Means of identification for protected medical transports*

by Gérald C. Cauderay

1. Introduction

The Geneva Conventions of 12 August 1949 provide that medical personnel and equipment shall in general be identified by the distinctive emblem of the red cross or red crescent.[1] The Second Geneva Convention,[2] applicable to the victims of conflict at sea, specifies that the exterior surfaces of hospital ships and smaller craft used for medical purposes shall be white and recommends that the parties to the conflict use "the most modern methods" to facilitate identification of medical transports at sea (Art. 43). It is also recommended that medical aircraft should be clearly marked with both the distinctive emblem and their national colours on their lower, upper and lateral surfaces. They should moreover be provided with "any other markings or means of identification" agreed upon between the belligerents from the outbreak or during the course of hostilities (First Convention, Art. 36, and Second Convention, Art. 39).

The use of most of the means of identification referred to in this paper is discussed in Annex I to Protocol I of 8 June 1977 additional to the 1949 Geneva Conventions.

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* This paper reflects the author's personal views and does not engage the responsibility of the ICRC.

Original: French.

[1] (First) Geneva Convention for the Amelioration of the Condition of the Wounded and Sick in Armed Forces in the Field of 12 August 1949, Arts 35-38.

[2] (Second) Geneva Convention for the Amelioration of the Condition of Wounded, Sick and Shipwrecked Members of Armed Forces at Sea of 12 August 1949, Arts 22, 24, 26, 27 and 43.

In 1990, a meeting of technical experts convened by the ICRC on the basis of Article 98 of Protocol I proceeded to review Annex I. The main purpose of the proposed amendments was to incorporate into Annex I of Protocol I technical provisions already adopted by the competent international organizations. The consultation procedure was concluded in 1993 and the amendments proposed by the experts entered into force on 1 March 1994[3] for all States party to Protocol I, with the exception, for the relevant amendments, of those States which made declarations of non-acceptance.[4]

2. Flags and signs painted on the hulls of ships

Flags and signs painted on the hulls or the sails of ships are probably the most ancient means of identification used by merchant vessels and warships. For several hundred years they were sufficient to allow fairly reliable identification of ships, even at reasonable distances and early enough to permit action to be taken if needed. The introduction of field-glasses and later binoculars somewhat improved the range of visibility.

However, to be identified from the greatest distance possible, ships have to use extremely large flags and signs. Recent tests made by the ICRC have confirmed that in clear weather a red cross flag measuring 5 m across is barely discernable at a distance of 3,000 m and that a red cross flag measuring 10 m across is no longer recognizable at a distance of 5,000 m.[5] The visibility of these flags, and therefore their identification, also largely depends on weather conditions which, for example in the event of heavy rain or fog, may render them totally invisible, even at a short distance.

These considerations were not, however, of great import when naval warfare was still limited to sailing warships, which used relatively modest gunnery with a limited shooting range, and when submarines were not yet a reality.

The tremendous development in the technical aspects of naval warfare during the last century and of air warfare since the First World War has changed the situation completely.

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[3] See *International Review of the Red Cross (IRRC)*, No. 298, January-February 1994, pp. 27-41.

[4] Sweden for Articles 8 and 9 and Jordan for Article 2.

[5] Gérald C. Cauderay, "Visibility of the distinctive emblem on medical establishments, units and transports", *IRRC*, No. 277, July-August 1990, pp.295-321.

Modern warfare relies increasingly on the use of sophisticated technology which makes it possible to destroy a target long before it can actually be seen. Moreover, the mechanization of means of combat and the widespread use of electronic means of observation, and even to some extent of automatic firing, especially of sea and air weapons, have considerably increased the range and rapidity with which weapons can be fired and their velocity. As a result it has become almost impossible to recognize at a sufficiently early stage personnel, establishments and especially protected transports (by land, sea or air) bearing only the distinctive emblem.

To make sure that medical establishments and transports can be properly identified, the visibility of the distinctive emblem must be significantly improved.

The use of visual markings and other means of visual identification is not in itself sufficient to provide effective identification of protected naval or air transports, especially during naval, air and amphibious operations.

Additional means of signalling and identification, such as radio, radar, underwater acoustic devices and, to some extent, light signals, are therefore needed.

Light signals can be compared to flags and painted signs, but they offer additional advantages, i.e. they are visible at night at greater distances, and their visibility can also be improved in daylight, depending on weather conditions and especially when the signal is a flashing light.

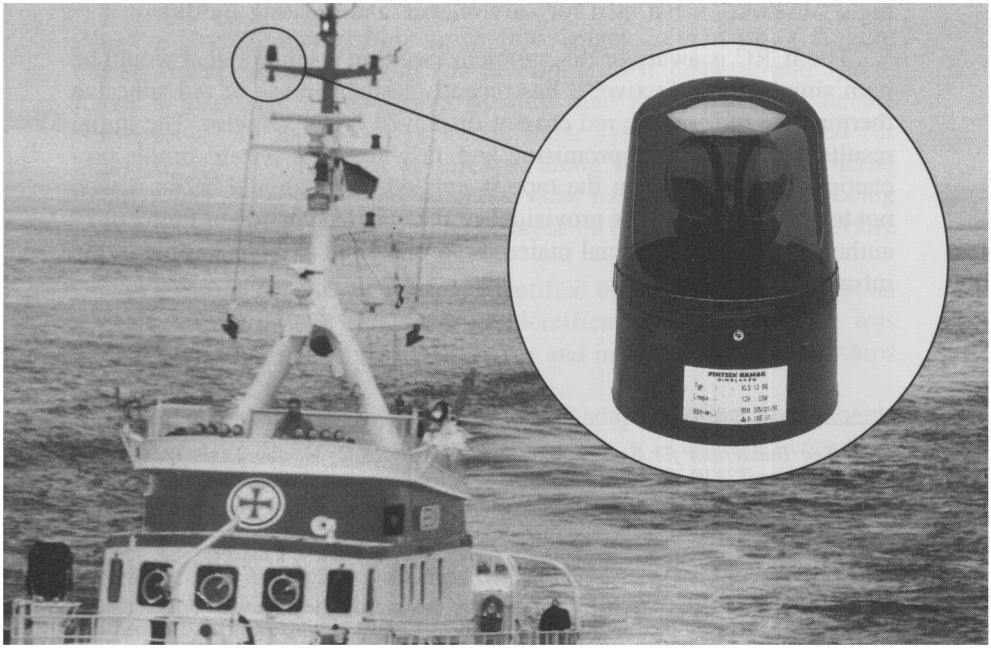
This category also includes the use of the International Code of Signals, Morse signalling lamps and even semaphore signalling. Until recently these means were still used for communication in both the merchant navy and the naval armed forces. They have since been progressively, but not completely, replaced by radiocommunications or by electronic devices.

High-intensity lights, such as those used on aircraft (anticollision beacons, strobe lights, landing lights, etc.) or at airports to indicate the approach path (PAPIs — Precision Approach Path Indicators) and illuminate the landing strips (runway lights), could be used, in accordance with the Geneva Conventions and their Additional Protocol I,[6] to illumi-

[6] Art. 5, para. 2, of Annex I to Protocol I additional to the 1949 Geneva Conventions (amended version of 1993).

nate the distinctive markings of hospital ships and other protected vessels, thereby somewhat extending their range of visibility and making it possible to identify them more rapidly.

For instance, the use of a flashing blue light is recommended in Annex I to Protocol I additional to the Geneva Conventions for the identification of hospital ships, medical aircraft and other protected transports (Art. 7, version amended in 1993). Many tests have been carried out to ascertain the maximum range of visibility obtainable with this type of identification. The results were rather disappointing: when used for the identification of medical aircraft, the light was visible only up to 1.5 km by day and approximately 8 km at night. Moreover, it tended to go from blue to white as the distance increased.



Model of a Flashing Blue Light Equipment for use on board sea-going vessels. *(Photo by courtesy of PINTSCH-BAMAG, Hamburg, Germany)*

More recent tests carried out at sea with a newly developed flashing blue light[7] have proved more promising. Whereas the maximum range of visibility in daylight was again about 1.5 km, at night it extended beyond 9.5 km, with the light maintaining its blue colour. The results achieved were thus in conformity with the relevant provisions in this regard.[8]

Interesting though they may be, these technically somewhat crude means of communication and identification are totally inadequate when it comes to ensuring rapid and reliable identification of medical transports in modern armed conflicts. They are therefore useful only as a supplementary means of identification.

Moreover, the increasingly frequent use of day and night vision systems, based on the principle of thermal imaging (or passive infrared),[9] raises a new problem with respect to the visibility of the emblem. If the emblem is painted with ordinary paint, it will not be visible when observed with a thermal-imaging camera. However, as these vision systems allow for a 1.5 to 1.8-fold increase in the range of visibility compared with that obtained by means of ordinary optical devices, they are used not only for night observation but also for surveillance and sighting by day.

The ICRC is aware of this problem. Seeking a solution that would be both simple and effective, it has recently tested the use of red adhesive therma tape to form the red crosses displayed on its vehicles. The initial results have been quite promising and, provided that certain simple precautions are taken when the tape is applied, there should be no reason not to make use of it. The provisions of the updated version of Protocol I[10] authorize the use of special materials to make the emblem visible in the infrared band.

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[7] See *Bundesamt für Seeschiffahrt und Hydrographie*, Hamburg, results recorded under ref. No. T2110, 29 May 1992.

[8] Article 7, Annex I to Additional Protocol I (updated version); *International Code of Signals*, Chap. XIV, para. 4, International Maritime Organization (IMO), London; *Airworthiness Technical Manual (Doc. 9051)*, Part 3, Section 7, Chap. 1, para. 4, International Civil Aviation Organization (ICAO), Montreal.

[9] *Thermal imaging — passive infrared*: by this means, the natural or artificial electromagnetic energy emitted in the far IR band (8-12 μm) by objects is transformed into electrical signals which are then used to draw a map of the hot points on the landscape, thus forming an image which can be observed through fieldglasses or on a screen or recorded using special apparatus.

[10] Art. 5, para. 3, of Annex I to Additional Protocol I.

3. Radiocommunications

During the Second World War medical transports at sea made wide use of radiocommunications to signal their identity and indicate their position and route. Today such means of identification for protected transports (hospital ships, rescue craft and medical aircraft) are even more effective.

When sailing through a dangerous area, e.g. where naval operations could take place, a hospital ship could send out a blind transmission on the appropriate frequency to provide identification, giving its call sign (which provides information on its nationality), its name, position, destination and route, in accordance with the International Telecommunication Union's Radio Regulations.[11] For obvious reasons of security, no answer would be transmitted by ships involved in military operations.

4. Radar identification

Since the beginning of the Second World War, radar has played an ever-increasing role in detecting the presence of objects and/or obstacles (ships or aircraft) representing a potential danger. In the case of moving objects, radar makes it possible to determine their distance and speed. Radar is also used in navigation by ships and aircraft to mitigate the consequences of bad visibility. Some radar systems are equipped for observing the ground from an aircraft, along the same lines as aerial photography; however, unlike cameras, radar has the advantage of being independent of weather conditions (a layer of clouds does not interfere with observation).

As a "target" cannot be directly identified by the echo it produces on a radar screen, a device called IFF (Identification Friend or Foe) was developed during the Second World War and installed on most warships and military aircraft.

The device has since been improved and adapted to the requirements of civil aviation. Known as a radar transponder, it is operated with Secondary Surveillance Radar (SSR) systems. It is very widely used, not only by passenger airliners, but also by all civilian and military aircraft using controlled airspaces, including almost all private aircraft, and thus contributes to the high grade of flight safety achieved today.

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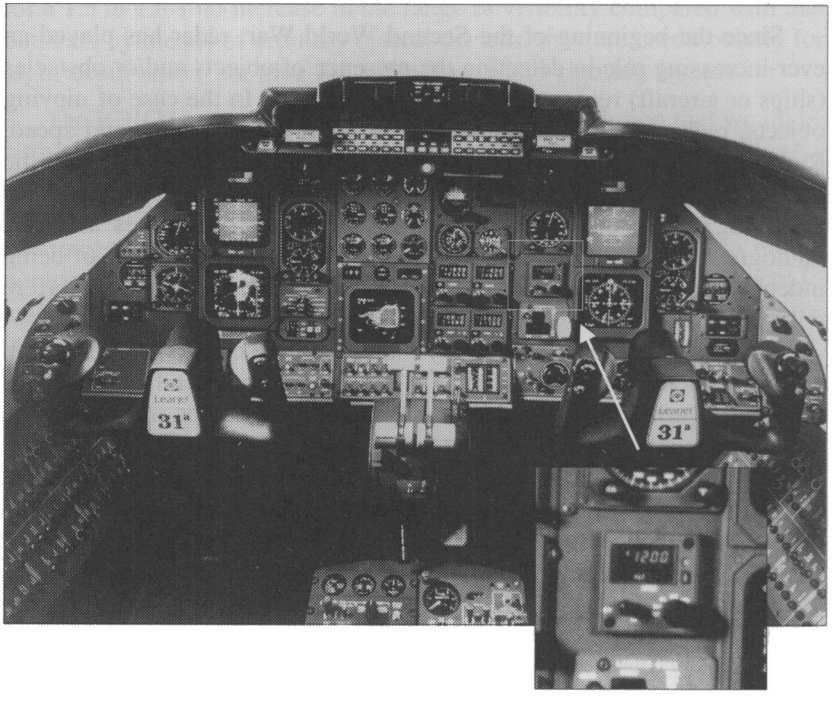
[11] *Radio Regulations*, Arts 40 and N40, International Telecommunication Union, Geneva.

As far as we know, all warships of a certain importance are equipped with IFF radar equipment and SSR systems which allow them to monitor and identify civil maritime and air traffic. We assume that this is also the case for AWACS (Airborne Warning and Control System) aircraft assigned to similar duties.

Tests have been carried out to determine whether it was possible to use aeronautical-type radar transponders to identify hospital ships. To this end, a standard aeronautical radar transponder unit was installed on a launch and set to Mode 3/A, which is common to both military and civil air traffic control. In spite of the rudimentary nature of the installation and the relatively low height of the transponder aerial, the results obtained have been very positive.



Aviation Transponder Control Unit, installed into the instrument panel of a twin-jet executive aircraft. *(Photo by courtesy of Allied-Signal Aerospace Company, BENDIX/KING General Aviation Avionics Divisions, Olathe, Kansas, USA)*

5. Identification by submarines

The development of submarine technology now allows submarines to stay underwater almost indefinitely and to attack targets well beyond the horizon, without prior visual contact. Ships protected under the Geneva Conventions and their Additional Protocols should therefore be easily identifiable by submarines. There are different methods of doing this.

a. Acoustic signature[12]

This method is widely used by naval forces to identify ships belonging to their own forces or to friendly forces. Its basic principle relies on the monitoring and analysis of the sound produced when a ship is under way, especially by its main and auxiliary engines, the propeller revolving, and so forth. The combination of these noises constitutes the ship's "acoustic signature". Each ship theoretically has its own unique acoustic signature, a sort of sonic fingerprint which can be used for identification purposes.

However, ships of identical design, built by the same shipyard but sailing under different flags, may have almost identical characteristics and thus acoustic signatures which are so similar as to be very easily confused.

Moreover, a ship's acoustic signature is not immutable. When a ship's load changes, so does its draught; this alters the acoustic signature, as does the ship's age and any damage or modifications made to it. Some experts believe that the acoustic signature should be measured and recorded every six months to make reliable identification possible. The identification is made by comparing the signal recorded by means of hydrophones with a pre-recorded specimen signature.

Acoustic signature is established by recording the noises produced by a ship when it performs manoeuvres in a basin especially fitted for the purpose. The operation requires complex installations and sophisticated measuring and recording instruments. This kind of installation is usually available only in countries which have a well-developed navy and are familiar with the technology involved. In time of war it might therefore be extremely difficult if not impossible for a ship from a small, neutral country, being used as a medical transport, to have its acoustic signature recorded and then to communicate it to the belligerents.

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[12] Philippe Eberlin, "Underwater acoustic identification of hospital ships", *IRRC*, No. 267, November-December 1988, pp. 505-518.

Given the complexity of establishing an acoustic signature and the uncertainties involved in its propagation at sea, only well-trained specialists with sophisticated equipment can make a reliable identification.

b. Active underwater acoustic identification

Experience during the Second World War and subsequent armed conflicts has prompted some governments, especially those of neutral countries, to develop the idea of an active underwater acoustic identification system. This idea was supported by the ICRC, which is concerned with the safety of hospital ships and other vessels protected by the Geneva Conventions.

The search for a solution led to a system based on underwater transmission of an acoustic signal emitting the ship's call sign in Morse code, preceded by the prefix NNN (for neutral) and YYY for a hospital ship, in accordance with the IMO International Code of Signals.[13] The transmission is automatically repeated either continuously or at set intervals. The ship's call sign, which is used for all communications, is a group of letters assigned to it under the ITU Radio Regulations. It gives the ship's nationality, while its individual identity can be derived by matching those letters against lists published by the ITU.

Different prototypes have been tested, as has, more recently, a type of equipment which is industrially produced in limited series. The results obtained have confirmed the soundness of the principle and the reliability of the system. Not only does the range of the signal extend to 25 nautical miles, but it has also been possible to take an accurate bearing of the signal at the same distance.

To our knowledge, several States are interested in this method of identification and at least one has decided to equip its merchant vessels with such a device.

6. Other devices facilitating identification

Most of the technical means of identification described above are already available on the market and even employed in civilian activities.

[13] *International Code of Signals*, Chap. XIV, para. 5, IMO, London, 1985.

Their use is mentioned in Annex I to Protocol I additional to the 1949 Geneva Conventions.

With the continued rapid development of technology, new technical means of identification will most probably become available in the future. Several devices in particular, which are already used for military purposes, could be made available for civilian applications as well.

Concerning radio transponders, in 1992 the ITU International Radio Consultative Committee (CCIR)[14] adopted a recommendation (Rec. 825) pertaining to the characteristics of a transponder system using digital selective-calling techniques for use with vessel traffic services and ship-to-ship identification. The recommendation provides for medical transports to be assigned a specific code that would make it possible to identify them automatically.

It is also important to mention the development of satellite-based location and data collection systems, one of which, called ARGOS,[15] is used by the World Meteorological Organization (WMO) to collect data supplied by a vast network of data-collecting and transmitting buoys distributed across all the world's oceans and seas. ARGOS is also used to monitor the position and progress of ships taking part in long-distance ocean races.

The Global Maritime Distress and Safety System (GMDSS)[16] can pinpoint emergencies by highly sophisticated and effective means: the International Maritime Satellite Organization (INMARSAT) and Cosmos Spacecraft/Search and Rescue Satellite-Aided Tracking (COSPAS/SARSAT) are capable of locating the EPIRBs (emergency position-indicating radio beacons) and ELTs (emergency locator transmitters) carried by mariners and navigators. The GMDSS terminals, as well as the INMARSAT Mobile Earth Stations, may now be equipped also with GPS

[14] The CCIR has since been incorporate into the ITU Radiocommunication Bureau.

[15] ARGOS is a satellite-based location and data collection system. It is the result of a cooperative effort between the CNES (*Centre national d'études spatiales*, France), NASA (National Space and Aeronautical Administration, USA) and NOAA (National Oceanic and Atmospheric Administration, USA). ARGOS equipment is carried on board two NOAA satellites in polar circular orbit (altitude, approximately 800 km), providing complete global coverage.

[16] *Global Maritime Distress and Safety System,* IMO, London 1987.

(Global Positioning System)[17] receiver cards, which enable those who carry them to communicate their positions as needed and even upon request.

These new radiolocation and satellite-location possibilities can also play an important part in making the identification of medical transports simpler and more precise and their movements easier to follow.

New technology for which military applications have already been found could be used to improve radar identification for medical transports: radar fingerprinting, for example, which consists in an electronic analysis of the carrier frequency and the pulses emitted by a commercially available navigation radar and the establishment of its electromagnetic signature. This technology should make it possible to identify a medical transport unit, either an aircraft or a ship, by simply observing and analysing the signals emitted by its navigation radar, provided a record of its radar signature has been made and communicated to all the parties concerned upon notification. However, it should be pointed out that a signature may change in course of time because of the ageing of the components, maintenance or modifications made to the radar equipment.

In our opinion, the effectiveness of this means of identification could be further improved, for instance by introducing on the carrier frequency a specific identification signal that would be recognized immediately by the surveillance system and the carrier digital analyser system. Other technical improvements could certainly be considered, but they would have to be as simple as possible to bring into operation and compatible with the surveillance systems used by parties to a conflict.

The use of modern automatic radio direction-finding equipment makes it possible to determine the direction of any radiocommunication transmitter with great accuracy and speed. Several radio bearings, taken simultaneously from different stations placed at a sufficient distance from each other, thus make it possible to check the position and/or route of a ship or aircraft protected under the Geneva Conventions and their Additional Protocols.

The means of identification described above are totally passive with respect to the belligerents, as they do not require the latter to emit any signal that could lead to their detection by the enemy.

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[17] GPS, also known as NAVSTAR, is a satellite global navigation system developed and maintained by the US Department of Defense. Based on a constellation of satellites (18 of the planned 24 satellites are in operation), it enables the carriers of special receivers to obtain their position on land, at sea or in the air within a range of 100 m.

7. Improper use of technical means of identification

Like the emblems of the red cross and red crescent, technical means of identification may be misused by one or other of the parties to a conflict. For instance, it may seem easy for an aircraft enjoying no protection to use a specific radar code which has already been assigned to a medical aircraft. However, such fraudulent use would imply knowledge of the code in question, which should not be easy to obtain; moreover, it would soon attract the attention of air traffic controllers. An unprotected ship might also use the provisions of Articles 40 and 40N of the ITU Radio Regulations, but its position, route and other characteristics would be different from those mentioned in an official notification and would immediately make the ship suspect. Other examples could be given; however, armed forces are now equipped with modern means of surveillance, detection and location (a great many of which are passive) which should enable them to uncover any improper use of technical means of identification.

8. Conclusion

We therefore think that identification is no longer a technical problem but an issue that largely depends on the will of the parties concerned to recognize the right of protected transports and those not involved in a conflict to use all technical means of identification available today, in order to avoid being taken as targets, or even destroyed, by belligerent forces.

It is important to point out, however, that **no means of identification** is fully reliable. Visual means are inevitably affected by distance, weather conditions, smoke screens and a number of other natural or man-made hindrances. Radiocommunication and electronic identification may be seriously jeopardized by electronic warfare measures such as the jamming of communication networks and radar systems. Electronic warfare also includes measures of deception which consist in generating and introducing false information into the enemy's systems.[18] In periods of armed

[18] Meeting of Technical Experts with a view to possible revision of Annex I to 1977 Protocole additional to the 1949 Geneva Conventions – Geneva, 20-24 August 1990 – Comments by the United States of America concerning Articles 8 through 14.

conflict, all these possibilities have to be taken into account and several different means of identification should therefore be used simultaneously to ensure that protected transports have the best possible chances of being rapidly and reliably identified by all the parties to the conflict.

Gérald C. Cauderay trained and worked for several years as a merchant navy radio navigator and radar operator. He later held a number of senior positions in the electronics industry, in particular in the fields of telecommunications and marine and aeronautical radio navigation, before being appointed Industrial and Scientific Counsellor to the Swiss Embassy in Moscow. At the ICRC, he is especially in charge of matters relating to the identification and marking of protected medical establishments and transports and to telecommunications. He has published several articles in the *Review:* "Visibility of the distinctive emblem on medical establishments, units and transports" (No. 277, July-August 1990, pp. 295-318), "The development of new anti-personnel weapons" (together with L. Doswald-Beck, No. 279, November-December 1990, pp. 565-576) and "Anti-personnel mines" (No. 295, July-August 1993, pp. 273-287).