

FOREWORD

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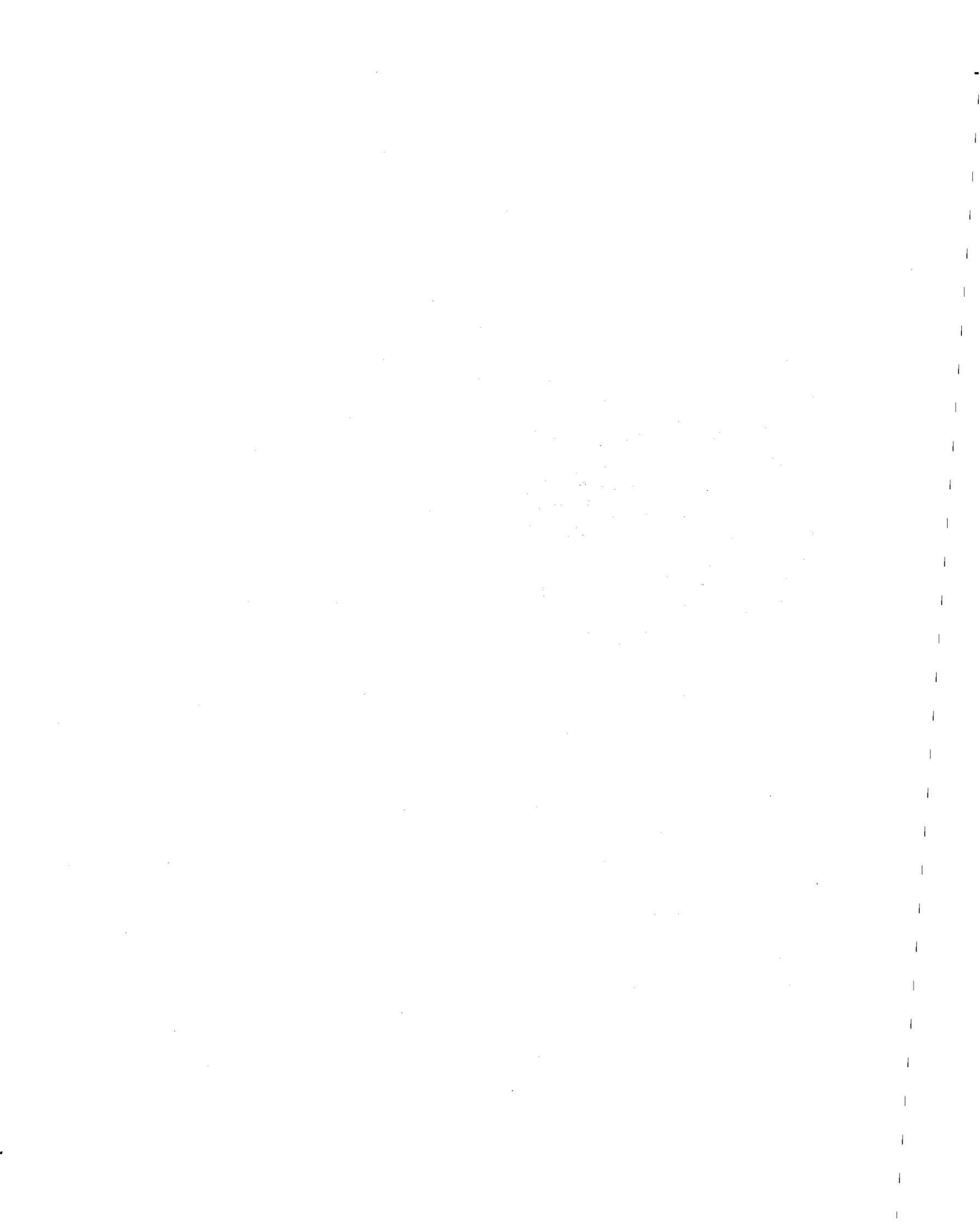


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APPENDIX A

DISCUSSION OF RECOMMENDED GUIDELINES

This appendix discusses the guidelines in Volume I in more detail. The discussion of definitions parallels Volume I; however, the rest of the discussion in this appendix is more general and does not parallel guidelines in Volume I.

A.1 Definitions

This section provides definitions of terms used in the guidelines - terms whose meanings are defined neither in Part 75 of 30 CFR, nor in the Coal Mine Health and Safety Inspection Manual dated March 9, 1978. The acronyms, SCSR and FSR, mean Self-Contained Self-Rescue device and Filter Self-Rescue device, respectively.

A.1.1 Miner

By statute, "miner" means any individual working in a coal or other mine. In the regulations for approved rescue devices, however, the words miner and "person" are used in a manner that one might interpret as being either arbitrary or deliberate. The regulations pertaining to self-rescuers have the following references to miner and person:

- .1714(b) Before *any miner* employed by the operator or visitor authorized by the operator goes underground the operator shall instruct and train *such person* . . .
- .1715-2(b) . . . worn or carried at all times by *each person* . . .
- (c) Where wearing or carrying . . . is hazardous to *the person*, it shall be placed . . . no greater than 25 feet from *such person*.
- (d) Where *a person* works on or around . . .
- (e) A mine operator may apply . . . The District Manager shall consider . . . to place an SCSR device more than 25 feet from *a miner*:

- (iv) Type of work performed by *affected miners* . . .
 - (vii) Degree of risk to which *affected miners* . . .
 - (ix) Degree of risk to which *affected miners* . . .
- (c) (2) Such application shall not be approved . . . *all miners* . . . have a {filter self rescuer} . . . sufficient to enable *each miner* to get an SCSR.
- (c) (3) . . . from *miners* on mantrips . . .
- (f) . . . end of a *miner's* shift, the place of storage . . .
- (g) (1) {10/60 devices} . . . the device of not less than 10 minutes shall be worn . . . by *each person* . . .
- (2) The 1-hour cannister shall be available . . . to *all persons*

Pending clarification of the differences, if any, between miners and persons, these guidelines suggest that the two terms can be used interchangeably.

A.1.2 Visitor Authorized by the Mine Operator

A "visitor authorized by the mine operator," or an invitee, includes employees of the mine operator who are not miners as well as all other persons who enter the mine at the request or discretion of the mine superintendent. Such persons include representatives of the: mine operator; manufacturers; consultants; contractors; and research organization. The definition does not include persons who are authorized by law to enter the mine.

The definition is based on the mine operator's duty with regard to miners and invitees to accomplish the following:

- a. Instruct them in the use of SCSRs
- b. Provide them with SCSRs before they enter the mine
- c. Make reasonable inspections of SCSRs to discover dangerous conditions
- d. Warn of dangerous conditions or correct them.

A mine operator does not owe duties a, b, and c to persons who are authorized by law to enter a mine. Neither may a mine operator prohibit such persons from carrying into the mine either defective SCSRs or SCSRs of a different type.

A.1.3 Hazardous

The term "hazardous" refers to an individual's judgement that wearing or carrying an SCSR may cause him injury. As further described in Appendix F (Paragraph 2) this definition is based upon present accepted practice with FSRs in underground coal mines. Although such determination can be disapproved by officials representing the mine operator, MSHA, or the state, disapproval is rare and is based on incontrovertible evidence. In the past decade, fewer than 120 notices of violation for failure to wear/carry an FSR have been issued by MSHA inspectors, and most of those purportedly were issued to persons who had left their FSR near a previous work site.

Presently, most persons in underground coal mines wear FSRs throughout their shift. However, the bulk, size, and weight of SCSRs is far greater than an FSR, the SCSR harness is relatively loose, and its strap ends are not easily secured. Such features might indeed precipitate an increase in miner-judgements that carrying an SCSR or wearing one hung over the shoulder with a neck strap is hazardous:

- a. Working on or around moving equipment including conveyors
- b. Doing jobs requiring bending and lifting
- c. Doing jobs requiring coordinated movement of both arms such as shoveling, pulling cable and carrying
- d. Crawling over rough terrain and traveling through small doors and along longwall faces
- e. If a worker is suffering from physical impairment of any part of the body between the groin and the neck.

Some tasks might be accomplished more easily than others while wearing an SCSR. However, discrimination charges or other grievances may result if some persons are required to wear or carry an SCSR while others are allowed to store it. Resolution of such charges would have negative effects on the efforts of MSHA and mine operators with regards to other health and safety matters.

A.1.4 Readily Accessible

The term "readily accessible" refers to circumstances under which there is reasonable assurance that an SCSR can be opened and activated without needless loss of time and that it will, upon activation, be adequate to protect the user against the hazardous mine atmosphere for 1 hr or longer.

The regulations define "reachable" as being either not farther than 25 ft from the person who judges the SCSR hazardous to wear or carry (30 CFR, 75.1714-2(c)) or on the equipment on or around which the person is working (30 CFR, 75.1714-2(d)). The regulations imply that usable refers to the adequacy of the device to protect against hazardous atmospheres for 1 hr or longer. Based on experience and judgement, we believe that usable must mean not only that an SCSR can be opened and activated without needless loss of time, but also that immediately upon activation it will provide sufficient oxygen to support the life and promote the escape of the user.

In order to provide reasonable assurance that an SCSR is usable, it must be protected against dirt, grease and water as well as temperature extremes. Dirt, grease, rust and corrosion make an SCSR difficult to open. As demonstrated by the Itmann and Sunshine Mine disasters (1972), difficulty in opening FSRs had serious consequences. Unless further experience provides a basis for contrary judgement, these guidelines suggest that accessibility requires that an SCSR be kept reasonably clean and dry.

With regard to temperature extremes, SCSRs should not be exposed for more than 1 hr to temperatures below freezing or above 100°F until experience proves that a wider range is safe.

At temperatures below freezing, chemical oxygen systems are slow to react; if manual activation is required, they may not start at all. With bottled oxygen systems, there is a danger of valves and regulators freezing. Currently, low temperature limits of 10° and 23°F are recommended by the manufacturers of presently approved SCSRs. However, our guidelines recommend "above freezing" for the following reasons:

- a. The setting of different limits for each manufacturer or type of SCSR will unnecessarily complicate compliance with regulations and enforcement of same.
- b. The freezing point of water, 32°F, is not only well understood, but also easily determined without instruments.

- c. Storage above freezing provides a margin of safety. This is particularly important since the guidelines suggest that SCSRs may be subjected to lower temperatures for up to 1 hr.

Upper temperature limits currently recommended for two approved units are 100° and 158°F. Our current guideline is "below 100°F," which should be observed until sufficient experience and research prove that SCSRs will continue to be readily accessible after prolonged exposure to higher temperatures. The reasons for this determination include the following:

- a. The setting of different upper temperature limits for each manufacturer or type of SCSR will unnecessarily complicate compliance with regulations and enforcement of same. Mine operators and inspectors might then be required to carry out temperature studies in the ceiling areas of bathhouses, in-mine offices and machine shops, the areas around resistance coils on mining equipment, and heaters in dinner holes in order to determine which type of SCSR may be stored in which location.
- b. At higher temperatures, reaction of latent moisture with KO_2 could create elevated pressures within the SCSR case, possibly damaging the airtight seal or injuring someone opening the case.
- c. Use of an SCSR which already starts at high temperature may provide excessively high breathing air temperatures.
- d. Allowing higher or lower temperatures for less than 1 hr is purely arbitrary, based solely on informal conversations with manufacturers and other informed persons. If a more precise determination is desired, extensive research would have to be conducted. Even if such research were conducted, it is unlikely that the needed information would be available by 21 December 1980. The information provided by research would probably be graphs of temperature and exposure duration which are apt to make things more complicated rather than enhance the safety factor. Acceptance of the 1-hr period is suggested.

Another factor affecting the accessibility of SCSRs is vibration. An analysis of the effects of vibration is given in Appendix D. Although the data was too limited to draw conclusions, the evidence suggests that the current NIOSH vibration tests are not truly representative of the vibrational stresses endured by SCSRs placed on underground mining equipment. Should this inference be proven by study and research, then the life expectancy of SCSRs subjected to such stresses is difficult to estimate and might be less than claimed.

No one has yet determined how to prevent vibrational stress or to ascertain from a nondestructive test whether vibration has indeed caused serious damage. To determine usability, at least one of the SCSRs placed on each type of equipment should be tested at least once a year. Tests should be carried out in-mine to ensure realistic and applicable results; tests should also be done in accordance with procedures given in Man Test I as described in Table 1, 30 CFR, 11-85.

A.1.5 Readily Accessible Location

The phrase "readily accessible location" refers to a holder or container in which an SCSR is stored. The following locations *do not* meet the requirements to be considered readily accessible.

- a. Any location where an SCSR is exposed to excessive dirt, grease, water, or to temperatures below freezing or above 100°F
- b. Any location where the SCSR is placed on equipment without an appropriate holder or container
- c. Any location where an SCSR is placed on the floor or next to the rib unless the SCSR is in an appropriate container.

Subsection A.1.4 contained a discussion of why these locations may not be considered readily accessible. An additional reason is the possibility of case rupture. Not only does case rupture destroy the integrity of an SCSR, but also rupture by a toothed mechanism has been known to cause a flame-producing reaction in USBM and German tests. Although it has not been demonstrated by study, it is certainly reasonable to anticipate the same flame-producing reaction from an SCSR crushed by a rough, sharp steel object such as the gathering arms on a loading machine, chain links in a conveyor, and crawler "cat" pads. Logically, then, an SCSR placed where it might fall into a feeder-breaker, or where it might be engaged by the cutting head of a continuous miner or shearer or be run over by crawler-mounted equipment might be considered an imminent danger.

Mechanics and equipment operators frequently must leave the equipment on or around which they are working. SCSRs that they place on equipment may be left behind not only because of neglect but also, and more likely, because they judge the SCSR hazardous to wear or carry while doing other tasks. Unless they are working under an approved storage plan, they may not have FSRs. Accessibility to SCSRs is an issue, then, because should they be out by the equipment at the time of an emergency, they would have to obtain an SCSR from another location or travel back to the equipment, which could mean movement through toxic atmosphere.

A.1.6 Holder

The term "holder" refers to both the means by which and the place wherein an SCSR is maintained readily accessible. Therefore, the design and choice of the holder should ensure that an SCSR will be kept reasonably clean and dry and will be protected against the following:

- a. Being run over or crushed by moving equipment
- b. Getting caught in machinery
- c. Being struck by a fall of roof or rib
- d. Being subjected to damaging vibrations
- e. Being exposed to prolonged extremes of temperature.

Any of the following may be considered an acceptable holder:

- a. A nail in a post, header, crib and stopping
- b. A hook from a roof bolt bearing plate
- c. A peg rack or shelf in a dinner hole
- d. A hammock inside a covered portal bus or beneath the canopy of a mining machine
- e. A vibration-dampened place on a locomotive, jeep, portal bus, or other equipment that travels along normally well-supported haulageways.

A holder may *not* be any of the following:

- a. The floor of a mine opening
- b. A shelf or peg rack on the rib in an open crosscut or entry
- c. A place where an SCSR lays on a piece of mining equipment or loose in the operator's or passengers' compartment of a piece of mining equipment.

A.1.7 Container

The term "container" describes a holder that additionally accomplishes the following:

- a. It protects an SCSR against an elastic load of at least 1 lb/in.².
- b. It is light enough such that even when filled it can be moved manually by two miners, without causing injury to them.
- c. It has sufficient size and visibility such that it can be easily seen by persons operating mobile equipment nearby.
- d. It can be opened without needless loss of time.

The maximum probable load imposed by a minor fall of roof or rib is 1 lb/in.². In order to be considered readily accessible, a container must protect SCSRs against damage from such a fall. Most containers will be under bolt-supported roof, and generally, falls of bolt-supported roof are either small pieces of rock from between bolts or else massive.

Naturally, a larger container would be required to protect against the more massive roof falls which sometimes occur. Most containers need to be moved frequently and manually; however, to move a container built to withstand a massive fall would require special equipment. The best interests of safety require maximizing the ready accessibility of the SCSRs. Therefore, overly large containers that cannot be moved manually are neither practical nor desirable. Extremely heavy containers would create the potential risk of injury to miners attempting to move them. Good containers, purchased at reasonable prices (see Appendix G), are the best alternative.

One feature mentioned above - that containers be light enough to be manually moved by two miners - should be an important consideration when formulating storage plans, particularly for low coal; in this instance, a container of six SCSRs might be dangerously heavy.

The guidelines also recommend that containers have sufficient size and visibility to be easily noticed by persons operating mobile equipment nearby. Adequate visibility is a feature intended not only to reduce the chances of the container being struck but also to reduce the chance of the container being a tripping hazard and to increase the likelihood that it will be seen in a place filling with smoke.

A.1.8 Section

For the sake of these guidelines, the term "section" refers to one or more working faces contained within an area bounded by the following:

- a. The most inby loading point or a distance not exceeding the fifth connecting crosscut outby the faces, if the latter is the lesser distance from the point of deepest penetration in the section.
- b. In room-and-pillar sections by the junction of the last permanent stopping(s) and the return airway(s) for the section.
- c. In longwall sections by the center of the face.

This definition is more limited than the generally accepted meaning of working section, as defined in 30 CFR. In some mines, loading points can be several thousand feet from the point of deepest penetration. In such instances, SCSRs stored near the beginning of a section could be too far to reach safely using FSRs (this is discussed in subsection A.3.2).

It is important to use a definition that is consistent and reasonably applicable to all mines, and in the best interests of safety. The distance factor is considered to be of particular importance to miners who are outby the loading point. These guidelines suggest that miners can be outby the loading point without an SCSR when the travel distance is equivalent to 5 min, and when the approved plan for the section is limited to primary storage (except for longwalls).

A.1.9 Store, Stored or Storage

The terms "store, stored or storage" refer to the placement of an SCSR in accordance with a plan submitted by the mine operator and approved by the District Manager. This is self-explanatory; however, A STORAGE PLAN CANNOT ABRIDGE THE RIGHT OF MINERS TO WEAR OR CARRY AN SCSR.

A.1.10 Commingling

The term "commingling" means mixing together. Commingling, as used in these guidelines, refers to SCSRs of different models or whose physical condition is not known to the mine operator.

A District Manager when evaluating a plan for storage of SCSRs must consider matters bearing on the safety of miners and the type of risk to which affected miners are exposed. Commingled SCSRs, unless the operator successfully prevents this, constitute a serious risk. For example, a mine operator instructs and trains miners in his employ and visitors he authorizes to enter the mine in the use of Model X SCSRs. Differences among the various models of SCSRs, and there may be as many as six commercially available in 1981, are great. It is reasonable to expect a miner's life might be jeopardized in the attempt to don and activate an unknown SCSR.

A miner's life also might be placed in jeopardy should the SCSR be defective. It is not unreasonable to suspect an SCSR might be defective if it has been carried by a visitor in a car, truck, airplane or other environment beyond the control of the mine operator. No present means exist to determine the adequacy of an SCSR that has been frozen in the winter, baked in the summer, and bounced the year around. For these reasons, the guidelines for coal mine operators and miners suggest prohibiting commingling of operator-supplied and other SCSRs.

A.2 Factors in the Evaluation of Storage Plans

The decision to allow storage of SCSRs is not for convenience but for safety. The development of suitable storage plans is not a simple matter. Storage plans were devised for five mines:

- a. An old mine in the Pittsburgh coal seam, with 11 continuous miner working sections, employing almost 700 miners on three shifts

- b. A "middle-aged" mine in the Pittsburgh coal seam with two longwalls and five continuous miner sections, employing more than 630 miners on three shifts
- c. A new mine in the Pittsburgh coal seam, with three sections driving mains, employing fewer than 130 miners on three shifts
- d. A middle-aged mine in the Pocahontas No. 3 seam, with nine sections, including two longwalls, employing 510 miners on three shifts
- e. An old mine in the Lower Freeport seam with 13 sections, employing 435 miners on three shifts.

Appendix H shows sample plans for mines b, c, and d.

From this experience, some important considerations were discovered concerning storage plans which include the following:

- a. A storage plan must be tailored to the specific activities, particularly the modes of travel being used
- b. Storage plans may result in the number of SCSRs in storage being greater than the total number of miners
- c. Mine supervisors consider the storing of SCSRs to be most cost-effective in terms of supervision, compliance, and control than the wearing and carrying of SCSRs by hourly employees. Prior to this exercise of devising plans, these same supervisors had expected that wearing and carrying would be the best method for compliance.
- d. Wearing or storing of SCSRs on mantrip vehicles is likely to reduce passenger capacity; thus, additional vehicles may be required
- e. It is difficult to include the miners of nonface crews in storage plans; their work sites and times are too inconsistent
- f. Careful planning and further consideration is needed to interrelate storage plans with both a potential fan outage of more than 15 min (30 CFR, 75.321) and the conductance of escapeway drills every 6 weeks and 90 days (30 CFR, 75.1704-2).

A.2.1 Size of 1-hr SCSRs

Belt-wearing of presently approved 1-hr SCSRs has been shown to be generally impractical. Their size, configuration and harness make them difficult to wear in tight places or around moving equipment. It is likely, therefore, that more SCSRs than FSRs will be judged "hazardous to wear or carry". If storage is not provided for SCSRs, miners might simply place them in random locations. Some locations may present fire hazard potential or reduce the SCSRs ability to provide oxygen (due to conditions described previously).

A.2.2 Distance of Miner from the Proposed Storage Location

Paragraph (e) (2) of 30 CFR, 75.1714-2, requires that when SCSRs are stored, miners must have approved filter self-rescuers that will provide sufficient oxygen to enable them to reach an SCSR. For an FSR to be considered sufficient miners should be able, under normal circumstances, to reach an SCSR in 5 min, walking (or crawling). In the case of an area where there is reason to expect a gas outburst, a major coal bump, or exposure to an oxygen-deficient atmosphere, the SCSRs should be at arm's length.

The basis for the determination of 5 min is detailed in Appendix C. A summary follows:

- a. In the event of an *explosion*, persons who escape the effects of flame and pressure have seconds to hours to obtain an SCSR.

<u>Explosion</u>	<u>Estimated Minutes From Awareness to Collapse</u>
Scotia (3/9/76)	10 - 360
Itmann (12/16/72)	1 - 45
Finley (12/20/70)	1 - 5

- b. In the event of *fire*, persons downwind may have as few as 5 min to obtain, put on and activate an SCSR.

<u>Fire</u>	<u>Estimated Minutes From Awareness to Collapse</u>
Pyro (9/29/73)	5
Blacksville (7/22/72)	5 - 15
Nemacolin (3/26/71)	5 - 10

- c. Persons who quickly become aware of fire may have more than 5 min to obtain, put on and activate an SCSR.

<u>Type of Fire</u>	<u>Incapacitation, Minutes in Undiluted Split of Air</u>
Belt conveyor	60
Coal on conveyor	20 - 60
Coal ribs and roof	15
Shuttle car tires	10
Compressor	10
Continuous miner	6

- d. Limited studies indicate that within a 5-min time lapse, the average miner, traveling at a normal pace, over rough terrain, in low top and across overcasts, will reach the distances indicated in the table below.

<u>Distance (feet)</u>	<u>Seam Height (inches)</u>
1000	60 or more
700	36 - 48
400	30 or less

Detailed study of escape time and oxygen cost has been planned. Results from that study should be available in 1981.

The recommended place of storage for 60-min cannisters is within a 5-min travel time. A greater distance is not in the best interests of safety based on present knowledge and experience. A distance that would require a 10-min travel time might be considered, but it leaves no margin for potential difficulties in obtaining and activating a 60-min cannister.

Discussions with concerned persons suggest that 10/60 devices might be used where an FSR is not adequate to enable miners to reach stored SCSRs. The conditions favoring such use of 10/60 devices include the following:

- a. Gas outbursts
- b. Coal bumps
- c. Oxygen-deficient atmospheres
- d. Examination of abandoned areas

- e. Sections without escapeways
- f. Longwalls
- g. Mantrips.

A.2.3 Place of Storage

It is expected that mine operators will request approval of two basic types of storage plans. One, "shift storage," would require that miners bring SCSRs into the mine every day, placing them in approved storage locations near their work site. The other, "full-time storage," involves leaving a supply of SCSRs in the approved storage locations and providing miners with other SCSRs when they are not in their work site.

Both of these plans should find acceptability within the constraints of the guidelines. These constraints are summarized as follows:

- a. Most SCSRs will be stored in intake airways.
- b. Storage locations must provide reasonable assurance that SCSRs will be readily accessible.
- c. Storage locations should be chosen such that access is not likely to be prevented by smoke from a fire, a fall or roof or rib or oxygen-deficient atmosphere.
- d. Storage locations must be chosen such that a miner is no more than 5 min travel time away from an SCSR.
- e. All persons in the mine must be aware of storage locations designated for their use.
- f. There should be signs indicating storage locations as well as directions to storage locations. These signs should be easily seen and be understandable to any persons likely to enter a mine.

A.2.4 Other Factors

FMA has found no basis for prohibiting storage of SCSRs in mines having a history of accidents, explosions, fires or gas inundations. As discussed previously, storage is not for convenience, but is in the best interests of safety. Further, no data were found to substantiate a relationship among accident

frequency, explosions, fire and gas inundations in American coal mines. In fact, the record contains nothing to indicate public knowledge of the inadequacies leading to the six fires and explosions previously described and to many of the fires and explosions in prior years. In other words, none could have been predicted with reasonable certainty. FMA judges MSHA's present program of mine inspection frequency based on accident and gas liberation history to be an effective means to protect miners; prohibition of SCSR storage would not.

A.3 Section Storage

Several characteristics of working sections make storage a viable concept. A limited area is involved; in such an area, supervision is provided and mine communications are close at hand. In addition, fire fighting and mine evacuation plans generally require that the crew assemble in a designated location.

As the guidelines suggest, a storage plan in no way infringes upon an individual miner's right to wear or carry an SCSR if he does not judge doing so to be hazardous. (This issue was presented in subsection A.1.3 when the definition of hazardous was discussed.)

A.3.1 Primary Storage

FMA conducted discussions with managers and key staff of the 10 coal mine health and safety districts and with representatives of workers and operators of underground coal mines producing more than 150 million tons annually. One result of these interviews was an abundance of good reasons for locating SCSRs in several different places on a section. The choice of storage location is affected not only by section layout but also by mine practices including escapeway drills and evacuation procedures. The fatal fire and explosions analysis (Appendix C) indicated that there is no one location in a section that can be considered most advantageous. These factors and others support the suggestion that a storage plan analysis is best carried out on a "mine-by-mine, section-by-section" basis rather than establishing a rigid nationwide standard.

The following subsections contain suggestions drawn from the guidelines.

Storage Plan

A *storage plan* does not abridge the rights of a miner who judges wearing or carrying an SCSR as not hazardous. The prohibition against requiring individuals to store SCSRs should they elect to wear or carry was discussed previously in the definition of hazardous.

Number

A *sufficient number* of SCSRs is one 1-hr SCSR for each miner for whom storage is requested or one 60-min canister if a 10/60 system is used.

Primary Storage

Members of the section face crew would most likely utilize *primary storage*, which should have the following features:

- a. Within the section and not farther than the miners can walk (crawl) in 5 min from the point of deepest penetration
- b. In intake air
- c. Out of the flow of equipment movement
- d. In containers unless the place inherently provides sufficient protection to allow the use of holders
- e. More than one block from an active loading point
- f. Accessible from more than one entry unless the place of storage is in the intake escapeway.

The reasons for these features are discussed in the following paragraphs.

Primary storage should take place in a section such that the face crew will have some control over the SCSRs intended for their use and safety. Primary storage should also be in intake air to increase the likelihood that the face crew can reach their SCSRs and should be out of the flow of equipment to reduce the possibilities of damage of SCSRs.

The preferred location for primary storage was the first outby crosscut in the intake escapeway. That preference was based on the fact that this location would likely be the last area of a section to be engulfed by a toxic atmosphere in the event of fire, explosion, or breakthrough to an oxygen-deficient place. However, it could also be the first location contaminated by a fire under the overcast on the main or in an adjoining belt or trolley wire haulageway.

When primary storage is accomplished in a relatively open area containers should be used in order to protect SCSRs from the rock dust and moisture which can make opening and activating the device dangerously time-consuming. Containers also help protect SCSRs from damage.

Primary storage in other locations in the section was also suggested in order to provide access from more than one entry. Then, if the access route becomes impassable, miners should still be able to reach an SCSR. Storage should be prohibited within one block of a loading point because that may be one of the first places engulfed by products of combustion.

A.3.2 Secondary Storage

During the development of potential storage plans for some 43 producing sections in five mines, secondary storage options become not only practical but important. In addition to the 8 to 12 miners in each face crew, there may be as many as 20 other miners in or near the section. It is typical that these other miners are present for a relatively short time and with no predictable regularity. While some who traveled in the same vehicle used by the face crew often remain on the section for the entire shift, others come and go in other vehicles. Sometimes these vehicles are removed without their knowledge. Other miners walk or crawl.

Many of these other miners may judge the wearing or carrying of SCSRs to be hazardous. Some may have no readily accessible location within 25 ft to place an SCSR; some work a portion of

their time out by the section. These miners, therefore, need a place to store SCSRs. Sole dependence on primary storage, in some circumstances, could cause difficult and dangerous conditions. Some possible problems include the following:

- a. In the event of emergency, many persons may gather in the same place to obtain an SCSR. If 30 people arrive at a storage location, it is reasonable to expect a greater danger potential for loss of life than if only 10 people gather at the same location.
- b. The section foreman's control of storage may be reduced.
- c. The chance of face crew members attempting to use a defective SCSR is increased.

To alleviate these problems, a mine operator might request approval for primary storage and secondary storage, with the following provisions:

- a. Section primary storage:
 1. Full-time (a supply of SCSRs remains in the approved storage location and other SCSRs are provided when miners are not in their work site)
 2. Contains a sufficient number of SCSRs for all miners in and around the section
 3. All miners have an FSR
- b. Secondary storage:
 1. Within 5 min of the primary storage
 2. In intake air
 3. Not in a belt entry
 4. Not in a trolley haulageway except a side track, spur or track loop runaround
 5. More than one block from an active loading point.

SCSRs that are stored in vehicles may be in holders or containers; SCSRs in open areas should be stored in containers. Provisions should be made to divert smoke which could prevent access to the SCSRs.

Storage planning in the above described manner provides a number of benefits. These benefits include the following:

- a. Miners working in and around a section do not have to wear or carry an SCSR
- b. Better supervision and control of SCSRs
- c. Miners will not have to remove SCSRs from primary storage because of fan outage or fire drill
- d. SCSRs are made available to miners as far as 10 min outby the section and as far as 15 min outby the working face
- e. If any miners remain beyond their shift, or if an injured person has been transported from a section, there are still enough SCSRs available.

In some other circumstances, it would be correct to consider a similar plan even though not enough SCSRs are in primary storage. The initial justification for the plan is that each miner will have access to at least one SCSR in either the primary or secondary storage locations. The second reason for approval of the plan is the likelihood that the miners should be within 5-min travel time of at least one storage location. This plan has many of the benefits mentioned above, but it suffers from a number of deficiencies. These deficiencies include the following:

- a. Miners who depend upon SCSRs that are stored in vehicles must maintain control over those vehicles
- b. SCSRs stored on vehicles may not be as readily accessible as those stored in other locations
- c. Miners who go to the primary storage location may find that all the SCSRs have already been taken. In such an instance, these miners should have FSRs. It is hoped that the FSR will be adequate until a miner can find a passable route to a secondary storage location.

A.3.3 Longwall Storage

Longwall storage planning will involve the placement of additional SCSRs in the tailgate entry. In a longwall section, it is probable that fire or explosion would begin near and outby the stageloader and in the gob. Then miners on the longwall face must reach SCSRs. It will likely be safer for a miner to go to the tailgate entry, even if it is a return rather than travel through the denser concentration of smoke and fumes likely to be present between them and the primary storage location, outby the stageloader. Containers are necessary to protect SCSRs stored in the tailgates.

A.3.4 Movement of SCSR Storage Locations

The movement of SCSR storage is based on the distance of the miners to the proposed location (see subsection A.2.2) and not the specific location. For example, the SCSRs should be moved even though the location of, for example, the dinner hole, the mouth of the intake escapeway, or another approved storage location is not changed. Normal work in a section should stop whenever SCSRs are moved until every person in the section is aware of the new storage location. This suggestion should not create undue hardship because movement of the location can be accomplished during a nonproduction shift.

A.3.5 Signs

Signs placed at storage areas and signs leading miners to storage areas should also be moved whenever SCSRs are moved. These signs should be readily understandable by any person entering the area. Paragraphs (c) and (g)(z) of 30 CFR, 75.1714-2 require that the word self-rescuer or self-rescuers be conspicuously posted. Miners were found who were neither able to read nor understand that word. Because of considerations of the anxiety and emotional stress associated with the need to escape, training and education alone may not suffice to correct that deficiency.

While the regulations require only that signs show the way to and location of 1-hr SCSRs not carried out of the mine and caches of 60-min cannisters, a good practice would be to have signs for most storage locations.

A.3.6 Ready Accessibility

It is important that stored SCSRs be readily accessible even though it is not required by the regulations. This conclusion is based on the difficulties encountered and the deaths that resulted from the failure to have stored FSRs accessible in the Sunshine Mine on 2 May 1972.

A.4 Storage on Vehicles

Plans for storage on vehicles should be allowed for those miners who depend upon a vehicle for a large portion of their time in the mine. Such persons might include the following:

- a. Motormen who might find wearing or carrying SCSRs hazardous when leaving their vehicles to throw switches, rerrail cars, open doors, and perform other normal activities
- b. Mechanics, trackmen, wiremen, masons, pumpers, brattice-men, supervisors, and general laborers who frequently are within 5 min of their parked vehicle.

Unless storage is provided, these miners will be required to pick up and put down their SCSRs frequently. This increases the chance for SCSRs to be left behind and/or damaged.

Plans for SCSR storage on vehicles in the mine environment should be limited to vehicles in intake airways and vehicles not in sections. Vehicles in return airways may have stored SCSRs only if they are kept within arm's length of the vehicle operator and passengers; otherwise, the time needed to reach a more distant device could be dangerously long. Reasons for this have been discussed previously. If storage takes place on vehicles in sections, it should comply with the suggestions listed for section storage (subsection A.3).

The vehicle storage plan should include the following provisions:

- a. At least one SCSR stored on the vehicle will be annually use-tested. The test will be conducted in the mine and will be equivalent to Man Test 1 as described in Table 1, 30 CFR, 11.85. Reasons for this test were given in subsection A.1.4 during the discussion of the effect of vibration.

- b. The lowest number of SCSRs stored on a vehicle should be equal to the maximum number of persons able to ride on that vehicle.
- c. Vehicles on which SCSRs are stored must be parked more than one block from an active loading point.
- d. A parked vehicle should not be moved without the knowledge of the miners for whom the SCSRs are stored on the vehicle.

A.5 Other Storage

Basically, "other storage" has all the same requirements as other types of storage, but with the added proviso that SCSRs be stored in containers. Many of these other storage areas may not be inspected daily, and open storage cannot be justified because of potential damage to SCSRs from falling off shelves or pegs, getting wet and dirty, and/or damaged from small falls of roof and rib.

Other storage will encompass many parts of a mine, far from working sections. However, we were not able to satisfy ourselves that equivalent safety could be provided by allowing other storage to be more than the 5 min required of section and vehicle storage. The following paragraphs explain the reasons in more detail, as does Appendix C.

Not all persons have ready access to escapeways. Some may have little knowledge of and experience in the safest direct practical routes of travel for evacuation for the following reasons:

- a. Escapeways need only be provided from each working section (30 CFR, 75.1704). Miners and visitors may be thousands of feet from an escapeway.
- b. Escapeway drills involve only miners in producing sections (30 CFR, 75.1704-2(e)).
 - 1. Only two of these miners need to travel through the main escapeway
 - 2. Escapeway drills satisfy the evacuation portion of fire drills
 - 3. Fire drills need not be held underground.

- c. Awareness of the need to escape may be delayed for some persons outside of working sections.
 - 1. It may come later than to persons close to the cause of danger, hearing range of radios and telephones, and in a reasonable distance of the escape route taken by persons evacuating the mine
 - 2. First warning may be smoke or clouds of dust
 - 3. Invisible, odorless, yet toxic gases often precede smoke from a fire and the clouds of explosion-raised dust
 - 4. Blackdamp is invisible and often odorless.
- d. Persons outside of normal working areas and far from or unaware of the safest direct practical routes of travel for evacuation could:
 - 1. Begin to be incapacitated before being aware of danger
 - 2. Have their breathing rate increased by incapacitation, concern, and other emotional-physical factors
 - 3. Have less time than other persons to obtain, put on, and activate an FSR or SCSR.

Persons who are in return airways of sections might have considerably less time to obtain an SCSR than miners in intake airways. This dangerous situation is due at least partly to the fact that persons on the section are more likely to be aware of and react to emergency conditions than are persons in the return airway. Dangerous situations that might not be immediately noticed by miners in the return include the following:

- a. Face ignition
- b. Breakthrough into oxygen-deficient atmosphere
- c. Report of trouble in another part of the mine.

Someone could notify persons in the return of their need to go to an SCSR storage location, but even so, it might not be accomplished quickly enough, even assuming the unlikely condition that someone was aware of the location of each and every miner. For persons in the return, smoke or dust clouds could be their first warning of danger, but invisible, odorless, yet toxic gases often precede smoke from a fire or clouds of explosion-raised dust. Blackdamp is also invisible and often odorless. Therefore, persons in the return could start to become incapacitated before being made aware of danger; thus they will have little time to obtain, don and activate an SCSR. Incapacitation occurs when fire products cause disorientation, dizziness, dimness of vision, nausea and vomiting, and possible collapse. Because of the likelihood of stress and rapid movements when trying to escape, FMA fire experts consider that a 15-percent saturation of hemoglobin with carbon monoxide has the potential to incapacitate many people. The relationship between carbon monoxide concentration and the time lapse needed to achieve a 15-percent COHgb is shown in Figure C-5, Appendix C.

A.6 Inspection and Testing

The mine operator is required to inspect all SCSRs after each and every instance in which they are worn or carried. These inspections and tests must be carried out in accordance with instructions approved by MSHA.

The guidelines suggest that each person know the location in which an SCSR is stored for him. This is an essential concern in order to achieve compliance with paragraphs (a) and (b) of 30 CFR, 75.1714.

The guidelines also suggest inspections and tests every 90 days. The inspection includes keeping an accurate account of each SCSR, according to its serial number. The following information should be recorded:

- a. The number of SCSRs available, along with the results of tests on them as required by 30 CFR, 75.1714-3(d)
- b. Those SCSRs that have been disposed of and the manner in which this was accomplished
- c. Those SCSRs that are missing, whether or not a search was carried out, and the last known locations of those devices.

This accounting procedure has two purposes. One is to ensure that defective SCSRs will be properly discarded, thus preventing them from becoming a potential fire hazard. The other purpose is to develop a history in the event that a lost or abandoned SCSR is suspected of being involved in fires or ignitions. This latter concern is considered to be particularly important in order to dispel claims that might eventually jeopardize the implementation of 30 CFR, 75.1714.

Inspection procedures are analyzed and discussed in Appendices E and I. The major conclusions may be summarized as follows:

a. For chemical SCSRs:

1. It is possible that a case leak undetectable by any of the presently approved daily inspection procedures could in time destroy a chemical oxygen SCSR
2. A periodic test (90 days) is necessary which will detect slow leaks. We strongly recommend a pneumatic pressure test such as that described in Appendix E. These testers have the best combination of accuracy, simplicity, speed of operation, and quantifiable, reproducible results.

b. For bottled oxygen SCSRs:

1. Inspection must assure integrity of the compressed oxygen supply, the valving system, and the CO₂ scrubber
2. A periodic test (90 days) is therefore necessary to check operating pressures and flow test the units. More detailed testing may be required at less frequent intervals.

c. For *all* types of SCSRs:

1. Ongoing field testing and evaluation is absolutely essential. This means that a perpetual program must be planned, initiated and continued to periodically sample SCSRs which have been in continuous underground service - especially those units which are carried daily and/or mounted or stored on vibrating machinery. "Sample" means that the SCSRs must be man- and/or machine-tested so that actual performance can be quantified.

APPENDIX B

WORLDWIDE USE OF OXYGEN SELF-RESCUERS

This appendix covers various aspects of research and experience with Self-Contained (oxygen) Self-Rescuers (SCSRs). The first seven subsections discuss information from western Europe, gathered from group meetings, discussions with individuals, first-hand observations (including mine visits), and written reports, both published and unpublished. Subsection B.8 summarizes additional information from all over the world, gathered through literature and catalog searches. The major areas of interest were as follows:

a. Use of SCSRs

1. *France* is selectively implementing a few SCSRs (total of 2000 as of 1 January 1980) in coal mines on a mine-by-mine basis. They do not use filter self-rescuers. We visited a French coal mine which was instituting an SCSR storage system which is designed to protect all underground miners. Two or more metal boxes each containing eight SCSRs are located near each working section in a small room cut into the entry.
2. *Germany* does not use SCSRs on a regular basis in coal mines. Of the 3000 units in Germany, about half are underground in potash mines; the other half are used as back-up equipment for mine rescue teams. We visited a potash mine in which every man is individually equipped with a 45-min compressed oxygen SCSR. Each man carries his SCSR into the mine and leaves it on his machine.
3. *Poland and Russia* also have used SCSRs fairly extensively, although no first-hand information has been obtained
4. *United Kingdom* utilizes SCSRs on a limited basis.

- b. Approval and Testing - The European community has just published guidelines for chemical SCSRs. The key element is a mechanical-lung machine test. Old SCSRs may have a 60-min life at a breathing rate of 30 l/min, but all new models must be rated for 90 min at 35 l/min. We

saw two of the test machines in operation. They are simple to operate and permit *easy* testing which is consistent and repeatable.

c. Research and Development

1. *Flammability Testing* - In the middle 1960s, experiments in Germany indicated that if KO₂ canisters were torn open and exposed to moist coal, an ignition could result.
2. *Man-Testing* - In 1977, the French conducted man-tests on several different models of SCSRs. The researchers indicated some preference of KO₂ over compressed O₂ because of the longer service time when a man was resting.
3. *Time Studies and Oxygen Consumption* - A German research program was conducted during the middle 1970s to measure travel speeds and breathing rate of men walking out escapeways. This program was one of the factors leading to the 90 min at 35 l/min standard for European SCSRs.
4. *Underground Trials of SCSRs* - The French have just started an underground evaluation program sponsored by the European community. Three different models of chemical SCSRs are being stored underground and then periodically removed from service and machine-tested. Results will be compared to evaluate performance as a function of manufacturer, length of time underground, and type of underground storage.

- d. Maintenance and Testing - The Europeans in general have a rigorous maintenance program for compressed oxygen SCSRs, while chemical SCSRs require almost none. However, compressed units are easy to rebuild after use and can be inexpensively used over and over.

Training is also rigorous in Europe - for example, the training galleries used for SCSR mantests actually look like the inside of a mine. For training in breathing through an SCSR, the Europeans feel that either very accurate simulation or else the actual use of an SCSR is necessary.

B.1 Introduction

Several European countries have been researching and testing oxygen SCSRs (self-rescuers) for close to two decades. To benefit from this experience, an American delegation traveled to Europe and met with appropriate officials from Luxembourg, Belgium, England, France, and Germany. The trip also included an underground tour of a mine using SCSRs in both France and Germany. Members of the group were:

- a. Randy Berry, FMA (under contract to USBM)
- b. Bob Peluso, MSHA
- c. Bob Vines, BCOA
- d. Martin Connors, UMW of A
- e. Ed Onuscheck, AMC.

In general, the Europeans feel that prevention and early detection of fires is the best safety policy, with self-rescuers as a last line of defense. Worldwide, eastern Europe, United States, and, to a certain extent, France seem to be the strongest believers in oxygen self-rescuers. This report covers only western Europe, and includes the following subjects discussed and activities witnessed first-hand:

- a. Underground use of self-rescuers (subsection B.2)
- b. Approval and testing (subsection B.3)
- c. Research projects (subsection B.4)
- d. Maintenance (subsection B.5)
- e. Training (subsection B.6)
- f. Chronology of visits, individuals, organizations and addresses (subsection B.7)
- g. Summary of information obtained through literature and catalog files (subsection B.8).

B.2 Underground Use of Self-Rescuers

Filter self-rescuers are required in Germany and the United Kingdom, but *not* in France.

Oxygen self-rescuers, on the other hand, have attained the most widespread use in coal mines in France. The particular

experiences of each country are summarized in the following subsections.

B.2.1 France

In general, the French philosophy on self-rescuers is that *filter* self-rescuers give limited protection and are, therefore, not generally used in France. On the other hand, the fire hazard associated with the widespread use (in France) of diesel, rubber-tired vehicles has caused them to give serious consideration to oxygen self-rescuers.

The French coal mining industry, "Charbonnage de France," is government owned. It is divided into three districts, or "basins," which are relatively autonomous. The three basins, and their experience with self-rescuers, are summarized below in Table B-1.*

TABLE B-1. - Total self-rescuers in French coal mines
(1 January 1980)

Basin	Compressed oxygen SCSRs (total - 795)			Chemical oxygen SCSRs (total - 1046)			Filter SCSRs (total - 214)
	Underground		Surface	Underground		Surface	
	Stored	Machine		Stored	Machine		
HBNPC	-	-	97	246	-	3	-
HBL	114	-	40	23	-	152	199
HBCM	344	6	194	546	43	38	15

*Coal mines are included in these figures. French potash mines also use SCSRs to a limited extent: about 800 to 1000 apparatus for a work force of 4000 to 5000 men, because of CH₂ and N₂ outbursts. The apparatus used is primarily small compressed oxygen Fenzy units (about 15-min duration). The units stay in the mine and are kept on or near machines in development headings. Once a week they are brought out for inspection and/or maintenance.

The HBNPC, or Northern District, uses SCSRs whenever men are far-removed from a source of fresh air. Their policy is to provide units wherever men are more than 15 min either from intake air or a source of compressed air. In other words, no matter where in the mine the individual is, he is always within 15 min of intake air, compressed air, or an SCSR.

HBL, Eastern, or Lorraine District is the least interested in SCSRs. Most of their units are stored on the surface at the Central Mine Rescue Station. They have no intention of equipping most men with SCSRs but rather distribute a few self-rescuers - both oxygen and filter types - to a few men in high risk areas or distant workings.

HBCM, the Central and Southern District, is the most committed to SCSRs. Six of the seven mines in the Basin have 100 or more SCSRs, with units either on the surface or stored underground. One of the lessons already learned is that you can't leave SCSRs lying around on the ground: already, eight SCSRs have been run over by vehicles or equipment. One of the mines in the HBCM, Gardanne (Provence) Mine, is especially committed to SCSRs. They have a storage plan underway which will eventually result in the protection of virtually every man underground. In addition, this mine is going to participate in an SCSR evaluation program sponsored by the European Community (see subsection 4.7). We visited this mine for a first-hand view of their underground practices.

Gardanne Mine

The Gardanne Mine is located in the south of France. Although there are three recoverable seams, all of the present production of 1.5 million tons/year comes from a single seam about 2.5m thick (8 ft), located under 600m (2000 ft) of cover. The mine has five continuous miners, which are used to drive single-entry developments for their two longwall plows. Panels can be as much as 1500m (5000 ft) long. A general layout of the mine is shown in Figure B-1. Rubber-tired, diesel-powered equipment is used extensively, both for trucks to haul men and supplies and the use of scoops. Continuous miners drive single entries ventilated by 1.2m blowing tubing.

In order to provide protection for the men, the mine has instituted a system of SCSR storage on the longwall panels, the continuous miner entries and at central locations.

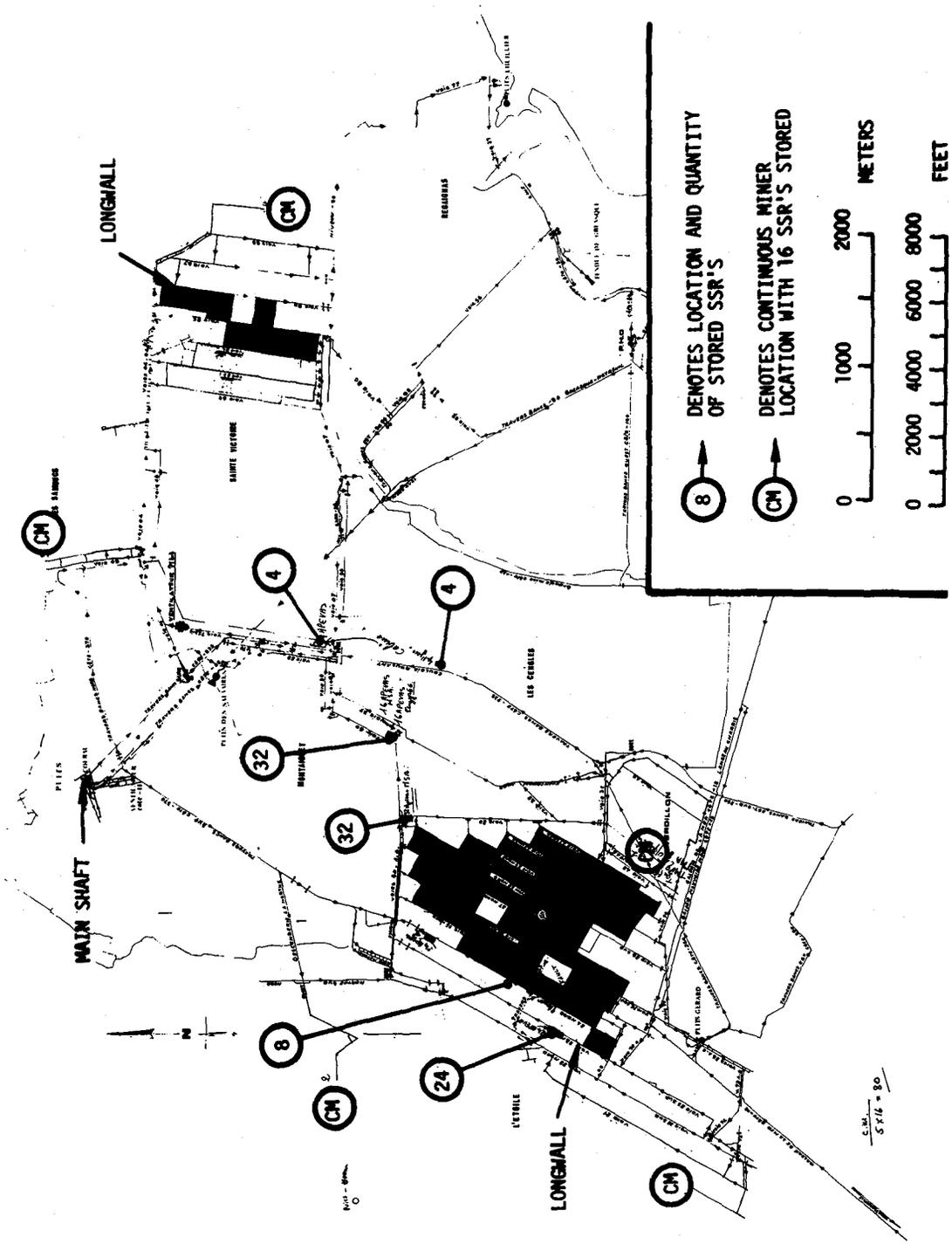


FIGURE B-1. - SCSR storage locations in Gardanne Mine.

Longwall panels, as mentioned previously, have a single entry on either side (headgate and tailgate). Approximately 15 men work on the section, not counting visitors, etc. In order to provide protection for the men in these areas, where there is only a single exit for thousands of feet, the mine has instituted a system of cutting alcoves, or cul-de-sacs, into the rib every 200m along each entry, as shown in Figure B-2. Each alcove is approximately 5m (15 ft) wide (and same height as the entry).

When the longwall panel is being mined, the alcove nearest the face is the one used as a sort of refuge chamber. Three boxes of eight SCSRs each (24 total) are stored in the alcove, and a compressed air line is also located there. Thus, in theory, this refuge chamber is always within 200m of the longwall face. However, in practice, the alcoves nearest the face might be used for other purposes, and the SCSR storage location could be 600 or 800m away from the face. In addition to the three boxes which are stored in the headgate entry, one box (that is, eight SCSRs) is stored in an alcove in the tailgate entry.

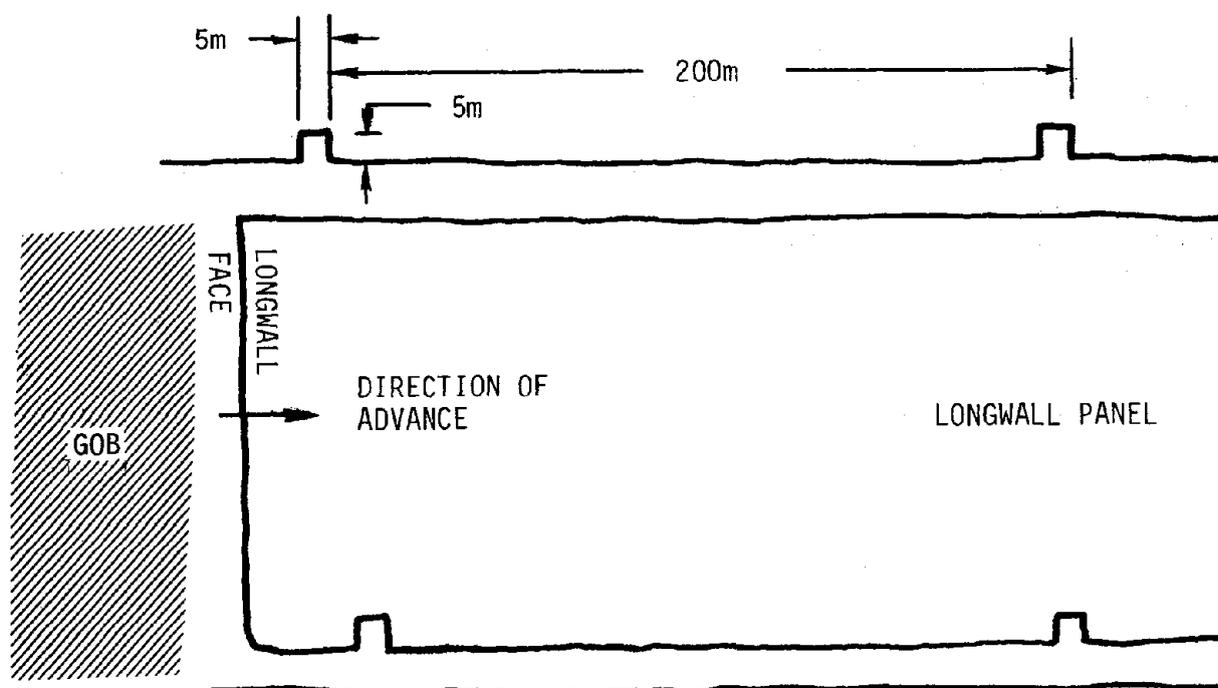


FIGURE B-2. - Location of refuge chambers.

Continuous miner sections, usually consisting of a single entry, typically employ 10 men. For these sections, mine policy is to store two boxes (that is, 16 units total) no more than 50m behind the continuous miner, although, like the longwall section, this distance could vary.

Other refuge chambers, in addition to the sections, are also equipped with stored SCSRs. The one chamber we visited had four boxes of SCSRs - a total of 32 units, 16 of which were chemical (MSA/Auer)* and 16 were compressed (Fenzy 66)*. All of the units stored on sections were chemical.

Storage details are explained as follows. All of the stored units at the time of our visit were kept in metal boxes which held eight units. The boxes were made of heavy sheet metal (approximately 12 gauge), measured approximately 30 × 30 × 100 cm (12 × 12 × 40 in.) and weighed 18 kg (40 lb). The SCSRs are individually wrapped in 2-cm (1-in.) thick foam rubber (low density - probably about 4 lb foam), which is also used to line the case. This prevents the SCSRs from banging around during transportation when the storage location is moved. The top of the box is hinged at the back and is held closed with a small lead seal on the upper front edge of the box.

The boxes which are stored underground are placed on specially-constructed metal shelves, constructed of angle-iron and bolted into the rib at a height of about 1.5m (15 ft), as shown in Figure B-3. This enables vehicles to pass by the stored boxes and is especially desirable in the alcoves on the longwall panels, which are used as turnarounds for trucks and scoops. Even if the vehicle hits the rib at the back of the alcove, the box is located high enough to avoid being struck. It should be noted that the same mounting arrangement is used even in permanent refuge chambers which are not located on the section.

Inspection and Testing

Chemical units stored underground are subject to a two-part test:

- a. Monthly the lead seals on storage boxes are checked for integrity
- b. Yearly every SCSR is taken outside and water-immersion tested.

*Reference to specific brands, equipment, or trade names in this report is made to facilitate understanding and does not imply endorsement by the USBM.

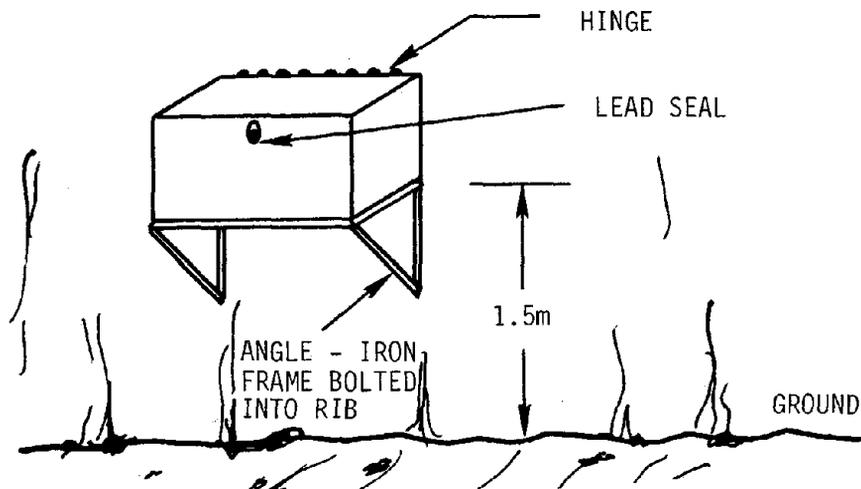


FIGURE B-3. - Mounting of SCSR storage boxes.

Training

Men receive an initial training of approximately 2 hr, with an actual unit or training model being carried for 15 min; once a year they receive a refresher course of 1/2 hr.

Actual Use in Emergencies

The SCSRs have been used in one fire situation. On a heading about 2 or 3 km long (about 1-1/2 mi), a fire on the middle conveyor belt of a three-belt system caused the line to shut down. Men went to investigate and saw smoke. They returned to the face area where they picked up stored SCSRs and donned them. Then they went back, crossed through the smoke and put out the fire. It is impossible to say for sure whether they could have done the same thing with *filter* SCSRs or no self-rescuers at all.

B.2.2 Germany

The major use of oxygen self-rescuers in Germany is in the potash mines, where compressed oxygen units are used. Both

compressed oxygen and chemical units are used as backup for rescue breathing apparatus in the coal mines. Compressed oxygen units are approved for use in all mines, although underground usage is mostly in potash mines. Chemical units do *not* have a general approval for use in coal mines, although there have been two permits issued for special applications. The first of these is a restricted approval granted in 1965 for the use of chemical SCSRs as auxiliary equipment for coal mine rescue teams. The second application is for use only in conjunction with a Robbins Tunnel Boring Machine. In this instance, the operator of the machine keeps an SCSR with him. There is also a box of SCSRs located just on the intake side of the electrical box which rides along on a monorail behind the machine.

Table B-2 shows the availability of self-rescuers in Germany as of 31 December 1979.

These figures include all types of mining, and also approximately 500 SCSRs used in the oil and natural gas industry. Most of the underground SCSRs are in the Clausthal-Zellerfeld region, where they are used in potash mines which have frequent CO₂ outbursts. The Wintershall Mine is a good example of a potash mine in which every man underground is individually equipped with an SCSR. We were given an underground tour of this mine in order to observe first-hand.

TABLE B-2. - Self-rescuers in West Germany (31 December 1979)

Item	Filter self-rescuers	Oxygen self-rescuers
Units underground	122,723	1384
Total units	154,869	3205
Number of incidents where units were used in 1979	20	-
Total units used in 1979	117	-

Wintershall Mine

The Wintershall Mine is a large potash mine located within 2 km of the East German border in central Germany. Daily production is 30,000 tons, using 650 employees. Mining method is room and pillar, with 14m (50 ft) pillars and 16m (55 ft) entries. The height ranges from 1.7 to 4.5m but averages 3m (10 ft). The mine is roughly 400m (1300 ft) underground.

Faces are mined by drilling and blasting. All the equipment in the mine is rubber-tired diesel, although all of the face equipment has trailing cables so that when situated they can work electrically with the diesel used only for tramping.

The mine has never had any methane, but like all of the potash fields in Germany, there are pockets of CO₂ embedded in the seam. This can lead to severe outbursts - usually during blasting, but sometimes during drilling - such as one in East Germany in 1950 which "flooded" the entire mine and also a valley on the surface, suffocating two residents.

Each miner is individually assigned an oxygen self-rescuer, Draeger Model SR45 (compressed O₂, approximately 45-min duration) which has the same number on it as his cap-lamp. One wall of the lamphouse has a large wooden rack of pigeon-holes, so that each SCSR (they have 775 total) is stored in its own pigeon-hole when the man is not in the mine.* Before going underground, each miner (visitors are also given SCSRs) takes his own SCSR, which can be carried or worn by using the shoulder strap. The man carries the unit with him to his work place (all mantrips are diesel-powered open trucks or jeeps).

At the working section, each man places his SCSR on the piece of equipment which he is operating. Typically, his lunch (which is usually carried in a leather briefcase) and his cap-lamp are also left on his equipment or vehicle, lighting from the machine usually makes it unnecessary to wear his cap-lamp, and

*We were told that a neighboring potash mine stored their units underground near the base of the shaft but that they were going to switch to surface storage in the lamphouse.

the rubber-tired equipment makes it pretty much unnecessary to walk anywhere in the mine. Theoretically, the man should take his SCSR whenever he ventures further than 10m from his vehicle or machine. From a practical standpoint, he hardly ever needs to go that far away.

The men in the large underground shop are just about the only people underground who would not be working on or around a rubber-tired piece of equipment. Like everyone else, they are required to carry their SCSR in every day. These units are usually left on or around the lunch tables, along with their lights and leather lunch cases, which could be 100m from their work location.

Storage details on rubber-tired equipment are explained as follows. Every piece of face equipment or jeep which we saw had two or more special pockets mounted in handy locations. These pockets were constructed of 4 mm- ($\sim 3/16$ -in.) steel plate wrapped in an oval shape so that a self-rescuer would fit snugly inside, as shown in Figure B-4. The pockets were about 10 cm (4 in.) high, or about half as high as the self-rescuer. Originally, each pocket had been lined with a jute-like material 6 mm (1/4 in.) thick, both to provide a tight fit and help protect against vibration. However, over time this lining tended to get beat up and torn out, and the mine was not replacing the linings because they didn't feel that they were worth it.

It was interesting to note that only about half the men used the special pockets to store the SCSR. The other half left them in a variety of places on their machine such as next to the operator's seat, at their feet, with their tools, etc. Quite a few men used the SCSR pockets as a place to store their cap-lamp and battery.

Inspection and Maintenance

The Draeger SR45 compressed oxygen self-rescuers have a multiphase inspection and testing program at the Wintershall Mine:

- a. Daily - SCSRs are cleaned by lampman, checked for visible damage, check seal, check bottle pressure
- b. Four times per year - SCSRs are opened and flow-tested on Draeger test apparatus. The soda lime is screened

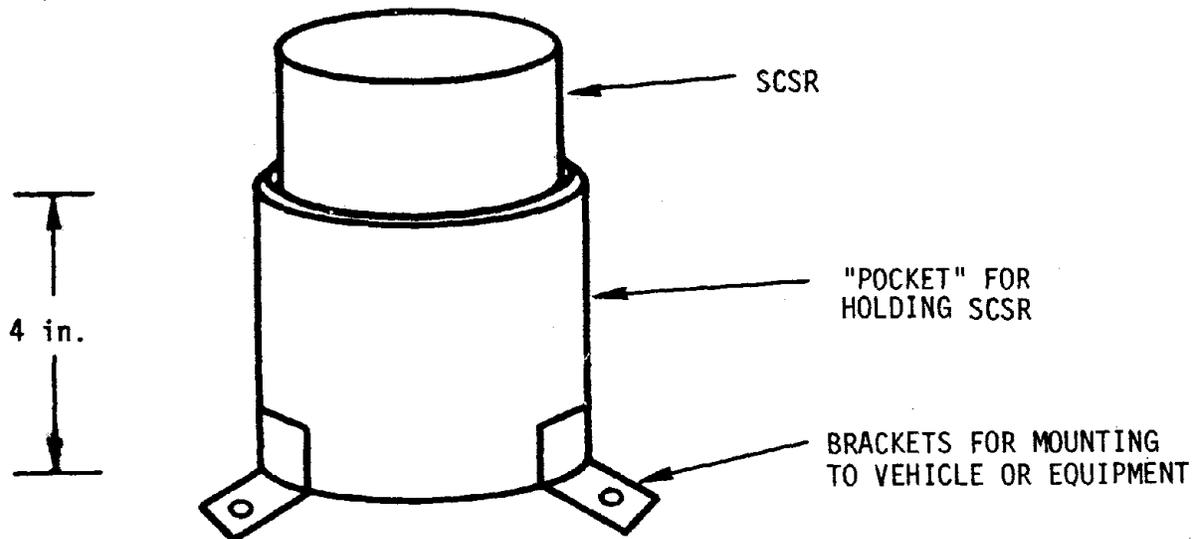


FIGURE B-4. - Storage pockets for SCSR.

for fines, because they have found that some dusting does occur from jostling and vibration due to carrying and storing on machines.

- c. Once per year - the soda lime is replaced and bottle recharged with oxygen after the unit has been test-worn (see "Training").
- d. Every 4 years - the main valves are checked and certified by a government agency.

According to the USBM's figures, maintenance on SCSRs cost 200 DM/year, or about 17 percent of the 1200 DM purchase price of an SR45.

Training

All men receive initial training in the use of the SR45, including wearing the actual unit. Visitors are given a 5-min

demonstration of how to don the unit by the lampman. Large step-by-step pictures on the lamphouse wall also show the procedure.

Once a year all miners receive a 20-min lecture for retraining. Also annually, every miner dons his unit on the shaft bottom.

Actual Use in Emergencies

There have been two occasions in which the SCSRs were used in fire situations, evidently without incident. They have never been required in an actual CO₂ outburst, which usually occurs during blasting when the mine is empty.

B.2.3 United Kingdom

Cynheidre Mine

The Cynheidre Mine in South Wales is the only major area using SCSRs in the United Kingdom. This mine has a serious problem with methane outbursts. They had tried several chemical oxygen self-rescuers but found that the delay in filling the breathing bag was unacceptable for their application of protecting men against the sudden outbursts. They now use only the AGA Mine Escape unit, a rather large (14 × 17 × 4 in., 14 lb) unit which can put out a maximum oxygen flow rate of 200 l/min (35 l/min is normal for heavy exertion), thus activating the unit and filling the breathing bag almost instantaneously.

Details of Use

At the Cynheidre Mine, the SCSRs are carried in daily by all face workers, and hung up on pegs near the face. The units are taken back out of the mine at the end of every shift.

Inspection and Maintenance

Units are examined daily and tested at frequent intervals (between a week and a month). For comparison, it is interesting to note that in the United Kingdom, all filter SCSRs (which have been required for all mines to be worn on the belt since 1967) are also left in the lamphouse daily and are tested monthly, both by weighing and by placing in a vacuum chamber and checking for loss of vacuum in the chamber.

B.3 Approval and Testing

The Mines Safety and Health Commission for the European Community gave final approval in March 1980 to "Guidelines for the Construction and Testing of Chemical Oxygen Self-Rescuers." This document is 32 pages long in English. The major specifications may be summarized as follows:

- a. 90-min life at 35 l/min breathing rate*
- b. 240-min life at 10 l/min breathing rate
- c. Maximum CO₂ content 1.5 percent
- d. Maximum inspired air temperature 50°C
- e. Maximum breathing resistance (in or out) 6.5 mbar.**

The requirement for a 90-min life at 35 l/min breathing rate is a relatively new standard, and there are no production models of chemical oxygen self-rescuers which could meet this test. The previous bench mark had been 60 min at 30 l/min; units which were designed to this standard and have already been purchased by mines will continue to be allowed for at least the next 5 years. The new standard - with both a longer duration and a higher breathing rate - was based on underground research testing (Funkemeyer of the Hauptstelle in Essen, Germany) in which both escape times and breathing rates of a cross-section of miners were measured.

To determine whether or not the above specifications can be met, the SCSR is tested on a mechanical lung machine. The European Community feels the machine test is absolutely necessary because it is repeatable and it cannot be faked. Mantests and underground tests are also required before approving a unit. Each of these areas is discussed in the following subsections.

B.3.1 Machine Testing

The machine test consists of a mechanical lung which conducts the following functions:

*70 l/min from eightieth to eighty-fifth min.

**12.0 mbar for exhalation for first few minutes after starting.

- a. "Inhales" air from the SCSR mouthpiece
- b. Removes a portion of the inhaled air for analysis
- c. Replaces that portion with CO₂
- d. Adjusts the temperature of the air in the lung
- e. Increases the air moisture content to 100 percent relative humidity
- f. "Exhales" the air back into the mouthpiece.

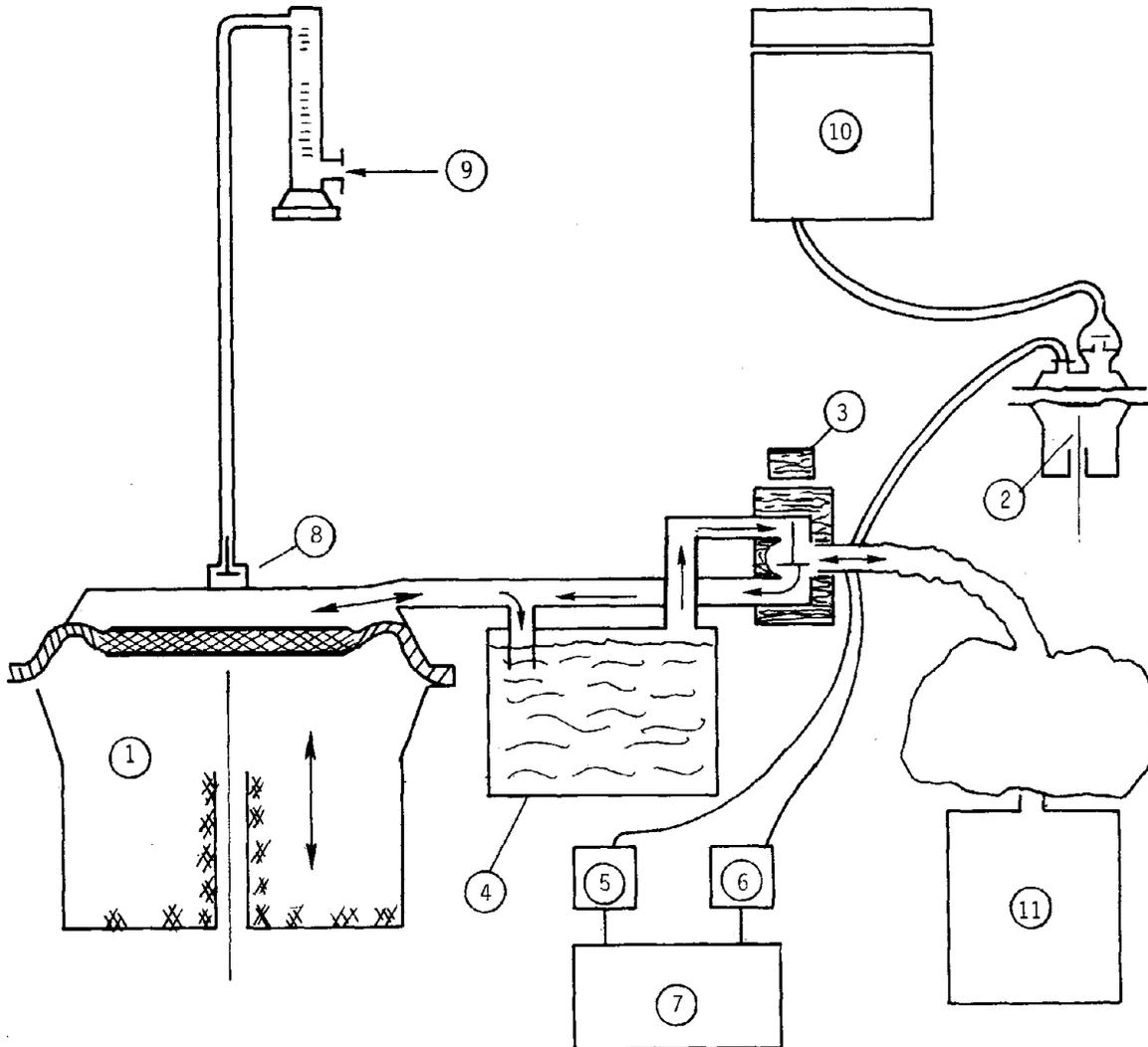
Figure B-5 shows a *simplified* schematic representation of the mechanical lung. A more detailed explanation and drawing may be found in the Commission Guidelines mentioned above. Actual construction of the test machine can vary from one builder to another as long as it meets the design specifications. An example of such a unit is shown in Figure B-6.

It is possible to adjust the mechanical lung in order to vary the breathing rate (both rate of breathing and depth of breath) and the amount of CO₂ which is substituted. The specifications for the various breathing rates are outlined in Table B-3.

During the test, the following quantities are measured and continuously recorded:

- a. Air temperature at the mouthpiece
- b. Air pressure at the mouthpiece
- c. CO₂ content of inspired air.

There is no such thing as a "pass" or "fail" grade when an SCSR is tested on the mechanical lung. Rather, the tested SCSR is assigned a rated life based on how long the machine "breathed" before either temperature, pressure or CO₂ level exceeded the specifications. Figure B-7 shows a simplified chart based on a machine test which we actually witnessed. In this instance, the inhaled air temperature exceeded the limit of 50°C at 39 min, even though the pressures and CO₂ levels were okay. Thus, that



- | | |
|--|--|
| 1. ARTIFICIAL LUNG | 6. PRESSURE GAUGE |
| 2. AUXILIARY LUNG (CONTROLLED BY MAIN LUNG) | 7. FAST-RESPONSE RECORDER FOR PRESSURE AND TEMPERATURE |
| 3. THREE-WAY VALVE (CONTROLLED BY MAIN LUNG) | 8. CHECK VALVE |
| 4. HUMIDIFIER AND TEMPERATURE CONTROLLER | 9. REGULATED CO ₂ SUPPLY |
| 5. TEMPERATURE MEASURING DEVICE | 10. CO ₂ -ANALYSER AND RECORDER (INHALED AIR) |
| | 11. OXYGEN SELF-RESCUER |

FIGURE B-5. - Schematic of "mechanical-lung" test machine.

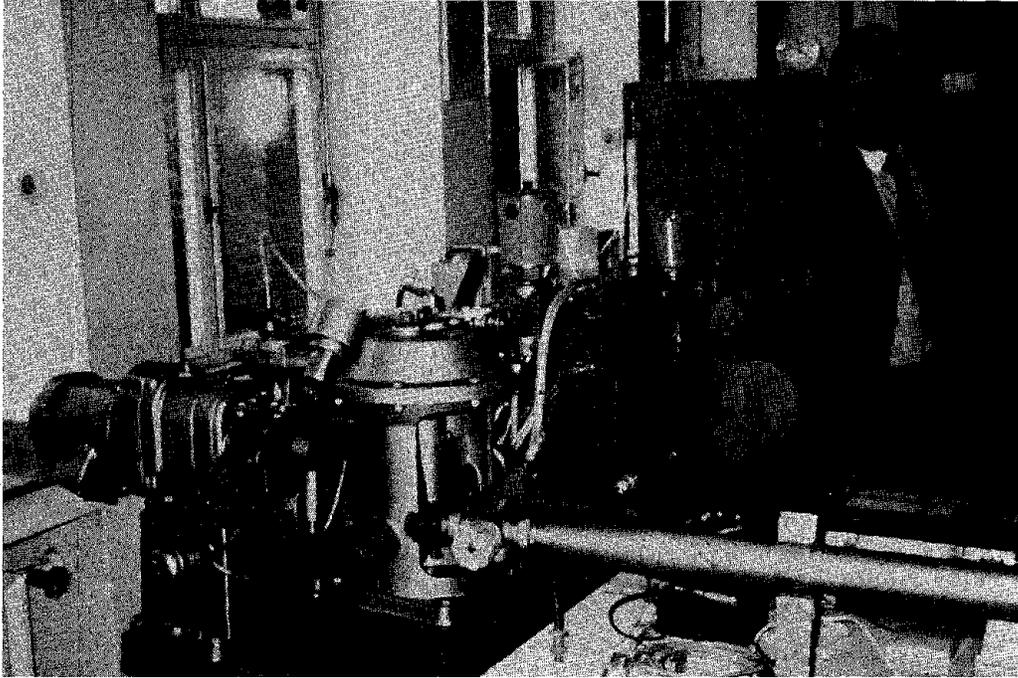


FIGURE B-6. - Example of "mechanical-lung" test machine

TABLE B-3. - European commission parameters
for machine testing

Minute volume (liters/min)	Cycles/min	Volume per cycle (liters)	CO ₂ substituted (percent)
10	10	1.00	4.0
30	20	1.50	4.5
35	20	1.75	4.5
70	30	2.33	5.0

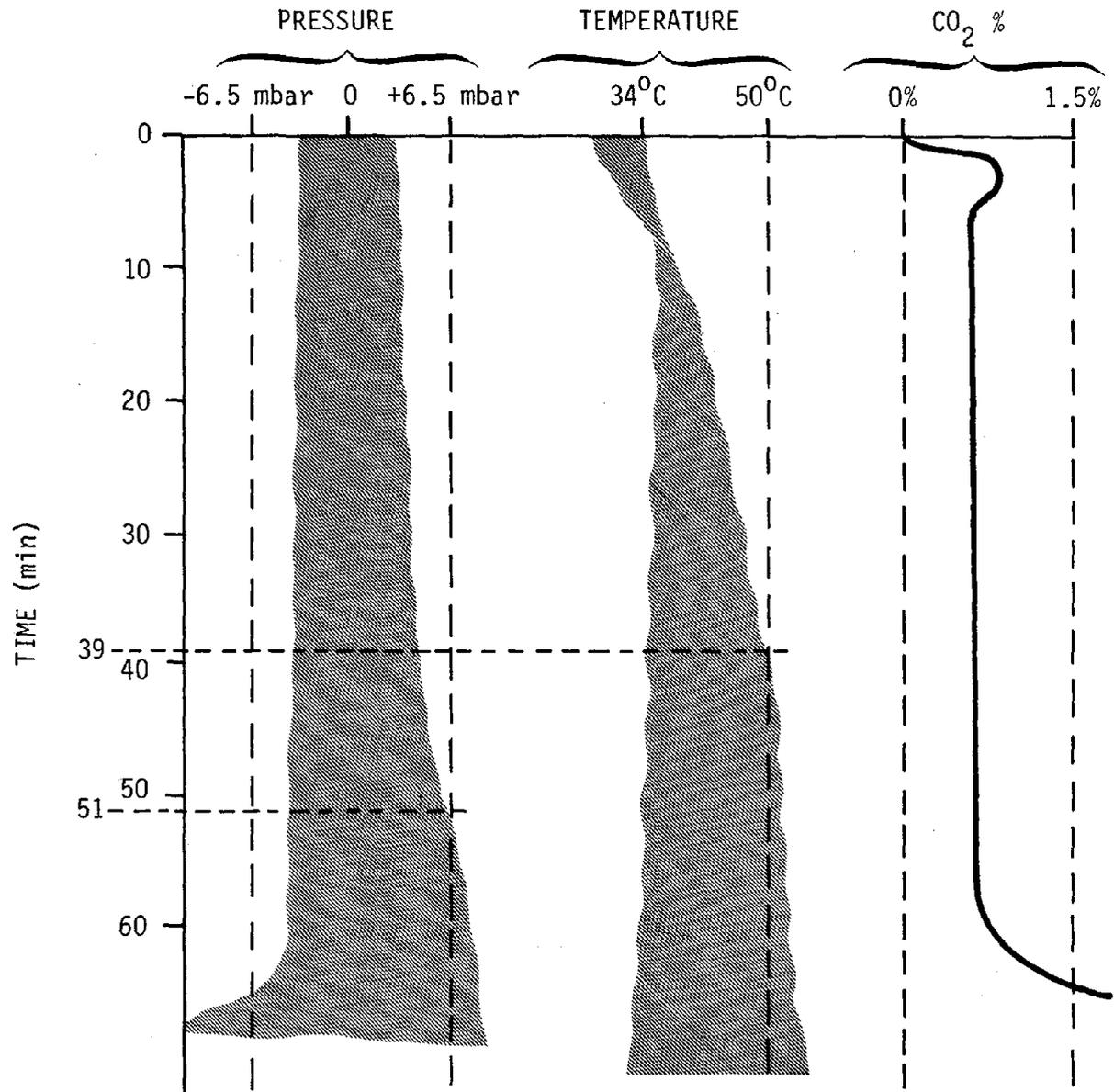


FIGURE B-7. - Simplified chart of machine test results.

unit had a service life of 39 min. If the temperature had stayed below 50°C, the SCSR would have been rated at 51 min because at that time the exhalation resistance exceeded 6.5 mbar.

B.3.2 Mantesting

The mantest is performed by trained rescue men in a training gallery (for more details on the training galleries, see subsection B.4) usually located at a central rescue station. The test is supposed to simulate escape activities and requires a breathing rate of about 35 l/min. The escape exercise takes 20 min, repeated over again as required. Although the exact pattern is at the discretion of the testing agency, the following example - which we witnessed - is typical:

- a. 3 min - treadmill at 3.3 km/hr
- b. 1 min - 56m walk to vertical treadmill
- c. 1.5 min - vertical treadmill at 10 m/min
- d. 1 min - 56m walk to data station
- e. 1 min - rest and data taking
- f. 8.5 min - travel through test gallery, both horizontal and vertical
- g. 2 min - treadmill at 20 percent incline, 2.4 km/hr
- h. 2 min - rest and data taking.

During this program, the man's pulse rate was continuously monitored by telemetry, and CO₂, O₂, and temperature of inhaled air was measured during the data taking periods indicated above.

B.3.3 Underground Testing

The European Community Guidelines also call for the conducting of escape exercises underground wearing SCSRs. However, we were not informed of any details on such programs during our visits.

A more important aspect is the "testing of storage and carrying of self-rescuers underground," which calls for at least 10 self-rescuers to be put "in use" every working day for at least 3 months, 80 percent on trackless diesel vehicles or heading machines and the rest used to establish the possibility of their being carried underground. At the end of the trial period, all units would be tested. Such a research program is currently underway in France, and is further discussed in subsection B.4.

B.3.4 Vibration Testing

There is at present no specific vibration test or specification for SCSRs. The general feeling seems to be that the required underground trials - including storage on vehicles and equipment - will fulfill that need.

We did observe the vibration test apparatus used in Germany for *filter* self-rescuers. It consisted of a small platform which was cam-driven so that it lifted 2 cm and then dropped. As shown in Figure B-8, shallow partitions on the platform enable two filter SCSRs to be placed on the platform and tested

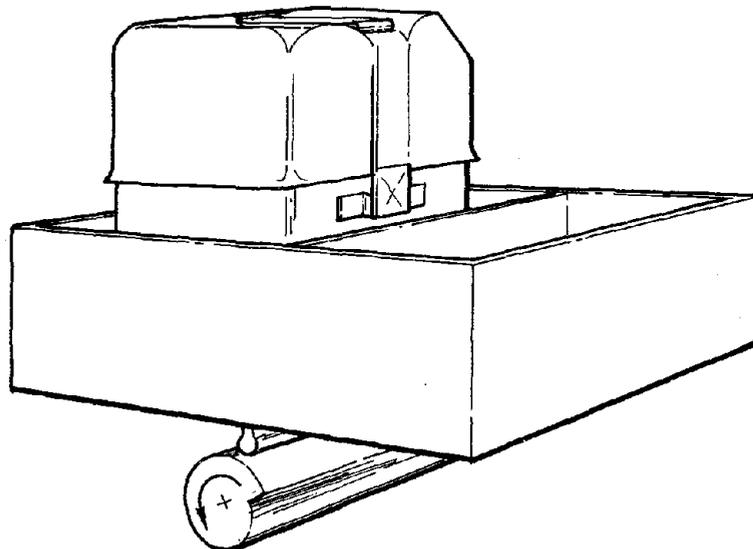


FIGURE B-8. - German vibration testing apparatus.

simultaneously. The SCSRs are not rigidly held on the platform, but rather "rattle" around every time the platform is dropped. The test consists of 50,000 cycles, after which the SCSRs are machine-tested.

B.4 Research Projects

During our trip we discussed a number of research activities which the Europeans had either conducted or that were ongoing. The following specific programs were discussed:

- a. Laboratory tests to investigate the flammability of KO_2 and coal; Germany, 1963
- b. Crusher tests to investigate the flammability of KO_2 self-rescuers; Germany, 1965
- c. Mantests on SCSRs, part 1; France, 1977
- d. Mantests on (different) SCSRs, part 2; France, 1977
- e. Escape-time studies and breathing requirements; Germany, 1977
- f. "Guidelines for the Construction and Testing of Chemical Oxygen Self-Rescuers"; Luxembourg, 1980
- g. Underground trials for carrying and storing of SCSRs; France, starting in 1980 and extending for 2 years.

English translations of reports on each of these subjects except the last one have been obtained. The pertinent results and conclusions are summarized in the following subsections.

B.4.1 Laboratory Tests to Investigate the Flammability of KO_2 and Coal

On 15, 16 and 22 May 1963, the Bergbauforschung Essen (Mine Research Center, Essen, Germany) carried out tests "to study the behavior of potassium superoxide in the presence of coal (slack and coal dust) under the influence of mechanical forces, such as impact, friction, etc."

The KO_2 was packaged in glass ampoules and brass cartridges, containing 25g (v1 oz) of KO_2 . Six different tests were then

conducted in which the ampoule or cartridge, embedded in 300g of coal dust, was smashed in different ways. Ignition occurred in half of the test cases.

Based on these results, unlimited usage of chemical oxygen SCSRs was not permitted; however, chemical SCSRs continue to be used in special cases which are individually evaluated.

B.4.2 Crusher Tests to Investigate the Flammability of KO_2 Self-Rescuers

On 12 November 1965 representatives from the Essen (Germany) Mine Research Center, the Auer (MSA) Company, and Hugo Mine conducted "destruction tests with the Auer self-rescuer (Auer SSR16B)" by passing it through a crusher set up on the surface. The Auer SSR16B was the first commercial chemical oxygen self-rescuer, developed in the early 1960s.

As shown in Figure B-9, the SSR16B was housed in a two-part stainless steel case, similar to an oversized MSA filter self-rescuer, except larger and flatter.

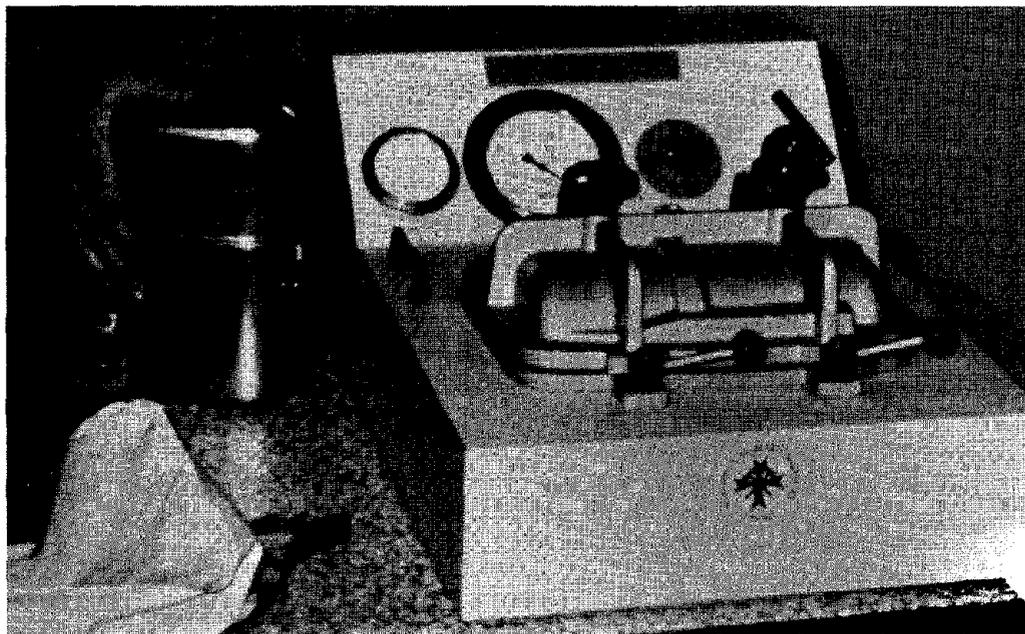


FIGURE B-9. - Auer/MSA SSR16B.

TABLE B-4. - Average service life, February tests

SCSR model	Escape operation	Survival operation
Draeger KO ₂ Oxy-60	1 hr, 27 min	3 hr, 42 min
MSA SSR16B	0 hr, 59 min	2 hr, 40 min
Draeger Oxy-45-SR	1 hr, 0 min	1 hr, 6 min
Fenzy 66	0 hr, 54 min	1 hr, 2 min

- c. The Draeger OXY-60 had the best service life for both escape and survival, although officials cautioned that at the time it was a prototype device.
- d. MSA and Fenzy indicated that they intended to present a prototype by the end of the year equivalent to or better than the Draeger.
- e. An interesting sidelight to the test program was that during one of the three morning survival tests, the wearer of a unit actually went to sleep.

B.4.4 Mantests on (Different) SCSRs, Part II

On 9 and 10 June 1977, the HBL (Lorraine Basin Coal Field of the French Coal Mining Industry) conducted mantests on three different self-rescuers for evaluation and comparison:

- a. Draeger Oxy-60
- b. Fenzy Spiral Mark II
- c. MSA SR-60.

All three of these were prototype KO₂ devices, the Fenzy and MSA having been developed since the previous tests described in

subsection B.4.3. Because of the limited number of prototypes available, only 12 tests were run:

- a. One "survival" (resting) test for each model
- b. Three "escape" tests for each model, using three rescue men each of whom tested each model.

Major results and conclusions were as follows:

- a. The service life was as shown in Table B-5.
- b. The MSA was preferred for the survival, both for the length of time and comfort to the wearer.
- c. Officials felt that training models must include use of KO₂ cartridges so that wearers would get used to possible irritation of the throat (see next item).
- d. One escape test of the MSA unit had to be aborted after 43 min because of coughing fits caused by scratchy sensation in the throat at the beginning of the exercise. Sixteen hours later, an MSA technician donned the identical, partly-used unit and wore it for an additional 63 min of escape testing.

B.4.5 Escape Time Studies and Breathing Requirements

In 1977, M. Funkemeyer of the Hauptstelle in Essen, Germany published a paper on "Investigations into the problem of miners escaping with filter self-rescuers." The impetus for the research was that new mine developments were being proposed with single entries longer than the legal 800m (~2500 ft). It was

TABLE B-5. - Average service life, June tests

SCSR model	Average time for three tests, escape (min)	Survival time single test (min)
Draeger Oxy-60	104	222
Fenzy Spiral Mark II	73	194
MSA-SR-60	93	255

therefore important to determine whether the existing filter self-rescuers would be adequate. This was done by measuring escape speeds and breathing rates, both of which are also important in the study of oxygen self-rescuers

The following is a summary of the testing:

- a. Escape routes were chosen using a variety of seam heights, longwall faces and roadways, intakes and returns, etc., a total of 98 km (~60 mi) of escape routes.
- b. A total of 105 men tested
 1. 26 of them "B2 persons" (slight to moderate lung damage)
 2. Average age 41.1 years
 3. Three men traversed each route, two wearing filter SCSRs and one wearing a medical gas meter to measure breathing rate.

Pertinent results were as follows:

- a. Breathing:
 1. Average - 31.4 l/min
 2. Range - 19.3 l/min to 48.9 l/min
- b. Speeds are outlined in Table B-6.

B.4.6 Guidelines for the Construction and Testing of Chemical Oxygen Self-Rescuers

As mentioned in subsection B.3, the Mines Safety and Health Commission for the European Community has just approved the above document for all of its member nations. The standards which are required were discussed in subsection B.3 and may be summarized as follows:

- a. *The service life* of new chemical oxygen self-rescuers must be 90 min at a breathing rate of 35 l/min, as determined on an artificial lung test machine. There are also requirements for mantesting and underground trials.

TABLE B-6. - Travel speeds in German coal mines

Roadways				
Inclination (deg)	Intakes (m/min) ascending/descending		Returns (m/min) ascending/descending	
0 to 5	55	55	55	55
5 to 10	45	60	40	45
10 to 15	35	55	30	35
15 to 20	30	45	25	25
>20	25	30	20	20
Faces				
Inclination (deg)	Seam thickness (m)		Face escape speed (m/min)	
0 to 20	<1		8	
0 to 20	1 to 1.4		10	
0 to 20	1.4 to 1.8		15	
0 to 20	>1.8		25	
>20	all thickness		10	
shafts	4 m/min up		8 down	
Essen, 20 August 1980				

- b. *Construction requirements* are also outlined for the mechanical details of the SCSR, including a maximum weight of 5.0 kg in the ready-to-be-used state.
- c. *Inspection (field-testing) and training* are specifically not covered in this report. In fact, the preface states that Committee on Self-Rescuers will still have to continue with the preparation of proposals in these areas.

B.4.7 Underground Trials for Carrying and Storing of SCSRs

CERCHAR (French Mine Research Organization) has just begun a 2-year evaluation of the use of *apeva* (French word for chemical SCSRs) in the underground environment. This program is being subsidized by the European Community and progress reports will be issued by 6-month intervals. The following units will be tested:

- a. MSA/Auer SSR90
- b. Draeger Oxy-SR-60B (same as United States model)
- c. Fenzy Spiral Mark II.

These units are going to be put into service and then machine-tested at periodic intervals. For each model, one-third will be stored on the surface, one-third will be stored in boxes underground, and one-third will be stored individually on diesel trucks underground.

Models from each manufacturer will then be taken out of service and tested accordingly to the schedule outlined in Table B-7.

Note that at each interval, two models from *each* manufacturer are taken from *each* storage location. These units are then tested on the mechanical-lung machine in order to determine if there has been any degradation in performance. The reason for taking two units of each model is that one unit is tested at 10 l/min ("survival" test) and one at 30 l/min ("escape" test -

TABLE B-7. - Schedule of testing for *each* model SCSR

Location of SCSRs to be tested	Start	First month	Second month	First year	Second year	Total
Surface	3	2	2	2	2	11
Stored underground in boxes	-	2	2	2	2	8
Stored underground on diesel trucks	-	2	2	2	2	8

Note: Total number of SCSRs from each manufacturer is 27.

remember that there are not any commercial units yet designed to the 90 min at 35 l/min standard; the three models being tested in this program are all so-called light duty - that is, designed to the 60 min at 30 l/min standard).

The first progress report on this research effort - which should include the initial tests and possibly the 1-month test - was scheduled for 1 July 1980.

B.5 Inspection and Maintenance

Inspection and maintenance of in-service self-rescuers is a vitally important area to the Europeans, especially the British. Just as an example: in the United Kingdom, filter self-rescuers are returned to the lamphouse every day for visual inspection, and they are both weighed and vacuum-tested monthly.

Inspection and maintenance - and its associated cost - is one of the major distinctions between chemical and bottled SCSRs in Europe. Bottled units require a great deal more inspection and testing in Europe. On the other hand, they are much cheaper and easier to return to service after they have been used. Chemical models have virtually no maintenance required, but are very expensive to reuse.

The chemical SCSR most easily reused is the MSA/Auer SSR 90. This model has a disposable KO_2 cannister, item 6 in Figure B-10 to make reusing easier. However, even this model still costs 50 percent of the original purchase price to reuse, compared to perhaps 15 percent for a bottled model.

Thus, in Europe the general philosophy is that where SCSRs will be used frequently (such as for mine rescue teams or for training) bottled units are advantageous; where SCSRs would be used infrequently, chemical models might be preferred.

It is worth mentioning again that the European Community still has plans to publish, in the future, guidelines for both inspection and training with chemical SCSRs.

B.5.1 Inspection and Maintenance for Chemical SCSRs

At the Hauptstelle in Essen, Germany we were shown one piece of test apparatus which was entirely new to us. This tester, shown in Figure B-11, was developed for testing of the original

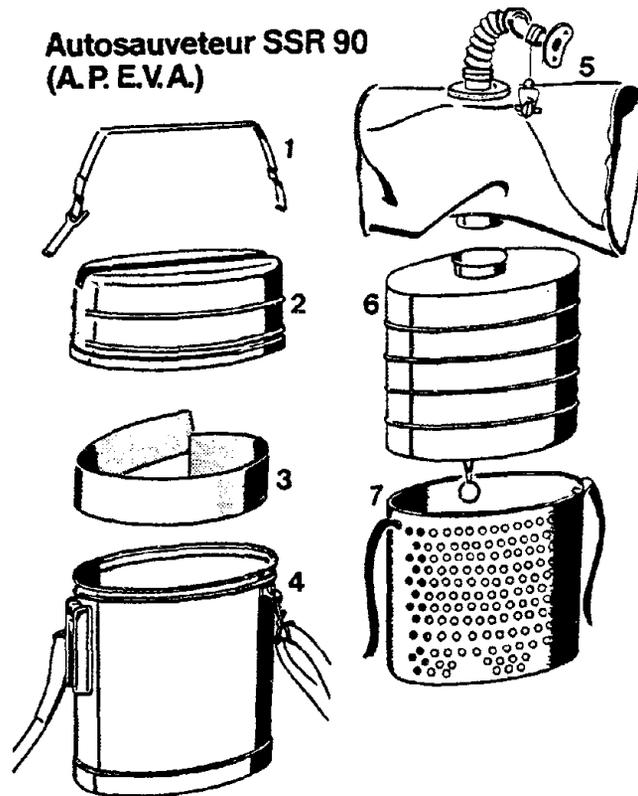


FIGURE B-10. - MSA/Auer SSR 90.

chemical SCSR, the Auer SSR 16B. The SCSR is placed in the chamber, which is closed and sealed. A hand-pump then applied a vacuum during the test period indicates that air is leaking out of the SCSR.

The SSR 16-B has been replaced in Europe by the SSR 90. However, MSA recommends a water immersion test for the new model and does not sell a vacuum tester, for reasons we are not aware of.

B.5.2 Inspection and Maintenance for Bottle SCSRs

As mentioned previously, the Europeans really believe in comprehensive inspection and testing, and the procedures for bottled oxygen SCSRs are a good example. Subsection B.2.2 discussed the maintenance procedures at a potash mine including daily, monthly, quarterly, yearly, and 4-year procedures. For coal mining, where Draeger SR45 units are used primarily by rescue teams, the procedures are somewhat different. Recommendations

Auer-Vakuum-Dichtprüfgerät 5130

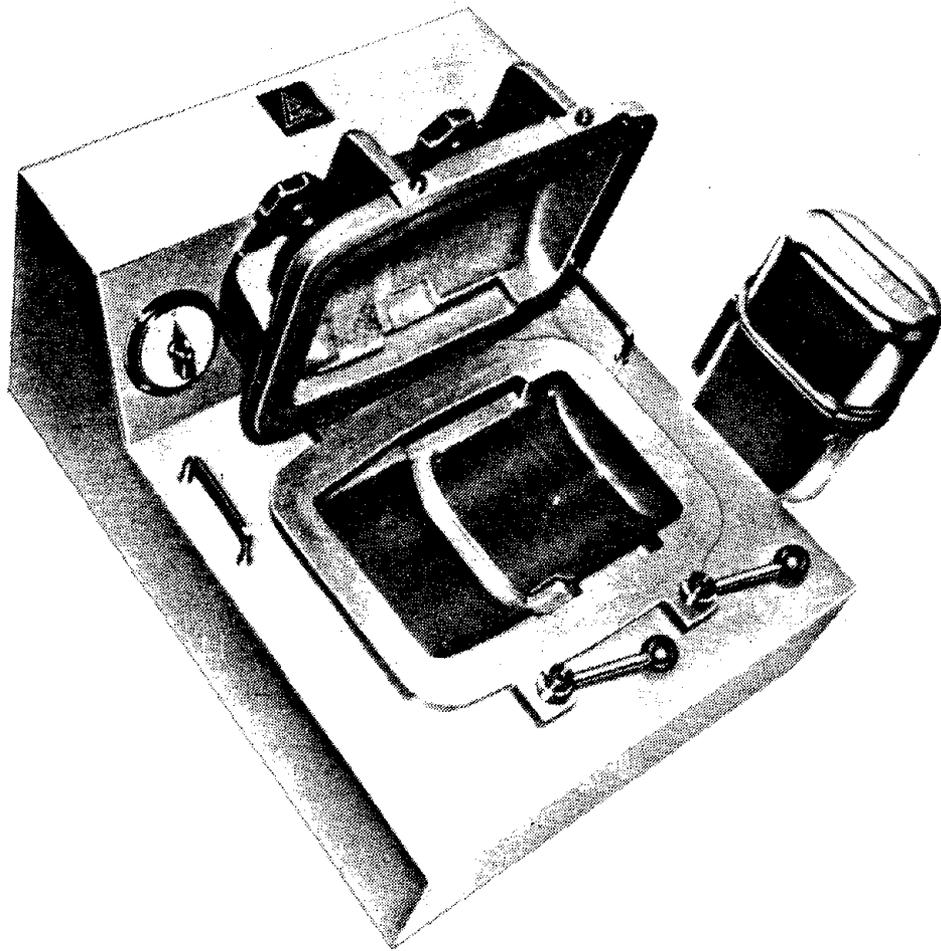


Bild 1
Dichtprüfgerät mit geöffneter Prüfkammer

FIGURE B-11. - Vacuum tester for Auer SSR 16B.

for maintenance and testing have been written by the Apparatus Foreman at the Hauptstelle in Essen, Germany and are published by Draeger in a brochure which is 12 large pages of small type. The requirements for periodic inspection may be summarized as follows:

- a. Check pressure before taking out
- b. Monthly - check seal quality under pressure and vacuum
- c. Quarterly - open unit and perform complete pressure-flow checks with special test equipment
- d. Yearly - SCSR should be used (breathed through), followed by complete disassembly, replacement of soda lime (CO₂ scrubber) and recharging of oxygen bottle.

B.6 Training

In general, the Europeans believe that training should simulate real conditions as closely as possible. For example, we visited training galleries at rescue stations in France and Germany where rescue teams train and where oxygen self-rescuers have been mantested. Part of one training gallery is shown in Figure B-12. These galleries have posts, timber sets - even rock dust on the floor - and travel routes which require standing, bending, crawling, and climbing vertically.

This same approach seems to apply in the training of miners to use self-rescuers. For filter self-rescuers, Great Britain has even developed a training unit which puts out hot air. For oxygen self-rescuers, the general opinion is that the training model should be extremely realistic, and preferably should actually involve breathing of the real thing, so that the men are used to the warm, dry air. Although this might be feasible for compressed oxygen self-rescuers (and is in fact done on an annual basis at some mines - see subsection B.2.2) which can be easily reused, the costs of using the real thing are high for chemical SCSRs. Thus, as chemical oxygen self-rescuers become more common in Europe, there is some concern over their belief in realistic training and its cost.

Details on specific training at mines using SCSRs were presented in subsection B.2.

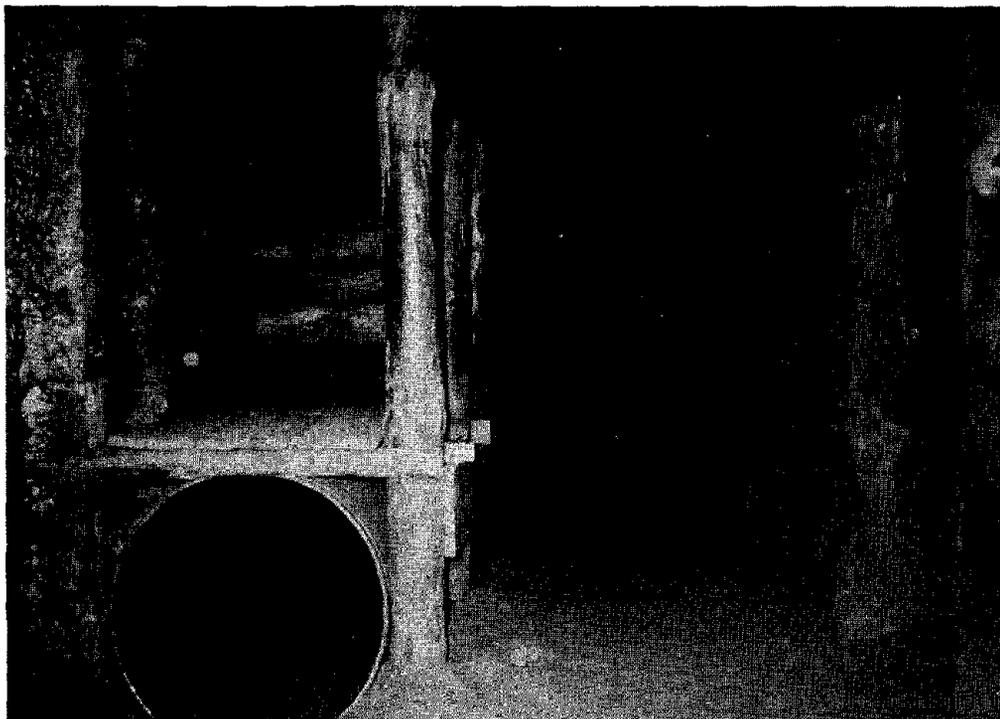


FIGURE B-12. - Portion of test gallery, France.

B.7 Chronology of Meetings, Organizations, Individuals,
and Addresses, May 1980

B.7.1 20 May, Luxembourg, Grand-Duchy

Members of the Mines Safety and Health Commission of the European Community present at this meeting included:

- a. J. LeClerq, executive secretary (now retired)
- b. Peter Walker, mining engineer for the Commission
- c. F.J. Kock, Germany
- d. R. Grisard, France
- e. P. Tricys, United Kingdom
- f. H. Gregoire, Belgium.

The Mines Safety and Health Commission is a European organization whose function is to "follow developments regarding safety in coal mines," and other extractive industries. The Commission accomplishes this by providing an exchange of information between member countries and by researching particular topics through "working parties" which will publish reports and recommendations. These recommendations are not binding on the member countries; however, because the reports and recommendations are approved by the Commission members, who are in turn the top officials from the individual countries, publications approved by the Commission carry a lot of weight.

The individuals who met with us were the leading officials in the area of rescue arrangements generally and oxygen self-rescuers in particular.

B.7.2 21 May, Merlebach, France (Eastern France)

Members of Houilleres du Bassin de Lorraine (HBL) (Coal Company of the Lorraine Basin) and Le Poste Central de Secours (Central Mine Rescue Station) present at this meeting included:

- a. M. Chevilard, Chief of Safety for HBL
- b. M. Cretin, Director of Rescue Operations
- c. Benno-R-Niedzielski, P.R. Director (interpreter)
- d. M. Keller, in charge of self-rescuers
- e. M. Fickinger, Deputy to Keller
- f. M. Froger, ventilation expert visiting from Cerchar.

French coal mining is divided into three districts, or basins. This basin, the HBL, is located in eastern France. Although all the coal mines are government-owned, each basin is essentially autonomous.

Associated with the mining district is the Central Rescue Station, which - among other functions - has responsibility for self-rescuers. This particular rescue station has engaged in operations far beyond their district including many parts of Europe.

B.7.3 22 May, Verneuil, France (just north of Paris)

Members of Cerchar Industrie present at this meeting included:

- a. Grisard, Chief of Safety for Charbonnage de France
- b. Ganier, Director of Cerchar
- c. Falque, Cerchar, Chief Engineer of technical services
- d. Perret, Cerchar, Engineer for breathing apparatus
- e. Rambertrat, Technical Services Engineer (interpreter).

Cerchar is a research organization owned by Charbonnage de France (the government-owned coal mining industry); they have done and are continuing with research on oxygen self-rescuers.

B.7.4 23 May, Meyreuil, France (south of France,
near Marseilles)

Members of Houilleres de Provence, Gardanne Mine (Coal Company of Provence) present at this meeting included:

- a. Jean Cerede, Chief Engineer
- b. Maurice Guillaume, Safety Engineer
- c. Jacques Daret, Engineer
- d. Fernand Long, Public Relations (interpreter).

The Provence, or Gardanne Mine, is in the HBCM, the Southern Basin (mining district) in France. This mine is probably the most similar to an American coal mine; with two longwalls (plows) and five continuous miners for development, they mine about 1-1/2 million metric tons/year. They have approximately 200 SCSRs stored underground.

B.7.5 27 May, Heringen, West Germany

Members of Wintershall Mine, Kali und Salz AG present at this meeting included:

- a. Henry Rininsland, Chief Engineer
- b. Ho Bruns, in charge of oxygen self-rescuers.

This potash mine is located in central West Germany on the East German border. This mine is of particular interest because for some years every man who travels underground is equipped with an oxygen self-rescuer.

B.7.6 28 May, Essen, West Germany

Franz-Josef Kock, Director, Hauptstelle fur das Grubenrettungswesen (Mine Rescue Center), was present at this meeting.

There are five mine rescue centers in Germany, but this is by far the biggest and best known. They are privately-owned and funded by the mining industry. Although they were primarily a rescue organization, they have become increasingly involved in general safety issues such as fire prevention, with a specialty in breathing apparatus. Although official approvals for underground use of equipment are granted only by the government Inspectorate, the latter will most often rely on the testing and recommendations of the Hauptstelle.

B.7.7 List of Addresses

Mr. M. Grisard
Charbonnage de France
9 avenue
B.P. 39608
75360 Paris Cedex 08
France

Mr. Jean Cerede
Houillered de Provence
13590 Meyreuil
France

Dr. Peter Walker
Mine Safety and Health Commission
Bat. J. Monnet - A.2
Avenue Alcide de Gasperi
Luxembourg, Kirchberg
Luxembourg

Mr. Chevillard
Cretin
Le Poste Central de Secours
Houilleres du Bassin de Lorraine
Belle-Roche
57802 Freyming-Merlebach
France

Herr Franz-Josef Kock
Bergbau-Forschung GMBH
Hauptstelle fur das
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4300 Essen-Kray 13
SchonscheidtstraBe 28
West Germany

Mr. Henry Rininsland
D6432 Heringen
Heringerstr: 43
West Germany

Mr. J. Faucounau
Mr. G. Beres
French Mining, Chemical and
Allied Industries
Chevy Chase Center Building
35 Wisconsin Circle
Chevy Chase, Maryland 20015

B.8 Summary of Information Obtained through Literature and Catalog Files

In addition to the European trip, a worldwide literature search was undertaken in order to identify currently available breathing apparatus and to evaluate the state of the art. The equipment itself was of less interest than two areas associated with the use of the equipment:

- a. Maintenance, inspection, and test procedures (for units already in service)
- b. Actual experience with underground use and/or storage.

Although the literature search originally included all types of breathing apparatus, the scope of the effort soon narrowed to include only escape breathing devices and rescue breathing apparatus (RBAs). Table B-8 shows a summary of the escape breathing apparatus currently being manufactured (similar units made by the same company have been omitted for simplicity), organized by manufacturer. Table B-9 shows the use of oxygen self-rescuers in various countries around the world.

Procedures for maintenance, inspection, and testing were found to be substantially different depending upon whether the unit was chemical or compressed oxygen.

B.8.1 Compressed Oxygen Units

Four different aspects of compressed oxygen units must be monitored:

- a. Oxygen supply (bottle pressure)
- b. Integrity of moving parts (valves, regulator)
- c. Integrity of elastomeric system (hose, bags)
- d. Integrity of chemicals (CO₂ scrubber).

Monitoring the oxygen supply is done by providing an integral visible pressure gauge on each unit. Not surprisingly, all manufacturers use the same procedure.

Recommendations for testing or inspecting the moving parts varied from manufacturer to manufacturer. In general, it seems

TABLE B-8. - Emergency escape breathing devices

Type of unit	Type and duration of unit	Size	Inspection and testing	Field usage
Draeger Oxy-SR60B	Chemical oxygen, 60 min	8 x 5 x 12 in. 8-1/2 lb	Visible humidity indicator	Caissons for oil drilling
Draeger Oxy-SR45	Compressed oxygen, 45 min	8 x 5 x 12 in. 5 lb	Visible pressure indicator	German potash mines
CSE AU-9A	Bottled oxygen cylinder, 60 min	11 x 7 x 4 in. 9-1/2 lb	Visible pressure indicator	Polish coal mines
Scott Aviation 802300-02	Chemical oxygen, 15 min	9 x 8 x 4 in. 3-1/2 lb	Visible humidity indicator	Navy testing, aviation applications
MSA 464213	Chemical oxygen, 60 min	11 x 8 x 4 in. 9 lb	Water immersion testing every 6 weeks	-
MSA/Auer SSR-90	Chemical oxygen, 90 min	10 x 8 x 4 in. 8 lb	Water immersion testing	Germany and United Kingdom coal mines
Russian SHS-7M	Chemical oxygen, 45 min	5 x 6 x 10 in. 6-1/2 lb	Special pressure chamber test	Canadian and Russian coal mines
Robertshaw "Air Capsule"	Bottled air with hood, 5 min	5 x 8 x 9 in. 4-1/2 lb	Visible pressure indicator	General industry
Suivair 0028-00	Bottled air, 5 min	12 x 8 x 3 in. 7 lb	Visible pressure indicator	General industry
Fenzy F-66	Compressed oxygen, 45 min	11 x 7 x 5 in. 5 lb	Visible pressure indicator	French coal mines
Fenzy Spiral Mark II	Chemical oxygen, 60 min	8 x 11 x 4 in. 6-1/2 lb	-	-
AGA Mine Escape	Compressed oxygen 30 min	17 x 14 x 4 in. 14 lb	Visible pressure gauge	English coal mines
Siebe Gorman Emox	Compressed oxygen, 15 min	-	-	-

TABLE B-9. - Worldwide usage of SCSRs

Country	Type of units	Reason for use	Comments
Russia	WC-7M	All miners in "gassy" mines	Carried or placed near work in service
Poland	AU-9	Hazardous areas	At least 6000 units in service
England	WC-7M Auer Draeger Oxy-45 AGA	Dust and methane outbursts at Cynheidre Colliery	AGA only unit now used; taken in and out daily and hung on boards near face; serviced every 30 days
Germany	Draeger Oxy-SR-45	CO ₂ outbursts in potash mines, 2000 units in service	Taken in and out daily and stored on equipment; detailed inspection every 3 months
France	Fenzy 66	Carried in dangerous areas - Lorraine district (150 units)	Inspected every month
	19 to 35 min units	Alsace potash mines - CO ₂ outbursts	
	Fenzy Mark II Draeger Oxy-SR60 Auer SSR60		Units to be both worn and stored underground
Canada	WC-7M	200 units in dangerous areas of Nova Scotia mines	

that some kind of periodic inspection and testing of the valve and regulator assembly is required. Germany, Poland, and France have had the most experience with maintenance procedures for in-service compressed oxygen self-rescuers, as discussed in Appendix I.

Integrity of the elastomeric system is performed whenever the system is opened to test other components; inspection is usually limited to a visual inspection and "hand-feel" for drying out, cracking, or other obvious damage.

The system for scrubbing CO₂ is usually a stable chemical which should not degrade unless exposed to substantial CO₂ or moisture. There is, however, one significant cautionary note: if the CO₂ scrubber should become depleted before all of the oxygen is consumed, the operation of the unit will continue to appear "normal" to the user. Although the user continues to receive plenty of oxygen, the carbon dioxide concentration can reach harmful and even potentially fatal levels.

B.8.2 Chemical Oxygen Units

Chemical oxygen units have neither a pressurized bottle nor mechanical moving parts. The one major component is the chemical used to produce the oxygen. All devices currently on the market are encased in an air-tight container, and recommended periodic inspection is designed to verify the integrity of this air-tight seal. A variety of inspection systems has been used:

- a. Vacuum gauge (for vacuum-sealed units)
- b. Humidity indicator
- c. Water-dunk test
- d. Pressure-chamber leak tester
- e. Vacuum-chamber leak tester.

Each of these methods has some advantages and disadvantages. A more detailed analysis of this entire subject is presented in Appendix E.

APPENDIX C

HYPOTHETICAL USE OF OXYGEN SELF-RESCUERS IN
POST-1972 COAL MINE EXPLOSIONS AND FIRESC.1 Introduction

The usefulness of oxygen self-rescuers (or self-contained self-rescuers, SCSRs) depends on *where they are stored*. One method of choosing the best locations is to apply the facts from past fire-and-explosion investigations, *in order to determine what storage locations would offer the greatest level of safety for the underground work-force*. That was the sole object of this report.

What occurred is discussed from what is known or what experienced persons believe to have happened. No criticism of persons or things is implied.

This study involved 118 miners in 3 mine explosions and 3 mine fires. Of the 70 who died, possibly 31 might have been saved had they been able to use SCSRs. Sixty-nine survivors would have been placed in far less jeopardy had SCSRs been available.

"Available" for 55 miners meant they had more than 10 min to obtain an SCSR. For eight miners, however, SCSRs had to be obtained and activated within 2 min of becoming aware of the need.

C.2 Explosions

To reach a cache of SCSRs following an explosion depends in part on the toxic product and oxygen concentrations in the atmosphere between the person and the cache. Immediately following an explosion, products of combustion fill the areas traversed by flame; on cooling, the products contract into a volume approximating that of the original explosive medium. Subsequent forced air flows or, in their absence, diffusion spreads the products into other areas of the mine. Initially, the area affected by an explosion can be expected to contain, among other gases (C-1, C-2, C-3):

	<u>Range (%)</u>	<u>Typical (%)</u>
O ₂	0.1 to 15	6
CO	0.1 to 12	1
CO ₂	4.0 to 16	11

Death is almost a certainty to persons exposed to such atmospheres. Those who initially survive can be expected to collapse within seconds into unconsciousness.

Filter self-rescuers (FSRs) provide no protection for persons attempting escape from such atmospheres. A source that supplies at least 15 percent oxygen is needed. The quantity of oxygen to be supplied depends on the mine layout, the location of the ignition source, and the extent of damage to the mine ventilation network. These are imponderables. In some mines, however, sections are almost 10,000 ft long; a healthy person might, under normal conditions, crawl from the face to the outby junction in one or more hours. In one of the explosions described below (Itmann) a miner wearing an FSR required 30 to perhaps 45 min to travel about 600 ft before collapsing into unconsciousness.

The oxygen source must also reduce the inhaled oxides of carbon. For a person to function properly for at least 1 hr the concentrations of CO and CO₂ would have to be less than 0.02 and 1.6 percent respectively (C-4, C-5).

The SCSRs considered in this study are designed to supply sufficient oxygen to a person traveling for at least 1 hr or resting at least 4 hr. They also reduce the oxides of carbon to safe levels.

C.2.1 Scotia (9 March 1976) (C-6)

Background

The Scotia Mine, Oven Fork, KY, is in the Imboden seam which locally ranges from 55 to 80 in. in thickness. Methane was ignited in 2 Southeast inby its junction with 2 Left (see Figure C-1). The forces of explosion extended through 2 Southeast.

Five miners in 2 Southeast were killed by flames and pressures. Ten miners died in 2 Left. One body was in No. 1 and 3 in No. 4 entry. Six miners (bodies A through F, Figure C-1) constructed a "barricade" in No. 5 Room, 2 Left; it is highly probable they died from insufficient oxygen and may have lived for as long as 6 hr following the explosion.* Two miners (bodies G and H,

*Unsubstantiated statements made to the Congressional committee investigating this disaster. Three of the deceased were partially autopsied to determine CWP. Autopsy records contain no evidence of studies to determine cause of death or carboxyhemoglobin percentages.

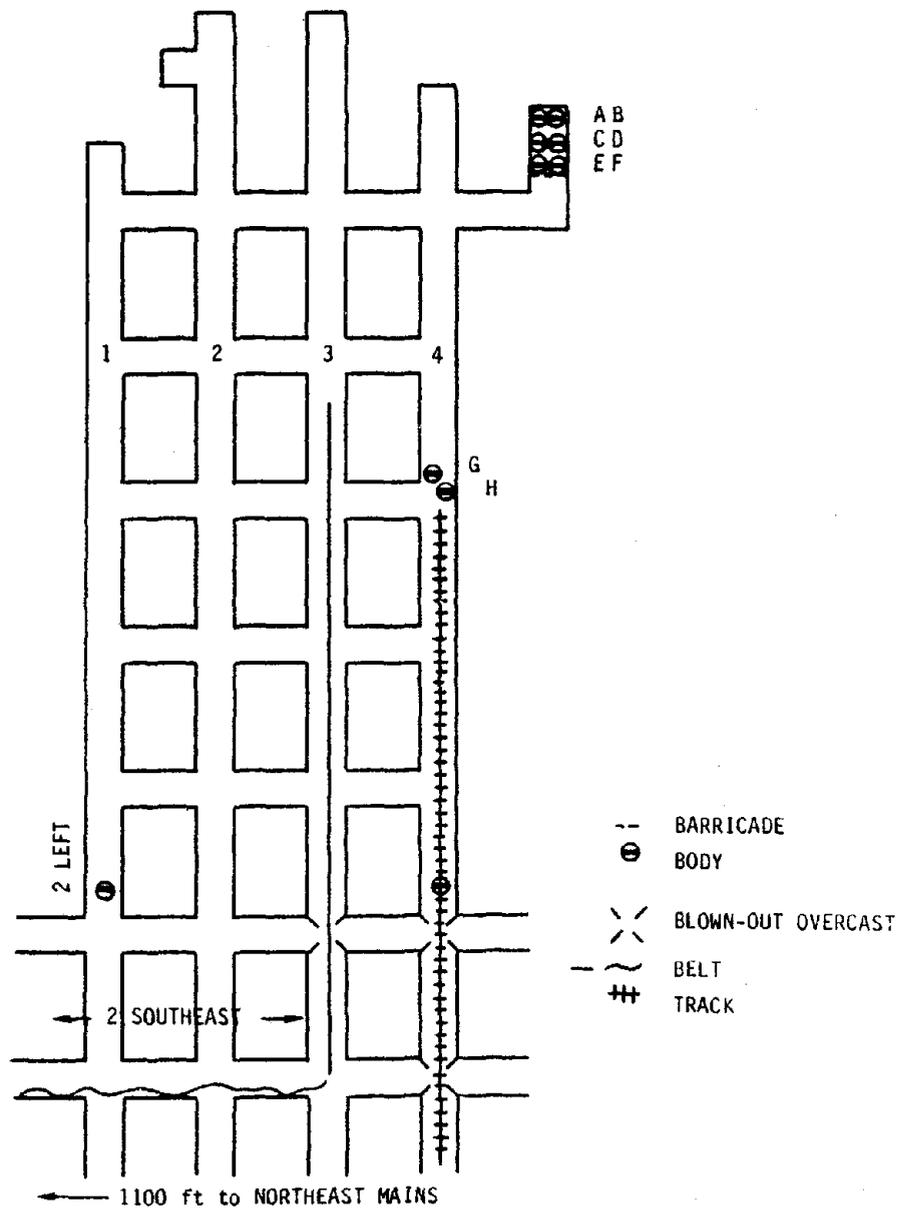


FIGURE C-1. - Scotia Mine, 2 Left - 2 Southeast, 9 March 1976.

Figure C-1) normally worked with miners A through F. Their bodies, found near the end of the track in No. 4 entry, showed none of the external signs common to death from explosion flame or pressure. This analysis assumes, without fact, these two miners died from breathing products of combustion.

The events leading up to the explosion are not discussed in this report because of pending civil and criminal complaints. Much information that would make this analysis less speculative is not available to the public.

Shortly after the explosion the section belt man reported he had gone up 2 Southeast to within 400 to 600 ft of the 2 Left junction. The dense smoke forced him to leave. Soon afterwards, four other miners attempted to go up into 2 Southeast. They went 400 to 600 ft, about half the distance from the mains to the junction, before dense smoke forced retreat.

Seven hours later, mine rescue teams found no perceptible air movement at the mouth of and in 2 Southeast, "heavy CO" was in the return entry and dense smoke was in the track entry. Ten hours after the explosion the atmosphere at the junction with 2 Left contained 0.2 percent CO and 18 to 19 percent O₂.

Analysis

The miners who died in this explosion had FSRs. Miners A through F had used them; miners G and H may have used them. Why did these miners not attempt escape? No one knows; however, four scenarios can be postulated from the evidence that some, if not all eight, traveled from their working places in Rooms 2 and 4 at least to Room 5 where they built the barricade. Several if not all also traveled partway down No. 2 entry as evidenced by discarded self-rescuer cannister lids.

Scenario 1 -- In traveling to the mouth of the section one or more miners saw a dead person(s).* They thereupon retreated assuming the atmosphere in 2 Southeast to be irrespirable.

*Two bodies were near the mouth of the section; one in No. 1 entry, the other, the section foreman, in No. 4 entry. Both bodies showed signs indicating death may have resulted from explosion-produced flame and pressure.

Scenario 2 -- A flame safety lamp would not stay lit except in the area where the barricade was erected. The miners, therefore, decided there was insufficient oxygen to attempt escape with FSRs. This is discussed below.

Scenario 3 -- Heat from the FSRs was so great the six retreated to the one face where the self-rescuers could be worn in relative comfort. This is discussed below.

Scenario 4 -- In traveling to the mouth of the section dense smoke and perhaps flame were observed. Barricading was considered prudent.

After barricading, could the miners escape successfully? To examine that question consider the information given above for the kinds of atmosphere that might have existed between the barricade and safety. Assuming dilution of the products of combustion by diffusion, the atmosphere outside the barricade in 2 Left might have changed as follows:

Hour	If Original, %		At Hour		Remarks
	O ₂	CO	O ₂	CO	
1st	6	1	7.0	0.9	Deadly without oxygen
	13	1	13.5	0.9	Potentially deadly without oxygen
	15	1	15.5	0.9	Safe with FSR
5th	6	1	12.0	0.7	Potentially deadly without oxygen
	13	1	16.0	0.7	Possibly safe with FSR
	15	1	17.0	0.7	Safe with FSR
6th	6	1	13.5	0.5	Potentially deadly without oxygen
	13	1	17.0	0.5	Safe with FSR
	15	1	17.5	0.5	Safe with FSR

Assume the atmosphere outby the barricade was within the ranges given above. Also assume miners G and H left the barricade during the first 6 hr:*

*Unsubstantiated information indicates miners A through H may have lived up to but not more than 6 hr.

- a. Without FSRs death would result within a few minutes from carbon monoxide poisoning (C-4, C-5).
- b. With FSRs and less than 12 percent oxygen they would collapse into unconsciousness within a few minutes or suffocate.
- c. With FSRs and between 12 and 17 percent oxygen the inhaled air would be in the range of 150°F and boiling (as a result of in-rescuer chemical reactions with carbon monoxide). Based on numerous other events during mine fires and explosions, it is probable that:
 1. Most people would consider retreat to the "safety" of the barricade.
 2. Many people would take off the rescuer and thus die from carbon monoxide poisoning within a few minutes.
 3. Others would become dizzy and have headaches, buzzing in the ears and heart palpitations. Many of these people can be expected to retreat to the "safety" of the barricade unless they believe "good" air is within a few minutes distance.

Miners A through F may have attempted escape and retreated to the safety of the barricade for the reasons given above. They also may have remained in the barricade believing rescue was near.

A third possibility is they had a flame safety lamp which would not stay lit in the atmosphere outby the barricade. Most miners believe and many are taught that air is unsafe when it will not support the flame of a safety lamp (17 or more percent O₂). Based on that assumption, miners A through F would not attempt escape before the fifth hour and more likely not before the sixth hour following the explosion.

Possible Use of SCSRs

Might SCSRs, had they been available, have saved lives? Yes; if the atmosphere outside the barricade was within the ranges given above, it is obvious an external source of oxygen and reduced oxides of carbon were essential to sustain life.

Could the miners depend on stored SCSRs? Yes; SCSRs stored on equipment or within the last three to four crosscuts outby the faces could have been obtained by miners who had traveled through that area.

Had SCSRs been available, therefore, miners A through F and possibly miners G and H might have escaped this explosion.

The five miners who had attempted to reach the explosion area were forced to retreat because of dense smoke. These miners were fortunate. They were fortunate in that they had not succumbed to products of combustion in what they thought was "safe" air. They were fortunate that no falls of roof, fires, or secondary ignitions occurred while they were in 2 Southeast; any of these would move explosion-contaminated air towards them.

Had SCSRs been available and used, therefore:

- a. The six miners, A through F, had a good chance to escape.
- b. Miners G and H might have escaped.
- c. The lives of five other miners might not have been jeopardized.

This recounting raises questions about the suitability of SCSRs. One is related to the five miners who attempted to go into the explosion area. Despite regulations, despite training and despite admonitions, history has taught that some miners will attempt rescue. Could having SCSRs increase the number of miners who would do this? Could having SCSRs increase the chances taken? Rescue attempts by highly trained, experienced five-man teams are difficult and sometimes dangerous. Rescue attempts by untrained, inexperienced individuals have resulted in their deaths and in more devastating secondary explosions.

Another question that needs to be examined is: with SCSRs, will more miners attempt to barricade? Some experienced mine rescue people believe this to be both possible and unsafe.

C.2.2 Itmann No. 3 (16 December, 1972)

Background

The Itmann No. 3 Mine, Itmann, WV, is in the Pocahontas No. 3 seam which locally ranges from 40 to 48 in. in thickness. Methane was ignited by electrical arcing or hot metal from a portal bus carrying eight miners. Five miners died; the other three collapsed into unconsciousness and were found 4-1/2 hr later.

The explosion occurred in the Cabin Creek 4 panel section (Figure C-2). About 3:40 p.m. the eight-man crew completed their work and boarded a portal bus to leave the mine. Dallas Mullens, Lacy Akers, Larry Bailey and Bill Hatfield, in that order, entered the inby covered seating compartment. In the open center operator's compartment were Larry Akers and Jerry Billings. In the outby covered seating compartment were Teddy McMillion and David Meador.

After traveling about 650 ft the trolley pole "bounced off" the trolley wire. Billings was just getting ready to get out to reset the pole when a "big boom" knocked him out of the bus and "half unconscious." Miners were "hollering about how bad they were burned." They piled out of the bus; Mullens "dived over top of" two miners.

Mullens was "blinded;" Billings could not see "4 ft" away; and, Bailey reported, "the smoke was so bad." "It was real hard to breathe. It was about all you could do to get a good breath and it was hot air. Too hot to take."

One survivor, Dallas Mullens, age 31, collapsed into unconsciousness about "8 to 10 sec" after getting out of the bus. He could not attempt to put on a self-rescuer; his was with his tools near the shuttle car he had been repairing. An electrician or mechanic working under most mining machines generally removes the FSR from his belt. Mr. Mullens' was found 20 ft inby the portal bus and close to Lacy Akers who did not survive.*

*Mr. Mullens has authorized FMA to obtain his medical records from this accident. These were studied to approximate the average carbon monoxide concentration in the area and the possible relationship among severity of burns, lung damage and survival potential.

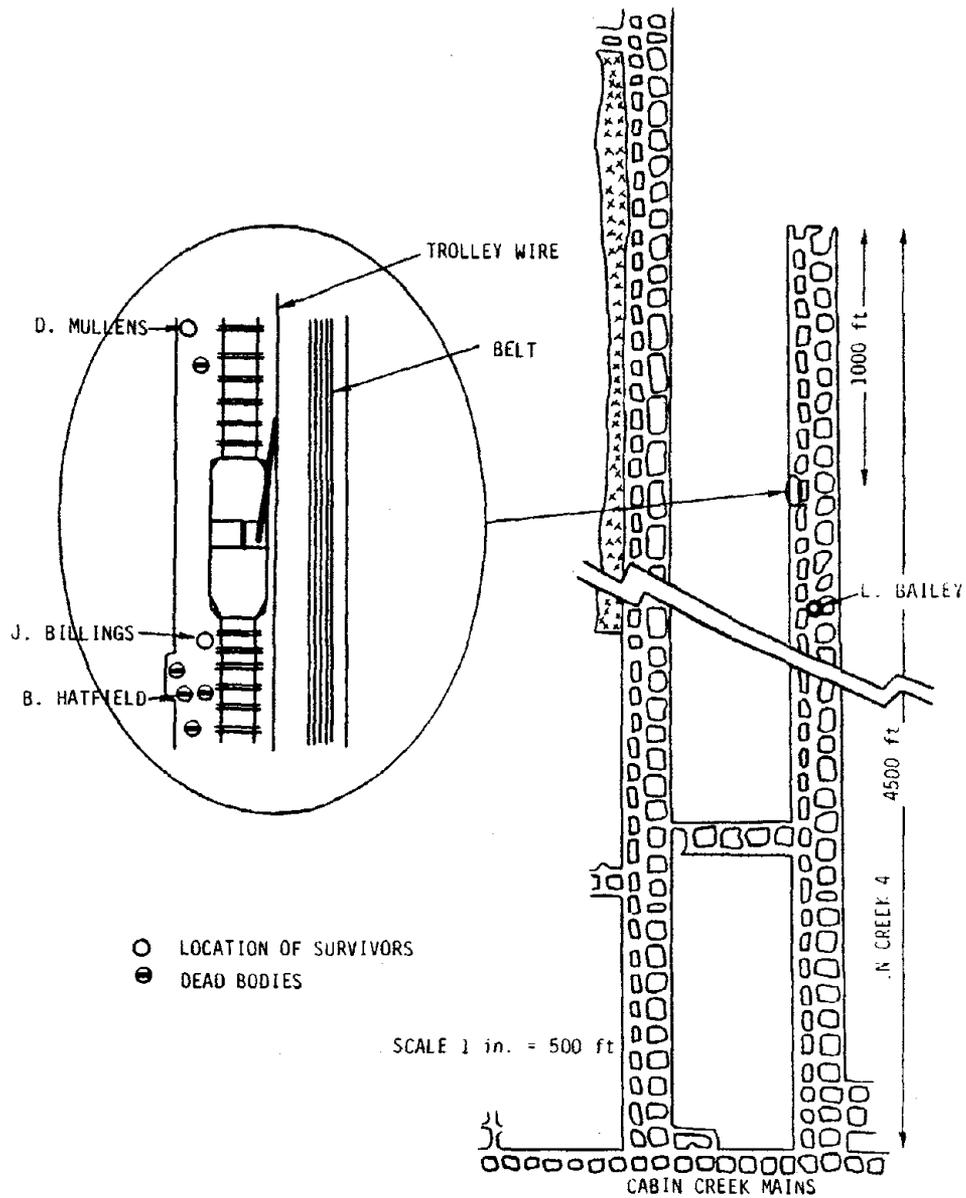


FIGURE C-2. - Itmann No. 3 mine explosion area
16 December 1972.

Another survivor, Jerry Billings, age 20, after being "knocked out" of the portal bus and "half unconscious," started out of the section. After about 200 ft he saw the belt on his right and realized he was going in the wrong direction, back towards the loading point. He then remembered his self-rescuer. He could not open it even after considerable effort and time; his hands were too badly burned. He crawled back and beyond the portal bus. Teddy McMillion told him "I'm burned completely up." Billings answered I was too. Being "so weak" he began crawling on his hands and knees; and, he passed out.

The third survivor was Larry Bailey, age 24. He thought the portal bus had blown up. He had trouble getting out (remember Dallas Mullens dove over two people). When he did get out he lay down. Then he said to himself, "It is the best I know to get outside." He walked to the front of the man car. Teddy McMillion was sitting on the rail. Bailey tried to open his FSR; he told McMillion to do the same if he could, Bailey "was hurt too bad and...couldn't help." After considerable time and effort Bailey put on the self-rescuer and continued down No. 1, the belt-track entry. The smoke was so bad he decided to go to No. 2, the intake airway. In No. 2 entry he collapsed into unconsciousness. He had traveled a total of 500 to 600 ft in about 45 min.

One of the deceased, Bill Hatfield, age 44, had opened his self-rescuer. He did not put it on. His was the only body autopsied.

The others who died were: Teddy McMillion, age 35; Larry Akers, age 29; Lacy Akers, age 28; and, David Meador, age 26.

About an hour later, the mine superintendent, mine foreman, assistant mine foreman and evening shift foreman arrived at the mouth of the section to investigate why the crew had not come out. Meanwhile, the on-coming shift were en route to their respective work areas. The superintendent went into the return airway and observed heavy smoke. He then gave orders to have all men removed from the mine and to deenergize the electrical power into Cabin Creek 4 panel section. Three of the group went into the section until they reached a blown-out stopping about 2800 ft inby. Then the order was given to cut the trolley wire, the track rails and the telephone line. It was decided to explore the section as quickly as possible and to restore temporary ventilation.

The first mine rescue team arrived on the section at 7:45, 3 hr after the ignition. About 8:00 p.m., Larry Bailey was found. About 8:30, the other seven crew members were found.

Possible Use of SCSRs

Might SCSRs, had they been available, have saved lives? To answer that question it is important to consider:

- a. Except for Bailey, the crew was exposed to similar atmospheres for almost 5 hr. For Mullens and Billings to survive, the atmosphere had to contain more than 10 percent O₂ and less than 0.06 percent CO (C-4, C-5).
- b. Bailey and Billings were relatively active during the first 20 to 45 min following the explosion. They, therefore, had to be in an atmosphere containing more than 14 percent oxygen and less than 0.05 percent carbon monoxide during that time (C-4, C-5).
- c. All eight had received serious burns to their bodies and lungs. To sustain life, therefore, the carbon monoxide concentration in all probability was less than 0.05 percent.

From the above considerations and recounting of events, it is reasonable to assume SCSRs were not necessary to sustain life. However, had Bailey an SCSR it is equally reasonable to postulate a different outcome. For that, it is appropriate to review time sequence of events as they occurred and to consider what might have been had Bailey had an SCSR.

The last column in the following table shows the least concentration of carbon monoxide likely to cause death to the average person. Those concentrations, particularly during the first hour, were considerably greater than could have existed. Lives, therefore, might have been saved had rescue been quicker. Rescue might have occurred at least 1 hr sooner had Bailey not collapsed into unconsciousness. Whether he collapsed because of injuries or from an oxygen deficiency is not known. If, however, an oxygen deficiency contributed to his collapse, then an SCSR might have changed the course of events.

<u>Time</u> (hr)	<u>Probable Event</u>	<u>Postulated SCSR Event</u>	<u>Lethal CO Minimum % (C-4)</u>
0	Ignition	Ignition	
0:05	-	Bailey puts on SCSR	0.40
0:10	-	Bailey goes to telephone at mouth of loading section; or at mouth of sec- tion	0.35
0:30	Billings collapsed		0.30
0:45	Bailey collapsed	-	0.10
0:45 - 1:00	Mine management aware of igni- tion	-	
3:00	-	Rescue team at mouth of section	0.075
3:30	-	Crew located	0.07
4:00	Rescue team at mouth of section	-	0.06
4:15	Bailey located	-	0.06
4:30	Other 7 located	-	0.06

Bailey could have obtained an SCSR if worn or carried. Could he have removed one from storage on the portal bus? Following the ignition the portal bus was engulfed in flame. The to-be-expected reaction would be and was to get out and away as fast as possible. To obtain an SCSR from the portal bus he would have to return to the bus. This is not likely because of the heat, smoke and trauma.

Would storage of SCSRs along the track entry been appropriate? Bailey apparently had sufficient physical strength and mental awareness to try to travel to an SCSR storage site in the first 20 min. It is not too speculative to believe he or Billings might have been able to travel the 700 ft back to the loading point (a 5-min distance) if SCSRs were there. SCSRs stored at 10-min travel distances outby the accident also could have been reached.

This accident introduces a potentially serious question with SCSRs. After seeing heavy smoke in the return, mine management traveled about 2800 ft up into the section. Purportedly they could go no farther because of the potentially hazardous atmosphere. They were 600 ft from the portal bus. Had they used SCSRs, it is plausible to assume they would have continued. The question is: when SCSRs become available what is the chance untrained persons might use them in a rescue attempt? In this case, mine management had the knowledge and foresight to deenergize electrical power to the affected section. Telephone lines, track and wires into the section, however, were not cut until after the initial probe. The atmosphere inby and around the portal bus was found to contain explosive mixtures of methane. Secondary explosions frequently are of far greater violence than the first. During mine management's exploration the second shift section crews were in the mine.

This accident also emphasizes another question. Can SCSRs be donned and activated by persons whose hands and faces are burned?

In summary, had SCSRs been available:

- a. Rescue might have occurred earlier which would have increased the potential savings of one to five lives.
- b. The probability that Bailey could and would use an SCSR was greatest if it was worn; the probability, decreased in descending order if it was carried, in a cache along the track entry, on the outside of the portal bus, and in the bus.
- c. The lives of the four mine officials might not have been jeopardized.

C.2.3 Finley No. 15 and 16 Mines
20 December 1970 (C-8)

Background

The Finley No. 15 and 16 Mines, Hyden, KY, are interconnected operations in the Hazard No. 4 seam which locally ranges from 29 to 36 in. in thickness. A coal dust explosion initiated in Mine No. 16 killed 38 miners in both mines.

The explosion was initiated by a combination of detonating cord, nonpermissible explosives, and unstemmed holes in the presence of excessive quantities of coal dust and minimal-to-no rock dust. This occurred in making a "boom hole" in the entry adjoining the working section. The explosion flame and forces propagated throughout most of the mine. One miner, near the portal, escaped.

The carbon monoxide concentration in the areas where the miners died exceeded 2300 ppm, 2-1/2 hr after the explosion. That concentration will cause collapse of an average person within 5 min. Some of the victims are believed to have had severe lung disorders in which case they could have been incapacitated by a lesser concentration in fewer minutes. Assuming dilution of products of combustion by diffusion and considering the known inadequacy of incombustible and excessive accumulations of coal dust in the area it is reasonable to expect the atmosphere within the original explosion area (Figure C-3) may have contained as much as 1.6 percent CO and less than 10 percent oxygen for 15 or more minutes following the explosion.

No autopsies were conducted. The bodies of 33 miners, however, clearly showed evidence of explosion forces and flames. Visual examination of the other five indicated the probable cause of death was from breathing products of combustion.

Possible Use of SCSRs

Might SCSRs, had they been available, have saved lives? To attempt an answer to that question it is appropriate to recreate the possible post-explosion activities of the five to six miners who may have escaped the explosion-generated forces and flames but not the products of combustion.

J. Spurlock, age 41, was a loading machine operator in Mine 16. His body was found 100 ft from the machine he apparently was operating immediately prior to the explosion. To travel 100 ft in this mine takes more than 1 min in the best of circumstances.

H. Couch, age 34, was Spurlock's helper, and was found next to Spurlock.

A. Whitehead, age 46, was the section foreman in Mine 16. Indications were he survived the explosion forces but not the products of combustion.

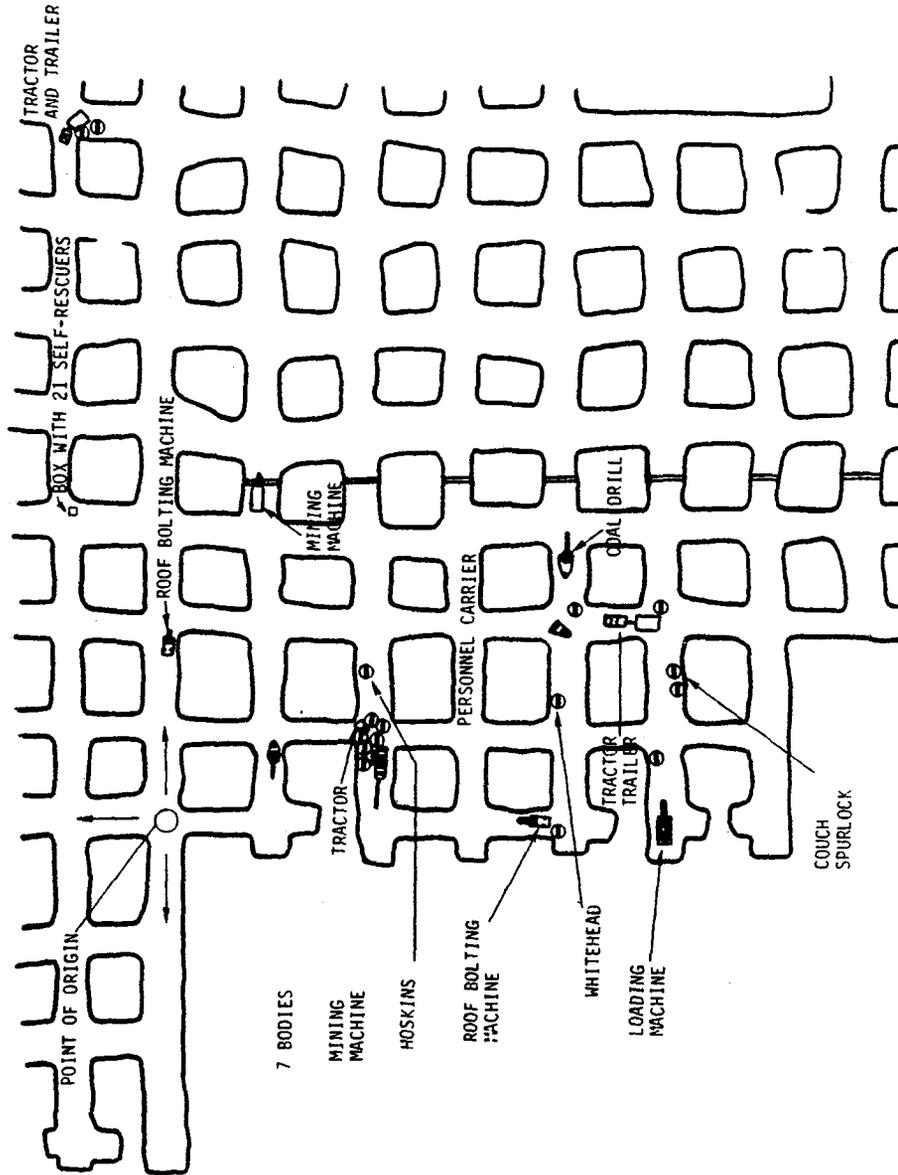


FIGURE C-3. - Initial explosion zone, Finley Coal Co. Mine No. 16, 30 December 1970.

B. Hoskins, age 24, was a tractor operator in Mine 16. He may or may not have been killed immediately. His body showed evidence of flame and pressure; however, he was found 40 ft from the eight-man group with whom he should have been.

A. Wagers, age 28, was a loading machine operator in Mine 15 (Figure C-4). The tram controls of his machine were found in the forward position indicating the equipment may have been in operation at the time of the explosion. His body, found 150 ft away, showed no evidence of being affected by flame or pressure. The time to travel 150 ft in this section of the mine is more than 1 min in the best of circumstances.

K. Hubbard, age 39, was a repairman purported to have been helping Mr. Wagers. He was found next to Mr. Wagers; and, he too showed no evidence of being affected by flame or pressure.

Assume loading machine operator Spurlock and helper Couch survived the explosion flame and pressure. This is highly probable when considering how explosion forces and flames would travel relative to the location of their machine (see Figure C-3).^{*} Had they put on SCSRs stored on the loading machine or worn or carried they might have traveled from their working place to the surface. They had at least 1 and possibly up to 5 min before the face air could become irrespirable. SCSRs stored at other locations would not have saved those two men.

Assume section foreman Whitehead survived the explosion flame and pressure. He, however, was possibly en route to either No. 2 or No. 3 entry of first Left at the time of the explosion (see Figure C-3). To survive the products of combustion he would have had to wear or carry an SCSR and don and activate it within seconds.

Assume Wagers and Hubbard survived the explosion flame and pressure (see Figure C-4). The atmosphere up to the last open crosscut, 150 ft outby their loading machine, probably was as deadly as that in the original explosion area (as much as 1.6 percent CO and less than 10 percent O₂). The probability is

^{*}Forces and flame from an external explosion rarely extends into dead-end rooms (C-9). As a general rule, penetration will not exceed two-thirds the depth. Thus, flame was not likely to penetrate more than 70 ft into the 100-ft-deep room where Spurlock and Couch were and 100 ft into the 150-ft-deep room where Wagers and Hubbard were.

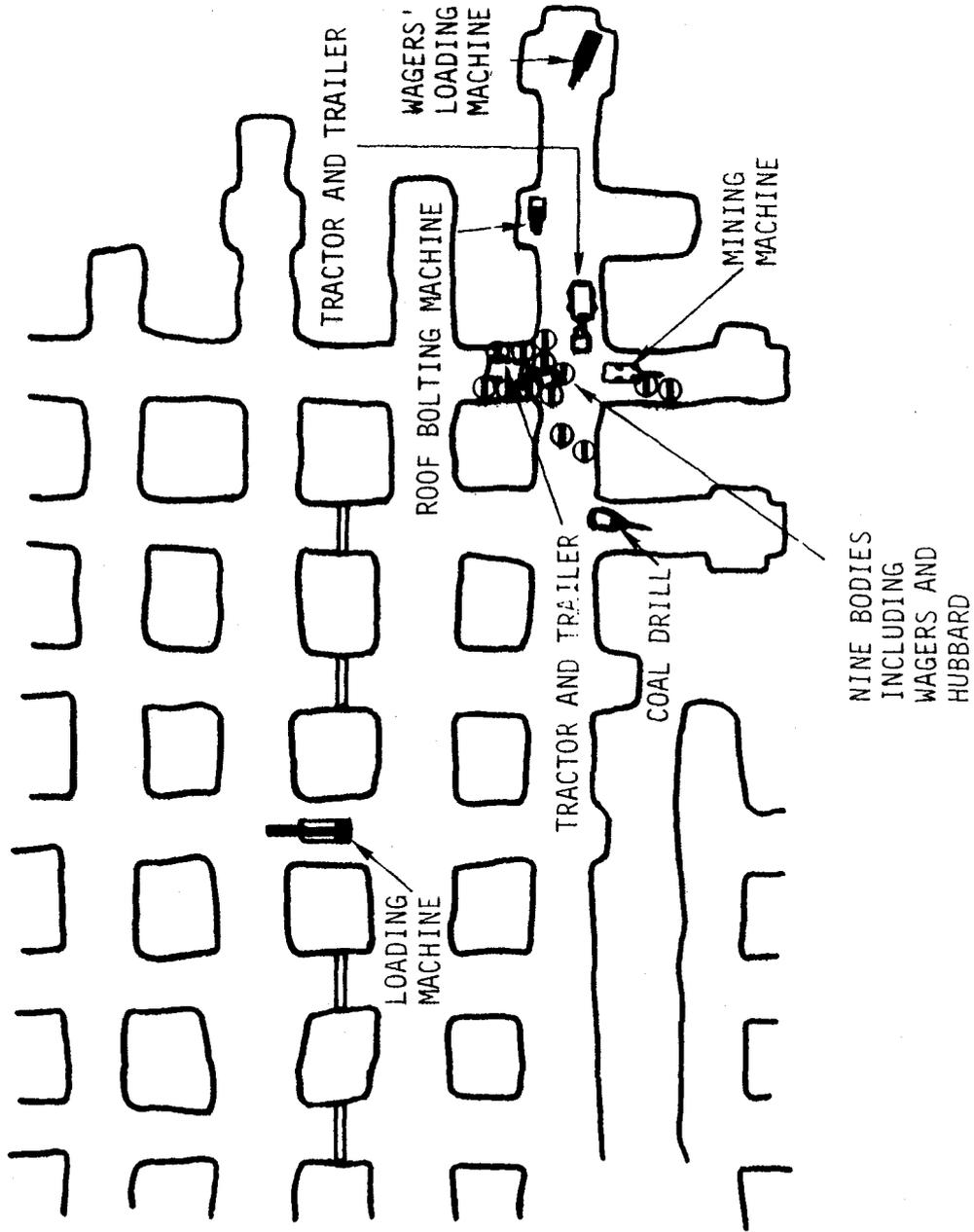


FIGURE C-4. - Working places in Finley Coal Co. Mine No. 15, 30 December 1970.

the atmosphere to within 50 ft of the face might have been almost as deadly. For Wagers and Hubbard to have a chance to survive, therefore, SCSRs would have to be worn or carried or have been at or near the loading machine. They had at least 1 and possibly up to 5 min before the face air could become irrespirable. In summary, had SCSRs been available:

- a. They had to be worn, carried or stored in a readily accessible location to be used by four miners.
- b. They had to be worn or carried for two miners to have had any chance to use them.

C.3 Fires

Table C-1 shows the average number of underground coal mine fires per year before and after 1970.

This table produces two clear conclusions:

- a. The average number of fires per year has declined dramatically
- b. The *location* of fires has changed dramatically; whereas the major location *used to be* the working section, it is now the belt-trolley entry.

TABLE C-1. - Average number of fires per year in underground coal mines

Description	1 July 1952 to <u>31 December 1969</u> (fires/year)	1 January 1972 to <u>31 December 1978</u> (fires/year)
	Section	27
Entry (belt-trolley)	15	5
Gob	3	2-1/2
Other	<u>2</u>	<u>1</u>
Total	47	10-1/2

Despite these improvements, the number of persons killed or injured in mine fires has not declined. In the 5-year period, 1972 to 1976, 12 miners died and 9 were injured. For the period 1962 to 1966, fires caused 10 deaths and 4 injuries.

All deaths resulted from asphyxiation by products of combustion. All injuries were from smoke inhalation. Temperatures produced by a fire had little impact except to those attempting to control the fire; air temperatures downwind of a fire decrease exponentially with distance (C-11, C-15).

Numerous studies and mine fire research indicate persons downwind in the fire-contaminated split of air will become incapacitated in the minutes given below for the following, fully-developed types of coal mine fires (C-4, C-11, C-18).

<u>Type of Fire</u>	<u>Incapacitation (min)*</u>
Belt conveyor	20
Coal on conveyor	20 to 60
Coal ribs and roof	15
Shuttle car tires	10
Compressor	10
Continuous miner	6

The above-listed times indicate a miner has at least 6 min to reach an SCSR. Except for fire on a longwall face, a much greater time is probable in that seldom will the distance between the fire and a diluted split of air exceed 150 ft.

C.3.1 Pyro (29 September 1973) (C-9)

Background

Pyro Mine No. 2, Sullivan, KY, is in the Kentucky No. 9 seam which locally ranges from 50 to 56 in. in thickness. B. Clayton, age 51, a belt cleaner, died in this fire. Initially, the fire involved trailing cable on a cutting machine; the fire quickly

*Incapacitation can occur when fire products cause disorientation, dizziness, dimness of vision, nausea and vomiting, if not collapse. Considering the probable stress and the rapid movement of a miner trying to escape from a fire, FMA fire experts consider a 15 percent saturation of hemoglobin with carbon monoxide has the potential for incapacitating most miners. The relationship between carbon monoxide concentration and time to achieve 15 percent COHgb is shown in Figure C-5.

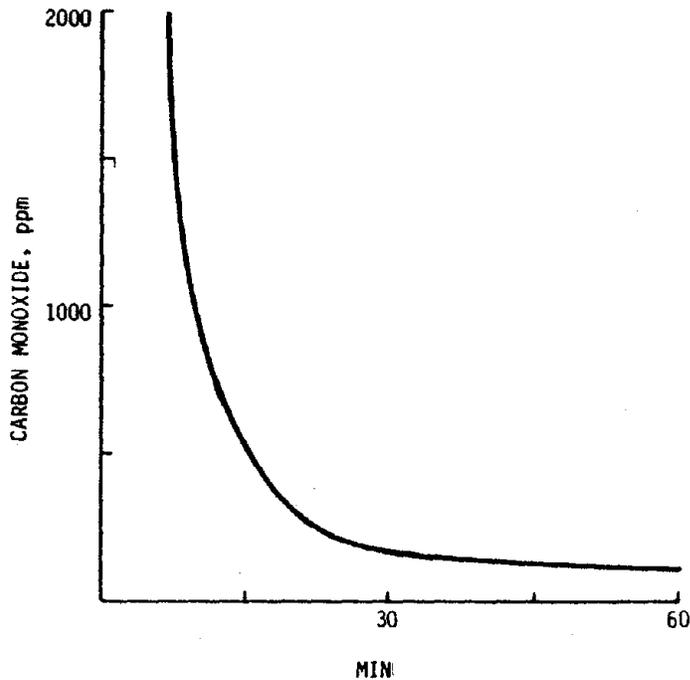


FIGURE C-5. - Potential incapacitation of the average miner by carbon monoxide.

spread to grease and oil on the machine and then to the coal ribs, roof and accumulations. The other 51 persons in the mine escaped via intake escapeways without incident and without the need for SCSRs.

The fire began at the face of Room 30 (Figure C-6) in the No. 1 entry of 8 East. Dense smoke forced the crew to leave the area 10 to 30 min after the fire began. Miners in No. 1 South were notified of the fire almost 3 hr later.

Mr. Clayton left the crew in Room 30 10 min before the fire started. He had been instructed by the section foreman to clean the belt tailpiece. Recovery teams found evidence near the tailpiece indicating Mr. Clayton had spent at least 15 min shoveling coal accumulations around the tailpiece onto the belt. Mr. Clayton's body was found in the belt entry near Crosscut No. 32, 500 ft upwind from the tailpiece. The FSR strap was around his neck.

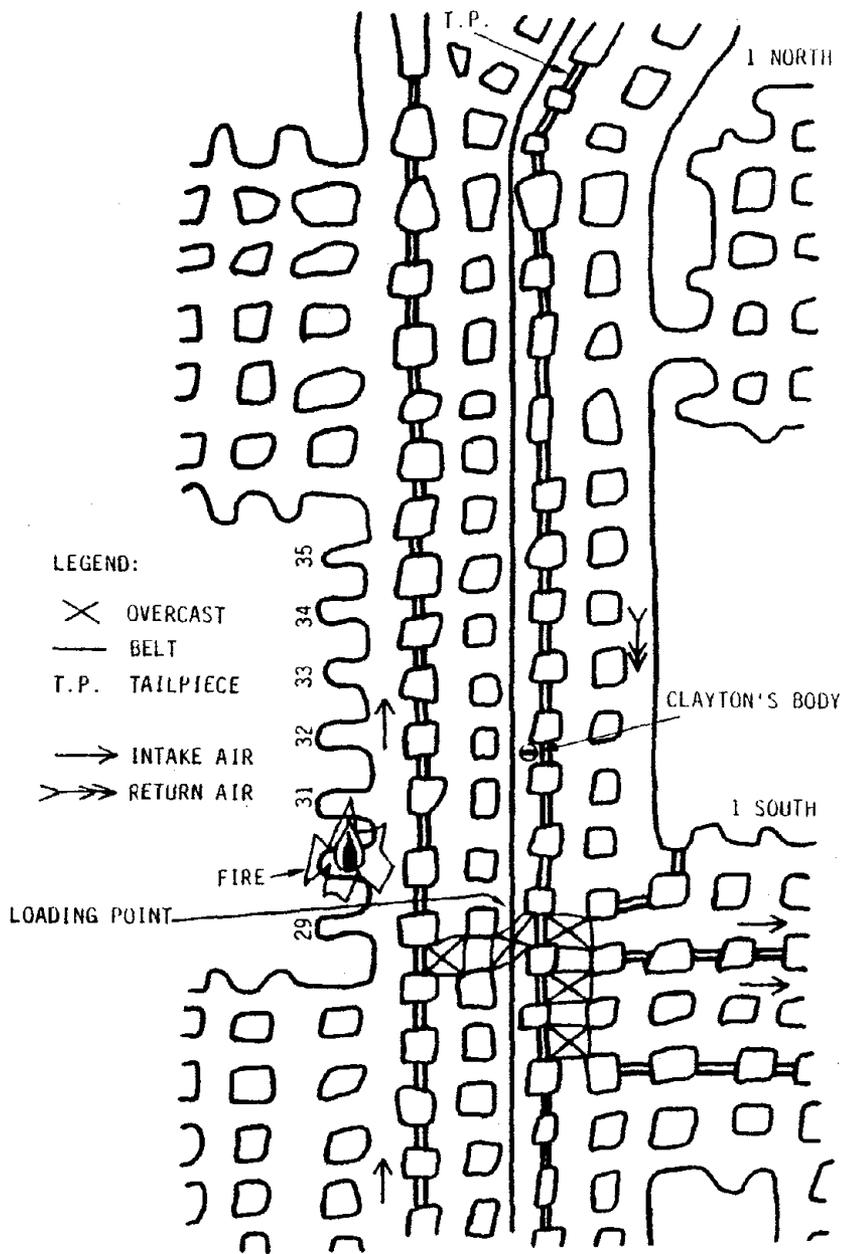


FIGURE C-6. - Pyro Mine No. 2, Pyro Mining Company, Sullivan, Union County, KY, 29 September 1973.

The following scenario provides a plausible, albeit unsupported, account of Mr. Clayton's actions. Smoke from the fire in Room 30 should have reached the tailpiece in 20 to 30 min (less if stoppings between the intake and belt entries were "leaky"). When the smoke came, Mr. Clayton would try to go to the intake entry through the door in a nearby stopping; however, he would observe dense smoke in the intake. Thereupon he probably assumed the fire was near Room 30 and decided the best escape route would be through a door near Crosscut 27, 800 ft away. For a man of his reputed health and for the physical conditions in the belt entry, he could have traveled 800 ft in less than 10 min. Mr. Clayton had an FSR and had not received burns; therefore, the probable cause of death was either insufficient oxygen or carbon monoxide poisoning as a result of his removing an FSR that provided air too hot to breathe.

After the No. 30 face crew reached safety, the section foreman and shuttle-car operator attempted to return to the fire area. Engulfed in dense smoke, they were forced to retreat.

Possible Use of SCSRs

Might SCSRs, had they been available, have saved Mr. Clayton? Yes. He was the belt cleaner; therefore, he had unquestionable knowledge of the belt entry and locations of doors. His body was found within 300 ft of safety. In all probability he was using an FSR and was making a best-effort attempt to reach safety.

From the scenario postulated above, it is obvious Mr. Clayton needed an SCSR to escape. To be available, the SCSR could have been worn, carried, within 25 ft, or stored in a cache near the tailpiece. SCSRs stored near doors in stoppings might have been reached. Whether he could or would remove one from such storage, however, is questionable, because he did not go through those doors.

Without SCSRs, the lives of the section foreman and shuttle-car operator were jeopardized. They were engulfed in dense smoke; they were fortunate the atmosphere outby the smoke as well as in the smoke was not irrespirable. Fortunately, falling roof in the fire area did not drive smoke and irrespirable atmosphere upwind into their escape route.

Without SCSRs, the lives of the 11-man crew in No. 1 South might have been jeopardized. These miners were unaware of the fire for 3 hr. Their working area was on a separate split of air. Fortunately, the spreading fire did not destroy the ventilation controls for that separate split. Also fortunately, the fire did not ignite methane, coal dust or volatiles, all of which were present in sufficient quantities to cause explosion.

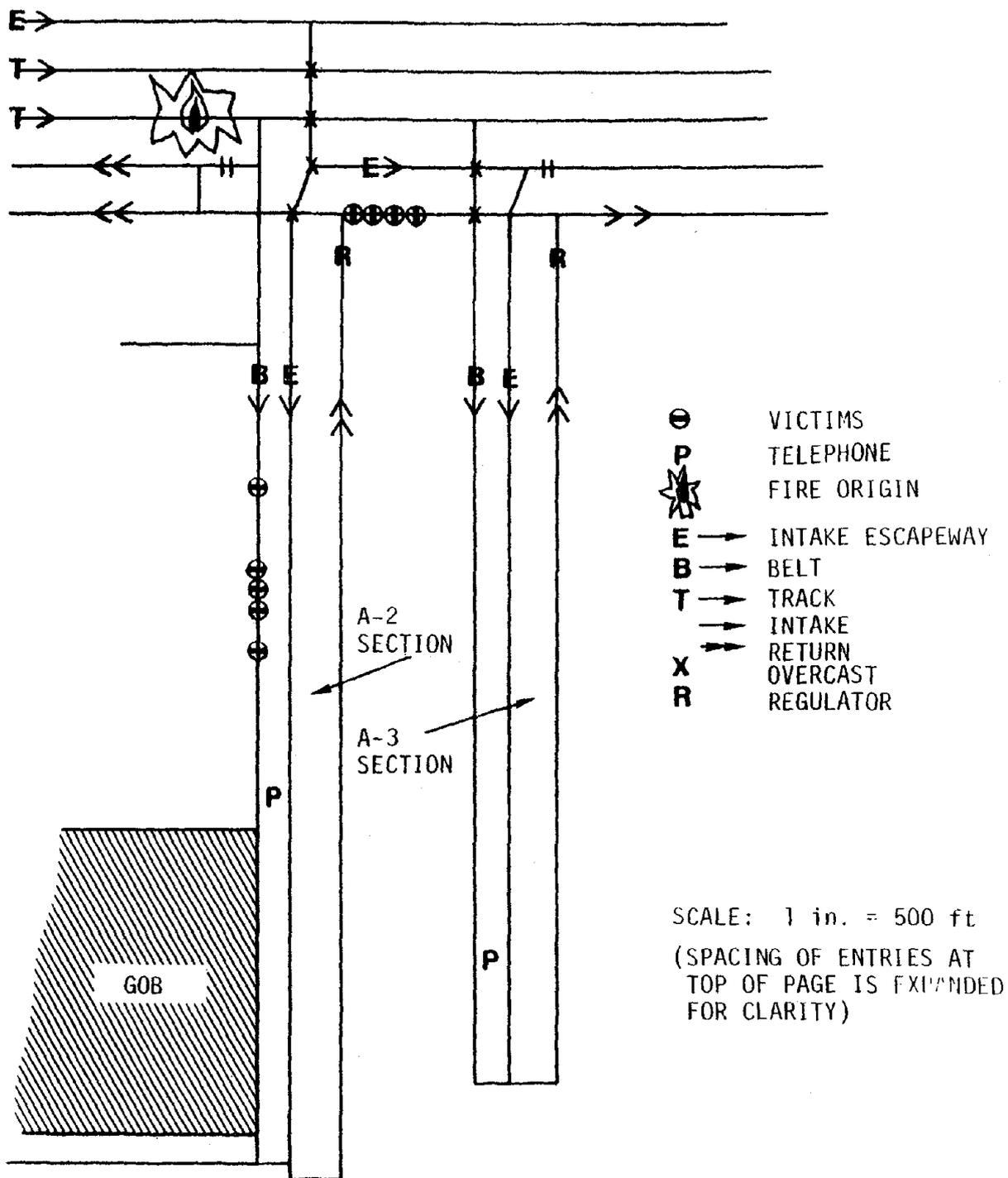


FIGURE C-7. - Blacksville No. 1 fire area.

In summary, had SCSRs been available:

- a. Mr. Clayton had a good chance to escape.
- b. The lives of 13 other miners would not have been jeopardized.
- c. The location of SCSRs would have been important, but not critical.

C.3.2 Blacksville No. 1 (22 July 1972) (C-20)

Background

Blacksville No. 1, Blacksville, WV, is in the Pittsburgh seam which locally is 70 and more inches in thickness. A foreman and eight miners died in this fire. At about 7:30 p.m., a continuous mining machine being transported on an equipment carrier along the 3 North Main track haulageway (Figure C-7) contacted the energized trolley and/or trolley feeder wires. Arcs from the resulting short-circuit ignited oil and other combustible materials on the miner or carrier. After many minutes, the roof and ribs in the area ignited.

The foreman and four miners, in Section A-2, were notified of the fire by telephone about 8 p.m. Reportedly, no smoke was in their work area. Fifteen minutes later the foreman telephoned that smoke was on the section. The telephone was near the belt tailpiece, 2200 ft downwind from the fire.

The bodies of the foreman and four miners subsequently were found in the A-2 section belt entry 400 to 900 ft from the telephone, a 3 to 5 min walk under normal conditions. They had traveled towards the fire into increasing concentrations of products from combustion. The next entry over was the intake escapeway. Recovery teams found only one body with an FSR; indications were the miner had been wearing it at the time of death. Two lids from rescuer cannisters were found at the junction of the A-2 longwall. One might speculate from knowledge and experience that the possibility is all five miners in the A-2 section initially wore FSRs. Four may have discarded their rescuers because of the heat generated in FSRs by high carbon monoxide concentrations. The probable cause of death, therefore, was either from breathing products of combustion or insufficient oxygen or a combination thereof.

The four miners in Section A-3 were notified by telephone about an hour after the fire began. Reportedly, no smoke was in their working area at that time. The telephone was near the belt tailpiece 3600 ft downwind from the fire.

The four miners, after being notified, put on FSRs and went into the A-3 section return escapeway. They traveled down the section return into 2 North Main's return. They continued travel until they collapsed and died, 2700 ft from the A-3 section telephone -- a 15-min walk under normal conditions. Rescue teams found the miners still wearing FSRs. One had an unused spare inside his shirt. The probable cause of death, therefore, was insufficient oxygen.

Possible Use of SCSRs

Might SCSRs, had they been available, have saved lives? Yes; it is obvious means to provide oxygen and to reduce the oxides of carbon which were essential to the escape of the nine miners from the A-2 and A-3 sections.

Could they have depended on stored SCSRs? Yes; SCSRs stored almost anywhere in the section outby the longwall would have been available. However, this disaster also shows the criticality of good planning, training and education in the use of SCSRs and evacuation.

C.3.3 Nemaocolin (26 March 1971) (C-21)

Background

Nemaocolin Mine, Nemaocolin, PA, is in the Pittsburgh seam which locally averages 84 in. in thickness. Two miners died in this fire; nine escaped.

The fire is believed to have been ignited when a trolley wire hanger grounded and generated heat causing the trolley wire to fall onto the mine floor striking the negative ground clamp on a track-mounted rotary compressor. Coal on the roof aided by ignition of the ribs caused the fire to propagate and eventually extend almost 2000 ft upwind of the source.

Activities during the first 30 min of this fire are detailed. They are quite typical of those in many other mine-fire incidents; and, in the opinion of this writer, represent to-be-expected activities in the future. Figure C-8 shows the section, the observed extent of smoke by the time the crew left the section, and other key locations and events.

Shortly after 10 a.m., air pressure to the stoper drill in Room No. 5 was lost. To ascertain the cause, the drill operator followed the air line, looking for a break. He travelled 400 ft in "O" crosscut to the No. 2 entry where, after opening the check

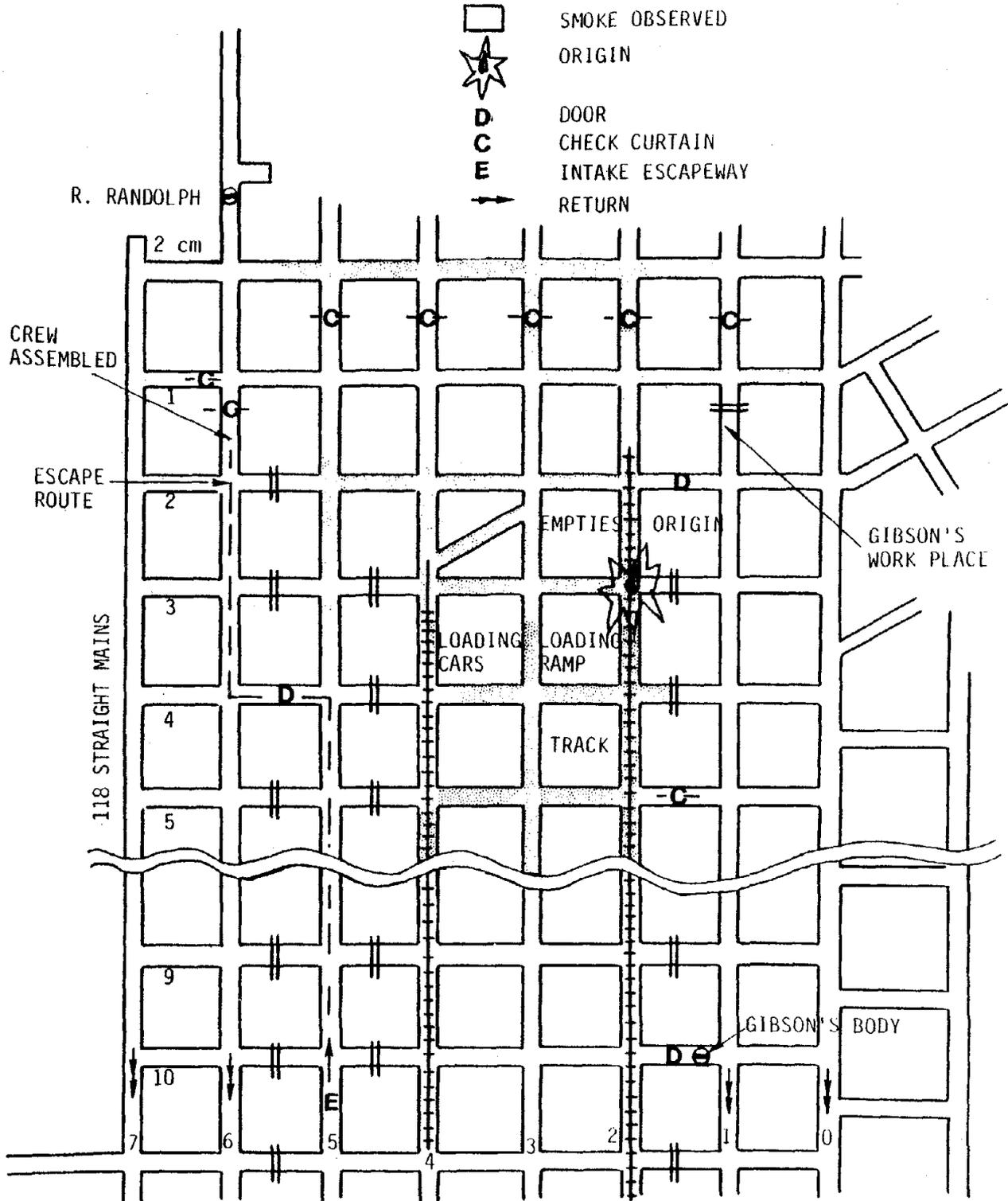


FIGURE C-8. - Nemacolin Mine fire area.

curtain, he saw dense yellow smoke. He then found the section foreman in Room No. 6, 500 ft from No. 2 entry. Together, they began to search for the cause. After another 700 ft they met the shuttle-car operator who was looking across No. 4 entry at dense smoke in No. 3 entry.

The foreman instructed the drill and shuttle car operators to notify the rest of the crew to leave the section. The foreman then continued to search for the cause of the smoke. The smoke got denser and was rolling back against the ventilating air current. This forced the foreman to crawl almost 1200 ft to the mouth of the section where he telephoned for assistance.

Meanwhile, nine members of the crew assembled in No. 6 entry, between crosscuts 1 and 2. Two of the crew decided to go back to their working places for their flame safety lamps. The one who went to the face of No. 7 entry returned. Richard Randolph, age 63, who went to the roof bolting machine in No. 6 room, did not. He subsequently was found near the machine.

When Randolph did not return, one of the crew went to the junction of Room No. 6 and "O" crosscut. He called "Randolph" but received no answer; observing dense smoke coming towards him he returned to the others. The remaining eight miners proceeded through the No. 6 return airway to No. 4 crosscut and thence continued out through No. 5 entry, the intake escapeway.

The eleventh member of the crew, Charles Gibson, Sr., age 64, had been constructing a stopping in No. 1 entry between crosscuts 1 and 2. His body subsequently was found near the door in the stopping of No. 10 crosscut between the No. 1 and 2 entries.

No one knows what Mr. Gibson did. It may be surmised, however, that he should have been aware of smoke about the same time, if not before, the stoper drill operator saw smoke in No. 2 entry. That is, for the ventilation system in this section, smoke and fumes from the fire should preferentially leak through the check curtain in No. 1 crosscut and the door in the No. 2 crosscut stopping. The stopping he was building would prevent his going to the other members of the crew through the No. 1 and "O" crosscuts. Smoke in No. 3 entry would prevent his going to the fresh air side through the No. 2 crosscut door. Probably by the time he reached the check curtain in No. 5 crosscut there was so much smoke in No. 3 entry he decided to continue to the next door, where he died.

None of the miners had an FSR. This fire occurred on 26 March 1971, 5 days before the regulations for their use (30 CFR 75.1714) became effective. The practice at this mine was to store FSRs on locomotives, and sometimes at the loading point. During this fire no locomotives were in the section and the loading point was engulfed in smoke.

Possible Use of SCSRs

Might SCSRs, had they been available, have saved lives? No one knows whether lack of oxygen or breathing products of combustion was the probable cause for the two deaths.

Mr. Randolph did not respond to the miner who called to him from 100 ft away in the same air flow. Mr. Randolph was 63 years old; the other miner was 52. Mr. Randolph was reputed to be a strong, active man with an excellent work and attendance record.

Mr. Gibson was 64 years old; and, reportedly, he was neither as strong nor as active as Mr. Randolph. He travelled at least 1000 ft farther than did Mr. Randolph before collapse; thus, he was in the fire-produced atmosphere for at least 5 min more. Additionally, for the ventilation system in the section it is reasonable to expect Mr. Gibson to have been exposed to higher concentrations of fire products for a longer period of time.

From the above, and considering Room No. 6 was for all practical purposes dead-ended, it is plausible to assume that if Mr. Gibson's death was mainly from breathing products of combustion then Mr. Randolph's death may be attributed to insufficient oxygen as well as toxic products. For those assumptions, Mr. Randolph needed an SCSR for escape. Mr. Gibson needed a self-rescuer; whether an FSR would have been adequate is not known.

Could they depend on stored self-rescuers? That depended on where the rescuers were. Mr. Gibson could have obtained one stored in his work place only. Mr. Randolph could have obtained one stored on the roof bolter he had been operating or near the crew assembly point in the return airway. Units at the loading point or dinner hole were not accessible.

Reviewing the activities of the section foreman it is obvious his life was jeopardized. He should have had an FSR. Had SCSRs been available, he could have obtained one stored near the mouth of the intake escapeway. He might, but exposed to great danger, have obtained one stored near the loading ramp or dinner hole.

The lives of the other members of the crew were jeopardized. A fall of roof or more rapid flaming, for example, could cause smoke to engulf their assembly point and initial escape route.

In summary, had SCSRs been available:

- a. Mr. Randolph and Mr. Gibson had a good chance to escape.
- b. The lives of the other nine miners might not have been jeopardized.

C.4 Conclusions

Explosions in the Scotia, Itmann No. 3 and Finley Nos. 15 and 16 Mines and fires in the Pyro No. 2, Blacksville No. 1 and Nemacolin Mines were studied. The potential of SCSRs with respect to their storage location is shown in Table C-2.

The potential for SCSRs in those incidents is summarized in Table C-3. It includes persons whose lives were jeopardized either while using FSRs or attempting rescue or escape without a rescuer. "Jeopardized" is based on the chance these persons could have been overcome by an oxygen deficiency or a major increase in extent and quantity of toxic products had there been a secondary explosion, a more rapid development of fire or a major fall of roof.

TABLE C-2. - Potential lives saved depending on SCSR location

Mine	Worn or carried	On equipment	Escapeway	Dinner hole	Other
Scotia	8	8	8	8	8
Itmann	5	0	5	5	5
Finley	6	4	0	0	0
Pyro	1	0	0	0	1
Blacksville	9	9	9	9	9
Nemacolin	2	2	1	0	0
Total	31	23	23	22	23

TABLE C-3. - Summary of incidents and potential SCSRs used

Mine	Number of persons involved	Number of potential SCSRs used	Number of fatalities
Scotia	20	13	15
Itmann	12	6	5
Finley	38	6	38
Pyro	22	22	1
Blacksville	15	15	9
Nemacolin	11	11	2
Total	118	73	70

The three mines fires bring to attention one of many matters of concern for persons involved in planning SCSR storage. The victims attempted escape only after smelling smoke. Invisible but toxic products of combustion, however, are evolved by fire before smoke. The victims, therefore, had begun to suffer incapacitation before they realized their predicament. This illustrates that persons working away from the communications network may not receive timely notice of danger. The farther they must travel to obtain SCSRs, the less their chances to escape.

The fires and explosions discussed also illustrate the criticality of good training and education. Not only must miners know how to use SCSRs, they must also know when not to use them; that is, rescue following explosion or fire must be attempted only by trained, competent mine rescue personnel. With SCSRs, untrained persons might attempt rescue and cause a greater number of lives to be lost should products of combustion be ignited as a result.

C.5 References

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APPENDIX D

VIBRATION TESTING OF SCSRs

How will this SCSR hold up in the mine environment - especially if it is stored on moving machinery?

This question was one of the five most commonly asked during discussions of the SCSR. To answer this question, three areas were investigated:

- a. NIOSH/MSHA vibration testing
- b. Other vibration test procedures
- c. Vibration levels of mining machinery.

D.1 Current NIOSH/MSHA Vibration Testing

The current vibration test requirements were originally established to provide a standard for filter-type self-rescuers (D-1). Inspection of a used FSR, which had been stored on a mining machine for 1 year, revealed that the hopcalite bed had shifted in such a way that air could pass through the device without going through the hopcalite - thus rendering the self-rescuer useless. Laboratory testing of new self-rescuers showed that the failure could be duplicated in the laboratory after 40 hr of vibration on a Rotap sieve shaker.

D.1.1 Description of Test Procedure

The Rotap machine is a testing sieve shaker, designed to be used with sieves of various wire mesh sizes, to separate different size stones and gravel into specific groups (D-2).

As shown schematically in Figure D-1, the object to be tested is placed in a frame that is "vibrated" as follows:

- a. *Oscillating* motion - One end of the frame (position A) is driven by an eccentric cam turning at 285 rpm (4.75 Hz).
- b. *Reciprocating* motion - The other end of the frame (position B) is constrained to move back and forth in a straight line, at the same rate of 4.75 Hz.

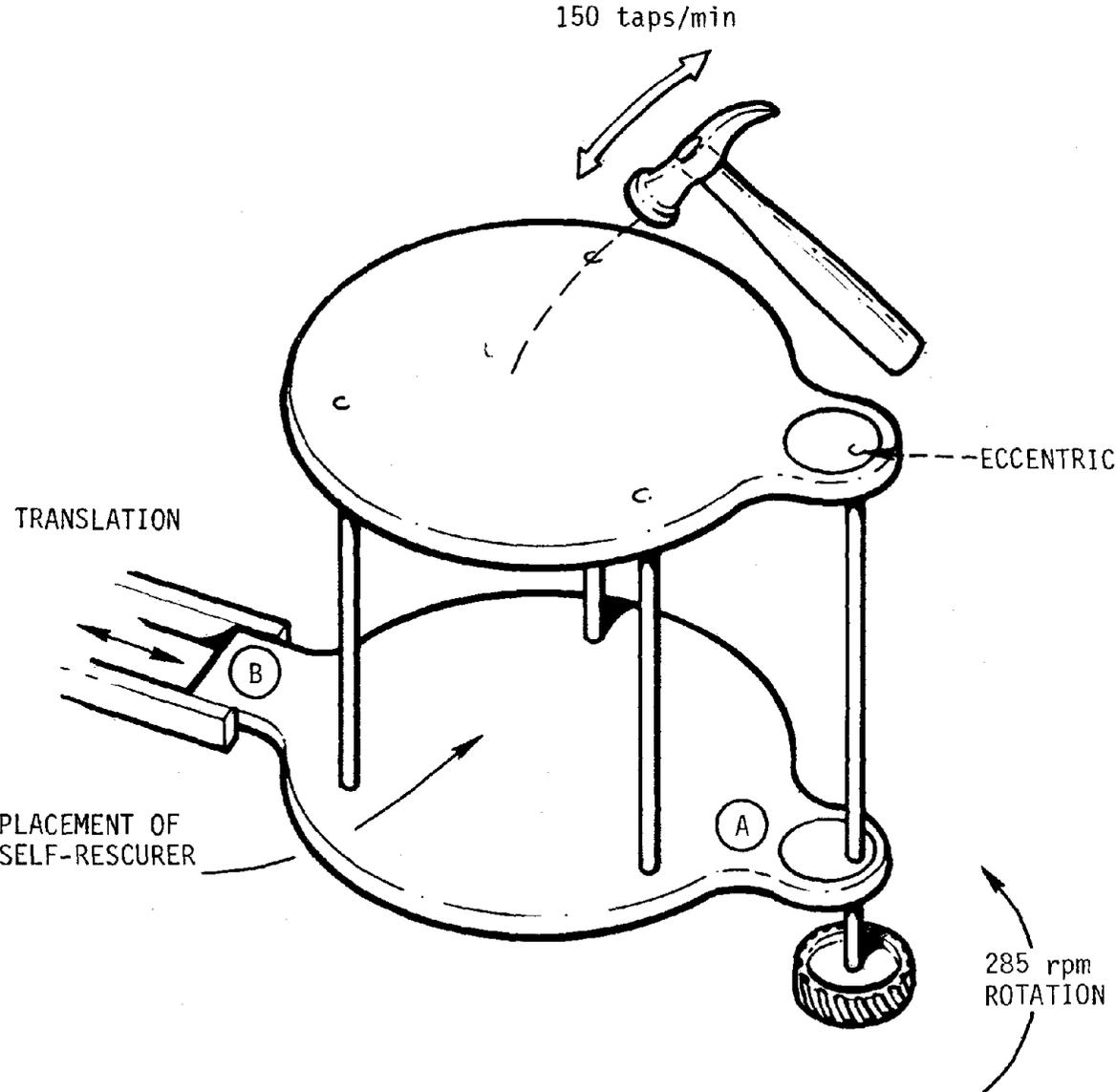


FIGURE D-1. - Schematic representation of Rotap tester.

- c. *Impact loading* - Simultaneously, a mechanically-driven hammer (weight 5.63 lb; height of fall adjustable; recommended 1-5/16 in.) bangs on the top of the frame at a rate of 150 taps/min (2.5 Hz).
- d. *Total Test Time* - The current NIOSH/MSHA testing requires that the SCSR be mounted in the Rotap machine in each of three different orientations (axes) and vibrated for 14-2/3 hr in each position for a total of 44 hr.

D.1.2 Analysis of Test Procedure

Operation of the Rotap machine causes an acceleration, or "g-force," to be applied to the test specimen. The magnitude of this force can be calculated, and it can also be measured.

- a. *Calculated* - At position B in Figure D-1, the motion of the tester can be described as:

$$S = A \sin \omega t \quad (D-1)$$

where

$$A = \text{radius of motion} = .625 \text{ in.}$$

$$\omega = 2 \cdot \pi \cdot \text{frequency} = 2 \cdot \pi \cdot 4.75 \text{ Hz}$$

Differentiating equation D-2 twice gives the acceleration:

$$\ddot{S} = -A\omega^2 \sin(\omega t) \quad (D-2)$$

or,

$$\text{peak acceleration} = A\omega^2 \quad (D-3)$$

$$\begin{aligned} \text{rms acceleration} &= 0.7A\omega^2 \\ &= 33 \text{ ft/sec}^2 \text{ or about } 1g \end{aligned} \quad (D-4)$$

Thus, the rms acceleration along the Y-axis at position B is about 1g. At position B there is no motion along the Y-axis, so the acceleration is 0.

Near position A, the tester moves the full 5/8 in. in both axes, so the acceleration in both X and Y axes is about 1g.

Acceleration in the Z axis is caused by the hammer blows. This is an impact loading, so both the peak and the rms acceleration levels would depend on the characteristics of the surface that the hammer hits, and how tightly the test specimen is clamped into the frame.

- b. *Measured* - During USBM-sponsored development of the SCSRs, the contractors instrumented the Rotap machine in order to measure acceleration levels in all three axes (D-3, D-4). Results of these tests are shown in Table D-1, together with the calculated results for comparison. There are several reasons for the differences in the numbers presented:
1. The hammer blows impart high instantaneous loads, not steady-state vibration. This makes it hard either to measure or calculate.

TABLE D-1. - Acceleration levels, three axes

Axis	Acceleration (g-rms)	
	Calculated	Measured (D-4)
X	1.0	0.825 - 1.37 1.37 - 2.06*
Y	0 - 1.0	0.55 - 0.685 0.685 - 0.825*
Z	N/A	0.355 - 0.494 0.82 - 6.0*

*Hammer operating.
Z = Axis of hammer.

2. Measured (and calculated) accelerations vary depending on where they are measured because the movement of the frame is different at different locations (that is, position A versus position B).
3. Measured accelerations were found to vary significantly depending upon how tightly the SCSR was attached to the test frame.

D.2 Other Vibration Test Procedures

D.2.1 MIL SPEC 810-C

The most common vibration test in use today is MIL SPEC Standard 810-C. This test is performed on a "shake table" that vibrates uniaxially at variable frequencies and amplitudes that are set by the operator depending upon prescribed test conditions (D-5). As shown in Table D-2, the frequency ranges and lengths of tests are different for different applications, such as for equipment carried on wheeled vehicles and tracked vehicles. The main differences between the NIOSH test and the MIL SPEC 810-C may be summarized as follows:

	NIOSH TEST	MIL SPEC 810-C
Frequency:	fixed 4.25 Hz on 2 axes fixed 2.5 Hz on 3 axes	variable 2-500 Hz one axis only
Amplitude:	lg rms on X axis 0-1g rms on Y axis impact loading on Z axis	√3g rms at frequencies above 50 Hz
Time*:	44 hr total (14-2/3 each axis)	16-1/2 hr total (5-1/2 each axis)
Special Features:	test machine especially designed for shaking of particle beds such as those in filter and in oxygen SCSRs	standardized test for vibration widely used throughout United States

*Note that although NIOSH test is longer in *time*, MIL SPEC test subjects the specimen to more *cycles* of testing.

TABLE D-2. - Frequency ranges, lengths of test for different applications

Vehicle type	Sweep frequency range (Hz)	Acceleration (g-RMS) *	Sweep time (min)	Total time/axis
Tracked	2.0 - 5.5	0.141 - 1.06	9	30 min/1000 mi vehicle use up to a 3-hr maximum
	5.5 - 30	1.06		
	30.0 - 50	1.06 - 2.96		
	50 - 500	2.96		
Wheeled	2.0 - 5.5	0.141 - 1.06	7.5	30 min/1000 mi vehicle use up to a 5.5 hr-maximum
	5.5 - 200	1.06		

*Values shown are converted to rms from peak values given in MIL STD 810-C.

D.2.2 European Procedures

The Mines Safety and Health Commission (Commission of the European Communities) has drafted specifications and testing procedures for chemical oxygen SCSRs (D-6), which are discussed more fully in Appendix B. The recommended approval procedures having to do with vibration and impact resistance can be summarized as follows:

- a. A "drop test" - A self-rescuer is allowed to fall freely from a height of 1.5m onto a concrete floor. The test is done three times on the same unit so as to stress the impact-sensitive parts of the self-rescuer.
- b. An "in-service" test - Units should be "in use" underground every working day for at least 3 months; 80 percent installed on trackless diesel vehicles and the rest "carried underground." At the end of the trial period, 60 percent of the units are laboratory-tested and 40 percent mantested.
- c. Each country can impose any additional test procedures which may be deemed necessary.

It is interesting to note that for FSRs, some specific vibration tests are required (D-7):

- a. Germany submits FSRs to 50,000 impacts in a vibrator
- b. In Britain, FSRs are tumbled in a cement mixer; however, the Mines Safety and Health Commission states it is desirable to develop - on a European basis - a test that would more closely simulate the conditions the rescuers are exposed to during their daily carrying underground (D-7).

D.3 Vibration Levels of Mining Machinery

A literature search was conducted to determine what data were available concerning vibration levels on modern mining equipment. Two recent reports sponsored by the USBM were found which were helpful (D-8, D-9). Figure D-2 shows data from individual pieces of mining equipment, as measured and reported

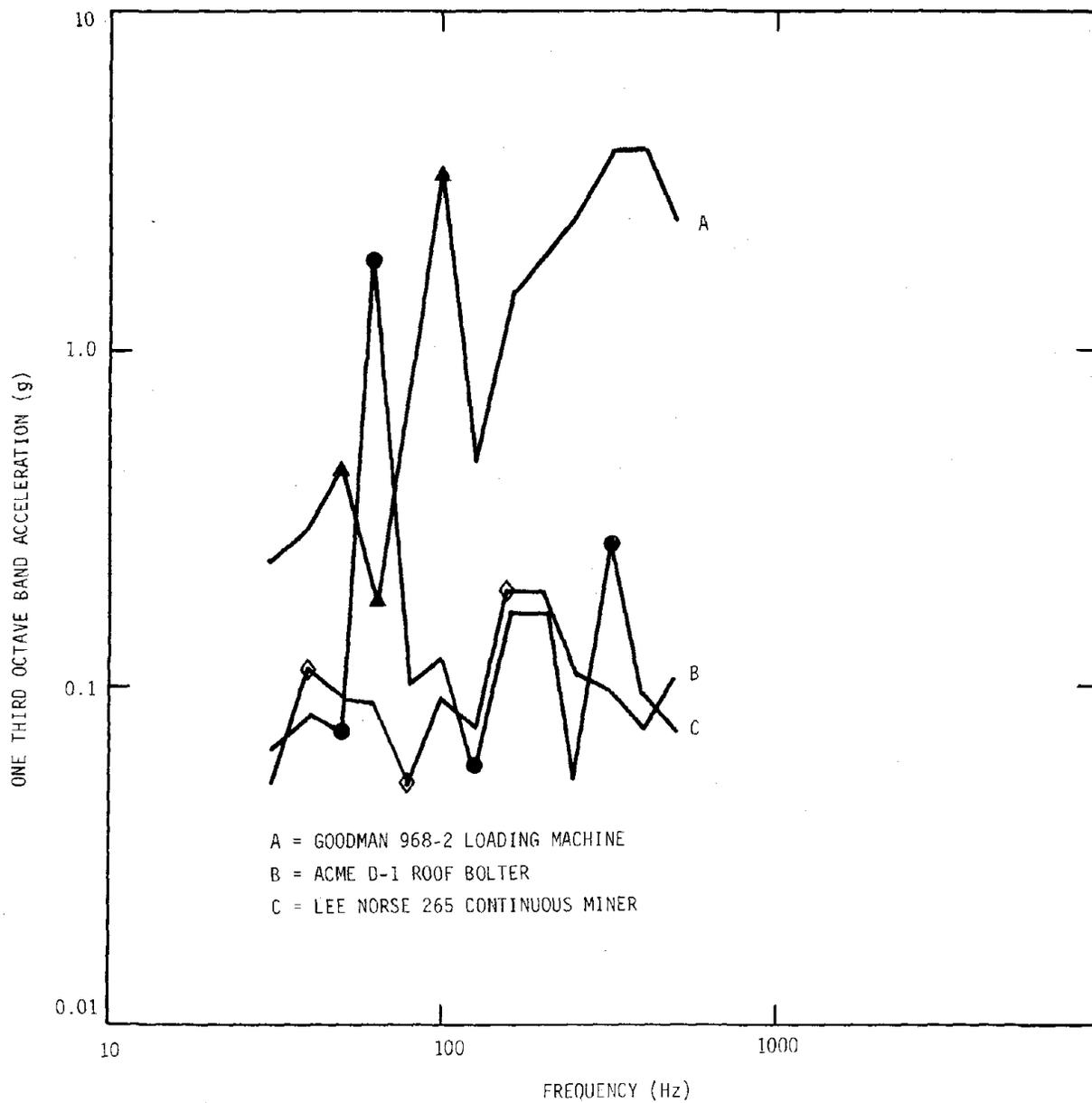


FIGURE D-2. - Vibration levels of mining machinery measured by Donaldson Corporation.

by the Donaldson Corp. The major conclusion from this information is that vibration levels vary widely, with peak levels of about 4g at higher (500 Hz) frequencies.

Because SCSRs might be stored on virtually any piece of mining equipment, "worst cases" must be considered. Figure D-3 shows the results of data and analysis performed by Bolt, Beranek & Newman (BB&N). The data points represent the highest measured levels of the 160 pieces of mining equipment which were measured. Applying statistical theory to the measured data, BB&N concluded that 99.9 percent of all mining machinery would have vibration characteristics equal to or less than the curve of Figure D-3. It is therefore assumed that SCSRs might be subjected to vibrational stresses as high as those shown in Figure D-3.

D.4 Conclusions and Recommendations

The capability of SCSRs to withstand vibration has been investigated by comparing three different standards:

- a. Current NIOSH/MSHA vibration testing
- b. Other vibration test methods
- c. Measured vibration levels on mining equipment.

A summary of this comparison is shown graphically in Figure D-4. The following conclusions may be drawn from this comparison:

- a. Conclusions:
 1. The NIOSH/MSHA is a highly specialized test - best suited for analyzing the movement of packed beds contained by screens.
 2. The NIOSH/MSHA test has two motions: one is a fixed amplitude, fixed frequency oscillation and the other is an impact loading which is not quantifiable.
 3. The frequency-amplitude range of MIL SPEC 810-C vibration testing seems to correspond well with data available on the actual vibration levels of underground mining equipment.

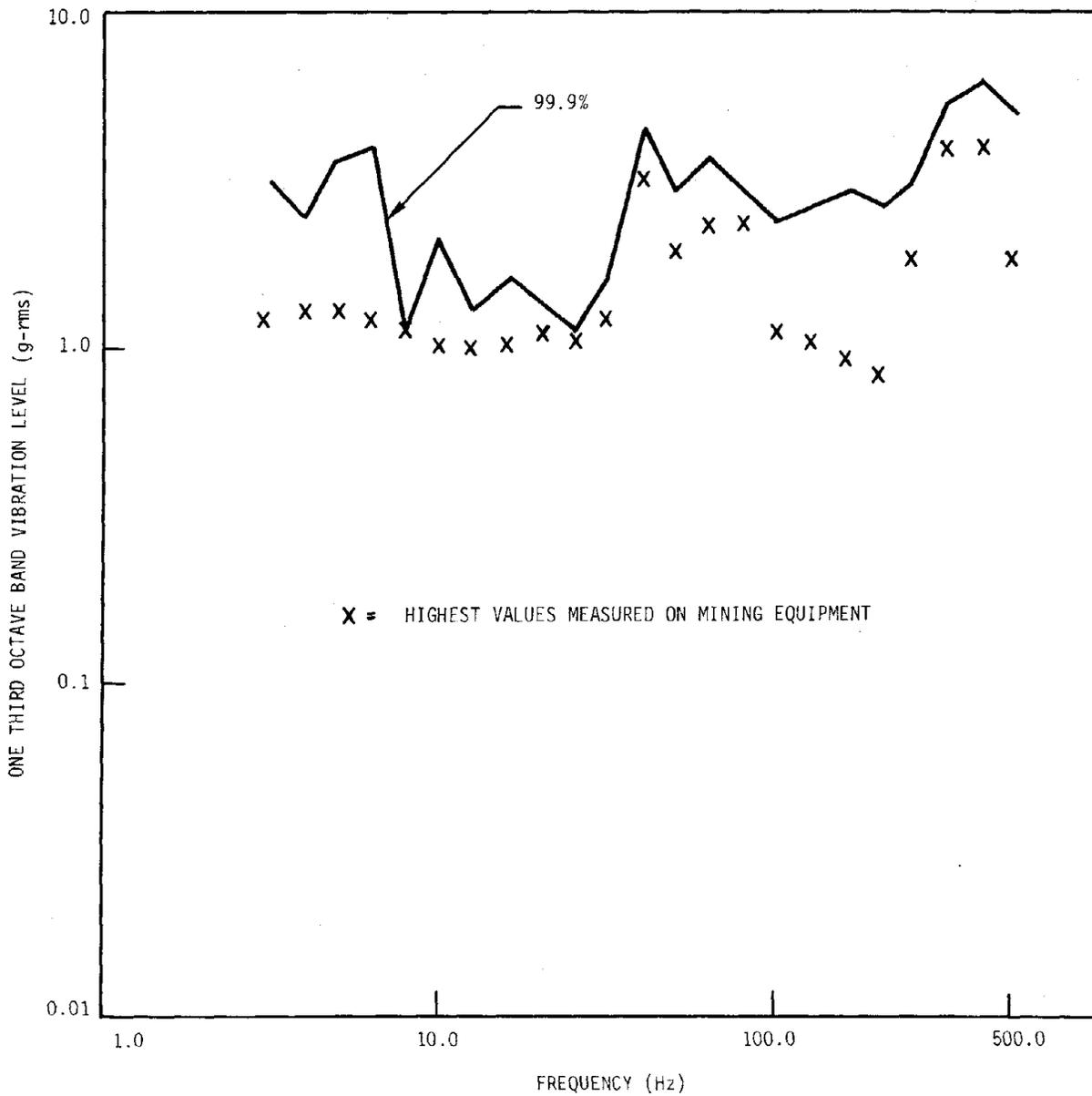


FIGURE D-3. - Vibration levels of mining machinery measured by Bolt, Beranek & Newman.

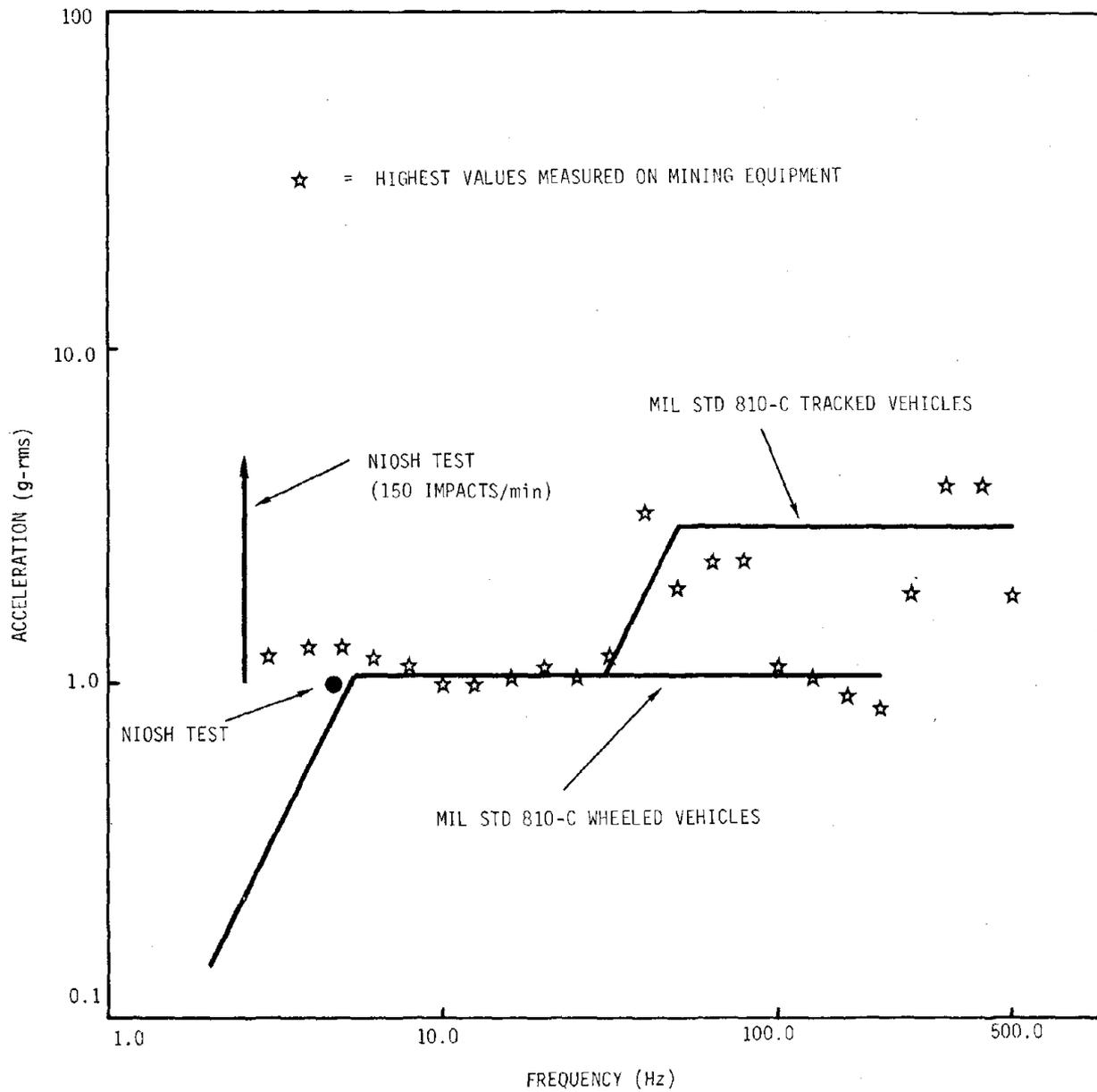


FIGURE D-4. - Comparison summary of SCSR vibration testing.

b. Recommendations

1. The Rotap machine used in the current NIOSH/MSHA test is a rugged test in a narrow frequency band.
2. A standardized vibration test such as MIL SPEC 810-C would more accurately represent actual vibration levels of underground equipment. Such a test might be better suited for testing mechanical assemblies in self-rescuers - especially units with moving parts such as valves, pressure vessels and regulators in SCSRs.
3. No matter what laboratory testing is conducted, perpetual field-testing is also recommended. In other words, self-rescuers should be placed in service on underground mining equipment and periodically changed out for examination and possible testing. It should be noted that it was this type of field-testing that first identified vibration-induced failures of early FSRs and led to the present vibration test standards. Such field testing is commended and similar future efforts - especially when new products are introduced - is most strongly recommended.

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APPENDIX E

TESTING OF IN-SERVICE CHEMICAL OXYGEN SCSRs

The critical element in chemical SCSRs is the chemical compound which produces oxygen and absorbs carbon dioxide. *The major goal of maintenance, inspection and/or testing of in-service units must be to ensure the integrity of the oxygen-producing chemical.*

E.1 Inspection of the Oxygen-Producing Chemical

At the present state of the technology, we know of no reliable method to easily determine the integrity of the potassium super-oxide. There are at least two methods which have some potential:

- a. *Color change* - It is reported that unreacted KO_2 is yellow in color and turns white when it has reacted. The difficulty in devising a test is that it is impossible to see, or visually examine, the KO_2 without disassembling the entire unit. Even then, it seems that each pellet of chemical would have to be pulverized in order to thoroughly examine it.
- b. *Weight change* - KO_2 is "consumed" by chemical reaction; therefore, there is some possibility that weight changes might occur. Weighing the entire self-rescuer might be a means of indirectly measuring the KO_2 . A cursory investigation of this area was not encouraging: it seems that KO_2 is subject to any number of different chemical reactions, some of which could cause weight gains and others potentially even weight losses. Although our initial assessment is pessimistic, *we recommend additional research and testing of weight change reactions.*

E.2 Inspection of the Airtight Seal

Because direct inspection of the KO_2 seemed impossible, all known testing procedures have been directed at assuring the integrity of the airtight seal which protects the KO_2 . Two major methods have been used to detect failure of the airtight seal:

- a. Humidity indicator
- b. Differential pressure.

E.2.1 Humidity Indicators

Humidity indicators are used in chemical SCSRs in order to indicate that moisture has penetrated the case and that the KO_2 may have been degraded. Typical indicators are small discs about the size of a dime, which turn from blue to red when exposed to humid air, which can have as low as 5 percent relative humidity for the most sensitive indicators.

For the SCSRs, the indicators are placed on the inside of the cover, where they are visible through a clear plastic window.

The great advantage of using humidity indicators is that they are readily visible - thus, the seal of the SCSR can be "inspected" easily and often.

The disadvantage of humidity indicators is that they are less sensitive to moisture than is KO_2 . As already mentioned, indicators require at least 5 percent relative humidity before starting to change colors, whereas KO_2 has a much stronger affinity for moisture: its equilibrium point is a fraction of 1 percent relative humidity. In other words, wherever KO_2 and the humidity indicator are exposed to the same moisture-laden air, the KO_2 may well "soak up" all the moisture, leaving the air so dry that the humidity indicator cannot change color. Whether or not this phenomenon occurs will probably depend on how fast moisture leaks in - i.e., whether or not the moisture leakage rate exceeds the rate at which the KO_2 can absorb it.

A typical example might best illustrate the problem. Assume that there is a leak of some sort in the outer case of an SCSR. If the leak is not too big, the KO_2 will absorb the moisture that leaks in, never allowing the relative humidity *inside* the case to get above the 5 percent necessary to make the humidity indicator change color. The question is: what is the maximum leakage rate which will not "trigger" the indicator?

In the best case, the KO_2 is further protected by containment inside the breathing bag system, through which moisture must permeate in order to reach the KO_2 . Laboratory data

indicate that this internal system has a permeation rate of 0.013g/day per 1 percent relative humidity differential at 25°C. Therefore:

- a. If KO₂ is protected by breathing bag system
- b. If relative humidity inside case is 5 percent or less

then:

- a. Indicator will *not* change color
- b. Moisture permeation into KO₂ can be as high as
 $0.013 \times 5 = 0.065\text{g/day}$.

It takes approximately 120g of water to completely react 1000g of KO₂, the approximate amount in 1-hr SCSRs. Thus, 12g of water will degrade 10 percent of the KO₂.

$$12\text{g}/0.065\text{g/day} = 184 \text{ days}$$

In other words, using the above assumptions, 10 percent of the KO₂ could be degraded in half of a year and the humidity indicator would not show a seal failure. Using the same assumptions, any moisture leakage rate which would degrade the KO₂ at a faster rate would "trigger" the indicator.

In summary, the humidity indicator is a good test for gross leaks, but should be "backed up" by a different test for smaller leaks to be conducted at appropriate intervals.

E.2.2 Differential Pressure Tests

A basic technique of leak detection is to create a differential pressure across the seal and either detect leakage flow or else loss of the differential pressure. This is the physical principle behind four state-of-the-art methods:

- a. Vacuum sealing plus vacuum gauge
- b. Raising internal pressure by dunking in warm water
- c. Lowering the pressure *outside* the seal and measuring the leakage *out of* the SCSR
- d. Pressurizing *outside* the seal and measuring leakage *into* the SCSR.

The theory behind vacuum sealing is that any leakage into the case will eliminate the vacuum. The loss of vacuum can then be detected by a vacuum gauge.

Dunking the SCSR in warm water will raise the internal pressure and expel air out of any leakage paths, thus producing a stream of bubbles in the warm water.

Lowering the pressure outside of the SCSR can be accomplished by placing the SCSR in a small chamber equipped with a vacuum pump. Leakage out of the SCSR case can then be detected by a change in the pressure inside the chamber. A tester of this nature was developed and sold by Auer for use with the SSR 16B, as described in Appendix B, subsection B.5.1.

Raising the pressure outside of the SCSR can be likewise accomplished by using a small pressure chamber. This type of test has been developed and marketed for use with the Russian SCSR Model WC-7M. This method of testing appears to be the most favorable in terms of simplicity and reliability, and is described in the following paragraphs.

An SCSR is placed in the test chamber, as shown in Figure E-1. This chamber is specially designed to closely fit the SCSR, so that there is little free air volume remaining once the SCSR is inside. The top of the chamber is first sealed, and then lowered a fixed distance. Lowering the top after it was sealed decreases the internal volume of the test chamber, thus raising the pressure in the test chamber. If the SCSR is airtight, this pressure increase will be predictable and repeatable. If, however, the SCSR leaks, some of the pressurized air in the chamber will flow into the SCSR - thus *decreasing* the pressure in the test chamber. The chamber pressure can therefore be monitored and used to detect leaking self-rescuers.

Laboratory experiments were conducted in order to quantify the behavior of the test chamber. In other words, how does the test chamber pressure vary as a function of:

- a. Size of leakage path (orifice diameter)
- b. Free volume inside SCSR.

The results of this testing are shown in Figure E-2. Not surprisingly, the test device is most sensitive when the leakage hole is bigger and the free volume inside the SCSR is greatest.

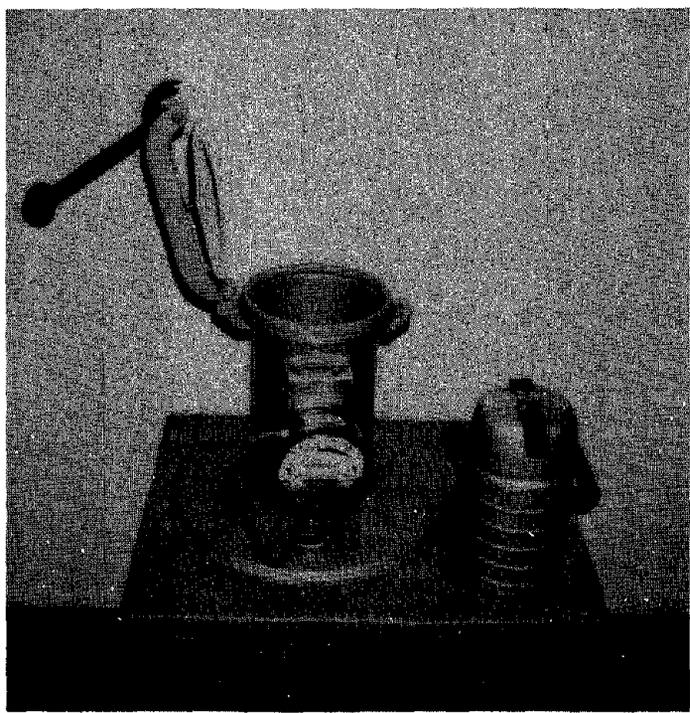
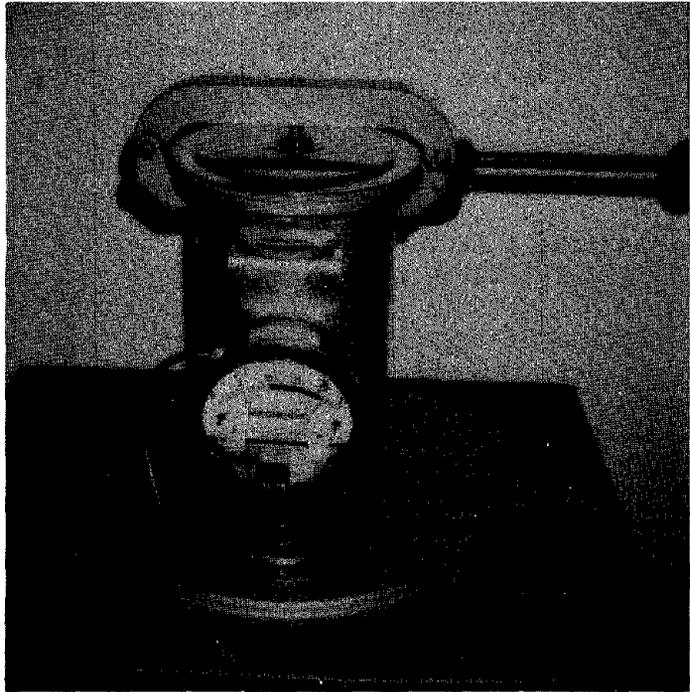


FIGURE E-1. - SCSR pressure tester.

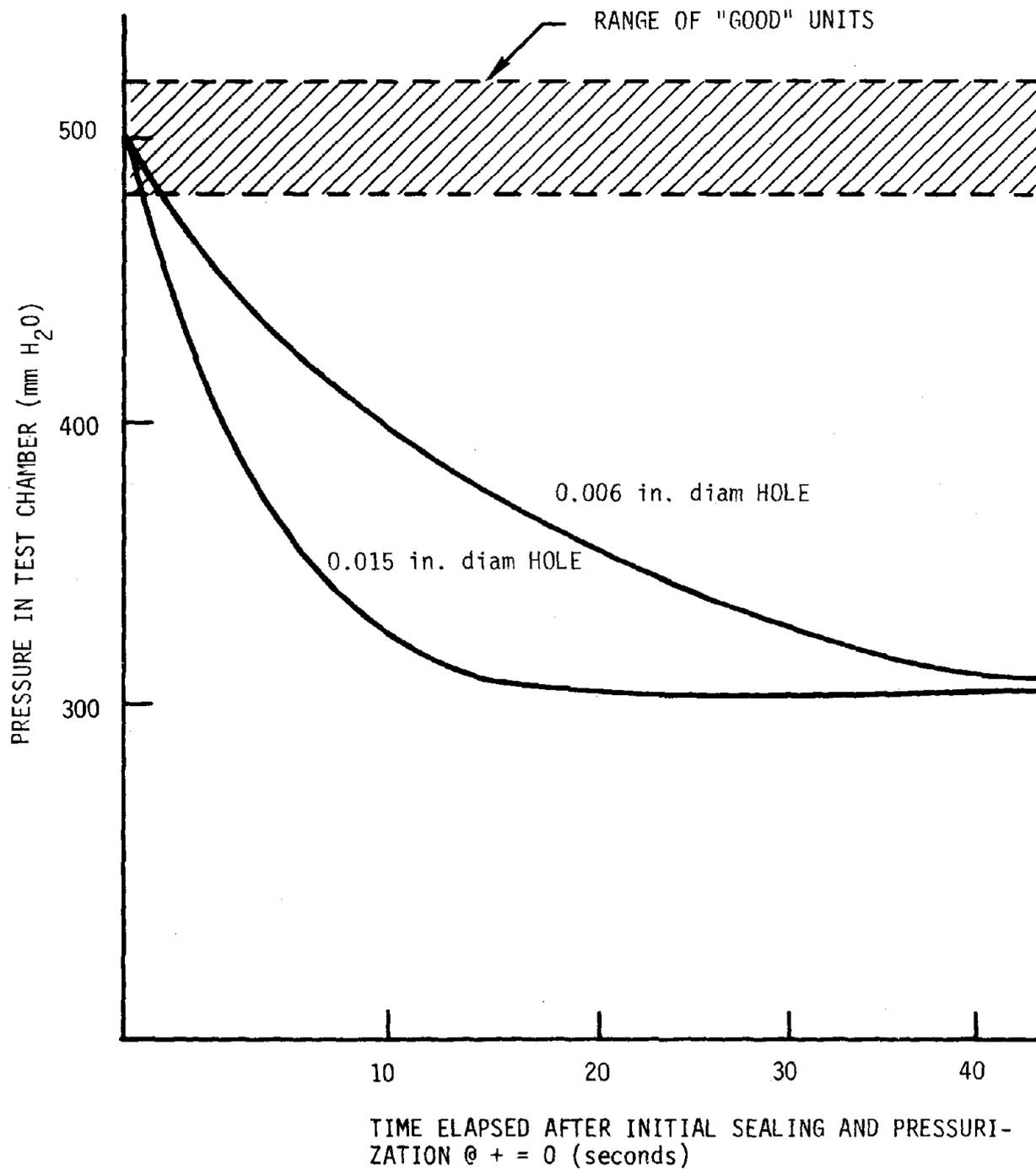


FIGURE E-2. - Test results, self-rescuer pressure tester.

The test chamber could be made even more sensitive by making it a "tighter fit" with the self-rescuer. However, this would also make the tester more sensitive to extraneous factors such as mud or dirt on self-rescuers (would increase test pressure) or dents in the case (would decrease test pressure). The best compromise is probably to design the test chamber so that the free volume *outside* the self-rescuer is somewhere between one and two times the free volume *inside* the self-rescuer.

In summary, laboratory experimentation showed that the existing pressure test apparatus could easily detect leaks as small as 0.006 in. diam.

The next question is: *how much moisture will leak through a 0.006 in. diam hole?* Leakage flow will occur through a hole because of two factors:

- a. Differential air pressure
- b. Differential humidity.

A differential air pressure will be created any time the ambient air pressure outside the SCSR case is increased. This could be caused by changes in barometric pressure or by transporting the case to a lower altitude (that is, going down a mine shaft or slope). Figure E-2 shows that even with leakage holes as small as 0.006, flow rates through the hole are high enough to equalize pressures in a matter of seconds - so any increase in ambient pressure will cause almost instantaneous flow of (moisture-laden) air into the case until the pressure equalizes. A typical example follows:

Example: An SCSR descends underground 1000 ft down every day into 60°F, 100 percent humidity air. Flow into case:

$$\Delta V = \frac{\Delta P}{P_0} \times V_0$$

where

P = 1000-ft air column 0.03 atm

P₀ = 1 atm

$$V_0 = 1 \text{ liter}$$

$$\therefore \Delta V = 0.03 \text{ liter}$$

$$\begin{aligned} \text{Total moisture leakage (at } 60^\circ, 100 \text{ percent} \\ \text{relative humidity} &= 0.013\text{g/liter)} \\ &= 0.013 \times 0.03 = 3.9 \times 10^{-4} \text{g/day} \\ &\text{or } 0.14\text{g/year} \end{aligned}$$

This amount of moisture leakage is not significant. Note, however, that if the same unit went into a hardrock mine - down 10,000 ft to 120°F, 100 percent relative humidity - the moisture penetration through a small hole could increase more than an order of magnitude.

Differential humidity, even without a differential pressure, will also cause moisture to flow through leakage paths by a process known as diffusion. The mass flow rate is given by Fick's Law:

$$\dot{m} = A \cdot D \cdot \frac{\Delta m}{\Delta l}$$

where

A = cross-sectional area of leakage path

D = diffusion coefficient = $0.24 \text{ cm}^2/\text{sec}$

Δm = differential moisture between inside and outside of case = $1.3 \times 10^{-5} \text{ g/cm}^3$ if outside is 100 percent relative humidity, 60°F and inside is 0 percent relative humidity

Δl = length of leakage path (that is, thickness of case, assumed to be 1/16 in.)

if leakage hole is 0.006 in. diam,

$$\dot{m} = 4.9 \times 10^{-9} \text{g/sec} = 0.15 \text{g/year},$$

which is insignificant - but note that the moisture leakage goes up as the *square* of the hole diameter.

Thus, we may conclude that the pressure-test device will detect holes small enough to have insignificant flow rates.

We recommend that this type of test be used periodically as a supplement to a daily inspection of an integral humidity indicator.

E.3 Other Testing Problems

Testing the airtight seal instead of testing the oxygen-producing chemical (KO₂) can create at least two problems:

- a. KO₂ is good, but airtightness test fails
- b. KO₂ is bad, but airtightness test passes.

E.3.1 Good KO₂, but Airtightness Test Fails

This problem is a situation where the error is on the side of safety: the KO₂ is still good, but the unit fails a test for airtightness. The question is: what is done with units which fail an airtightness test? At the present time, we have not been made aware of any procedure - either inspection or *nondestructive* testing - whereby a unit may be returned to service once the airtight seal has been found faulty. *We recommend that an investigation be undertaken to develop nondestructive test methods to ensure the integrity of the oxygen-producing chemical in SCSRs. (See Section 1 for a similar, but more specific, recommendation).*

E.3.2 Bad KO₂, but Airtightness Test Passes

This situation is one in which the error is on the side of unsafe conditions. In simple terms, it is possible for KO₂ to degrade even though the airtight seal is intact. Major possibilities are as follows:

- a. *Mechanical degradation* - major cause: vibration
- b. *Chemical degradation* - major causes:

1. Moisture leakage by permeation through case
2. Age (shelf-life limitations)
3. Thermal cycling.

The subject of mechanical degradation due to vibration is discussed in Appendix D. The areas of chemical degradation will be briefly discussed below.

Moisture leakage by permeation through the case is a distinct possibility. Some SCSRs will probably be permanently stored underground, where relative humidities of 90 percent and higher are not uncommon. Thus, the case of the SCSR will be exposed to a significant differential in humidity between the inside of the case and the outside. Using reasonable assumptions, the amount of moisture permeation through the case may be calculated:

$$W = M \cdot A \cdot \Delta P$$

where

W = moisture permeation rate, grains/hr

M = permeance, grains/hr - ft²

A = surface area, ft²

ΔP = difference of vapor pressure, in. Hg.

Using M = 0.006 (corresponding to 1/16-in. thick polyethylene or 3/16-in. PVC) and P = 0.84 in. (90 percent relative humidity at 25°C)

$$W = 0.015\text{g/day.}$$

This number is in rough agreement with laboratory data and would indicate that the KO₂ would be 10 percent consumed in less than 3 years under the above conditions. Thus, it would appear that moisture permeance is a problem but not a critical

one; however, it should definitely be considered in the design and approval of the outer housing of chemical SCSRs.

Age and shelf-life considerations were beyond the scope of this investigation.

Thermal cycling is another potential hazard to which SCSRs will be subjected. When units are brought into and out of mines, they will be exposed to wide swings in temperature. Tests of thermal cycling of KO_2 were conducted by NASA under USBM Contract No. HO202047. Results of testing on both pelletized and granular KO_2 showed no effects after two temperature cycling regimes. One regime consisted of 24 hr (eight 3-hr cycles) of gradual temperature exposures between -78° and 65.5° C (-109° to 150° F). The second regime of thermal shocks involved 20 instantaneous temperature gradients of 143.5° C as the KO_2 sample was transferred directly from the 65.5° C bath to the -78° C bath, held for 1 hr, and transferred again.

These results indicate thermal cycling of KO_2 within the anticipated storage temperature ranges is not likely to be a problem.

E.4 Summary

We once again recommend that the evaluation program of underground use of SCSRs be extended indefinitely with the objective of periodically sampling in-service units to identify any irregularities before they become major problems.

APPENDIX F

DISCUSSIONS WITH REPRESENTATIVES OF
UNDERGROUND COAL MININGF.1 Introduction

A major part of this program was to meet with as many people as possible who might provide us with fact and opinion on the best ways of implementing the new regulations for the use of SCSRs. This report is a summary of those meetings and the major comments which were made. We have attempted not to editorialize or otherwise change the tone of the remarks. In many cases, different people had different opinions and thus at least two sides of the story are reflected here.

Discussions were held with the following groups:

- a. The managers and key staff of the 10 MSHA coal mine safety and health districts
- b. NIOSH
- c. United Mine Workers of America
- d. Representatives of operators producing more than 150 million tons annually from underground coal mines.

This appendix is divided into the following areas:

- a. Definition of "Hazardous"
- b. Attitudes
- c. The need for Guidelines
- d. Storage
- e. Inspection
- f. Miscellaneous
- g. Chronological list of meetings and attendees.

F.2 Definition of "Hazardous"

30 CFR 75.1714-2(b) requires "Where the wearing or carrying ... is hazardous to the miner, such ... devices shall be ... no greater than 25 feet from such miner." Neither the regulations nor the MSHA Underground Manual 9 March 1978 provides policy in the definition of hazardous. West Virginia requires them to be within arm's length.

When defining hazardous, it would be appropriate to consider the movement and mobility of a person wearing or carrying the device; if restricted, he is exposed to danger. How can you dispute a miner's claim that he has a sore back and that wearing the device could make it worse?

The definition of hazardous for present SCSR design should not be based on experiences with the filter type. Except in District 1, most miners do or could wear the filter all the time. The shuttle car operator is the person most likely to not wear or carry a filter type. Chockmen and shearer operators in low coal may try not to wear or carry it. Since 1972, only 104 notices have been issued citing failure to comply with 30 CFR 75.1714-2(b). Compliance with 30 CFR 75.1714-2(b) is not believed to be that good.

Because most miners will consider the devices to be hazardous if worn or carried, it is necessary for companies "to do whatever must be done to achieve storage". Attitudes toward these devices will be more psychological than real for many miners. With proper introduction the devices might be accepted as wearable or carryable in time. Virginians, central Pennsylvanians and eastern Kentuckians, however, are unanimous in their belief that no worker ever would carry or wear the devices except possibly while traveling through bleeders.

There is a need for SCSRs. Many experienced persons believe FSRs provide little to no protection. They also believe, however, the size, shape and weight of present MSA and Draeger SCSR models would make these hazardous to wear or carry while miners perform their normal work; and, the occasions when these could be safely worn or carried would be too few to generalize. Concern was expressed there would be an increase in injury frequency and severity should SCSRs be worn or carried.

F.3 Attitudes

Considerable hostility towards SCSRs was expressed. The attitudes of some seemingly flowed from their belief that the devices either would not contribute to safety or might be a diminution of safety. The hostility of many was shaped by the cost which some anticipate will range from 30 to 70 cents/ton. "During 1979 in eastern Kentucky alone 979 mines were forced to close because of the combination of market conditions and dealing with 27 different regulatory agencies. In 1980, the market probably will not improve; the number of agencies is likely to increase; and, with the cost of these devices added another group of coal mines will be forced to close." "In Anthracite mines escape is often a matter of minutes (10 to 30); and, in addition to the 'excessive cost' for these devices, there will be additional, 'unwarranted' enforcement problems."

Overcoming attitudes will be the major problem. We can better predict what needs to be done after the evaluation tests, assuming the tests are proper and thorough. The tests must identify major problems. It is important for the tests to include people and activities identified as having the more critical problems with wear, carry and storage. There may be an attitudinal difference between miners and inspectors. There may not be cooperation from inspectors in general. Miners will be vocally resistant; some may "rebel". The older inspectors and miners might be the most cooperative.

Concern was expressed with use of SCSRs by persons having chronic lung diseases who have a potential for hyperoxygenating (quit breathing, absence of CO₂ fails to activate breathing nerves in brain - also refer to EMT Instructor's Manual, Chapter II, page 109). FMA studies indicate this is not a problem with KO₂-based devices; typically, the inhaled "oxygen" will contain from 0.3 to 1.5 percent CO₂.

Some questioned the reliability of SCSRs:

- a. Unless training is more frequent than proposed many miners will not be able to use these in the event of an emergency; monthly training is the minimum needed for the use of oxygen breathing apparatus by mine rescue teams.
- b. Could the breathing bag be punctured or torn off? How does a miner pinch off a puncture when he needs both hands to crawl to safety?

- c. How do these devices differ importantly and safely from Chemox units?
- d. Are the humidity indicators a positive means to determine 1 hr of oxygen generating capability?
- e. Multiple freezing cycles and the fact that no one knows their effect is of concern. Are the SCSRs able to withstand vibrations during the 5 years of storage recommended by manufacturers? How does this affect:
 - 1. Breathing resistance
 - 2. Startup at the beginning of a shift (the time many believe is the most likely for fire on face equipment)
 - 3. Moisture entrapped within the device
 - 4. The chemicals and filters during 3 to 5 years of use?
- f. Could there be a fire or explosion should water containing coal particles come in contact with KO_2 in a ruptured device? Hazard is defined not only for storage, wear and carry, but what if after use it is left in the mine? Accountability is important.

F.4 The Need for Guidelines

Guidelines are needed to identify problem areas and to optimize conformity. Some expect guidelines to be of little use and, therefore, they should not be written if they were "predicated on what an inspector can or cannot do."

If there are guidelines there must be flexibility. Some feel guidelines are in reality policy and take away knowledge, experience and judgement. It is only on a mine-by-mine basis that critical questions could be answered, such as where are these needed? Where can't they be used? What is the integrity of the escapeway? Temperature differentials? Abuse or damage potential? There must be flexibility to approve plans appropriate to the situation.

With the present regulations it is to be expected that requests for permission to store will come from almost every operator. Storage will be requested, even if wearing or carrying is feasible. For example, in mines working two or three shifts, a set of devices sufficient for one shift could be used by the other shifts. The regulations don't require each person to have his own, just that the person has one available while in the mine.

Guidelines need to be flexible. Factors influencing storage, inspection and testing should be supported by detailed criteria and information. Precautions which need to be taken on such things as vibration, humidity, water, and dust must be detailed.

Guidelines should provide details on problems and their probabilities to develop for a wide range of scenarios. The guidelines should enable a mine operator to make more than a guess on how to comply with the regulations and on how to assure the availability of effective oxygen self-rescuers in the event of their need. "Someone will have to define procedures for checking and inspecting the devices on jeeps and trips as well as in stationary storage."

Guidelines must clearly explain tests with respect to their purpose, frequency, methods and skills and equipment required. Potential deficiencies in the devices which cannot be determined from these tests need to be detailed.

Training and education should be detailed in the guidelines. Mines might have to be closed to give self-rescuer training to 1500 miners between the time they can get now-nonexistent training models and 21 December 1980.

Will the guidelines address "practical problems" such as:

- a. Section workers are sent to clean up a fall. Must they remove units from storage? Is damage potential to removed units worth the risk?
- b. Construction crews are dropped off near their work site from a mantrip that proceeds to another place. Could devices be easily damaged if worn or carried on mantrips? Could below-freezing temperatures prevent having SCSRs brought to or stored at the work site with crew supplies and equipment?
- c. Do the mechanics in the motor barn take a unit with them when they leave the barn?

- d. What if the time to escape exceeds 1 hr? This is not addressed in the regulations, and, therefore, a mine operator need not elect to provide additional units enroute. Would this be in the best interests of safety?
- e. A person is required to wear or carry an SCSR and, therefore, may not have a filter unit. If he goes to work on a section where SCSRs are stored, what does he do?
- f. A block layer constantly moves at his job. He takes his SCSR off for safety and mobility and places it with his tools; to get water to mix cement he has to go 300 to 500 ft from his unit. Must he take the SCSR with him? If so, how does he safely carry the water -- in 3-ft coal?
- g. How do you write guidelines for wear, carry or store for a mantrip consisting of miners crawling 2000 ft in 30-in. coal, or, for a mantrip that requires seven changes?

F.5 Storage

F.5.1 Reasons Against Storage

The units must be worn or carried if they are to be available in an emergency. Another important concern was grievances resulting from some persons being required to wear or carry in areas where others had their devices stored.

Theft and vandalism were the most common reasons against storage. Theft would be a problem mainly during the first 3 to 6 months, that is, until all mine operators had sufficient SCSRs. It has been suggested that each device have a molded serial number on the top of the case. In the 1950s and '60s, BM 1447 units stored on mantrips and face equipment "didn't last very long".

A large number of people believe that in an emergency the first people reaching the stored devices would take more than one. Other equally knowledgeable persons reject that possibility.

F.5.2 Reasons for Storage

The devices, if carried or worn, would suffer damage from day-to-day abuse which could make the devices worthless if and when they were needed. They have a high potential for being damaged by dragging on the bottom, or against the roof in low coal and in tight places. Particular concern is damage to devices carried by fire bosses and belt men.

Most miners just would not wear the devices. It would be difficult to work all day with a 9-lb load on their rib cage. The size and weight of the devices would be meaningless when devices are stored. Complaints could cause severe problems. Eventually miners will accept these devices; the time to achieve acceptance will be shortened if it is made as easy as possible. Storage allows control as well as something that can be managed.

The greatest support for storage is that miners must wear or carry the filter type if oxygen units were stored.

F.5.3 Whose Could Be Stored

Three factors are dominant on storage:

- a. The devices must be where people can reach them as quickly as possible
- b. The devices must be in usable condition
- c. A sufficient number must be stored.

The storage plan should "spell out" who must wear or carry the devices, and when they have to be worn or carried. This would consider "outsiders" such as MSHA and state inspectors, government-funded contractors, equipment manufacturer representatives, Congresspeople and students.

Some suggestions are that labor would require storage whereas most of management would have to wear or carry the devices. The principal deciding factor would be what the person might do during his time underground and his ability to do that work safely and efficiently.

Additionally:

- a. Shuttle car operators are the persons most likely to require and justify storage of the as-presently-designed devices, regardless of mine constraints.
- b. During cold weather, storage will be needed for: persons working in shafts and slopes; track and supply crews; surveyors; hilltop miners; miners who rely on at-mine diesel generation of electrical power; and most anthracite miners.
- c. Wearing or carrying the devices could be hazardous to persons being transported or working in low coal, particularly 30 in. or less. The likelihood is low that for these people the devices could always be within 25 ft.
- d. Persons on longwall faces may not be able to wear or carry the devices; however, storage associated with face page phones would place the devices within 50 ft on many longwalls.
- e. Belt men may find it hazardous to wear or carry the devices in low coal and where clearance is 30 in. or less.
- f. Rovers could cause a major enforcement problem. For example, fire bosses, seal examiners and MSHA inspectors may not be able to wear or carry the devices or have them within 25 ft in some returns, bleeders, belt entries and abandoned areas. These persons might travel several thousand feet from their vehicles.

"Mixed" storage for nonsupervisory employees was condemned. Mixed storage is where in a section some persons would be required to wear, carry or have their devices within 25 ft while others are permitted to store or depend on stored devices. Mixed storage could lead to discrimination charges, would cause problems where miners "switch" duties during the shift; and, could result in some persons not having a device available in the event of an emergency.

Suggestions were that the construction crew and rovers need not have the unit by their side. Theirs could be on the locomotive and in caches along the belt or track. The pumper, who

may or may not have a jeep, knows that a mandoor is every 300 ft (West Virginia) and 500 ft (MSHA), so he could have access to a central storage unit.

F.5.4 Number to be Stored

The mine operator can store as many devices as he wishes. He has only to make sure one is available for each person in the area covered by the storage plan. Additional devices could be stored *not for rovers and itinerants* (who should carry or wear their own), but in the event some stored devices malfunctioned in an emergency. To compensate for potential deficiencies in quality control during manufacture the number of additional devices needed might be 20 percent.

More than an adequate number could be made available through storage on main lines, in belt entries, and on jeeps. One unit could be issued to each person who would take it to an assigned storage point. Inspectors, students, government people, equipment manufacturing representatives and other "outsiders" should supply their own and show evidence of training.

F.5.5 Where Should They Be Stored

Stored devices must be where:

- a. People "psychologically" would go in the event of emergency
- b. People could in safety reach them, put them on, and activate them correctly
- c. The devices are protected against abuse, excessive vibrations, cold temperatures, water and falls
- d. The storage containers are pressure vented.

A dominant factor in considering storage is that miners would have a filter unit. Time and distance are not as important as situations.

Time applies to the person who is distant from the origin of the fire or explosion. He has more time than people near the origin. Time generally applies, therefore, to the rovers. Distance applies to the face area.

Regarding time to reach, who and what determine time? Some persons will travel from point A to B in much less time than others; and, charts, curves or tables derived from studies of travel time as a function of height will fail to incorporate important factors inherent to actual conditions in the section and mine. Charts, curves or tables provide guidance not guidelines.

Distance of travel is of less importance than the suitability of the location. Five hundred feet would not be unreasonable in low coal. A 53-year-old miner weighing 210 lb can crawl 800 ft in a 39-in. seam in 5 min. A 5-min maximum was the consensus for normal conditions in comparatively high coal seams.

A suitable location should be towards the escape routes. An example is section storage at the dinner hole; a person going some distance outby that point should be required to wear or carry the device. The maximum distance he could go without the device would depend on conditions, but probably should not exceed a few hundred feet.

Where the miner has sufficient oxygen to use the FSR, the time and distance to reach storage is not critical. The need, therefore, is to determine where and how an oxygen deficiency could develop and prevent miners from reaching the storage and putting on the devices. The crew should be trained to use their FSRs and go to a specified central location where the foreman can make sure all are present and give appropriate instructions.

Miners can do things more calmly in a place they know well and where the air is most likely to be comparatively safe. The probable quality of the air should be a major factor in determining storage location. This would reduce the chance that the miner will have to put on the device in smoke. Psychologically, that would be the worst condition and location. Another factor is familiarity with location. Units could be stored where miners would see them every day.

Although centralized storage is preferred, the question is of its practicality in low coal. Where miners could squat or stand to take a device from a storage box and put it on, the problem is not too severe; however, in low coal, where miners are in the prone position, it could be difficult for six or more persons to congregate at a single storage container.

It is not in the best interest of safety to require devices where they would not or could not be used. There is a need for a careful study of actual fires, ignitions, explosions and black-damp emissions with respect to the adequacy of storage sites likely to be where smoke came into the section. Machine operators have not been lost because of fire on their machines.

F.5.6 Specific Storage Sites

F.5.6.1 Shafts, Slopes and Mantrips

Most fires, explosions and blackdamp flows occur in the mine workings. Storage should be where the devices will be most needed while requiring wearing or carrying them up a shaft. Although shafts and slopes are part of the mantrip, SCSR regulations should not apply to areas where temperatures are below freezing. A major problem is temperatures. Without heaters, the devices could be useless in winter; with heaters they may be damaged. Below freezing temperatures often extend considerable distances into mines along mantrip haulage routes. Heaters are not suitable; there is no way to energize them on an unattended vehicle.

Shafts and slopes are part of the mantrip and as such the devices would have to be worn, carried or be within 25 ft. It would be difficult, if not counterproductive, to require devices for miners in an elevator, cage, or on a slope hoist. The miners would have filter units which should permit safe escape in all events except an explosion in the shaft or slope, in which event SCSRs would be of little or no use.

SCSR storage on mantrips will be a major problem. Caches along main lines are more appropriate than storage on mantrips with the potential for "vibrations rendering the devices useless".

The requirement that SCSRs be worn, carried or be within 25 ft may create a hazard on mantrips in low coal, particularly where the mantrip consists of multiple belt changes, "flying carpets," scoops or crawling. It could be difficult keeping an SCSR within 25 ft.

There is concern with storage on a multiple change mantrip. For example, a mantrip could consist of an elevator, then a 5-min walk to a trolley-powered portal bus with change to a battery-powered portal bus or to belts or to a scoop. Designs for suitable storage containers may differ greatly among these forms of transport.

Why are SCSRs needed on mantrips if the units are available at or near worksites? Often, the mantrip travels on a designated escapeway; in the event of emergency it would be far safer for the mantrip to head out rapidly, than for the persons to get off, obtain SCSRs from storage and receive instructions.

F.5.6.2 Anthracite and Small Mines

Overnight storage during cold weather could be a major problem at many small mines. Many generate electrical power by diesels which are turned off at night. Miners often charge their cap lamps at home. Miners could be required to take their SCSRs home, but how can it be assured that the devices are kept in a warm place and are not damaged in transport? Education and training will not get the attention of anthracite and "hilltop" miners who insist the device is a "useless" burden.

The problem may be compounded in anthracite mines where filter units are seldom worn and may be distant from the miner.

F.5.6.3 On Equipment

The best storage site often is the one the miner can reach as quickly as possible. In most western mines, there is sufficient space for storage on equipment by all except the section foreman and mechanic. However, the equipment operator is away from the machine a great deal of the time. Jeeps and other transport used by rovers are often moved by other people. Containers must protect against dust, water and vibration which could be exceedingly difficult. People might leave the devices on the equipment when going to the dinner hole or for supplies. Enforcement is made difficult by a mix of storage and wear/carry in the same section.

F.5.6.4 On Mantrip Left in Section

The normal exit is via mantrips. This reduces the number of devices needed. Section crew and most rovers would know the location of the storage area. This location could be readily inspected. The storage plan must state clearly under what circumstances the mantrip would be moved. However, fire in the track entry could contaminate the atmosphere around mantrips.

What if the storage container is moved to and from the personnel carrier and work site? The associated problems are considered too great. For example, should the personnel carrier be used as an ambulance, would the injured and escorts first take the devices from the section storage container or would additional devices have to be stored with the first aid supplies? What about persons remaining on the section after the crew leaves? If they removed devices from the storage container, it could result in an inadequate number on the mantrip and it would require more accounting than is practical.

F.5.6.5 Dinner Hole

Everyone in the section knows the location of the dinner hole. Most rovers know the location. The area can be most readily included in education and training plans. Miners would probably see the devices every day. The dinner hole often is the cleanest, best-supported, warmest place in the section. The escapeway map is posted there. The section telephone is at or close to the dinner hole.

The location of dinner holes depends on the size of the section. To have the dinner hole inby the loading point generally requires a panel to consist of six or more entries. Where the dinner hole is outby the loading point, fire in the belt or track entry can be diverted unless the fire is between the dinner hole and loading point. Access to the dinner hole can be through a door from the intake escapeway in some mines.

The intake escapeway is technically the best place to go. Miners, however, will instinctively go to the dinner hole where they have their jackets and buckets. In an emergency most go for their bucket -- not for food as much as for the water he thinks he might need. The psychological advantage of the dinner hole was demonstrated in the No. 9 disaster, where footsteps were traced back to the dinner hole in at least two sections.

However, fire in the belt or track entry could contaminate the dinner hole. In an emergency, miners should head directly for the intake escapeway. Hilltop and anthracite miners seldom have or use a dinner hole. The site might not be moved up in a timely manner. When moving the site, storage containers might be abused. Operators try to keep the dinner hole one crosscut from the loading point. If the recognized travel time-distance is less than from the farthest projection to the dinner hole there may be

a need for another cache, and that could create problems unless the cache contained as many devices as there are in the dinner hole. Most mine operators believe having the dinner hole near the intake escapeway is impractical.

F.5.6.6 Loading Point

Almost everything is centered at the loading point. Loading points frequently are close to the face. Contaminated air can be diverted except when the fire is at the loading point. However, the loading point may not be close to the face, in fact, it could be outside the mine.

F.5.6.7 On-Face Equipment

SCSRs would be immediately available to the equipment operator. Operators, however, are frequently away from the equipment. In the event of a fire, ignition, roof fall or rib roll the operator would run rather than attempt to remove the SCSR from storage.

F.5.6.8 On Longwalls

Pros and cons are dependent on the open area of the supports, the type of communication system and method of ventilation. It is likely a storage plan might have to be modified several times during the life of a longwall. It is unlikely that shearer operators and most chockmen would or could wear or carry devices. Tailgate storage provides protection should the fire or explosion occur at the headgate, the most likely site other than in the gob. Page phones are frequently 50 to 60 ft apart and seldom more than 100 ft apart; if phones could be protected against damage so could rescuers.

Except where cross-ventilation is used, the miners would be putting on the device in smoke or in a toxic atmosphere. Miners might attempt escape in the return. The foreman might not know the status of the entire crew. Devices would likely be damaged by an explosion propagating along the face or from the gob.

F.5.6.9 Near Intake Escapeway

The intake escapeway is the most probable site for good air. This area is also the "proper place" for foremen to instruct crews to meet in the event of an emergency. MSHA training has

emphasized the need for miners to head for the intake escapeway in the event of an emergency. The District Manager has the authority to require the intake escapeway to be within a certain distance from the farthest point of penetration; thus, storage areas could be within three crosscuts outby the face. In intake escapeways, there will be little danger of equipment striking storage containers.

The intake escapeway is frequently the most rock dusted place in the section. Would this be harmful? What about mines where the escapeway begins 1000 or more feet outby the face? Some sections are not required to have escapeways. Miners in returns or near a tailgate could experience great difficulty in reaching stored SCSRs in the intake escapeway. If miners wear or carry the devices to a section, it is not practical to put a bucket in the dinner hole, receive instructions, and then carry the rescuer to a storage site near the mouth of the intake escapeway area. Of what value is an SCSR obtained in the intake escapeway except in the unlikely event that the intake escapeway air is contaminated?

F.5.6.10 Belt and Track Mains

Persons in returns adjacent to belt and track mains could reach devices through manddoors. It is a remote possibility that a person coming from the return would go to the same cache as a person in the belt or track entry, and, in that event, the next cache could be within a few minutes travel. Caches at reasonable distances could provide undamaged self-rescuers for persons on mantrips as well as for persons working in or traveling on these mains. The regulations do not allow "caches on line" in lieu of wear or carry by persons in portal buses, jeeps and motors. It would be difficult, if not impossible, to determine with reasonable assurance the number of devices to be stored in each cache. Belt men and track crews could keep their devices with their buckets. However, persons on mains and in the returns may not receive timely warning of an emergency and could have little to no time to obtain a device.

F.6 Inspection

The storage plan is incorporated into compliance with 30 CFR 75.1101-23, thus assuring inspection and familiarity by all persons on the section. The plan must include provisions for either moving or maintaining inspection of the stored devices when a section is temporarily as well as permanently abandoned.

There should be "regular" inspection by all miners to at least familiarize them with their location.

There should be a daily count of stored devices. If the mine operator is required to check some daily, he must check all daily. The principal purpose is to assure that there is at least one device for each person on the section, mantrip or vehicle.

Unless there is obvious damage, the inspector or counter would have no knowledge about the condition of the devices. Vibrational damage to devices stored on portal buses, jeeps and motors could not be ascertained. There could be a greater reliance on a properly designed, sealed storage container with a polycarbonate cover and a good humidity sensor than on the possibly meaningless Draeger indicator or MSA "dunk" test. They warn primarily of a gross leak. Neither indicates internal deterioration resulting from moisture permeation. Quoting Kloos, "... all... cartridges ... tested had intact lid seals ... nothing in their external appearance to indicate whether or not they would perform" NIOSH tests the humidity indicator by removing the device cover for several hours. NIOSH says the device should be discarded if the indicator color becomes pink or the dunk test indicates a leak.

Guidelines must explain how stored devices should be inspected. Inspection guidelines must be associated with abuse; the type of inspection required depends on the type of storage. For example, if stored on mantrips, how could adverse effects of vibration be determined? Should devices be tested in accordance with manufacturers' recommendations only? Is storage life equivalent to shelf-life? What protection must the storage container provide? Can the internal temperature be measured?

Who would inspect stored devices? If it is a supervisor, he has only so much time. If the preshift examiner signs a book saying all of the section is OK, does this require him to inspect the self-rescuers? The unit foreman is responsible for all equipment in the section; therefore, he too might have to inspect the self-rescuers. Could multiple responsibility lead to diminution of safety? If a MSHA inspector finds an inadequate number of "good" devices, will he issue a citation regardless of what inspection the company performed and when? Why do these devices need to be inspected more frequently than other critical safety items such as fire extinguishers (6 months), hose and fire suppression systems (annually), and fire sensors (weekly)?

Inspection requirements will depend on security and the method of storing. There may be serious differences between MSHA and states on storage, inspection, and general use.

F.7 Miscellaneous

F.7.1 Signs

There should be a symbol that directs miners to storage sites. The design of the sign is the mine operator's responsibility, with MSHA being responsible for approval or rejection of the design. Standardized signs are a "good idea" because many persons will work in many different mines. Non-English speaking miners should be able to understand the sign. An easily understood symbol and an uncommon color (for example, a reflective green) would be good. "If someone tells us what signs we must use they should buy the signs and have inspectors put them up."

F.7.2 Forms

"We don't want a form." There are too many variations and situations for a standardized form; however, there probably will be a form or forms. In that case, it would be beneficial to make sure certain minimum information is available, at least enough to serve as a starting point and a guide that reduces disagreements and negotiations.

F.8 Chronological List of Meetings and Attendees

The listing which follows details people attending and dates of meetings:

- a. November 8: MSHA CMHSD 9, Denver, CO
J. Barton, I. Van Horne, E. Teaster
- b. November 20: MSHA CMHSD 7, Barbourville, KY
J. Spicer, T. Marks, R. Garcia, E. Teaster
- c. November 21: MSHA CMHSD 5, Norton, VA
R. Ross, F. Mann, V. Hileman, E. Teaster
- d. November 21: MSHA CMHSD 6, Pikeville, KY
L. Phillips, J. Begley, D. Harmon, R. Ratliff,
E. Teaster

- e. November 22: MSHA CMHSD 4, Mt. Hope, WV
J. Krese, F. Casteel, C. Spangler, J. Rutherford,
J. Trent, R. Worley
- f. November 27: MSHA CMHSD 8, Vincennes, IN
M. Childers, C. Rath, E. Teaster
- g. November 28: MSHA CMHSD 10, Madisonville, KY
H. Hubson, E. Teaster
- h. December 1: MSHA CMHSD 3, Morgantown, WV
R. Keaton, H. Lough, Jr., M. Evanoff, R. Peluso
- i. December 3: AMC - Ad Hoc Committee, Pittsburgh, PA
H. Chayet, R. Hatch, J. Girod, J. Sertan, R. Peluso,
E. Teaster
- j. December 4: NIOSH, Morgantown, WV
R. Ronk, S. Terry, R. Peluso
- k. December 5: Bruceton, PA
B. Bray, G. Pace (Conoco), C. Parisi, J. Sheppard
(Consol), J. Cook, D. Huntley, E. Teaster, E. Kloos
(MSHA), J. Murphy, J. Stengel (USBM)
- l. December 6: MSHA CMHSD 1, Schuylkill Haven, PA
J. Laird, D. DeHaven, D. Updegrave, J. Schoffstall,
M. Scheib, B. Thomas
- m. December 20: Central PA Mine Operators, Ebensburg, PA
E. Millward, J. Gallick (Bethlehem Mines), P. Ford
(Bethlehem-Cambria), S. Olexo, M. Pallas (Bethlehem-33),
E. Krupa, W. McCauliff (Bethlehem-38), W. Elliott
(Bethlehem-73 and -77), W. Craig (Bethlehem-Butler),
J. Korber, E. Hrutkay, L. Stepp, J. van Voortas
(Bethlehem-Ellsworth), D. Flack (R&P), J. Kreutzberger,
J. Kubin (PMC), J. Burnett (B&T), F. Nickler (North
American), A. Dodson (Florence-Helen)
- n. December 21: Eastern Associated Coal Corporation,
Pittsburgh, PA
M. Graham, J. Tisdale

- o. December 28: United Mine Workers of America,
Morgantown, WV
M. Connors, H. Nickolai, R. Weaver, J. Mains,
T. Osborne, E. Justice

- p. January 3: Virginia Mine Operators, Appalachia, VA
Twenty representatives led by M. West (Pittston),
D. Bamron (Bethlehem-Elkhorn), L. Samples (Westmoreland,
including Imperial, Winding Gulf and Stonega),
W. Stanley (Island Creek), A. Wagers (U.S. Steel-Lynch)

- q. January 9: MSHA CMHSD 2, Pittsburgh, PA
D. Huntley, A. O'Rourke, J.D. Breedon, R. Uhazie,
J. Garcia, P. Lanyo, T. Bioni

- r. January 17: Eastern Kentucky Mine Operators,
Pikeville, KY
Thirty-six representatives of 18 coal companies, the
Kentucky Departments of Energy and of Mines, Coal
Industry Technical Assistance Centers of Pikeville
College and Southwest VA Community College, Louis
Hunter (NICOA), Everett Brown.

APPENDIX G

RECOMMENDATIONS FOR SCSR STORAGE CONTAINERS

G.1 Necessity for Storage Containers

When SCSRs are permanently stored within the mine, the use of a storage container is recommended for the following reasons:

- a. Where several units are stored together, they are more apt to be kept together if they are in a container.
- b. A container which is much larger than a single SCSR is less likely to be run over or loaded out.
- c. Stored units may have to be moved periodically (that is, as a section advances), and a container can provide protection during these moves.
- d. Moderate protection from small roof falls, rib sluffing, etc., can be provided.
- e. Periodic inspection will be easier if SCSRs are stored together.

G.2 Major Required Features of Storage Containers

Features which storage containers must have are listed below:

- a. *Reasonable size and weight* - If the weight of the container with self-rescuers is kept down to approximately 100 lb, then it will be possible for two men to easily lift/carry the container when it needs to be moved. As to size, we recommend that SCSRs be stored in lots of six or less because of weight limitations just mentioned.
- b. *Ruggedness* - Containers should be able to survive small falls of roof or rib, men standing or sitting on them, static loads of 1 lb/in.² and being dropped from reasonable heights (up to 4 ft). We have investigated published specifications for shipping containers and found that there are several in use, which may be summarized as follows:

1. *Military* - There are many different MILSPECS. MIL-C-4150 is probably the toughest, requiring loaded drop tests from 48 in. onto all corners, edges, and sides, waterproof (before and after drop tests), pressure vents, etc. This specification would be more than enough, in that the cost of such a container would include some requirements not needed for this application.
2. *Commercial* - The most common commercial specification is ATA-300, Category I. In a nutshell, it requires a case rugged enough to be used for 100 shipments.

A case meeting the spirit of either of the above specifications would be adequate.

- c. *Shock Resistance* - Common industrial practice seems to indicate that a 2-in. layer of 2-lb polyurethane foam on all sides of the SCSR will provide more than adequate protection. If the SCSRs have flat surfaces, then they can be nestled beside each other with no padding between them; otherwise, up to 2 in. of foam should be used between the SCSRs.
- d. *Provisions for Inspection* - Ideally, the storage container should have clear viewports so that the presence of the SCSRs can be determined at a glance without opening the box. However, two factors might make this impractical:
 1. Use of internal foam padding
 2. Difficulty of fabricating (or purchasing standard commercial) units with such a feature.

Therefore, in lieu of such a feature, we recommend that containers be sealed when placed in storage - using the common lead-and-wire type seal which can be easily broken without tools when entry is required but which can be inspected at a glance.

- e. *Miscellaneous Features*:
 1. A storage box should allow for only one layer of SCSRs, all of which must be visible when the box is opened.

2. The box should be prominently labeled with reflective paint or tape.
3. Total water- or dust-proofing should not be necessary, but a thorough hosing down should not allow the contents to get wet.
4. Any nonporous material could be used to construct the container, specifically metals, plastics, or fiberglass. Wooden containers are specifically *not* recommended.
5. Carrying handles should be provided.
6. Top may be hinged or completely removable. (NOTE: If the lid is hinged, then the height of the container *plus* the width of the lid [that is, distance from hinge to opposite edge] must be less than the mining height of the coal mine.)

G.3 Practical Examples

A mine operator should be able to choose between many commercially manufactured containers, or he may construct his own. To aid in the process, an example of a six-SCSR container is shown here, assuming a hypothetical SCSR with dimensions $10 \times 9 \times 4\text{-}1/2$.

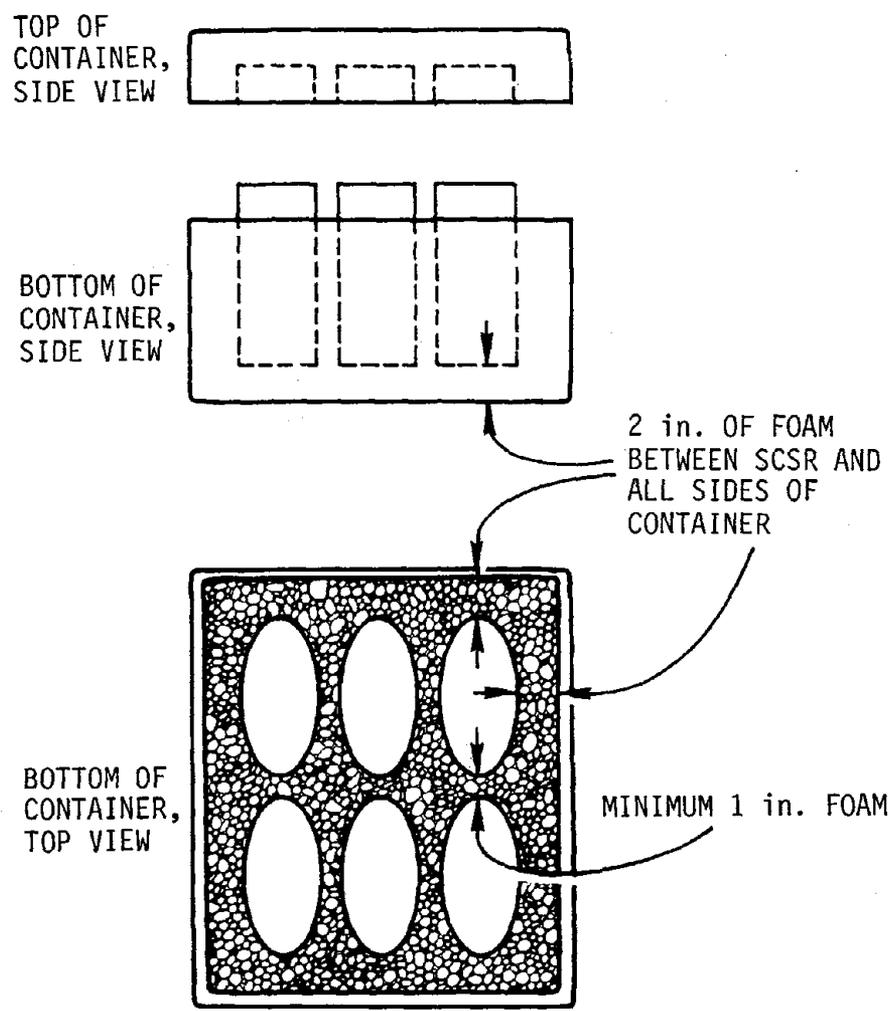
As shown in Figure G-1, this configuration results in a container with internal dimensions of $23 \times 19\text{-}1/2 \times 14$.

G.3.1 Mine-Fabricated Containers

Most mines which might construct their own containers would most likely use steel plate. Theoretically, 3/16- or even 1/8-in. plate, properly reinforced, would suffice for this application. However, if plate as thin as 1/8 in. were used, proper welding might be difficult and some angle iron would be required. Even 3/16-in. plate would result in a weight of at least 100 lb for the box alone.

G.3.2 Standard, Commercial Containers

There are many manufacturers of all types of rugged shipping containers. Table G-1 gives a brief summary of the range of products available, examples of which are shown in Figures G-2, G-3, and G-4.



INTERNAL DIMENSIONS:

WIDTH:	2 in. PADDING	LENGTH:	2 in. PADDING	HEIGHT:	2 in. PADDING
	9 in. SCSR WIDTH		4-1/2 in. SCSR		10 in. SCSR
	1 in. PADDING		1 in. PADDING		<u>2 in. PADDING</u>
	9 in. SCSR WIDTH		4-1/2 in. SCSR		14 in. TOTAL
	<u>2 in. PADDING</u>		1 in. PADDING		
	23 in. TOTAL		4-1/2 in. SCSR		
			<u>2 in. PADDING</u>		
			19-1/2 in. TOTAL		

FIGURE G-1. Example of SCSR storage container.

TABLE G-1. - Representative shipping containers

Type of Container	Availability	Approximate cost for six-SCSR size
Aluminum, built to MIL-C-4150. Very rugged, shown in Figure G-2.	At least 8 weeks	In quantities of 10 \$400 to \$1000
Fiberglass, commercial-grade but similar to MIL-C-4150. Shown in Figure G-3.	4 to 8 weeks	\$200
Plastic, commercial-grade built to ATA-300 spec. Shown in Figure G-4.	4 weeks	\$140

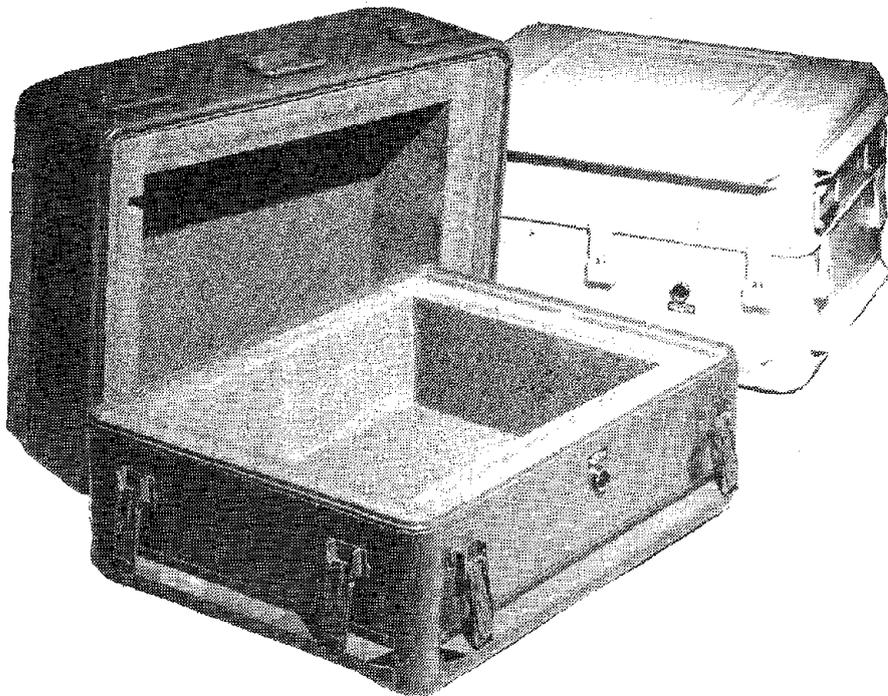


FIGURE G-2. - Aluminum container.

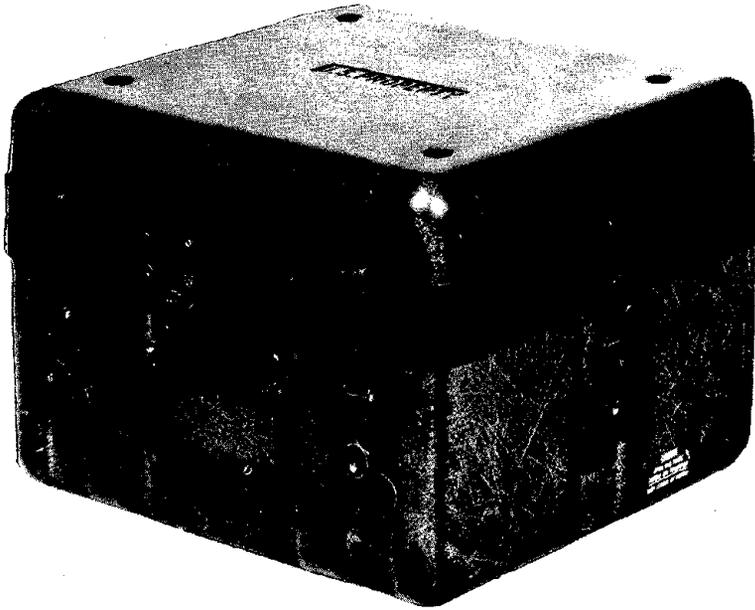


FIGURE G-3. - Fiberglass container.



FIGURE G-4. - Plastic container.

APPENDIX H

EXAMPLE SCSR STORAGE PLANS

H.1 General

Studies were made in five mines to test the adequacy of these guidelines. Sample SCSR storage plans for two of those mines are given in this appendix. Important characteristics of the two mines included:

	<u>Mine A</u>	<u>Mine B</u>
Coal seam	Pittsburgh	Pocahontas No. 3
Average height, inches	62	38
Underground miners, total	129	610
1st shift	27	109
2nd shift	67	260
3rd shift	35	241
Producing sections:		
Continuous miners	3	11
Longwalls	0	2
Coal transport	Mine cars	Belt conveyors/cars
Man trips	Portal buses from surface	
Abandoned areas	None	Sealed

H.2 Mine A Plan Summary

Four storage plans are illustrated for Mine A. In summary these provide the following types of storage for miners:

- a. Plan 1 - This plan requires a minimum of 102 SCSRs, the same minimum required without a storage plan. This plan requests shift primary section storage for the face crews in each of the three producing sections. That is:
 1. All miners have SCSRs while traveling into and out of the mine.
 2. All miners except the face crews have SCSRs immediately available while in the mine.

3. The eight miners on each face crew may place their SCSRs in holders in the "dinner hole" when they arrive on the section.
 4. Face crew miners must take SCSRs when they go a distance equivalent to five or more minutes outby the section.
- b. Plan 2 - This plan also requires a minimum of 102 SCSRs. The plan requests shift primary section storage for the face crews as in Plan 1. Additionally, it requests shift secondary section storage for miners other than the face crew while they are in the section or within a distance equivalent to 10 min walk outby the section. That is:
1. All miners have SCSRs while traveling into and out of the mine.
 2. Primary section storage permits the eight miners on each face crew to place SCSRs in holders in the "dinner hole" when they arrive on the section.
 3. While the face crew maintains its primary storage, other miners may place SCSRs in the secondary section storage (their vehicle or a container). The place of secondary storage is within 5 min walk outby the primary section storage. These miners now can be in the section or a distance equivalent to less than 10 min walk outby the section without an SCSR.
- c. Plan 3 - This plan requires a minimum of 215 SCSRs. An average of 15 additional SCSRs will be required each month as the Mains advance. The plan requests various types of storage for all miners as follows:
1. All miners have SCSRs while traveling into and out of the mine.
 2. Face crew members may leave SCSRs in their portal bus which is parked within 5 min walk of the section. This requires a secondary section storage plan.
 3. The face crew has 12 SCSRs in containers in the intake escapeway. This provides full-time primary section storage.

4. Members of the face crew take an SCSR from their secondary storage should they need to go a distance equivalent to more than a 10 min walk outby the section.
 5. Secondary shift section storage on vehicles or temporarily in containers in an entry is provided for other miners while they are in or within a 10 min walk outby the section.
 6. Vehicle storage provides shift storage of SCSRs for miners whose whole work depends on their using a vehicle.
 7. Fixed caches in crosscuts with manddoors off of the main track haulageways provide full-time storage of SCSRs for all other miners.
- d. Plan 4 - This plan requires a minimum of 120 SCSRs at first. An additional 15 SCSRs probably would be required each month as the Mains advance. This plan is the same as Plan 3 except:
1. It assumes a petition for modification will be approved to allow miners not to have SCSRs within 25 ft while on mantrips into and out of the mine.
 2. Vehicle storage is limited to portal buses.

H.3 Mine B Plan Summary

Three storage plans are illustrated for Mine B. In summary these provide the following types of storage for miners:

- a. Plan 1 - This plan requires a minimum of 513 SCSRs, 12 more than the minimum required without a plan. The additional SCSRs are required for longwall section storage. The plan requests shift primary section storage for miners on the face crews of each of the 11 continuous miners and two longwall sections. That is:
1. All miners have SCSRs while traveling into and out of the mine.
 2. All miners except the face crews have SCSRs immediately available while in the mine.

3. The miners on each face crew may place their SCSRs in containers. The containers could be in the "dinner hole," in the intake escapeway, or on the control box for the stageloader; the actual location will depend on specific conditions such as equipment travel routes, mandoors, wetness and dust.
 4. A container of six SCSRs provides full-time storage in the tailgate of each longwall section.
- b. Plan 2 - This plan also requires a minimum of 513 SCSRs. This requests in addition to the Plan 1 storage, secondary storage for other miners while they are in the section or within a distance equivalent to 10 min crawl outby the section. The results are basically the same as those detailed for Mine A's Plan 1.
- c. Plan 3 - This plan requires a minimum of 673 SCSRs. It provides the same primary and secondary section storage as Plan 2. Additionally, it provides full-time fixed cache storage for miners.
1. Working at belt conveyor-to-mine car and belt-to-belt transfer points and along belt conveyors
 2. In entries parallel to the belt haulageway and within 700 ft (equal to 5 min) of one of these caches.

Date: 12/22/80

To: Manager, CMH&S District No. _____

For:

Mine A _____, I.D. No. 12-34567

1. Your approval is requested of the following supplement to our Program of Instruction submitted in accordance with 30 CFR, 75.1101-23(a) and approved by your office on 6/30, 1974.
- 1.1 This supplement is for storage of OXY-SR608, TC-13F-87 self-contained (Model) (Approval No.) self-rescue devices, hereafter referred to as SCSR's, in accordance with the provisions of paragraph (e), 30 CFR, 75.1714-2.
- 1.2 These SCSR's are to be stored for (MINERS ONLY) ~~(MINERS AND OTHER PERSONS AUTHORIZED BY THE APPLICANT TO ENTER THIS MINE)~~ ~~(ALL PERSONS)~~
- 1.3 (WITH NO EXCEPTIONS) ~~(WITH THE EXCEPTIONS DETAILED IN ATTACHMENT 1-3)~~ persons for whom SCSR's are stored will not enter an area in which an oxygen-deficient atmosphere is likely to develop as a result of breaking into such an atmosphere, a coal bump and/or a gas outburst.
- 1.4 (WITH NO EXCEPTIONS) ~~(WITH THE EXCEPTIONS DETAILED IN ATTACHMENT 1-4)~~ all persons for whom SCSR's are stored shall have at all times while underground a filter or other self-rescue device approved under subpart I of Part 11 of 30 CFR in accordance with paragraphs (b), (c) and (d) of 30 CFR, 75.1714-2 except the "readily accessible location" referred to need not be a holder or container.
- 1.5 (WITH NO EXCEPTIONS) ~~(WITH THE EXCEPTIONS DETAILED IN ATTACHMENT 1-5)~~ all persons for whom SCSR's are stored shall have the right to wear or carry another SCSR (IN LIEU OF) ~~(IN ADDITION TO)~~ an approved filter or other self-rescue device.
- 1.6 Temperatures in the place(S) of storage shall be maintained above freezing and below 100°F. ~~(METHODS TO BE USED TO PREVENT TEMPERATURES OUTSIDE THAT RANGE ARE GIVEN IN ATTACHMENT 1-6).~~

2. PRIMARY SECTION STORAGE

- a) Map(S) marked Figure(S) 1 to 2 in Attachment 2-a) show the place(S) of section storage of SCSR's. Also shown are:
These two figures apply to the 3 sections.
1. The maximum distance in feet and minutes from the point of deepest penetration of the working faces to the place(S) of primary storage. *<1200', <5 minutes*
 2. The maximum distance in feet and minutes from the place(S) of primary storage to the mouth of and/or mandoor into the designated escapeways.
<600', <5 minutes
 3. The average and least heights of travel routes 1. and 2. above.
62 inch avg. 50" in some places
 4. The average and maximum pitch of travel routes 1. and 2. above.
flat ± 3%
 5. The quality and quantity of air flows in travel routes 1. and 2. above.
at least 18000 cfm intake in each.
 6. Any ~~belt conveyors~~, trolley wire, and loading points in the section and for a distance equivalent to five minutes (WALK) (~~CRAWL~~) outby the section.
 7. The location of all permanent stoppings in the section.
 8. The routes of movement of equipment into and in the section(S).
- b) The (MINERS) (~~MINERS AND OTHER PERSONS~~) for whom the above 2-a) storage is planned are listed by section, job classification, number, and shift in Attachment 2-b).
- c) Storage for the persons listed in Attachment 2-b) should be approved for the following reasons: *These miners judge wearing or carrying SCSR's to be hazardous while performing their normal duties. No readily accessible location within 25 feet of every miner can be assured with reasonable certainty at all times.*
- d) SCSR's will be stored in: (Note: If in holders, respond to 1. below and cross out 2. If in containers, cross out 1. and respond to 2.)
1. Holders. The design and location of these holders and how SCSR's will be protected against damage, dust, grease, water and commingling are detailed in Attachment 2-d).
 - ~~2. Containers. The specifications for these containers and their weight when filled are detailed in Attachment 2-d).~~

e) This plan is for ~~(FULL-TIME)~~ (SHIFT) storage of SCSR's. (Note: If full-time, respond to 1. and 2. below).

~~1. Signs showing the location of and direction to the place(S) of storage are described in Attachment 2-e)1.~~

~~2. In the event of a fan outage or drill requiring withdrawal from the section the procedures to be followed in obtaining SCSR's and in subsequent inspection and testing of those SCSR's are detailed in Attachment 2-e)2.~~

3. SECONDARY SECTION STORAGE

(Note: Do not submit a plan for secondary storage unless you have submitted a plan for primary section storage.)

a) Map(S) marked Figure(S) _____ to _____ in Attachment 3-a) show the place(S) of secondary storage of SCSR's. Also shown are:

1. The maximum distance in feet and minutes to the place(S) of primary storage.
2. The maximum distance in feet and minutes from the place(S) of secondary storage to the designated escapeways.
3. The average and least heights of travel routes 1. and 2. above.
4. The average and maximum pitch of travel routes 1. and 2. above.
5. The quality and quantity of air flows in travel routes 1. and 2. above.
6. Any belt conveyors, trolley wire, and loading points within a distance equivalent to five minutes (WALK) (CRAWL) inby and outby the proposed place(S) of secondary storage.
7. The routes of movement of equipment in and around the proposed place(S) of secondary storage.

b) The (MINERS) (MINERS AND OTHER PERSONS) for whom the above 3-a) storage is planned are listed by job classification, number, and shift in Attachment 3-b).

c) _____ SCSR's will be in full-time primary storage as described in 2. (Number) above.

d) _____ SCSR's will be in secondary storage. (Number)

- d) SCSR's will be stored in containers. The specifications for these containers and their weight when filled are detailed in Attachment 6-d.
- e) This plan is for (FULL-TIME) (SHIFT) storage of SCSR's. (Note: If full-time, respond to 1. and 2. below.)
 - 1. Signs showing the location of and direction to the place(S) of storage are described in Attachment 6-e)1.
 - 2. In the event of a fan outage or drill requiring withdrawal from the area the procedures to be followed in obtaining SCSR's and in subsequent inspection and testing of those SCSR's are detailed in Attachment 6-e)2.

7. INSPECTION AND TESTING

(Note: Complete a) for shift storage and b) for full-time storage of SCSR's made available by the mine operator. Cross out the one, if any, which does not apply.)

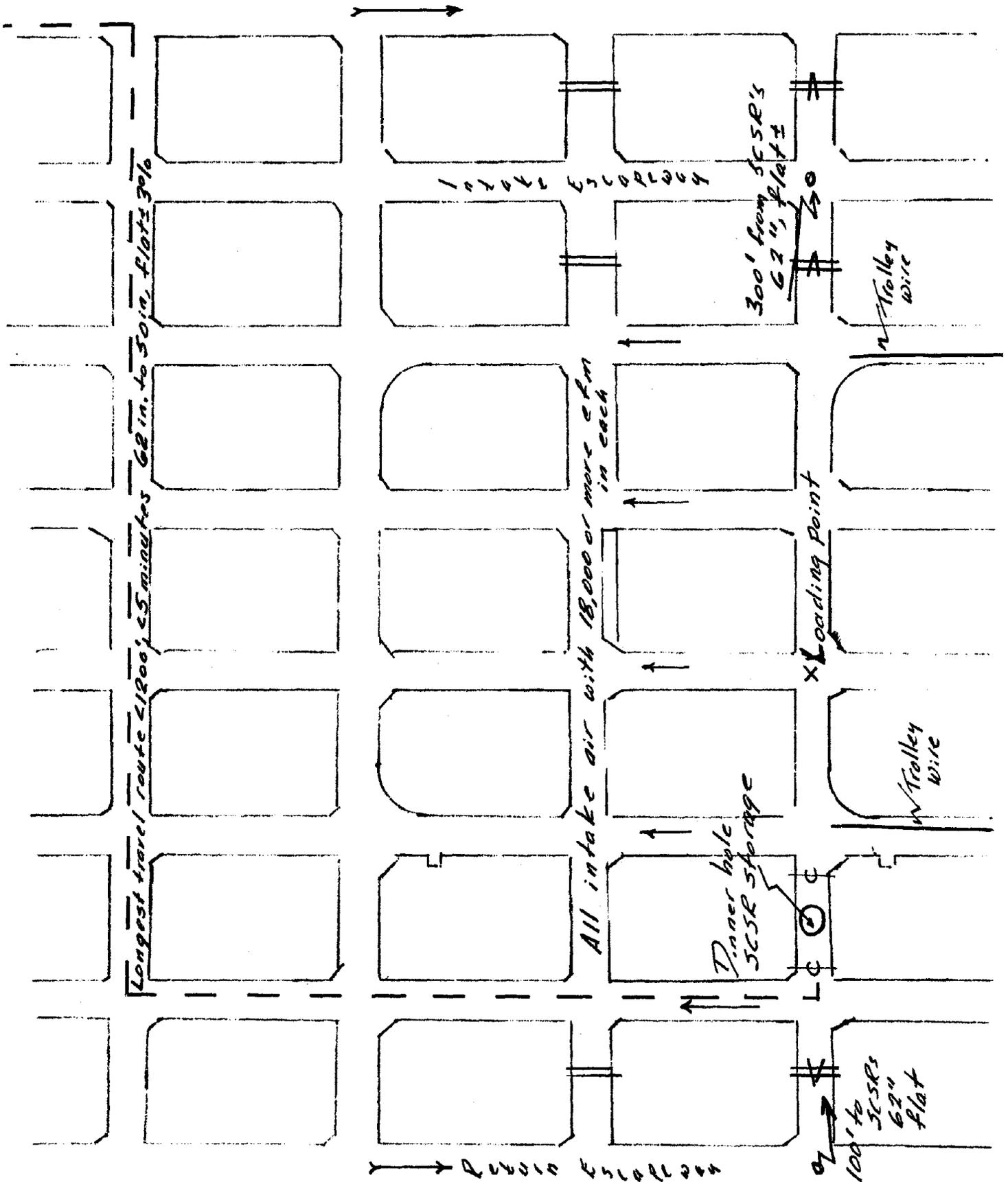
- a) This plan is for SCSR's carried out of the mine at the end of a miner's shift and within nine hours after an invitee enters the mine.

- 1. The "daily" inspection and testing approved by MSHA are detailed in Attachment 7-a)1.
- 2. The "daily" inspection and testing to be followed by the applicant mine operator, detailed in Attachment 7-a)2, include who will inspect and test the SCSR's and the training given to ~~(THAT)~~ (THOSE) person(S).
- 3. Other inspection and testing approved by MSHA is detailed in Attachment 7-a)3.
- 4. The other inspection and testing to be followed by the applicant mine operator detailed in Attachment 7-a)4 includes who will inspect and test the SCSR's and the training given to ~~(THAT)~~ (THOSE) person(S).
- 5. A record by SCSR serial number will be maintained to account for SCSR's tested in 4. above; ~~and, for other SCSR's~~

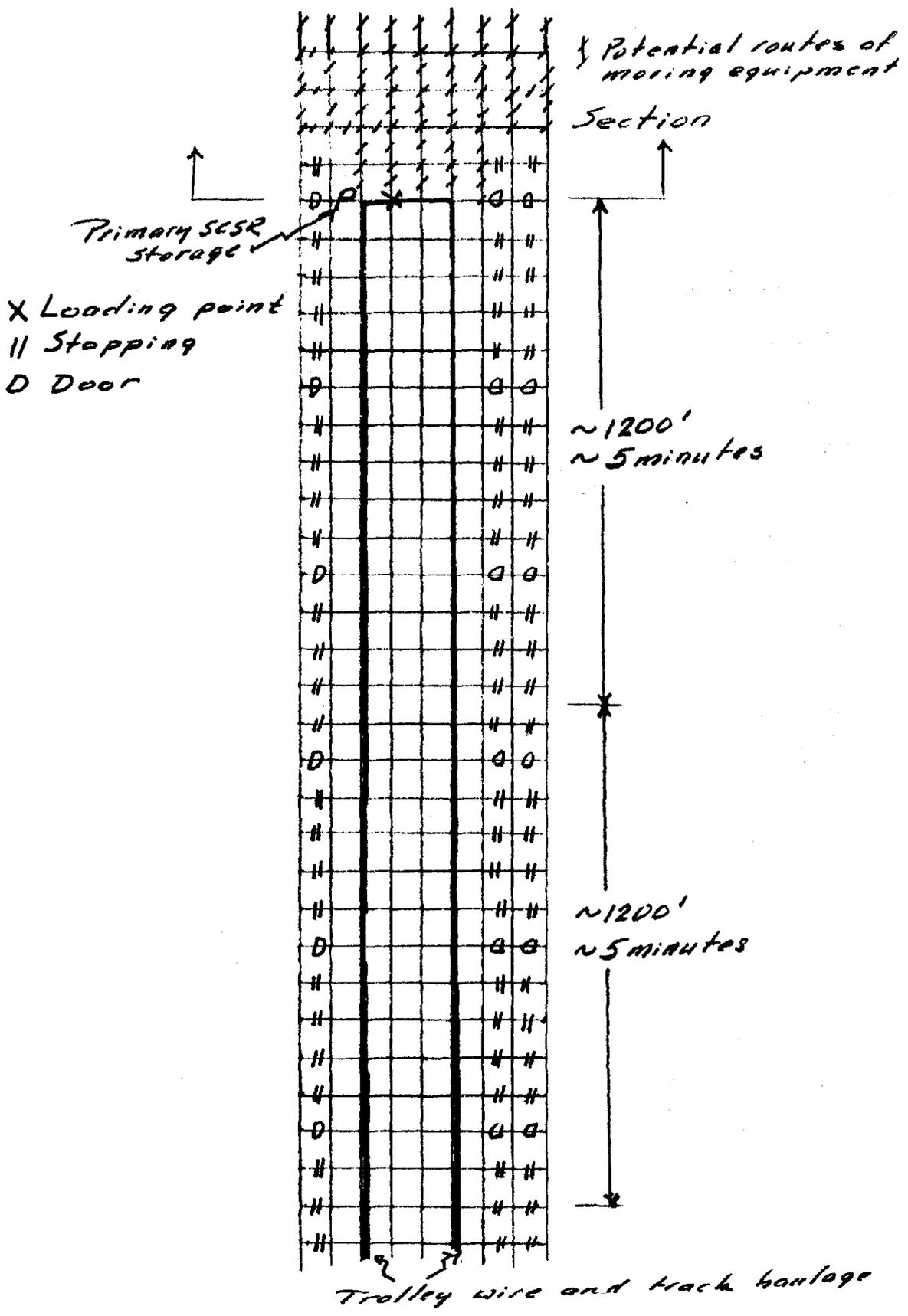
~~-- Disposed of and how disposed of~~

~~-- Missing, and the last known locations.~~

- ~~b) This plan is for SCSR's that remain in the mine at the end of a miner's shift.~~



Mine A Attachment 2-a Figure 1 of 2



Mine A Attachment 2-a Figure 2 of 2

December 22, 1980

Mine A
I.D. 12-34567

Attachment 2-b

Storage of SCSR's is requested for the face crews of the three sections now operating in this mine. The miners for whom this is requested are:

<u>Miner</u>	<u>Number</u>	<u>Shift</u>
<u>West Mains Parallel</u>		
Section Foreman	3	1,2,3
Continuous Mining Machine Operator	3	
Machine Operator Helper	3	
Shuttle Car Operator	6	
Roof Bolter	3	
Roof Bolter Helper	3	
General Inside Labor	3	
Mechanic	3	
<u>North Mains</u>		
Section Foreman	3	1,2,3
Continuous Mining Machine Operator	3	
Machine Operator Helper	3	
Shuttle Car Operator	6	
Roof Bolter	3	
Roof Bolter Helper	3	
General Inside Labor	3	
Mechanic	3	
<u>West Mains</u>		
Section Foreman	2	2,3
Continuous Mining Machine Operator	2	
Machine Operator Helper	2	
Shuttle Car Operator	4	
Roof Bolter	2	
Roof Bolter Helper	2	
General Inside Labor	2	
Mechanic	2	

December 22, 1980

Mine A
I.D. 12-34567

Attachment 2-d

SCSR's will be hung by their straps at least 40 inches above the floor from substantial wooden pegs (such as cut from broomsticks). The pegs will be secured in either:

- a) 2" x 8" or larger hardwood timber bolted to the rib; or,
- b) 4-inch diameter posts.

Either protects SCSR's against damage by excessive water, fall of rib or roof, vibrations and being struck by equipment.

December 22, 1980

Mine A
I.D. 12-34567

Attachment 7-a)1

The following is from page 7 Drager Operating Manual 1165.2e,
April 1980.

DAILY CHECK (if carried daily)

The device should be checked for external damage daily if carried daily. This visual inspection includes viewing the indicator 25 to ensure that it is blue in color and inspecting the sealing clip 35 to ensure it is present.

Additionally the outer housing 24, 29 should be inspected for cracks, punctures, or other obvious physical damage to rescuer. If indicator has changed color, or if sealing clip is missing, or if other damage to rescuer is obvious, it should be removed from service (see Troubleshooting page 13), but the unit may not be unsealed for maintenance of parts or replacement of same by the user in the field.

December 22, 1980

Mine A
I.D. 12-34567

Attachment 7-a)2

Inspection and Testing

SCSR's will be OXY-SR60B, Approval No. TC-13F-87. Each shall be inspected and tested for damage and for the integrity of its seal

- a) Each time it is worn or carried (the applicant mine operator assumes that "each time" is what is meant by Drager's "daily" in instructions).
- b) By the person who wears or carries it, which person will have been trained to inspect and test these SCSR's.
- c) In the SCSR house
- d) In accordance with the instructions specified by the manufacturer and posted on a wall of the SCSR house in bold, easily understood graphics.
- e) These instructions consist of:
 - Viewing indicator 25 to ensure it is blue in color
 - Inspect sealing clip 35 to ensure it is present
 - Inspect the outer housing 24 and 29 for obvious cracks, punctures, or other physical damage.

Each miner will have received an initial 1-hour training with a subsequent review of at least 5 minutes at least twice a year. We are convinced the simplicity of inspection e) and clarity of poster d) ensure the adequacy of the required inspection by any miner.



December 22, 1980

Mine A
I.D. 12-34567

Attachments 7-a)3 and 7-a)4

The following is from page 11 Drager Operating Manual 1165.2e,
April 1980.

Additionally it is recommended that all devices (units carried daily and units in storage) be tested for leakage every 90 days through use of visual inspection (page 7) and water immersion or any other recognized testing method approved by the U.S. Government agency or agencies governing such methods.

Any unit which has a visible puncture in the case or has visible damage at the seal area must be removed from service and should not be tested for leakage. Such a unit is obviously not in order for further service. If the indicator is blue, place the unit in a sealed plastic bag for possible repair by a Draeger Agency.

The applicant will have each SCSR visually inspected using the procedures specified in e) of Attachment 7-a)2. This will be done by a trained person authorized by the applicant to record the results of the inspection by SCSR serial number in a book.

PLAN 2.

Date: 12/26/80

To: Manager, CMH&S District No. _____

For:

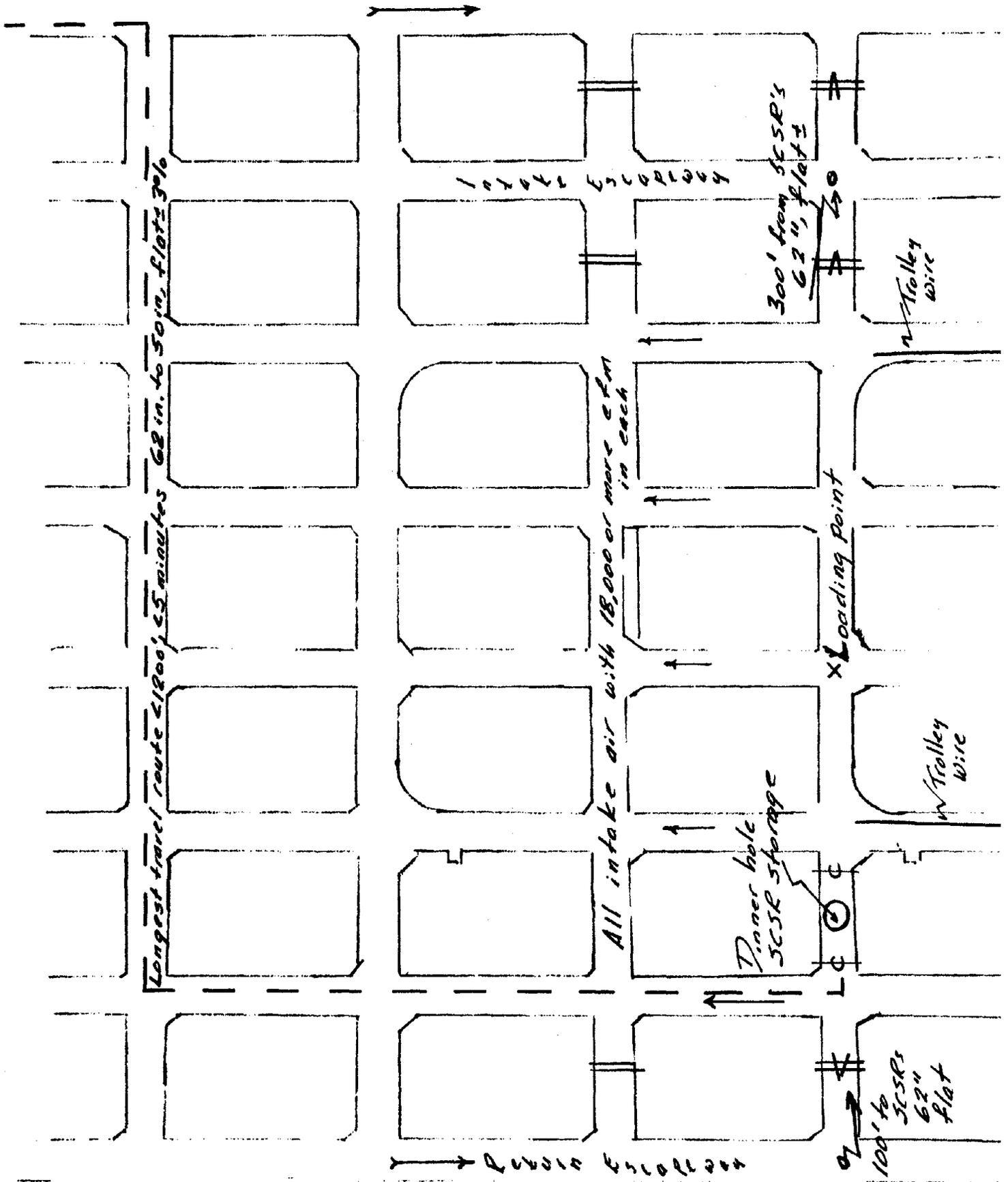
Mine A, I.D. No. 12-34567

1. Your approval is requested of the following supplement to our Program of Instruction submitted in accordance with 30 CFR, 75.1101-23(a) and approved by your office on 6/30, 19 74
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- 1.2 These SCSR's are to be stored for (MINERS ONLY) ~~(MINERS AND OTHER PERSONS AUTHORIZED BY THE APPLICANT TO ENTER THIS MINE)~~ ~~(ALL PERSONS)~~
- 1.3 (WITH NO EXCEPTIONS) ~~(WITH THE EXCEPTIONS DETAILED IN ATTACHMENT 1-3)~~ persons for whom SCSR's are stored will not enter an area in which an oxygen-deficient atmosphere is likely to develop as a result of breaking into such an atmosphere, a coal bump and/or a gas outburst.
- 1.4 (WITH NO EXCEPTIONS) ~~(WITH THE EXCEPTIONS DETAILED IN ATTACHMENT 1-4)~~ all persons for whom SCSR's are stored shall have at all times while underground a filter or other self-rescue device approved under subpart I of Part 11 of 30 CFR in accordance with paragraphs (b), (c) and (d) of 30 CFR, 75.1714-2 except the "readily accessible location" referred to need not be a holder or container.
- 1.5 (WITH NO EXCEPTIONS) ~~(WITH THE EXCEPTIONS DETAILED IN ATTACHMENT 1-5)~~ all persons for whom SCSR's are stored shall have the right to wear or carry another SCSR (IN LIEU OF) ~~(IN ADDITION TO)~~ an approved filter or other self-rescue device.
- 1.6 Temperatures in the place(S) of storage shall be maintained above freezing and below 100°F. (METHODS TO BE USED TO PREVENT TEMPERATURES OUTSIDE THAT RANGE ARE ~~GIVEN IN ATTACHMENT 1-6~~).

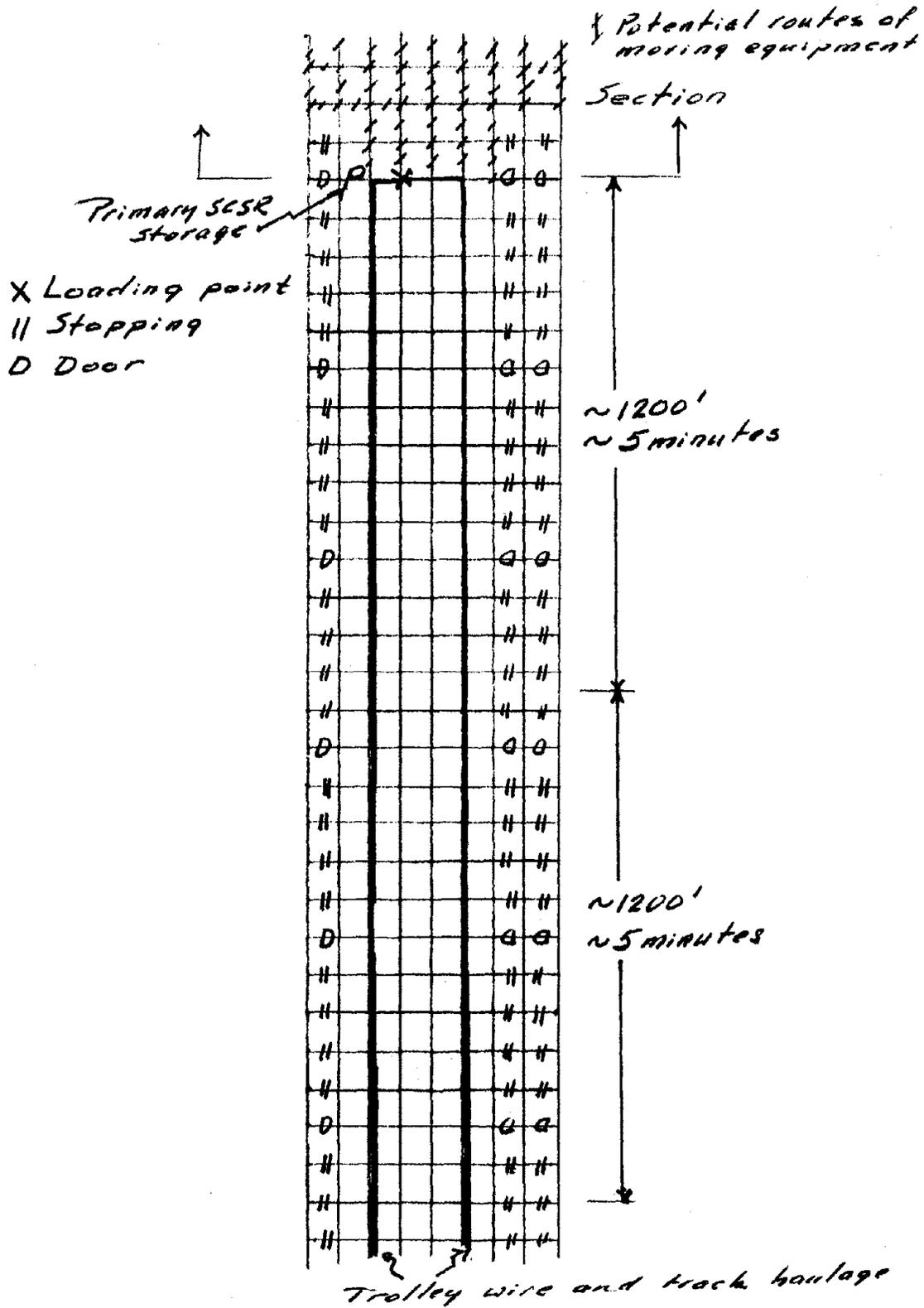
A heater will be used in the unlikely event temperatures go below freezing. The temperature will be monitored by frequent observation of a

2. PRIMARY SECTION STORAGE

- a) Map(S) marked Figure(S) 1 to 2 in Attachment 2-a) show the place(S) of section storage of SCSR's. Also shown are:
These apply to all three sections
1. The maximum distance in feet and minutes from the point of deepest penetration of the working faces to the place(S) of primary storage. *< 1200', < 5 minutes*
 2. The maximum distance in feet and minutes from the place(S) of primary storage to the mouth of and/or mandoor into the designated escapeways. *< 600', < 5 minutes*
 3. The average and least heights of travel routes 1. and 2. above. *62" avg., 50" least*
 4. The average and maximum pitch of travel routes 1. and 2. above. *flat \pm 3%*
 5. The quality and quantity of air flows in travel routes 1. and 2. above. *at least 18000 cfm intake in each*
 6. Any ~~belt conveyors~~, trolley wire, and loading points in the section and for a distance equivalent to five minutes (WALK) (~~CRAWL~~) outby the section.
 7. The location of all permanent stoppings in the section.
 8. The routes of movement of equipment into and in the section(S).
- b) The (MINERS) ~~(MINERS AND OTHER PERSONS)~~ for whom the above 2-a) storage is planned are listed by section, job classification, number, and shift in Attachment 2-b).
- c) Storage for the persons listed in Attachment 2-b) should be approved for the following reasons: *These miners judge wearing or carrying SCSR's to be hazardous while performing many of their normal activities. No readily accessible location within 25 feet of each miner can be assured with reasonable certainty at all times.*
- d) SCSR's will be stored in: (Note: If in holders, respond to 1. below and cross out 2. If in containers, cross out 1. and respond to 2.)
1. Holders. The design and location of these holders and how SCSR's will be protected against damage, dust, grease, water and commingling are detailed in Attachment 2-d).
 2. ~~Containers. The specifications for these containers and their weight when filled are detailed in Attachment 2-d).~~



Mine A Attachment 2-a Figure 1 of 2



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Mine A
I.D. 12-34567

Attachment 2-b

Storage of SCSR's is requested for the face crews of the three sections now operating in this mine. The miners for whom this is requested are:

<u>Miner</u>	<u>Number</u>	<u>Shift</u>
<u>West Mains Parallel</u>		
Section Foreman	3	1,2,3
Continuous Mining Machine Operator	3	
Machine Operator Helper	3	
Shuttle Car Operator	6	
Roof Bolter	3	
Roof Bolter Helper	3	
General Inside Labor	3	
Mechanic	3	
<u>North Mains</u>		
Section Foreman	3	1,2,3
Continuous Mining Machine Operator	3	
Machine Operator Helper	3	
Shuttle Car Operator	6	
Roof Bolter	3	
Roof Bolter Helper	3	
General Inside Labor	3	
Mechanic	3	
<u>West Mains</u>		
Section Foreman	2	2,3
Continuous Mining Machine Operator	2	
Machine Operator Helper	2	
Shuttle Car Operator	4	
Roof Bolter	2	
Roof Bolter Helper	2	
General Inside Labor	2	
Mechanic	2	

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Attachment 2-d

SCSR's will be hung by their straps at least 40 inches above the floor from substantial wooden pegs (such as cut from broomsticks). The pegs will be secured in either:

- a) 2" x 8" or larger hardwood timber bolted to the rib; or,
- b) 4-inch diameter posts.

Either protects SCSR's against damage by excessive water, fall of rib or roof, vibrations and being struck by equipment.

e) This plan is for ~~(FULL TIME)~~ (SHIFT) storage of SCSR's. (Note: If full-time, respond to 1. and 2. below).

~~1. Signs showing the location of and direction to the place(S) of storage are described in Attachment 2-e)1.~~

~~2. In the event of a fan outage or drill requiring withdrawal from the section the procedures to be followed in obtaining SCSR's and in subsequent inspection and testing of these SCSR's are detailed in Attachment 2-e)2.~~

3. SECONDARY SECTION STORAGE

(Note: Do not submit a plan for secondary storage unless you have submitted a plan for primary section storage.)

a) Map ~~(S)~~ marked Figure ~~(S)~~ 3 to — in Attachment 3-a) show the place(S) of secondary storage of SCSR's. Also shown are:

1. The maximum distance in feet and minutes to the place(S) of primary storage. < 1200', < 5 minutes

2. The maximum distance in feet and minutes from the place(S) of secondary storage to the designated escapeways. 500' ~ 3 minutes to return escapeway. < 600' ~ 3 minutes to intake escapeway.

3. The average and least heights of travel routes 1. and 2. above.

62" avg., 50" least in a few areas

4. The average and maximum pitch of travel routes 1. and 2. above.

flat ± 3%

5. The quality and quantity of air flows in travel routes 1. and 2. above. at least 18000 cfm intake in each

6. Any ~~belt conveyors~~, trolley wire, and loading points within a distance equivalent to five minutes (WALK) ~~(CRAWL)~~ inby and outby the proposed place(S) of secondary storage.

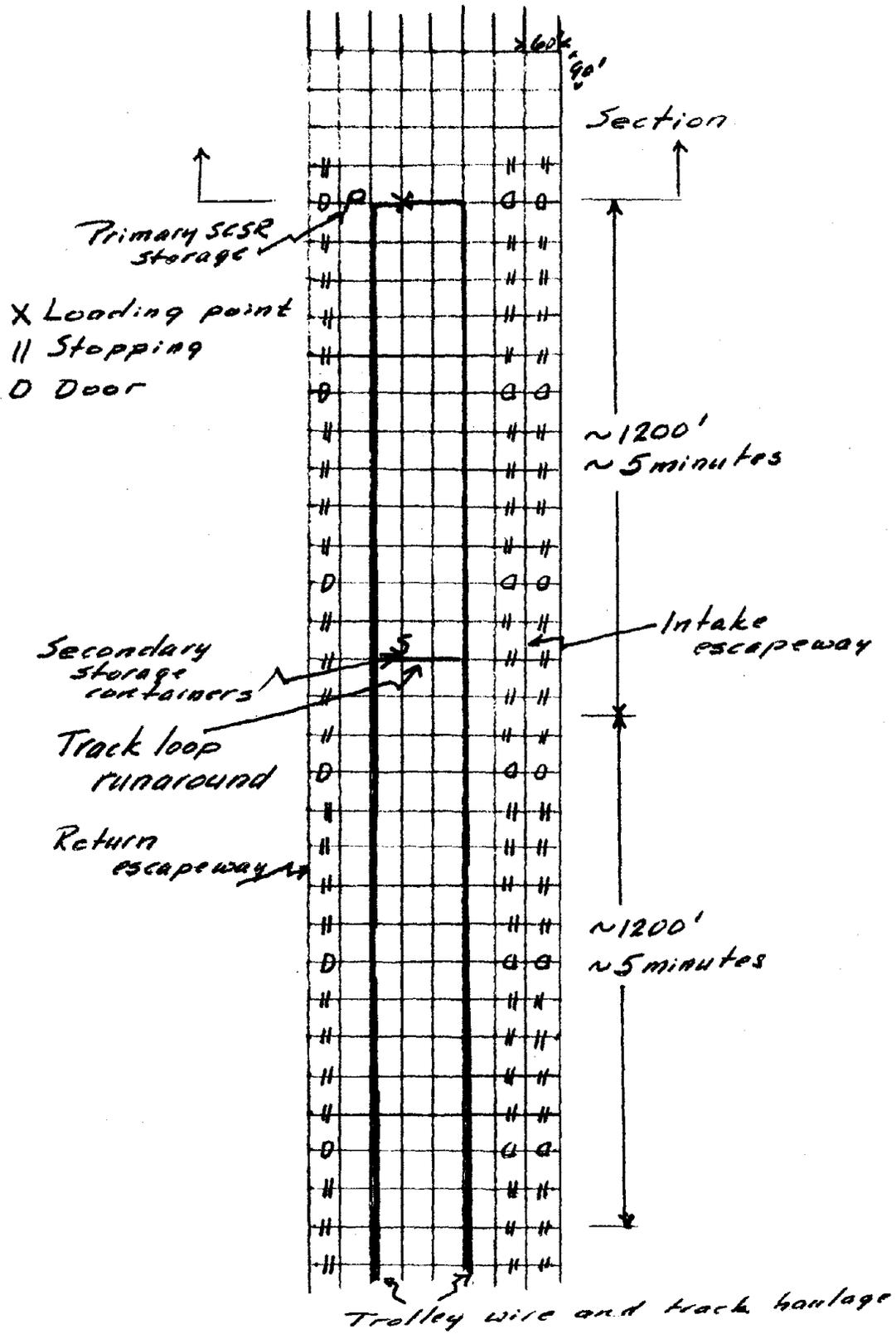
7. The routes of movement of equipment in and around the proposed place(S) of secondary storage. None other than parking in the track loop runaround

b) The (MINERS) ~~(MINERS AND OTHER PERSONS)~~ for whom the above 3-a) storage is planned are listed by job classification, number, and shift in Attachment 3-b).

c) — SCSR's will be in ~~full time~~ primary storage as described in 2. (Number) above. See Attachment 3-c

d) — SCSR's will be in secondary storage. (Number) See Attachment 3-c

- e) Storage for the persons listed in Attachment 3-b) should be approved for the following reasons: *These miners judge wearing or carrying SCSR's to be hazardous while performing many of their normal activities. No readily accessible location within 25 feet of each miner can be assured with reasonable certainty at all times.*
- f) SCSR's will be stored in: (Note: If in holders, respond to 1. below and cross out 2. If in containers, cross out 1. and respond to 2.)
1. Holders. The design and location of these holders and how SCSR's will be protected against damage, dirt, grease, water and commingling are detailed in Attachment 3-f)1.
 2. Containers. The specifications for these containers and their weight when filled are detailed in Attachment 3-f)2.
- g) This plan is for ~~(FULL-TIME)~~ (SHIFT) storage of SCSR's. (Note: If full-time, respond to 1. and 2. below.)
1. ~~Signs showing the location of and direction to the place(s) of storage are described in Attachment 3-g)1.~~
 2. ~~In the event of a fan outage or drill requiring withdrawal from the area the procedures to be followed in obtaining SCSR's and in subsequent inspection and testing of these SCSR's are detailed in Attachment 3-g)2.~~
- h) Products of combustion will be divertable from the place(S) of secondary storage by the methods detailed in Attachment 3-h).
- i) (Note: Cross out if not applicable.) No parked vehicles used as a place of secondary storage shall be moved until each person dependent on an SCSR in that vehicle either:
1. Knows the new location of that vehicle; and, is within five minutes (WALK) ~~(CRAWL)~~ of that vehicle. Or,
 2. Knows the vehicle will be moved; and, has another readily accessible SCSR in the secondary storage
(Location)
in Entry No. 4 as shown on Attachments 3-a
and 3-c.



Mine A Attachment 3-a Figure 3
12/12/10

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Mine A
I.D. 12-34567

Attachment 3-b

This plan provides for the storage of SCSR's used by any miner whose duties require working in and around the three operating sections, specifically: West Mains Parallel, North Mains and West Mains. Those miners are:

<u>Type</u>	<u>Shift</u>	<u>1</u>	<u>2</u>	<u>3</u>	<u>Total</u>
Wireman		0	2	0	2
Trackman		0	6	0	6
Mason		0	1	0	1
Bratticeman		0	1	0	1
Mechanic		2	2	2	6
Master mechanic		0	1	0	1
Pumper/fireboss		0	1	0	1
General labor		3	11	3	17
Shift foreman		1	1	1	3
Mine foreman		-	*	-	1
Maintenance foreman		1	1	1	3
Safety inspector		-	*	-	1
General Assistant		-	*	-	1
Superintendent		-	*	-	1
Transitman		0	2	0	2
Mine engineer		-	*	-	1
Draftsman		0	1	0	1
Safety supervisor		-	*	-	1
Training coordinator		-	*	-	1
Regional company inspector		-	*	-	1

* Most frequent shift. These miners will comply with the provisions of subparagraphs (b), (c) and (d) of 30 CFR, 75.1714-2 while in other areas of the mine; all other persons will comply with those provisions in all areas of the mine.

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I.D. 12-34567

Attachment 3-c

The number of SCSR's in primary storage will be:

1. Equal to or greater than the number of miners on the face crew for that section (see Attachment 2-b)
2. Less the number of those face crew members who have removed an SCSR from primary storage
3. Plus the number of miners resulting from a)(i) and b) as follows.

Three places of storage will be provided based on travel mode as follows:

- a) Walk -- Miners who walk to the section and whose normal duties are
 - (i) Within the section, can store their SCSR's in the primary storage
 - (ii) Outby and within ten minutes walk to the section, can store their SCSR's in a container provided for this purpose in Entry No. 4 near its junction with the track loop runaround shown in Attachment 3-a.
- b) Face crew vehicle -- Miners who travel to the section in the vehicle(s) used to bring the face crew to the section can store their SCSR's in the primary storage.
- c) Other vehicles -- Miners in or around the section who travel in vehicles that remain at their assigned parking place can leave their SCSR's in holders or containers in those vehicles or in a container in the Entry No. 4 storage. The assigned parking place will be in a track loop runaround not farther than 1200 feet from the Plan 1 place of storage.

Note: Storage of SCSR's on Vehicles is detailed also in Section 5.

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Attachment 3-f)1, 3-f)2, 3-h

3-f)1 Holders -- Nylon net hammocks may be slung across the front of each passenger compartment of some covered portal buses. These hammocks may be used to store up to 15 SCSR's in a portal bus. These hammocks will provide at least as much protection to SCSR's against damage, dirt and grease as the portal buses provide the passengers. All invitees will be issued SCSR's by the applicant; therefore, such SCSR's do not create a commingling hazard. All other persons must wear or carry their SCSR's while traveling in a vehicle in Mine A.

3-f)2 Containers -- Containers may be used in lieu of holders in vehicles. These containers will be placed in a padded holder bolted to a seat. Each container will have a capacity for up to six SCSR's. Each container will be Dobson Shippers Model 600, a plastic case built to ATA-300 specifications. When filled with six SCSR's a container may weigh up to 107 pounds.

These containers may be removed from the vehicles and placed in the Entry No. 4 place of secondary storage. This would be done should temperatures in the assigned vehicle parking place go below freezing and when the vehicle is moved away from its assigned parking place. In either event, the miners for whom these SCSR's are stored will know of the changed location. One or more other containers may be placed in Entry No. 4 within 50 feet inby its junction with the track loop runaround.

The place will have posts or other means to alert equipment operators, though mobile equipment seldom travels through this place. This place is warm, generally 36° to 65°F. A heater will be provided should temperatures go below freezing.

3-h Safe access to SCSR's stored on the vehicles will be obtained by miners wearing or carrying FSR's and by erection of check curtains, should the need arise, at appropriate places. A supply of brattice for that purpose will be near the Entry No. 4 place of storage.

For safe access to Entry No. 4 storage, miners will wear or carry FSR's. The only time the area could contain a toxic atmosphere is in the event of fire in or outby the trolley loop turnaround. Spads in the roof and a brattice against one rib outby the containers will permit rapid diversion of smoke and gases away from the place of storage.

- ~~d) SCSR's will be stored in containers. The specifications for these containers and their weight when filled are detailed in Attachment 6-d.~~
- ~~e) This plan is for (FULL-TIME) (SHIFT) storage of SCSR's. (Note: If full-time, respond to 1. and 2. below.)~~
- ~~1. Signs showing the location of and direction to the place(s) of storage are described in Attachment 6-e)1.~~
 - ~~2. In the event of a fan outage or drill requiring withdrawal from the area the procedures to be followed in obtaining SCSR's and in subsequent inspection and testing of those SCSR's are detailed in Attachment 6-e)2.~~

7. INSPECTION AND TESTING

(Note: Complete a) for shift storage and b) for full-time storage of SCSR's made available by the mine operator. Cross out the one, if any, which does not apply.)

- a) This plan is for SCSR's carried out of the mine at the end of a miner's shift and within nine hours after an invitee enters the mine.
1. The "daily" inspection and testing approved by MSHA are detailed in Attachment 7-a)1.
 2. The "daily" inspection and testing to be followed by the applicant mine operator, detailed in Attachment 7-a)2, include who will inspect and test the SCSR's and the training given to (THAT) (THOSE) person(S).
 3. Other inspection and testing approved by MSHA is detailed in Attachment 7-a)3.
 4. The other inspection and testing to be followed by the applicant mine operator detailed in Attachment 7-a)4 includes who will inspect and test the SCSR's and the training given to (THAT) (THOSE) person(S).
 5. A record by SCSR serial number will be maintained to account for SCSR's tested in 4. above; ~~and, for other SCSR's~~
~~Disposed of and how disposed of~~
~~Missing, and the last known locations.~~
- ~~b) This plan is for SCSR's that remain in the mine at the end of a miner's shift.~~

December 26, 1980

Mine A
I.D. 12-34567

Attachment 7-a)1

The following is from page 7 Drager Operating Manual 1165.2e,
April 1980.

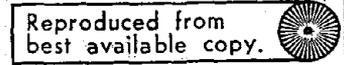
DAILY CHECK (if carried daily)

The device should be checked for external damage daily if carried daily. This visual inspection includes viewing the indicator 25 to ensure that it is blue in color and inspecting the sealing clip 35 to ensure it is present.

Additionally the outer housing 24, 29 should be inspected for cracks, punctures, or other obvious physical damage to rescuer. If indicator has changed color, or if sealing clip is missing, or if other damage to rescuer is obvious, it should be removed from service (see Troubleshooting page 13), but the unit may not be unsealed for maintenance of parts or replacement of same by the user in the field.

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Mine A
I.D. 12-34567



Attachment 7-a)2

Inspection and Testing

SCSR's will be OXY-SR60B, Approval No. TC-13F-87. Each shall be inspected and tested for damage and for the integrity of its seal

- a) Each time it is worn or carried (the applicant mine operator assumes that "each time" is what is meant by Drager's "daily" in instructions).
- b) By the person who wears or carries it, which person will have been trained to inspect and test these SCSR's.
- c) In the SCSR house
- d) In accordance with the instructions specified by the manufacturer and posted on a wall of the SCSR house in bold, easily understood graphics.
- e) These instructions consist of:
 - Viewing indicator 25 to ensure it is blue in color
 - Inspect sealing clip 35 to ensure it is present
 - Inspect the outer housing 24 and 29 for obvious cracks, punctures, or other physical damage.

Each miner will have received an initial 1-hour training with a subsequent review of at least 5 minutes at least twice a year. We are convinced the simplicity of inspection e) and clarity of poster d) ensure the adequacy of the required inspection by any miner.

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Mine A
I.D. 12-34567

Attachments 7-a)3 and 7-a)4

The following is from page 11 Draeger Operating Manual 1165.2e, April 1980.

Additionally it is recommended that all devices (units carried daily and units in storage) be tested for leakage every 90 days through use of visual inspection (page 7) and water immersion or any other recognized testing method approved by the U.S. Government agency or agencies governing such methods.

Any unit which has a visible puncture in the case or has visible damage at the seal area must be removed from service and should not be tested for leakage. Such a unit is obviously not in order for further service. If the indicator is blue, place the unit in a sealed plastic bag for possible repair by a Draeger Agency.

The applicant will have each SCSR visually inspected using the procedures specified in e) of Attachment 7-a)2. This will be done by a trained person authorized by the applicant to record the results of the inspection by SCSR serial number in a book.

Date: 2/18/81

To: Manager, CMH&S District No. _____

For: Mine A, I.D. No. 12-34567

1. Your approval is requested of the following supplement to our Program of Instruction submitted in accordance with 30 CFR, 75.1101-23(a) and approved by your office on 6/30, 19 74.
- 1.1 This supplement is for storage of OXY-SR60B TC-13F-87
 (Model) (Approval Number)
 self-contained self-rescue devices, hereafter referred to as SCSR's, in accordance with the provisions of paragraph (e), 30 CFR, 75.1714-2.
- 1.2 These SCSR's are to be stored for (MINERS ONLY) ~~(MINERS AND OTHER PERSONS AUTHORIZED BY THE APPLICANT TO ENTER THIS MINE)~~
~~(ALL PERSONS)~~
- 1.3 (WITH NO EXCEPTIONS) ~~(WITH THE EXCEPTIONS DETAILED IN ATTACHMENT 1-3)~~ persons for whom SCSR's are stored will not enter an area in which an oxygen-deficient atmosphere is likely to develop as a result of breaking into such an atmosphere, a coal bump and/or a gas outburst.
- 1.4 (WITH NO EXCEPTIONS) ~~(WITH THE EXCEPTIONS DETAILED IN ATTACHMENT 1-4)~~ all persons for whom SCSR's are stored shall have at all times while underground a filter or other self-rescue device approved under subpart I of Part 11 of 30 CFR in accordance with paragraphs (b), (c) and (d) of 30 CFR, 75.1714-2 except the "readily accessible location" referred to need not be a holder or container.
- 1.5 (WITH NO EXCEPTIONS) ~~(WITH THE EXCEPTIONS DETAILED IN ATTACHMENT 1-5)~~ all persons for whom SCSR's are stored shall have the right to wear or carry another SCSR (IN LIEU OF) ~~(IN ADDITION TO)~~ an approved filter or other self-rescue device.
- 1.6 Temperatures in the place(S) of storage shall be maintained above freezing and below 100°F. (METHODS TO BE USED TO PREVENT TEMPERATURES OUTSIDE THAT RANGE ARE GIVEN IN ATTACHMENT 1-6).

February 18, 1981

Mine A
I.D. 12-34567

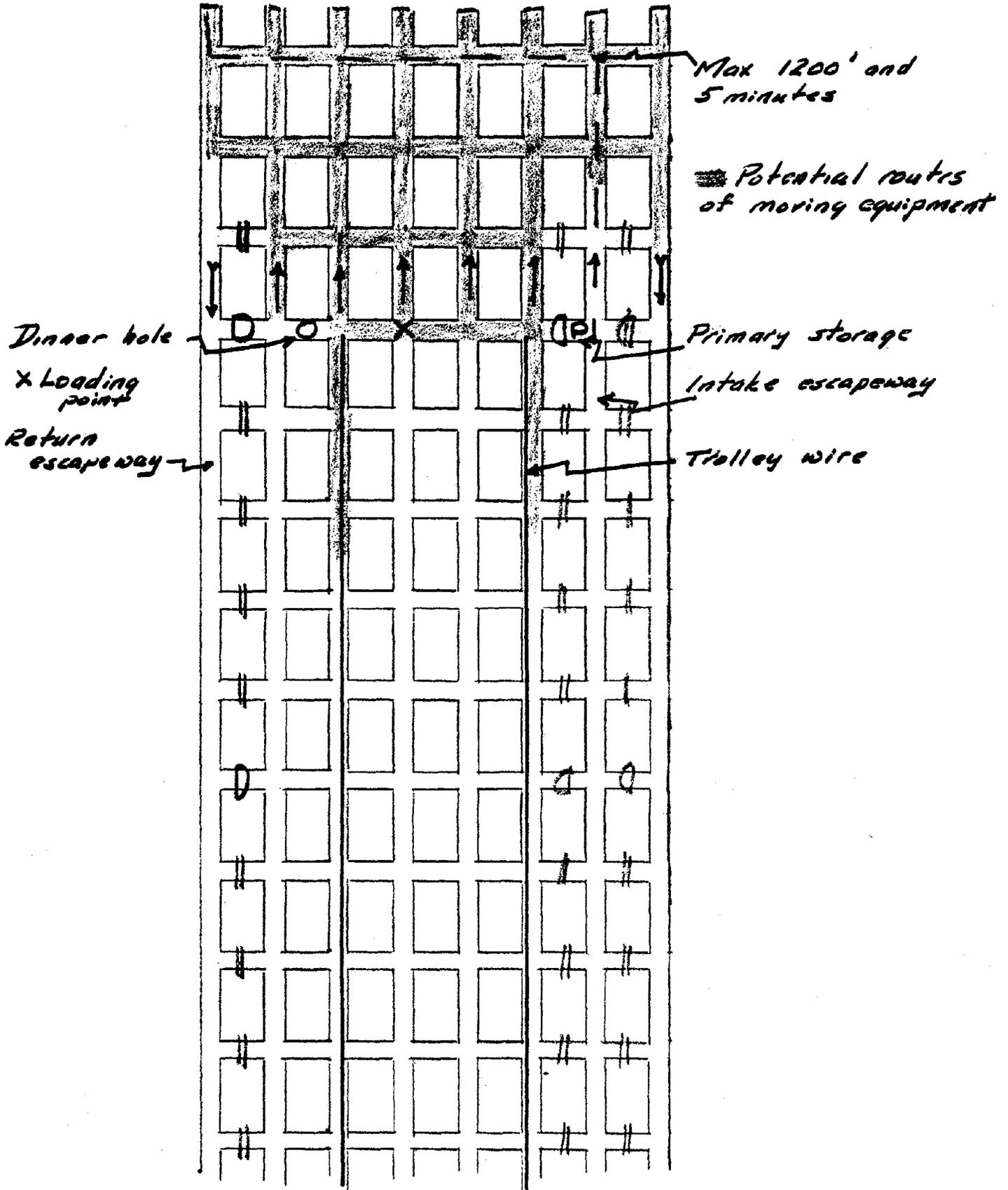
Attachment 1-6

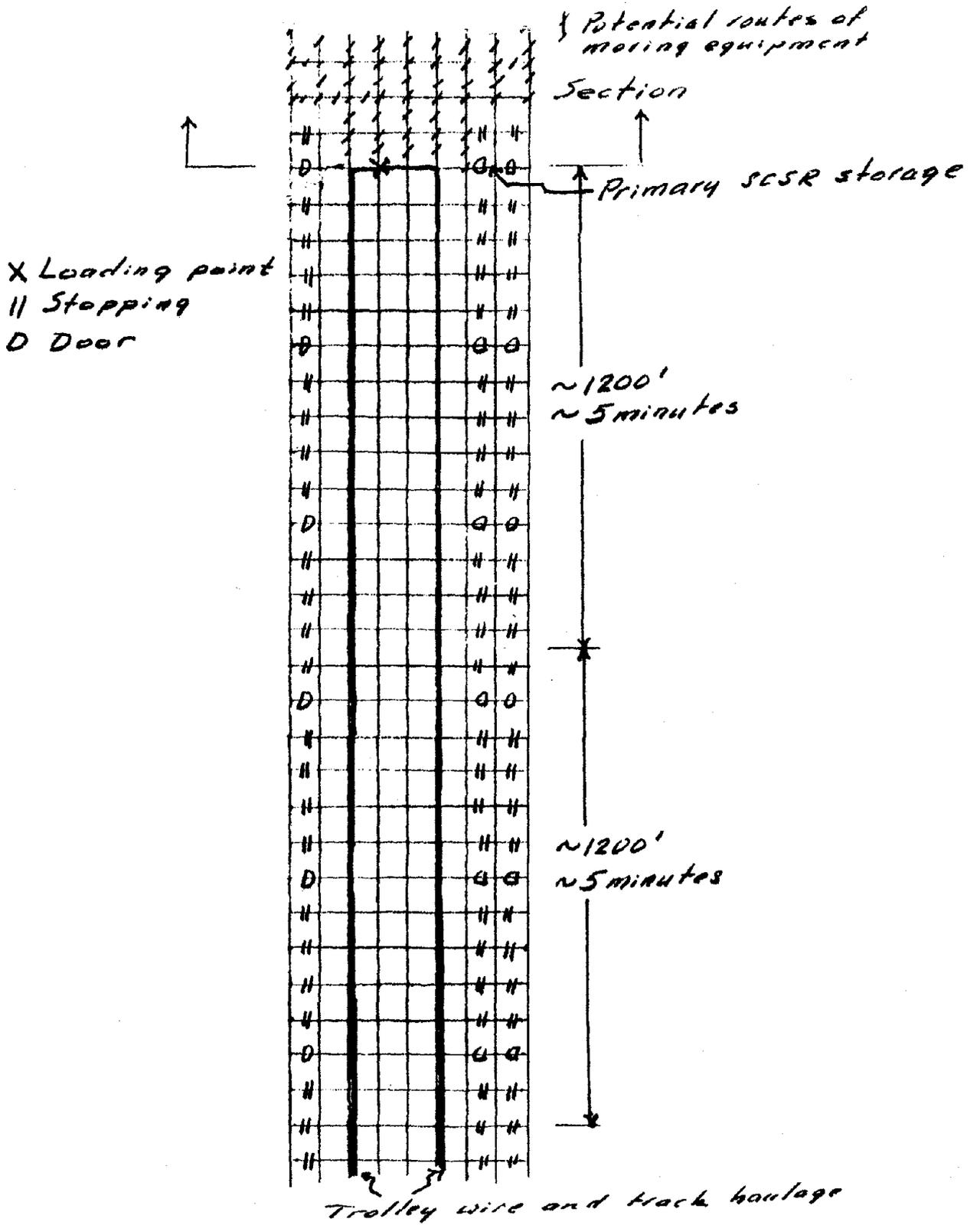
SCSR's will not be exposed to temperatures above 100°F. They might be subjected to below freezing temperatures in

- Secondary storage on a vehicle. Should that occur and the vehicle is to remain in the place of secondary storage for more than one hour, SCSR's will be placed in a container in the Entry No. 4 secondary storage.
- Entry No. 4 secondary storage. A heater will be available to prevent below freezing temperatures being sustained for more than one hour.
- Vehicle storage other than secondary. We are investigating means to prevent this.
- Other storage. These places will be enclosed by stoppings on one side and a curtain on the other. We anticipate the heat from two 100-watt bulbs will maintain temperatures above freezing. In the event of a power outage the combination of no forced ventilation, the shelter affect of the place, and the residual heat should suffice. Unless persons are forbidden to enter the mine, we would inspect these places at least daily during a power outage.

2. PRIMARY SECTION STORAGE

- a) Map(S) marked Figure(S) 1 to 2 in Attachment 2-a) show the place(S) of section storage of SCSR's. Also shown are:
These apply to all three sections
1. The maximum distance in feet and minutes from the point of deepest penetration of the working faces to the place(S) of primary storage. *< 1200', < 5 minutes*
 2. The maximum distance in feet and minutes from the place(S) of primary storage to the mouth of and/or man door into the designated escapeways. *< 600', < 5 minutes*
 3. The average and least heights of travel routes 1. and 2. above. *62" avg., 50" least*
 4. The average and maximum pitch of travel routes 1. and 2. above. *flat \pm 3%*
 5. The quality and quantity of air flows in travel routes 1. and 2. above. *at least 18000 cfm intake in each*
 6. Any ~~belt conveyors~~, trolley wire, and loading points in the section and for a distance equivalent to five minutes (WALK) (~~CRAWL~~) outby the section.
 7. The location of all permanent stoppings in the section.
 8. The routes of movement of equipment into and in the section(S).
- b) The (MINERS) ~~(MINERS AND OTHER PERSONS)~~ for whom the above 2-a) storage is planned are listed by section, job classification, number, and shift in Attachment 2-b).
- c) Storage for the persons listed in Attachment 2-b) should be approved for the following reasons: *These miners judge wearing or carrying SCSR's to be hazardous while performing many of their normal activities. No readily accessible location within 25 feet of each miner can be assured with reasonable certainty at all times.*
- d) SCSR's will be stored in: (Note: If in holders, respond to 1. below and cross out 2. If in containers, cross out 1. and respond to 2.)
- ~~1. Holders. The design and location of these holders and how SCSR's will be protected against damage, dust, grease, water and con-mingling are detailed in Attachment 2-d).~~
 2. Containers. The specifications for these containers and their weight when filled are detailed in Attachment 2-d).





February 18, 1981

Mine A
I.D. 12-34567

Attachment 2-b

Storage of SCSR's is requested for the face crews of the three sections now operating in this mine. The miners for whom this is requested are:

<u>Miner</u>	<u>Number</u>	<u>Shift</u>
<u>West Mains Parallel</u>		
Section Foreman	3	1,2,3
Continuous Mining Machine Operator	3	
Machine Operator Helper	3	
Shuttle Car Operator	6	
Roof Bolter	3	
Roof Bolter Helper	3	
General Inside Labor	3	
Mechanic	3	
<u>North Mains</u>		
Section Foreman	3	1,2,3
Continuous Mining Machine Operator	3	
Machine Operator Helper	3	
Shuttle Car Operator	6	
Roof Bolter	3	
Roof Bolter Helper	3	
General Inside Labor	3	
Mechanic	3	
<u>West Mains</u>		
Section Foreman	2	2,3
Continuous Mining Machine Operator	2	
Machine Operator Helper	2	
Shuttle Car Operator	4	
Roof Bolter	2	
Roof Bolter Helper	2	
General Inside Labor	2	
Mechanic	2	

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Mine A
I.D. 12-34567

Attachment 2-d, 2-e)1 and 2-e)2

- 2-d Each container will have a capacity for up to six SCSR's. Each container will be Dobson Shippers Model 600, a plastic case built to ATA-300 specifications. When filled with six SCSR's a container will weigh less than 110 pounds.
- 2-e)1 Signs with the words "SELF RESCUERS" and an arrow will be not farther than one crosscut apart from the beginning to at least the first outby mandoor in the intake escapeway.
- 2-e)2 In the event of a fan outage or drill the face crew will use SCSR's taken from their Secondary Storage.

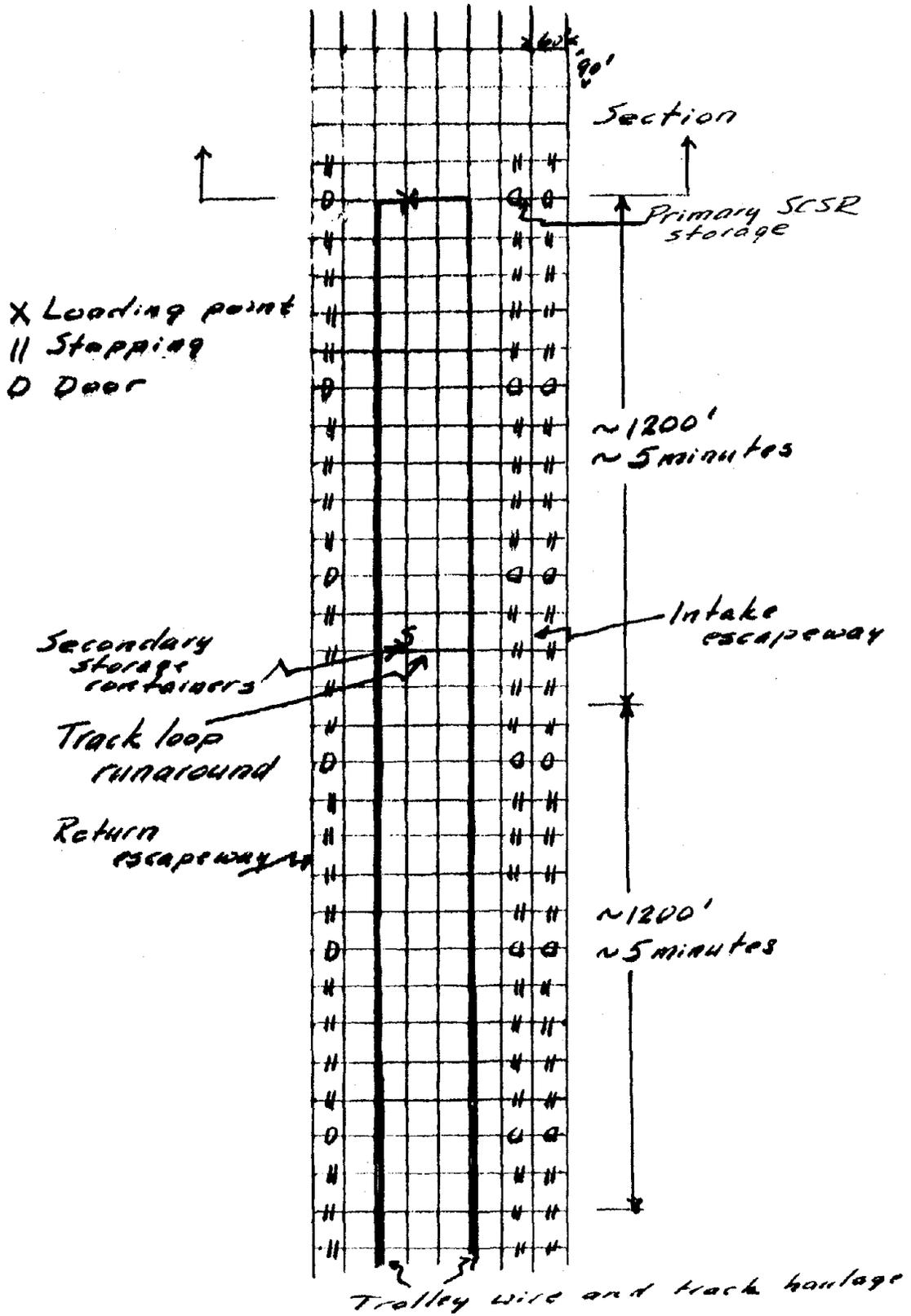
- e) This plan is for (FULL-TIME) ~~(SHIFT)~~ storage of SCSR's. (Note: If full-time, respond to 1. and 2. below).
1. Signs showing the location of and direction to the place(S) of storage are described in Attachment 2-e)1.
 2. In the event of a fan outage or drill requiring withdrawal from the section the procedures to be followed in obtaining SCSR's and in subsequent inspection and testing of those SCSR's are detailed in Attachment 2-e)2.

3. SECONDARY SECTION STORAGE

(Note: Do not submit a plan for secondary storage unless you have submitted a plan for primary section storage.)

- a) Map(s) marked Figure(s) 3 in Attachment 3-a) show the place(s) of secondary storage of SCSR's. Also shown are:
1. The maximum distance in feet and minutes to the place(S) of primary storage. *<1200', <15 minutes*
 2. The maximum distance in feet and minutes from the place(S) of secondary storage to the designated escapeways. *500' ~ 3 minutes to return escapeway. 600' ~ 3 minutes to intake escapeway*
 3. The average and least heights of travel routes 1. and 2. above. *62" org. 50" least in a few areas*
 4. The average and maximum pitch of travel routes 1. and 2. above. *flat ± 3%*
 5. The quality and quantity of air flows in travel routes 1. and 2. above. *at least 18,000 cfm intake in each*
 6. Any ~~belt conveyors~~, trolley wire, and loading points within a distance equivalent to five minutes (WALK) (~~CHAWL~~) inby and outby the proposed place(S) of secondary storage.
 7. The routes of movement of equipment in and around the proposed place(S) of secondary storage. *None other than parking in the track loop runaround.*
- b) The (MINERS) ~~(MINERS AND OTHER PERSONS)~~ for whom the above 3-a) storage is planned are listed by job classification, number, and shift in Attachment 3-b).
- c) 12 SCSR's will be in full-time primary storage as described in 2. (Number) above.
- d) — SCSR's will be in secondary storage. *At least 1 for each face crew member in and around the section. Plus one for each miner listed in Attachment 3-b who is in or around the section.*

- e) Storage for the persons listed in Attachment 3-b) should be approved for the following reasons: *Many of these miners judge wearing or carrying SCSR's to be hazardous while performing many of their normal activities. No readily accessible location within 25 feet of each miner can be assured with reasonable certainty at all times. These miners spend a considerable proportion of their time outby the last open crosscut and much of their time in entries 3-6. Most have readier access to the place of secondary than to primary storage.*
- f) SCSR's will be stored in: (Note: If in holders, respond to 1. below and cross out 2. If in containers, cross out 1. and respond to 2.)
1. Holders. The design and location of these holders and how SCSR's will be protected against damage, dirt, grease, water and commingling are detailed in Attachment 3-f)1.
 2. Containers. The specifications for these containers and their weight when filled are detailed in Attachment 3-f)2.
- g) This plan is for (FULL-TIME) (SHIFT) storage of SCSR's. (Note: If full-time, respond to 1. and 2. below.)
1. Signs showing the location of and direction to the place(S) of storage are described in Attachment 3-g)1.
 2. In the event of a fan outage or drill requiring withdrawal from the area the procedures to be followed in obtaining SCSR's and in subsequent inspection and testing of those SCSR's are detailed in Attachment 3-g)2.
- h) Products of combustion will be divertable from the place(S) of secondary storage by the methods detailed in Attachment 3-h).
- i) (Note: Cross out if not applicable.) No parked vehicles used as a place of secondary storage shall be moved until each person dependent on an SCSR in that vehicle either:
1. Knows the new location of that vehicle; and, is within five minutes (WALK) ~~(CRAWL)~~ of that vehicle. Or,
 2. Knows the vehicle will be moved; and, has another readily accessible SCSR in the secondary storage
(Location)
in Entry No. 4 shown on attachments
3-a and 3-c.



Mine A Attachment 3-a Figure 3

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Mine A
I.D. 12-34567

Attachment 3-b

This plan provides for the storage of SCSR's used by any miner whose duties require working in and around the three operating sections, specifically: West Mains Parallel, North Mains and West Mains. Those miners are:

Job Classification	Shift	1	2	3	Total
Face crew, faces ()		16 (2)	24 (3)	24 (3)	64
Wireman		0	2	0	2
Trackman		0	6	0	6
Mason		0	1	0	1
Bratticeman		0	1	0	1
Mechanic		2	2	2	6
Master mechanic		0	1	0	1
Motorman		2	2	2	6
Pumper/fireboss		0	1	0	1
General labor		3	11	3	17
Section foreman, sections ()		2 (2)	3 (3)	3 (3)	8
Shift foreman		1	1	1	3
Mine foreman		-	*	-	1
Maintenance foreman		1	1	1	3
Safety inspector		-	*	-	1
General Assistant		-	*	-	1
Superintendent		-	*	-	1
Transitman		0	2	0	2
Mine engineer		-	*	-	1
Draftsman		0	1	0	1
Safety supervisor		-	*	0	1
Training coordinator		-	*	0	1
Regional company inspector		-	*	0	1

* Most frequent shift

All other persons, including invitees, shall comply with the provisions of subparagraphs (b), (c) and (d) of 30 CFR, 75.1714-2.

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Mine A
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Attachment 3-f)1, 3-f)2, 3-h

3-f)1 Holders -- Nylon net hammocks may be slung across the front of each passenger compartment of some covered portal buses. These hammocks may be used to store up to 15 SCSR's in a portal bus. These hammocks will provide at least as much protection to SCSR's against damage, dirt and grease as the portal buses provide the passengers. All invitees will be issued SCSR's by the applicant; therefore, such SCSR's do not create a commingling hazard. All other persons must wear or carry their SCSR's while traveling in a vehicle in Mine A.

3-f)2 Containers -- Containers may be used in lieu of holders in vehicles. These containers will be placed in a padded holder bolted to a seat. Each container will have a capacity for up to six SCSR's. Each container will be Dobson Shippers Model 600, a plastic case built to ATA-300 specifications. When filled with six SCSR's a container may weigh up to 107 pounds.

These containers may be removed from the vehicles and placed in the Entry No. 4 place of secondary storage. This would be done should temperatures in the assigned vehicle parking place go below freezing and when the vehicle is moved away from its assigned parking place. In either event, the miners for whom these SCSR's are stored will know of the changed location. One or more other containers may be placed in Entry No. 4 within 50 feet inby its junction with the track loop runaround. The place will have posts or other means to alert equipment operators, though mobile equipment seldom travels through this place. This place is warm, generally 36° to 65°F. A heater will be provided should temperatures go below freezing.

3-h Safe access to SCSR's stored on the vehicles will be obtained by miners wearing or carrying FSR's and by erection of check curtains, should the need arise, at appropriate places. A supply of brattice for that purpose will be near the Entry No. 4 place of storage.

For safe access to Entry No. 4 storage, miners will wear or carry FSR's. The only time the area could contain a toxic atmosphere is in the event of fire in or outby the trolley loop turnaround. Spads in the roof and a brattice against one rib outby the containers will permit rapid diversion of smoke and gases away from the place of storage.

4. LONGWALL SECTION STORAGE

This plan is in addition to the plan(S) submitted in 2. (AND 3.) above.

- a) Map(S) marked Figure(S) _____ to _____ in Attachment 4-a) show the place(S) of longwall storage of SCSR's. Also shown is the maximum distance in feet and minutes from the center of the longwall face(S) to the place(S) of longwall storage.
- b) Not more than _____ persons will not wear or carry an SCSR while in by the stageloader(S).
- c) _____ SCSR's shall be stored in container(S). Container specifications, their weight when filled, provisions to be taken to maintain them readily accessible, and signs showing the travel route to and location of the place(S) of storage are detailed in Attachment 4-c).

5. VEHICLE STORAGE

(Note: This plan does not apply to: A mantrip while en route into and out of the mine; a vehicle while in a section. Cross out a) if no plan is submitted.)

- a) This plan is for storage of SCSR's on the vehicles specified in Attachment 5-a). Also given in that Attachment are:
 1. The maximum number of persons who can ride in and/or on each vehicle.
 2. The (MINERS) ~~(MINERS AND OTHER PERSONS)~~ for whom the above storage, listed by job classification, number, and shift.
See Attachment 3b.
 3. The specifications for SCSR holders or containers on each vehicle.
See Attachment 3-f1 and 3-f2
 4. Areas in the mine each vehicle might travel, particularly return airways.
 5. Vehicle parking practices.
- b) Storage for the persons listed in Attachment 5-a)2 should be approved for the following reasons:

Trackmen, wiremen, mason, bratticemen, and general labor all claim wearing or carrying is hazardous during some activities, particularly when lifting or carrying materials. These miners frequently work in areas several thousand feet long. They have been unable to coordinate movement of their SCSR's with their materials and tools.

Motormen claim they cannot wear or carry an SCSR safely while operating their vehicles. They place their SCSR's in a padded holder on top of the locomotives. When they leave the locomotive for various, proper reasons such as to throw switches, close derailleurs, rerail vehicles they opine the frequent removal and replacement of the SCSR's into the holders might make these fail in the event of emergency. We sought help from your office on February 11, 1981; you told us no data or non-destructive tests were available to determine when these SCSR's were no longer useable.

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Mine A
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Attachment 5-a and 5-d

5-a	1.	<u>Vehicle</u>	<u>Number</u>	<u>Seating Capacity</u>	
				<u>Each</u>	<u>Total</u>
		Portal bus	4	16	64
		Jeeps	5	9-12	54
		Locomotives	8	2	16

The above numbers may be changed at the discretion of the applicant. The sole intent of this list is to report present vehicles and their seating capacities.

2. The same as Attachments 2-b) and 3-b).
3. The same as Attachment 3-f)a and 3-f)2.
4. These vehicles normally travel only in intake air under supported roof.
5. Vehicles are always parked off the track entry except for periods seldom exceeding 20 minutes. A vehicle parked in a spur, side track or track loop runaround is not moved except when it blocks another vehicle; and, it is returned after the other vehicle is moved.

5-d At least one SCSR from each vehicle will be annually use-tested. The test will involve miners at least 45 years old with at least 15 years' experience in mines. They will use the SCSR while walking escapeways and other entries for one hour; the distance traveled will approximate 12,000 feet.

- c) The temperature in the place(S) of storage will be maintained above freezing and below 100°F (WITH THE EXCEPTIONS GIVEN IN ATTACHMENT ~~5-c~~ 1-6).
- d) SCSR's stored on vehicles (WILL) (~~WILL NOT~~) be "use" tested annually. The "use" test to be performed is described in Attachment 5-d.

6. OTHER STORAGE

(Note: This plan does not apply to VEHICLE or SECTION storage.)

- a) ~~Map(S) marked Figure(S)~~ to in Attachment 6-a show the places of other storage of SCSR's. Also shown are:
 1. The maximum distance in feet and minutes from the persons listed in Attachment 6-b to the place(S) of other storage.
 2. The maximum distance in feet and minutes from the place(S) of other storage to access into an escapeway.
 3. The average and least heights of travel routes 1. and 2. above.
 4. The average and maximum pitch of travel routes 1. and 2. above.
 5. The quality and quantity of air flows in travel routes 1. and 2. above.
 6. The routes of movement of equipment in and around the place(S) of storage.
- b) The (MINERS) (MINERS AND OTHER PERSONS) for whom the above 6a) storage is planned are listed by job classification, number, and shift in Attachment ~~6-b~~ *3-b except the face crews.*
- c) Storage for the persons listed in Attachment 6-b should be approved for the following reasons:

A mechanic while working around some equipment might be able to wear an SCSR whereas he could not when working under the equipment or around all equipment. Clearance and the type of work dictate the ability. We are unable to identify readily accessible locations in which to place SCSR's on all equipment mechanics might work on or around. Trackmen, wiremen, mason, bratticemen, and general labor all claim wearing or carrying is hazardous during some activities, particularly when lifting or carrying materials. These miners frequently work in areas several thousand feet long. They have been unable to coordinate movement of their SCSR's with their materials and tools. Motormen claim they cannot wear or carry an SCSR safely while operating their vehicles. They place their SCSR's in a padded holder on top of the locomotives. When they leave the locomotive for various, proper reasons such as to throw switches, close derailleurs, rerail vehicles they opine the frequent removal and replacement of the SCSR's into the holders might make these fail in the event of emergency. We sought help from your office on January 2, 1981; you told us no data or non-destructive tests were available to determine when these SCSR's were no longer useable.

We are convinced that the best interests of safety will be served by having unified, simplified SCSR use, education and training procedures applicable to all miners and situations. These procedures are incorporated in this plan.

February 18, 1981

Mine A
I.D. 12-34567

Attachment 6-a

This plan is for full-time storage of SCSR's from the junction of the North and West Mains (place 1) to within 15 minutes walk of the faces of those two Mains and of the West Mains Parallel. Place 1 will have 24 SCSR's. All other Entry Storage places will have 12 SCSR's. SCSR's will be in containers at least 8 inches above the floor. Each place of storage will be in a crosscut on the side opposite the trolley wire. Posts on at least 8-foot centers down the center of the storage crosscuts will provide additional roof support and militate against damage to SCSR's by equipment and vehicles.

Two 100-watt light bulbs will provide illumination as well as maintain the places of storage above freezing. SCSR-storage temperatures will be less than 100°F.

Brattice will be in the places of storage in the event miners need to reduce the inflow of products of combustion while donning SCSR's.

1. The distance between any two places of storage in a Main will not exceed 2000 feet. Thus, stored SCSR's will be within five minutes walk under normal conditions of any miner anywhere in a Main.
2. The distance from any place of storage to the main escapeway system will normally be less than 300 feet and never more than 1000 feet. Thus, the places of storage will be within five minutes of access into the escapeway.
3. and 4. The routes of travel to and from the places of storage have heights averaging 62 inches, though in some short lengths heights could be as low as 50 inches. Travel routes are relatively flat with changes of less than three percent.
5. Air flows in these travel routes are normally intake and in excess of 18,000 cfm.
6. Only track-mounted equipment will move in these travel routes. They have no means of access into the places of storage.

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Attachments 6-e)1 and 6-e)2

6-e)1 Signs with the words "SELF RESCUER" and an arrow will show the direction to and location of the places of storage. The signs will be in the track entry off of which the SCSR's are stored. Signs will be near at least every third crosscut on the rib opposite the trolley wire.

6-e)2 In the event of a fan outage miners who have no other SCSR will remove one from the nearest place of Other Storage. Each SCSR in Other Storage will have a label showing its assigned storage location. Each one removed will be inspected and tested following the procedures given in Attachment 7-a)2 and then will be returned to its proper place of storage prior to the miners beginning work again.

Miners working in the areas covered by Other Storage do not participate in escapeway drills in those areas.

- d) SCSR's will be stored in containers. The specifications for these containers and their weight when filled are detailed in Attachment ~~6-d.~~ *2-d.*
- e) This plan is for (FULL-TIME) ~~(SHIFT)~~ storage of SCSR's. (Note: If full-time, respond to 1. and 2. below.)
1. Signs showing the location of and direction to the place(S) of storage are described in Attachment 6-e)1.
 2. In the event of a fan outage or drill requiring withdrawal from the area the procedures to be followed in obtaining SCSR's and in subsequent inspection and testing of those SCSR's are detailed in Attachment 6-e)2.

7. INSPECTION AND TESTING

(Note: Complete a) for shift storage and b) for full-time storage of SCSR's made available by the mine operator. Cross out the one, if any, which does not apply.)

- a) This plan is for SCSR's carried out of the mine at the end of a miner's shift and within nine hours after an invitee enters the mine.
1. The "daily" inspection and testing approved by MSHA are detailed in Attachment 7-a)1.
 2. The "daily" inspection and testing to be followed by the applicant mine operator, detailed in Attachment 7-a)2, include who will inspect and test the SCSR's and the training given to (THAT) (THOSE) person(S).
 3. Other inspection and testing approved by MSHA is detailed in Attachment 7-a)3.
 4. The other inspection and testing to be followed by the applicant mine operator detailed in Attachment 7-a)4 includes who will inspect and test the SCSR's and the training given to (THAT) (THOSE) person(S).
 5. A record by SCSR serial number will be maintained to account for SCSR's tested in 4. above; ~~and, for other SCSR's~~
~~--- Disposed of and how disposed of~~
~~--- Missing, and the last known locations.~~
- b) This plan is for SCSR's that remain in the mine at the end of a miner's shift.

1. Location of SCSRs shall be checked at the time of mandatory examinations in the area of storage.
2. The inspection and testing approved by MSHA are detailed in Attachment ~~7-b)1-~~ *7-a 3*
3. The inspection and testing to be followed by the applicant mine operator, detailed in Attachment ~~7-04~~, include who will inspect and test the SCSR's and the training given to ~~(THAT)~~ (THOSE) person(S). *Also see Attachment 5-d.*
4. A record by SCSR serial number will be maintained to account for SCSR's tested in 3. above; ~~and, for other SCSR's~~
~~— Disposed of, and how disposed of~~
~~— Missing, and the last known locations.~~

February 18, 1981

Mine A
I.D. 12-34567

Attachment 7-a)1

The following is from page 7 Drager Operating Manual 1165.2e,
April 1980.

DAILY CHECK (if carried daily)

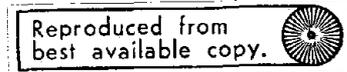
The device should be checked for external damage daily if carried daily. This visual inspection includes viewing the indicator 25 to ensure that it is blue in color and inspecting the sealing clip 35 to ensure it is present.

Additionally the outer housing 24, 29 should be inspected for cracks, punctures, or other obvious physical damage to rescuer. If indicator has changed color, or if sealing clip is missing, or if other damage to rescuer is obvious, it should be removed from service (see Troubleshooting page 13), but the unit may not be unsealed for maintenance of parts or replacement of same by the user in the field.

February 18, 1981

Mine A
I.D. 12-34567

Attachment 7-a)2



Inspection and Testing

SCSR's will be OXY-SR60B, Approval No. TC-13F-87. Each shall be inspected and tested for damage and for the integrity of its seal

- a) Each time it is worn or carried (the applicant mine operator assumes that "each time" is what is meant by Drager's "daily" in instructions).
- b) By the person who wears or carries it, which person will have been trained to inspect and test these SCSR's.
- c) In the SCSR house
- d) In accordance with the instructions specified by the manufacturer and posted on a wall of the SCSR house in bold, easily understood graphics.
- e) These instructions consist of:
 - Viewing indicator 25 to ensure it is blue in color
 - Inspect seating clip 35 to ensure it is present
 - Inspect the outer housing 24 and 29 for obvious cracks, punctures, or other physical damage.

Each miner will have received an initial 1-hour training with a subsequent review of at least 5 minutes at least twice a year. We are convinced the simplicity of inspection e) and clarity of poster d) ensure the adequacy of the required inspection by any miner.

February 18, 1981

Mine A
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Attachments 7-a)3 and 7-a)4

7-a)3 The following is from page 10, Drager Operating Manual 1165.2e, April 1980.

INSPECTION AND TESTING

Inspection should not be necessary as long as the indicator shows the device to be ready for use. Carried devices must be checked daily. For safety reasons, the devices in storage should be checked every ninety days. This daily visual check, as well as the ninety days check, should include examining the external case with regard to damages and viewing the indicator color. As long as the indicator is of blue color (as shown in Fig. 1b), the device is ready for use. If the indicator has turned pink the device should be removed from service. If a color change should occur during a working shift without evidence of any physical damage to the rescuer, the rescuer can be safely carried for the remainder of the shift. Did the color of the indicator change but a hint of blue is still left, then the device should be removed from service and placed in a sealed plastic bag for sending to a Draeger Agency, where it will be determined if resealing is possible.

7-a)4 The applicant will have each SCSR visually inspected using the procedures specified in e) of Attachment 7-a)2. This will be done by a trained person authorized by the applicant to record the results of the inspection by SCSR serial number in a book. The training will consist of at least

- a) Testing the person's ability to discern differences among the colors blue and pink
- b) An initial 1-hour SCSR training program with subsequent review at least twice a year.

PLAN 4.

Mine A
I.D. 12-34567

May 20, 1981

This plan supplements that approved by your office February 25, 1981. This plan is submitted as an attachment to our petition for modification of the provisions of subparagraph (3) of 30 CFR, 75.1714-2(e). Whereas those provisions state

- (3) An operator may not obtain permission under paragraph (e) of this section to place self-contained self-rescuers more than 25 feet away from miners on mantrips into and out of the mine.

We have found:

1. The majority of miners in Mine A judge SCSR's to be hazardous to wear or carry while traveling on portal buses, jeeps and locomotives used as mantrip vehicles as well as for other travel.
2. Holders made in accordance with designs suggested by MSHA, MSA, and our engineers have failed to maintain SCSR's readily accessible as determined in the use tests conducted April 28, 1981 by us with the cooperation of your office and the safety committee of this mine. In those tests five SCSR's removed from holders on a portal bus, two jeeps and a locomotive provided oxygen for 20 to 40 minutes.
3. Containers of SCSR's cannot be secured on vehicles used in Mine A in a manner that prevents those containers from being either hazardous to persons riding in these vehicles or exposed to severe damage.
4. SCSR's cannot be maintained readily accessible with reasonable certainty at all times when placed loose in these vehicles.

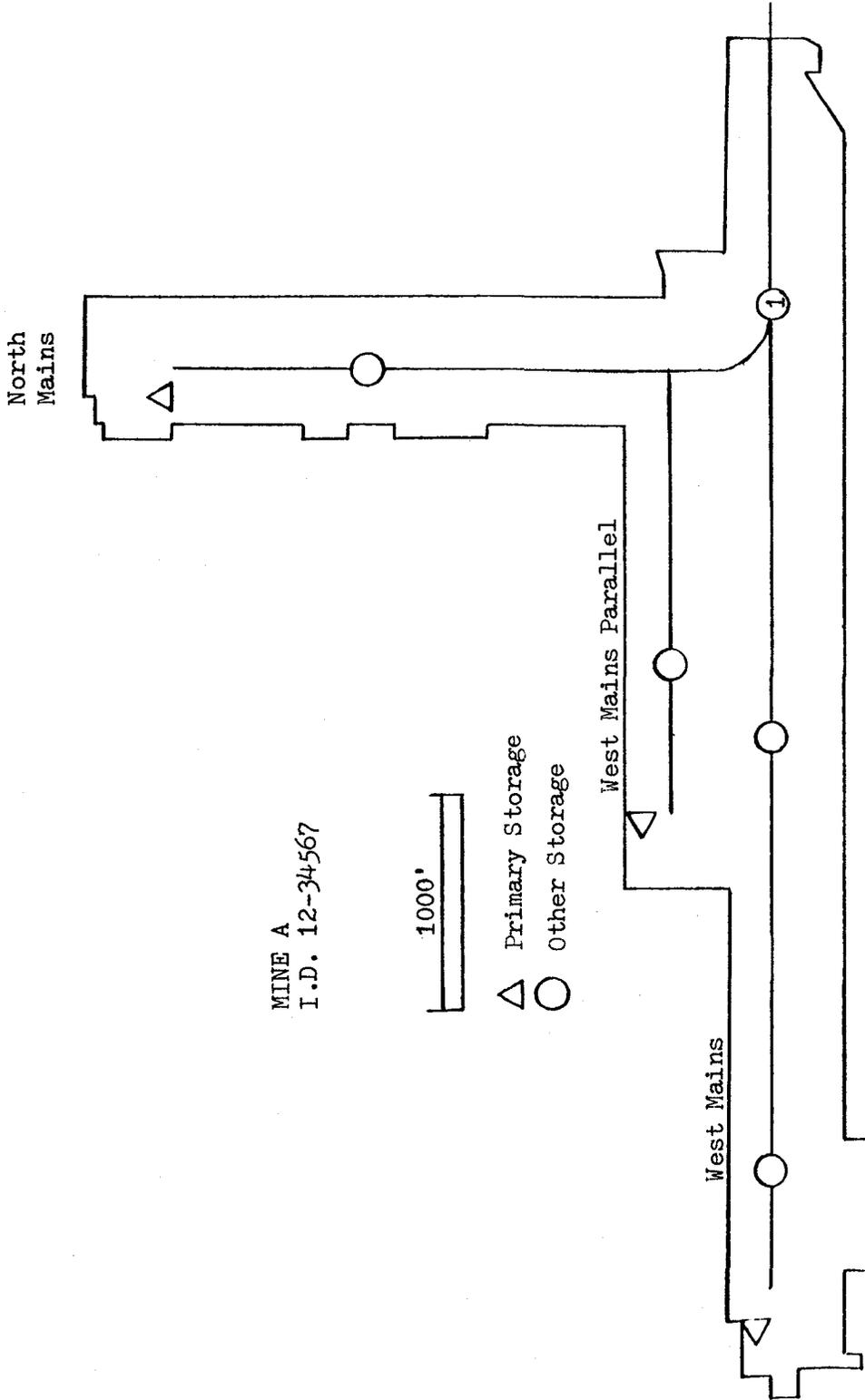
In support of its Petition:

1. Your approval is requested of the following supplement to our Program of Instruction submitted in accordance with 30 CFR, 75.1101-23(a) and approved by your office on June 30, 1974.
 - 1.1 This supplement is for storage of MSA 464213, TC-13F-78 self-contained self-rescue devices, hereafter referred to as SCSR's, in accordance with the provisions of paragraph (e), 30 CFR, 75.1714-2.
 - 1.2 These SCSR's are to be stored for miners only.
 - 1.3 Persons for whom SCSR's are stored will not enter an area in which an oxygen-deficient atmosphere is likely to develop as a result of breaking into such an atmosphere, a coal bump and/or gas outburst.

- 1.4 All persons for whom SCSR's are stored shall have at all times while underground a filter or other self-rescue device approved under subpart I of Part 11 of 30 CFR in accordance with paragraphs (b), (c) and (d) of 30 CFR, 75.1714-2 except the "readily accessible location" referred to need not be a holder or container.
- 1.5 All persons for whom SCSR's are stored shall have the right to wear or carry another SCSR in lieu of an approved filter or other self-rescue device.
- 1.6 Temperatures in the place(s) of storage shall be maintained above freezing and below 100°F.
- 1.7 A map of the mine is attached showing the proposed SCSR storage locations. The triangle (Primary Section) will be moved to comply with this plan. Circles (Other Storage) are fixed and additional ones will be similarly placed as the Mains are advanced.
- 1.8 This plan is for storage of SCSR's for the following miners:

<u>Job Classification</u>	<u>Shift</u>	<u>1</u>	<u>2</u>	<u>3</u>	<u>Total</u>
Face crew, sections ()		16 (2)	24 (3)	24 (3)	64
Wireman		0	1	0	2
Trackman		0	6	0	6
Mason		0	1	0	1
Bratticeman		0	1	0	1
Mechanic		2	2	2	6
Master mechanic		0	1	0	1
Motorman		2	2	2	6
Pumper/fireboss		0	1	0	1
General labor		2	11	3	16
Section foreman, sections ()		2 (2)	3 (3)	3 (3)	8
Shift foreman		1	1	1	3
Mine foreman		-	*	-	1
Maintenance foreman		1	1	1	3
Safety inspector		-	*	-	1
General Assistant		-	*	-	1
Superintendent		-	*	-	1
Transitman		0	2	0	2
Mine engineer		-	*	-	1
Draftsman		0	1	0	1
Safety supervisor		-	*	-	1
Training coordinator		-	*	-	1
Regional company inspector		-	*	-	1

* Most frequent shift



MINE A
I.D. 12-34567

1000'

△ Primary Storage
○ Other Storage

North
Mains

West Mains Parallel

West Mains

1

1.9 Reason for Storage

Storage of SCSR's is needed for these miners while at their places of work. These miners judge wearing or carrying SCSR's to be hazardous while performing some of their duties. Additionally, no readily accessible locations within 25 feet of each can be assured with reasonable certainty at all times. We have been unable to establish where wearing or carrying SCSR's would not be hazardous; our investigations indicate a myriad of conditions and activities lead to these judgements. For example:

- Miners claim their safety is jeopardized if they wear or carry SCSR's while in a mantrip. The mine safety committee is on record as believing SCSR's loose on the laps of passengers are potential flying objects likely to cause injury in the event of an accident; the committee states that buckets and tools on the floor of the mantrips do not present as great a hazard. The committee states that SCSR's when worn seriously impede the rapid, safe egress of passengers as well as being a potential cause for rib or chest injury.
- A mechanic might be able to wear an SCSR while working around some equipment whereas he could not when working under the equipment or around all equipment. Clearance and type of work dictate the ability. We are unable to identify readily accessible locations in which to place SCSR's on all equipment mechanics might work on or around.
- Trackmen, wiremen, mason, bratticemen, and general labor find wearing or carrying to be hazardous particularly when lifting or carrying materials. Additionally, their work areas often are several thousand feet long and they have been unable to coordinate movement of SCSR's with materials and tools.
- Motormen claim they cannot wear or carry an SCSR safely while operating their vehicles. There is no safe place in locomotive cabs for a holder; therefore, they place their SCSR's in a padded holder on top of the locomotives. When they leave the locomotive for various, proper reasons such as to throw switches, close derailleurs, rerail vehicles they opine the frequent removal and replacement of the SCSR's into the holders might make these fail in the event of emergency. We sought help from your office on January 2, 1981; you told us no data or non-destructive tests were available to determine when these SCSR's were no longer useable.

We are convinced that the best interests of safety will be served by having unified, simplified SCSR use, education and training procedures applicable to all miners and situations. These procedures are incorporated in this plan.

2. Proposed Storage Plan

2.1 General -- This plan is for full-time storage of SCSR's:

- a) In each section -- Primary Section Storage
- b) In main track entries -- Other Storage

2.2 Primary Section Storage

a) Primary Section storage of SCSR's is requested for the 9 members of each face crew in the three sections now operating in this mine. Specifically, these are:

<u>Miner/Section</u>	<u>Number/Shift</u>
Section Foreman	1
Continuous Mining Machine Operator	1
Machine Operator Helper	1
Shuttle Car Operator	2
Roof Bolter	1
Roof Bolter Helper	1
General Inside Labor	1
Mechanic	1

<u>Section</u>	<u>Operating Shift</u>
West Mains Parallel	1st, 2nd, 3rd
North Mains	1st, 2nd, 3rd
West Mains	--- 2nd, 3rd

b) This same plan will be applicable to other, yet-to-be established sections. This plan will not apply to a section which is stopped, closed or abandoned.

c) The place of storage in each section shall be the intake escapeway. Normally, it will be in a crosscut near the permanent stopping between it and the adjoining entry which is on intake air. The exact location will be at the discretion of the applicant who will select the place based, among other things, on:

1. Its being outby the normal flow of equipment
2. The condition of the ribs and roof
3. Water in and wetness of the area
4. Rock dusting requirements
5. The location of the high-voltage cable.

These factors may, therefore, result in the primary storage being a short distance outby the section. It will, however, always be within 1200 feet from the point of deepest penetration of the working faces. The travel routes average 62 inches high though they could be as low as 50 inches in isolated, short lengths. The routes are flat with deviations of less than 3 percent. Air flows will exceed 18,000 cfm and access to the place of storage will be from at least two places, the mouth of the escapeway and a mandoor in the adjoining intake airway. Under normal conditions any miner can walk those 1200 feet in fewer than five minutes.

- d) This plan is for full-time storage of at least 12 SCSR's in containers. Each has foam-padded compartments for six SCSR's and will weigh less than 110 pounds when filled. These containers are Boston Shippers Model 600, a plastic case built to ATA-300 specifications.
- e) Signs with the word "SELF-RESCUERS" and a directional arrow will be not farther than a crosscut apart from the beginning of the escapeway to at least the first outby mandoor.
- f) In the event of a fan outage requiring withdrawal or an escapeway drill, members of the face crew will first obtain SCSR's from the primary storage.

Each SCSR removed from primary storage will be visually checked prior to its being replaced in the storage containers. The visual check will be made in accordance with procedures described in Section 3 of this plan. At least 12 SCSR's will be in primary storage prior to the face crew beginning work in the section.

2.3 Other Storage

- a) SCSR's stored in caches along the main track entries are requested for miners listed in 1.8 while underground.
- b) The places of storage are shown by circles on the attached outline of the mine. The cache at the circle marked "1" will contain 36 SCSR's. all other caches will contain 12 SCSR's.
- c) Each place of storage will be in a crosscut on the side opposite the trolley wire. Posts on not more than 8-foot centers down the center of the storage crosscuts will provide additional roof support and militate against damage to SCSR's. Only track-mounted equipment will move in these travel routes; they have no means of access into the places of storage.

- d) Two 100-watt light bulbs will provide illumination as well as maintain the places of storage above freezing. SCSR-storage temperatures will be less than 100°F. Brattice will be in the places of storage in the event miners need to reduce the inflow of products of combustion while donning SCSR's or to maintain above-freezing temperatures.

The distance between any two places of storage in a Main will not exceed 2000 feet. Thus, stored SCSR's will be within five minutes walk under normal conditions of any miner anywhere in a Main.

The distance from any place of storage to the main escapeway system will normally be less than 300 feet and never more than 1000 feet. Thus, the places of storage will be within five minutes of access into the escapeway.

The routes of travel to and from the places of storage have heights averaging 62 inches, though in some short lengths heights could be as low as 50 inches. Travel routes are relatively flat with changes of less than three percent.

- e) Air flows in these travel routes are normally intake and in excess of 18,000 cfm.
- f) Signs with the word "SELF-RESCUER" and an arrow will show the direction to and location of the places of storage. The signs will be in the track entry off of which SCSR's are stored. Signs will be near at least every third crosscut on the rib opposite the trolley wire.
- h) In the event of a fan outage requiring withdrawal, miners who have no other SCSR will remove one from the nearest place of Other Storage. Each one removed will be inspected following the procedures given in Section 3 of this plan prior to its being returned to storage. Each cache will contain the proper number of SCSR's prior to miners going in by a cache. Miners working in areas covered by Other Storage do not participate in escapeway drills in those areas.

3. Inspection and Testing

- a) The following are key excerpts from page 6 of MSA's instruction manual (TAL088(L)REV 1) for these SCSR's.
 1. Units shall be checked for leakage every 90 days.
 2. Units which are carried should be visually checked daily.
 3. Any unit which has visible external damage at the seal area or has a visible puncture in the case must be removed from service immediately.

4. Any unit with damage to the external case in the form of dents 1/4-inch or deeper should be removed from service.
5. Any unit with minor visible damage must be tested for leakage of the case as soon as possible.
6. No unit which has had the sealing band completely removed shall be leak tested; remove these units from service.
7. If there has been disturbance of one or two links of the seal band spring, but the seal still appears to be intact, the unit should first be subjected to a leak test.

Page 7 of the manual describes the leak testing referred to in excerpts 1, 5 and 7 above.

- b) All SCSR's as well as any removed from storage will be visually checked using the procedures referred to in excerpts 2 through 7 above prior to being placed in an underground storage or made available to a miner or invitee.
- c) All SCSR's will be checked for leakage at intervals not exceeding 90 days using the procedures given on page 7 of the instruction manual.
- d) A record of each SCSR by serial number will be maintained in a book showing the results of the tests required by paragraph c) of this section.
- e) The person or persons making the inspections and tests referred to in paragraphs b) and c) of this section will be trained to perform such inspections and tests and to replace links in the seal band spring.
- f) No other SCSR repair shall be done by the applicant.

Date: 12/22/80

To: Manager, CMH&S District No. _____

For:

Mine B, I.D. No. 76-54321

- 1. Your approval is requested of the following supplement to our Program of Instruction submitted in accordance with 30 CFR, 75.1101-23(a) and approved by your office on 6/30, 19 74.
- 1.1 This supplement is for storage of M/SA464213, TC-13F-87 self-contained (Model) (Approval No.) self-rescue devices, hereafter referred to as SCSR's, in accordance with the provisions of paragraph (e), 30 CFR, 75.1714-2.
- 1.2 These SCSR's are to be stored for (MINERS ONLY) ~~(MINERS AND OTHER PERSONS AUTHORIZED BY THE APPLICANT TO ENTER THIS MINE)~~ ~~(ALL PERSONS)~~
- 1.3 (WITH NO EXCEPTIONS) ~~(WITH THE EXCEPTIONS DETAILED IN ATTACHMENT 1-3)~~ persons for whom SCSR's are stored will not enter an area in which an oxygen-deficient atmosphere is likely to develop as a result of breaking into such an atmosphere, a coal bump and/or a gas outburst.
- 1.4 (WITH NO EXCEPTIONS) ~~(WITH THE EXCEPTIONS DETAILED IN ATTACHMENT 1-4)~~ all persons for whom SCSR's are stored shall have at all times while underground a filter or other self-rescue device approved under subpart I of Part 11 of 30 CFR in accordance with paragraphs (b), (c) and (d) of 30 CFR, 75.1714-2 except the "readily accessible location" referred to need not be a holder or container.
- 1.5 (WITH NO EXCEPTIONS) ~~(WITH THE EXCEPTIONS DETAILED IN ATTACHMENT 1-5)~~ all persons for whom SCSR's are stored shall have the right to wear or carry another SCSR (IN LIEU OF) ~~(IN ADDITION TO)~~ an approved filter or other self-rescue device.
- 1.6 Temperatures in the place(S) of storage shall be maintained above freezing and below 100°F. ~~(METHODS TO BE USED TO PREVENT TEMPERATURES OUTSIDE THAT RANGE ARE GIVEN IN ATTACHMENT 1-6).~~

2. PRIMARY SECTION STORAGE

a) Map(S) marked Figure(S) 1 to 5 in Attachment 2-a) show the place(S) of section storage of SCSR's. Also shown are:

1. The maximum distance in feet and minutes from the point of deepest penetration of the working faces to the place(S) of primary storage. *Attachment 2-a1*
2. The maximum distance in feet and minutes from the place(S) of primary storage to the mouth of and/or mandoor into the designated escapeways. *Attachment 2-a2*
3. The average and least heights of travel routes 1. and 2. above. *Average 42", lowest 32"*
4. The average and maximum pitch of travel routes 1. and 2. above. *Flat ± 3%*
5. The quality and quantity of air flows in travel routes 1. and 2. above. *Intake, 8000 - 36,000 CFM*
6. Any belt conveyors, trolley wire, and loading points in the section and for a distance equivalent to five minutes (WALK) (CRAWL) outby the section.
7. The location of all permanent stoppings in the section.
8. The routes of movement of equipment into and in the section(S).

b) The (MINERS) ~~(MINERS AND OTHER PERSONS)~~ for whom the above 2-a) storage is planned are listed by section, job classification, number, and shift in Attachment 2-b).

c) Storage for the persons listed in Attachment 2-b) should be approved for the following reasons:

These low seam miners judge wearing or carrying SCSR's to be hazardous while performing their normal job tasks. Longwall mining equipment hinders miner's mobility. No readily accessible location within 25 feet of each of these miners can be assured with reasonable certainty at all times.

d) SCSR's will be stored in: (Note: If in holders, respond to 1. below and cross out 2. If in containers, cross out 1. and respond to 2.)

~~1. Holders. The design and location of these holders and how SCSR's will be protected against damage, dust, grease, water and con-~~
~~mining are detailed in Attachment 2-d).~~

2. Containers. The specifications for these containers and their weight when filled are detailed in Attachment 2-d).

e) This plan is for ~~(FULL-TIME)~~ (SHIFT) storage of SCSR's. (Note: If full-time, respond to 1. and 2. below).

~~1. Signs showing the location and direction to the place(S) of storage are described in Attachment 2-a)1.~~

~~2. In the event of a fall outage or drill requiring withdrawal from the section the procedures to be followed in obtaining SCSR's and in subsequent inspection and testing of these SCSR's are detailed in Attachment 2-e)2.~~

3. SECONDARY SECTION STORAGE

(Note: Do not submit a plan for secondary storage unless you have submitted a plan for primary section storage.)

a) ~~Map(S) marked figure(S) to in Attachment 3-a) show the place(S) of secondary storage of SCSR's. Also show:~~

- ~~1. The maximum distance in feet and minutes to the place(S) of primary storage.~~
- ~~2. The maximum distance in feet and minutes from the place(S) of secondary storage to the designated escapeways.~~
- ~~3. The average and least heights of travel routes 1 and 2. above.~~
- ~~4. The average and maximum pitch of travel routes 1. and 2. above.~~
- ~~5. The quality and quantity of air flows in travel routes 1 and 2. above.~~
- ~~6. Any belt conveyors, trolley wire, and loading points within distance equivalent to five minutes (WALK) (CRAWL) in and out by the proposed place(S) of secondary storage.~~

~~The routes of movement of equipment in and around the proposed place(S) of secondary storage.~~

b) ~~The (MINERS) (MINERS AND OTHER PERSONS) for whom the above (a) storage is planned are listed by job classification, number, and shift in Attachment 3-b).~~

c) ~~SCSR's will be in full-time primary storage as described in 2. (Number) above.~~

d) ~~SCSR's will be in secondary storage (Number) above.~~

4. LONGWALL SECTION STORAGE

This plan is in addition to the plan(S) submitted in 2. (AND 3.) above.

- a) Map(S) marked Figure(S) 1 to 2 in Attachment 4-a) show the place(S) of longwall storage of SCSR's. Also shown is the maximum distance in feet and minutes from the center of the longwall face(S) to the place(S) of longwall storage.
- b) Not more than 6 persons will not wear or carry an SCSR while inby the stageloader(S).
- c) Six SCSR's shall be stored in container(S). Container specifications, their weight when filled, provisions to be taken to maintain them readily accessible, and signs showing the travel route to and location of the place(S) of storage are detailed in Attachment 4-c).

VEHICLE STORAGE

Note: This plan does not apply to: A night trip while en route into and out of the mine; a vehicle which is in a section. Crosscut a) if no plan is submitted.)

- a) This plan is for storage of SCSR's on the vehicles specified in Attachment 5-a). Also given in that Attachment are:
 1. The maximum number of persons who can ride in and/or on each vehicle.
 2. The (MINERS) (MINERS AND OTHER PERSONS) for whom the above storage, listed by job classification, number, and shift.
 3. The specifications for SCSR holders or containers on each vehicle.
 4. Areas in the mine each vehicle might travel, particularly return airways.
 5. Vehicle parking practices.
- b) Storage for the persons listed in Attachment 5-a)2 should be approved for the following reasons:

- d) ~~SCSR's will be stored in containers. The specifications for these containers and their weight when filled are detailed in Attachment 6-d.~~
- e) ~~The plan is for (FULL-TIME) (SHIFT) storage of SCSR's. (Note: If full-time, respond to 1. and 2. below.)~~
 - 1. ~~Signs showing the location of and direction to the place(S) of storage are described in Attachment 6-e)1.~~
 - 2. ~~In the event of a fan outage or drill requiring withdrawal from the area, the procedures to be followed in obtaining SCSR's and in subsequent inspection and testing of those SCSR's are detailed in Attachment 6-e)2.~~

7. INSPECTION AND TESTING

(Note: Complete a) for shift storage and b) for full-time storage of SCSR's made available by the mine operator. Cross out the one, if any, which does not apply.)

- a) This plan is for SCSR's carried out of the mine at the end of a miner's shift and within nine hours after an invitee enters the mine.
 - 1. The "daily" inspection and testing approved by MSHA are detailed in Attachment 7-a)1.
 - 2. The "daily" inspection and testing to be followed by the applicant mine operator, detailed in Attachment 7-a)2, include who will inspect and test the SCSR's and the training given to ~~(THAT)~~ (THOSE) person(S).
 - 3. Other inspection and testing approved by MSHA is detailed in Attachment 7-~~a)3~~ **61**
 - 4. The other inspection and testing to be followed by the applicant mine operator detailed in Attachment 7-~~a)2~~ **62** includes who will inspect and test the SCSR's and the training given to ~~(THAT)~~ (THOSE) person(S).
 - 5. A record by SCSR serial number will be maintained to account for SCSR's tested in 4. above; and, for other SCSR's
 - Disposed of and how disposed of
 - Missing, and the last known locations.
- b) This plan is for SCSR's that remain in the mine at the end of a miner's shift.

1. Location of SCSRs shall be checked at the time of mandatory examinations in the area of storage.
2. The inspection and testing approved by MSHA are detailed in Attachment 7-b)1.
3. The inspection and testing to be followed by the applicant mine operator, detailed in Attachment 7-b)2, include who will inspect and test the SCSR's and the training given to ~~(THAT)~~ (THOSE) person(S).
4. A record by SCSR serial number will be maintained to account for SCSR's tested in 3. above; and, for other SCSR's
 - Disposed of, and how disposed of
 - Missing, and the last known locations.

MINE B
ATTACHMENTS 2-a

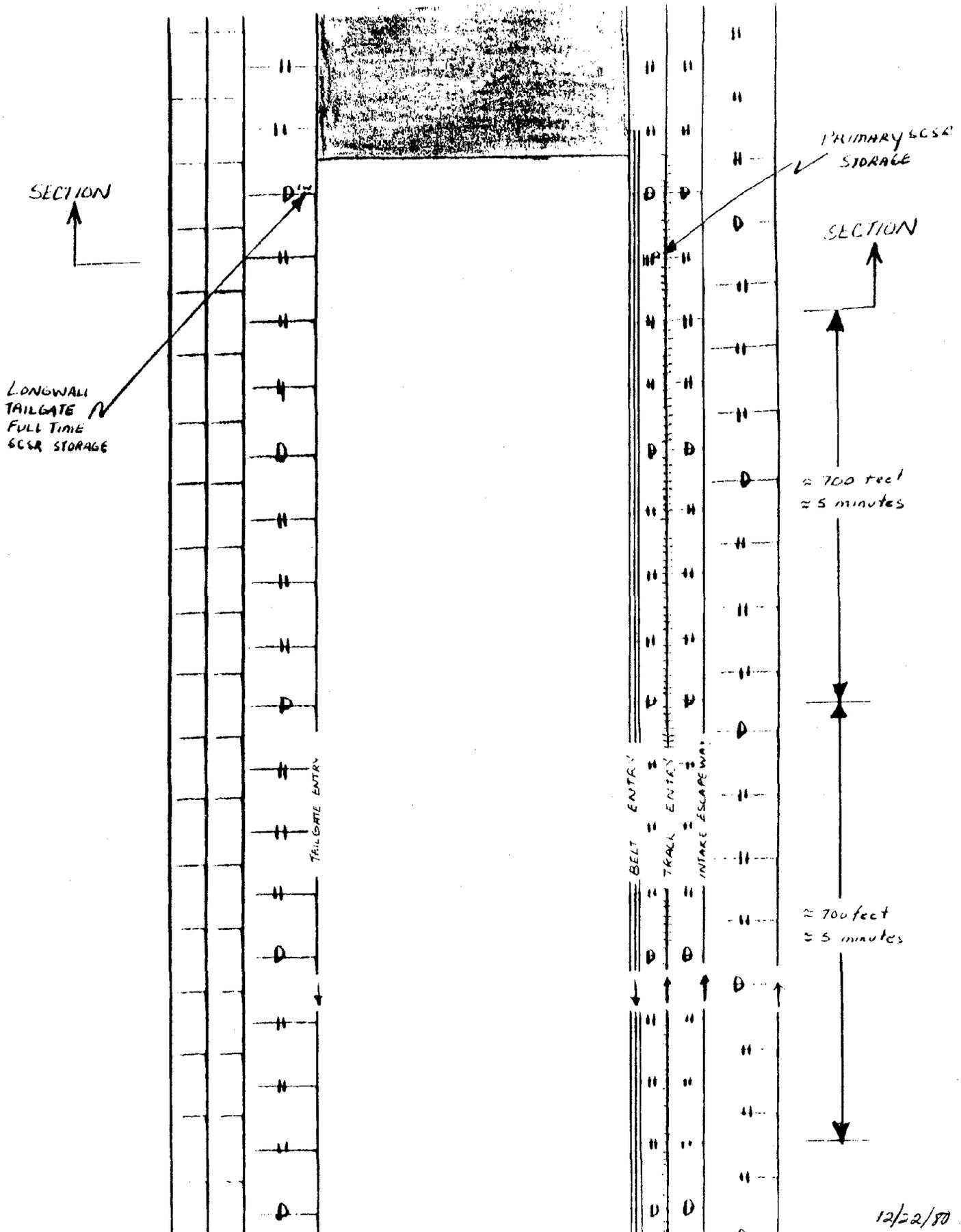
These maps show typical face crew sections at Mine B.

FIGURE 1+2. LONGWALL SECTION

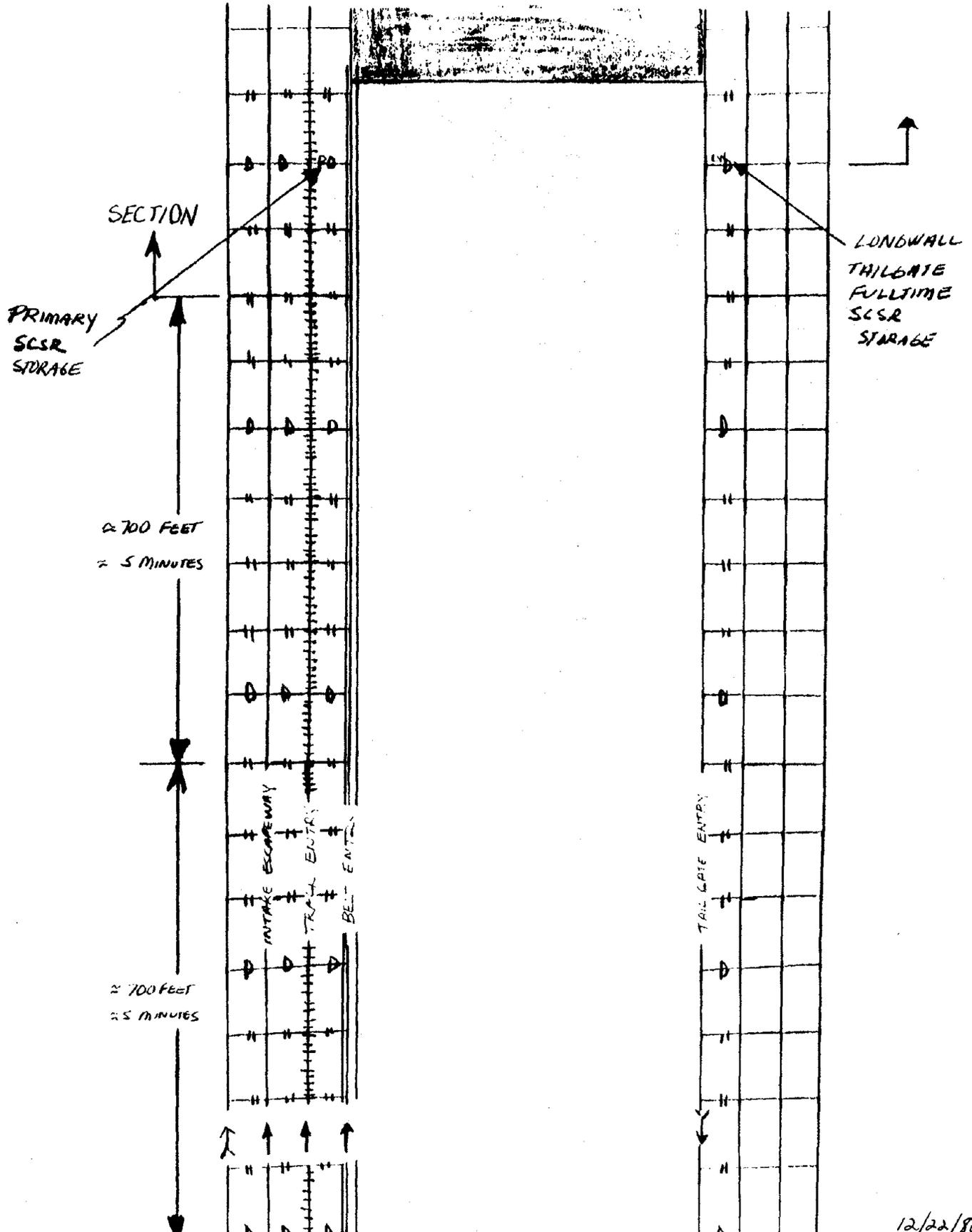
FIGURE 3+4. CONTINUOUS MINER SECTION DEVELOPING
PANEL ENTRIES FOR A LONGWALL

FIGURE 5 MAIN ENTRY CONTINUOUS MINER SECTION

Attachment 2-a Figure 1 of 5

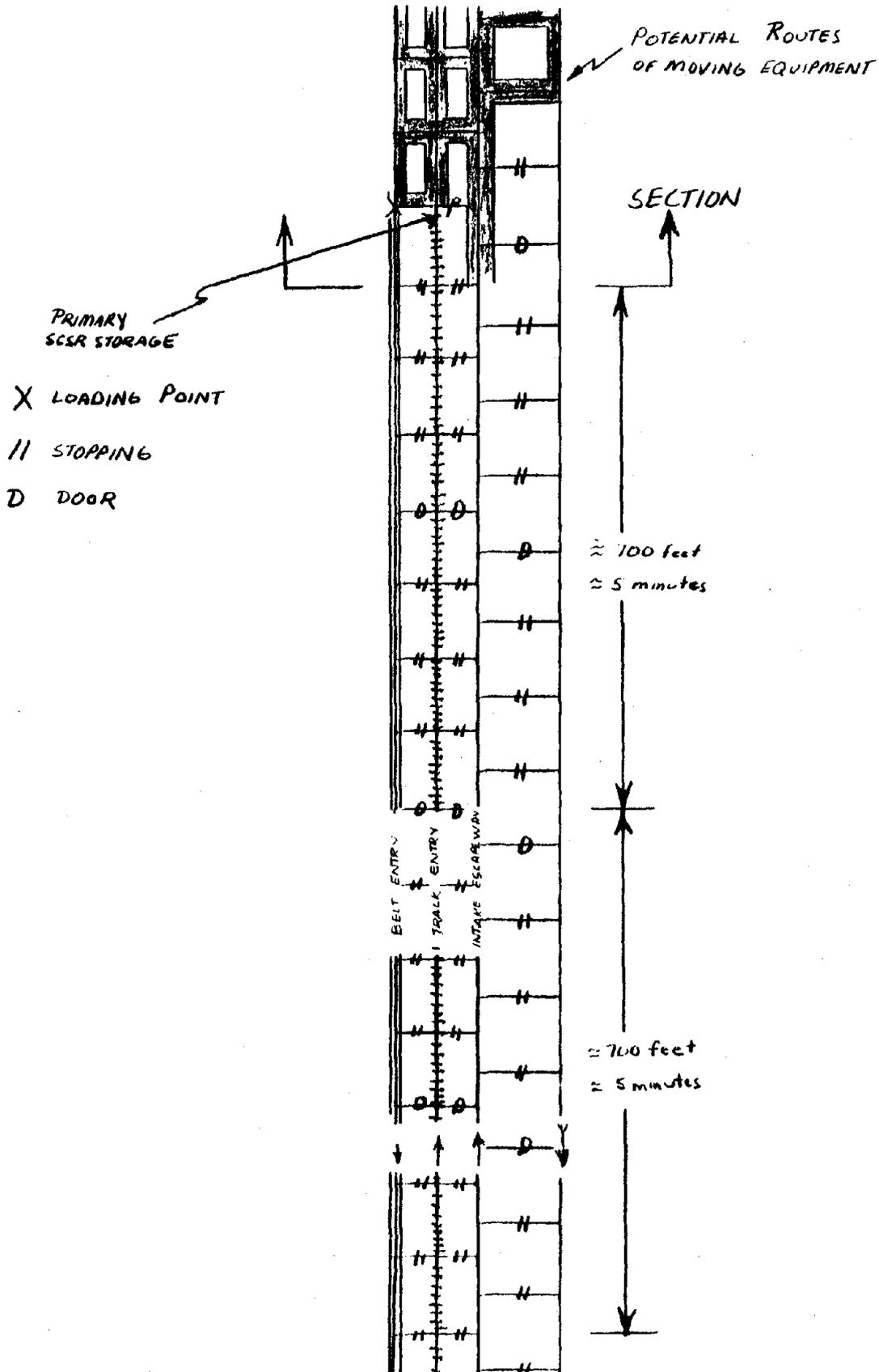


Attachment 2-a Figure 2 of 5



12/22/80

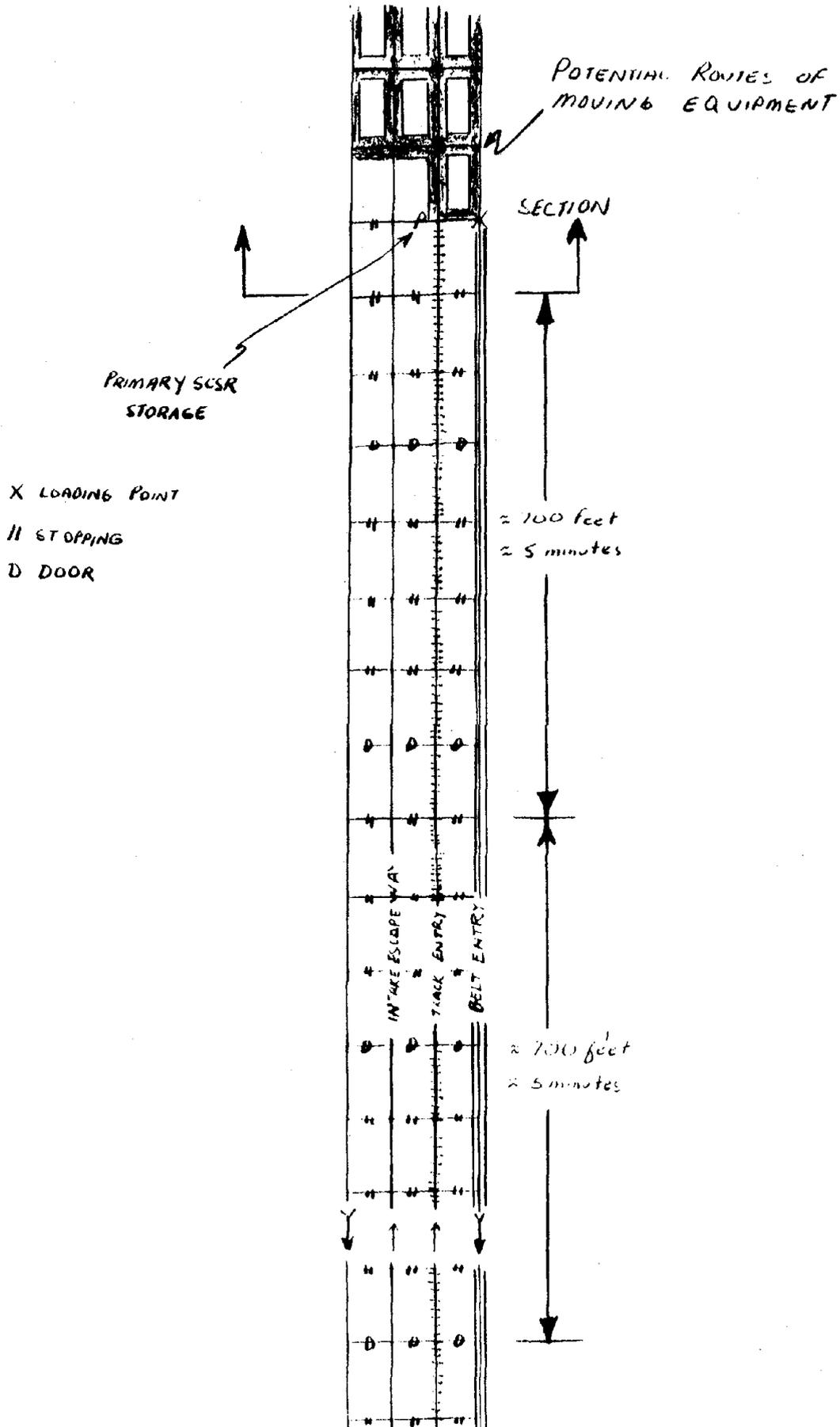
Attachment 2-a Figure 3 of 5



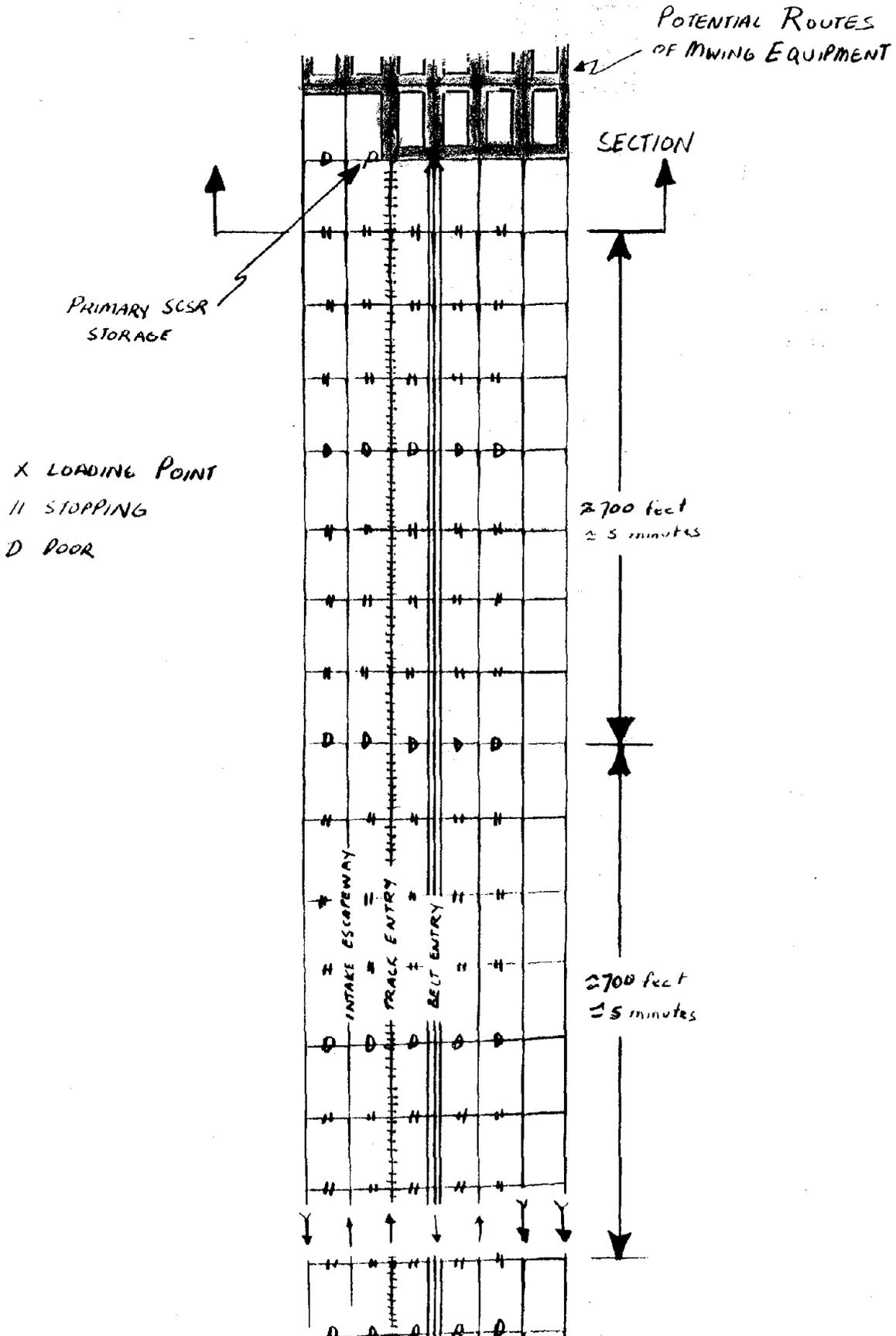
12/22/80

Mine B

Attachment 2-a Figure 4 of 5



Mine B Attachment 2-a Figure 5 of 5



12/22/80

December 22, 1980

Mine B
I.D. 76-54321

Attachment 2-a1, 2-a2, 2-d2

2-a1

Longwall Section

- From the stageloader to the primary SCSR
< 300 feet, < 3 minutes

Continuous Miner Section

- From the point of deepest penetration to the primary SCSR storage
< 700 feet, < 5 minutes

2-a2

Longwall Section

- Primary SCSR storage to intake escapeway
< 400 feet, < 5 minutes

Continuous Miner Section

- Primary SCSR Storage to intake escapeway
< 400 feet, < 5 minutes

2-d2

Each container will have a capacity for up to four SCSR's. Each container, Model 400, manufactured by Boston Shippers, is a plastic case built to ATA-300 specifications. When filled with four SCSR's a container will weigh less than 55 pounds.

Mine B
 I.D. 76-54321

Attachment 2-b

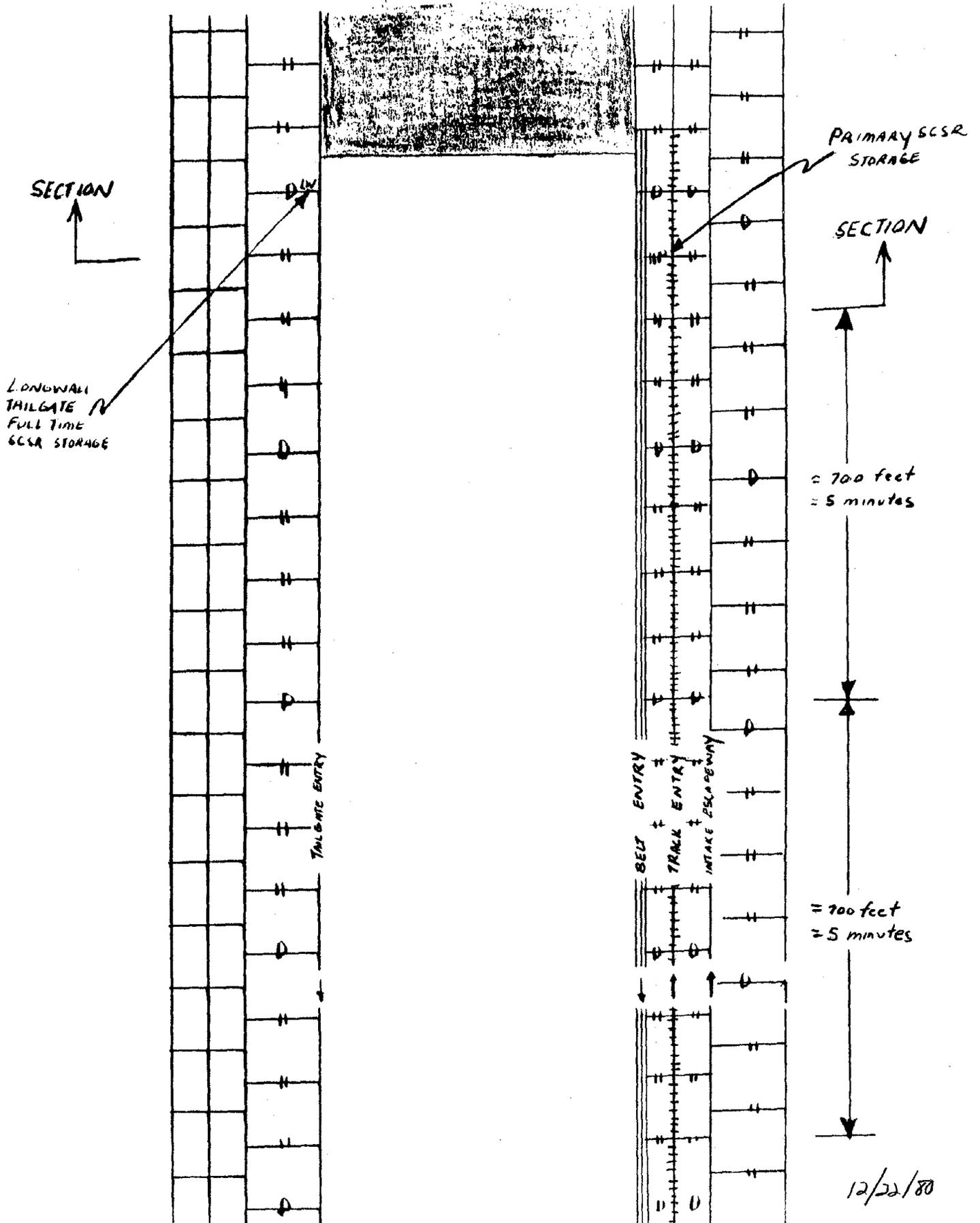
Storage of SCSR is requested for the face crews of the 9 working faces and 4 idle faces at this mine. (General inside labors could be bratticemen, construction crews, maintenance and electrician-mechanics depending on job assignment.)

<u>Miner</u>	<u>Number</u>	<u>Shift</u>
<u>Bluegrass Mains - Continuous Mining</u>		
Section Foreman	3	1,2,3
Continuous Miner Operator	3	
Machine Operator Helper	3	
Shuttle Car Operator	6	
Roof Bolter	3	
Roof Bolter Helper	3	
General Inside Labor	3	
<u>Elk #4 Panel - Longwall Mining</u>		
Section Foreman	2	2,3
Longwall Machine Operator	2	
Longwall Coordinator	1	
General Inside Labor	15	
Electrician-Mechanic	2	
<u>Elk #5 Panel - Continuous Mining</u>		
Section Foreman	3	1,2,3
Continuous Miner Operator	3	
Machine Operator Helper	3	
Shuttle Car Operator	6	
Roof Bolter	3	
Roof Bolter Helper	3	
General Inside Labor	3	
Electrician-Mechanic	3	
<u>Elk #6 Panel - Continuous Mining</u>		
Section Foreman	2	2,3
Continuous Miner Operator	2	
Machine Operator Helper	2	
Shuttle Car Operator	4	
Roof Bolter	2	
Roof Bolter Helper	2	
General Inside Labor	2	
<u>Evergreen Mains - Continuous Mining</u>		
Section Foreman	6	1,2,3
Continuous Miner Operator	6	
Machine Operator Helper	6	
Shuttle Car Operator	12	
Roof Bolter	6	

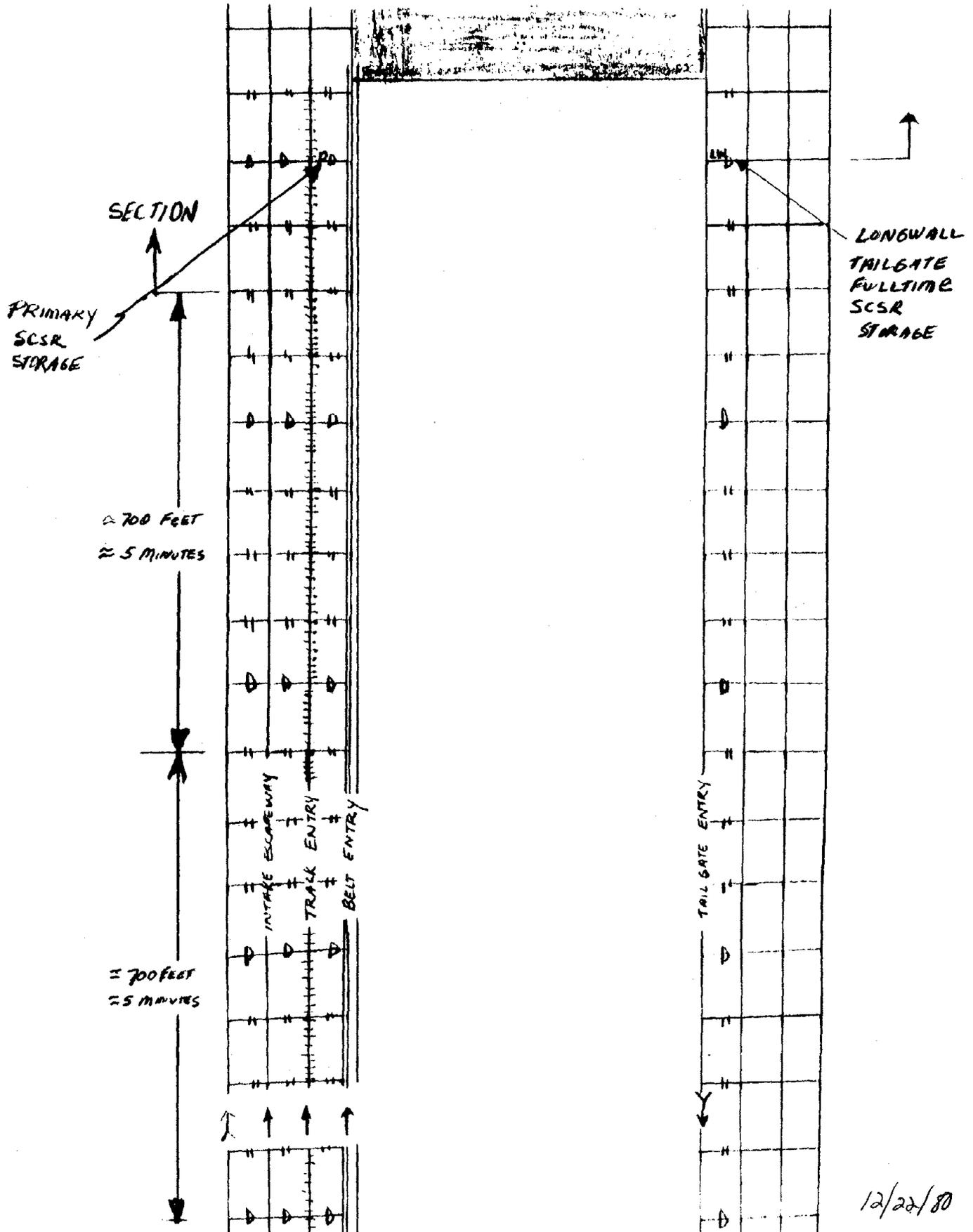
<u>Miner</u>	<u>Number</u>	<u>Shift</u>
<u>Evergreen Mains - Continuous Mining (Continued)</u>		
Roof Bolter Helper	6	
General Inside Labor	6	
Electrician-Mechanic	6	
<u>Bluegrass #6 Panel - Longwall Mining</u>		
Section Foreman	2	2,3
Longwall Machine Operator	2	
Longwall Technician	1	
General Inside Labor	15	
Electrician-Mechanic	2	
<u>Bluegrass #7 Panel - Continuous Mining</u>		
Section Foreman	3	1,2,3
Continuous Miner Operator	3	
Machine Operator Helper	3	
Shuttle Car Operator	6	
Roof Bolter	3	
Roof Bolter Helper	3	
General Inside Labor	3	
Electrician-Mechanic	3	
<u>Bluegrass #9 Panel - Continuous Mining</u>		
Section Foreman	2	2,3
Continuous Miner Operator	2	
Machine Operator Helper	2	
Shuttle Car Operator	4	
Roof Bolter	2	
Roof Bolter Helper	2	
General Inside Labor	2	
Electrician-Mechanic	2	
<u>Rapid Run #1 Panel - Continuous Mining</u>		
Section Foreman	2	2,3
Continuous Miner Operator	2	
Machine Operator Helper	2	
Shuttle Car Operator	4	
Roof Bolter	2	
Roof Bolter Helper	2	
General Inside Labor	2	
Electrician-Mechanic	2	

<u>Miner</u>	<u>Number</u>	<u>Shift</u>
<u>Spruce Mains #7 - Continuous Mining</u>		
Section Foreman	2	2,3
Continuous Miner Operator	2	
Machine Operator Helper	2	
Shuttle Car Operator	4	
Roof Bolter	2	
Roof Bolter Helper	2	
General Inside Labor	2	
Electrician-Mechanic	2	
<u>Spruce Mains #8 - Continuous Mining</u>		
Section Foreman	2	2,3
Continuous Miner Operator	2	
Machine Operator Helper	2	
Shuttle Car Operator	4	
Roof Bolter	2	
Roof Bolter Helper	2	
General Inside Labor	2	
Electrician-Mechanic	2	
<u>Prairie Drainage - Continuous Mining</u>		
Section Foreman	2	2,3
Continuous Miner Operator	2	
Machine Operator Helper	2	
Shuttle Car Operator	4	
Roof Bolter	2	
Roof Bolter Helper	2	
General Inside Labor	2	

Attachment 4-a Figure 1 of 2



Attachment 4-a Figure 2 of 2



December 22, 1980

Mine B
I.D. 76-54321

Attachment 4-c

Containers

Each container will have the capacity for four SCSR's. The containers are the same as described in Attachment 2-d2.

Accessibility

Full-time SCSR storage in the tailgate entry shall be at the first mandoor outby the tailgate. Mandoors are located at a distance no more than every fourth stopping, in excess of 325 feet or greater than five minutes from the next mandoor.

If the SCSR storage site is not at the first mandoor outby the tailgate, full-time SCSR storage will be based on the distance of the miner to the proposed location. Normal work in the section will stop when SCSR's are moved until each miner on the section knows the new storage location.

Signs

Signs with the word "SELF-RESCUERS" will be conspicuously posted with directional arrows leading to the storage site in the tailgate entry. The signs will not be farther than a crosscut from the longwall tailgate.

Additional signs may or may not be used at the discretion of the mine operator.

December 22, 1980

Mine B
I.D. 76-54321

Attachments 7-a1, 7-a2, 7-b1 and 7-b2

7-a1 The following are key excerpts from page 6 of MSA's instruction manual (TAL088(L)REV 1) for these SCSR's.

1. Units which are carried should be visually checked daily.
2. Any unit which has visible external damage at the seal area or has a visible puncture in the case must be removed from service immediately.
3. Any unit with damage to the external case in the form of dents 1/4-inch or deeper should be removed from service.
4. Any unit with minor visible damage must be tested for leakage of the case as soon as possible.

7-a2 All SCSR's as well as any removed from storage will be visually checked using the procedures referred to above prior to being placed in an underground storage or made available to a miner or invitee.

The intent is for the lamp men, fire bosses and selected salaried personnel to make these inspections. Their training will consist of study of the instruction manual under the supervision of the Safety Inspectors.

7-b1 The following are key excerpts from pages 6 and 7 of MSA's instruction manual (TAL088(L)REV 1) for these SCSR's.

1. The units shall be checked for leakage every 90 days.
2. Any unit with minor visible damage must be tested for leakage of the case as soon as possible.
3. No unit which has had the sealing band completely removed shall be leak tested; remove these units from service.
4. If there has been disturbance of one or two links of the seal band spring, but the seal still appears to be intact, the unit should first be subjected to a leak test.

Page 7 of the manual describes the leak testing referred to above.

7-b2

- a) All SCSR's will be checked for leakage at intervals not exceeding 90 days using the procedures given on page 7 of the instruction manual.
- b) A record of each SCSR by serial number will be maintained in a book showing the results of the tests required by paragraph c) of this section.
- c) The person or persons making the inspections and tests referred to in paragraphs b) and c) of this section will be trained to perform such inspections and tests and to replace links in the seal band spring. These persons and their training are given in Attachemnt 7-a2.
- d) No other SCSR repair shall be done by the applicant.

PLAN 2.

Mine B
I.D. 76-54321

February 18, 1981

This plan complements Plan 1. dated December 22, 1980, approved by your office January 19, 1981.

Plan 2. provides for SCSR storage used by miners whose duties require working in and around the nine operating sections and four idle sections given in Plan 1.

The miners for whom this is requested are:

<u>Job Classification</u>	<u>Shift</u>	<u>1</u>	<u>2</u>	<u>3</u>	<u>Total</u>
Belt Trouble Shooters		2	4	4	10
Trouble Shooter Electrician		1	4	4	9
Electrician-Mechanic		4	13	13	30
General Crew Fillers		5	13	13	31
Construction Crew		5	10	10	25
Pumpers		3	4	4	11
Bratticeman		2	5	5	12
Maintenance		1	6	6	13
Environmental Dust Technician		1	6	6	13
Time Study		-	1	-	1
Inspector Escort		-	2	-	2
Mine Foreman		1	1	1	3
Mine Superintendent		-	1	-	1
Assistant Supervisor		-	1	-	1
General Superintendent		-	1	-	1
Vice President		-	1	-	1
Safety Engineer		-	1	-	1
Safety Inspector		-	3	-	3
Safety Coordinator		-	1	-	1
Safety Supervisor		-	1	-	1
Shift Foreman		1	1	1	3
Maintenance Foreman		5	11	11	27
Belt Foreman		2	2	2	6
Electrical Foreman		1	1	1	3
Assistant Foreman		1	1	-	2
Construction Foreman		1	1	1	3
Chief Electrician-Mechanic		-	1	-	1
Fireboss		3	3	3	9

Reason for Storage

Storage of SCSR's is needed for the above-listed miners because they judge wearing and carrying SCSR's to be hazardous while performing their normal duties in and around these sections. No readily accessible location within 25 feet of each of these miners can be assured with reasonable certainty at all times.

Wear and Carry, FSR's, Commingling

This plan does not prevent a miner from electing to wear or carry an SCSR. All who store, however, must have an FSR.

Persons other than specified above and in Plan 1 will not be allowed to store SCSR's.

Proposed Storage Plan

This plan is for shift storage of SCSR's by miners, other than the face crew, who work in or around a section. These miners are referred to below as rovers. The proposed storage plans depend on the individual rover's mode of travel; i.e. when travel to and from section is:

1. In the same vehicle as the face crew, rovers may store SCSR's in accordance with Plan 1.
2. By another vehicle or by crawling may store SCSR's in the Secondary Section Storage.

Additionally, when no more than six face crew miners plus rovers are in by the stage loader, these rovers can depend on SCSR's stored in the tailgate (see Plan 1) rather than have SCSR's on the longwall face.

Place of Secondary Section Storage -- In the first crosscut with a mandoor outby the mouth of the intake escapeway. SCSR's will be placed in containers. The containers are the same as in Plan 1, Attachment 2-d2.

SCSR storage in the intake escapeway in each section will always be

1. Accessible through at least three travel routes -- two on intake and one on return; i.e., the mouth of the intake escapeway, mandoor between the track and intake escapeway, and mandoor between the return and the intake escapeway.
2. Consistently located throughout active sections of the mine. Mandoor are in every fourth stopping and not farther than 360 feet apart. Miners can crawl that distance in less than five minutes.
3. Supported by roof bolts.
4. Normally 42 inches in thickness locally with areas where heights may be as little as 36 inches; and flat \pm 3 percent.
5. Within 400 feet of the Primary Storage, a less than 5-minute crawl under normal circumstances.

6. Warm: 35 to 75°F. A heater will be provided should temperatures go below freezing.
7. Out of the flow of equipment.
8. More than one block away from an active loading point.
9. Within 700 feet and 5 minutes
 - From the last open crosscut for continuous miner sections
 - From the stageloader in the intake escapeway for longwall sections.
10. In intake air with 8,000 to 36,000 cfm.
11. In an area in which an oxygen-deficient atmosphere is not likely to develop as a result of breaking into such an atmosphere, a coal bump and/or a gas outburst.

Inspection and Testing

SCSR's will be inspected and tested in accordance with Plan 1, Attachment 7-a1, 7-a2, 7-b1 and 7-b2.

Date: February 26, 1981

For:

Mine B, I.D. No. 76-54321

1. Your approval is requested of the following supplement to our Program of Instruction submitted in accordance with 30 CFR, 75.1101-23(a) and approved by your office on 6/30, 1974.
- 1.1 This supplement is for storage of MSA 464213, TC-13F-87
(Model) (Approval Number)
self-contained self-rescue devices, hereafter referred to as SCSR's, in accordance with the provisions of paragraph (e), 30 CFR, 75.1714-2.
- 1.2 These SCSR's are to be stored for (MINERS ONLY) ~~(MINERS AND OTHER PERSONS AUTHORIZED BY THE APPLICANT TO ENTER THIS MINE)~~
~~(ALL PERSONS)~~
- 1.3 ~~(WITH NO EXCEPTIONS)~~ ~~(WITH THE EXCEPTIONS DETAILED IN ATTACHMENT 1.3)~~ persons for whom SCSR's are stored will not enter an area in which an oxygen-deficient atmosphere is likely to develop as a result of breaking into such an atmosphere, a coal bump and/or a gas outburst.
- 1.4 ~~(WITH NO EXCEPTIONS)~~ ~~(WITH THE EXCEPTIONS DETAILED IN ATTACHMENT 1.4)~~ all persons for whom SCSR's are stored shall have at all times while underground a filter or other self-rescue device approved under subpart I of Part 11 of 30 CFR in accordance with paragraphs (b), (c) and (d) of 30 CFR, 75.1714-2 except the "readily accessible location" referred to need not be a holder or container.
- 1.5 ~~(WITH NO EXCEPTIONS)~~ ~~(WITH THE EXCEPTIONS DETAILED IN ATTACHMENT 1.5)~~ all persons for whom SCSR's are stored shall have the right to wear or carry another SCSR (IN LIEU OF) ~~(IN ADDITION TO)~~ an approved filter or other self-rescue device.
- 1.6 Temperatures in the place(S) of storage shall be ~~maintained~~ above freezing and below 100°F. ~~(METHODS TO BE USED TO PREVENT TEMPERATURES OUTSIDE THAT RANGE ARE GIVEN IN ATTACHMENT 1.6).~~



2. PRIMARY SECTION STORAGE *See Plan 2 approved by your office 12/22/80. This plan is a supplement to Plan 2.*
- a) Map(S) marked Figure(S) to in Attachment 2-a) show the place(S) of section storage of SCSR's. Also shown are:
1. The maximum distance in feet and minutes from the point of deepest penetration of the working faces to the place(S) of primary storage.
 2. The maximum distance in feet and minutes from the place(S) of primary storage to the mouth of and/or mandoor into the designated escapeways.
 3. The average and least heights of travel routes 1. and 2. above.
 4. The average and maximum pitch of travel routes 1. and 2. above.
 5. The quality and quantity of air flows in travel routes 1. and 2. above.
 6. Any belt conveyors, trolley wire, and loading points in the section and for a distance equivalent to five minutes (WALK) (CRAWL) outby the section.
 7. The location of all permanent stoppings in the section.
 8. The routes of movement of equipment into and in the section(S).
- b) The (MINERS) (MINERS AND OTHER PERSONS) for whom the above 2-a) storage is planned are listed by section, job classification, number, and shift in Attachment 2-b).
- c) Storage for the persons listed in Attachment 2-a) should be approved for the following reasons:
- d) SCSR's will be stored in: (Note: If in holders, respond to 1. below and cross out 2. If in containers, cross out 1. and respond to 2.)
1. Holders. The design and location of these holders and how SCSR's will be protected against damage, dust, grease, water and commingling are detailed in Attachment 2-d).
 2. Containers. The specifications for these containers and their weight when filled are detailed in Attachment 2-d).

- e) This plan is for (FULL-TIME) (SHIFT) storage of SCSR's. (Note: If full-time, respond to 1. and 2. below).
1. Signs showing the location of and direction to the place(S) of storage are described in Attachment 2-e)1.
 2. In the event of a fan outage or drill requiring withdrawal from the section the procedures to be followed in obtaining SCSR's and in subsequent inspection and testing of those SCSR's are detailed in Attachment 2-e)2.

3. SECONDARY SECTION STORAGE

See Plan 2, approved 12/22/80
This plan is a supplement to Plan 2.
(Note: Do not submit a plan for secondary storage unless you have submitted a plan for primary section storage.)

- a) Map(S) marked Figure(S) _____ to _____ in Attachment 3-a) show the place(S) of secondary storage of SCSR's. Also shown are:
1. The maximum distance in feet and minutes to the place(S) of primary storage.
 2. The maximum distance in feet and minutes from the place(S) of secondary storage to the designated escapeways.
 3. The average and least heights of travel routes 1. and 2. above.
 4. The average and maximum pitch of travel routes 1. and 2. above.
 5. The quality and quantity of air flows in travel routes 1. and 2. above.
 6. Any belt conveyors, trolley wire, and loading points within a distance equivalent to five minutes (WALK) (CRAWL) inby and outby the proposed place(S) of secondary storage.
 7. The routes of movement of equipment in and around the proposed place(S) of secondary storage.
- b) The (MINERS) (MINERS AND OTHER PERSONS) for whom the above 3-a) storage is planned are listed by job classification, number, and shift in Attachment 3-b).
- c) _____ SCSR's will be in full time primary storage as described in 2. (Number) above.
- d) _____ SCSR's will be in secondary storage. (Number)

4. LONGWALL SECTION STORAGE *See Plan 2, approved 12/22/80.
This plan is a supplement to Plan 2.*
This plan is in addition to the plan(S) submitted in 2. (AND 3.) above.

- a) Map(S) marked Figure(S) to in Attachment 4-a) show the place(S) of longwall storage of SCSR's. Also shown is the maximum distance in feet and minutes from the center of the longwall face(S) to the place(S) of longwall storage.
- b) Not more than persons will not wear or carry an SCSR while inby the stageloader(S).
- c) SCSR's shall be stored in container(S). Container specifications, their weight when filled, provisions to be taken to maintain them readily accessible, and signs showing the travel route to and location of the place(S) of storage are detailed in Attachment 4-c).

~~5. VEHICLE STORAGE~~

~~(Note: This plan does not apply to: A) a) a) trip while en route into and out of the mine, a vehicle while in a section. Cross out a) if no plan is submitted.)~~

- ~~a) This plan is for storage of SCSR's on the vehicles specified in Attachment 5-a). Also given in that Attachment are:~~
- ~~1. The maximum number of persons who can ride in and/or on each vehicle.~~
 - ~~2. The (MINERS) (MINERS AND OTHER PERSONS) for whom the above storage, listed by job classification, number, and shift.~~
 - ~~3. The specifications for SCSR holders or containers on each vehicle.~~
 - ~~4. Areas in the mine each vehicle might travel, particularly return airways.~~
 - ~~5. Vehicle parking practices.~~
- ~~b) Storage for the persons listed in Attachment 5-a)2 should be approved for the following reasons:~~

- c) ~~The temperature in the place(S) of storage will be maintained above freezing and below 100°F (WITH THE EXCEPTIONS GIVEN IN ATTACHMENT 5-c)).~~
- d) ~~SCSR's stored on vehicles (WILL) (WILL NOT) be "use" tested annually. The "use" test to be performed is described in Attachment 5-d).~~

6. OTHER STORAGE

(Note: This plan does not apply to VEHICLE or SECTION storage.)

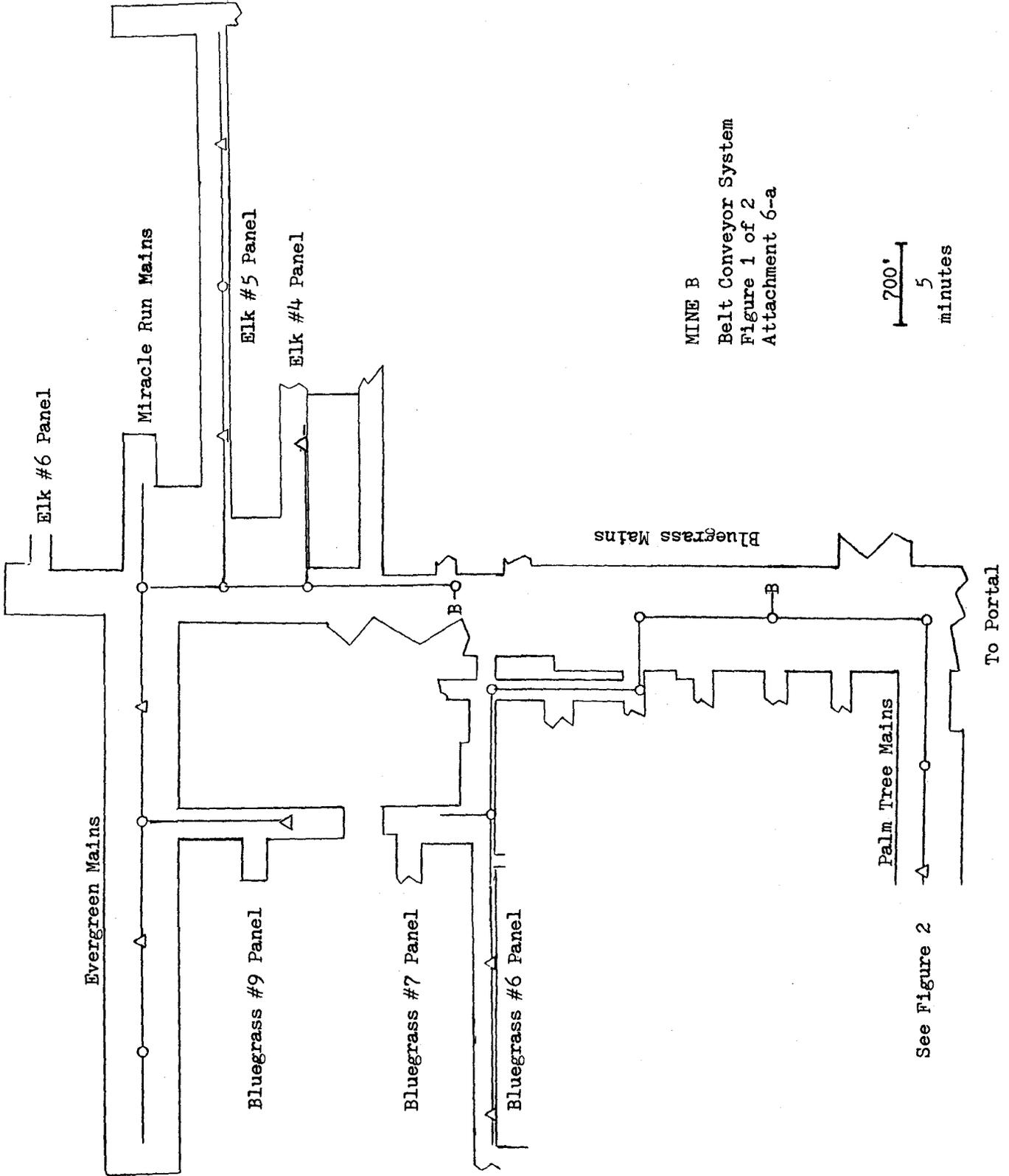
- a) Map(S) marked Figure(S) 1 to 2 in Attachment 6-a show the places of other storage of SCSR's. Also ~~shown~~ are:
 1. The maximum distance in feet and minutes from the persons listed in Attachment 6-b to the place(S) of other storage. *700 feet, 5 minutes*
 2. The maximum distance in feet and minutes from the place(S) of other storage to access into an escapeway. *700 feet, 5 minutes*
 3. The average and least heights of travel routes 1. and 2. above. *38 inches avg. 39 inches lowest*
 4. The average and maximum pitch of travel routes 1. and 2. above. *flat ± 3%*
 5. The quality and quantity of air flows in travel routes 1. and 2. above. *Intake, 8000-36000 cfm*
 6. The routes of movement of equipment in and around the place(S) of storage. *No equipment other than belt conveyors and bottom rock dusters.*
- b) The (MINERS) ~~(MINERS AND OTHER PERSONS)~~ for whom the above 6a) storage is planned are listed by job classification, number, and shift in Attachment 6-bC *for full-time, 6-bT for shift.*
- c) Storage for the persons listed in Attachment 6-b should be approved for the following reasons: *These miners judge wearing or carrying SCSR's to be hazardous when traveling along the conveyors, cleaning accumulations around conveyors, checking and maintaining fire detection and extinguishing systems, examining and lubricating rollers and drives, and other work. No readily accessible location can be maintained at all times within 25 feet of these miners who may work in areas of several thousand feet during a shift.*

- d) SCSR's will be stored in containers. The specifications for these containers and their weight when filled are detailed in Attachment 6-d.
- e) This plan is for (FULL-TIME) ^{and} (SHIFT) storage of SCSR's. (Note: If full-time, respond to 1. and 2. below.)
 - 1. Signs showing the location of and direction to the place(S) of storage are described in Attachment 6-e)1.
 - 2. In the event of a fan outage or drill requiring withdrawal from the area the procedures to be followed in obtaining SCSR's and in subsequent inspection and testing of those SCSR's are detailed in Attachment 6-e)2.

7. INSPECTION AND TESTING

(Note: Complete a) for shift storage and b) for full-time storage of SCSR's made available by the mine operator. Cross out the one, if any, which does not apply.)

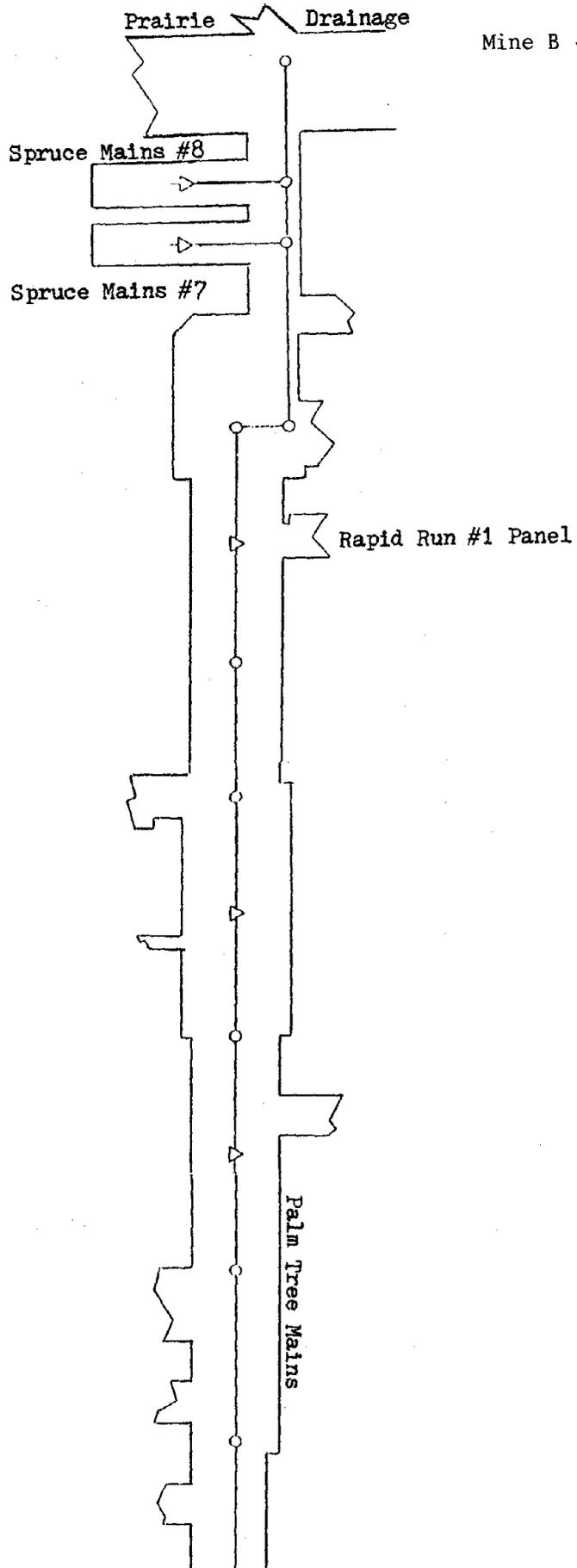
- a) This plan is for SCSR's carried out of the mine at the end of a miner's shift and within nine hours after an invitee enters the mine.
 - 1. The "daily" inspection and testing approved by MSHA are detailed in Attachment 7-a)1.
 - 2. The "daily" inspection and testing to be followed by the applicant mine operator, detailed in Attachment 7-a)2, include who will inspect and test the SCSR's and the training given to ~~(THAT)~~ (THOSE) person(S).
 - 3. Other inspection and testing approved by MSHA is detailed in Attachment 7-~~a)2~~ **b1**
 - 4. The other inspection and testing to be followed by the applicant mine operator detailed in Attachment 7-~~b2~~ includes who will inspect and test the SCSR's and the training given to ~~(THAT)~~ (THOSE) person(S).
 - 5. A record by SCSR serial number will be maintained to account for SCSR's tested in 4. above; and, for other SCSR's
 - Disposed of and how disposed of
 - Missing, and the last known locations.
- b) This plan is for SCSR's that remain in the mine at the end of a miner's shift.



MINE B
Belt Conveyor System
Figure 1 of 2
Attachment 6-a

700'
5
minutes

See Figure 2



MINE B
Figure 2 of 2

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Attachment 6-bC and 6-bT

6-bC	<u>Job Classification</u>	<u>Shift</u>	<u>1</u>	<u>2</u>	<u>3</u>	<u>Total</u>
	Belt Cleaners		6	9	9	24
	Belt Examiners		4	4	4	12
	Belt Trouble Shooters		2	4	4	10
	Trouble Shooter Electrician		1	4	4	9
	Electrician-Mechanic		4	13	13	30
	General Crew Fillers		5	13	13	31
	Construction Crew		5	10	10	25
	Pumpers		3	4	4	11
	Bratticeman		2	5	5	12
	Maintenance		1	6	5	13
	Environmental Dust Technician		1	6	6	13
	Time Study		-	1	-	1
	Inspector Escort		-	2	-	2
	Mine Foreman		1	1	1	3
	Mine Superintendent		-	1	-	1
	Assistant Supervisor		-	1	-	1
	General Superintendent		-	1	-	1
	Vice President		-	1	-	1
	Safety Engineer		-	1	-	1
	Safety Inspector		-	3	-	3
	Safety Coordinator		-	1	-	1
	Safety Supervisor		-	1	-	1
	Shift Foreman		1	1	1	3
	Maintenance Foreman		5	11	11	27
	Belt Foreman		2	2	2	6
	Electrical Foreman		1	1	1	3
	Assistant Foreman		1	1	-	2
	Construction Foreman		1	1	1	3
	Chief Electrician-Mechanic		-	1	-	1
	Fireboss		3	3	3	9
6-bT	Same as above plus:					
	Belthead-Transfer Point		15	15	15	45

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Attachments 6-d)C, 6-e)1, and 6-e)2

6-d)C Containers will be Boston Shippers Model 400, a plastic case built to ATA-300 specifications. Each has foam-padded compartments for four SCSR's.

One container of four SCSR's in full-time storage for miners listed in Attachment 6-b)C will be

- Near each transfer point (circles on Attachment 6-a)
- Between transfer points when more than 1400 feet apart (triangles on Attachment 6-a).

These containers will be marked "4-SCSR's" and the location. Additional containers for shift (part-time) storage for miners listed in Attachment 6-b)T will be

- Near each transfer point
- Near each boom (B on Attachment 6-a).

Containers will be in a crosscut with access from two entries, both of which are normally intake. The exact location will be at the discretion of the applicant who will select the place based, among other things, on:

1. Its having a mandoor
2. Its being outby the normal flow of equipment
3. The condition of the ribs and roof
4. Water in and wetness of the area.

6-e)1 Signs with the word "Self-Rescuer" and a directional arrow will be not farther than every fourth crosscut in the two entries and at every transfer point and other main and secondary belt-conveyor drives.

6-e)2 In the event of a fan outage requiring withdrawal, miners who have no other SCSR will remove one from the nearest place of Other Storage. Each one removed will be inspected following the procedures given in Section 7 of this plan prior to its being returned to storage. Each cache will contain the proper number of SCSR's prior to miners going inby a cache. Miners working in areas covered by Other Storage do not participate in escapeway drills in those areas.

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Attachments 7-a1, 7-a2, 7-b1 and 7-b2

7-a1 The following are key excerpts from page 6 of MSA's instruction manual (TAL088(L)REV 1) for these SCSR's.

1. Units which are carried should be visually checked daily.
2. Any unit which has visible external damage at the seal area or has a visible puncture in the case must be removed from service immediately.
3. Any unit with damage to the external case in the form of dents 1/4-inch or deeper should be removed from service.
4. Any unit with minor visible damage must be tested for leakage of the case as soon as possible.

7-a2 All SCSR's as well as any removed from storage will be visually checked using the procedures referred to above prior to being placed in an underground storage or made available to a miner or invitee.

The intent is for the lamp men, fire bosses and selected salaried personnel to make these inspections. Their training will consist of study of the instruction manual under the supervision of the Safety Inspectors.

7-b1 The following are key excerpts from pages 6 and 7 of MSA's instruction manual (TAL088(L)REV 1) for these SCSR's.

1. The units shall be checked for leakage every 90 days.
2. Any unit with minor visible damage must be tested for leakage of the case as soon as possible.
3. No unit which has had the sealing band completely removed shall be leak tested; remove these units from service.
4. If there has been disturbance of one or two links of the seal band spring, but the seal still appears to be intact, the unit should first be subjected to a leak test.

Page 7 of the manual describes the leak testing referred to above.

7-b2

- a) All SCSR's will be checked for leakage at intervals not exceeding 90 days using the procedures given on page 7 of the instruction manual.
- b) A record of each SCSR by serial number will be maintained in a book showing the results of the tests required by paragraph c) of this section.
- c) The person or persons making the inspections and tests referred to in paragraphs b) and c) of this section will be trained to perform such inspections and tests and to replace links in the seal band spring. These persons and their training are given in Attachemnt 7-a2.
- d) No other SCSR repair shall be done by the applicant.

APPENDIX I

TESTING OF IN-SERVICE COMPRESSED OXYGEN
SCSRs

At the time this report was written, an NIOSH-approved compressed SCSR was not commercially available. It was therefore not possible to analyze such a unit first-hand in order to make recommendations for the periodic testing of such devices after they are placed in service.

The next best procedure, instead of first-hand analysis, was to gather information on the testing procedures which have been utilized in other countries using compressed oxygen SCSRs. This information was *not* obtained from manufacturers or their representatives. It was obtained entirely from organizations who have operating experience with compressed oxygen SCSRs, including government agencies, testing laboratories, and mining companies. Table I-1 shows the countries, SCSR models used, and cognizant agencies whose recommendations for testing were surveyed.

Subsections I.1 through I.4 discuss these testing recommendations in more detail; subsection I.5 presents our conclusions based on this foreign experience.

TABLE I-1. - European use of compressed oxygen SCSRs

Country	SCSR model	Agency establishing testing procedures
Germany	Draeger OXYSR45	Wintershall Mine
	Draeger OXYSR45	Main Rescue Center (Hauptstelle)
Poland	AU-9	Central Mine Rescue Station
France	Fenzy 66	Charbonnage de France
	Draeger OXYSR45	
United Kingdom	AGA Mine Escape	National Coal Board

I.1 Testing Practices in Germany

I.1.1 Potash Mining

Because of the dangers of gas inundations, some German potash mines equip all underground workers with compressed oxygen SCSRs. The Wintershal Mine uses Draeger SR45SSR models, which are carried into the mine every day, placed on whatever equipment the miner is operating, and taken out at the end of the shift. This mine has developed the following inspection and testing procedures:

- a. *Daily* - SCSRs are cleaned by lampman, checked for visible damage; seal and bottle pressure is checked.
- b. *4 times per year* - SCSRs are opened and flow-tested on Draeger test apparatus. The soda lime is screened for fines, because they have found that some dusting does occur from jostling and vibration due to carrying and storing on machines.
- c. *Once per year* - The soda lime is replaced and the bottle recharged with oxygen after the unit has been test-worn.
- d. *Every 4 years* - The main valves are checked and certified by a government agency.

I.1.2 Main Rescue Center

The Instrument Master of the Main Rescue Center in Essen, Germany, has authored a manual on "The Maintenance and Testing of Draeger OXYSR45 Oxygen Self-Rescuers." Section 4 is entitled "Testing of the Apparatus," and may be loosely translated and summarized as follows:

Testing of the Apparatus

a. Test Intervals

When used as auxiliary apparatus by mine rescue teams, or in daily use by underground miners:

1. Before embarking: check oxygen pressure
2. Monthly: check oxygen pressure; check seal quality of assembly under pressure and vacuum (see items C6 and C7)

3. After heavy usage or banging around: complete testing (see item C)
4. Quarter-Annually: complete testing
5. Annually: apparatus should be breathed through at least once a year as part of a training program.

b. Instructions for Testing

Complete testing requires using a Universal Test Instrument to do pressure and flow tests.

Before new oxygen bottles are installed in an SCSR, the bottles must be placed in storage for 8 days.

c. Complete Testing

1. Hook up the SCSR to the test instrument
2. Perform flow and pressure tests (of the oxygen bottle and valve system)
3. Check overpressure valve
4. Check response of "automatic valve"
5. Install the oxygen bottle
6. Overpressure tests: the low-pressure part of the system (check-valves, hose, etc.) is pressurized to 3 in. WG; the pressure must not drop more than 0.4 in. in 1 min.
7. Underpressure test: same as No. 6 above using a negative pressure of 3 in. WG.
8. Closing of self-rescuer
9. Ready for use.

I.2 Testing Practices in Poland

The Central Mine Rescue Station in Bytom, Poland, has issued a manual entitled "Instructions on Training of Men, Usage, Inspection, Dispensing, Storage and Management of AU-9 Self-Rescuers" dated June, 1979. Section III, subsection 1, "Inspection of Apparatus," reads as follows:

- 1.1 After each usage all self-rescuers must undergo a careful inspection by the rescuer mechanic according to the 'Instructions for Use. No. 232,' point 5, issued by the manufacturer FASER with previous change of soda lime in the CO₂ cannister, replacement of the empty cylinder with a new one, fitting the apparatus with the cover removed in the course of retreat and carrying out disinfection and maintenance operation.

The rescuer mechanic is obliged, according to point 5 of the 'Instructions for Use. No. 232' of the manufacturer, FASER, to regularly inspect the currently used apparatuses, once a month, and the inspection results must be entered in the 'Inspection Book for Self-Rescuers,' according to the form attached herewith {see Figure I-1}.

- 1.2 The District Rescue Station is responsible for carrying out, once in a quarter, a thorough inspection of 10 percent of the total number of self-rescuers stored, not less, however, than 50 units.

The results and conclusions derived from the inspection must be recorded in the inspection book kept by the Mine Rescue Station.

I.3 France

We did not obtain specific information regarding the testing practices in France. Coal mining industry representatives indicated that periodic testing was recommended and that extended storage without testing was not advisable.

As mentioned in Appendix B, CERCHAR is currently conducting a comprehensive underground evaluation program which may include at least one compressed oxygen model which will be stored underground. Results of this program will be made available periodically over the next 2 years.

I.4 United Kingdom

The Cynheidre Mine in Wales is subject to gas outbursts, and therefore, it equips all face miners with AGA Mine Escape compressed oxygen SCSRs. These units are carried in daily and hung on pegs near the face. National Coal Board policy is to test these units approximately once a month.

UNIT NO.	DATE OF INSPECTION	EXTERNAL APPEARANCE	CHECKING OF CO ₂ CANNISTER	LEAK PROOFNESS OF HIGH-PRESSURE JOINTS	LEAK PROOFNESS OF LOW-PRESSURE SYSTEM	CONSTANT FLOW OF OXYGEN	NEGATIVE PRESSURE FOR OPENING DEMAND VALVE	STARTING PRESSURE ACTUATING RELIEF VALVE	CHECKING OF OXYGEN PRESSURE IN CYLINDER	CHECKING OF PRESSURE GAUGE WITH CALIBRATION	SIGNATURE OF MECHANIC	REMARKS OF MECHANIC AND INSPECTOR OF DISTRICT MINING RESCUE STATION

FIGURE I-1. - Inspection form for AU-9 self-rescuers.

I.5 Conclusions

Table I-2 summarizes, or "averages," the recommendations of the organizations in Europe who have had the most experience with compressed oxygen SCSRs. It is therefore reasonable to expect that a test program based on their recommendations would provide a good starting point until further experience is gained in the United States. The one area of concern is that there is no real "test" of the adequacy of the CO₂ scrubber. If means were available to easily determine that the chemical were still fully effective, it could be tested at the same time as other components and then replacement would not be required unless it failed a test.

CO₂ scrubbers in SCSRs are designed to have substantially larger breathing life than the oxygen supply. If the oxygen is depleted, the breathing bag will deflate and the user will remove the SCSR. But if the CO₂ scrubber fails first, the user will continue to receive oxygen and can unknowingly continue to breath progressively higher and potentially fatal, levels of CO₂. Thus, it is imperative that the procedures be developed to ensure the adequacy of the scrubber, either through replacement or testing.

In summary, until a sufficient body of experience has been developed to provide new test procedures, compressed oxygen SCSRs should be implemented in the United States with test procedures patterned after those of others who already have such experience. These procedures might include the following:

TABLE I-2. - Simplified recommendations of European organizations

Item to be checked/tested	Frequency of test
Oxygen supply	Daily or before each use
Integrity of moving parts and elastomeric system	30 to 90 days
Integrity of CO ₂ scrubber	Replace annually

- a. Daily inspection of oxygen pressure
- b. 90-day tests to include pressure and flow through the apparatus
- c. 90-day testing of scrubber if possible, otherwise annual replacement.

APPENDIX J

30 CFR 75.1714, 30 REGULATIONS PERTAINING TO SELF-RESCUERS

§ 75.1714 Availability of approved self-rescue devices; instruction in use and location.

(a) Each operator shall make available to each miner employed by the operator who goes underground and to visitors authorized to enter the mine by the operator a self-rescue device or devices approved by the Secretary which is adequate to protect such person for one hour or longer.

(b) Before any miner employed by the operator or visitor authorized by the operator goes underground the operator shall instruct and train such person in the use and location of the self-rescue device or devices made available at the mine. Instruction and training of miners shall include instruction in use, care, and maintenance of the device in accordance with provisions set forth in 30 CFR Part 48.

[43 FR 54246, Nov. 21, 1978, as amended at 43 FR 56894, Dec. 5, 1978]

§ 75.1714-1 Approved self-rescue devices.

The requirements of § 75.1714 shall be met by making available to each person referred to in that section a self-rescue device or devices as follows:

(a) Until [2 years from effective date] a self-rescue device or devices which have been approved under:

(1) Bureau of Mines Schedule 14F, Gas Masks, April 23, 1955, as amended (Part 13, 30 CFR, 1972 ed.); or

(2) Subpart I of part 11 of this chapter; or

(3) Subpart H of part 11 of this chapter, as follows:

(i) A 1-hour self-contained self-rescue device; or

(ii) A self-contained self-rescue device of not less than 10 minutes and a 1-hour canister; or

(iii) Any other self-contained breathing apparatus approved under subpart H of part 11 of this chapter which provides protection for a period of 1 hour or longer and which is approved for use by MSHA for the purpose of a self-rescue device or devices when used and maintained as prescribed by MSHA.

(b) After [2 years from effective date] a self-rescue device or devices which have been approved under subpart H of part 11 of this chapter, as follows:

(1) A 1-hour self-contained self-rescue device; or

(2) A self-contained self-rescue device of not less than 10 minutes and a 1-hour canister; or

(3) Any other self-contained breathing apparatus approved under subpart H of part 11 of this chapter which provides protection for a period of 1 hour or longer and which is approved for use by MSHA for the purpose of a self-rescue device or devices when used and maintained as prescribed by MSHA.

[43 FR 54246, Nov. 21, 1978]

§ 75.1714-2 Self-rescue devices; use and location requirements.

(a) Self-rescue devices shall be used and located as prescribed in paragraphs (b) through (f) of this section.

(b) Except as provided in paragraphs (c), (d), (e), or (f) of this section, self-rescue devices shall be worn or carried at all times by each person when underground.

(c) Where the wearing or carrying of the self-rescue device is hazardous to the person, it shall be placed in a readily accessible location no greater than 25 feet from such person.

(d) Where a person works on or around equipment, the self-rescue device may be placed in a readily accessible location on such equipment.

(e) A mine operator may apply to the District Manager under 30 CFR 75.1101-23 for permission to place the self-contained self-rescue device more than 25 feet away.

(1) The District Manager shall consider the following factors in deciding whether to permit an operator to place a self-contained self-rescue device more than 25 feet from a miner:

(i) Distance from affected sections to surface,

(ii) Pitch of seam in affected sections,

(iii) Height of coal seam in affected sections,

(iv) Location of escapeways,

(v) Proposed location of self-contained self-rescuers,

(vi) Type of work performed by affected miners.

(vii) Degree of risk to which affected miners are exposed,

(viii) Potential for breaking into oxygen deficient atmospheres,

(ix) Type of risk to which affected miners are exposed,

(x) Accident history of mine, and

(xi) Other matters bearing upon the safety of miners.

(2) Such application shall not be approved by the District Manager unless it provides that all miners whose self-contained self-rescuer is more than 25 feet away shall have, in accordance with paragraphs (b), (c), and (d) of this section, at all times while underground, a self-rescue device approved under subpart I of part 11 of this chapter or Bureau of Mines Schedule 14F, Gas Masks, April 23, 1955, as amended (Part 13, 30 CFR, 1972 ed.) sufficient to enable each miner to get to a self-contained self-rescuer.

(3) An operator may not obtain permission under paragraph (e) of this section to place self-contained self-rescuers more than 25 feet away from miners on mantrips into and out of the mine.

(f) If a self-contained self-rescue device is not carried out of the mine at the end of a miner's shift, the place of storage must be approved by the District Manager, a sign with the word "SELF-RESCUER" or "SELF-RESCUERS" shall be conspicuously posted at each storage place, and direction signs shall be posted leading to each storage place.

(g) Where devices of not less than 10 minutes and 1 hour are made available in accordance with § 75.1714-1(a)(3)(ii) or § 75.1714-1(b)(2), such devices shall be used and located as follows:

(1) Except as provided in paragraphs (c) and (d) of this section, the device of not less than 10 minutes shall be worn or carried at all times by each person when underground, and

(2) The 1-hour canister shall be available at all times to all persons when underground in accordance with a plan submitted by the operator of the mine and approved by the District Manager. When the 1-hour canister is placed in a cache or caches, a sign with the word "SELF-RESCUERS" shall be conspicuously posted at each cache, and direction signs shall be posted leading to each cache.

§ 75.1714-3 Self-rescue devices; inspection, testing, maintenance, repair, and recordkeeping.

(a) Each operator shall provide for proper inspection, testing, maintenance, and repair of self-rescue devices by a person trained to perform such functions.

(b) After each time a self-rescue device is worn or carried by a person, the device shall be inspected for damage and for the integrity of its seal by a person trained to perform this function. Self-rescue devices with broken seals or which are damaged so that the device will not function properly shall be removed from service.

(c) All self-rescue devices approved under subpart I of part 11 of this chapter or Bureau of Mines Schedule 14F, April 23, 1955, as amended (Part 13, 30 CFR, 1972 ed.) except devices using vacuum containers as the only method of sealing, shall be tested at intervals not exceeding 90 days by weighing each device on a scale or balance accurate to within ± 1 gram. A device that weighs more than 10 grams over its original weight shall be removed from service.

(d) All self-contained self-rescue devices approved under subpart H of part 11 of this chapter shall be tested in accordance with instructions approved by MSHA. Any device which does not meet the specified test requirements shall be removed from service.

(e) Results of the tests required by paragraphs (c) and (d) of this section shall be recorded for each self-rescue device in a book which shall be made available to an authorized representative of the Secretary.

(f) Self-rescue devices removed from service shall be repaired for return to service only by a person trained to perform such work and only in accordance with the manufacturer's instructions.

