



# **Rules for the Certification of Combat System Physical Integration**

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# GENERAL CONDITIONS

## Definitions:

"Rules" in these General Conditions means the documents below issued by the Society:

- Rules for the Classification of Ships or other special units;
- Complementary Rules containing the requirements for product, plant, system and other certification or containing the requirements for the assignment of additional class notations;
- Rules for the application of statutory rules, containing the rules to perform the duties delegated by Administrations;
- Guides to carry out particular activities connected with Services;
- Any other technical document, as for example rule variations or interpretations.

"Services" means the activities described in Article 1 below, rendered by the Society upon request made by or on behalf of the Interested Party.

"Society" or "RINA" means RINA Services S.p.A. and/or all the companies in the RINA Group which provide the Services.

"Surveyor" means technical staff acting on behalf of the Society in performing the Services.

"Interested Party" means the party, other than the Society, having an interest in or responsibility for the Ship, product, plant or system subject to classification or certification (such as the owner of the Ship and his representatives, the ship builder, the engine builder or the supplier of parts to be tested) who requests the Services or on whose behalf the Services are requested.

"Owner" means the registered Owner, the ship Owner, the manager or any other party with the responsibility, legally or contractually, to keep the ship seaworthy or in service, having particular regard to the provisions relating to the maintenance of class laid down in Part A, Chapter 2 of the Rules for the Classification of Ships or in the corresponding rules indicated in the specific Rules.

"Administration" means the Government of the State whose flag the Ship is entitled to fly or under whose authority the Ship is authorised to operate in the specific case.

"Ship" means ships, boats, craft and other special units, as for example offshore structures, floating units and underwater craft.

## Article 1

**1.1.** - The purpose of the Society is, among others, the classification and certification of ships and the certification of their parts and components.

The Society:

- sets forth and develops Rules;
- publishes the Register of Ships;
- issues certificates, statements and reports based on its survey activities.

**1.2.** - The Society also takes part in the implementation of national and international rules and standards as delegated by various Governments.

**1.3.** - The Society carries out technical assistance activities on request and provides special services outside the scope of classification, which are regulated by these general conditions, unless expressly excluded in the particular contract.

## Article 2

**2.1.** - The Rules developed by the Society reflect the level of its technical knowledge at the time they are published. Therefore, the Society, though committed, also through its research and development services, to continuous updating, does not guarantee they meet state-of-the-art science and technology at the time of publication or that they meet the Society's or others' subsequent technical developments.

**2.2.** - The Interested Party is required to know the Rules on the basis of which the Services are provided. With particular reference to Classification Services, special attention is to be given to the Rules concerning class suspension, withdrawal and reinstatement. In case of doubt or inaccuracy, the Interested Party is to promptly contact the Society for clarification.

The Rules for Classification of Ships are published on the Society's website: [www.rina.org](http://www.rina.org).

**2.3.** - The Society exercises due care and skill:

- in the selection of its Surveyors
- in the performance of its Services, taking into account the level of its technical knowledge at the time the Services are performed.

**2.4.** - Surveys conducted by the Society include, but are not limited to, visual inspection and non-destructive testing. Unless otherwise required, surveys are conducted through sampling techniques and do not consist of comprehensive verification or monitoring of the Ship or of the items subject to certification. The surveys and checks made by the Society on board ship do not necessarily require the constant and continuous presence of the Surveyor. The Society may also commission laboratory testing, underwater inspection and other checks carried out by and under

the responsibility of qualified service suppliers. Survey practices and procedures are selected by the Society based on its experience and knowledge and according to generally accepted technical standards in the sector.

## Article 3

**3.1.** - The class assigned to a Ship, like the reports, statements, certificates or any other document or information issued by the Society, reflects the opinion of the Society concerning compliance, at the time the Service is provided, of the Ship or product subject to certification, with the applicable Rules (given the intended use and within the relevant time frame).

The Society is under no obligation to make statements or provide information about elements or facts which are not part of the specific scope of the Service requested by the Interested Party or on its behalf.

**3.2.** - No report, statement, notation on a plan, review, Certificate of Classification, document or information issued or given as part of the Services provided by the Society shall have any legal effect or implication other than a representation that, on the basis of the checks made by the Society, the Ship, structure, materials, equipment, machinery or any other item covered by such document or information meet the Rules. Any such document is issued solely for the use of the Society, its committees and clients or other duly authorised bodies and for no other purpose. Therefore, the Society cannot be held liable for any act made or document issued by other parties on the basis of the statements or information given by the Society. The validity, application, meaning and interpretation of a Certificate of Classification, or any other document or information issued by the Society in connection with its Services, is governed by the Rules of the Society, which is the sole subject entitled to make such interpretation. Any disagreement on technical matters between the Interested Party and the Surveyor in the carrying out of his functions shall be raised in writing as soon as possible with the Society, which will settle any divergence of opinion or dispute.

**3.3.** - The classification of a Ship, or the issuance of a certificate or other document connected with classification or certification and in general with the performance of Services by the Society shall have the validity conferred upon it by the Rules of the Society at the time of the assignment of class or issuance of the certificate; in no case shall it amount to a statement or warranty of seaworthiness, structural integrity, quality or fitness for a particular purpose or service of any Ship, structure, material, equipment or machinery inspected or tested by the Society.

**3.4.** - Any document issued by the Society in relation to its activities reflects the condition of the Ship or the subject of certification or other activity at the time of the check.

**3.5.** - The Rules, surveys and activities performed by the Society, reports, certificates and other documents issued by the Society are in no way intended to replace the duties and responsibilities of other parties such as Governments, designers, ship builders, manufacturers, repairers, suppliers, contractors or sub-contractors, Owners, operators, charterers, underwriters, sellers or intended buyers of a Ship or other product or system surveyed.

These documents and activities do not relieve such parties from any fulfilment, warranty, responsibility, duty or obligation (also of a contractual nature) expressed or implied or in any case incumbent on them, nor do they confer on such parties any right, claim or cause of action against the Society. With particular regard to the duties of the ship Owner, the Services undertaken by the Society do not relieve the Owner of his duty to ensure proper maintenance of the Ship and ensure seaworthiness at all times. Likewise, the Rules, surveys performed, reports, certificates and other documents issued by the Society are intended neither to guarantee the buyers of the Ship, its components or any other surveyed or certified item, nor to relieve the seller of the duties arising out of the law or the contract, regarding the quality, commercial value or characteristics of the item which is the subject of transaction.

In no case, therefore, shall the Society assume the obligations incumbent upon the above-mentioned parties, even when it is consulted in connection with matters not covered by its Rules or other documents.

In consideration of the above, the Interested Party undertakes to relieve and hold harmless the Society from any third party claim, as well as from any liability in relation to the latter concerning the Services rendered.

Insofar as they are not expressly provided for in these General Conditions, the duties and responsibilities of the Owner and Interested Parties with respect to the services rendered by the Society are described in the Rules applicable to the specific Service rendered.

#### Article 4

**4.1.** – Any request for the Society's Services shall be submitted in writing and signed by or on behalf of the Interested Party. Such a request will be considered irrevocable as soon as received by the Society and shall entail acceptance by the applicant of all relevant requirements of the Rules, including these General Conditions. Upon acceptance of the written request by the Society, a contract between the Society and the Interested Party is entered into, which is regulated by the present General Conditions.

**4.2.** – In consideration of the Services rendered by the Society, the Interested Party and the person requesting the service shall be jointly liable for the payment of the relevant fees, even if the service is not concluded for any cause not pertaining to the Society. In the latter case, the Society shall not be held liable for non-fulfilment or partial fulfilment of the Services requested. In the event of late payment, interest at the legal current rate increased by 2% may be demanded.

**4.3.** – The contract for the classification of a Ship or for other Services may be terminated and any certificates revoked at the request of one of the parties, subject to at least 30 days' notice to be given in writing. Failure to pay, even in part, the fees due for Services carried out by the Society will entitle the Society to immediately terminate the contract and suspend the Services.

For every termination of the contract, the fees for the activities performed until the time of the termination shall be owed to the Society as well as the expenses incurred in view of activities already programmed; this is without prejudice to the right to compensation due to the Society as a consequence of the termination.

With particular reference to Ship classification and certification, unless decided otherwise by the Society, termination of the contract implies that the assignment of class to a Ship is withheld or, if already assigned, that it is suspended or withdrawn; any statutory certificates issued by the Society will be withdrawn in those cases where provided for by agreements between the Society and the flag State.

#### Article 5

**5.1.** – In providing the Services, as well as other correlated information or advice, the Society, its Surveyors, servants or agents operate with due diligence for the proper execution of the activity. However, considering the nature of the activities performed (see art. 2.4), it is not possible to guarantee absolute accuracy, correctness and completeness of any information or advice supplied. Express and implied warranties are specifically disclaimed.

Therefore, except as provided for in paragraph 5.2 below, and also in the case of activities carried out by delegation of Governments, neither the Society nor any of its Surveyors will be liable for any loss, damage or expense of whatever nature sustained by any person, in tort or in contract, derived from carrying out the Services.

**5.2.** – Notwithstanding the provisions in paragraph 5.1 above, should any user of the Society's Services prove that he has suffered a loss or damage due to any negligent act or omission of the Society, its Surveyors, servants or agents, then the Society will pay compensation to such person for his proved loss, up to, but not exceeding, five times the amount of the fees charged for the specific services, information or opinions from which the loss or damage derives or, if no fee has been charged, a maximum of one hundred thousand Euro. Where the fees charged are related to a number of Services, the amount of the fees will be apportioned for the purpose of the calculation of the maximum compensation, by reference to the estimated time involved in the performance of the Service from which the damage or loss derives. Any liability for indirect or consequential loss, damage or expense is specifically excluded. In any case, irrespective of the amount of the fees charged, the maximum damages payable by the Society will not be more than 1 million Euro. Payment of compensation under this paragraph will not entail any admission of responsibility and/or liability by the Society and will be made without prejudice to the disclaimer clause contained in paragraph 5.1 above.

**5.3.** – Any claim for loss or damage of whatever nature by virtue of the provisions set forth herein shall be made to the Society in writing, within the shorter of the following periods: THREE MONTHS from the date on which the Services were performed or THREE MONTHS from the date on which the damage was discovered. Failure to comply with the above deadline will constitute an absolute bar to the pursuit of such a claim against the Society.

#### Article 6

**6.1.** – Any dispute arising from or in connection with the Rules or with the Services of the Society, including any issues concerning responsibility, liability or limitations of liability of the Society, will be determined in accordance with Italian Law and settled through arbitration assigned to a board of three arbitrators who will proceed in compliance with the Rules of the Chamber of National

and International Arbitration of Milan. Arbitration will take place in Genoa, Italy.

**6.2.** – However, for disputes concerning non-payment of the fees and/or expenses due to the Society for services, the Society shall have the right to submit any claim to the jurisdiction of the Courts of the place where the registered or operating office of the Interested Party or of the applicant who requested the Service is located.

In the case of actions taken against the Society by a third party before a public Court, the Society shall also have the right to summon the Interested Party or the subject who requested the Service before that Court, in order to be relieved and held harmless according to art. 3.5 above.

#### Article 7

**7.1.** – All plans, specifications, documents and information provided by, issued by, or made known to the Society, in connection with the performance of its Services, will be treated as confidential and will not be made available to any other party other than the Owner without authorisation of the Interested Party, except as provided for or required by any applicable international, European or domestic legislation, Charter or other IACS resolutions, or order from a competent authority. Information about the status and validity of class and statutory certificates, including transfers, changes, suspensions, withdrawals of class, recommendations/conditions of class, operating conditions or restrictions issued against classed ships and other related information, as may be required, may be published on the website or released by other means, without the prior consent of the Interested Party.

Information about the status and validity of other certificates and statements may also be published on the website or released by other means, without the prior consent of the Interested Party.

**7.2.** – Notwithstanding the general duty of confidentiality owed by the Society to its clients in clause 7.1 above, the Society's clients hereby accept that the Society will participate in the IACS Early Warning System which requires each Classification Society to provide other involved Classification Societies with relevant technical information on serious hull structural and engineering systems failures, as defined in the IACS Early Warning System (but not including any drawings relating to the ship which may be the specific property of another party), to enable such useful information to be shared and used to facilitate the proper working of the IACS Early Warning System. The Society will provide its clients with written details of such information sent to the involved Classification Societies.

**7.3.** – In the event of transfer of class, addition of a second class or withdrawal from a double/dual class, the Interested Party undertakes to provide or to permit the Society to provide the other Classification Society with all building plans and drawings, certificates, documents and information relevant to the classed unit, including its history file, as the other Classification Society may require for the purpose of classification in compliance with the applicable legislation and relative IACS Procedure. It is the Owner's duty to ensure that, whenever required, the consent of the builder is obtained with regard to the provision of plans and drawings to the new Society, either by way of appropriate stipulation in the building contract or by other agreement.

In the event that the ownership of the ship, product or system subject to certification is transferred to a new subject, the latter shall have the right to access all pertinent drawings, specifications, documents or information issued by the Society or which has come to the knowledge of the Society while carrying out its Services, even if related to a period prior to transfer of ownership.

Pursuant and owing to Italian legislative decree 196/2003, the Interested Party declares that it has read the information sheet concerning the processing of personal data published on the society's website and gives its consent to such processing, also for commercial information purposes.

#### Article 8

**8.1.** – Should any part of these General Conditions be declared invalid, this will not affect the validity of the remaining provisions.

**8.2.** – In the event of doubts concerning the interpretation of these General Conditions, the Italian text will prevail.

#### Article 9

**9.1.** – When the Society provides its Services to a consumer - i.e. a natural person who does not act within the scope of his business or professional activity - the following provisions do not apply: art. 3.2. (as far as the Society is solely entitled to the interpretation of the Rules); art. 4.2., (as far as the payment of the fees is also due for services not concluded due to causes not attributable to the Interested Party); art. 5.1. (as far as the exclusion of liability is concerned); art. 5.2.; art. 5.3.; and art. 6.1. (as far as the jurisdiction of a Board of Arbitrators based in Genoa is concerned).

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## Chapter 1 – GENERAL

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### 1 GENERAL

#### 1.1 PURPOSE

##### 1.1.1 Premise

For military vessels, the Combat System represents the payload of the ship and its importance is equivalent, and even paramount, to that of the ship's platform (intended as the hull, propulsion, steering and essential auxiliary systems).

The RINAMIL Rules for the Classification of Naval Ships and the Rules for the Classification of Fast Patrol Vessels provide exhaustive technical requirements for the classification of the Naval Ships and Fast Patrol Vessels platforms but are not sufficient for an adequate verification of the Combat System.

The scope of these Rules is to complete the classification Rules with additional technical requirements for the RINA verification of the Combat System Physical Integration.

##### 1.1.2 Field of application

These Rules apply, at the request of the Interested Party, to military newbuildings with the scope of issuing a Statement of Compliance the present Rules for the Combat System Physical Integration.

##### 1.1.3 Additional Class Notation CSPI

When the newbuilding is surveyed by RINA during the construction in accordance with the RINAMIL Rules for the Classification of Naval Ships or with the Rules for the Classification of Fast Patrol Vessels, the ship may be assigned with the additional class notation **CSPI**.

The notation CSPI is assigned a construction mark which identifies the procedure under which the ship has been surveyed for initial assignment of the CSPI notation as follows:

- the mark ☒ is assigned where the procedures for the assignment of CSPI additional class notation are those of the present Rules;
- the mark ● is assigned where the procedures for the assignment of CSPI additional class notation are other than those detailed in the present Rules but however deemed acceptable.

#### 1.2 DEFINITIONS

##### 1.2.1 Combat System

For the purpose of the present Rules, Combat System (CS) is the payload of the ship and comprehends:

- weapons (guns, missiles, etc.), countermeasures;
- Combat Management System;
- internal and external communication means including antennas and navigation system;
- radar, sonar, pointing devices and other sensors

##### 1.2.2 Main Combat System equipment

For the purpose of the present Rules, main CS equipment is equipment with a primary role in the operative tasks of the ship or inducing significant loads, static or dynamic, on the ship structure.

Generally, main CS equipment is represented by:

- firing weapons and countermeasures
- surveillance and long range radar
- sonar

##### 1.2.3 Combat System Physical Integration

For the purpose of the present Rules, Combat System Physical Integration (CSPI) represents the physical installation of the combat system on the ship's platform in terms of:

- positioning of the Combat System equipment (room layout, ventilation and air-conditioning, etc.)
- structural interface (basement, bolting devices, anti-vibration and shock mounts)
- cables (electrical power supply, data cables, wave guides and RF cables)
- auxiliary systems (compressed air, water, hydraulic oil, etc.)
- outfittings (thermal or acoustic insulation, shielding, etc.)

##### 1.2.4 Acronyms and abbreviations

In the present Rules, the following acronyms and abbreviations are used:

RINAMIL are the RINA Rules for the classification of Naval Ships, edition in force

CS is the Combat System as defined in [1.2.1]

CSPI is the Combat System Physical Integration as defined in [1.2.2]

**Chapter 1 – GENERAL**

**1.3 DOCUMENTS TO BE SUBMITTED**

The documents listed in Tab 1 are to be sent to the Society for approval.

The Society reserves the right to require additional plans or information in relation to the specific characteristics of the installations.

**Table 1: Documentation to be submitted**

No.	I/A (1)	Document	Document details
1	I	List of combat system equipment	Drawing is to provide indication of : <ul style="list-style-type: none"> <li>• mechanical requirements,</li> <li>• dissipation needs</li> <li>• fluid needs</li> </ul>
2	I	Layout of CS technical and operative rooms and top side	
3	A	Structural drawings of foundations of main CS equipment.	Drawings are to provide indication of static and dynamic loads
4	A	Structural drawings of elements subject to blast, blaze and foreign object debris hazard	Drawings are to provide indication of static, dynamic and thermal loads
5	I	Structural calculation reports as justification of the structural drawings listed in previous items 3 and 4	
6	I	Arrangement of shields and thermal protections for blast, blaze and foreign object debris, if any	
7	I	Alignment criteria and layout of the positioning of weapons, radars, sensors and targeting devices and gyrocompass	Drawing is to provide also indication of the clearance from adjacent structures and equipment
8	A	Functional diagrams of auxiliary systems for combat system equipment, such as: <ul style="list-style-type: none"> <li>• sea water,</li> <li>• fresh water</li> <li>• compressed air</li> <li>• ventilation and conditioning</li> </ul>	Drawings are to provide indication of: <ul style="list-style-type: none"> <li>• nature, service temperature and pressure of the fluids</li> <li>• material, external diameter and wall thickness of the pipes</li> <li>• type of connections between pipe lengths, including details of the welding, where provided</li> <li>• material, type and size of the accessories</li> <li>• capacity, prime mover and, when requested, location of the pumps</li> </ul>
9	A	Single line diagram of power supply of combat system	
10	A	List of circuits	For each supply and distribution circuit, data concerning the nominal current, the cable type, length and cross-section, nominal and setting values of the protective and control devices are to be provided
11	I	Cable routing policy	Drawing is to provide indication of : <ul style="list-style-type: none"> <li>• class of cables for electromagnetic behaviour ,</li> <li>• segregation and separation criteria</li> </ul>
12	I	CSPI installation check procedures	
(1)	A = to be submitted for approval, in quadruplicate I = to be submitted for information, in duplicate.		

**Chapter 2 – GENERAL REQUIREMENTS FOR DESIGN AND CONSTRUCTION**

**2 GENERAL REQUIREMENTS FOR DESIGN AND CONSTRUCTION**

**2.1 STRUCTURES AND FOUNDATIONS**

**2.1.1 Structural scantling**

Foundations of firing weapons and countermeasures (e.g. missile/chaffs/torpedo launchers, guns), surveillance and long range radar and relevant supporting structures are to be verified in respect of static and dynamic loads.

Unless otherwise stated by the weapon's manufacturer, the loads to be applied to the foundations are indicated in RINAMIL Pt B, Ch 5, Sec 3 for static loads deriving from the ship's motions acceleration and Pt B, Ch 5, Sec 6, [8] for dynamic loads.

The scantling criteria for plating of structures and foundation subject to dynamic loads are provided in RINAMIL Pt B, Ch 7, Sec 1, [3.6]; ordinary stiffeners and primary supporting members are to be verified by means of a direct calculation performed through three-dimensional models as indicated in RINAMIL Pt B, Ch 7, Sec 3, [7].

When the dynamic load is associated with a thermal load, special consideration is to be given to the scantling of the foundation and relevant surrounding structures unless specific thermal insulation is adopted to reduce the heating of structures.

**2.1.2 Alignment of basements**

For the alignment of basements of CS equipment, a Master Reference Plane (MRP) is to be installed and the ship centreline is to be marked on the main deck of the ship.

The procedures for the determination of the ship centreline, and for the installation and alignment of the Master Reference Plane are to be agreed with the Society and measuring equipment used for that purpose is to be calibrated as required in RINAMIL Pt A, Ch 1, Sec 1, [3.4.1].

The MRP is to be installed in a sheltered position where the effects of hull deformations are minimised.

The MRP is to have a surface with characteristics of flatness and planarity adequate in respect of the precision required for the CS equipment.

The MRP is to be installed with an adjustable support that allows the fine alignment of the plane; after the alignment of the plane is obtained, the regulation bolts and screws are to be permanently locked, their position is to be marked for subsequent verification and the MRP is to be enclosed in a case for protection against accidental shocks.

**2.2 ELECTRICAL SYSTEM**

**2.2.1 General design requirements**

Where not specifically modified by the present Rules, RINAMIL Pt C, Ch 2 is to be applied for the combat system electrical system considering the combat system as an essential service of the ship.

**2.2.2 Power supply**

Unless otherwise stated by the Naval Authority, the power supply to the combat system and relevant auxiliary systems is to be arranged as indicated in Tab 2.

**2.2.3 Quality of power supply**

All electrical appliances supplied from the main or emergency systems are to be so designed and manufactured that they are capable of operating satisfactorily under the normally occurring variations in voltage and frequency.

Unless otherwise stated by the Naval Authority, the allowable voltage and frequency variations are to be in accordance with STANAG 1008 Ed. 09

**2.2.4 Electromagnetic behaviour of cables**

For the purpose of the management of electromagnetic interferences, cables are to be classed on the basis of the electromagnetic behaviour (emission of and/or susceptibility to electromagnetic fields) taking into account the following aspects:

- carried signal characteristics (e.g. frequency, voltage, current),
- cable characteristics (e.g. shielding)
- characteristics of the connected system (e.g. system criticality).

Unless otherwise stated by the Naval Authority, at least the following classes of cables are to be defined:

C1	cables with negligible electromagnetic emission and susceptibility characteristics (e.g. ground cables)
C2	power cables and degaussing loop cables
C3	cables with high electromagnetic emission characteristics
C4	cables with high electromagnetic susceptibility characteristics

Acronyms used and number of classes of cables may vary depending on the Shipyard or Navy standard.

**Chapter 2 –GENERAL REQUIREMENTS FOR DESIGN AND CONSTRUCTION**

**Table 2: Power supply to Combat System equipment**

Type of power supply	Type of Combat system equipment	Weapons	Combat system sensors	Communication and navigation equipment (3)
Ship category (1)				
Front line ships		EPS (2)	EPS (2)	UPS
Second line ships		MPS	EPS (2)	UPS
Auxiliary ships		MPS	MPS	UPS

(1) ship categories are defined in RINAMIL Pt A, Ch 1, Sec 2, [4.2]  
 (2) number and type of equipment to be supplied by EPS (and relevant contemporaneity factors) are to be defined by the Naval Authority  
 (3) when duplicated/redundant systems are present, only one system is to be supplied by the UPS

Legend:  
 MPS = equipment is to be supplied by the main source of electrical power as defined in RINAMIL Pt C, Ch 2, Sec 1, [3.13.1]  
 EPS = equipment is to be supplied by the emergency source of electrical power as defined in RINAMIL Pt C, Ch 2, Sec 1, [3.18.1] for a period of 18 hours  
 UPS = equipment is to be supplied by the transitional source of electrical power in accordance with RINAMIL Pt C, Ch 2, Sec 3, [2.3.6]

**2.2.5 Cable routing policy**

In general, cables belonging to different classes are to be routed in separate trays and, as far as possible, they are not to run parallel to each other; where it is not feasible, the risk of interference is to be considered and mitigated with alternative methods.

Cables intended for the transmission of classified information are to conform to the applicable standards defined by the Navy (e.g. NATO TEMPEST).

A cable routing policy plan indicating the clearances and separation criteria among different cable classes is to be developed by the shipyard taking into account the effects of all the coupling typologies (capacitive, inductive, common-mode impedance, radiated couplings) on the connected systems and is to be sent for information to the Society. The plan is to provide details of electromagnetic shielding to be adopted in the case of cables passing through bulkheads and decks.

In general, cable trays are to provide additional space for a 20% of growth capability for additional cables; where it is not feasible or practicable a lower degree of growth capability may be accepted.

**2.2.6 Grounding of equipment**

All CS equipment that requires an electrical power supply is to be connected to ground potential in compliance with MIL-STD-1310G.

Cross sectional area of the ground cable connection is to be properly sized in respect of the power supply cable used by the equipment as detailed in Tab 3.

For non-metallic ships, a specific grounding policy is to be specifically developed by the shipyard.

**Table 3: Cross sectional area of ground cables**

Power Supply Cable	Ground Cable
≤ 2,5 mm <sup>2</sup>	≥ 1,5 mm <sup>2</sup>
from 4 mm <sup>2</sup> to 120 mm <sup>2</sup>	min 4 mm <sup>2</sup> max 60 mm <sup>2</sup>
> 120 mm <sup>2</sup>	= 70 mm <sup>2</sup>

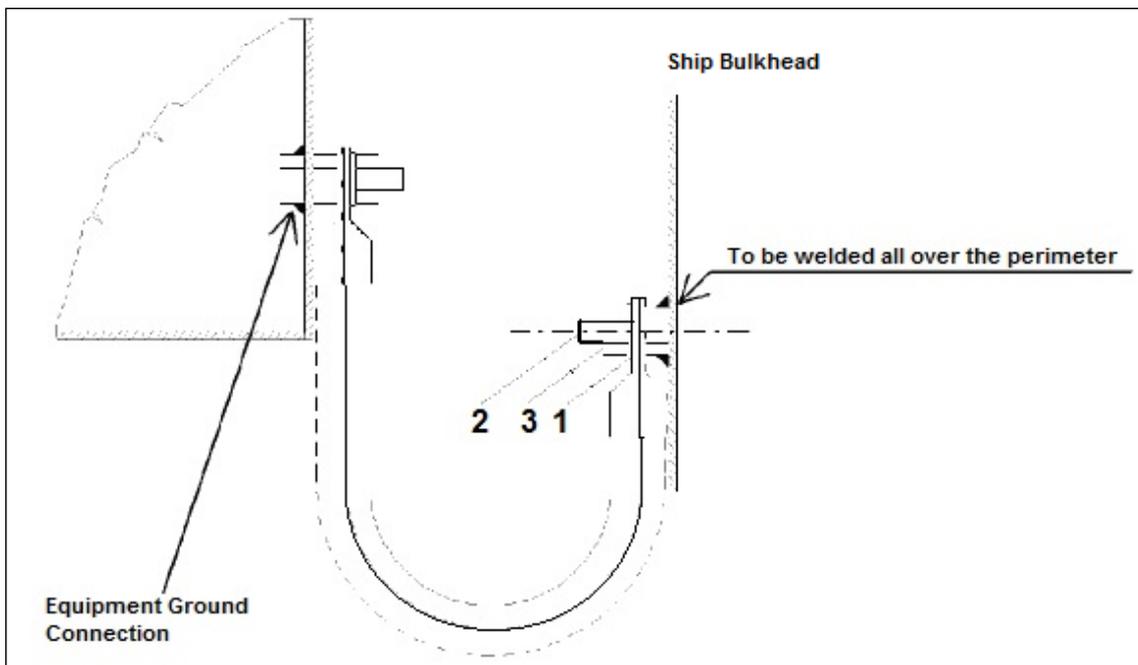
A common arrangement for ground connections is shown in Fig. 1 where the required types of lock washers, nuts and bolts are based on the ground cable section as indicated in Tab 4

**Chapter 2 –GENERAL REQUIREMENTS FOR DESIGN AND CONSTRUCTION**

**Table 4: Type of lock washer, nut and bolt for ground connections**

Ground Connection Cable	(1) Lock washer type	(2) Nut type	(3) Bolt type
> 10 mm <sup>2</sup>	A 10,5	M10x25	M10
≥ 10 mm <sup>2</sup>	A 13	M12x25	M12

**Figure 1: Common arrangement for ground connections**



**2.3 AUXILIARY SYSTEMS**

**2.3.1 General requirements**

Auxiliary systems that are essential for the operability of the combat systems are to comply with the applicable requirements of RINAMIL Pt C, Ch 1, Sec 10, from [1] to [5].

**2.3.2 Availability of systems**

Unless otherwise stated by the Naval Authority or by the equipment manufacturer, the use of plastic pipes is to be avoided.

Auxiliary systems are to be designed to maintain the operability of the combat system equipment in the event of any single failure of:

- Sea-chests
- Pumps and compressors
- Filters
- Pressure reduction units

- Heat exchangers
- Ventilators

Means are to be provided to by-pass and shut-off each of the components which may be subject to a single failure without impairing the functioning of the system itself (including machinery and equipment) or of the other systems which are to be operated simultaneously.

## Chapter 3 – INSPECTION, VERIFICATION AND CERTIFICATION

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### 3 INSPECTION, VERIFICATION AND CERTIFICATION

#### 3.1 EQUIPMENT INSTALLATION

##### 3.1.1 Availability of information

Combat System component list and physical integration design requirements are to be made available to the Surveyor prior to the survey of the installation of each piece of equipment.

##### 3.1.2 Equipment visual inspection

For each main CS equipment, visual inspection is to be carried out in order to verify compliance with the combat system technical and operative rooms layout scheme.

##### 3.1.3 Equipment ground connections

Visual inspection of the correct equipment connection to the ship ground in accordance with the CSPI design documentation and with the indications provided by manufacturer of the equipment is to be carried out.

In particular, it is to be verified that:

- all the items are correctly connected to the ground
- each item has its own ground connection, in order to avoid that by disconnecting one item from the ground, no other items are disconnected;
- the ground connections are positioned so as to facilitate inspection and maintenance and protect them from damage;
- the ground connections, exposed to the external environmental conditions, are adequately covered by protective material.

#### 3.2 FOUNDATIONS

##### 3.2.1 Survey of foundation construction

Foundations of main combat system equipment (firing weapons and combat system radars) are to be surveyed by the Society during construction in accordance with approved drawings and in compliance with the general requirements for inspection and testing of materials and structures provided in RINAMIL Pt B, Ch 12.

##### 3.2.2 Connections and mountings

Bolted connections of main equipment (firing weapons and combat system radars) are to be verified for tightening in accordance with the shipyard or manufacturer indications.

In particular, it is to be verified that:

- screws and bolts are suitable for the environmental conditions (AISI 304 bolts for

internal installation and AISI 316 for external installations);

- plain washer and/or self-blocking nuts are used for protection from vibration effects, as required by the manufacturer of the equipment;
- tightening torque value applied is in accordance with the requirements indicated by the manufacturer of the equipment.

Installation of shock absorbent and resilient mounting is to be verified in accordance with the manufacturer's indications.

##### 3.2.3 Clearance and alignment

Areas surrounding weapons are to be verified for clearance in respect of moving parts, obstacles in the line of sight and blast/blaze impingement; design data on clearance and specific arrangement are to be provided by the manufacturer of the equipment or by the shipyard; special care is to be paid to clearance in the case of equipment installed on shock absorbent or resilient mounting.

When it is necessary to locate systems, equipment or structures in the blast impingement area, these are to be protected both from dynamic and thermal loads induced by the weapon's firing.

Firing weapons, radars, sensors for targeting/tracking and gyrocompass are to be verified for alignment in respect of the ship's centreline; unless otherwise specified by the equipment manufacturer or by the shipyard, the following parameters and acceptable deviations are to be verified:

- planarity
- parallelism to the Master Reference Plane
- alignment to the keel line
- roughness of contact surface

In particular, the following operations are to be performed with the ship in dry-dock condition:

- marking of the ship's centreline
- positioning and alignment of the Master Reference Plane
- the positioning and alignment of basements

Final alignment of weapons and sensors may be carried out with the ship in dry dock or with the ship in floating condition in sheltered waters and with a loading condition comparable to the operating condition (see Pt B, Ch 1, Sec 2, [5.3]).

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Unless otherwise stated by the Naval Authority or by the manufacturer of the equipment, the reference sequence of operations relevant to the levelling and alignment of weapon and sensor basements is described in Appendix 1.

### 3.3 ELECTRICAL INSTALLATION

#### 3.3.1 Cable routing

Cable routing is to be verified in accordance with the cable routing policy plan, on the basis of cable route detailed drawings (e.g. cables list, cable running sheets and interconnection diagrams) provided by the shipyard to the Surveyor.

In particular, as far as applicable, it is to be verified that:

- cables are installed on cable trays, insoles, rods in an ordered way;
  - cable tray segments are identified and marked with the electromagnetic class of the routed cables (see [2.2.4]);
  - optical fibre cables are the last positioned on the cable tray in order to limit the possibility of damage;
  - adequate bending radius of cables is adopted;
  - cables have a sufficient slack to compensate for possible structural movements and deformations;
  - cables are protected from any heat source;
  - cables are adequately fastened and, in particular:
    - every 2 meters in horizontal routes inside a room
    - every 5 meters in horizontal routes inside corridors
    - every 1 meter in vertical routes;
    - at each end of bulkhead/deck passage or cable bend
  - nuts and bolts used are made of stainless steel (AISI 304 inside the ship, AISI 316 for external installations);
  - means are adopted to avoid galvanic currents due to different metal coupling for cable trays
  - physical separation is provided for cables belonging to different categories:
  - conductive pipes are connected to ship ground
- for metallic ships, shielded or armed cables entering the ship have a ground connection with the hull in proximity of their entrance.

#### 3.3.2 Cables identification plates

Cables and connectors are to be clearly and adequately identified in accordance with the cable list and cable running sheet.

As far as feasible and practicable, the following criteria for cable identification are to be adopted:

- labels are visible and fastened on the cable;
- labels installed on an external environment are made of a material resistant to atmospheric agents;
- labels are positioned at about 30 cm distance from each connector in order to make the label readable without unplugging the connector from the device and are to contain the identification of the relevant connection point;
- labels are positioned at about 30 cm distance in the case of connection towards a junction box. The label should be visible without moving the connector directed to the junction box;
- labels are positioned at about 50 cm distance in the case of bulkhead or deck passage in order to allow easy identification of each cable routed in the passage;
- Labels are to indicate the electromagnetic class of the cable if not yet indicated in the cable tray (see [2.2.4]).

#### 3.3.3 Electric cables final check

After installation, electric cables are to be verified for:

- integrity of insulation:
  - insulation test is to be carried out on the cable with both ends disconnected to measure the electrical resistance of each conductor in respect of the other conductors composing the cable and in respect of the ground potential
  - the insulation resistance is not to be lower than 1 MΩ.
- electrical continuity:
  - the continuity test is to be performed on the cable with both ends disconnected on each single conductor using a wire of return that is external to the conductors of the cable under test (this may be the cable shield or ship ground)

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- connector installation:
  - pins are correctly crimped or welded and are in accordance with the cable running sheet;
  - heat-shrinking material used is of self-extinguisher type;
  - presence of shields, if required;
  - tightening of the back-shell of the cables;
  - presence of the ground connection for cables that carry voltages over 30V (R.M.S. or DC).

The above tests may be carried out by a spot check method to the satisfaction of the Surveyor.

**3.4 FIBRE OPTIC CABLES, RF CABLES AND WAVE GUIDES**

**3.4.1 Fibre optic cables**

Installation of fibre optic cables is to be in accordance with MIL-STD-2042 specification.

After installation, fibre optic cables are to be verified in respect of attenuation by means of an optical power meter with optical light source.

Unless otherwise specified, the measured attenuation is not to exceed 2,5 dB.

Fibre optic cables will be verified to ensure they have been properly installed and have avoided critical positions capable of inducing unwanted stress or deformation to the cable.

Guidance for the measurement of the attenuation by means of an optical power meter with optical light is provided in Appendix 2; alternative methods may be agreed on a case by case basis by the Society.

**3.4.2 RF cables and wave guides**

After installation, RF cables and wave guides are to be verified in respect of VSWR (Voltage Standing Wave Ratio) by means of a RF network analyser.

The Voltage Standing Wave Ratio (VSWR) is the ratio of the maximum to minimum voltage of the standing wave pattern on the transmission line caused by the reflection of the incident wave at the transition between the antenna (load) and the feed line due to the different impedances or within the feed line itself:

$$VSWR = \frac{E_{MAX}}{E_{MIN}} = \frac{E_i + E_r}{E_i - E_r}$$

where:

$E_{MAX}$  = maximum voltage on the standing wave

$E_{MIN}$  = minimum voltage on the standing wave

$E_i$  = incident voltage wave amplitude

$E_r$  = reflected voltage wave amplitude

In general, VSWR is to be verified for the cables before the coupling of the antenna by applying a test load at the cable end in order to obtain the signal reflexion.

After the connection with the transmittal antenna, the VSWR is to be verified for the cable plus antenna system.

Limit values for VSWR are to be provided by the manufacturer of the equipment.

Wave guides are to be carefully verified for routing in accordance with the designer's indications; in particular, it is to be verified in respect of:

- Path laying and correct installation
- Waveguide protection
- Stamp of warning signals "WAVE GUIDE - DO NOT TOUCH" on the waveguide unprotected areas.
- Waveguide identification labelling
- Joint and flange alignment
- Penetration on decks and bulkhead
- Grounding
- Air and condensation drain

After installation, wave guides are to be tested for gas tightness with air.

**3.5 AUXILIARY SYSTEMS**

**3.5.1 General requirements**

Auxiliary systems that are essential for the operability of the combat systems are to be surveyed during installation and tested in accordance with the requirements of RINAMIL Pt C, Ch 1, Sec 10, [17].

**Appendix 1 – REFERENCE GUIDELINES FOR BASEMENT LEVELLING AND ALIGNMENT**

**APPENDIX 1 – REFERENCE GUIDELINES FOR BASEMENT LEVELLING AND ALIGNMENT**

**1. PROCEDURE**

Unless otherwise stated by the Naval Authority or by the manufacturer of the equipment, the reference sequence of operations relevant to the levelling and alignment of weapon and sensor basements is described in:

- **Tab 1:** for preliminary activities and identification of references;
- **Tab 2:** for basements that require mechanical machining (Cannons, Machine guns, heavy sensors/radar);
- **Tab 3:** for basements prepared with epoxy resin such as lightweight radar antennas, secondary sensors, radio antennas.

**2. MEASUREMENT INSTRUMENTS**

Measurement instruments are to be suitable for accurate measurements of the required

parameters and are to be duly calibrated to a recognised national or international standard.

Unless otherwise specified by the manufacturer of the CS equipment, measurement instruments shall have the following minimum characteristics in respect of the type of parameter to be measured:

- parallelism: digital spirit level or electronic inclinometer with an accuracy greater than 20" of a degree
- alignment: theodolites with accuracy greater than 1" of arc and level with sensitivity greater than 20" of arc
- roughness: roughness meter with resolution not less than 0.1µm if reading = 100µm

Measurement of planarity may be carried out in different ways and is to be agreed with the surveyor.

**Table 1: Preliminary activities and identification of references**

Phase	Step	Activity	Additional information
INSTALLATION OF REFERENCES	1.1	<ul style="list-style-type: none"> <li>• Reference plane installation and levelling</li> </ul>	After levelling of the reference plane, the regulating screws and bolts are to be marked and secured against undesired misalignment.
	1.2	<ul style="list-style-type: none"> <li>• Ship centreline marking on the dock border</li> </ul>	The ship centreline is transferred on the dock border by means of theodolites and triangulations
	1.3	<ul style="list-style-type: none"> <li>• Ship centreline marking on the ship deck</li> </ul>	Markings of ship centreline are to be placed on external deck by using the line drawn on the dock border as reference
	1.4	<ul style="list-style-type: none"> <li>• Installation of additional benchmarks on external deck</li> </ul>	Additional benchmarks may be required for the mechanical alignment of barrels or line-of-sight sensors
	1.5	<ul style="list-style-type: none"> <li>• Ship centreline marking in gyro compass rooms</li> </ul>	The ship centreline is to be transferred and marked in the gyrocompass rooms by means of triangulations
PRELIMINARY CHECKS	1.6	<ul style="list-style-type: none"> <li>• Basement visual check</li> <li>• Verification of measurement instruments calibration</li> <li>• Check of boring machine</li> <li>• Visual inspection on the surfaces to be bored</li> </ul>	All the activities in the surrounding area that may influence the levelling/alignment of the basement (e.g. welding) are to be completed or stopped during basement preparation/verification

**Appendix 1 – REFERENCE GUIDELINES FOR BASEMENT LEVELLING AND ALIGNMENT**

**Table 2: Procedure for basements requiring mechanical machining**

Phase	Step	Activity	Additional information
SURFACE PREPARATION	2.1	Surface machining	The basement surface is to be machined in order to meet the parameters required by the manufacturer of the equipment.
	2.2	Measurement of flatness, planarity, roughness	The flatness of the surface is to be measured by suitable instruments and methodologies such as the use of micro alignment telescope
LEVELLING AND ALIGNMENT	2.3	Levelling compliance verification	The levelling between the surface and the Master Reference Plane <sup>(1)</sup> is to be measured by means of electronic inclinometer; measurements are to be recorded at every 30°
	2.4	Calculation of the vector of average levelling	The levelling values are used to calculate the vector of the average levelling and the Master Reference Plane <sup>(1)</sup> ; the final values of levelling and alignment are to be collected and recorded in order to be available for future alignment verifications.

Note 1: The basement of the main gun (after being aligned with the MRP) may be used as reference plane for the alignment of other equipment in lieu of the MRP; if the main gun basement is used for the alignment the vector of average levelling of each equipment is to be corrected taking into account the vector of average levelling of the main gun.

**Appendix 1 – REFERENCE GUIDELINES FOR BASEMENT LEVELLING AND ALIGNMENT**

**Table 3: Levelling and alignment procedure for basements prepared with epoxy resin**

Phase	Step	Activity	Additional information
EPOXY RESIN APPLICATION	3.1	<ul style="list-style-type: none"> <li>Positioning of the drilling mask</li> <li>Basement drilling</li> </ul>	The drilling mask (provided by the supplier of the equipment), is to be installed on the basement and duly aligned in order to locate the drilling point on the surface.
	3.2	<ul style="list-style-type: none"> <li>Counter plate physical installation</li> </ul>	The counter plate (provided by system supplier) is to be properly fixed to the basement by means of screws and bolts that allow fine tuning and levelling of the support. Temporary screws may be used for filling of holes during the chocking of the resin.
	3.3	<ul style="list-style-type: none"> <li>Counter plate final placement verification</li> </ul>	The planarity of the plate is verified in respect of limit values provided by the supplier of the equipment.
	3.4	<ul style="list-style-type: none"> <li>Epoxy resin leak</li> </ul>	Instructions provided by the producer of the resin are to be followed. Chocking resins are to be type approved.
LEVELLING AND ALIGNMENT	3.5	<ul style="list-style-type: none"> <li>Levelling compliance verification</li> <li>Calculation of the vector of average levelling</li> </ul>	See Table 2 – Steps 2.3 and 2.4

**Appendix 2 – GUIDANCE FOR THE MEASUREMENT OF ATTENUATION OF FIBRE OPTIC CABLES**

**APPENDIX 2 - GUIDANCE FOR THE MEASUREMENT OF ATTENUATION OF FIBRE OPTIC CABLES**

**1. TOOLS AND TEST EQUIPMENT**

The following items are to be used for the performance of the attenuation test of optical fibres:

- Steady light source (LED)
- Optical Power meter
- Bayonet ST connector adapter
- Microscope for optical fibres

**2. CALIBRATION**

Instruments used for testing are to be duly calibrated to a recognised national or international standard.

The arrangement of a typical test bed for calibration measurement is shown in Fig 1, where:

- TX is the steady light source (LED) with wavelength  $\lambda$  adequate to the signal to be transmitted (in general 850 nm or 1300 nm);
- RX is the Optical Power meter.

**Figure 1: Calibration test bed**



For the calibration test the following steps are to be followed:

- cleaning of ST terminals with isopropyl alcohol;
- direct connection of TX and RX with a reference cable;
- switch on TX and RX at least one minute before the calibration test in order to reach steady conditions;
- verification of the  $\lambda$  value in the RX display which is to correspond to the same transmitted by the TX.

The calibration test is positive if the power value on the RX results below 20dBm (optimal values between 14 and 20 dBm): in such a case, the measured value is to be assumed as the reference measure, the Optical Power Meter is to be set to zero and the attenuation measure unit is to be switched from dBm to dB.

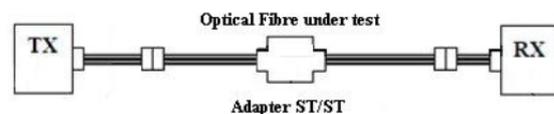
The calibration procedure is to be repeated at least every 10 measurements.

**3. ATTENUATION MEASUREMENT**

For the measurement of the attenuation value, the optical fibre under test is to be connected to the test bed, duly calibrated as described in [2], as shown in Fig 2.

Particular care is to be paid to avoid rotation of the optical contacts during the physical coupling due to the possibility of scratches with consequent increase of the attenuation level.

**Figure 2: Attenuation test bed**



The attenuation value on the RX power meter should not exceed the following values:

- 2,5 dB for fibre optics with 800 nm wavelength
- 4,5 dB for fibre optics with 1300 nm wavelength

If the measured value is outside the acceptable test range, the following steps are to be followed:

- cleaning of the ceramic ferrule of connectors with a paper serviette dipped in isopropyl alcohol; and, if necessary
- verify the status of the optical fibre connectors with the microscope for evaluation of wear/damage and possibility of repair.

If the measured value remains outside the acceptable values, the optical fibre could be damaged by a crack and requires replacement.