



**BUREAU
VERITAS**

Approval of the Manufacturing Process of Metallic Materials

January 2021

**Rule Note
NR480 DT R05 E**

**Marine & Offshore
8 Cours du Triangle - CS 50101
92937 Paris La Defense Cedex - France
Tel: + 33 (0)1 55 24 70 00
<https://marine-offshore.bureauveritas.com/bv-rules>
© 2021 Bureau Veritas – All rights reserved**

AVA **Documents**
Document Sharing Hub

GENERAL CONDITIONS

1. INDEPENDENCE OF THE SOCIETY AND APPLICABLE TERMS

- 1.1 The Society shall remain at all times an independent contractor and neither the Society nor any of its officers, employees, servants, agents or subcontractors shall be or act as an employee, servant or agent of any other party hereto in the performance of the Services.
- 1.2 The operations of the Society in providing its Services are exclusively conducted by way of random inspections and do not, in any circumstances, involve monitoring or exhaustive verification.
- 1.3 The Society acts as a services provider. This cannot be construed as an obligation bearing on the Society to obtain a result or as a warranty. The Society is not and may not be considered as an underwriter, broker in Unit's sale or chartering, expert in Unit's valuation, consulting engineer, controller, naval architect, designer, manufacturer, shipbuilder, repair or conversion yard, charterer or shipowner; none of them above listed being relieved of any of their expressed or implied obligations as a result of the interventions of the Society.
- 1.4 The Society only is qualified to apply and interpret its Rules.
- 1.5 The Client acknowledges the latest versions of the Conditions and of the applicable Rules applying to the Services' performance.
- 1.6 Unless an express written agreement is made between the Parties on the applicable Rules, the applicable Rules shall be the Rules applicable at the time of entering into the relevant contract for the performance of the Services.
- 1.7 The Services' performance is solely based on the Conditions. No other terms shall apply whether express or implied.

2. DEFINITIONS

- 2.1 "Certificate(s)" means classification or statutory certificates, attestations and reports following the Society's intervention.
- 2.2 "Certification" means the activity of certification in application of national and international regulations or standards, in particular by delegation from different governments that can result in the issuance of a Certificate.
- 2.3 "Classification" means the classification of a Unit that can result or not in the issuance of a classification Certificate with reference to the Rules. Classification is an appraisalment given by the Society to the Client, at a certain date, following surveys by its surveyors on the level of compliance of the Unit to the Society's Rules or to the documents of reference for the Services provided. They cannot be construed as an implied or express warranty of safety, fitness for the purpose, seaworthiness of the Unit or of its value for sale, insurance or chartering.
- 2.4 "Client" means the Party and/or its representative requesting the Services.
- 2.5 "Conditions" means the terms and conditions set out in the present document.
- 2.6 "Industry Practice" means international maritime and/or offshore industry practices.
- 2.7 "Intellectual Property" means all patents, rights to inventions, utility models, copyright and related rights, trade marks, logos, service marks, trade dress, business and domain names, rights in trade dress or get-up, rights in goodwill or to sue for passing off, unfair competition rights, rights in designs, rights in computer software, database rights, topography rights, moral rights, rights in confidential information (including know-how and trade secrets), methods and protocols for Services, and any other intellectual property rights, in each case whether capable of registration, registered or unregistered and including all applications for and renewals, reversions or extensions of such rights, and all similar or equivalent rights or forms of protection in any part of the world.
- 2.8 "Parties" means the Society and Client together.
- 2.9 "Party" means the Society or the Client.
- 2.10 "Register" means the public electronic register of ships updated regularly by the Society.
- 2.11 "Rules" means the Society's classification rules and other documents. The Society's Rules take into account at the date of their preparation the state of currently available and proven technical minimum requirements but are not a standard or a code of construction neither a guide for maintenance, a safety handbook or a guide of professional practices, all of which are assumed to be known in detail and carefully followed at all times by the Client.
- 2.12 "Services" means the services set out in clauses 2.2 and 2.3 but also other services related to Classification and Certification such as, but not limited to: ship and company safety management certification, ship and port security certification, maritime labour certification, training activities, all activities and duties incidental thereto such as documentation on any supporting means, software, instrumentation, measurements, tests and trials on board. The Services are carried out by the Society according to the applicable referential and to the Bureau Veritas' Code of Ethics. The Society shall perform the Services according to the applicable national and international standards and Industry Practice and always on the assumption that the Client is aware of such standards and Industry Practice.
- 2.13 "Society" means the classification society 'Bureau Veritas Marine & Offshore SAS', a company organized and existing under the laws of France, registered in Nanterre under number 821 131 844, or any other legal entity of Bureau Veritas Group as may be specified in the relevant contract, and whose main activities are Classification and Certification of ships or offshore units.
- 2.14 "Unit" means any ship or vessel or offshore unit or structure of any type or part of it or system whether linked to shore, river bed or sea bed or not, whether operated or located at sea or in inland waters or partly on land, including submarines, hovercrafts, drilling rigs, offshore installations of any type and of any purpose, their related and ancillary equipment, subsea or not, such as well head and pipelines, mooring legs and mooring points or otherwise as decided by the Society.

3. SCOPE AND PERFORMANCE

- 3.1 Subject to the Services requested and always by reference to the Rules, the Society shall:
- review the construction arrangements of the Unit as shown on the documents provided by the Client;
 - conduct the Unit surveys at the place of the Unit construction;
 - class the Unit and enter the Unit's class in the Society's Register;
 - survey the Unit periodically in service to note whether the requirements for the maintenance of class are met.
- The Client shall inform the Society without delay of any circumstances which may cause any changes on the conducted surveys or Services.
- 3.2 The Society will not:
- declare the acceptance or commissioning of a Unit, nor its construction in conformity with its design, such activities remaining under the exclusive responsibility of the Unit's owner or builder;
 - engage in any work relating to the design, construction, production or repair checks, neither in the operation of the Unit or the Unit's trade, neither in any advisory services, and cannot be held liable on those accounts.

4. RESERVATION CLAUSE

- 4.1 The Client shall always: (i) maintain the Unit in good condition after surveys; (ii) present the Unit for surveys; and (iii) inform the Society in due time of any circumstances that may affect the given appraisalment of the Unit or cause to modify the scope of the Services.
- 4.2 Certificates are only valid if issued by the Society.
- 4.3 The Society has entire control over the Certificates issued and may at any time withdraw a Certificate at its entire discretion including, but not limited to, in the following situations: where the Client fails to comply in due time with instructions of the Society or where the Client fails to pay in accordance with clause 6.2 hereunder.
- 4.4 The Society may at times and at its sole discretion give an opinion on a design or any technical element that would 'in principle' be acceptable to the Society. This opinion shall not presume on the final issuance of any Certificate or on its content in the event of the actual issuance of a Certificate. This opinion shall only be an appraisal made by the Society which shall not be held liable for it.

5. ACCESS AND SAFETY

- 5.1 The Client shall give to the Society all access and information necessary for the efficient performance of the requested Services. The Client shall be the sole responsible for the conditions of presentation of the Unit for tests, trials and surveys and the conditions under which tests and trials are carried out. Any information, drawing, etc. required for the performance of the Services must be made available in due time.
- 5.2 The Client shall notify the Society of any relevant safety issue and shall take all necessary safety-related measures to ensure a safe work environment for the Society or any of its officers, employees, servants, agents or subcontractors and shall comply with all applicable safety regulations.

6. PAYMENT OF INVOICES

- 6.1 The provision of the Services by the Society, whether complete or not, involve, for the part carried out, the payment of fees thirty (30) days upon issuance of the invoice.

6.2 Without prejudice to any other rights hereunder, in case of Client's payment default, the Society shall be entitled to charge, in addition to the amount not properly paid, interests equal to twelve (12) months LIBOR plus two (2) per cent as of due date calculated on the number of days such payment is delinquent. The Society shall also have the right to withhold Certificates and other documents and/or to suspend or revoke the validity of Certificates.

- 6.3 In case of dispute on the invoice amount, the undisputed portion of the invoice shall be paid and an explanation on the dispute shall accompany payment so that action can be taken to solve the dispute.

7. LIABILITY

- 7.1 The Society bears no liability for consequential loss. For the purpose of this clause consequential loss shall include, without limitation:
- Indirect or consequential loss;
 - Any loss and/or deferral of production, loss of product, loss of use, loss of bargain, loss of revenue, loss of profit or anticipated profit, loss of business and business interruption, in each case whether direct or indirect.
- The Client shall defend, release, save, indemnify, defend and hold harmless the Society from the Client's own consequential loss regardless of cause.
- 7.2 Except in case of wilful misconduct of the Society, death or bodily injury caused by the Society's negligence and any other liability that could not be, by law, limited, the Society's maximum liability towards the Client is limited to one hundred and fifty per-cents (150%) of the price paid by the Client to the Society for the Services having caused the damage. This limit applies to any liability of whatsoever nature and howsoever arising, including fault by the Society, breach of contract, breach of warranty, tort, strict liability, breach of statute.
- 7.3 All claims shall be presented to the Society in writing within three (3) months of the completion of Services' performance or (if later) the date when the events which are relied on were first discovered by the Client. Any claim not so presented as defined above shall be deemed waived and absolutely time barred.

8. INDEMNITY CLAUSE

- 8.1 The Client shall defend, release, save, indemnify and hold harmless the Society from and against any and all claims, demands, lawsuits or actions for damages, including legal fees, for harm or loss to persons and/or property tangible, intangible or otherwise which may be brought against the Society, incidental to, arising out of or in connection with the performance of the Services (including for damages arising out of or in connection with opinions delivered according to clause 4.4 above) except for those claims caused solely and completely by the gross negligence of the Society, its officers, employees, servants, agents or subcontractors.

9. TERMINATION

- 9.1 The Parties shall have the right to terminate the Services (and the relevant contract) for convenience after giving the other Party thirty (30) days' written notice, and without prejudice to clause 6 above.
- 9.2 In such a case, the Classification granted to the concerned Unit and the previously issued Certificates shall remain valid until the date of effect of the termination notice issued, subject to compliance with clause 4.1 and 6 above.
- 9.3 In the event where, in the reasonable opinion of the Society, the Client is in breach, or is suspected to be in breach of clause 16 of the Conditions, the Society shall have the right to terminate the Services (and the relevant contracts associated) with immediate effect.

10. FORCE MAJEURE

- 10.1 Neither Party shall be responsible or liable for any failure to fulfil any term or provision of the Conditions if and to the extent that fulfilment has been delayed or temporarily prevented by a force majeure occurrence without the fault or negligence of the Party affected and which, by the exercise of reasonable diligence, the said Party is unable to provide against.
- 10.2 For the purpose of this clause, force majeure shall mean any circumstance not being within a Party's reasonable control including, but not limited to: acts of God, natural disasters, epidemics or pandemics, wars, terrorist attacks, riots, sabotages, impositions of sanctions, embargoes, nuclear, chemical or biological contaminations, laws or action taken by a government or public authority, quotas or prohibition, expropriations, destructions of the worksite, explosions, fires, accidents, any labour or trade disputes, strikes or lockouts.

11. CONFIDENTIALITY

- 11.1 The documents and data provided to or prepared by the Society in performing the Services, and the information made available to the Society, are treated as confidential except where the information:
- is properly and lawfully in the possession of the Society;
 - is already in possession of the public or has entered the public domain, otherwise than through a breach of this obligation;
 - is acquired or received independently from a third party that has the right to disseminate such information;
 - is required to be disclosed under applicable law or by a governmental order, decree, regulation or rule or by a stock exchange authority (provided that the receiving Party shall make all reasonable efforts to give prompt written notice to the disclosing Party prior to such disclosure).
- 11.2 The Parties shall use the confidential information exclusively within the framework of their activity underlying these Conditions.
- 11.3 Confidential information shall only be provided to third parties with the prior written consent of the other Party. However, such prior consent shall not be required when the Society provides the confidential information to a subsidiary.
- 11.4 Without prejudice to sub-clause 11.1, the Society shall have the right to disclose the confidential information if required to do so under regulations of the International Association of Classifications Societies (IACS) or any statutory obligations.

12. INTELLECTUAL PROPERTY

- 12.1 Each Party exclusively owns all rights to its Intellectual Property created before or after the commencement date of the Conditions and whether or not associated with any contract between the Parties.
- 12.2 The Intellectual Property developed by the Society for the performance of the Services including, but not limited to drawings, calculations, and reports shall remain the exclusive property of the Society.

13. ASSIGNMENT

- 13.1 The contract resulting from to these Conditions cannot be assigned or transferred by any means by a Party to any third party without the prior written consent of the other Party.
- 13.2 The Society shall however have the right to assign or transfer by any means the said contract to a subsidiary of the Bureau Veritas Group.

14. SEVERABILITY

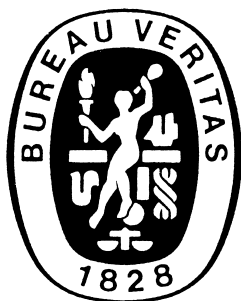
- 14.1 Invalidity of one or more provisions does not affect the remaining provisions.
- 14.2 Definitions herein take precedence over other definitions which may appear in other documents issued by the Society.
- 14.3 In case of doubt as to the interpretation of the Conditions, the English text shall prevail.

15. GOVERNING LAW AND DISPUTE RESOLUTION

- 15.1 These Conditions shall be construed and governed by the laws of England and Wales.
- 15.2 The Parties shall make every effort to settle any dispute amicably and in good faith by way of negotiation within thirty (30) days from the date of receipt by either one of the Parties of a written notice of such a dispute.
- 15.3 Failing that, the dispute shall finally be settled under the Rules of Arbitration of the Maritime Arbitration Chamber of Paris ("CAMP"), which rules are deemed to be incorporated by reference into this clause. The number of arbitrators shall be three (3). The place of arbitration shall be Paris (France). The Parties agree to keep the arbitration proceedings confidential.

16. PROFESSIONAL ETHICS

- 16.1 Each Party shall conduct all activities in compliance with all laws, statutes, rules, economic and trade sanctions (including but not limited to UN sanctions and EU sanctions) and regulations applicable to such Party including but not limited to: child labour, forced labour, collective bargaining, discrimination, abuse, working hours and minimum wages, anti-bribery, anti-corruption, copyright and trademark protection, personal data protection (<https://personal.dataprotection.bureauveritas.com/privacypolicy>).
- Each of the Parties warrants that neither it, nor its affiliates, has made or will make, with respect to the matters provided for hereunder, any offer, payment, gift or authorization of the payment of any money, directly or indirectly, to or for the use or benefit of any official or employee of the government, political party, official or candidate.
- 16.2 In addition, the Client shall act consistently with the Bureau Veritas' Code of Ethics. <https://group.bureauveritas.com/group/corporate-social-responsibility>



RULE NOTE NR 480

NR 480

Approval of the Manufacturing Process of Metallic Materials

Section 1 General

Section 2 Steelmaking and Rolled Steel Products

Section 3 Seamless Pipes and Fittings

Section 4 Welded Pipes and Fittings

Section 5 Steel Forgings

Section 6 Steel Castings

Section 7 Wrought Aluminium Alloy Products

Section 8 Explosion Bonded Aluminium/Steel Transition Joints

Section 9 Anchor Chain Cables and Accessories for Ships

Appendix 1 Evaluation of Kca

Appendix 2 Crack Arrest Temperature (CAT) Test

January 2021

Section 1 General

1	General	7
1.1	Scope	
1.2	Request for approval	
1.3	Preliminary information to be submitted	
1.4	Approval test program	
1.5	Certification	
1.6	Renewal of approval	
1.7	Reconsideration of the approval	
1.8	Responsibilities of the manufacturer	

Section 2 Steelmaking and Rolled Steel Products

1	General	9
1.1	Scope	
1.2	Manufacturing process specification	
1.3	Documents to be submitted for changing the approval conditions	
1.4	Approval survey	
1.5	Position of the test samples	
1.6	Test specimens and testing procedure	
1.7	Other tests	
1.8	Results	
2	Semi finished products for hull structural steel grades	11
2.1	Scope	
2.2	Selection of the test product	
2.3	Extent of the approval tests	
2.4	Tests on semi finished products	
3	Rolled products made in normal and higher strength steel for hull and other structural applications	11
3.1	Scope	
3.2	Selection of the test product	
3.3	Extent of the approval tests	
3.4	Tests on rolled products	
3.5	Weldability tests	
4	Rolled products made in hull structural steel for high heat input welding	13
4.1	Scope	
4.2	Application of certification	
4.3	Confirmation tests	
4.4	Grade designation	
5	Rolled products made in normal and higher strength corrosion resistant steel for cargo oil tanks	15
5.1	Scope	
5.2	Manufacturing process specification	
5.3	Test program	
5.4	Corrosion tests	

6	Rolled products made in EH47 and crack arrest steels for container carriers	15
6.1	Scope	
6.2	Manufacturing process specification	
6.3	Selection of the test product	
6.4	Extent of the approval tests	
6.5	Tests on rolled products	
6.6	Crack arrest properties	
6.7	Weldability tests	
7	Rolled products made of extra high strength steels for welded structure	18
7.1	Scope	
7.2	Manufacturing process specification	
7.3	Selection of the test product	
7.4	Extent of the approval tests	
7.5	Tests on rolled products	
7.6	Weldability tests	
8	Rolled products for boilers and pressure vessels	21
8.1	Scope	
8.2	Selection of the test product	
8.3	Extent of the approval tests	
8.4	Tests on rolled products	
8.5	Weldability tests	
9	Rolled products made in ferritic steels for low temperature applications	23
9.1	Scope	
9.2	Selection of the test product	
9.3	Extent of the approval tests	
9.4	Tests on rolled products	
9.5	Weldability tests	
10	Rolled products made in stainless steel	25
10.1	Scope	
10.2	Manufacturing process specification	
10.3	Selection of the test product	
10.4	Extent of the approval tests	
10.5	Tests on rolled products for austenitic grades (304L, 316L, 316LN, 317L, 317LN)	
10.6	Tests for austenitic-ferritic grades	
11	Round bars for anchor chain cables	27
11.1	Scope	
11.2	Selection of the test product	
11.3	Extent of the approval tests	
11.4	Tests on round bars	
12	Clad steel plates	28
12.1	Scope	
12.2	Manufacturing process specification	
12.3	Selection of the test product	
12.4	Extent of the approval tests	
12.5	Tests on clad plate	

13	Plates with specified through thickness properties	29
13.1	Scope	
13.2	Manufacturing process specification	
13.3	Selection of the test product	
13.4	Extent of the approval tests	
13.5	Tests on plates	

Section 3 Seamless Pipes and Fittings

1	Seamless pipes and fittings	30
1.1	Scope	
1.2	Approval Range	
1.3	Manufacturing process specification	
1.4	Documents to be submitted for changing the approval conditions	
1.5	Approval survey	
1.6	Approval test program	
1.7	Approval tests	

Section 4 Welded Pipes and Fittings

1	Welded pipes and fittings	32
1.1	Scope	
1.2	Approval range	
1.3	Manufacturing process specification	
1.4	Documents to be submitted for changing the approval conditions	
1.5	Approval survey	
1.6	Approval test program	
1.7	Approval tests	

Section 5 Steel Forgings

1	Steel forgings	34
1.1	Scope	
1.2	Approval range	
1.3	Manufacturing process specification	
1.4	Documents to be submitted for changing the approval conditions	
1.5	Approval survey	
1.6	Approval test program	
1.7	Approval tests	

Section 6 Steel Castings

1	Steel castings	36
1.1	Scope	
1.2	Approval range	
1.3	Manufacturing process specification	
1.4	Documents to be submitted for changing the approval conditions	
1.5	Approval survey	
1.6	Approval test program	
1.7	Approval tests	

Section 7 Wrought Aluminium Alloy Products

1	Wrought aluminium alloy products	38
1.1	Scope	
1.2	Manufacturing process specification	
1.3	Documents to be submitted for changing the approval conditions	
1.4	Approval survey	
1.5	Position of the test samples	
1.6	Test specimens and testing procedure	
1.7	Selection of the test product	
1.8	Extent of the approval tests	
1.9	Tests on base material	
1.10	Weldability tests	

Section 8 Explosion Bonded Aluminium/Steel Transition Joints

1	Explosion bonded aluminium/steel transition joints	41
1.1	Scope	
1.2	Manufacturing process specification	
1.3	Documents to be submitted for changing the approval conditions	
1.4	Approval survey	
1.5	Selection of the test product	
1.6	Extent of the approval tests	
1.7	Approval tests	
1.8	Other tests	

Section 9 Anchor Chain Cables and Accessories for Ships

1	Anchor chain cables and accessories for ships	43
1.1	Scope	
1.2	Manufacturing process specification	
1.3	Documents to be submitted for changing the approval conditions	
1.4	Approval survey	
1.5	Selection of the test product	
1.6	Extent of the approval tests	
1.7	Approval tests and documentation	

Appendix 1 Evaluation of Kca

1	Evaluation	47
1.1		

Appendix 2 Crack Arrest Temperature (CAT) Test

1	Scope of application	48
1.1		

2	Testing equipment	48
	2.1	
3	Test specimens	48
	3.1 Impact type crack initiation	
	3.2 Double tension type crack initiation	
	3.3 Embrittled zone setting	
	3.4 Side grooves	
	3.5 Nominal length of embrittled zone	
	3.6 Tab plate/pin chuck details and welding of test specimen to tab plates	
4	Test method	50
	4.1 Preloading	
	4.2 Temperature measurement and control	
	4.3 Loading and brittle crack initiation	
5	Measurements after test and test validation judgement	52
	5.1 Brittle crack initiation and validation	
	5.2 Crack path examination and validation	
	5.3 Fracture surface examination, crack length measurement and their validation	
6	Judgement of “arrest” or “propagate”	53
	6.1	
7	Ttest, Tarrest and CAT determination	53
	7.1 Ttest determination	
	7.2 Tarrest determination	
	7.3 CAT determination	
8	Reporting	54
	8.1	
9	Use of test for material qualification testing	54
	9.1	

SECTION 1

GENERAL

Symbols

A5%	: Elongation
AISI	: American Iron and Steel Institute
Ar3	: Temperature at which ferrite phase starts during cooling
ASSET test:	Visual Assessment of Exfoliation Corrosion Susceptibility of 5xxx Series Aluminium Alloys
ASTM	: American Society for Testing and Materials
CET	: Carbon equivalent
C _{EQ}	: Carbon equivalent
CR	: Controlled Rolling
CTOD	: Crack Tip Opening Displacement
CTS	: Controlled Thermal Severity
GB/T	: Chinese national standard
GCHAZ	: Grain Coarsened Heat Affected Zone
HAZ	: Heat Affected Zone
HV	: Hardness Vickers
IIW	: International Institute of Welding
ISO	: International Standard Organisation
JIS	: Japan Industrial Standard
Kca	: Brittle crack arrest toughness value
KS	: Korean Standard
KV	: Charpy V energy
N	: Normalised
NAMLT	: Nitric Acid Mass Loss Test
NDT	: Nil Ductility Temperature
NR	: Normalised Rolling
Pcm	: Parameter of crack measurement
PWHT	: Post Weld Heat Treatment
QT	: Quenched and Tempered
RA%	: Reduction of area
R _{eH}	: Yield stress
R _m	: Tensile strength
TM	: Thermo-mechanical Rolling
TM+AcC:	Thermo-mechanical Rolling follow by Accelerated Cooling
TM+DQ:	Thermo-mechanical Rolling with Direct Quenching follow by tempering
UNS	: Unified Numbering System.

1 General

1.1 Scope

1.1.1 This document gives the procedure to be followed to obtain the Society's approval certificate of material for manufacturing process of metallic products in accordance with NR216 Rules on Materials and Welding for the Classification of Marine Units.

Procedures for products and/or grades not explicitly included are subject to special examination by the Society.

1.2 Request for approval

1.2.1 The request for approval is to be submitted to the Society using the form obtained from BV office. In addition to the preliminary information mentioned in [1.3] as applicable, manufacturing process specification related to the products is to be submitted together with the request for approval.

1.3 Preliminary information to be submitted

1.3.1 Preliminary information to be submitted is to include:

- a) Name and site address of the manufacturer, location of the workshops, general indications relevant to the background, dimensions of the works, total annual production of finished products for marine applications and others as deemed useful
- b) Organization and quality
 - Organizational chart
 - Total number of staff
 - Organization of the quality control department and qualification of personnel involved
 - Certification of compliance of the quality system with ISO 9001, ISO 9002 or equivalent, if any.
- c) Manufacturing facilities
 - Flow chart of manufacturing process
 - Manufacturing equipments and capacities
 - Origin of raw materials
 - Storage of raw materials and finished products
 - Equipment for systematic control during manufacturing.

- d) Details of inspections and quality control facilities
 - How are materials and components identified at the various manufacturing stages
 - Equipment for chemical analysis, metallography, mechanical tests and relevant calibration procedures
 - Equipment for non-destructive examinations
 - List of quality control procedures.
- e) Approval(s) already granted by other Classification Societies and relevant approval test reports as deemed useful.

1.4 Approval test program

1.4.1 Unless otherwise agreed, the manufacturer shall submit for review an approval test program.

Typical approval programs for the various products are given in the relevant articles.

The approval tests are in general to be witnessed by the Society’s surveyor at the manufacturer’s works. If the testing facilities are not available at the manufacturer’s works, the tests are to be carried out at recognised laboratories accepted by the Society, and, witnessed by the Society’s surveyor.

1.5 Certification

1.5.1 Approval certificate

Upon satisfactory completion of the procedure, an approval certificate will be issued by the Society.

The validity of the approval is to be a maximum of five years.

1.5.2 List of approval certificates

The approval certificates issued to manufacturers are entered in a list containing the scope and the main conditions of approval available for consultation on the internet site “www.veristar.com”.

1.6 Renewal of approval

1.6.1 The manufacturer shall apply for renewal of the approval certificate before the date of expiry. Renewal can be carried out by an audit and assessment of survey results, if satisfactory, during the period.

Manufacturers who have not produced the approved products during the period between renewals will be required to carry out approval tests or at the discretion of the Society, submit the results of production of similar products.

1.7 Reconsideration of the approval

1.7.1 During the period of validity, the approval may be reconsidered in the following cases:

- a) In service failures, traceable to product quality
- b) Major non conformity during testing of the product or non conformity revealed during fabrication and construction
- c) Breakdown of the Manufacturer’s Quality System
- d) Changes brought by the Manufacturer, without preliminary agreement of the Society, to the extent of the approval defined at the time of the approval.

1.8 Responsibilities of the manufacturer

1.8.1 The Manufacturer is fully responsible for the quality of the finished product and ensuring compliance with the specified requirements, as checked on the specimens subjected to the approval tests.

The routine production of approved products shall be carried out according to the same procedures followed for the manufacture of specimens submitted to approval tests.

The manufacturer shall give prior warning to the Society of any significant modifications to the manufacturing and control procedures. The Society may at its discretion, require further tests and surveys deemed necessary to extend the approval to the new manufacturing conditions.

The manufacturer shall keep up-to-date records covering the manufacture and quality control of the products; the records shall contain details allowing the identification of the various productions, original materials, heat treatment and results of tests and examinations carried out. The Society’s surveyor is to have easy access to these records as deemed necessary.

SECTION 2

STEELMAKING AND ROLLED STEEL PRODUCTS

1 General

1.1 Scope

1.1.1 This Section gives the approval scheme for steelmaking and rolling products made in hull structural steel grades, extra high strength steel grades, steel grades for boilers and pressure vessels, steel grades for low temperature applications, stainless steel grades and chain cable steel grades.

1.2 Manufacturing process specification

1.2.1 The following information is to be supplied by the manufacturer for all steel grades except for stainless steel grades (refer to [10]):

- a) Type of products (plates, sections, coils), grades of steel, range of thickness and aim material properties, as follows:
 - Range of chemical composition and aim analyses, including grain refining, micro alloying and residual elements, for the various grades of steel; if the range of chemical composition depends on thickness and supply condition, the different ranges are to be specified, as appropriate
 - Aim maximum carbon equivalent according to IIW formula
 - Aim maximum P_{cm} content for higher strength grades with low carbon content $C < 0,13\%$
 - Production statistics of the chemical composition and mechanical properties (R_{eH} , R_m , A% and KV). The statistics are intended to demonstrate the capability to manufacture the steel products in accordance with the requirements.
- b) Steelmaking
 - Steelmaking process and capacity of furnace(s) or converter(s)
 - Raw material used
 - Deoxidation and alloying practice
 - Desulphurisation and vacuum degassing installations, if any.
- c) Casting methods: ingot or continuous casting

In the case of continuous casting, information relevant to type of casting machine, teeming practice, methods to prevent re-oxidation, inclusions and segregation control, presence of electromagnetic stirring, soft reduction, etc., is to be provided as appropriate

 - Ingot or slab size and weight
 - Ingot or slab treatment: scarfing and discarding procedures.
- d) Reheating and rolling
 - Type of furnace and treatment parameters
 - Rolling: reduction ratio of slab/bloom/billet to finished product thickness, rolling and finishing temperatures
 - Descaling treatment during rolling
 - Capacity of the rolling stands.
- e) Heat treatment
 - Type of furnaces, heat treatment parameters and their relevant records
 - Accuracy and calibration of temperature control devices.
- f) Programmed rolling

For products delivered in the controlled rolling (CR) or thermo-mechanical rolling (TM) condition, the following additional information on the programmed rolling schedules is to be given:

 - Description of the rolling process
 - Normalizing temperature, re-crystallization temperature and Ar₃ temperature and the methods used to determine them
 - Control standards for typical rolling parameters used for the different thickness and grades of steel (temperature and thickness at the beginning and at the end of the passes, interval between passes, reduction ratio, temperature range and cooling speed of accelerated cooling, if any) and relevant method of control
 - Calibration of the control equipment.
- g) Recommendations for working and welding in particular for products delivered in the CR or TM condition
 - Cold and hot working recommendations if needed in addition to the normal practice used in the shipyards and workshops
 - Minimum and maximum heat input if different from the ones usually used in the shipyards and workshops (15 - 50 kJ/cm).
- h) Where any part of the manufacturing process is assigned to other companies or other manufacturing plants, additional information required by the Society is to be included.
- i) For the approval of the semi-finished products such as slabs, blooms and billets, the above information a), b) and c) is to be given.

1.3 Documents to be submitted for changing the approval conditions

1.3.1 The manufacturer has to submit to the Society the documents required in [1.2] together with the request of changing the approval conditions, in the case of the following a) through e):

- a) Change of the manufacturing process (steel making, casting, rolling and heat treatment)
- b) Change of the maximum thickness (dimension)
- c) Change of the chemical composition, added element, etc.
- d) Subcontracting the rolling, heat treatment, etc.
- e) Use of the slabs, blooms and billets manufactured by other companies which are not approved.

However, where the documents are duplicated by the ones at the previous approval for the same type of product, part or all of the documents may be omitted except the approval test program.

1.4 Approval survey

1.4.1 The approval tests are to be witnessed by the Surveyor at the manufacturer's plant and the execution of the plant inspection in operation may be required by the Surveyor during the visit for the approval.

If the testing facilities are not available at the works, the tests are to be carried out at laboratories accepted by the Society.

1.5 Position of the test samples

1.5.1 The test samples are to be taken, unless otherwise agreed, from the product (plate, flat, section, bar) corresponding to the top of the ingot, or, in the case of continuous casting, a random sample.

The position of the samples to be taken in the length of the rolled product, and the direction of the test specimens with respect to the final direction of rolling of the material are indicated in the relevant table for the material.

The position of the samples in the width of the product is to be in compliance with NR216 Materials and Welding, Ch 2, Sec 1, [1.8].

1.6 Test specimens and testing procedure

1.6.1 The test specimens and testing procedures are to be in accordance with NR216 Materials and Welding, Ch 1, Sec 2, unless agreed otherwise.

In particular the following applies:

- a) Tensile test
 - For plates made from hot rolled strip one additional tensile specimen is to be taken from the middle of the strip constituting the coil

- For plates having thickness greater than 40 mm, when the capacity of the available testing machine is insufficient to allow the use of test specimens of full thickness, multiple flat specimens, representing collectively the full thickness, can be used. Alternatively two round specimens with the axis located at one quarter and at mid-thickness can be taken.

b) Impact test

- For plates made from hot rolled strip one additional set of impact specimens is to be taken from the middle of the strip constituting the coil
- For plates having thickness greater than 40 mm one additional set of impact specimens is to be taken with the axis located at mid-thickness
- In addition to the determination of the energy value (Joule), the lateral expansion and the percentage crystallinity are to be reported for each specimen.

c) Chemical composition

In general the content of the following elements is to be checked: C, Mn, Si, P, S, Ni, Cr, Mo, Al, N, Nb, V, Cu, As, Sn, Ti and, for steel manufactured from electric or open-hearth furnace, Sb and B. The material for the check analysis should be taken from the tensile test specimen. Both the ladle and product analysis are to be reported.

d) Sulphur prints

Sulphur prints are to be taken from plate edges which are perpendicular to the axis of the ingot or slab.

They are to be approximately 600 mm long taken from the centre of the edge selected, i.e. on the ingot centre-line, and are to include the full plate thickness.

e) Micrographic examination

The micrographs are to be representative of the full thickness. For thick products in general at least three examinations are to be made at surface, one quarter and mid-thickness of the product.

All photomicrographs are to be taken at x100 magnification and where ferrite grain size exceeds ASTM 10, additionally at x500 magnification. Where applicable, ferrite grain size should be determined for each photomicrograph.

f) Drop weight test

When required the test is to be performed in accordance with ASTM E208. The Nil Ductility Transition temperature (NDT) is to be determined and photographs of the tested specimens are to be taken and enclosed with the test report.

The test results are to be in accordance, where applicable, with the requirements specified for the different steel grades in NR216 Materials and Welding, Ch 2, Sec 1.

1.7 Other tests

1.7.1 Additional tests such as CTOD test, large scale brittle fracture tests (Double Tension test, ESSO test, Deep Notch test, etc) or other tests may be required in the case of newly developed type of steel, outside the scope of NR216 Materials and Welding, Ch 2, Sec 1, [2], or when deemed necessary by the Society.

1.8 Results

1.8.1 All the results, which are to comply with the requirements of NR216 Materials and Welding, are evaluated for the approval; depending on the results, particular limitations or testing conditions, as deemed appropriate, may be specified in the approval document.

All the information required under [1.2], applicable to the products submitted to the tests, is to be collected by the manufacturer and put in the technical documentation which will include all the results of the tests and operation records relevant to steel making, casting, rolling and heat treatment of the test products.

2 Semi finished products for hull structural steel grades

2.1 Scope

2.1.1 This Article specifies the scheme for the approval of the manufacturing process of semi finished products such as ingots, slabs, blooms and billets for the hull structural steels.

2.2 Selection of the test product

2.2.1 For each grade of steel and for each manufacturing process (e.g. steel making, casting, rolling and condition of supply), one test product with the maximum thickness and one test product with the minimum thickness to be approved are in general to be selected for each kind of product (ingots, slabs, blooms/billets).

The selection of the casts for the test product is to be based on the typical chemical composition, with particular regard to the specified C_{EQ} or Pcm values and grain refining micro-alloying additions.

2.3 Extent of the approval tests

2.3.1 The extent of the test program is specified in [2.4]; it may be modified on the basis of the preliminary information submitted by the manufacturer.

In particular a reduction of the indicated number of casts, product thicknesses and grades to be tested or complete suppression of the approval tests may be accepted by the Society taking into account:

- Approval already granted by other Classification Societies and documentation of approval tests performed.
- Grades of steel to be approved and availability of long term statistic results of chemical properties and of mechanical tests performed on rolled products.
- Change of the approval conditions.

On the other hand, an increase of the number of casts and thicknesses to be tested may be required in the case of newly developed types of steel or manufacturing processes.

Where the number of tests differs from those shown in [2.4], the program is to be confirmed by the Society before the tests are carried out.

2.4 Tests on semi finished products

2.4.1 Type of tests

The tests to be carried out for the approval of the manufacturing process of semi finished products are:

- Chemical analysis. The analysis is to be complete and is to include micro-alloying elements
- Sulphur prints.

In addition, for initial approval and for any upgrade of the approval, the Society will require full tests indicated in this section to be performed at rolling mill on the minimum thickness semi finished product.

In case of multi-caster work, full tests on finished products shall be carried out for one caster and reduced tests (chemical analysis and sulphur print) for the others. The selection of the caster shall be based on the technical characteristics of the casters to be evaluated on case by case basis. Tests are to be performed at rolling mill on products manufactured from the minimum thickness semi finished product.

3 Rolled products made in normal and higher strength steel for hull and other structural applications

3.1 Scope

3.1.1 This Article gives the approval test program for the manufacture of normal and higher strength hull and structural steel products in groups A, B, D, E and AH32, DH32, EH32, FH32, AH36, DH36, EH36, FH36, AH40, DH40, EH40 and FH40.

3.2 Selection of the test product

3.2.1 For each grade of steel and for each manufacturing process (e.g. steel making, casting, rolling and condition of supply), one test product with the maximum thickness (dimension) to be approved is in general to be selected for each kind of product.

In addition, for initial approval, the Society will require selection of one test product of average thickness.

The selection of the casts for the test product is to be based on the typical chemical composition, with particular regard to the specified C_{EQ} or Pcm values and grain refining micro-alloying additions.

3.3 Extent of the approval tests

3.3.1 The extent of the test program is specified in [3.4] and [3.5]; it may be modified on the basis of the preliminary information submitted by the manufacturer.

In particular a reduction of the indicated number of casts, steel plate thicknesses and grades to be tested or complete suppression of the approval tests may be accepted by the Society taking into account:

- Approval already granted by other Classification Societies and documentation of approval tests performed.

- b) Grades of steel to be approved and availability of long term statistic results of chemical and mechanical properties.
- c) Approval for any grade of steel also covers approval for any lower grade in the same strength level, provided that the aim analysis, method of manufacture and condition of supply are similar.
- d) For higher tensile steels, approval of one strength level covers the approval of the strength level immediately below, provided the steelmaking process, deoxidation and fine grain practice, casting method and condition of supply are the same.
- e) Change of the approval conditions.
- f) Approval of the semi-finished products such as slabs, blooms and billets.

On the other hand, an increase of the number of casts and thicknesses to be tested may be required in the case of newly developed types of steel or manufacturing processes.

In case of multi-source slabs or changing of slab manufacturer, the rolled steel manufacturer is required to obtain the approval of the manufacturing process of rolled steels using the slabs from each slab manufacturer and to conduct approval tests in accordance with [3.4].

- The rolled steel manufacturer has already been approved for the manufacturing process using other semi finished products characterized by the same thickness, steel grade, grain refining and micro-alloying elements, steel-making and casting process
- The semi finished products manufacturer has been approved for the complete manufacturing process with the same conditions (steelmaking, casting, rolling and heat treatment) for the same steel types.

Where the number of tests differs from those shown in [3.4] and [3.5], the program is to be confirmed by the Society before the tests are carried out.

Table 1 : Tests on rolled products

Type of test		Position of the samples and direction of the test specimens (1)	Remarks				
Tensile test		Top and bottom - transverse (2)	R _{eH} , R _m , A5(%), RA(%) are to be reported				
Tensile test (stress relieved) only for TM steels		Top and bottom - transverse (2)	Stress relieving at 600°C (2 min/mm with minimum 1 hour)				
Impact test (3) on non aged specimens for grades:	A, B, AH32, AH36, AH40	Top and bottom - longitudinal	Testing temperature (°C):	+20	0	-20	
	D, DH32, DH36, DH40			0	-20	-40	
	E, EH32, EH36, EH40			0	-20	-40	-60
	FH32, FH36, FH40			-20	-40	-60	-80
	A, B, AH32, AH36, AH40	Top - transverse (4)	Testing temperature (°C):	+20	0	-20	
	D, DH32, DH36, DH40			0	-20	-40	
	E, EH32, EH36, EH40			-20	-40	-60	
	FH32, FH36, FH40			-40	-60	-80	
Impact test (3) on strain aged specimens (5) for grades:	AH32, AH36, AH40	Top - longitudinal	Testing temperature (°C):	+20	0	-20	
	D, DH32, DH36, DH40			0	-20	-40	
	E, EH32, EH36, EH40			-20	-40	-60	
	FH32, FH36, FH40			-40	-60	-80	
Chemical composition (6)		Top	Complete analysis including micro alloying elements				
Sulphur prints		Top					
Micro examination		Top					
Grain size determination		Top	Only for fine grain steels				
Drop weight test (4)		Top	Only for grades E, EH32, EH36, EH40, FH32, FH36, FH40 - Determination of NDT				
Through thickness tensile tests		Top and bottom	Only for grades with improved through thickness properties				
(1) For hot rolled strips, see [1.6].							
(2) Longitudinal direction for sections and plates having width less than 600 mm.							
(3) One set of 3 Charpy V-notch impact specimens is required for each impact test.							
(4) Not required for sections and plates having width less than 600 mm.							
(5) Deformation 5% + 1 hour at 250°C.							
(6) Besides product analyses, ladle analyses are required.							

3.4 Tests on rolled products

3.4.1 The tests to be carried out are indicated in Tab 1.

3.5 Weldability tests

3.5.1 General

Weldability tests are required for plates and are to be carried out on samples of the thickest plate.

Tests are required for normal strength grade E and for higher strength steels.

3.5.2 Preparation and welding of the test assemblies

The following tests are in general required:

- a) 1 butt weld test assembly welded with a heat input approximately 15 kJ/cm
- b) 1 butt weld test assembly welded with a heat input approximately 50 kJ/cm.

The butt weld test assemblies are to be prepared with the weld seam transverse to the plate rolling direction, so that impact specimens will result in the longitudinal direction.

The bevel preparation should be preferably 1/2V or K.

The welding procedure should be as far as possible in accordance with the normal welding practice used at the yards for the type of steel in question.

The welding parameters including consumables designation and diameter, pre-heating temperatures, interpass temperatures, heat input, number of passes, etc. are to be reported.

3.5.3 Type of tests

From the test assemblies the following test specimens are to be taken:

- a) One cross weld tensile test
- b) A set of 3 Charpy V-notch impact specimens transverse to the weld with the notch located at the fusion line and at a distance 2, 5 and minimum 20 mm from the fusion line. The fusion boundary is to be identified by etching the specimens with a suitable reagent. The test temperature is to be the one prescribed for the testing of the steel grade in question
- c) Hardness tests HV 5 across the weldment. The indentations are to be made along a 1 mm transverse line beneath the plate surface on both the face side and the root side of the weld as follows:
 - Fusion line
 - HAZ: at each 0,7 mm from fusion line into unaffected base material (6 to 7 minimum measurements for each HAZ)
 - The maximum hardness value should not be higher than 350 HV.

A sketch of the weld joint depicting groove dimensions, number of passes, hardness indentations should be attached to the test report together with photomicrographs of the weld cross section.

3.5.4 Other tests

Additional tests such as cold cracking tests (CTS, cruciform, implant, Tekken, bead on plate), CTOD, or other tests may be required in the case of newly developed type of steel, outside the scope of NR216 Materials and Welding, Ch 2, Sec 1, [2], or when deemed necessary by the Society.

4 Rolled products made in hull structural steel for high heat input welding

4.1 Scope

4.1.1 The application for weldability confirmation scheme is optional for manufacturers. The weldability confirmation scheme is intended to assess the weldability for high heat input welding under testing conditions.

This Article specifies the weldability confirmation scheme of normal and higher strength hull structural steel stipulated in [3] intended for welding with high heat input over 50kJ/cm.

Demonstration of conformance to the requirements of this document approves a particular steel mill to manufacture grade of steel to the specific chemical composition range, melting practice, and processing practice for which conformance was established. The approval scheme does not apply to qualification of welding procedures to be undertaken by the shipyards.

4.2 Application of certification

4.2.1 The manufacturer is to submit to the Society, request of certification, proposed weldability test program (see [4.3.2]) and technical documents relevant to:

- a) Outline of steel plate to be certified
 - Grade
 - Thickness range
 - Deoxydation practice
 - Fine grain practice
 - Aim range of chemical composition
 - Aim maximum C_{EQ} and P_{cm}
 - Production statistics of mechanical properties tensile and Charpy V-notch impact test, if any.
- b) Manufacturing control points to prevent toughness deterioration in heat affected zone when welded with high heat input, relevant to chemical elements, steelmaking, casting, rolling, heat treatment, etc.
- c) Welding control points to improve joint properties on strength and toughness, if any.

4.3 Confirmation tests

4.3.1 Range of certification

Range of certification for steel grades is to be the following a) through e) unless otherwise agreed by the Society:

- a) Approval tests on the lowest and highest toughness levels cover the intermediate toughness level
- b) Approval tests on normal strength cover that strength level only
- c) For high tensile steels, approval tests on one strength level cover strength level immediately below
- d) Tests may be carried out separately subject to the same manufacturing process
- e) Certification and documentation of confirmation tests performed by other Classification Societies may be accepted at the discretion of the Society.

4.3.2 Weldability test program

Extent of the test program is specified in [4.3.5] but it may be modified according to the content of certification. In particular, additional test assemblies and/or test items may be required in the case of newly developed type of steel, welding consumable and welding method, or when deemed necessary by the Society.

Where the content of tests differs from those specified in [4.3.5], the program is to be confirmed by the Society before the tests are carried out.

4.3.3 Test plate

Test plate is to be manufactured by a process approved by the Society in accordance with the requirements of [3].

For each manufacturing process route, two test plates with different thickness are to be selected. The thicker plate (t) and the thinner plate (less than or equal to $t/2$) are to be proposed by the manufacturer.

Small changes in manufacturing processing (e.g. within the TMCP process) may be considered for acceptance without testing, at the discretion of the Society.

4.3.4 Test assembly

One butt weld assembly welded with heat input over 50kJ/cm is to be generally prepared with the weld axis transverse to the plate rolling direction.

Dimensions of the test assembly are to be amply sufficient to take all the required test specimens specified in [4.3.5].

The welding procedures should be as far as possible in accordance with the normal practices applied at shipyards for the test plate concerned.

Welding process, welding position, welding consumable (manufacturer, brand, grade, diameter and shield gas) and welding parameters including bevel preparation, heat input, preheating temperatures, interpass temperatures, number of passes, etc. are to be reported.

4.3.5 Examinations and tests for the test assembly

The test assembly is to be examined and tested in accordance with the following a) through h) unless otherwise agreed by the Society:

- a) Visual examination: Overall welded surface is to be uniform and free from injurious defects such as cracks, undercuts, overlaps, etc.
- b) Macroscopic test: One macroscopic photograph is to be representative of transverse section of the welded joint and is to show absence of cracks, lack of penetration, lack of fusion and other injurious defects.
- c) Microscopic test: Along mid-thickness line across transverse section of the weld, one micrograph with x100 magnification is to be taken at each position of the weld metal centreline, fusion line and at a distance 2, 5, 10 and minimum 20 mm from the fusion line. The test result is provided for information purpose only.

- d) Hardness test: Along two line across transverse weld section 1 mm beneath plate surface on both face and root side of the weld, indentations by HV5 are to be made at weld metal centreline, fusion line and each 0,7 mm from fusion line to unaffected base metal (minimum 6 to 7 measurements for each heat affected zone).

The maximum hardness value should not be higher than 350 HV.

- e) Transverse tensile test: Two transverse (cross weld) tensile specimens are to be taken from the test assembly. Test specimens and testing procedures are to comply with the requirements of NR216 Materials and Welding, Ch 1, Sec 2.

The tensile strength is to be not less than the minimum required value for the grade of base metal.

- f) Bend test: Two transverse (cross weld) test specimens are to be taken from the test assembly and bent on a mandrel with diameter of quadruple specimen thickness. Bending angle is to be at least 120°. Test specimens are to comply with the requirements of NR216 Materials and Welding, Ch 1, Sec 2.

For plate thickness up to 20 mm, one face-bend and one root-bend specimens or two side-bend specimens are to be taken.

After testing, the test specimens shall not reveal any crack nor other open defect in any direction greater than 3 mm.

- g) Impact test: Charpy V-notch impact specimens (three specimens for one set) are to be taken within 2 mm below plate surface on face side of the weld with the notch perpendicular to the plate surface.

One set of the specimens transverse to the weld is to be taken with the notch located at the fusion line and at distance 2, 5 and minimum 20 mm from the fusion line. The fusion boundary is to be identified by etching the specimens with a suitable reagent. The test temperature is to be the one prescribed for the testing of the steel grade in question.

For steel plate with thickness greater than 50 mm or one side welding for plate thickness greater than 20 mm, one additional set of the specimens is to be taken from the root side of the weld with the notch located at each the same position as for the face side.

The average impact energy at the specified test temperature is to comply with NR216 Materials and Welding, Ch 2, Sec 1, Tab 4 and Ch 2, Sec 1, Tab 7 depending on the steel grade and thickness.

- h) Other test: Additional tests such as wide-width tensile test, HAZ tensile test, cold cracking tests (CTS, Cruciform, Implant, Tekken and Bead-on plate), CTOD or other tests should be required at the discretion of the Society (see [4.3.2]).

4.4 Grade designation

4.4.1 Upon issuance of the certificate, the notation indicating the value of heat input applied in the confirmation test may be added to the grade designation on the test plate, e.g. "EH36-W300" (in the case of heat input 300kJ/cm applied). The value of this notation is not to be less than 50 and every 10 added.

5 Rolled products made in normal and higher strength corrosion resistant steel for cargo oil tanks

5.1 Scope

5.1.1 This Article gives the scheme for the approval of the manufacturing process of normal and higher strength corrosion resistant steel products for cargo oil tanks.

The requirements of this Article are intended as a supplement to the requirements of Article [3], which specifies the test program for the manufacture of normal and higher strength hull and structural steel products.

5.2 Manufacturing process specification

5.2.1 In addition to the information mentioned in [1.2], the following information is to be submitted:

- Corrosion test plan and details of equipment and test environments
- Technical data related to the product assessment criteria for confirming corrosion resistance
- The technical background explaining how the variation in added and controlled elements improves corrosion resistance. The manufacturer will establish a relationship of all the chemical elements which affect the corrosion resistance, the chemical elements added or controlled to achieve this are to be specifically verified for acceptance. Verification is to be based on the ladle analysis of the steel
- The grades, the corrosion designation and maximum thickness of corrosion resistant steel to be approved
- The welding processes and the brand name of the welding consumables to be used for approval.

5.3 Test program

5.3.1 General

The extent of approval is to be as per [3.3] with the addition of corrosion test plan.

5.3.2 Corrosion test plan

The corrosion test plan is to be submitted by the manufacturer for review. If the test program is found satisfactory by the Society, it will be approved and returned to the manufacturer for acceptance prior to tests being carried out. Tests that need to be witnessed by the Surveyor will be identified.

The number of test samples is to be in accordance with the requirements of Appendix of the Annex to IMO MSC.289 (87) "Performance Standard for Alternative Means of Corrosion Protection for Cargo Oil Tanks of Crude Oil Tankers".

The number of casts and test samples selected are to be sufficient to make it possible to confirm the validity of interaction effects and/or the control range (upper limit, lower limit) of the elements which are added or intentionally controlled, for improving the corrosion resistance. Where agreed, this may be supported with data submitted by the manufacturer.

5.4 Corrosion tests

5.4.1 The corrosion tests are to be carried out in accordance with the approved test plan as per [5.3.2] and the corrosion testing procedure given in Appendix of the Annex to IMO MSC.289 (87) "Performance Standard for Alternative Means of Corrosion Protection for Cargo Oil Tanks of Crude Oil Tankers".

5.4.2 The Interpretation given in IACS UI SC258 on Test Procedures for Qualification of Corrosion Resistant Steel for Cargo Tanks in Crude Oil Tankers is to be applied.

6 Rolled products made in EH47 and crack arrest steels for container carriers

6.1 Scope

6.1.1 This Article gives the approval test program for the manufacture of steel products made of grades EH47, EH36CAS1, EH36CAS2, FH36CAS1, FH36CAS2, EH40CAS1, EH40CAS2, FH40CAS1, FH40CAS2, EH47CAS1 and EH47CAS2.

6.2 Manufacturing process specification

6.2.1 In addition to the information mentioned in [1.2], the following information is to be submitted for crack arrest steels:

- In-house test reports of the crack arrest properties of the steels intended for approval
- Approval test program for the crack arrest properties
- Production test procedure for the crack arrest properties

6.3 Selection of the test product

6.3.1 For each grade of steel and for each manufacturing process (e.g. steel making, casting, rolling and condition of supply), one test product with the maximum thickness (dimension) to be approved is in general to be selected for each kind of product.

In addition, for initial approval, the Society will require selection of one test product of average thickness.

The selection of the casts for the test product is to be based on the typical chemical composition, with particular regard to the specified C_{EQ} or Pcm values and grain refining micro alloying additions.

6.4 Extent of the approval tests

6.4.1 The extent of the test program is specified in [6.5] and [6.7]. It may be modified on the basis of the preliminary information submitted by the manufacturer.

In particular a reduction of the indicated number of casts, steel plate thicknesses and grades to be tested or complete suppression of the approval tests may be accepted by the Society, taking into account:

- Approval already granted by other Classification Societies and documentation of approval tests performed
- Grades of steel to be approved and availability of long term statistic results of chemical and mechanical properties
- Approval for any grade of crack arrest steel also covers approval for any lower grade in the same strength level, provided that the aim analysis, method of manufacture, mechanism to ensure the crack arrest properties and condition of supply are similar
- For crack arrest steels, approval of one strength level covers the approval of the strength level immediately below, provided the steelmaking process, deoxidation and fine grain practice, casting method, condition of supply and mechanism to ensure the crack arrest properties are same
- Change of the approval conditions
- Approval of the semi-finished products such as slabs, blooms and billets.

On the other hand, an increase of the number of casts and thicknesses to be tested may be required in the case of newly developed types of steel or manufacturing processes.

Where the number of tests differs from those shown in [6.5] and [6.7], the program is to be confirmed by the Society before the tests are carried out.

6.5 Tests on rolled products

6.5.1 The tests to be carried out are indicated in Tab 2.

6.6 Crack arrest properties

6.6.1 Crack arrest properties for crack arrest steels are to be verified by either the crack arrest toughness K_{ca} or Crack Arrest Temperature CAT.

6.6.2 In the case where the crack arrest properties are evaluated by K_{ca} , the crack arrest test method is to be in accordance with ISO 20064-2019. To obtain K_{ca} at a specific temperature the method specified in Annex B of ISO 20064-2019 can be used.

As a method for initiating a crack, a secondary loading mechanism (Double tension test) can also be used specified in Annex D of ISO 20064-2019.

The loading direction of crack arrest tests is to be parallel to the final rolling direction of the test plate.

The thickness of the test specimens of the crack arrest tests is to be the full thickness of the test plate.

The test specimens and repeat test specimens are to be taken from the same steel plate.

The evaluation of K_{ca} is to be in accordance to Appendix 1.

6.6.3 In the case where the crack arrest properties are evaluated by CAT, the test method is to be in accordance with Appendix 2.

6.7 Weldability tests

6.7.1 General

Weldability tests are required for plates and are to be carried out on samples of the thickest plate.

6.7.2 Preparation and welding of the test assemblies

The following tests are in general required:

- 1 butt weld test assembly welded with a heat input approximately 15 kJ/cm
- 1 butt weld test assembly welded with a heat input approximately 50 kJ/cm.

The butt weld test assemblies are to be prepared with the weld seam transverse to the plate rolling direction, so that impact specimens will result in the longitudinal direction.

The bevel preparation should be preferably 1/2V or K.

The welding procedure should be as far as possible in accordance with the normal welding practice used at the yards for the type of steel in question.

The welding parameters including consumables designation and diameter, pre-heating temperatures, interpass temperatures, heat input, number of passes, etc. are to be reported.

6.7.3 Type of tests

From the test assemblies the following test specimens are to be taken:

- One cross weld tensile test
- A set of 3 Charpy V-notch impact specimens transverse to the weld with the notch located at the fusion line and at a distance 2, 5 and minimum 20 mm from the fusion line. The fusion boundary is to be identified by etching the specimens with a suitable reagent.

Charpy V-notch impact tests are to be taken at a position of $\frac{1}{4}$ thickness from the plate surface on the face side of the weld with the notch perpendicular to the plate surface.

One additional set of specimens is to be taken from the root side of the weld with the notch located at the same position and at the same depth as for the face side.