

MODERNIZATION OF PROTECTIVE MARKINGS AND SIGNALLING

by Ph. Eberlin

I

SURVEY OF PROTECTIVE MARKING

The remarkable advances made during the last few years in technology, and particularly in electronics, and the increasingly rapid development of scientific inventions are likely to render obsolete the protective markings of the medical service as laid down in the Geneva Conventions of 12 August 1949.

For over a hundred years, the identification of persons and property protected by the Geneva Conventions has been based on purely *visual* methods, whereas armed forces nowadays very often employ *technical* means of detection: radar, radio location, infra-red observation, light amplifiers, acoustic detection. Sometimes, these detectors, or "sensors", may be combined, and other secret systems no doubt exist. An objective may thus be detected, localized and destroyed, without having been necessarily observed visually, which means that visual markings alone are insufficient for the identification of persons and objects protected by the Conventions.

1. GENEVA CONVENTIONS

The rules for visual protective markings are laid down mainly in Chapter VII (articles 38 *et seq.*) of the First Geneva Convention for the Amelioration of the Condition of the Wounded and Sick in Armed Forces in the Field of 12 August 1949. The principal rules may be summarized as follows:

Military medical services

Protected personnel

Medical and religious personnel shall wear an armband affixed to the left arm and carry a special identity card, both armband and identity card bearing the distinctive emblem¹. The 1949 Diplomatic Conference recommended in its resolution 4 that States and National Red Cross Societies should provide their medical personnel with these means of identification.

Medical units; military hospitals; hospital zones

For the identification of fixed or mobile medical units, the distinctive flag of the Convention should be hoisted; it is recommended that the distinctive emblems should be made clearly visible to the enemy land, air or naval forces, in order to ward off hostile action. Hospital zones and localities should be marked by means of the distinctive red cross sign placed on the buildings and the perimeter of the zone or locality. Appropriate illumination at night or in case of poor visibility will aid the identification of such zones and localities.

Medical transports

Land medical transports may be marked with the distinctive emblem in the same way as mobile medical units. Medical aircraft shall bear the distinctive emblem together with their national colours and any other markings or means of identification that may be agreed upon between the belligerents.

Under the Second Convention hospital ships, medical craft and coastal rescue craft shall make themselves known by being painted white all over, with dark red crosses painted on different parts of the vessel, and by flying a white flag with a red cross at the mainmast. By night and at times of reduced visibility, the emblems may be illuminated. The most modern methods available to facilitate the identification of the vessels protected by the Conventions may be used and the Parties to the conflict must endeavour to conclude agreements to that end. The use of modern

¹ The expression "distinctive emblem" comprises the emblems recognized by the Geneva Conventions of 12 August 1949, these being the red cross, the red crescent and the red lion and sun, on a white ground. For the sake of simplicity, only the red cross is mentioned in this paper.

means of communication—that is to say, radio communication—by hospital ships was the subject of Resolutions 6 and 7 addressed by the 1949 Diplomatic Conference to the High Contracting Parties, but it was only twenty-eight years later that the use of radio was regulated, after it had been discussed by the Diplomatic Conference on the Reaffirmation and Development of International Humanitarian Law applicable in Armed Conflicts which met at Geneva from 1974 to 1977.

Civilian medical services

The Fourth Convention says that civilian medical personnel, medical means of transport and hospitals, and hospital zones shall be marked in accordance with the same rules as those laid down in the First and Second Conventions concerning the use of the distinctive sign for the military medical services.

Other protective signs

The protection granted by the Geneva Conventions of 12 August 1949 is extended to other categories of persons and objects identifiable visually by signs other than the distinctive emblem:

Prisoners of war

The letters PW or PG: to indicate prisoner of war camps; the Powers concerned may agree upon any other system of marking (Third Convention, article 23).

Civilian internees

The letters IC: to indicate civilian internments camps; the Powers concerned may agree upon any other system of marking (Fourth Convention, article 83.)

Safety zones

Oblique red bands on a white ground: to mark safety zones, their buildings and outer precincts. The zones may be marked at night by means of appropriate illumination (Fourth Convention, article 14 and Annex I, article 6).

Neutralized zones

The neutralized zones referred to in article 15 of the Fourth Convention must be the subject of an agreement between the Parties to the conflict. The Conventions do not, however, provide for any special sign for such zones.

Special means of transport

Safe-conducts shall be granted for the circulation of the means of transport referred to in article 111 of the Fourth Convention. No provision is made for a special sign. It may be inferred that if the distinctive emblem may not be used, such means of transport may be marked in the same manner as neutral means of transport.

2. OTHER INTERNATIONAL CONVENTIONS

Besides the Geneva Conventions, several international conventions have laid down various markings and signals, visual and non-visual, for identification, in peacetime and in wartime, of the persons and objects which those conventions aim to protect.

The Hague Conventions of 1907

Article 27 of the Regulations annexed to *Convention No. IV of The Hague of 18 October 1907* protects certain buildings and the places where the sick and the wounded are collected in case of sieges or bombardments, without laying down any uniform rules as to the protective and identification sign to be employed. Under *Convention No. IX of The Hague of 18 October 1907*, in case of bombardment by naval forces, hospitals and places where the sick and wounded are collected, sacred edifices, buildings used for artistic, scientific or charitable purposes and historic monuments must be spared. Such places must be indicated by large stiff rectangular panels divided diagonally into two triangular portions, the upper portion black, the lower portion white.¹

¹ In the draft Regulations respecting aerial warfare, prepared in 1923 by the Commission of Jurists of The Hague, and which were never ratified, these protected sites were also to be marked by the same black and white rectangular panels.

Convention for the Protection of Cultural Property

Cultural property and the transport of cultural property are protected by the *Convention for the Protection of Cultural Property in the Event of Armed Conflict (The Hague, 14 May 1954)*. The Convention provides for a distinctive protective emblem in the form of a blue-and-white shield as a means of identification of cultural property, or three such shields as a means of identification of cultural property under special protection or for the transport of cultural property.

International Code of Signals

At sea, the *International Code of Signals*, based on various old-established signals, was adopted in 1965 by the fourth Assembly of the Inter-Governmental Maritime Consultative Organization (IMCO). It lays down the various means of identifying vessels and persons in distress, and wounded, sick and shipwrecked persons. The International Code is valid in wartime and in time of peace and may also be used by aircraft and coastal radiocommunication stations. It describes identification procedures by visual, sound, radioelectric and light signals and also the means of communicating with persons in distress and in search and rescue operations. It includes, too, signals relating to medical and pharmaceutical questions. All hospital ships carry on board the International Code; it is universally utilized and is recognized by the International Telecommunication Union (ITU), the International Civil Aviation Organization (ICAO), the World Health Organization (WHO) and other organizations. Extracts from the International Code of Signals are printed in the WHO "International Medical Guide for Ships".

International Convention for the Safety of Life at Sea

The international procedures used by shipping or aircraft for identifying and locating vessels in rescue operations on the high seas or in coastal areas are laid down in the *1960 International Convention for the Safety of Life at Sea* adopted by the Assembly of IMCO and effective since 26 May 1965. Rule 10 of Chapter V of the Convention reaffirms the obligation on every master of a ship at sea to proceed to the assistance of persons in distress, in accordance with the International Convention for the unification of certain rules with regard to Assistance and Salvage at Sea, signed at Brussels on 23 September 1910.

Under article VI of the 1960 Convention, in case of war or other hostilities a Contracting Government which considers that it is affected,

whether as a *belligerent* or as a *neutral*, may suspend the operation of the whole or any part of the Regulations annexed to the Convention. The IMCO must notify all Contracting Governments of any suspension or termination of suspension under this article. Any special rules drawn up by agreement between all or some of the Contracting Governments must also be communicated to the IMCO for circulation to all the Contracting Governments (article VIII). Article IX lays down the procedure for the amendment of the Convention. Such provisions make it possible to adopt the most efficient identification systems for safety of life at sea, in peacetime and in wartime, especially for hospital ships and neutral vessels responding to the appeals mentioned in article 21 of the Second Geneva Convention of 12 August 1949.

Chicago Convention on International Civil Aviation

Annexes 10, 11 and 12 to the *Chicago Convention on International Civil Aviation signed on 7 December 1944* lay down procedures for communication and provisions for identification by radio, radar and luminous signals or visual signals, in particular in case of distress and for search and rescue operations. Annex 2 to the Convention introduced, in its sixth edition, international rules, adopted on 4 February 1975, for the interception of civil by military aircraft. Annex 2 also specifies an international method enabling an aircraft to identify a prohibited or dangerous area in which it may be flying without authorization or which it might be entering. The aim of the procedures mentioned in Annex 2 is to remove or reduce the hazards—which are multiplied in areas where hostilities are taking place—inherent in interceptions of civil aircraft. All those Annexes are amended from time to time and published by the ICAO.

Article 89 of the Chicago Convention says that in case of war, the provisions of that Convention shall not affect the freedom of action of any of the contracting States affected, whether as belligerents or as neutrals. The same principle shall apply in the case of any contracting State which declares a state of national emergency.

International Telecommunication Convention

The operation of a range of radio frequencies for communication, radar and identification purposes is governed by the Radio Regulations of the International Telecommunication Union (ITU). The basic instrument of the ITU is the *International Telecommunication Convention* which is subject to revision every five years by the Plenipotentiary Conference

of the ITU. Nearly all States are members of the ITU. The last Plenary Conference, held at Malaga-Torremolinos in 1973, adopted Recommendation No. 2, "relating to the use of radiocommunication for announcing and identifying hospital ships and medical aircraft protected under the Geneva Conventions of 1949".

It was not the first time that this problem was examined at an ITU Conference.

3. RESOLUTIONS OF THE DIPLOMATIC CONFERENCES OF 1949 AND 1974-1977

One of the tasks of the Administrative Radio Conference in Geneva in 1959 was to examine draft Regulations prepared by Swedish, Italian and Swiss experts, with reference to Resolutions 6 and 7 of the Diplomatic Conference of 1949. These draft Regulations for radiocommunication by hospital-ships were approved by the ITU Conference and were adopted unilaterally by some States, although they were not included in the Radio Regulations.

In 1974, the World Maritime Administrative Radio Conference adopted Recommendation Mar 2-17, of considerable significance for medical and neutral means of transport. Mention will be made of this recommendation below, in connection with identification by radio.

In future, the employment of modern identification methods and procedures required for the safety of civilian and military medical services in armed conflicts will depend in great part on the action taken on Resolutions 17, 18 and 19 addressed by the Diplomatic Conference at Geneva in 1977 to ICAO, IMCO and the ITU.

In those resolutions, the Diplomatic Conference¹ requested the specialized international organizations to settle those questions on announcement, identification and radiocommunication, each within its own competence, so that any gaps in the present identification system should be filled by the introduction of modern methods of identification.

The organizations responded favourably. IMCO inserted in the International Code of Signals a new part—Chapter XIV—entitled "Identification of medical transports in armed conflicts". This amendment will enter into force on 1 January 1980.

¹ Diplomatic Conference on the Reaffirmation and Development of International Humanitarian Law Applicable in Armed Conflicts, Geneva 1974-1977—(CDDH).

ICAO submitted some proposals concerning Resolution 18, to be discussed at the World Administrative Radio Conference (WARC—79) that will open at Geneva on 24 September 1979.

At the ITU, Resolution 19 was studied at the Special Preparatory Meeting of the International Radio Consultative Committee (SPM of the IRCC). The SPM report will serve as a technical basis for WARC—79. Chapter XI of the report concerns the identification of medical means of transport.

4. TECHNICAL SHORTCOMINGS IN VISUAL MARKINGS

What are those shortcomings?

In the first place, the distinctive emblem, which is intended to protect medical personnel and vehicles on contemporary battlefields, is visible only at a short distance, while the armed forces confronting each other today possess much greater mobility and fire-power of far greater range than when the Geneva Conventions were conceived a hundred years ago. The rule concerning the armlet which medical personnel have to wear on the left arm is quite inadequate to give them protection from all sides, as has become necessary today. A 10 cm red cross on an armlet cannot be distinguished at a distance of more than fifty metres. The red cross painted on an ambulance cannot be identified at a range of a thousand metres, while the vehicle itself is an easy target for modern weapons. Today a purely visual method of identification, by means of the distinctive emblem, is quite useless, when modern military techniques for locating a target are used by land, sea or air forces.

One of the most familiar modern methods is infra-red observation, in which the red colour disappears if certain precautions are not taken. Another method is radar, together with a "friend or foe" system of identification which has been known since the Second World War, but without a "neutral" identification signal. A third means of detection is the sonar for under-water acoustic detection, a device, however, which cannot identify the noise of vessels such as hospital ships which have "neutral" status.

Details about various other ultra-modern methods of detection have been published: seismic and calorimetric "sensors", various detectors, military spy satellites, under-water acoustic monitoring stations, etc. It is obvious that the visual sign alone is not sufficient to afford protection

to hospitals, mobile medical units, medical ships, aircraft and personnel, whenever military operations are being carried out with such systems, involving the use of long-range destructive weapons on land, on sea and in the air.

In the case of air attacks, the odds are heavily against the sign of the red cross as a means of protection without the prior notification to all the parties to the conflict of the exact location of the sites which have to be protected and which are marked by flags, red oblique bands, etc.

Very often, infra-red photographic air reconnaissance is carried out on objectives before they are attacked. ICRC tests have shown that an ordinary red cross is not visible in infra-red photographs and is too small for identification from the altitude at which aircraft carry out their attacks. A 5×5 m red cross flag cannot be seen from an altitude of 2,500 metres vertically above it, and still less when observed at an angle.

Modern aircraft conducting low-flying attacks travel at such a high speed and are armed with weapons which have such a long range that a 5×5 m red cross flag does not afford any effective protection if the attackers are not briefed beforehand of the location of the flag.

II

MODERNIZATION OF THE PROTECTIVE MARKINGS AND SIGNALLING PROVIDED FOR IN THE GENEVA CONVENTIONS

1. Regulations concerning Identification, appended to Protocol I

Visual markings alone being inadequate for identification by modern detection techniques, it was necessary to evolve other means of identification of persons and property, and especially vehicles protected by the Geneva Conventions.

The ICRC submitted various suggestions to several meetings of technical experts. The first of these meetings was at ICRC Headquarters on 28 and 29 October 1970. Following the conferences of government experts on signalling in 1972 and 1973, draft regulations for identification were prepared by the ICRC for submission to the 1974 Diplomatic Conference in Geneva. That Diplomatic Conference set up a technical

sub-committee to study the draft regulations which, after several amendments, were adopted unanimously by the plenary meeting of the Diplomatic Conference in June 1977. The regulations were appended to Protocol I as Annex I. A procedure for the periodical up-dating of the Regulations was also unanimously adopted. The Regulations give the necessary technical bases for application of the provisions of Protocol I relative to marking, signalling and identification.

The Regulations should improve the visual markings and permit identification by such techniques as radar, radio and other means appropriate for technical detection systems. The new provisions are designed first and foremost to protect medical personnel and vehicles which require at least a minimum degree of safety to accomplish their mission. The modern identification methods proposed may also be used to make known non-defended localities and demilitarized zones (articles 59 and 60 of Protocol I).

2. Improvement of visual markings

Articles 1 to 4 of the Regulations concerning Identification, annexed to the Protocols of the Geneva Conventions of 12 August 1949, supplement the Geneva Convention provisions on the identification of civilian and military medical and religious personnel, permanent or temporary, and those on the distinctive sign and its use. Article 4 mentions the wearing by medical and religious personnel of headgear and clothing bearing the distinctive emblem. This gives legal authority to the wearing of white helmets with a red cross—as used during the Second World War—and of white tabards with a red cross back and front—used today by several National Red Cross Societies.

Colours and shape of the distinctive Red Cross emblem

In the official Records¹ of the Diplomatic Conference on humanitarian law, Geneva 1974-77, the distinctive signs are represented in colour, in Volume I, Annex I, p. 173-181, “Regulations concerning Identification”. The colours used by the printers do not comply with any special specification since no colorimetric data are mentioned in the Conventions, the Protocols or the Regulations. The sign is depicted in a dark red

¹ The Records, published by the Federal Political Department, Berne, in 1978, are on sale at the Office central fédéral des imprimés et du matériel, CH 3000 Berne, and in bookshops.

which it would have been inexpedient to define precisely, bearing in mind the expert opinions on marking and the comments given below.

In physics the study of colours is akin to the study of light, which is essential for the perception of colours. To determine a colour, the science of colours, or colorimetry, uses a chromaticity diagram (colour triangle), all the colours of which can be defined by chromaticity co-ordinates. The International Commission on Illumination (CIE) standardized a system of trichromatic co-ordinates x , y and z . These have been recognized by various international organizations, including the International Organization for Standardization (ISO). The trichromatic co-ordinates of a colour may be measured by a spectrophotometer, a device fitted with a standard source of light. Colours are defined by means of a trichromatic co-ordinate system delimiting a monochromatic zone of the colour spectrum of diffracted white light.

It has always been held preferable not to define or standardize the red and white of the distinctive sign for three reasons:

- The protective sign of the red cross must be a sign that can be improvised on the battle-field;
- Time and means might not be available to obtain, out in the open, a colour defined with scientific precision;
- With time and use all colours deteriorate, but this should not be allowed to diminish the protection conferred by the sign in a zone where fighting is going on, for example.

Consequently, the Geneva Conventions of 12 August 1949 specified no standard for the red or the white of the distinctive sign, so that the sign would retain its full value whatever the hues of the red and the white.

Article 43 of the Second Convention states that hospitals, ships and protected craft, with all exterior surfaces white, shall be marked with one or more dark red crosses as large as possible. This requirement is particularly important, as will be seen later in connection with infra-red observation.

In the Regulations concerning Identification annexed to Protocol I, the red colour of the distinctive sign is not defined for the reasons already mentioned.

The Regulations define only one colour, the blue of the light signal for identification of medical transport. The trichromatic co-ordinates recommended in Article 6 of the Regulations should make it possible to choose the blue light to be fitted to medical aircraft and other vehicles.

The red and white of the emblem must therefore not be specified or standardized. If any particular hue of red for the protective sign were to be recommended, it would be advisable to specify dark red, for this would contrast more sharply against the white background and, because it contains black pigment, would be identifiable by infra-red monitoring.

But the dark red would become lighter on an armband, helmet, flag, aircraft, ambulance, etc. with time, as a result of exposure to the elements and to dust, and it would not always be possible to remedy this deterioration.

Hence the shape and size of the sign are more determinant than ever for identification at a distance. A simple shape is the best for any protective sign of two contrasting colours. It may be said that the simple cross, a purely geometrically convenient sign, is effective as a visual mark and technically preferable to any other shape. This was shown in the visibility tests mentioned below.

Size of the distinctive sign

Article 3 of the Regulations specifies that this sign shall be as large as appropriate to circumstances, so that it shall be as conspicuous as possible from afar.

As long ago as 1936, the ICRC, anxious about the visibility of the emblem, asked the Swiss Army to make aerial observations and tests of the visibility of the red cross. The reports on these tests and the photographs taken during them were published in number 209 of *Revue internationale de la Croix-Rouge*, in May 1936.

Hospitals were marked by red crosses on a white background measuring 5×5 m. The cross straddled the summit of the roofs.

- From an altitude of 2,000 metres directly above the hospital, the cross appeared distorted but still identifiable;
- From a height above 2,500 m the cross was identifiable only in very good conditions of visibility to an observer exactly vertically above it and if he knew where to look for it.

The reports recommended displaying the red cross not astride the ridge of the roof but on each slope, or horizontally on a large lawn beside the building. It was stressed that signs measuring 5×5 m were visible only up to a vertical altitude of about 2,500 m.

The 1936 observations are still valid and must be taken into account when the sign is used to protect an object from attack by land, sea or air. It should be visible in every direction. The ICRC uses emblems as large

as circumstances permit. Its red cross flags vary in size from 1×1 m to 10×10 m and in some operations it uses even larger flags.

The distinctive sign also should be as large as possible when displayed on medical means of transport such as medical ships, ambulances and medical aircraft. For example, the red cross markings on the Transall C 160, an aircraft with a 34-ton cargo capacity, assigned to medical transport, have the following dimensions:

- white background $3 \text{ m} \times 3 \text{ m}$;
- height and width of the cross 2 m;
- width of the branches of the cross 0.60 m.

This type of aircraft can display seven red crosses on a white background as follows:

- one on each side of the forward part of the fuselage;
- one on each side of the fin;
- one on the top of the fuselage, between the wings;
- one on the lower surface of each wing, near the engines.

The 1929 Geneva Convention stipulated that medical aircraft should be painted entirely in white. Neither the 1949 Conventions nor the 1977 Regulations concerning Identification make this a requirement. The distinctive sign of the red cross on a white background may therefore be displayed on an aircraft painted in military camouflage colours. In that case the aircraft must be permanently or temporarily assigned solely to medical missions. No medical aircraft may be armed.

If a medical aircraft is painted entirely white, its identification when flying low, as medical helicopters often do, is easier.

Illumination of the sign on a medical aircraft would be difficult and not very effective. Commercial aircraft equipped with projectors illuminate their airline colours on the fin only for publicity at airports.

Self-adhesive material for marking of the distinctive sign

There are a number of self-adhesive materials of various colours on the market which air transport companies use to mark their aircraft. Military aircraft are often marked in the same way. Marking by self-adhesive emblems is quicker than painting but requires special tools and skilled staff. To paint the seven emblems on the Transall C 160 requires sixteen hours of work by six painters.

When a medical aircraft displays the distinctive sign it must also display its national markings.

Retro-reflective materials

Many self-adhesive materials are reflectorised or retro-reflective. Like phosphorescent or fluorescent surfaces they noticeably improve the efficiency of signs in some cases, for instance in road traffic, and under certain conditions. The retro-reflective surface throws the light impinging upon it back to the light source in a narrow cone, as do the eyes of a cat which are natural retro-reflectors, an optical principle on which the invention of retro-reflective material was based. The surface of such material consists of 40 millions microscopic spherical balls per square metre embedded in coloured or colourless flexible transparent plastic material. The incident light is reflected back without dispersal and therefore with slight loss of intensity in a cone of which the angle of incidence is about three degrees. The diameter of the base of the cone can be easily calculated:

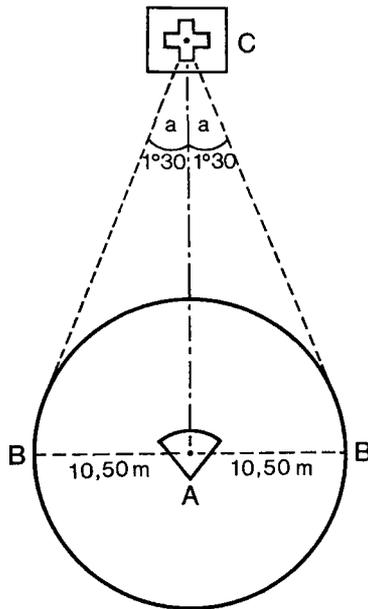
Diameter of the base of a cone of light reflected by a retro-reflective surface 400 m from the source

A = light source

AC = 400 m

angle A = $1^{\circ} 30'$; tangent = 0.02619

AB = AC \times tan. a = $400 \times 0.02619 = 10.50$ m.



From 400 m the reflected light is brightly visible in any direction 10.50 m on a vertical plane from the source light. Maximum intensity will be on the perpendicular AC; the reflected light will be visible from anywhere within the three degree cone formed by the angles of incidence.

Visibility tests have shown that the beam from a small electric torch revealed a 1 meter square reflectorized sign 500 yards away on a clear night. Manufacturers claim the retro-reflective tapes or films used on lifeboats increase the useful range of searchlights tenfold.

The use of retro-reflective material for security signals and for marking life-saving appliances is provided for in various national regulations and international treaties; in some cases it is compulsory.¹

Visibility tests

During the second session of the conference of government experts on the reaffirmation and development of international humanitarian law in Geneva, from 3 May to 3 June 1972, the ICRC organized tests to assess the visibility of the distinctive sign.

The Swiss army collaborated on the Bière exercise ground where, on 25 March 1972, tests were carried out jointly with the Geneva Civil Defence organization and the Swiss Association of NCOs. These tests were repeated at Versoix (Geneva) on 29 April 1976, for the experts attending the third session of the Diplomatic Conference.

The tests showed that the distinctive sign 10 cm × 10 cm on a white helmet could not be identified beyond 50 m. The 40 cm × 40 cm red cross on a tabard was identifiable at no more than 200 m. If seen at an angle, the range at which these signs could be identified by the naked eye was even less. The tests demonstrated that the flag was the best visual marking.

The observations confirmed the need to have a distinctive sign as large as possible on persons, flags, field medical stations, ambulances and buildings.

Phosphorescent paint, which accumulates light falling on it, emits only a small quantity of light in obscurity and is therefore not a great deal of use. Fluorescent paint, absorbing ultra-violet rays and re-emitting it in the form of visible light, is very effective, especially at dawn or twilight when ultra-violet radiation in the atmosphere increases for a short time and makes fluorescent colours very bright.

¹ IMCO, *Safety of Fishing Vessels*, Chapter VI: "Protection of the Crew" Regulation 15: Retro-reflective tapes on life-saving appliances.

Night visibility tests showed the usefulness of retro-reflective materials for the marking of the distinctive sign and the need to make the sign visible to infra-red monitoring devices; this was the only detection technique used in these tests.

Materials making the sign recognizable by technical detection methods

Under Article 3 of the Regulations concerning Identification, the distinctive emblem may be made of materials rendering it recognizable by technical means of detection.

These means include all systems for observation otherwise than by the naked eye. With the use of infra-red monitors and light-amplifying sights, their range far exceeds that of the human eye, especially at night. The infra-red detection systems have been the subject of studies, research and patents since the beginning of the century. During the two World Wars a number of systems were developed and there are now several types of infra-red detection devices, active, passive or thermic. Infra-red photography which has existed since before the Second World War, is now used with black and white or colour films. With other types of detectors, seismic sensors for example, infra-red devices can monitor large areas where military operations are being conducted.

With observation by pilotless aircraft, radar, radio and various types of detectors, surveillance of the battlefield is becoming increasingly automated and the distinctive sign symbolic of the protection afforded by the Geneva Conventions is ineffective if it is not identifiable by these detection techniques.

Infra-red detection of the distinctive sign

Under infra-red radiation, the red colour does not appear against a light-coloured background and the screens of infra-red observation instruments and infra-red photography reveal no contrast of the red cross with the white background. There are several ways of making the necessary contrast visible. e.g., the addition of black pigment to the red colour; a black coating beneath the red; the use of retro-reflective material, etc. If a retro-reflective material, such as the self-adhesive materials for road signs or the marking of civilian and military aircraft, is used, only one of the two colours need be reflectorized to bring out the contrast under infra-red monitoring.

Another method would be to outline the perimeter of the cross by a wide black reflectorised strip. However, to identify the cross as red and not white, the red must be shown as a dark surface on the screen of the

infra-red image converter or on an infra-red photograph. For that purpose the background has to be reflectorized and the red cross to be superposed on a black cross.

Light amplification tubes

This is an electro-optical system to intensify the feeble light at night and thus improve night visibility.

With such spectacles or light amplification tubes, the scene viewed takes on a greenish hue with a clear/dark contrast of red and white colours, without those colours having to be treated in any way. Such spectacles may be used in infra-red observation but if the colours are not treated as mentioned above the red cross on a light surface is not detected.

3. Distinctive signals

These are the essential feature of modern means to indicate the protection provided by the Geneva Conventions.

They are “active” as opposed to the “passive” visual markings. The signal and the sign supplement each other. Article 5 of the Regulations concerning Identification recommends their simultaneous use. However, there is no provision forbidding the use only of signals to identify a medical aircraft if time and the necessary materials are not available to mark the aircraft with the visual sign, which in any case is practically useless as an aid to identification of a medical aircraft flying even at only a few thousand feet or seen from fore or aft.

Flashing blue light signal

Article 6 of the Regulations establishes the use of a flashing blue light for the identification of medical aircraft. It recommends a dark blue as defined by trichromatic co-ordinates of the International Commission on Illumination (CIE) with a view to standardizing the blue colour and ensuring that the blue is visible from as far as possible. Beyond 1,500 m it is difficult to identify blue colour either by day or by night; to the naked eye it appears white.

For the blue signal to be visible in every direction the medical aircraft must be equipped with two such lights, like the anti-collision lights, one above the fuselage and one below. The red dome of the anti-collision lights could be changed for a blue dome if available, otherwise the blue

light should be fitted beside the anti-collision light, with an electric switching device. Experience has shown that it is difficult to improvise a blue dome by using a white dome; the heat from the bulb cracks the glass or white plastic dome if it is given a blue coating. For medical aircraft, it is essential to obtain the necessary parts and accessories for the blue light, including spares.

Resolution 17 adopted by the Diplomatic Conference in 1977 was transmitted to the ICAO, requesting that organization to recognize the use of a blue light flashing between 60 and 100 times per minute as a means of identifying medical aircraft.

Article 6 of the Regulations authorizes the use of such a flashing blue light for medical vehicles of all kinds, and the Diplomatic Conference Resolution 18 requested IMCO to consider introducing into the appropriate documents, such as the International Code of Signals, the flashing blue light for medical ships and craft.

In 1978 the IMCO Maritime Safety Committee after examining Resolution 18 did adopt the blue light as an additional visual signal for medical ships and craft; this is provided in the new chapter XIV of the International Code of Signals.

During the ICRC's visibility tests it was found that the flashing blue light on an ambulance could easily be seen and identified by the naked eye from 1,000 m whereas the red cross on the vehicle could not.

Radio signal

In armed conflict the monitoring of radio communications is considered a military necessity. By transmitting a message on known radio frequencies at appropriate intervals medical vehicles can be heard by the enemy who may then give the necessary orders for respect and protection of such vehicles.

This system was inaugurated at the request of belligerents during the Second World War for neutral and non-belligerent shipping. From 1942 in the Atlantic and 1943 in the Mediterranean such ships were required to transmit their position and route at certain intervals on 500 Khz by radio telegraphy. It was because several attacks had been made by error, due to the difficulty of visual identification, against hospital ships and neutral merchantmen by submarines or planes that the use of radio for protective signalling was introduced.

The Diplomatic Conference not being competent to deal with radio communications, Articles 7, 8 and 9 of the Regulations were attached to Resolution 19 which was sent in 1977 to the ITU, requesting the World Administrative Radio Conference (WARC 79), scheduled to meet in

Geneva in September 1979, to make suitable provision to meet the essential radio communication needs of medical vehicles protected in armed conflict, especially hospital ships and craft and medical aircraft.

ITU Recommendations No. 2 and No. Mar 2-17 (1973-1974)

In 1973, at the ITU meeting of plenipotentiaries at Malaga-Torre-molinos, the Swiss PTT delegation submitted a draft recommendation on radio communication by neutral and medical vehicles in the event of war. The draft was adopted with some amendments and became Recommendation No. 2 in the International Telecommunication Convention. In 1974, at the World Maritime Administrative Radio Conference in Geneva, Switzerland presented another draft relating to radiocommunication by neutral shipping and hospital ships in the event of war. The Conference adopted that proposal, recommending that technical and administrative questions raised be dealt with by the WARC 79. It is included in the ITU Radio Regulations as "Recommendation Mar 2-17 Relating to the Use of Radiocommunications for Marking, Identifying, Locating, and Communicating with the Means of Transport protected under the Geneva Conventions of 12 August 1949, concerning the Protection of War Victims and any Additional Instruments of those Conventions, as well as for ensuring the Safety of Ships and Aircraft of States not Parties to an Armed Conflict".

Priority signal for radiotelephony and radiotelegraphy

One of the important points to be settled is the adoption of a distinctive signal to claim priority for radiotelephony and radiotelegraphy transmissions by medical vehicles on land, at sea or in the air. One proposal was that the word "MEDICAL" be transmitted three times but this was rejected by the experts as a signal which could not be exclusively used by medical vehicles. It is in fact already used by ships consulting by radio a doctor at a coastal station. Suggestions should therefore reach the WARC 79 on a signal claiming priority and distinguishable from the priority calls already included in the ITU Radio Regulations.

The ICRC would be pleased to receive suggestions.

The signal should be brief and emphatic since its aim would be to make known immediately the nature of the message which follows it, with a view to facilitating military control and avoiding jamming of the transmission. In addition, in the event of an attack by mistake, the

signal would warn the attacker who may not have the means of identifying a normal call sign. The risk of abuse is no greater than with other signs or protective signals; it is even less, since the source of transmission can be located by radiogoniometry.

Electronic identification systems

The electronic "identification friend or foe" (IFF) has existed since the introduction of air and naval radar monitoring between 1937 and 1939. In the intervening forty years no military system for the identification of neutrals or non-belligerents has supplemented the military IFF system. This question is occupying the minds of experts, one of whom stated at the beginning of 1977 that to devise a foolproof system of identifying friends, foes and neutrals was one of the most urgent and most difficult technical and operational problems to be solved.

Secondary radar identification

To solve this problem of identifying medical aircraft by radar, Article 8 of the Regulations proposes the use of the secondary surveillance radar (SSR) adopted in civil aviation. The system is perhaps not perfect for medical vehicles in the event of war but at least it exists, and the ICAO has published international SSR standards, procedures and practices. The SSR can be used also with military radar systems for search and surveillance. It is in widespread use wherever aircraft are subject to regional air-traffic control.

In simple terms, the identification of an aircraft by SSR may be described as follows. A surveillance radar or interrogation radar sweeps the airspace with its impulse beam and detects the presence of an aircraft which is revealed as a luminous point on the radar panoramic screen. Aboard the aircraft detected is a transponder. This apparatus, hardly bigger than a packet of cigarettes, is a receiver-transmitter which automatically transmits a signal as soon as it is interrogated by the surveillance radar beam. The signal transmitted by the transponder is received by the radar interrogator and shows up on the panorama screen as an identification signal beside the luminous spot representing the detected aircraft.

The identification signal, depending upon the systems or codes agreed to beforehand, may consist of a series of dashes or figures. The radar codes used are displayed in advance in the transponders.

Secondary radar codes

The International Civil Aviation Organization has prescribed the secondary radar modes and codes necessary for air-traffic control. It is therefore possible to identify an aircraft by radar and to check its height and course.

The Diplomatic Conference, in its Resolution 17, invited ICAO to establish procedures for the designation, in case of an international armed conflict, of an exclusive SSR mode and code to be employed by medical aircraft.

There is no radar surveillance system for civilian shipping comparable to the secondary radar for international civil aviation. Naval vessels are equipped with surveillance or search radar and IFF antennas for the identification of enemy or friendly ships. The enemy is the ship which does not reply by the IFF "friend" code which is secret and is constantly changed, hence the impossibility for non-belligerent or neutral vessels to be identified by such a system.

Both ITU and IMCO are examining the use of radar transponders aboard merchant shipping with a view to improving safety in the approaches to ports and in congested shipping areas. Proposals in this field will be put forward at the WARC 79.

When similar transponders have been fitted aboard non-belligerent vessels, such as hospital ships, medical craft and lifeboats, and aboard all neutral commercial shipping, warships will be able to identify them by radar, beyond the visible horizon sometimes, and thereby abstain from indiscriminate attacks.

Submarine acoustic identification

Naval warfare was not an agenda item for the Diplomatic Conference. A special conference might some day deal with the problems peculiar to modern naval warfare, with particular reference to the signalling and identification of neutral and non-belligerent shipping. Several experts are of the opinion that it is high time to update the Hague Conventions on sea warfare which date back to the beginning of the century.

Since that time navies have changed from propulsion by sail to propulsion by atomic power. The large number of submarines which today plough the seas can detect the noise of ships from great distances but they can identify only the previously recorded acoustic "signature" of friendly vessels. The problem of acoustic identification of non-belligerent or neutral shipping is therefore comparable to the problem of identification by radar.

The provisions in the Regulations concerning distinctive signals—lights, radio, radar—are equally valid for ships and craft at sea protected by the Geneva Conventions. Under Article 8 of the Regulations, parties to a conflict may, by special agreement, establish for their use an electronic system similar to secondary radar for the identification of medical vehicles, ships and craft.

Electro-acoustic systems would therefore be admissible for submarine acoustic identification, in order to settle the old problem of identification of non-belligerent vessels by submerged submarines from a great distance, i.e. at least 25 nautical miles.

This need for identification was mentioned at the Tenth International Red Cross Conference in Geneva on 30 March 1921. On page 13 of its report on its work during the First World War, the Netherlands Red Cross mentioned that on 2 July 1917 the German Government asked that hospital ships engaged in the exchange of casualties be escorted by at least two paddle steamers, since “only the noise of paddles could be recognized from afar by submarines.”

Acoustic signalling

An acoustic system of morse transmission of a ship's call sign on a sound-wave frequency in relation to the frequency of the vessel's noise was recently tested in the waters of the Lake of Geneva. The injection of the identification signal into the ship's noise causes that signal to follow the same submarine acoustic path and will be detected at the same time as the ship by the acoustic monitoring system of the submerged submarine. By a system of transducers, fed with an automated coding device, the underwater identification signal is omni-directional. The system is so construed that it cannot be used otherwise than for transmission of the identification signal. During the tests, the range of the underwater signal reached 40 km—about 22 nautical miles.

The acoustic identification of ships should enable any submerged submarine to refrain from attacking non-belligerent vessels, whether they be neutral or protected by the Geneva Conventions. With this acoustic system it is not necessary to notify parties to a conflict of the acoustic “signature” of the vessel, and the risk of confusion is eliminated.

4. Communications, international codes

The Geneva Conventions and their Protocols make provision for agreements and notification between parties to conflicts, particularly for the evacuation and transport of wounded, sick or shipwrecked persons.

Such agreements must be concluded rapidly, otherwise casualties who might have been saved by timely intervention may die. Medical aviation would be useless if helicopter-ambulances were grounded while commanders of enemy forces were engaged in protracted negotiations for the approval of flight plans. However, there are international radio codes and maritime and aviation signal codes. The Regulations annexed to the Protocol mention their use to permit in all circumstances urgent bilateral communication with medical services.

The communications of medical units and vehicles, necessary for the application of the procedures provided for in the section on medical transportation in Protocol I, are the subject of Articles 9-12 of the Regulations.

Interception of medical aircraft—International signals

Article 13 of the Regulations states that the international procedures prescribed by ICAO for the interception of civilian aircraft should also be used for the interception of medical aircraft. Consequently, the intercepting aircraft must use radiocommunication, and manœuvre as prescribed, to summon a medical aircraft to land, and not force it to do so by firing on it.

Radio signalling and interception aircraft manœuvres are described in Annex 2 to the Chicago Convention on International Civil Aviation of 7 December 1944.

5. Civil defence—Works containing dangerous forces

The international distinctive sign for civil defence services is defined in Article 15 of the Regulations. It consists of a dark blue equilateral triangle on an orange background. The recommendations to ensure the visibility of the red cross apply also to this distinctive sign. Under infra-red monitoring, the dark blue triangle contrasts with the orange background without any special treatment. The same applies to observation with light amplifying devices. To permit, where necessary, improvisation of the sign with colours approximately the same as illustrated in the official records of the Diplomatic Conference (Vol I, Annex I, p. 173-181) no colorimetric specification is given for the blue or the orange.

The Regulations give no guidance concerning the distinctive signals which civil defence services may use under Article 66 of Protocol I.

Such signals could be useful for ships or aircraft to be given the benefit of the protection of the civil defence sign. Parties to a conflict should agree upon the use of distinctive signals in case of need.

The last chapter of the Regulations provides a special international sign for works and installations containing dangerous forces. This sign consists of three bright orange circles of equal size on the same axis, the distance between each circle being equal to one radius.

The hue of the orange is not specified by any colorimetric co-ordinates. The colour was chosen because it contrasted well against the colour of the concrete walls of atomic power plants and against the colour of dams on which the sign may be painted direct and may be illuminated or made of retro-reflective materials. Like the distinctive red cross, this sign, to be visible to infra-red monitoring, must be similarly treated, i.e. a black coating beneath each orange circle.

On a rectangular flag having a white background as prescribed in Article 16 of the Regulations, the three bright orange circles must be superposed on black circles of the same diameter in order to be visible to infra-red photography or to appear on the screen of infra-red monitoring systems. No special signal is provided for to supplement the visual sign.

Articles 56 of Protocol I lists three types of works and installations containing dangerous forces but does not say that there may be other types, such as offshore oil rigs which could pollute vast areas, causing harm on a world scale because of their geographic distribution.

6. Conclusions

Article 98 of Protocol I provides for the periodic updating of the Regulations. In future, the protective markings and signals of the Geneva Conventions and their Protocols may be adapted to the changing military technology for identification and thus remain effective. The ICRC must keep up to date on this matter and convene meetings of experts if necessary; this is a new task assigned to it in 1977 by the Diplomatic Conference.

Radiotelephony, flashing blue lights and sound signals are already in common use by military and civilian ambulances. Medical aircraft are fitted with radar transponders and by radio they obtain priority in air traffic. An international sound signal for medical vehicles has been considered. Identification by visual markings alone is a thing of the past but is still useful to confer protection at short range. Distinctive

signals are more effective; they have the advantage of representing no symbol and of still leaving room for improvement.

Civilian and military research workers, scientists and technicians working to improve transport by land, sea or air and telecommunications may find a wide field for their activities in seeking improvements to protective signalling, and transmitting to others their knowledge on new techniques.

Ph. Eberlin

*Technical Adviser
to the ICRC Legal Department*

