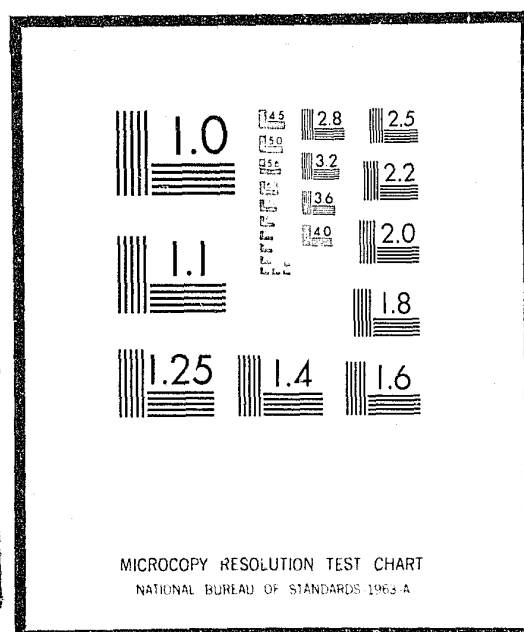


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	MITRE Technical Report				
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Subject: Riot Helmet Requirements					
Author: S. H. Roth					
Dept.: D-38					
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Page 1 of 22 Pages					
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## ABSTRACT

A requirements analysis based on user-derived information is provided to assist the Law Enforcement Standards Laboratory (LESL) in developing riot helmet standards. LESL has requested MITRE to provide requirements information relative to three questions. Questions and responses are summarized as follows:

1. What is maximum weight for a riot helmet? - Weight is not the definitive criteria; comfort in use over an extended period is the true measure and is a function of design as well as weight. Use test is recommended as criteria.

2. What is requirement for coverage of neck, ears, and forehead? - Neck coverage should extend to base of skull, full ear protection desired, and removable shield desired for face.

3. What is requirement for chin strap in terms of maximum or minimum strength? - Operational procedures preclude situation where helmet can be wrested from the officer. They prefer a quick disconnect strap for safety and convenience.

Additional requirements recommended are:

1. Helmet design to be compatible with self-contained communications.
2. Helmets with non-reflective exposed surface areas should be available.
3. Anti-fogging capability should be provided for face shields.
4. Helmets should be available in a full range of head sizes (as contrasted to universally adjustable head bands).
5. Adequate ventilation to be provided to minimize perspiration.

A recommendation is made to develop a head protective system in modular form to include the following functions:

- . Head protection
- . Face protection
- . Neck and ear protection
- . Communication terminal
- . Gas protection

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# 1. INTRODUCTION

The National Institute of Law Enforcement and Criminal Justice has requested that MITRE provide certain requirement information pertaining to riot helmets.<sup>1</sup> This document responds to the specific inquiries of that request and includes additional information generated during the investigation.

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<sup>1</sup> Requesting letters are included in the Appendix.

## 2. STATEMENT OF THE PROBLEM

Riot helmets are a component of the protective gear in common usage by law enforcement personnel. They serve to protect the user against thrown objects such as rocks, bottles, sticks, etc. The helmets should be designed to allow the law enforcement officer to function in a hostile environment without fear of injury due to these objects. The helmets are not designed to protect against gun fire.

The Law Enforcement Standards Laboratory (LESL) is preparing standards for riot helmets and has requested user requirement information from the Analysis Group in the form of the following questions:

1. How much can a riot helmet weigh before weight will interfere with operations or militate against the helmet's use? Is there a generally accepted maximum weight?

2. How much coverage of the neck, ears, forehead, etc., is desirable? When does coverage start interfering with side vision, hearing, upward tilting of the head, etc.?

3. Should a chin strap have minimum breaking strength, maximum breaking strength, or both? Do rioters try to wrest helmets off officers' heads? Would the officer want the helmet to stay on his head for continued protection or would he want the chin strap to break or separate to prevent neck or other injury? Are there other considerations?

User comments on any other characteristics of riot helmets were also solicited.

### 3. APPROACH

The questions on helmet requirements were submitted to the MITRE field site representatives (FSRs) for discussion with their respective hosts. The FSRs received comments from the:

- . Los Angeles Police Department (LAPD)
- . Los Angeles County Sheriff's Department (LACS)
- . Columbus Police Department (CPD)
- . Michigan State Police (MSP)

The following discussion draws on the information in these reports, analyzes the specific information, and makes recommendations for performance requirements.

#### 3.1 Responses to Specific Questions

1. How much can a riot helmet weigh before weight will interfere with operations or militate against the helmet's use? Is there a generally accepted maximum weight?

##### Los Angeles Police Department

The Metro staff feels that the weight of riot helmets is not as important as the comfort which can be achieved over a period of several hours. The protection afforded by the Bell TX-300 (which weighs 23 ounces) appears to be quite satisfactory. The basic construction of the helmet (consisting of an adjustable string to hold the liner straps together) introduces discomfort after several hours of use. The knot in the string has a tendency to irritate the scalp. It also loosens during periods of heavy perspiration and lowers the helmet onto the head (a very dangerous condition).

Los Angeles County Sheriff

The 23 ounces of the TX-300 appears to be satisfactory. No maximum weight can be specified - comfort plus protection are prime considerations.

Columbus Police Department

Columbus currently utilizes two riot helmets. One is a simple inverted bowl shape with vestigial bill, manufactured by Buco. The other is a similar bowl shape with about a two-inch bill and with semi-flexible ear and neck protector flap, manufactured by McHal. The first model weighs one and one-half pounds and is more applicable to everyday police work, while the second model weighs two pounds and offers more protection to the neck and ears. This difference of one-half pound seems to make a substantial difference in the ability of the officers to wear them for extended periods of time without discomfort.

Michigan State Police

Information is not available on an accepted maximum weight. MSP's riot helmet weighs 33-1/2 ounces. This weight includes the plastic face shield weight of 6-1/2 ounces.

An important aspect of weight is the distribution rather than the total weight. The weight of the helmet is very noticeable if it is unbalanced (a lightweight helmet with a heavy shield results in a very noticeable effect of weight). The psychological effect of feeling adequately protected is far more important than the physiological effects of weight (up to several pounds). The relevant threats to be protected against are sticks and hand-thrown objects, rather than sniper fire and/or hand-to-hand combat.

In addition to the above, Mr. Wargovich of the Army Land Warfare Laboratory, Aberdeen Proving Grounds, was queried. His opinion was that three to three and a half pounds would be considered acceptable for continuous wear. More than 4 to 5 pounds tends to cause neck muscle fatigue.

#### Conclusions

The responses from the field do not provide a definitive basis for determining a maximum weight. Comfort, in extended usage, is the determining factor and the user cannot discriminate between design features and absolute weight. This implies that a more meaningful performance specification would be in terms of comfort and fatigue effects of the helmets on a test population. If it is deemed necessary to specify a maximum weight, then a test project is recommended. In the test project, a well-designed comfortable helmet could be weight loaded until discomfort or fatigue are induced with extended wear.

2. How much coverage of the neck, ears, forehead, etc., is desirable? When does coverage start interfering with side vision, hearing, upward tilting of the head, etc.?

#### Los Angeles Police Department

The present helmet design (Bell TX-300) with the neck, ear, and face shields appears to satisfy all of their coverage needs. The only problem they have is that they cannot hear their portable radios. They need a helmet which provides full protection with a self-contained speaker and microphone. Due to the lack of such helmets, some Metro members use the low-cost transistor radio earpieces for use with their portable radios. However, this does not solve the microphone problem and becomes potentially dangerous to the ear.



Los Angeles County Sheriff

They would prefer more neck area protection for riot conditions (especially preferred the Buco model). However, they feel that for continuous general purpose use, the neck protection section of the helmet may introduce discomfort. They also indicated that it is sometimes awkward to quickly attach the face shield.

Full ear protection is preferred over the open or V-shaped open flap. They have experienced the same radio communication problem as discussed in the LAPD section. They have evaluated one vendor's accessory kit under various conditions.

Columbus Police Department

The helmet should cover the head from just above the eyebrows in front, to the middle of the ears on the side, and to about a quarter inch below the ears in back. (General shape would be that of a World War II German helmet.) Additional protection for the ears and neck should be of flexible material to allow for movement. While such flexible protection would not afford protection from a direct blow, it is felt that the risk of limited head movement was greater than from injury from a direct blow.

Interference with vision seems to be a function of sun and position of shield. A glare point is provided at the edges of vision if the shield is too far from the face or if the side of the face is completely covered by the shield. Field vision is thereby reduced to somewhere around 170°.

#### Michigan State Police

MSP's helmet (Buco) has a protector which covers the ears and back of the neck. They feel the protector on their helmet provides adequate protection with no apparent interference with vision, hearing, and movement (it completely covers the ears and extends just below the curvature of the skull in the rear). The face shield extends just below the mouth. A small space (approximately one-half inch) exists between the face shield and the protector covering the ears.

#### Conclusions

Not surprisingly, the users prefer a maximum of protection with a minimum of discomfort and inconvenience. The requirements are for helmet coverage of:

- Neck - to just below curvature of skull;
- Ears - complete coverage;
- Face - shield, available for facial coverage.

The respondees feel that this coverage provides the feeling of security that an officer needs to function effectively in a hostile environment.

3. Should a chin strap have a minimum breaking strength, maximum breaking strength, or both? Do rioters try to wrest helmets off officers' heads? Would the officer want the helmet to stay on his head for continued protection or would he want the chin strap to break or separate to prevent neck or other injury? Are there other considerations?

Los Angeles Police Department

Metro is using snaps on their chin straps. They feel that this approach is superior to the D-rings used on some manufacturers' models. They do not feel that a minimum or maximum breaking strap strength could be identified, since they want the helmets to stay on the head at all times with the capability of quick release. They have not had any difficulty with rioters trying to remove riot helmets. In fact, their training is such that they typically operate in an organized, unified moving force during operations. They specifically train each Metro member to prevent an officer from being in a position whereby a rioter can approach him from the backside. By carrying the night sticks in their hands, they reduce the probability of any rioters approaching Metro officers from the front.

Los Angeles County Sheriff

They don't expect rioters to be able to remove helmets due to their use of tactics designed to maintain team integrity. Similar to LAPD, they specifically train officers to prevent rioters from getting in a position to grab any portion of their gear (e.g., helmet, gun, radio, etc.). They prefer a snap-on chin strap for quick release under their control.

Columbus Police Department

It was generally held that the strap should be designed so that the helmet would not tear off except under the most severe conditions, i.e., force quickly applied. It was felt that in the majority of instances in which the officer would like the helmet to come off, he would be able to unsnap the chin strap before injury was sustained.

#### Michigan State Police

The MSP feel the chin strap should not be easily broken (i.e., no set maximum breaking strength). MSP's procedures for using the helmets are designed to avoid getting into situations where rioters would have the opportunity to wrest helmets off of officers' heads. It was found that the MSP helmets provide several "handles" for rioters (e.g., upper part of face shield and underneath ear/neck protector). The pulling of these "handles" does not necessarily provide a large force on the chin strap. Therefore, it would be very difficult to define a minimum/maximum chin strap break strength.

#### Conclusions

The operational procedures of police in riot situations are designed to preclude individuals from wresting helmets and other equipment from the persons of the officers. Actual experience from the departments queried substantiates the effectiveness of this policy. Therefore, a specification on minimum and/or maximum breaking strength is not required. For both the safety and convenience of the officers utilizing helmets, a requirement is desirable for quick disconnect of the chin strap to aid in rapid removal of the helmet. This can be used by the officer in the unlikely event that a rioter is trying to remove his helmet.

#### 4. ADDITIONAL USER COMMENTS

A number of comments were received in addition to the responses to the three questions discussed above. These are discussed here in relation to the derivation of requirements.

##### 4.1 Exact Fit

Both the Los Angeles Police Department and Columbus Police Department mentioned the desirability of providing riot helmets in a full range of sizes rather than with a universal head adjustment. They view this as one method of achieving increased comfort and improved protection. The primary performance requirements are in terms of safety and comfort; however, if exact fit provides an improvement in performance that cannot be provided with universally adjustable helmets, then size availability to provide exact fit should be made a requirement.

##### 4.2 Compatibility with Portable Communications

Both the Los Angeles Police and the Los Angeles County Sheriff's Department expressed a strong need for a helmet compatible with portable radio communication systems. This is a requirement that has been recognized, and a current Land Warfare Laboratory (LWL) program is underway to develop such a unit. The basic requirements for such a unit would be to provide full communications capability in a noisy environment compatible with:

- . Full ear protection
- . Neck protection
- . Use of the face shield
- . Use of a gas mask

#### 4.3 Shield Fogging

The Columbus and Michigan Police have identified problems with fogging of the face shields. It is desirable, therefore, for standards to be established for face shield material and for defogging solutions to prevent fogging of face shields in use.

#### 4.4 Reflective Surface

Both the Los Angeles County Sheriff's Department and Michigan State Police prefer that helmets not contain reflective material that might make the officer visible during night operations. Many helmets are offered in both reflective and non-reflective surface models, there being a variation in preference. It is, therefore, recommended as a requirement that non-reflective models be available.

#### 4.5 Miscellaneous User Comments

Three comments applied to the user comfort in a functional situation:

- . Designs should be improved so the helmet stays in place when an officer is running. Helmet should not be able to float around. (LAPD)
- . In a down position, the shield makes breathing difficult especially when the officer is exerting himself as in subduing a subject. (CPD)
- . Need for a well-ventilated helmet in combination with the necessary strength. Special need for such a helmet in the South. (CPD)

These comments have implications beyond the specific points addressed. The helmets should be tested in a simulated operational environment designed to reveal these types of problems. Standard tests should include a set of operational scenarios designed to surface functional deficiencies under conditions likely to occur in the field.

## 5. PERFORMANCE REQUIREMENTS

The following general performance requirements are recommended for riot helmets:

1. The riot helmets should protect the user against the possibility of injury by thrown objects such as rocks, bottles, sticks, etc. (Specific standards are being set by LESL.)

2. The coverage of the helmet shall include the ears, the back of the neck to below the curvature of the skull, and capability for facial protection.

3. The design of the helmet shall be such that the user can wear the device for periods of up to four hours without undue fatigue or discomfort, both with and without facial protection.

4. The design of the helmet shall be such that it stays in place, provides the proper protection, and does not unduly impede the user during such activities as running, jumping, driving and scuffling with adversaries. (Both with and without facial protection.)

5. The helmet shall be compatible with self-contained communications (speakers and microphone). Additionally, the helmet communications capability shall be compatible with the wearing of gas masks or face shields.

6. The helmet shall be available with non-reflective exposed surface to aid in covert night operations.

7. The helmet shall provide the performance capabilities over a wide range of environmental conditions.

- . -20 to 95° F
- . Humidity up to 100 percent
- . Rain
- . Snow

In addition to the general requirements stated above, several specific requirements derived from the analysis can be stated:

8. The chin strap of the helmet shall have a quick-disconnect capability to allow rapid removal of the helmet, but shall not release as a result of pulling on the helmet.

9. Anti-fogging capability shall be provided for the face shield. This may be done by the application of cream or lotions to the shield surface.

10. The helmets shall be available in a range of sizes to allow exact fit to the user's head size. This requirement would apply only in the absence of a universally adjustable helmet able to provide the same degree of comfort and functional capability.

11. Adequate provision for ventilation of the interior of the helmet shall be provided to minimize the discomfort due to perspiration.



## 6. RECOMMENDATIONS

Law Enforcement officers are highly desirous of equipment which will:

- . Provide protection against injury
- . Be comfortable enough to allow continuous use
- . Allow the users to function effectively in their assigned tasks
- . Be compatible with other equipment

The officers are highly motivated to use the equipment in hostile environments.

To provide the equipment needed, the following recommendations are made:

1. That an integrated system for head protection be developed.  
That this system include the functions of:

- . Head protection
- . Face protection
- . Neck and ear protection
- . Communication terminal
- . Gas protection

One approach would be to develop compatible modules to provide capability as needed. The head protection system would consist of a set of modules which would allow the law enforcement officer to select the performance required for the situation at hand. The head protector would be the basic module, and the others would be added-on as needed.

2. That the head protection system be designed and tested for comfort and fatigue effects.

3. That the head protection system be designed (and tested) to perform in an operational environment without impeding the officer's ability to accomplish his duties.

*S. H. Roth*  
\_\_\_\_\_  
S. H. Roth

SHR:kk

APPENDIX

LESL REQUEST FOR INFORMATION ON  
RIOT HELMETS



UNITED STATES DEPARTMENT OF JUSTICE  
LAW ENFORCEMENT ASSISTANCE ADMINISTRATION

WASHINGTON, D.C. 20530

NATIONAL INSTITUTE OF LAW ENFORCEMENT  
AND CRIMINAL JUSTICE

December 18, 1972

Mr. William E. Holden  
The MITRE Corporation  
Westgate Research Park  
McLean, Virginia 22101

Dear Mr. Holden:

Attached are copies of a letter from LESL requesting information needed for the forthcoming standard on riot helmets. Please query our people in the field and return their answers to me for Mr. Shubin by 8 January 1973.

Sincerely,

Marc A. Nerenstone  
Program Manager, Analysis  
Research Administration Division

Enclosure: J. J. Diamond letter, Dec. 13, 1972.  
Seven Copies

cc: Kochanski  
Shubin  
ESIP File A-4



U.S. DEPARTMENT OF COMMERCE  
National Bureau of Standards  
Washington, D.C. 20234

Date: December 13, 1972

To: Lester D. Shubin, Program Manager for Standards  
National Institute of Law Enforcement  
and Criminal Justice

From: Jacob J. Diamond, Chief  
Law Enforcement Standards Laboratory

Subject: User Requirements for Riot Helmets

A proposed NILECJ Standard for Riot Helmets has been drafted and is now undergoing LESL review. This review process has highlighted several helmet characteristics concerning which LESL must have additional user requirement information before rational decisions can be made on test methods and performance levels to be required by the standard.

It would be extremely helpful if the Analysis Group of ESIP, through its analysts resident in police departments or by other appropriate means, could supply tentative answers or discussions of the following questions.

1. How much can a riot helmet weigh before weight will interfere with operations or militate against the helmet's use? Is there a generally accepted maximum weight?
2. How much coverage of the neck, ears, forehead, etc., is desirable? When does coverage start interfering with side vision, hearing, upward tilting of the head, etc.
3. Should a chin strap have minimum breaking strength, maximum breaking strength, or both? Do rioters try to wrest helmets off officers' heads? Would the officer want the helmet to stay on his head for continued protection or would he want the chin strap to break or separate to prevent neck or other injury? Are there other considerations?

User comments on these and any other desired or undesired characteristics of riot helmets are urgently needed. For maximum effect on the present standard-writing effort, this information should be forthcoming as soon as possible.

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