establishment (SMRE) and the Council of Underground Machinery Manufacturers (CUMM).

8.3. The third interim report of the committee produced in August 1975 has been submitted to the Working Party on Ventilation and Firedamp for consideration (Document n° 3738/75). The report lists all the ignitions which have been reported in the United Kingdom

1) At the Versuchsgrubengesellschaft Dortmund (Experimental Mine Tremonia) ignition experiments with methane in the bottom race of armoured conveyors have been carried out (see Doc. 3080/74). To complete these experiments further work is currently being done to examine among other factors the influence of underplating the pans of armoured conveyors on the effects of CH_4 ignitions within the closed bottom race.

for the 10 year period up to 1974 and gives details of the research programmes carried out at SMRE, MRDE and the work done by CUMM. The report concludes with a list of recommendations.

8.4. Research Work by SMRE

Experimental work has been carried out to consider the influence of cutting speeds, depth of cut, shape, size and material of the cutting picks and the use of water in preventing ignitions. High speed photography has been done to show the likely source of ignition (see Appendix II for a summary of the results of this work.)

8.5. Research Development Work by MRDE

This has been mainly directed towards producing positive ventilation at the point of cutting of power loaders by the use of hollow shaft ventilators (HSV) abd water powered air jets. Work has also been carried out for local ventilation on heading machines by means of small hydraulic fans and compressed air operated air movers. Detailed studies have been made of airflow and the liability for gas accumulations around power loaders and heading machines.

8.6. Work by the CUMM

Manufacturers of underground machinery have co-operated in producing machines incorporating some of the features found desirable in the research work carried out.

9. Actions already taken in Member Countries

In the United Kingdom the National Coal Board issued an instruction (see Appendix I).

10. Fields in which further efforts seem to be appropriate to the MSHC

10.1. Development and use of mobile automatic and continuously operating CH_4 monitoring instruments which contain equipment to cutt off electric power or to give alarm.

10.1.1. Such an instrument which can be mounted on power loaders and heading machines has been developed by CERCHAR (the GTM 741) and is already in use in France on a continuous miner. This instruments can be supplied from the mains or by battery.

10.1.2. In the Federal Republic of Germany the development of two mobile automatic CH_4 monitoring instruments is nearly completed. They have not yet been tested to see if they are suitable for use on power loaders and heading machines.[1)]

10.1.3. In the United Kingdom a mobile automatic CH_4 monitoring instrument is in use.
Several experiments have been carried out with such instruments mounted on power loaders and heading machines.

10.1.4. In Belgium no mobile automatic CH_4 monitoring instrument has been used untill now on power loaders or heading machines.

10.1.5. The Mines Safety and Health Commission believes that development and use of such instruments should be encouraged.

10.2. Further research work to clarify the ignition mechanism during ignition by picks seems to be appropriate.

10.3. Moreover special attention should be paid to the long term recommandation of the National Coal Board (See Appendix I at the end):

1. There should be further examination and development of a water operated ventilator or other methods to ventilate the space between the face and the body of the machine.
2. Work should continue to develop suitable equipment to monitor automatically the efficiency of auxiliary ventilation devices.
3. More attention should be given to making available better facilities for horizon control.

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1) In Germany another method for automatic CH_4 monitoring is used when heading machines are in operation: the return air leaving the dust suppression device is monitored.

PI/1974/4 ANNEX 1

RECOMMENDATIONS OF THE 3RD INTERIM REPORT OF THE UK JOINT CO-ORDINATING COMMITTEE ON FRICTIONAL IGNITIONS

a) Incendive Temperature Potential of Rocks

As a result of recommendations in the 2nd Interim Report, the National Coal Board issued the following Mining Department Instruction.

National Coal Board

Minig Department Instruction

Geological assessment of faces and headings to determine the incendive temperature potential of rocks

1. Certain rocks which can occur adjacent to and also within coal seams are capable of producing incendive temperatures when struck by the picks of various machines used both in coal production and roadway drivage. If methane is present the concentration may be high enough for the gas to be ignited.

2. It is important to establish, if possible before operations commence, whether rocks are present or likely to be present which if struck by machine pucks can give rise to incendive temperatures. In cases where ignitions actually occur, it is important to establish the source of the ignition.

3. The Area Chief Mining Engineer will have overall responsibility for establishing a procedure for investigation of strata conditions to determine the Incendive Temperature Potential of every prospective and working coal face and heading where mineral or rock are cut by machine.

4. The procedure will include the routine geological investigation of strata conditions and the arrangement of ventilation, selection of type of machine and method of working to be used consequent upon the results of such geological investigations. In addition the procedure will allow for investigation of the circumstances of any frictional ignition which may occur.

5. The Appendix of this Instruction sets out information relating to the types of incendive rocks, and recommendations as to the method of carrying out the necessary investigations.

6. Those to whom this Instruction is distributed are reminded that it is their responsibility to bring its provisions to the notice of any members of their staff, not included in the distribution list, who are concerned with complying with this Instruction or taking action on it.

APPENDIX to PI/1974/4

Incendive Rocks

1. The only two minerals likely to be encountered in British coal mines which can produce an incendive temperature when struck by machine picks, are quartz and pyrites.

2. Quartz is present in most coal measures sediments and varies in both amount and grain size. In general, the higher the quartz content and the stronger the rock the greater will be the risk of producing an incendive temperature experience and research work to date has indicated that the Incendive Temperature Potential (I.T.P.) of rocks can be related to the proportion of the quartz grains over 5 u in diameter as follows:

Rocks containing	over 50% quartz	-High I.T.P.
" "	30 to 50% quartz	-Intermediate I.T.P.
" "	under 30% quartz	-Negligible I.T.P.

3. Sandstones usually contain 50 to 75% quartz with the grains 20 to over 200 u , usually well cemented giving a strong rock. Exceptionally, quartz contents can be over 90% as in the case of ganister and ortho-quartzites. Infrequently, precipitated quartz occurs in lenses or irregular bands in coal seams and is known as "quartzlagen". Quartz contents of 80% have been recorded in such bands.

4. Siltstones usually have quartz contents of 20 to 50 % and mudstones less than 20%. The coarser siltstones or finely interbanded siltstones/sandstones generally have quartz contents of 30-50% and have an intermediate I.T.P.

5. Pyrites is commonly found in and adjacent to coal seams. Massive pyrites, strong highly pyritic dirt bands, and ironstone with pyrites, probably have an intermediate I.T.P.[+)] and pyritic sandstones or siltstones or siltstone-seatearths a high I.T.P. Experience has indicated that the combination of a high

+) Work to date has not established the relative potentials of the different types of pyrite occurrence.

quartz content rock and pyritic rock (e.g. pyritic sandstone) represents the most incendive type of strata likely to be encountered in coal mines.

Routine Geological Assessment

6. The first requirement is for a rapid initial screening of existing faces and headings to establish where sandstone and other rocks with a high I.T.P. are present close to the seam. Visual examination of the geological environment of the seams by the geologists and others trained for this work, combined with data on high pick wear, will enable this rapid screening to be made with the minimum of effort being devoted to detailed strata examination, thin sectioning and microscope quartz counting. In longwall faces particular regard is to be paid to the immediate roof and floor as well as to dirt bands in the seam.

7. For new faces and headings, an initial visual geological examination may suffice but sampling, thin sectioning and quartz counting may prove desirable, particularly where siltstone occur, in order to establish whether or not the quartz content is under or over 30%, i.e. a negligible or intermediate I.T.P. Mudstones, silty mudstones, seatearth-mudstones and sandstones can usually be classified visually and would not require thin sectioning. The presence and mode of occurrence of pyrites also needs to be recorded with special reference where it is associated with strong rocks.

8. The geological assessment may reveal the presence of border-line rocks which can vary laterally. In these instances further examinations will be necessary as the faces or headings advance.

9. Reports prepared as a result of the routine geological assessment of existing and new faces and headings will be sent to the Chief Mining Engineer, the Area Ventilation Engineer, the Area Safety Engineer and the colliery Manager concerned. Reports on new faces should be available for the face design stage.

Frictional Ignition Incidents

10. As soon as possible after an incident the Area Ventilation Engineer should inform the Regional/Area Geologist so that arrangements can be made to visit the site of the ignition to take strata samples and measure the geological section. Geological Branch will then provide a brief report on the relevant strata and geological background based on this visual examination. After the samples have been thin-sectioned and examined under the microscope, a detailed description of the samples and their quartz content will augment the initial report. Reports on frictional ignition incidents will be sent to the Chief Mining Engineer and the Area Ventilation Engineer of the Area concerned, with a copy to the Headquarters Specialist on frictional ignitions.

Responsibility for the Geological Work

11. The Regional/Area Geologist concerned, in consultation with the appropriate Chief Mining Engineer, will be responsible for ensuring that the geological work required under this procedure is effectively carried out. He will arrange for rock samples to be despatched to the Manvers Laboratory for thin sectioning and then returned to the appropriate Regional/Area office for microscope examination. Suitable equipment has been established in the Scottish, North East, and West Midlands Areas and in the Yorkshire Region, the latter also serving the needs of South Wales Area and the East Midlands Region.

b) General

1. Specific attention should be given where conditions are more conducive to an ignition and, in particular, to those places where there is the greatest potential danger associated with an ignition:
   a) the return end of longwall faces
   b) thin seams - 107 cm or less
   c) headings and rippings
   d) geologically faulted strata

2. Extra care should be exercised where strata comprises a combination of quartzitic and pyritic rock. This type of strata is likely to be the most incendive encountered in mining. Generally it is better to cut a pyritic rock with a drum or auger type cutting element rather than with a disc/jib type of cutting element.

3. A high standard of ventilation supplemented, as and where necessary, by systematic firedamp drainage should be provided as the best insurance against the risk of an ignition propogating into an explosion. It is important to ensure that the firedamp drainage is always maintained well forward.

4. More widespread use should be made of ancillary ventilation devices (e.g. HSV*, venturi type air movers, small hydraulic fan) and the same applies in the case of equipment for directing water to the vicinity of the pick point. Additionally, external water jets should be so positioned to apply water directly into any cutting zone containing an incendive rock. Ancillary ventilation devices should be regularly checked to ensure their operating efficiency. The use of a device for the in-situ measurement of airflow in HSV is recommended. This would help to evaluate doubt regarding the efficacy of an HSV at any particular time.

5. Sharp picks and low pick speeds should be used to minimise the risk of an ignition; in addition, high haulage rates lead to better product size, a lower dust and gas make.

6. The facilities available for horizon control should be used.

7. Adequate fire fighting facilities should be provided and maintained at all working places so as to minimise the chance of an ignition developing into a serious fire. This involves ensuring that an adequate quantity and pressure of water is always provided at the working face and this requirement is, of course, equally important from the dust control aspect.

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* HSV - Hollow Shaft Ventilator

c) Longwall Faces

1. The return end of a face is a high risk zone and the length of the fast end should be kept to a minimum and preferably avoided.
2. The shearer type of machine is generally prefered to the trepanner where there is an incendive rock at roof level, and this applies especially if the rock is of a pyritic nature. The shearer is also preferred if pyrites is present at or near to floor level.
3. As much as practicable of the cut coal should be loaded onto the AFC* on the cutting run. An appreciable amount of freshly cut coal, left in the face track behind the machine, considerably increases the ignition, explosion and fire risk and this applies particularly in the thinner seams (e.g. less than 100 cm thick).
4. Freshly cut coal should not be allowed to build up close enough to roof level to restrict seriously the normal ventilation over the machine. Good loading out onto the AFC* and clearance by the AFC* are essential at all times, and this again is particularly important in the thinner seams, where appropriate measures (e.g. interlock) should be taken to ensure that the machine does not continue to cut when the AFC stops.
5. The underplated type of AFC should be used wherever there is a risk of firedamp accumulation underneath the conveyor, and suitable discharge arrangement provided on to the stage loader to minimise carry-back of coal under the AFC.

Shearer Type Machines

6. Where the seam height permits, the ranging drum shearer is preferred to the fixed head machine for superior horizon control and ventilation distribution around the machine.
7. All shearer type machines should be provided with a hollow shaft ventilator when working in conditions liable to the risk of a frictional ignition. From the ignition and dust suppression aspects HSV should be used with a high water/air ratio.

*) AFC - Armoured Face Conveyor

New designs of shearers should include a suitable hollow shaft for HSV purposes with a maximum bore diameter which should not be less than 90 mm.

8. Return end stable elimination machines should cut in on the snake and not sump in at the corner in a fast end.

9. Extra precaution should be taken where a ranging drum shearer is used to cut out a return end rip, e.g. use of an ancillary/auxiliary ventilation device.

Trepanner (i.e. D.E.C.M.T.)

10. The diameter of the trepan wheels should be as large as it is practical to accommodate in the working height. They should be provided with an internal water feed and the trailing wheel should also rotate.

11. Scraper ploughs (cowls) behind the floor discs should not be used. Whenever the machine is cutting, water should be provided to both the leading and trailing floor discs. The speed of the floor discs should be as low as practicable - the lowest speed currently obtainable is 35 r.p.m.

12. The roof disc should rotate at the lowest speed (i.e. 72 r.p.m.), and be provided with an internal water feed.

Fire Fighting Provisions and Automatic Firedamp Detectors

13. Fire Fighting provisions should comprise :

a) A facility on the machine to ensure that the dust suppression water can quickly be used for fire fighting purposes.

b) A dry power type fire extinguisher kept on the machine and others at regular intervals along the face. Dry powder type fire extinguishers are generally much more effective than water for extinguishing burning firedamp.

14. It is desirable for an automatic firedamp detector to be provided and kept as close as practicable to the return end of a face and near to roof level.

d) Headings/Rippings

1. The ignition problem with machine cut headings/rippings is relatively straightforward to define and not subject to the wide variety of conditions which occur on longwall faces. Even so, it must be appreciated that a heading/ripping is one of the two places underground where the danger associated with an ignition will generally be highest; the other place being the return end of a face. Special attention therefore, needs to be given to headings/rippings particularly in the case of return end advance headings.

2. The basic requirements are to ventilate adequately :

   a) the face of the heading
   b) the roof level near to the face of the heading in order to prevent layering
   c) the vicinity of the cutting head in order to minimise the risk of an ignition.

   An effective auxiliary ventilation system is essential to satisfy the first requirement. The second can be best satisfied by a ventilator (i.e. small hydraulic fan or compressed air operated air mover) mounted on the machine and the third by water powered airjets. The ventilators on the machine should be interlocked to ensure that they must be operating before the cutting head can be revolved.

3. The face of any advance heading of a longwall face should not coincide with the abutment zone.

Heading/Ripping Machine

4. The preferred type of machine for coal headings, rock heading or ripping is one in which it is practical to ventilate effectively the vicinity of the cutting element continuously, e.g. by water powered airjets.
5. The type of machine which cuts upward and loads on top of the pick mat is preferred to one which cuts downward and loads along the floor. In the former type the material is removed as it is made whilst in the second, further degradation occurs resulting in increased firedamp make.

Fire Fighting Facilities and Automatic Firedamp Detectors

6. Adequate fire fighting facilities should always be maintained as close as practicable to the face of the heading and include dry powder type extinguishers.

7. It is desirable for an automatic firedamp detector to be provided and kept as close as practicable to the face of the heading and near to roof level.

e) Long Term Recommendations

1. There should be further examination and development of a water operated ventilator or other methods to ventilate the space between the face and the body of the machine.

2. Work should continue to develop suitable equipment to monitor automatically the efficiency of auxiliary ventilation devices.

3. More attention should be given to making available better facilities for horizon control.

APPENDIX II

Short summary of results from research work carried out by SMRE
(see Doc. n° 2228/75 and 3075/75)

1. The probability of ignition decreases with the reduction of pick speed.
2. The probability of ignition can be reduced by applying water behind the picks.
3. The probability of ignition is greatly increased with worn picks.
4. The probability of ignition is less when large round-nosed picks are used than large V shaped picks or radial type picks.

APPENDIX III

B I B L I O G R A P H Y

Document n° 578/75	National Coal Board, Mining Department "Frictional Ignitions"
Document n° 2228/75	"Ignition of Firedamp by Friction during Rock Cutting" F Powell and K Billings
Document n° 3072/75	Ignitions of Firedamp by Power Loaders and Heading Machines. List of Incidents occurring between 1.1.1970 and 30.6.1975 in the districts of the Landesoberbergamt (Mines Inspectorate) for the North Rhine-Westphalia and Oberbergamt for the Saarland and Rhineland Pfalz
Document n° 3073/75	Report on ignitions of firedamp by power loaders in the Campine Coalfield Incidents occurring on 16 and 24.4.75
Document n° 3075/75	The ignition of methane-air by machine picks cutting into rock F Powell, K Billings and D P Cutter
Document n° 3738/75	Joint NCB/HSE/CUMM co-ordinating committee on frictional ignitions Third Interim Report - August 1975

ANNEX XI

BIBLIOGRAPHY OF THE WORK OF THE MINES SAFETY AND HEALTH COMMISSION

A. MINE RESCUE, FIRES AND UNDERGROUND COMBUSTION

I. - Mine rescue

1. Organization of mine rescue arrangements

- Report on tour of central rescue stations in the Community countries and Great Britain (First Report on the organization of mine rescue services 1958/59) (2nd Report of the Mines Safety and Health Commission, Annex B, June 1961);

- Second Report on the organization of mine rescue services, 1960 (3rd Report of the MSHC, Annex V a, November 1966);

- Third Report on the organization of mine rescue services, 1961 (3rd Report of the MSHC, Annex VI a, November 1966);

- Fourth Report on the organization of mine rescue services, 1962 (3rd Report of the MSHC, Annex VII a, November 1966);

- Fifth Report on the organization of mine rescue services, 1963 and 1964 (3rd Report of the MSHC, Annex VIII a, November 1966);

- Sixth Report on the organization of mine rescue services, 1965/66 (5th Report of the MSHC, Annex V, October 1968);

- Seventh Report on the organization of mine rescue services, 1967/68, (7th Report of the MSHC, Annex IV, September 1970);

- Recommendations regarding the provision of advice from foreign experts in the case of major accidents (3rd Report of the MSHC, Annex III, November 1966);

- Communication links between the rescue base and the rescue team (3rd Report of the MSHC IVm Annex IV, November 1966);

- List of regulations and directives concerning the organization of mine rescue services in the countries of the Community and the United Kingdom (Doc. 3845/1/70; to be published in the 9th Report of the MSHC).

- Ninth Report on Mine Rescue Services, Organization, Personnel, Apparatus available, and recent developments for rescue work in irrespirable atmospheres, giving the position in Member States of the Community as at 31.12.1975 (14th Report of the MSHC, Annex VI, June 1977).

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- Interim report on the continued development of the CO-filter self-rescuer (Doc. 1872/68/1, 10th October 1968);

- Results of the research carried out with financial assistance from the Commission of the European Communities into the improvement of the physiological conditions for the wearing of breathing apparatus (8th Report of the MSHC, Annex IV, June 1971).

- First report on filter self-rescuers for use in coal mines in the European Community countries - Part I : minimum design requirements and testing procedures (13th Report of the MSHC, Annex X, 1976).

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3. Research work at high temperatures

- Final report on research into the establishment of simple criteria for the selection of rescue team personnel for heavy work in high temperatures (3rd Report of the MSHC, Annex IX a, November 1966).

4. Rescue with boreholes

- List of specialists for borehole rescue work and equipment available in Community countries (8th Report of the MSHC, Annex III, June 1971, revised giving position as at 1.1.76. (13th Report of the MSHC, Annex VI, 1976).

II. - Fires and underground combustion

1. Shaft fires at great depth

- Recommendation on the equipment having regard to the prevention of open fires (1st Report of the MSHC, April 1959);

- Fighting of fires in shafts by bringing in water (2nd Report of the MSHC, page 24, June 1961); see also modification contained in 10th Report of MSHC, Annex VI, June 1972.

- Final report on experiments with shaft fires carried out by the Experimental Roadway Association in Dortmund, with the financial aid of the High Authority, at Dorstfeld Colliery, Dortmund (3rd Report of the MSHC, Annex III a, November 1966);

- Explanatory notes and views of the Working Parties on Underground Combustion and Fires and Mine Rescue Organization, and their expert sub-committees, concerning the final report of the Experimental Roadway Association, Dortmund, on the shaft fire experiment atDorst-feld Colliery. (3rd Report of the MSHC, Annex III b, November 1966).

- Memorandum on the Neutralization of Mine Fires by the Injection of Nitrogen (14th Report of the MSHC, Annex VIII, June 1977).

2. Fire stoppings (dams)

- Sealing-off of mine fires and underground combustion by dams (2nd Report of the MSHC, page 51, June 1961);

- Report on trials with explosion-proof dams carried out by the Experimental Roadway Association in Dortmund at the request of the Safety Commission and with financial aid of the High Authority - Statement of policy regarding the erection of advance dams of plaster as a fire fighting measure (3rd Report of the MSHC, Annex I, November 1966);

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- Opinion on the use underground of polyurethane foam in the coal mining industry (7th Report of the MSHC, Annex VI, September 1970).

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- Final report on electro-magnetic tests carried out with the financial aid of the High Authority in the Bochum Rope-testing Station (3rd Report of the MSHC, Annex XI a, November 1966);

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- Report on measurement and testing procedures for shaft and roadway winding ropes and for guides for shaft and roadway haulage installations (7th Report of the MSHC, Annex VII, September 1970);

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- Requirements which must be met by electrical shotfiring leads (2nd Report of the MSHC, page 8, June 1961);

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The 14th Report of the Mines Safety and Health Commission contains an account of the work done during the year for this Commission, its Working Parties and Committees of Experts, together with accident statistics, and an analysis thereof.

The annexes include lists of members of the MSHC and its Working Parties, etc, terms of reference for these groups and seven reports which are either proposals to governments for improving safety or for information. These apply to the following fields: inflammable dusts, firedamp, rescue and mine fires, and details of new regulations appertaining to safety and health in the extractive industries.

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