

75600

SHIP BUILDING & REPAIR QUALITY STANDARD FOR NEW
CONSTRUCTION, EXISTING SHIP

YÜKSEK LİSANS TEZİ

Gemi Makinaları İşletme Müh.
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Anabilim Dalı : Gemi Makinaları İşletme Mühendisliği

Programı : Gemi Makinaları İşletme Mühendisliği

75600

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DOKÜMANLAMA BİRİMİ

HAZİRAN 1998

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Tezin Enstitüye Verildiği Tarih : Haziran 1998

Tezin Savunulduğu Tarih : Haziran 1998

Tez Danışmanı : Prof. Dr. Ahmet R. BAYÜLKEN

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HAZİRAN 1998

FOREWORD

This thesis brings together the effort of all who have advised, assisted and encouraged me during the entire phase of this project. First, I would like to express my deepest appreciation and thanks to Prof. Dr. Ahmet R. BAYÜLKEN, my advisory, for his consistent encouragement and guidance throughout this project.. In completing of this thesis, I relied heavily upon the knowledge of different authors as referenced in the thesis. I would like to thank all those authors, whose work formed the basis in this project.

I would also like to extend my appreciation to all the employees at I.T.U. MARITIME FACULTY, other people who have contributed in one way or the other to the completion of this project.

İBRAHİM HAMİ BALMUMCU, Istanbul 08/06/1998

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ABBREVIATION

ANSI	American National Standard Institute
AQAP	Allied Quality Assurance Publication
IEC	International Electrotechnical commission
JTC	Joint of (ISO/IEC) technical committee
NDE	non-destructive examination
QAM	Quality Assurance Manual.
ADİK	Anadolu Deniz İnşaat Kızakları Sanayi ve Ticaret Şirketi
Q.A	Quality Assurance.
Q.C	Quality Control
TSE	Turkish Standard Organization
KK	Data Sheets For Quality Control
KKK	Office Quality Control Books
KKD	Office Quality Documents
DD	Auxiliary Documents
GT	Personal Definition
KP	Working Procedures
IT	Operating Instructions
ED	Training Documents
KD	Calibration Documents
SKD	Order Acceptance Quality Control
TS	Technical Specifications
MSD	Customer Complaints
MB	Mechanical Maintenance
YI	Auxiliary Works
SA	Purchasing Dept.
OT	Foreign Sales Dept.
SD	Sales Dept.

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ABSTRACT

SHIP BUILDING QUALITY STANDARD was drawn up in order to set ship's quality control modality for all ships built in Turkish Ship Building Industries.

When applying ship's quality control in each stage of construction, can be found the defects and diminished their effects that direct to a final quality accordance with documented requirements.

We hope this STANDARD application will improve our products quality, productivity increasing and production activities economic efficiency.

This thesis consist of six chapters:

- Chapter 1 Introduction to ISO : In this chapter get the idea of what the ISO is; history of ISO, why we needed as well as what does it cover.
- Chapter 2 Ship building and repair quality standard for new construction : How the standards can be applied to new ship building and requirements of this standard
- Chapter 3 Ship building and repair quality standard for existing ship : The way standards can be applied in repair of vessel
- Chapter 4 Major process of ship building : In this chapter major processes are informed.
- Chapter 5 Inspection and test items : Does are the check lists for new building as well as the existing ships.
- Chapter 6 Quality Assurance manual for an example company (A.D.İ.K.)

In the event of conflict, however the requirements of the contract, building specification, approved drawings of agreed letters/memoranda shall prevail over this Turkish Shipyards.

ÖZET

YENİ İNŞAA VE GEMİ BAKIM ONARIMINDA İSO 9000 UYARLAMASI

Globalleşen dünyamızda her alanda olduğu gibi gemi inşaa ve bakım onarım sektöründede rekabet vardır ve her geçen gün artmaktadır. Bu rekabet yurt içinde olduğu gibi yurt dışındaki sektörler arasında da sürmektedir. Bununla beraber içinde bulunduğumuz yüzyılın sonlarına doğru dünyada her konuda büyük değişimler yaşanmaktadır ve işletmeleri etkileyen değişimlerden en önemlisi ise *kalite* konusundaki gelişmeler olmuştur. Kendilerini yıllara taşımak isteyen firmalar müşteri ihtiyaçlarını tam karşılamak için, teknolojiyi yakalayabilmek ve aynı zamanda kalitelerini, kaliteye bakış açılarını değiştirmek zorunda kalmışlardır. Dünyamız üzerindeki hemen hemen bütün ülkelerin ve sektörlerin kabul ettiği standartlar uygulanmaya başlanmıştır (İSO).

1924 Yılında bir matematikçi olan Walter Shewhart, seri üretim ortamlında kalitenin ekonomik olarak kontrolü için bir yöntem olan İstatiksel Kalite Kontrol (İKK) kavramını gündeme getirdi. II. Dünya savaşı kalite teknolojisinin gelişimde büyük rol oynamaktadır.

Üretim kalitesinin gelişmesi, iyileştirilmesi gerekliliği kalite kontrolü konusundaki çalışmaların artmasına ve bilginin daha çok paylaşılmasına yol açtı. 1946 yılında Amerika Kalite Kontrol Derneği (American Society for Quality Control) oluşturuldu ve başkanlığına George Edwards seçildi. Ancak II. Dünya Savaşının bitişi ile kalite kontrolüne olan ilgide yitirmeye başlandı. Kuruluşların bir çoğu, kalite kontrolü yalnızca savaş sırasında gerekli olarak algıladıkları için, bu konuda yapılacak çalışmaları gereksiz buluyorlardı.

Savaş sonrası, Japon Bilim adamları ve Mühendisleri Birliği (Japanese Union of Scientist and Engineers) tarafından George Edwards ve Walter Shewhart ile beraber çalışmış olan W. Edward Deming'i konferans vermek üzere Japonyaya davet ettiler. Burada amaç savaştan sonra Japonyayı yeniden imar etmek, dış pazarlara girmek ve en önemlisi düşük kaliteli ürünlerin iyileştirilebilmesi için yöntemler geliştirebilmek idi. Böyle başlayan Japonyanın gelişme süreci, yeni teknikler kullanarak hem teknolojilerini geliştirmiş, dolayısı ile ürünlerindeki kalite artmış ve verimlilikle beraber rekabet güçleride sürekli olarak iyileşmiştir. Bir takım firmalar, konularında en büyük yararı sağlayanlar, Deming ödülü diye adlandırılan ödülü almaya hak kazanmışlardır. Bu ödülü kazananlar arasında, Nissan, Toyota, Hitachi yer almaktadır.

İSO herhangi bir devlet kuruluşuna bağlı olmayan 1947 de Cenovada kurulan bir organizasyondur. Hızla bütün dünyaya yayılmaktadır. Bu standartlar sayesinde farklı dil, adetlere sahip olan ülkeler arasındaki her türlü alış-veriş ve beraber iş yapabilme olanağı sağlamaktadır. Çünkü istenilen kalite, dayanıklılık, servis teknoloji her yerde aynıdır. Bununla beraber daha sağlıklı, emniyetli, doğaya ve çevreye dost bir ortam sağlamaktadır.

Bu standartlar;

- Gıda sektörü,
- Uluslar arası ölçüm sistemi,
- Semboller,
- Kağıt ebadları,
- Her türlü halatın mukavemetleri,
- Vida başı, vida dişi, somun ve civatalar,
- Gemilerde yapılan kaynak işleri ve türleri,
- Gemilerde kullanılan kaynak ebadları ve kalitelerini

ve daha bir çok sektör, malzeme ve hizmeti kapsamaktadır.

İSO 8402 Kalite sözlüğünde (1986) kalite güvencesi “ürün yada hizmetin kalite için belirlenmiş gereklilikleri karşılamaında yeterli güveni sağlayacak planlı ve sistematik çalışmaların toplamı” olarak tanımlanmıştır. Aşağıda yapılan açıklamalar tanıma açıklık getirmek amacı ile yapılmıştır;

- Belirlenmiş gereklilikler kullanıcının gereksinimlerini bütünü ile yansıtmadıkça, kalite güvencesi sağlanmamış olacaktır. Kalite güvencesinde ilk adım, müşterinin gerekliliklerini tam ve doğru olarak anlaşılmasıdır,
- Etkinliğin sağlanması için kalite güvencesi üretim, montaj ve muayene işlemlerinin denetimleri ve doğrulamaları çalışmalarında olduğu gibi, amaçlanan uygulamalar için spesifikasyon yada tasarım uygunluğunu etkileyen unsurların sürekli olarak değerlendirilmesini gerektirir,
- Güven sağlama çalışmaları kayıtlarla desteklenmelidir,
- Bir organizasyonda kalite güvencesi sistemi bir yönetim aracı olarak işler görür. Sözleşmeli durumlarda ise bu sistem müşteriye güven sağlar,

Kalite güvencesi, yönetimin devredemeyeceği fonksiyonlarından birisidir. Yönetim, tüm fonksiyonları bütünleştirme operasyonlarını kendisi yürütmelidir. Kalite yalnızca imalt sürecinde oluşturulacak birşey değildir. Kalite güvencesi, istenilen sonuca ulaşmak için işletmede toplam bütünleşme gerektiren bir felsefedir.

Bu arada ISO 9000 standartlar serisi, tez konumuz bu standartların bir kısmını kapsamaktadır, hakkında biraz bilgi verelim;

ISO 9000, işletmenin koşullarına uygun bir Kalite Güvence Sistemi geliştirilmesinde veya başka bir organizasyonun kalite güvence sisteminin değerlendirilmesinde esas alınabilecek bir modeldir. Model uygulandığında işletmeye işlem maliyetlerinin azaltılması, yönetim kontrolünün ve organizasyonun toplam iş etkinliğinin iyileştirilmesi, daha iyi ürün tasarımı yapılması, hurda/yeniden işleme ve müşteri memnuniyetinde artma, verimlilikte iyileşme, işçi - işveren ilişkilerinde üretimdeki dar boğazların kaldırılması ve iş ortamındaki stresin azaltılması sonucu iyileşmeler yapılması, şirketin kalite kültürünün iyileşmesi ile çalışanlarda daha çok iş tatmini ve kalite bilincinin yaratılması, müşterilere karşı işletmenin güveninin artması ve dış satımda başarılı olan şirket imaj ve itibarının iyileştirilmesi fırsatını verir. ISO 9000'in belgelendirmeye esas 3 (üç) ana bölümde kısaca şöyle açıklayabiliriz:

ISO 9001, Bir işletmenin tasarım ve geliştirme, imalat veya tesis kurma ile ilgili gerekliliklerini tanımlar. İşletmenin büyüklüğüne değil fonksiyonuna bağlıdır. Örneğin ürün tasarımı yapan ve satış sonrası hizmet veren beyaz eşya yada otomobil v.b üretim yapan işletmeler.

ISO 9002, Özellikle daha önceden meydana getirilmiş, onaylanmış tasarımlar doğrultusunda imalat yapan işletmeler için uygundur. Ürün geliştirme fonksiyonu olmayan herhangi bir imalatçı yada nakliye, ambalajlama, dağıtım ve taşıma gibi işler yapan hizmet firmaları kalite sistemlerini eğer belgelendirmek isterlerse ISO 9002'ye göre bu işlemleri gerçekleştirebilirler.

ISO 9003, Süreçlerin çok basit olduğu ve ürün kalitesinin nihai ürün üzerinde yapılan muayene ve testlerle belirlendiği işlemler için uygulanabilir. Bir firma, bitmiş yarı mamülleri temin ederek bunları müşterinin tasarımı doğrultusunda birleştirip yeni bir ürün elde edip piyasaya sürüyorsa kalite sistemlerini ISO 9003'e göre belgelendirmelidir.

Büyük çoğunluğu büyük firmalara, ana firmalara, fason imalat yapan diğer küçük ve orta büyüklükteki firmalar için bu standartlar kaçınılmaz olmuştur. Ana firmalar kendilerine parça, yarı mamül sağlayan diğer firmalardan belli bir kaliteyi tutturmalarını istedikleri gibi tam zamanında üretim sistemine geçmelerini istemektedirler. Bu da tedarikçi firmaların teknolojiyi yakından izlemeleri gereğini doğurmuştur. Tam zamanında üretim sistemini ilgilendiren tedarikçi firmaları ilgilendiren önemli konu, ana firmanın vermiş olduğu zamanlama ve kalite özelliklerine uygun üretimi en düşük maliyette gerçekleştirmektir. Ana firmada da hedef, giriş kalite kontrolü yapmadan tedarikçinin temin ettiği parçaları direk olarak montaja almaktır. Bu nedenle tedarikçi firmaların üretimi kusursuz yapmalıdırlar. Bunların gerçekleşebilmesi içinde tedarikçi firmaların etkili bir kalite güvence sistemine sahip olmaları gerekmektedir.

Tezin konusu olan, bu standartların gemi inşaa, bakım ve onarım sektörüne, kısaca tersaneler, uyarlanması yapılabılır. Yukarıda da belirtildiği üzere, yeni inşaa edilmekte olan ve/veya bakım onarımı yapılacak gemilerde kullanılacak saçların ebadları ve kaliteleri belirlenmiştir. Bununlada kalmayıp verilecek olan hizmetinde kalitesinin yüksek düzeyde, tam olabilmesi içinde bir takım sınırlamalar, standartlar getirilmiştir. Fakat bu daha çok servis amaçlı sistemler için geçerlidir. Örneğin, gemilerde ana ve yardımcı makinanın bakım onarımı veya servis işlerini yapan kuruluşlar.

Tersanelerde bu standartların uygulanması yapılacak işe ve gemi türüne göre bazı farklılıklar içerir. Genelde aşağıdaki listede bir kısmı mevcuttur,

- kullanılacak olan kaynak tipi (dik, düz, tepe, armuz v.b.),
- elektrodunun çeşitleri ve kalitesi,
- kullanma şartları ve yerleri,
- kaynak makinesi tipleri,
- kaynak yapılacak olan yerin kaynak yapılabilir hale getirilmesi,
- kullanılacak olan sacın yerine göre kalitesi ve ebadları,
- Kaynağı yapacak olan personelin yeterliliği,

Yeni inşaada bu yukarıdaki listeye ek olarak kontrol listeleri hazırlanır. Bu kontroller her gün yapıldığı gibi raporlar tutularak gemi sahibine ve klass kuruluş denetleyicisine teslim edilir. Bununla beraber bir takım testler yapılarak yine raporlar tutulur. Bütün bu yapılan işler klass kuruluşu diye adlandırılan yetkili makamların öngördüğü çerçeve ve kurallar içersinde devam eder.

Bu tezde;

Bölüm 1 ISO'ya giriş, kısaca ISO nedir ?, nasıl başlamıştır ?, kısa bir tarihçesi, niçin böyle bir standartlaşmaya gidilmiştir ve neleri kapsadığı hakkında bilgiler vermektedir,

Bölüm 2 Yeni inşa gemiler için kalite standartları, adındanda anlaşılacağı gibi bu bölümde yeni inşa edilecek olan bir gemiye nasıl uygulanacağı, kullanılacak malzemenin kalitesi hakkında, çalışan personelin yeterlilikleri, nasıl bir statüye sahip olmaları gerektiği, yapılacak olan işlemler tablolar halinde detaylı olarak anlatılmaktadır.

Bölüm 3 Bakım ve onarımı yapılacak olan gemilerde kalite standartları, bu bölüm de tipik gemi bakım onarımı saçı işlemlerinde uyulması gereken unsurlar, kullanılacak

Tezin konusu olan, bu standartların gemi inşaa, bakım ve onarım sektörüne, kısaca tersaneler, uyarlanması yapılabılır. Yukarıda da belirtildiği üzere, yeni inşaa edilmekte olan ve/veya bakım onarımı yapılacak gemilerde kullanılacak sacların ebadları ve kaliteleri belirlenmiştir. Bununlada kalmayıp verilecek olan hizmetinde kalitesinin yüksek düzeyde, tam olabilmesi içinde bir takım sınırlamalar, standartlar getirilmiştir. Fakat bu daha çok servis amaçlı sistemler için geçerlidir. Örneğin, gemilerde ana ve yardımcı makinanın bakım onarımı veya servis işlerini yapan kuruluşlar.

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Bu tezde;

Bölüm 1 ISO'ya giriş, kısaca ISO nedir ?, nasıl başlamıştır ?, kısa bir tarihçesi, niçin böyle bir standartlaşmaya gidilmiştir ve neleri kapsadığı hakkında bilgiler vermektedir,

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malzemenin standartları, yapılacak olan kaynak elektrodu çeşidi, kaynak yapılacak olan yerin tedariki ve malzemenin yerine alıştırılması, kaynak sırası (gerilmeleri ve deformasyonu önlemek için), çatlak ve erozyona uğramış yerlerin nasıl dolgu kaynağı yapılacağı anlatılmaktadır.

Bölüm 4 Yeni inşada uygulanan işlemler, bu bölümde malzemelerin kesilmesi, şekil verilmesi, parçaların birbirine montesi, boru devreleri için boruların hazırlanması, çeşitleri, boruların birbirine montajı (flençli / kaynaklı), flençli bağlantıda contaların çeşitleri ve yapılan işlemlerin sızdırmazlığının test çeşitleri, köprü üstünün donatımı (elektrik, havalandırma v.b), makina, techizatının yerleştirilmesi, dümen, yeke montajı ve son iş olarakta gemi yüzeyinin boyaya hazırlanması, boyanın seçimi ve boyanın tatbiki detaylı olarak bu bölümde anlatılmaktadır.

Bölüm 5 Kontroller ve testler, bu bölümde de yukarıda diğer bölümlerde anlatılan, değinilen bütün işlerim nasıl kontrol ve test edileceği, çek listeleri verilmektedir.

Son bölümü olan bölüm 6'da ise örnek bir firmaya uyarlanan kalite güvence manueli tarif edilmektedir.

Dahada önce belirtildiği üzere bütün bunlardan amaçlanan, iyi kaliteyi tutturmak, burtunla beraber piyasadaki rekabetten kopmamaktır.

Uzun ve zorlu yolların sonundaki ödüller her zaman büyüktür.

CHAPTER 1

INTRODUCTION TO ISO

1.1 WHAT IS ISO ?

ISO is a non-governmental organization established in 1947 head quartered in Geneva, Switzerland. The ISO 9000 standards is neither a quality control standard nor a product oriented standard like the MIL-Q-9858A or the ASME Boiler Code. This standard is based on the philosophy that if the process used to produce the product was developed and maintained properly, the product would be consistent and the quality could be improved. It describes a quality management system which could prevent the production of non-conformities from design to servicing. If the system is adhered to, the supplier will always produce and deliver a predictable product or service. In other words, it makes sure that we actually do what we claim we do, all the time and that we have addressed some specific requirements as well. [1]

1.2 ISO'S NAME: A USER'S GUIDE.

Many people will have noticed a seeming lack of correspondence between the official title when used in full, International Organization for Standardization, and the short form, ISO. Shouldn't the acronym be " IOS " ? Yes, if it were an acronym - which it is not.

In fact, "ISO" is a word, derived from the Greek isos, meaning "equal ", which is the root of the prefix " iso-" that occurs in a host of terms, such as " isometric " (of equal

measure or dimensions - Shorter Oxford English Dictionary) and "isonomy" (equality of laws, or of people before the law - *ibid.*).

From "equal" to "standard", the line of thinking that led to the choice of "ISO" as the name of the organization is easy to follow.

In addition, the name has the advantage of being valid in each of the organization's three official languages - English, French and Russian. The confusion that would arise through the use of an acronym is thus avoided, e.g. "IOS" would not correspond to the official title of the organization in French - Organisation internationale de normalisation.

1.3 HOW IT ALL STARTED.

International standardization began in the electrotechnical field : the International Electrotechnical Commission (IEC) was created in 1906. Pioneering work in other fields was carried out by the International Federation of the National Standardizing Associations (ISA), which was set up in 1926. The emphasis within ISA was laid heavily on mechanical engineering.

ISA's activities ceased in 1942, owing to the Second World War. Following a meeting in London in 1946, delegates from 25 countries decided to create a new international organization "the object of which would be to facilitate the international coordination and unification of industrial standards". The new organization, ISO, began to function officially on 23 February 1947.

The first ISO standard was published in 1951 with the title, "Standard reference temperature for industrial length measurement".

1.4 WHAT FIELDS ARE COVERED ?

The scope of ISO is not limited to any particular branch; it covers all standardization fields except electrical and electronic engineering, which is the responsibility of IEC.

The work in the field of information technology is carried out by a joint ISO/IEC technical committee (JTC 1).

ISO 9000 is not a single standard. It is actually a series of five separate, but interrelated, standards numbered from 9000 to 9004. ISO 9000 and 9004 provide general quality management guidelines. ISO 9001, ISO 9002, and ISO 9003 detail specific requirements for registration. Basically, the standards are of two types: guidance standards and conformance standards. [2]

1.5 WHAT'S IN A STANDARD ?

What does an ISO standard look like? It can be anything from a four-page document to a 1000-page tome, including twice the weight of the standard itself in informative annexes. It may specify the tasks that a certain range of equipment must be able to perform, or describe in detail an apparatus and its safety features. It may contain symbols, definitions, diagrams, codes, test methods, etc.

- m, kg, s, A, K, mol, cd are the symbols representing the seven base units of the universal system of measurement known as SI (Système international d'unités). The SI system is covered by a series of 14 International Standards.
- Paper sizes. The original standard was published by DIN in 1922. Now used worldwide as ISO 216.
- A well-designed symbol conveys a clear cut message in a multilingual world. The same symbols for automobile controls are displayed in cars all over the world, no matter where they are manufactured.
- Safety of wire ropes : used on oil rigs, on fishing vessels, in mines, in all types of building operations, for lifts and cable cars, etc. ISO International Standards systematically define basic characteristics such as size, surface finish, type of construction, tensile grade of the wire, minimum breaking load and linear mass.

- The ISO international codes for country names, currencies and languages help to eliminate duplication and incompatibilities in the collection, processing and dissemination of information. As resource-saving tools, universally understandable codes play an important role in both automated and manual documentation.
- The ISO film speed code, among many other photographic equipment standards, has been adopted worldwide making things simpler for the general user.
- The internationally standardized freight container enables all components of a transport system - air and seaport facilities, railways, highways, and packages - to interface efficiently.
- The diversity of screw threads for identical applications used to represent an important technical obstacle to trade. It caused maintenance problems, and lost or damaged nuts or bolts could not easily be replaced. A global solution is supplied in the ISO standards for ISO metric screw threads.

The first ISO standard was published in 1951 with the title, " Standard reference temperature for industrial length measurement ".

ISO 9000 and ISO 9004 are guidance standards and companies do not register to these where as, ISO 9001, ISO 9002, and ISO 9003 are conformance standards and companies register to any one of these standards.

The three main models for a quality system are the conformance standards ISO 9001, 9002, and 9003. [3]

ISO 9001:1987 - Model 1: This model is for those companies that conform to specified requirements throughout the whole cycle from design to service. This is the most complete standard involving all the quality system elements. It includes 20 sections describing the various elements of a quality system.

ISO 9002:1987 - Model 2: This model is for companies that perform all functions except the design/development of products and after sales service e.g., a job shop like

Engineering Services, that builds to prints supplied by a customer. It includes 18 sections describing the various elements of a quality system in production and installation. Here all one has to demonstrate is one's capabilities in production, and installation.

ISO 9003:1987 - Model 3: This model is for those companies that addresses the requirements for detection and control of problems only during final inspection and testing. In this case, the product is supplied by an outside manufacturer. It is the least comprehensive standard and contains 12 sections.

1.6 INTERNATIONAL STANDARDIZATION : WHAT DOES IT ACHIEVE ?

Industry-wide standardization is a condition existing within a particular industrial sector when the large majority of products or services conform to the same standards. It results from consensus agreements reached between all economic players in that industrial sector - suppliers, users, and often governments. They agree on specifications and criteria to be applied consistently in the choice and classification of materials, the manufacture of products, and the provision of services. The aim is to facilitate trade, exchange and technology transfer through enhanced product quality and reliability at a reasonable price, improved health, safety and environmental protection, and reduction of waste, greater compatibility and interoperability of goods and services, simplification for improved usability, reduction in the number of models, and thus reduction in costs, increased distribution efficiency, and ease of maintenance.

1.7 ISO'S VISION

Approaching the 21st century, ISO sees a world in which global trade between nations continues to grow at a rate 3 to 4 times faster than national economies; a world in which the design, manufacturing, marketing, and customer service operations of a growing majority of individual enterprises are distributed across many countries; and a world in which electronic communications have dramatically increased technical

collaboration between experts in academia, governments, and industries from all countries.

The increasingly rapid development of technology in many sectors will continue to present major opportunities as well as underlying dangers for the general welfare of society. It will therefore be incumbent on all social and economic partners to collaborate closely in guiding the applications of appropriate technologies toward sustainable economic development and global prosperity.

In this rapidly evolving scenario, globally applicable standards will play a key role. Such standards, whether developed by ISO or others, will become primary technical instruments supporting international commerce. In this context ISO intends to be recognized globally as an influential and innovative leader as well as an effective and responsive producer in the development of globally applicable international standards which meet or exceed the expectations of the community of nations. It shall strive at all times to perfect the application of consensus and transparency principles in standardization, and in this way promote the values of rationality, utility, safety and environmental protection for the benefit of all peoples. 2.1 ISO shall produce International Standards and actively promote their voluntary adoption and use in order to make worldwide industry and trade as efficient as possible.

- ISO standards shall be amenable for use in conformity assessment and shall promote quality and reliability at

competitive prices at all levels of industry and trade for the ultimate benefit of consumers.

- ISO standards will promote human and societal benefits whenever applicable in relation to health, safety and

environment, and in relation to general market and growing trade needs.

- ISO standards will, when applicable, be suitable for reference in the regulatory and procurement activities of

federal, state and local authorities.

CHAPTER 2

SHIP BUILDING AND REPAIR QUALITY STANDARD FOR NEW CONSTRUCTION

2.1.SCOPE

This standard provides guidance on shipbuilding quality standards for the hull structure during new construction and the repair standard where the quality standard is not met.

Whereas the standard generally applies to

- conventional ship types,
- parts of hull covered by the rules of Classification Society,
- hull structures constructed from normal and higher strength hull structural steel,

the applicability of the standard is in each case to be agreed upon by the Classification Society.

The standard does generally not apply to the new construction of

- special types of ships as e.g. gas tankers
- structures fabricated from stainless steel or other, special types or grades of steel

The standard covers typical construction methods and gives guidance on quality standards for the most important aspects of such construction. Unless explicitly stated elsewhere in the standard, the level of workmanship reflected herein will in principle be acceptable for primary and secondary structure of conventional designs. A more stringent standard may however be required for critical and highly stressed areas of the hull, and this is to be agreed with the Classification Society in each case. In assessing the criticality of hull structure and structural component[4,5,6]

Details relevant to structures or fabrication procedures not covered by this standard are to be approved by the Classification Society on the basis of procedure qualifications and/or recognized national standards.

It is intended that these standards provide guidance where established shipbuilding or national standard approved by the Classification Society do not exist.

For use of this standard, fabrication fit-ups, deflections and similar quality attributes are intended to be uniformly distributed about the nominal values. The shipyard is to take corrective action to improve work processes that produce measurements where a skewed distribution is evident. Relying upon remedial steps that truncate a skewed distribution of the quality attribute is unacceptable.

2.2 GENERAL REQUIREMENTS FOR NEW CONSTRUCTION

In general, the work is to be carried out in accordance with the Classification Society Rules and under the supervision of the Surveyor to the Classification Society.

Provisions are to be made for proper accessibility, staging, lighting and ventilation. Welding operations are to be carried out under shelter from rain, snow and wind.

Welding of hull structures is to be carried out by qualified welders, according to approved and qualified welding procedures and with welding consumable approved by

the Classification Society, see Section 2.3. Welding operations are to be carried out under proper supervision by the shipbuilder.

2.3.QUALIFICATION OF PERSONNEL AND PROCEDURES.

2.3.1.Qualification Of Welders

Welders are to be qualified in accordance with the procedures of the Classification Society or to a recognized national or international standard, e.g. EN 287, ISO 9606, ASME Section IX, ANSI/AWS D1.1. Recognition of other standards is subject to submission to the Classification Society for evaluation. Subcontractors are to keep records of welders qualification and, when required, furnish valid approval test certificates.

Welding operators using fully mechanized or fully automatic processes need generally not pass approval testing provided that the production welds made by the operators are of the required quality. However, operators are to receive adequate training in setting or programming and operating the equipment. Records of training and production test results shall be maintained on individual operator's files and records, and be made available to the Classification Society for inspection when requested.

2.3.2 Qualification Of Welding Procedures

Welding procedures are to be qualified in accordance with the procedures of the Classification Society or a recognized national or international standard, e.g. EN288, ISO 9956, ASME Section IX, ANSI/AWS D1.1. Recognition of other standards is subject to submission to the Classification Society for evaluation. The welding procedure should be supported by a welding procedure qualification record. The specification is to include the welding process, types of electrodes, weld shape, edge preparation, welding techniques and positions.

2.3.3 Qualification Of NDE Operators

Personnel performing non-destructive examination for the purpose of assessing quality of welds in connection with new construction covered by this standard, are to be qualified in accordance with Classification Society rules or to a recognized international or national qualification scheme. Records of operators and their current certificates are to be kept and made available to the Surveyor for inspection.

2.4 MATERIALS

2.4.1 Materials For Structural Members

All materials, including weld consumable, to be used for the structural members are to be approved by the Classification Society as Per the approved construction drawings and meet the respective IACS Unified Requirements. Additional recommendations are contained in the following paragraphs.

All materials used should be manufactured at a works approved by the Classification Society for the type and grade supplied.

2.4.2 Under Thickness Tolerances

The maximum permissible under thickness tolerance, for hull structural plates and wide flats with thickness of 5mm. and over, for both normal and high strength steels, is -0.3mm. The thickness is to be measured at random locations whose distance from an edge shall be at least 10mm. Local surface depressions resulting from imperfections and ground areas resulting from the elimination of defects may be disregarded provided the imperfections or grinding are in accordance with the requirements of Section 2.4.3 "Surface Conditions".

2.4.3 Surface Conditions

2.4.3.1 Definitions

Minor Imperfections : pitting, rolled-in scale, indentations, roll marks, scratches and grooves

Defects : cracks, shells, sand patches, sharp edged seams and minor imperfections not exceeding the limits of table 1 in case that the sum of the influenced area exceeds 5% of the total surface in question

Depth of Imperfections or defects : the depth is to be measured from the surface of the product

2.4.3.2 Unrepaired conditions

Minor imperfections, in accordance with the limits described in Table 1, are permissible and may be left un-repaired.

2.4.3.3 Repairs of defects

Defects are to be repaired by grinding or welding irrespective of their size and number. Repair by grinding may be carried out over the entire surface up to a depth equal to the under thickness tolerances given in para.2.4.2.

To sum of the repairs by welding and of the repairs by grinding, reducing the nominal thickness by more than 0.3mm, shall not exceed 2% of the total surface in question.

2.4.3.4.Repairs by grinding

For ground areas with a thickness less than the minimum permissible thickness stated in para.4.2., the nominal thickness is not to be reduced by more than 7% or 3mm, whichever is the lesser. Each single ground area is not to exceed 0.25m

The defects are to be completely removed by grinding. Complete elimination of the defects is to be verified by a magnetic particle or dye penetrant test procedure. The ground areas must have smooth transitions to the surrounding surface.

2.4.3.5.Repairs by welding

Local defects, which cannot be repaired by grinding, may be repaired by chipping and/or grinding followed by welding in accordance with the qualified procedures approved by the Classification Society concerned.

Any single welded area is not to exceed 0.125m^2 . The weld preparation should not reduce the thickness of the product below 80% of the nominal thickness. Welding is to be completed with one layer of weld bead in excess, which is subsequently to be ground smooth, level with the plate surface. The soundness of the repair is to be verified by ultrasonic, magnetic particle or dye penetrant methods.

Table.2.1 Limits for minor imperfections left un-repaired

Plate Thickness	Surface area	100%	15%	5%	2%
3 < t < 8 mm	N+0.1	0.2	—	0.4	—
	N	0.2	—	0.3	0.4
	N-0.1	0.2	—	—	0.4
	N-0.2	0.1	0.2	—	0.4
	N-0.3	0.0	0.2	—	0.4
8 < t < 25mm	N+0.2	0.3	—	0.5	—
	N+0.1	0.3	—	0.4	0.5
	N	0.3	—	—	0.5
	N-0.2	0.1	0.3	—	0.5
	N-0.3	0.0	0.3	—	0.5
25 < t < 40mm	N+0.3	0.4	—	0.6	—
	N+0.2	0.4	—	0.5	0.6
	N+0.1	0.4	—	—	0.6
	N	0.3	0.4	—	0.6
	N-0.1	0.2	0.4	—	0.6
	N-0.2	0.1	0.4	—	0.6
	N-0.3	0.0	0.4	—	0.6
40 < t < 80mm	N+0.5	0.5	—	0.8	—
	N+0.4	0.5	—	0.7	0.8
	N+0.3	0.5	—	0.6	0.8
	N+0.2	0.5	—	—	0.8
	N+0.1	0.4	0.5	—	0.8
	N	0.3	0.5	—	0.8
	N-0.1	0.2	0.5	—	0.8
	N-0.2	0.1	0.5	—	0.8
	N-0.3	0.0	0.5	—	0.8
80 < T < 150	N+0.6	0.6	—	0.9	—
	N+0.5	0.6	—	0.8	0.9
	N+0.4	0.6	—	0.7	0.9
	N+0.3	0.6	—	—	0.9
	N+0.2	0.5	0.6	—	0.9
	N+0.1	0.4	0.6	—	0.9
	N	0.3	0.6	—	0.9
	N-0.1	0.2	0.6	—	0.9
	N-0.2	0.1	0.6	—	0.9
	N-0.3	0.0	0.6	—	0.9

N - Nominal plate Thickness

2.4.3.6. Further defects

2.4.3.6.1. Lamination

Investigation to be carried out at the steel mill into the cause and extent of the laminations. Serve lamination is to be repaired by a local insert plates. The minimum breadth of the plate to be repaired by insert is to be:

- 1.600mm. for shell and strength deck plating in way of cruciform or T-joints
- 800mm. for shell, strength deck plating and other primary members,
- 300mm. for other structural members.

Local limited lamination may be repaired by chipping and/or grinding followed by welding in accordance with sketch (a). In case where the local limited lamination is near the plate surface, the repair may be carried out as shown in sketch (b). For limitations see paragraph 2.4.3.5.

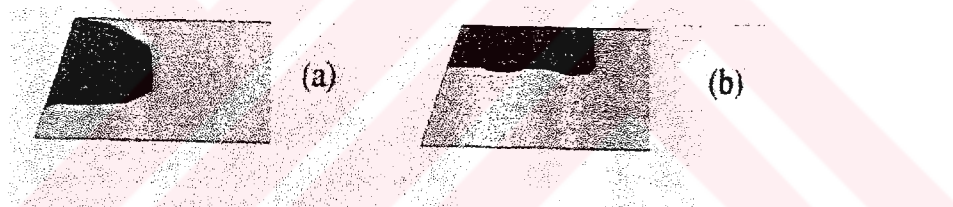


Fig:2.1 Laminations

2.4.3.6.2. Weld Spatters

Loose weld spatters are to be removed completely by grinding to clean metal (see Table 9.13) on:

- shell plating
- deck plating on exposed decks
- in tanks for chemical cargoes
- in tanks for fresh water and drinking water
- in tanks for lubricating oil, hydraulic oil, including service tanks

2.5.CUTTING

2.5.1.Gas Cutting

The deviation u of cut edges (see sketch (a)), from a right angle or from a required slope, and the roughness of the cut edge R , is meet the following requirements:

Mechanized Gas Cutting

Manual Gas Cutting: Free Edges

Cut Thick.	Stand.	Lmt	Strength Mem.	Stand.	Lmt
$a \leq 20\text{mm}$	$u=0.6\text{mm}$	$u=1.2\text{mm}$		$u=1.5\text{mm}$	$u=1.5\text{mm}$
	$R=100\mu\text{m}$	$R=150\mu\text{m}$		$R=150\mu\text{m}$	$R=300\mu\text{m}$
00Others					
$a > 20\text{mm}$	$u=0.75\mu\text{mm}$	$u=1.5\text{mm}$		$u=1.5\text{mm}$	$u=1.5\text{mm}$
	$R=100\mu\text{m}$	$R=150\mu\text{m}$		$R=300\mu\text{m}$	$R=500\mu\text{m}$

Manual Gas Cutting: Welding Edges

	Standard	Limit
Strength Members	$u=1,5\text{mm}$ $R=400\mu\text{m}$	$u=1,5\text{mm}$ $R=800\mu\text{m}^*$
Others	$u=1,5\text{mm}$ $R=800\mu\text{m}^*$	$u=1,5\text{mm}$ $R=1.500\mu\text{m}^*$

Individual non-sharp notches caused by torch failures(scouring) are not be greater than 3mm in depth. Deeper scores should be removed by grinding.

* Unless the welding procedure needs smaller tolerances.

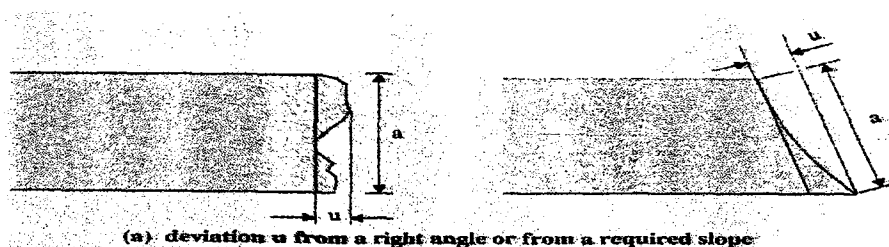


Fig. 2.2 Deviation u form a right angle or from a required slope

2.5.2 Plasma Arc Cutting

The deviation u of the cut edge (see sketch (a)), from a right angle or from a required slope, and the roughness of the cut edge R , is to meet the following requirements:

Mechanized Plasma Arc Cutting

<u>Cut Thickness</u>	<u>Standard</u>	<u>Limit</u>
$a \leq 20\text{mm}$	$u=1,0\text{mm}$	$1,5\text{mm}$
	$R=100\mu\text{m}$	$R=150\mu\text{m}$

The tolerances for manual cutting are agreed by the Classification Society concerned.

2.5.3 Laser Beam Cutting

The standard range and the tolerance limits for the deviation from a required slope of the cut edges and the roughness of the cut edges are to be agreed by the Classification Society concerned.

2.6.FABRICATION AND FAIRNESS.

2.6.1 Flanged Longitudinal And Flanged Brackets (see Table 2.2)

2.6.2 Built-up Section (see Table 2.3)

2.6.3 Corrugated Bulkheads (see Table 2.4)

2.6.4 Pillars, Brackets And Stiffeners (see Table 2.5)

2.6.5 Maximum Heating Temperature On Surface For Line Heating (see Table 2.6)

2.6.6 Block Assembly (see Table 2.7)

2.6.7 Special Sub-assembly (see Table 2.8)

2.6.8 Shape (see Table 2.9 and 2.10)

2.6.9 Fairness Of Plating Between Frames (see Table 2.11)

2.6.10 Fairness Of Plating With Frames (see Table 2.12)

2.7. ALIGNMENT

The quality standards for alignment of hull structural components during new construction are shown in Tables 2.13, 2.14 and 2.15. The classification society may require a closer construction tolerance in areas requiring special attention, as follows:

- Regions exposed to high stress concentrations
- Fatigue prone areas
- Detail design block erection joints
- Higher tensile steel regions

2.8. WELDING DETAILS

2.8.1 Typical Butt Weld Plate Edge Preparation (Manual Welding) See Table 2.16
And 2.17

2.8.2 Typical Fillet Weld Plate Edge Preparation (Manual Welding) - See Table 2.18
And 2.19

2.8.3 Typical Butt And Fillet Weld Profile (Manual Welding) - See Table 2.20

2.8.4 Lap Plug And Slot Welding - See Table 2.21

2.8.5 Distance Between Welds - See Table 2.22

2.8.6 Automatic Welding - See Table 2.23

2.9. REPAIR

2.9.1 Typical Misalignment Repair - See Tables 2.24 to 2.26

2.9.2 Typical Butt Weld Plate Edge Preparation Repair (Manual Welding) See Table
2.27 And 2.28

2.9.3 Typical Fillet And Butt Weld Profile Repair (Manual Welding) - See Table 2.29
To 2.31

2.9.4 Typical Fillet And Butt Weld Profile Repair (Manual Welding) - See Table 2.32

2.9.5 Distance Between Welds Repair - See Table 2.33

2.9.6 Erroneous Hole Repair - See Table 2.34

2.9.7 Repair By Insert Plate - See Table 2.35

2.9.8 Weld Surface Repair - See Table 2.36



TABLE 2.2 - FLANGED LONGITUDINAL AND BRACKETS

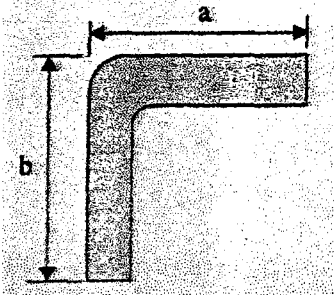
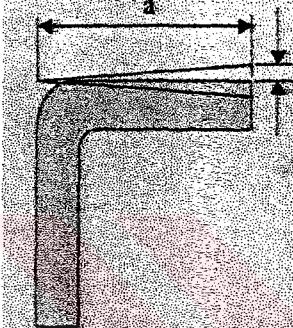
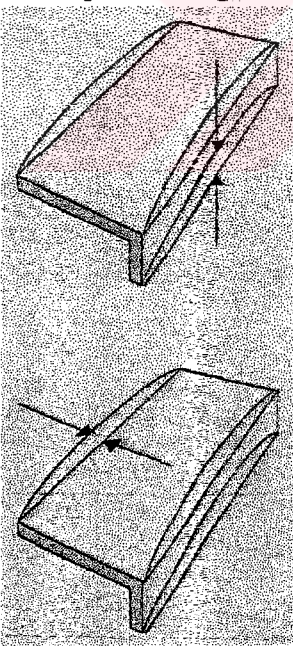
Detail	Standard	Limit	Remarks
Breadth of flange 	63 mm	65 mm	
Compared to correct size Angle between flange and web 	63 mm	65mm	
Compared to template Straightness in plane of flange and web 	6 10 mm	6 25 mm	Per 10 m

TABLE 2 3 - BUILD UP SECTION

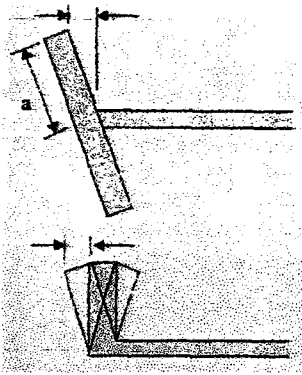
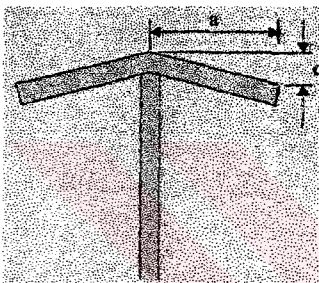
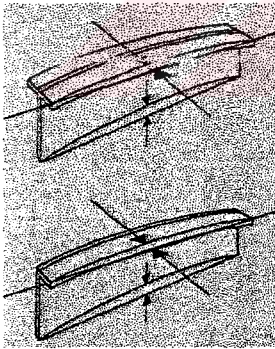
Detail	Standard	Limit	Remarks
Frames and Longitudinal 	$\pm 1,5 \text{ mm.}$	$\pm 3 \text{ mm.}$	Per 100 mm of a
Distortion of face plate 	$d \leq 3 + a/100 \text{ mm.}$	$d \leq 5 + a/100 \text{ mm}$	
Distortion of girder and transverse at upper edge and flange 	$\pm 5 \text{ mm}$	$\pm 8 \text{ mm}$	Per span between primary members

TABLE 2.4 - CORRUGATED BULKHEADS

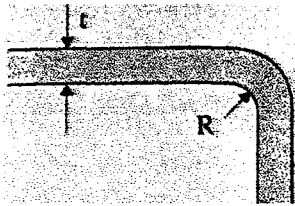
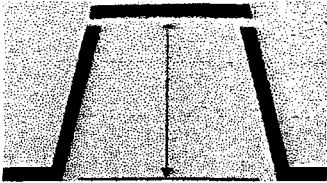
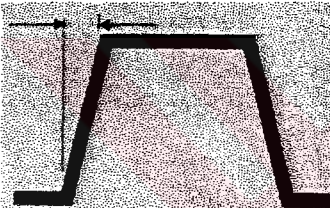
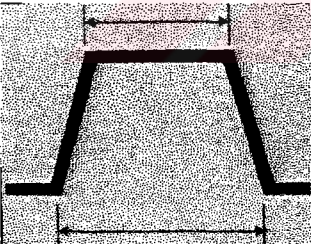
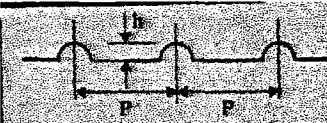
Detail	Standard	Limit	Remarks
Mechanical Bending 	$R < 3t \text{ mm}$		Material to be suitable for cold flanging (forming) and welding in way of radius
Depth of corrugation 	$\pm 3 \text{ mm.}$	$\pm 6 \text{ mm}$	
Breadth of corrugation web 	$\pm 3 \text{ mm.}$	$\pm 6 \text{ mm}$	
Breadth of corrugation 	$\pm 3 \text{ mm.}$	$\pm 6 \text{ mm}$	
Pitch and depth of swedged corrugated bulkhead compared with correct value 	$h : \pm 2,5 \text{ mm}$ where there is no aligned with other bulkhead $P : \pm 6 \text{ mm}$ where it is aligned with other bulkhead $P : \pm 2 \text{ mm}$	$h : \pm 5 \text{ mm}$ where there is no aligned with other bulkhead $P : \pm 9 \text{ mm}$ where it is aligned with other bulkhead $P : \pm 3 \text{ mm}$	

TABLE 2.5 - PILLARS, BRACKETS AND STIFFENERS

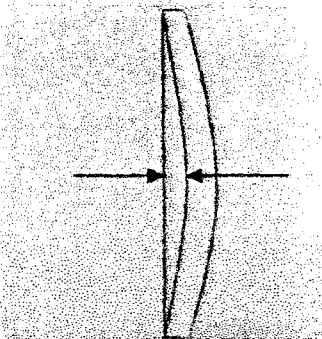
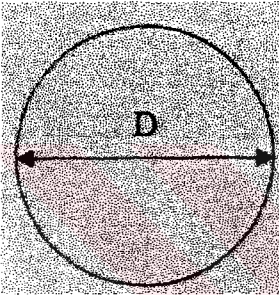
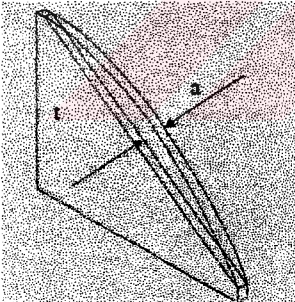
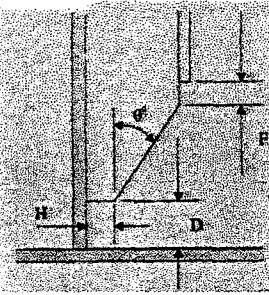
Detail	Standard	Limit	Remarks
Pillar (between decks) 	4 mm	6 mm	
Cylindrical structure dia. (pillars, masts, posts, etc.) 	$\pm D/200$ mm. Max ± 5 mm	$\pm D/150$ mm.	
Tripping bracket and small stiffener, distortion at the part of the free edge 	$a \leq t/2$ mm	Max ± 8 mm	
Snipe end of secondary face plates and stiffeners 	Y8 = 308 H = 15 mm D = 25 mm F = 15 mm	65 mm + 10 mm - 5 mm 65 mm	

TABLE 2.6 - MAXIMUM HEATING TEMPERATURE ON SURFACE FOR LINE HEATING FOR PLATE FORMING

Item		Standard	Limit	Remarks
Conventional Process AH32 - EH32 & AH36 - EH36	Water cooling just after heating	Under 650 8C		
TCMP type AH32 - EH32 & AH36 - EH 36 (Ceq. >0,38%)	Air cooling after heating	Under 9008C		
	Air cooling and subsequent water cooling after heating	Under 9008C (starting temp. of water cooling to be under 5008C)		
TMCP type AH32 - DH32 & AH36 - DH36 (Ceq. [0,38%)	Water cooling just after heating or air cooling	Under 1.0008C		
TMCP type EH32 - EH36 & (Ceq. [0,38%)	Water cooling just after heating or air cooling	Under 9008C		

NOTE :

$$Ceq = C + \frac{Mn}{6} + \frac{Cr + Mo + V}{5} + \frac{Ni + Cu}{15} (\%)$$

[1]

Table 2.7 - Block Assembly

Item	Standard	Limit	Remarks
Flat Plate Assembly			
Length and Breadth	$\pm 2,5 \text{ mm}$	$\pm 5 \text{ mm}$	
Distortion	$\pm 10 \text{ mm}$	$\pm 20 \text{ mm}$	
Squareness	$\pm 5 \text{ mm}$	$\pm 10 \text{ mm}$	
Deviation of interior members from plate	5 mm	10 mm	
Flat Plate Assembly			
Length and Breadth	$\pm 2,5 \text{ mm}$	$\pm 5 \text{ mm}$	Measured along the girth
Distortion	$\pm 10 \text{ mm}$	$\pm 20 \text{ mm}$	
Squareness	$\pm 10 \text{ mm}$	$\pm 15 \text{ mm}$	
Deviation of interior members from plate	5 mm	10 mm	
Flat cubic Assembly			
Length and Breadth	$\pm 2,5 \text{ mm}$	$\pm 5 \text{ mm}$	
Distortion	$\pm 10 \text{ mm}$	$\pm 20 \text{ mm}$	
Squareness	$\pm 5 \text{ mm}$	$\pm 10 \text{ mm}$	
Deviation of interior members from plate	5 mm	10 mm	
Twist	$\pm 10 \text{ mm}$	$\pm 20 \text{ mm}$	
Deviation between upper and lower plate	$\pm 5 \text{ mm}$	$\pm 10 \text{ mm}$	
Flat cubic Assembly			
Length and Breadth	$\pm 2,5 \text{ mm}$	$\pm 5 \text{ mm}$	Measured along the girth
Distortion	$\pm 10 \text{ mm}$	$\pm 20 \text{ mm}$	
Squareness	$\pm 5 \text{ mm}$	$\pm 10 \text{ mm}$	
Deviation of interior members from plate	5 mm	10 mm	
Twist	$\pm 10 \text{ mm}$	$\pm 20 \text{ mm}$	
Deviation between upper and lower plate	$\pm 5 \text{ mm}$	$\pm 10 \text{ mm}$	

Table 2.7 - Block Assembly

Item	Standard	Limit	Remarks
Flat Plate Assembly			
Length and Breadth	$\pm 2,5$ mm	± 5 mm	
Distortion	± 10 mm	± 20 mm	
Squareness	± 5 mm	± 10 mm	
Deviation of interior members from plate	5 mm	10 mm	
Flat Plate Assembly			
Length and Breadth	$\pm 2,5$ mm	± 5 mm	Measured along the girth
Distortion	± 10 mm	± 20 mm	
Squareness	± 10 mm	± 15 mm	
Deviation of interior members from plate	5 mm	10 mm	
Flat cubic Assembly			
Length and Breadth	$\pm 2,5$ mm	± 5 mm	
Distortion	± 10 mm	± 20 mm	
Squareness	± 5 mm	± 10 mm	
Deviation of interior members from plate	5 mm	10 mm	
Twist	± 10 mm	± 20 mm	
Deviation between upper and lower plate	± 5 mm	± 10 mm	
Flat cubic Assembly			
Length and Breadth	$\pm 2,5$ mm	± 5 mm	Measured along the girth
Distortion	± 10 mm	± 20 mm	
Squareness	± 5 mm	± 10 mm	
Deviation of interior members from plate	5 mm	10 mm	
Twist	± 10 mm	± 20 mm	
Deviation between upper and lower plate	± 5 mm	± 10 mm	

TABLE 2.9 - SHAPE

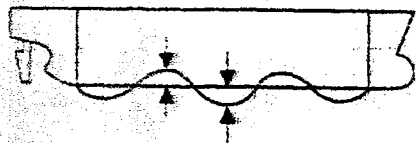
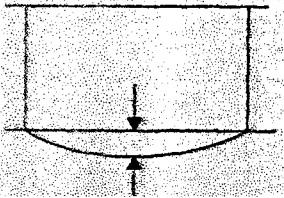
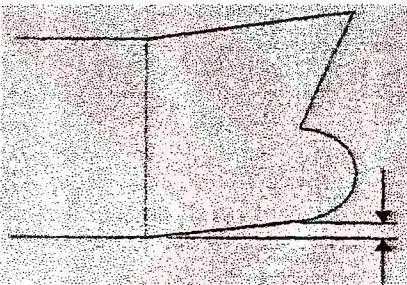
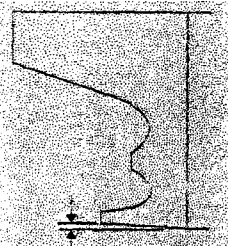
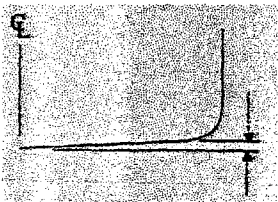
Detail	Standard	Limit	Remarks
Deformation for the whole length 	$\pm 50 \text{ mm}$		Per 100 m against the line of keel sighting
Deformation for the distance between two adjacent bulkheads 	$\pm 15 \text{ mm.}$		
Cocking-up of fore body 	$\pm 30 \text{ mm.}$		
Cocking-up of aft-body 	$\pm 20 \text{ mm.}$		
Rise of floor amidships 	$\pm 15 \text{ mm.}$		

TABLE 2.10 - SHAPE

Item	Standard	Limit	Remarks
Length between perpendiculars	± 50 mm		Applied to ships of 100 meter length and above For the convenience of the measurement the point where the keel is connected to the stern may be substituted for the fore perpendicular in the measurement of the length.
Length between aft edge of boss and main engine	± 25 mm		
Moulded breadth at midship	± 15 mm		Applied to ships of 15 meter breadth and above. Measured on the upper deck.
Moulded depth at midship	± 10 mm		Applied to ships of 10 meter depth and above.

TABLE 2.11 - FAIRNESS OF PLATING BETWEEN FRAMES

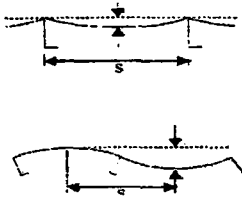
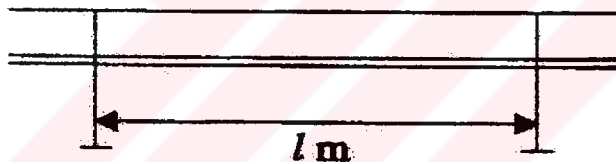
Item		Standard	Limit	Remarks
Shell plate	Parallel part (side & bottom shell)	4 mm		 $300 < s < 1.000$
	Fore and aft part	5 mm		
Tank top plate		4 mm		
Bulkhead	Long. Bulkhead Trans. Bulkhead Swash bulkhead	6 mm		
Strength Deck	Parallel part	4 mm		
	Fore and aft part	6 mm	9 mm	
	Covered part	7 mm	9 mm	
Second deck	Bare part	6 mm	8 mm	
	Covered part	7 mm	9 mm	
Forecastle deck Poop deck	Bare part	4 mm	8 mm	
	Covered part	6 mm	9 mm	
Super structure deck	Bare part	4 mm	6 mm	
	Covered part	7 mm	9 mm	
House wall	Outside wall	4 mm	6 mm	
	Inside wall	6 mm	8 mm	
	Covered part	7 mm	9 mm	
Interior member (web of girder, etc.)		5 mm	7 mm	
Floor and girder in double bottom		5 mm	7 mm	

TABLE 2.12 - FAIRNESS OF PLATING WITH FRAMES

Item		Standard	Limit	Remarks
Shell plate	Parallel part	62 /1.000 mm	63 /1.000 mm	To be measured between on trans. Space (min. $l=3\text{m}$)
	Fore and aft part	63 /1.000 mm	64 /1.000 mm	
Strength deck (excluding cross deck) and top plate of double bottom		63 /1.000 mm	64 /1.000 mm	
Bulkhead		64 /1.000 mm	65 /1.000 mm	
Others		65 /1.000 mm	66 /1.000 mm	



l = span of frame
(minimum $l = 3 \text{ m}$)

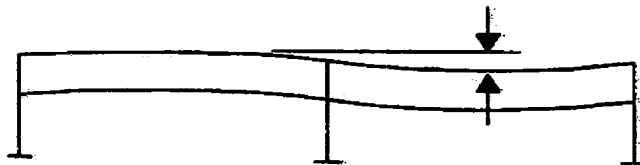


TABLE 2.13 - ALIGNMENT

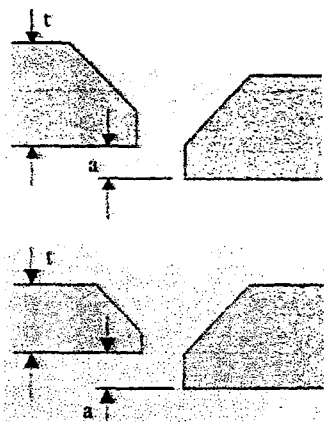
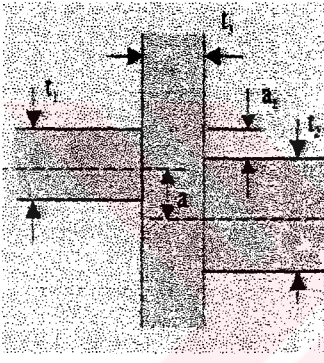
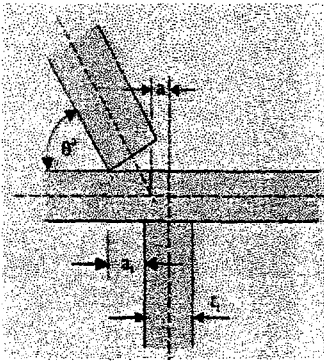
Detail	Standard	Limit	Remarks
Alignment of butt welds 	$a \leq 0,15t$ strength $a \leq 0,2t$ other	$a \leq 3,0 \text{ mm}$	
Alignment of fillet welds 	a) strength and higher tensile $a \leq (5t_1 - 3t_2) / 6$ measured on the heel line b) other $a \leq t_1 / 2$ measured on the median $a_1 \leq (2t_1 - t_2) / 2$ measured on the heel line		Where t_3 is less than t_1, then t_3 should be substituted for t_1 in the standard
Alignment of fillet welds 	a) strength and higher tensile steel $a \leq t_1 / 3$ measured on the median b) other $a_1 \leq t_1 / 2$ measured on the heel line		

TABLE 2.14 - ALIGNMENT

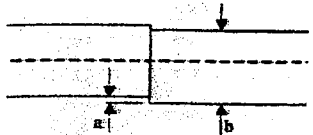
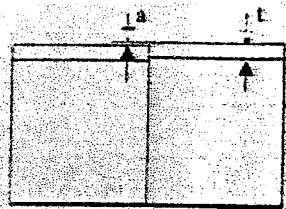
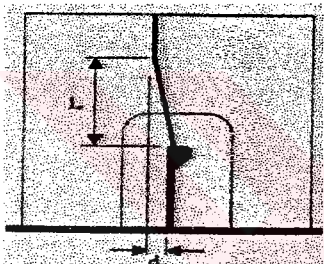
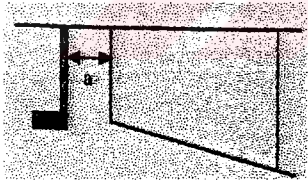
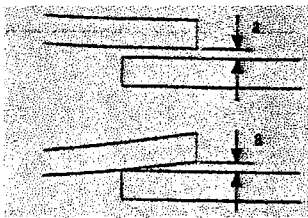
Detail	Standard	Limit	Remarks
Alignment of flange of T-longitudinal 	$a \leq 0,04b$ strength	$a = 8,0$ mm	
Alignment of height of T-bar, L-angle bar or bulb 	Primary members $a \leq 0,15t$ Secondary members $a \leq 0,20t$	3,0 mm	
Alignment of panel stiffener 	$d \leq L/50$		
Gap between bracket/intercostal and stiffener 	$a \leq 2,0$ mm	3,0 mm	
Alignment of lap welds 	$a \leq 2,0$ mm		

TABLE 2.15 - ALIGNMENT

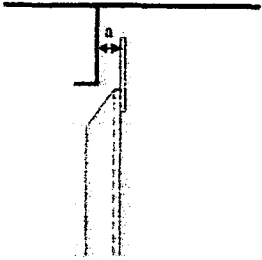
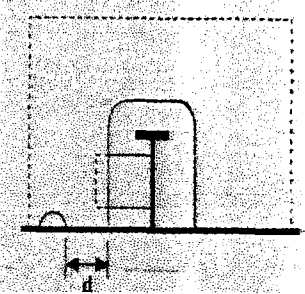
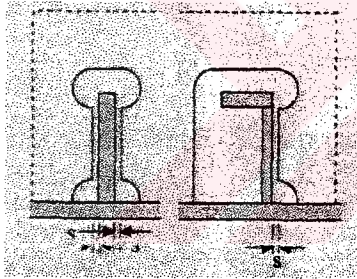
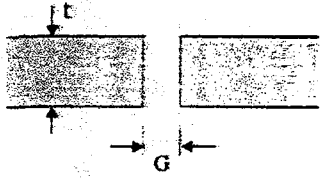
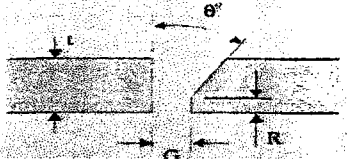
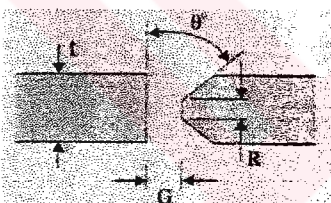
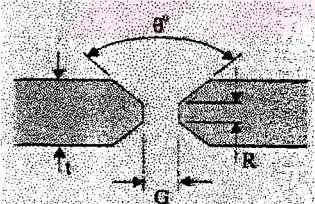
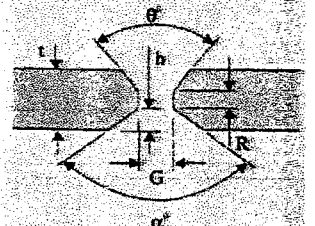
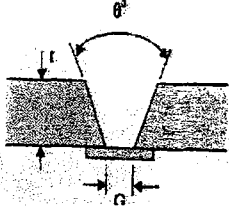
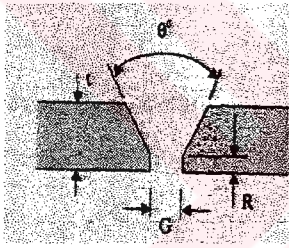
Detail	Standard	Limit	Remarks
Gap between beam and frame 	$a \leq 2,0 \text{ mm}$		
Position of scallop 	$d \geq 75 \text{ mm}$		
Gap around stiffener cut-out 	$s \leq 2,0 \text{ mm}$		

TABLE 2.16 – TYPICAL BUTT WELD PLATE EDGE PREPARATION (MANUAL WELDING)

Detail	Standard	Limit	Remarks
Square butt 	$t \leq 5 \text{ mm}$ $G = 3 \text{ mm}$		See Note 1
Single bevel butt 	$t > 5 \text{ mm}$ $G \leq 3 \text{ mm}$ $R \leq 3 \text{ mm}$ $\theta = 50^\circ - 70^\circ$		See Note 1
Double bevel butt 	$t > 19 \text{ mm}$ $G \leq 3 \text{ mm}$ $R \leq 3 \text{ mm}$ $\theta = 50^\circ - 70^\circ$		See Note 1
Double vee butt, uniform bevels 	$G \leq 3 \text{ mm}$ $R \leq 3 \text{ mm}$ $\theta = 50^\circ - 70^\circ$		See Note 1
Double vee butt, non-uniform bevel 	$G \leq 3 \text{ mm}$ $R \leq 3 \text{ mm}$ $\theta = 50^\circ$ $\alpha = 90^\circ$		See Note 1

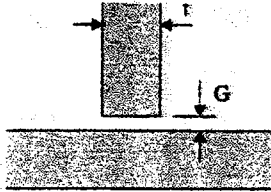
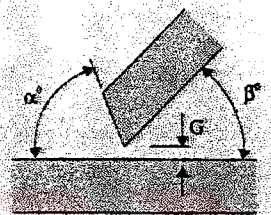
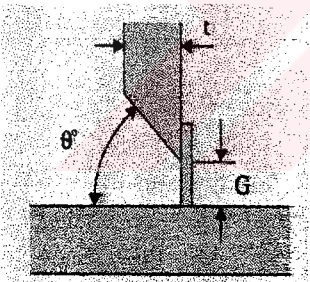
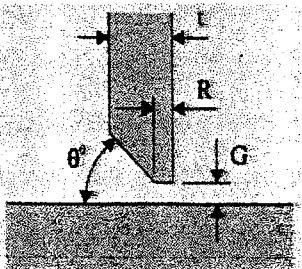
Note 1 : Different plate edge preparation may be accepted or approved by the classification Society on the basis of an appropriate welding procedure specification. For welding procedures other than manual welding, see paragraph 2.3.2 Qualification of weld procedures.

TABLE 2.17 – TYPICAL BUTT WELD PLATE EDGE PREPARATION (MANUAL WELDING)

Detail	Standard	Limit	Remarks
Single vee butt, one side welding with backing strip (temporary or permanent) 	$G = 3 - 9 \text{ mm}$ $\theta = 30^\circ - 45^\circ$		See Note 1
Single vee butt 	$G \leq 3 \text{ mm}$ $R \leq 3 \text{ mm}$ $\theta = 50^\circ - 70^\circ$		See Note 1

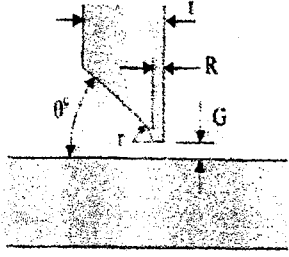
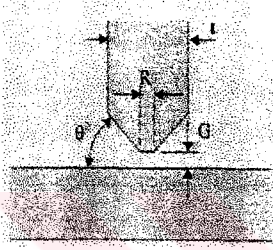
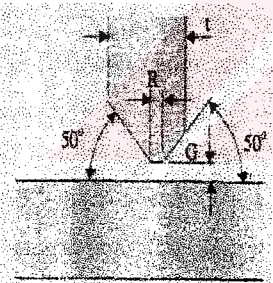
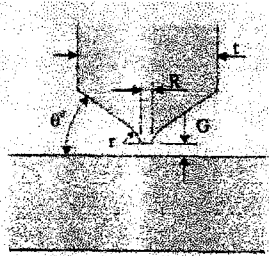
Note 1 : Different plate edge preparation may be accepted or approved by the classification Society on the basis of an appropriate welding procedure specification. For welding procedures other than manual welding, see paragraph 2.3.2 Qualification of weld procedures.

TABLE 2.18 – TYPICAL FILLET WELD PLATE EDGE PREPARATION (MANUAL WELDING)

Detail	Standard	Limit	Remarks
Tee fillet 	$G \leq 2 \text{ mm}$		See Note 1
Small angle fillet 	$\alpha = 50^\circ - 70^\circ$ $\beta = 70^\circ - 90^\circ$ $G \leq 2 \text{ mm}$		See Note 1
Single bevel tee with permanent backing 	$G \leq 4 - 6 \text{ mm}$ $\theta = 30^\circ - 45^\circ$		See Note 1 Not normally for strength members
Single bevel tee 	$G \leq 3 \text{ mm}$ $R \leq 3 \text{ mm}$ $\theta = 50^\circ$		See Note 1

Note 1 : Different plate edge preparation may be accepted or approved by the classification Society on the basis of an appropriate welding procedure specification. For welding procedures other manual welding, see paragraph 2.3.2 Qualification of weld procedures.

TABLE 2.19 – TYPICAL FILLET WELD PLATE EDGE PREPARATION (MANUAL WELDING)

Detail	Standard	Limit	Remarks
Single 'J' tee 	$G = 2,5 - 4 \text{ mm}$ $r = 12 - 15 \text{ mm}$ $R = 3 \text{ mm}$ $\theta \geq 35^\circ$		See Note 1
Double bevel tee symmetrical 	$t > 19 \text{ mm}$ $G \leq 3 \text{ mm}$ $R \leq 3 \text{ mm}$ $\theta = 50^\circ$		See Note 1
Double bevel tee asymmetrical 	$t > 19 \text{ mm}$ $G \leq 3 \text{ mm}$ $R \leq 3 \text{ mm}$		See Note 1
Double 'J' bevel symmetrical 	$G = 2,5 - 4 \text{ mm}$ $R \leq 3 \text{ mm}$ $r = 12 - 15 \text{ mm}$ $\theta \geq 35^\circ$		See Note 1

Note 1 : Different plate edge preparation may be accepted or approved by the classification Society on the basis of an appropriate welding procedure specification. For welding procedures other manual welding, see paragraph 2.3.2 Qualification of weld procedures.

TABLE 2.20 – TYPICAL BUTT AND FILLET WELD PROFILE (MANUAL WELDING)

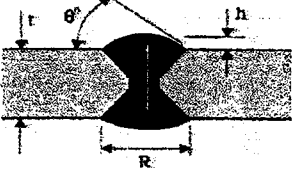
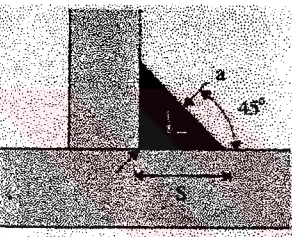
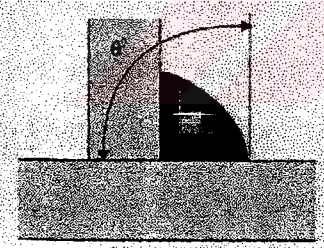
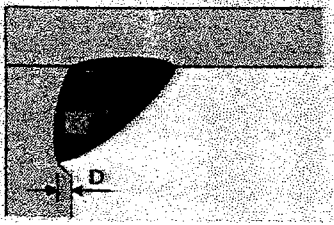
Detail	Standard	Limit	Remarks
Butt weld toe angle 	$\theta \leq 60^\circ$ $h \leq 0,2R$	Maximum $h \leq 6 \text{ mm}$	
Butt weld undercut 	$D = 0 \text{ mm}$	$0,5 \text{ mm}$	
Fillet weld leg length 	$s = \text{leg length}$ $a = \text{throat depth}$	$s \geq 0,9 s_d$ $a \geq 0,9 a_d$ over short weld lengths	$s_d = \text{design } s$ $a_d = \text{design } a$
Fillet weld toe angle 		$\theta \leq 90^\circ$	In areas of stress concentration and fatigue, the Class Society may require a lesser angle
Fillet weld undercut 	$D = 0 \text{ mm}$	$0,5 \text{ mm}$	

TABLE 2.21 – TYPICAL LAP, PLUG AND SLOT WELDING (MANUAL WELDING)

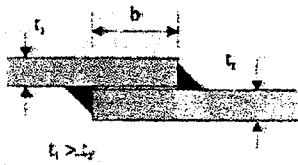
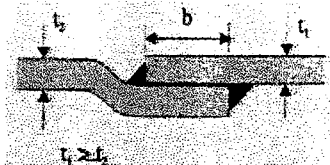
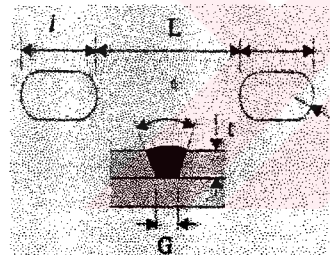
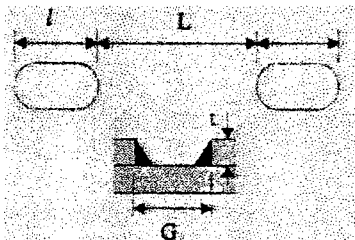
Detail	Standard		Limit	Remarks
Fillet weld in lap joint 	$b = 2t_2 + 25 \text{ mm}$			Location of lap joint to be approved by the Classification Society
Fillet weld joggled lap joint 	$b \geq 2t_2 + 25 \text{ mm}$			
Plug welding 	L	$t \leq 12 \text{ mm}$ 60 mm	$12 \leq t \leq 25 \text{ mm}$ 80 mm	
	R	6 mm 40° - 50°	0,5t mm 30°	
	G	12 mm	t mm	
	L		> 2l	
Slot welding 	G	$t \leq 12 \text{ mm}$ 20 mm	$t > 12 \text{ mm}$ 2t	
	l	80 mm	100 mm	
	L	2l – 3l max. 250 mm		

TABLE 2.22 – DISTANCE BETWEEN WELDS

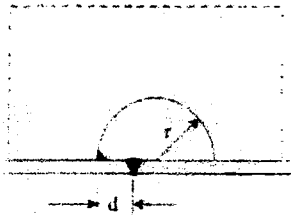
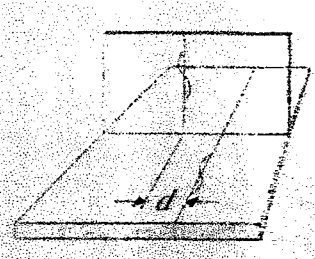
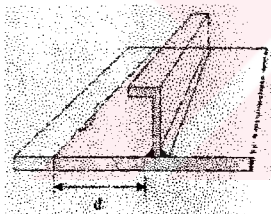
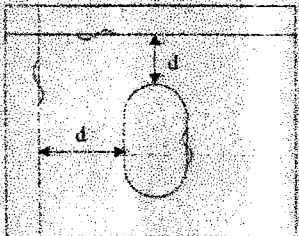
Detail	Standard	Limit	Remarks
Scallop over weld seams 	For $r \geq 30 \text{ mm}$ $d \geq 5 \text{ mm}$		
Distance between two butt welds 	$d \geq 0 \text{ mm}$		
Distance between butt weld and fillet weld 	$d \geq 10 \text{ mm}$		
Distance between butt welds 	For cut-outs $d \geq 30 \text{ mm}$		
	For margin plates $d \geq 300 \text{ mm}$	150 mm	

TABLE 2.23 –AUTOMATIC ARC WELDING

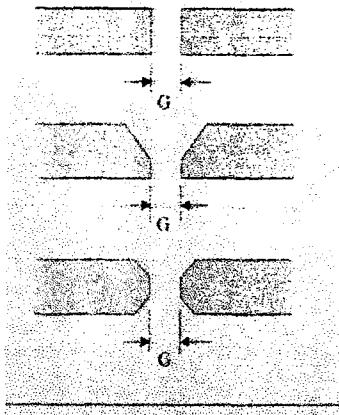
Detail	Standard	Limit	Remarks
Submerged Arc Welding (SAW) 	$0 \leq G \leq 0,8 \text{ mm}$	$G \leq 5 \text{ mm}$	Edge preparation as per Table 8.1 and 8.2 SAW may follow WPS approved by the Classification Society See Note 1

TABLE 2.24 – TYPICAL MISALIGNMENT REPAIR

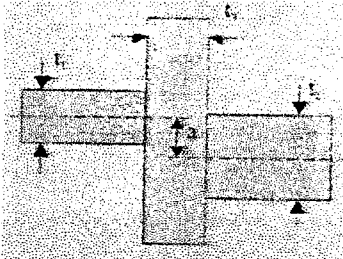
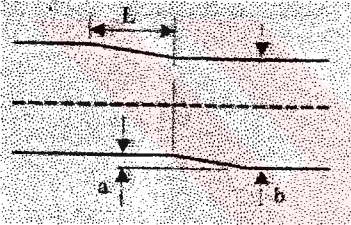
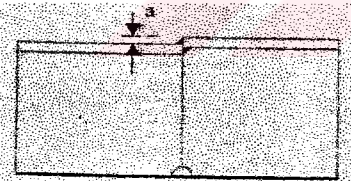
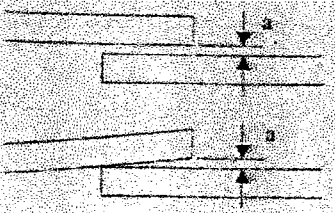
Detail	Repair Standard	Remarks
Alignment of butt joints 	Strength members $a > 0,15t_1$ or $a > 3\text{mm}$ release and adjust Others $a > 0,2t_1$ or $a > 3\text{mm}$ release and adjust	
Alignment of fillet welds 	a) strength and higher tensile steel $t_1/3 < a < t_1/2$ generally increase weld throat by 10% $a > t_1/2$ – release and adjust over a min. of 50a b) other $a > t_1/2$ – release and adjust over a min. of 30a	Where t_3 is less than t_1 , then t_3 should be substituted for t_1 in standard
Alignment of flange of T-longitudinal 	When $0,04b < a \leq 0,08b$, max. 8 mm grind corners to smooth taper over a min. distance $L = 3a$ When $a > 0,08b$ or 8 mm release and adjust over min. $L = 50a$	
Alignment of height of T-bar, L-angle bar or bulb 	When $3\text{ mm} < a \leq 6\text{ mm}$ building up by welding When $a > 6\text{ mm}$ release and adjust over min. $= 50a$ for primary structure and $L = 30a$ elsewhere	
Alignment of lap welds 	$2\text{ mm} < a \leq 5\text{ mm}$ weld leg length to be increased by the same amount as increase in gap $a > 5\text{ mm}$ members to be re-aligned	

TABLE 2.25 – TYPICAL MISALIGNMENT REPAIR

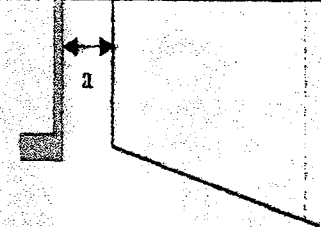
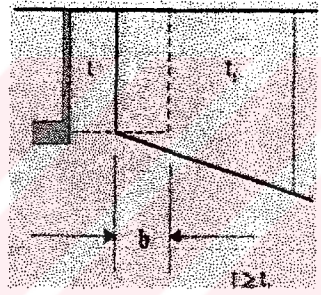
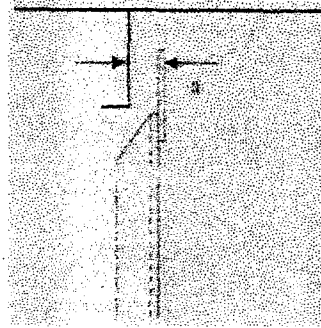
Detail	Repair Standard	Remarks
Gap between bracket/intercostal and stiffener 	When $2 \text{ mm} < a \leq 5 \text{ mm}$ weld leg length to be increased by increase gap	
	When $5 \text{ mm} < a \leq 10 \text{ mm}$ chamfer $30^\circ - 40^\circ$ and build up with welding	
	When $a > 10 \text{ mm}$ increase gap to 50 mm and fit collar plate  $b = (2t + 25) \text{ mm, min. } 50\text{mm}$	
Gap between beam and frame 	$a > 2 \text{ mm}$ release and adjust	

TABLE 2.26 – TYPICAL MISALIGNMENT REPAIR

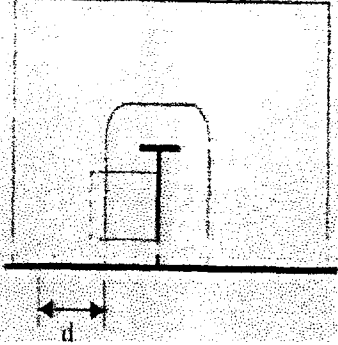
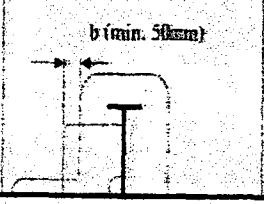
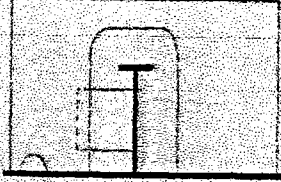
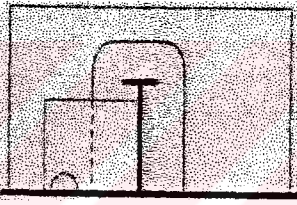
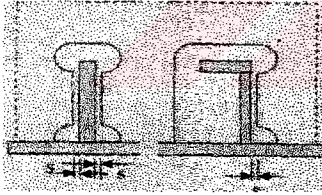
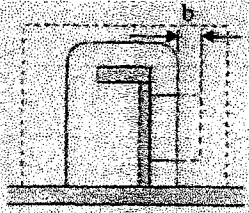
Detail	Repair Standard	Remarks
Position of scallop 	When $d < 75$ mm, web plate to be cut between scallop and slot, and collar plate to be fitted  Or fit small collar over scallop  Or fit collar plate over scallop 	
Gap between beam and frame 	When $2 \text{ mm} < s \leq 5 \text{ mm}$ weld leg length to be increased as much as increase in gap opening over 2 mm	
	When $5 \text{ mm} < s \leq 10 \text{ mm}$ nib to be chamfered and built up by welding	
	When $s > 10 \text{ mm}$ cut off nib and fit collar plate with same height as nib  $20 \text{ mm} \leq b \leq 50 \text{ mm}$	

TABLE 2.27 – TYPICAL BUTT WELD PLATE PREPARATION REPAIR (MANUAL WELDING)

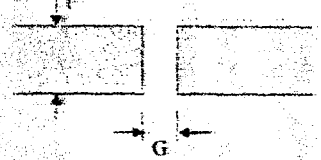
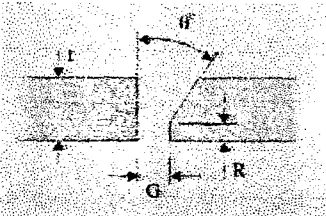
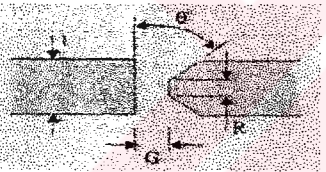
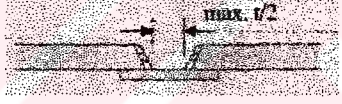
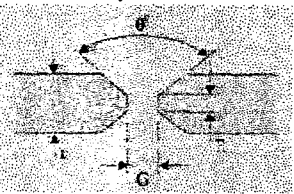
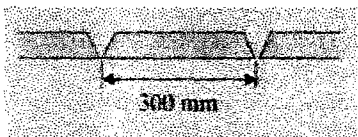
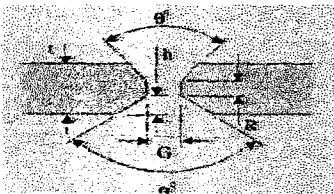
Detail	Repair Standard	Remarks
Square butt 	When $G \leq 10$ mm chamfer to 45° and build up by welding When $G > 10$ mm build up with backing strip; remove, back gouge and seal weld; or insert plate, min. width 300 mm	
Single Bevel butt 	When $3 \text{ mm} < G \leq 3t/2$ mm (max. 25mm) Build up gap with welding on one or both sides of preparation, with possible use of backing strip as necessary, to max. $t/2$. Where a backing strip is used, the backing strip is to be removed, the weld back gouged and a sealing weld made	
Double bevel butt 	 When $G > 25$ mm or $3t/2$ an insert plate, of min. width 300 mm, to be welded in place	
Double vee butt, uniform bevel 		
Double vee butt, non-uniform bevel 		

**TABLE 2.28 – TYPICAL BUTT WELD PLATE EDGE PREPARATION REPAIR
(MANUAL WELDING)**

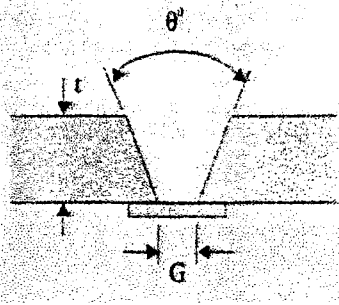
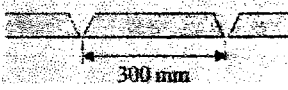
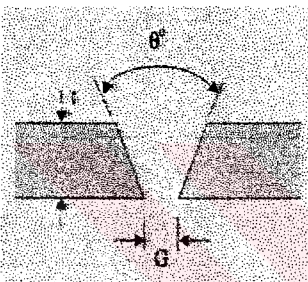
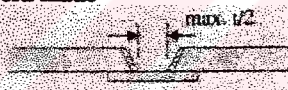
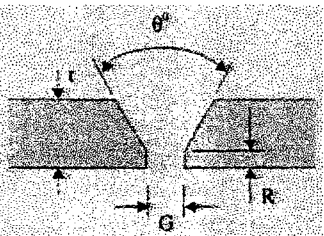
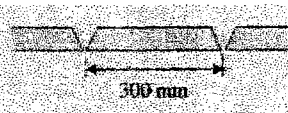
Detail	Repair Standard	Remarks
Single vee butt, one side welding with backing strip 	When $G \leq 25$ mm or $G \leq t/2$ build up edge preparation on one or both sides, grind edge preparation, weld with backing strip, remove backing strip, back gouge and back weld  When $G > 25$ mm insert plate, min. width 300 mm 	
Single vee butt, one side welding 	When $3 \text{ mm} < G \leq 3t/2$ mm (max. 25mm) Build up gap with welding on one or both sides of preparation, with possible use of backing strip as necessary, to max. $t/2$. Where a backing strip is used, the backing strip is to be removed, the weld back gouged and a sealing weld made  When $G > 25$ mm or $3t/2$ an insert plate, of min. width 300 mm, to welded in place	
Single vee butt 		

**TABLE 2.29 – TYPICAL FILLET WELD PLATE EDGE PREPARATION REPAIR
(MANUAL WELDING)**

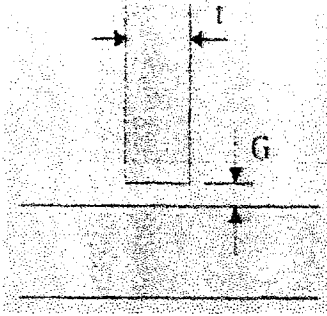
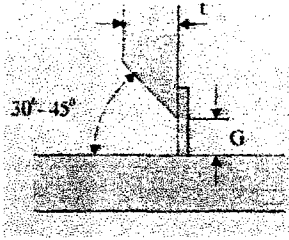
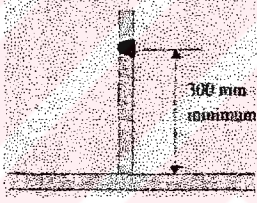
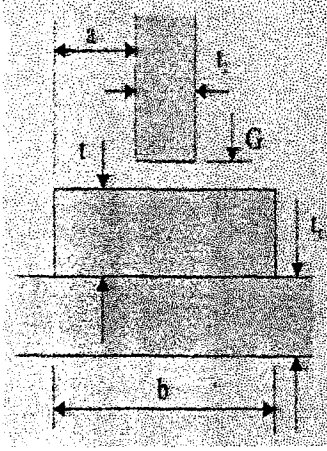
Detail	Repair Standard	Remarks
Tee Fillet	$2 \text{ mm} < G \leq 5 \text{ mm}$ – leg length increase to Rule leg + (G-2)	
	$5 \text{ mm} < G \leq 16 \text{ mm}$ – chamfer to 30° to 45° , build up with welding, on one side, with or without backing strip, grind and weld. 	
	$G > 16 \text{ mm}$ or $G > 1.5t$ – new plate to be inserted (min.300mm) 	
Liner treatment 	$t_2 \leq t \leq t_1$ $G \leq 2 \text{ mm}$ $a = 5 \text{ mm} + \text{fillet leg length}$	Not to be used in cargo area or areas of tensile stress perpendicular to liner

**TABLE 2.30 – TYPICAL FILLET WELD PLATE EDGE PREPARATION REPAIR
(MANUAL WELDING)**

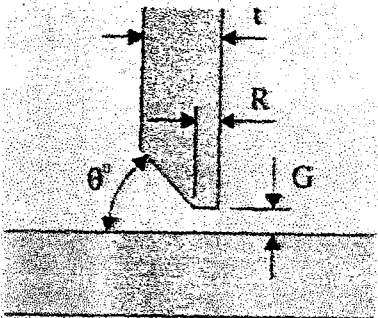
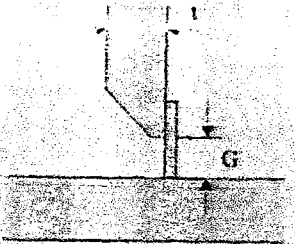
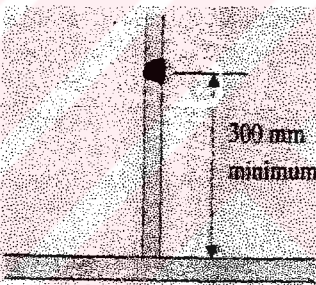
Detail	Repair Standard	Remarks
Single bevel tee	3 mm < G ≤ 5 mm build up weld	
	5 mm < G ≤ 16 mm build up with welding, with or without backing strip, remove backing strip if used, back gouge and back weld. 	
	G > 16 mm new plate to be inserted (min.300mm) 	

**TABLE 2.31 – TYPICAL FILLET WELD PLATE EDGE PREPARATION REPAIR
(MANUAL WELDING)**

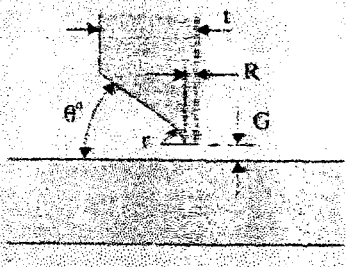
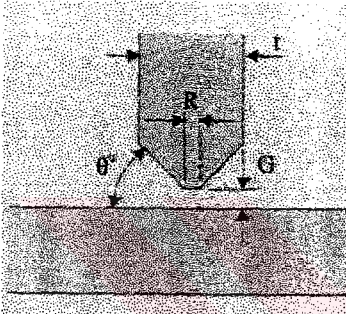
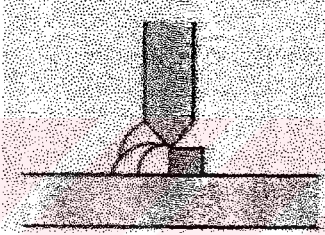
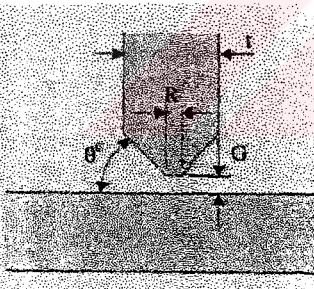
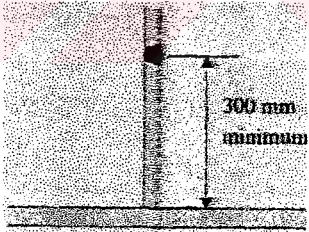
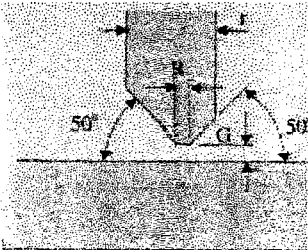
Detail	Repair Standard	Remarks
Single 'J' tee 	As single bevel tee	
Double bevel tee symmetrical 	When $3 \text{ mm} < G \leq 16 \text{ mm}$ build up with welding using ceramic or other approved backing bar, remove, back gouge and back weld. 	
Double bevel tee asymmetrical 	$G > 16 \text{ mm}$ insert plate of min. height 300mm to be fitted 	
Double J bevel symmetrical 		

TABLE 2.32 – TYPICAL FILLET AND BUTT WELD PROFILE REPAIR (MANUAL WELDING)

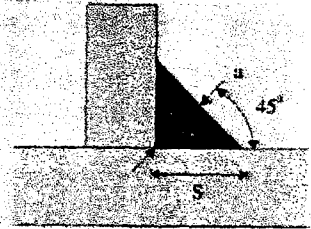
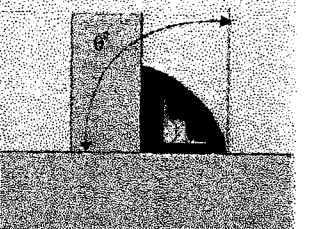
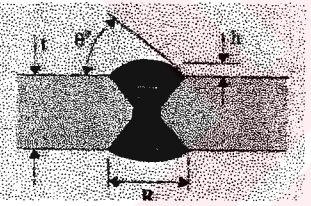
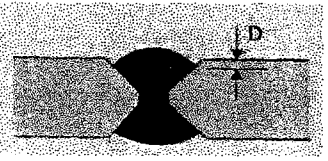
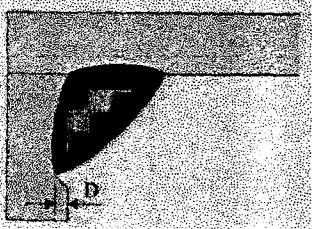
Detail	Repair Standard	Remarks
Fillet weld leg length 	Increase leg or throat by welding over	Short beads, less than 50mm, to be avoided in higher tensile steel
Fillet weld toe angle 	$\theta > 90^\circ$ grinding and welding where necessary, to make $\theta < 90^\circ$	
Butt weld toe angle 	$\theta > 90^\circ$ grinding and welding where necessary, to make $\theta < 90^\circ$	Microgrooves of ground edge to be parallel to main stress direction
Butt weld undercut 	Where $0,5 < D \leq 1$ mm undercut to be ground smooth (localized only)	
Fillet weld undercut 	Where $D > 1$ mm undercut to be filled by welding.	

TABLE 2.33 – DISTANCE BETWEEN WELDS REPAIR

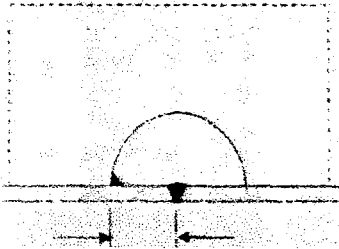
Detail	Repair Standard	Remarks
Scallops over weld seams 	Hole to be cut and ground smooth to obtain distance	

TABLE 2.34 – ERRONEOUS HOLE REPAIR

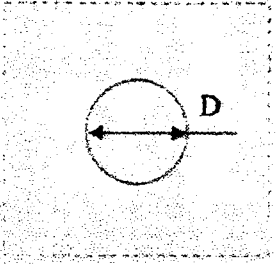
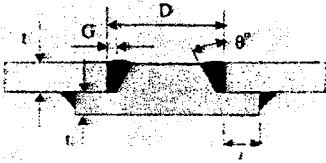
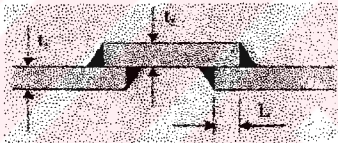
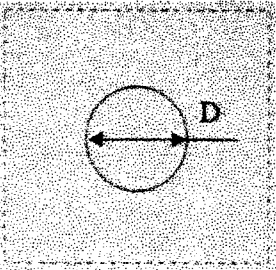
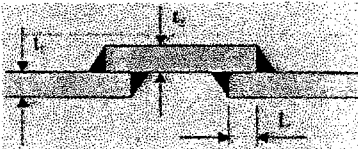
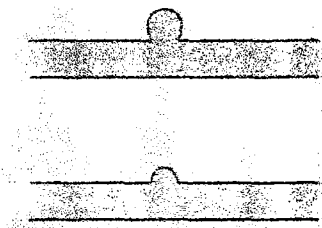
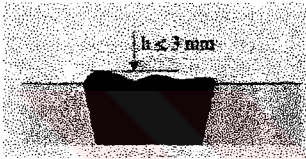
Detail	Repair Standard	Remarks
Holes made erroneously $D < 200$ mm 	Strength members open hole to min. 75mm dia. ,fit and weld spigot piece  $\theta = 30^\circ - 40^\circ$ $G = 4 - 6$ mm $1/2 t < t_1 < t$ $l = 50$ mm OR Open hole to over 300 mm and fit insert plate	Fillet weld to be made after butt weld The fitting of spigot pieces in areas of high stress concentration or fatigue is to be approved by the Classification Society
	Other members Open hole to over 300 mm and fit insert plate OR fit lap plate  $t_1 = t_2$ $L = 50$mm min.	
Hole made erroneously $D > 200$ mm	Strength members open a hole to over 300 mm and fit insert plate	
	Other members Open hole to over 300 mm and fit insert plate OR fit lap plate  $t_1 = t_2$ $L = 50$mm min	

TABLE 2.35 – REPAIR BY INSERT PLATE

Detail	Repair Standard	Remarks
Repair by insert plate	$L = 300\text{mm min.}$ $B = 300\text{mm min.}$ $R = 5t \text{ mm}$ 100 mm min. (1) seam with insert piece is to be welded first (2) original seam is to be released and welded over for a min. of 100 mm	
Repair of built section by insert plate	$L_{\min} > 300 \text{ mm}$ Welding sequence (1) → (2) → (3) → (4) Web butt weld scallop to be filled during final pass	

TABLE 2.36 – WELD SURFACE REPAIR

Detail	Repair Standard	Remarks
Weld spatter 	1. Remove spatter observed before blasting with scraper or chipping hammer, etc. 2. For spatter observed after blasting: a) Remove with a chipping hammer, scraper, etc. b) For spatter not easily removed with a chipping hammer, scraper, etc., grind the sharp angle of spatter to make it obtuse.	In principal, no grinding is applied to weld surface
Irregularity of manual weld 	When the surface irregularity exceeds 3mm, apply grinding until the irregularity becomes less than 3 mm	This repair standard is applicable to fillet welds also
Arc strike	Remove the hardened zone by grinding	

CHAPTER 3

SHIP BUILDING AND REPAIR QUALITY STANDARD FOR EXISTING SHIPS

3.1 SCOPE :

This standard provides guidance on quality of repair of hull structures. The standard covers permanent repairs as existing ships.

Whereas the standard generally applies to

- conventional ship types,
- parts of hull covered by the rules of the Classification Society,
- hull structures constructed from normal and higher strength structural steel,

the applicability of the standard in each case to be agreed upon the Classification Society.

The standard does generally not apply to repair of

- special types of ships as e.g. gas tankers,
- structures fabricated from stainless steel or other, special type or grade of steel

The standard covers typical repair methods and gives guidance on quality standard on the most important aspects of such repairs. Unless explicitly stated elsewhere in the standard, the level of workmanship reflected here in will in principle be acceptable for

primary and secondary of conventional design. A more stringent standard may however be required for critical and highly stressed areas of the hull, and is to be agreed with the Classification Society in each case. In assessing the criticality of hull structure and structural components, [4, 5, 6]

Restoration of structure to the original standard may not constitute durable repairs of damages originating from insufficient strength or inadequate detail design. In such cases strengthening or improvements beyond the original design may be required. Such improvements are not covered by this standard, [4, 5, 6]

3.2 GENERAL REQUIREMENTS FOR REPAIR AND REPAIRERS.

In general, when hull structure covered by classification is to be subjected to be repairs, the work is to be carried out under the supervision of the Surveyor to the Classification Society. Such repairs are to be agreed prior to commencement of the work.

Repairs are to be carried out by workshops, repair yards or personnel who have demonstrated their capability to carry out hull repairs of adequate quality in accordance with the Classification Society's requirements and this standard.

Repairs are to be carried out under working conditions that facilitate sound repairs. Provisions are to be made for proper accessibility, staging, lighting and ventilation. Welding operations are to be carried out under shelter from rain, snow and wind.

Welding of hull structures is to be carried out by qualified welders, according to approved and qualified welding procedures and with welding consumable approved by the Classification Society, see section 3.3. Welding operations are to be carried out under supervision of the repair yard.

Where repairs to hull which affect or may affect classification are intended to be carried out during a voyage, complete repair procedure including the extent and

sequence of repair is to be submitted to and agreed upon by the Survey to the Classification Society reasonably in advance of repairs. [7]

3.3 QUALIFICATION OF PERSONNEL :

3.3.1 Qualification Of Welders

Welders are to be qualified in accordance with the procedures of the Classification Society or to a recognized national or international standard, e.g. EN 287, ISO 9606, ASME Section IX, ANSI/AWS D1.1. Recognition of other standards is subject to submission to the Classification Society for evaluation. Repair yards and workshops are to keep records of welder's qualification and, when required, furnish valid approval test certificates.

Welding operators using fully mechanized or fully automatic processes need generally not pass approval testing, provided that production welds made by the operators are of the required quality. However, operators are to receive adequate training in setting or programming and operating the equipment. Records of training and production test results shall be maintained on individual operator's files and records, and made available to the Classification Society for inspection when requested.

3.3.2 Qualification Of Welding Procedures

Welding procedures are to be qualified in accordance with the procedures of the Classification Society or to a recognized national or international standard, e.g. EN 287, ISO 9606, ASME Section IX, ANSI/AWS D1.1. Recognition of other standards is subject to submission to the Classification Society for evaluation. The welding procedure should be supported by a welding procedure qualification record. The specification is to include the welding process, type of electrodes, weld shape, edge preparation, welding techniques and positions.

3.3.3 Qualification Of NDE Operators

Personnel performing non-destructive examination for the purpose of assessing quality of welds in connection with repairs covered by this standard are to be qualified in accordance with the Classification Society rules or to a recognized international or national qualification scheme. Records of operators and their current certificates are to be kept and made available to the Surveyor for inspection.

3.4 MATERIAL.

3.4.1 General Requirements For Material

The requirements for materials used in repair are general the same as the requirements for materials specified in the Classification Society's rules for new constructions[8]

Replacement material is in general to be of the same grade as the original approved material. Alternatively, material grades complying with recognized national or international standards may be accepted by the Classification Societies provided such standards give equivalency of the original grade or are agreed by the Classification Society. For assessment of equivalency between steel grades, the general requirements and guidelines in Section 3.4.2 apply.

Higher tensile steel is not be replaced by steel of lesser strength unless specially approved by the Classification Society.

Normal and higher strength hull structure steels are to be manufactured at works approved by the Classification Society for the type and grade being supplied.

Materials used in repairs are to be certified by the Classification Society applying the procedures and requirements in the rules for new constructions. In special cases, and normally limited to small quantities, materials may be accepted on the basis of alternative procedures for verification of the material's properties. Such procedures are subjected to agreement by the Classification Society in each separate case.

3.4.2 Equivalency Of Material Grades

Assessment of equivalency between material grades should at least include following aspects;

- heat treatment / delivery condition
- chemical composition
- mechanical properties
- tolerances

When assessing the equivalence between the grades of normal or higher strength hull structural steels up to and including grade E40 in thickness limited to 50 mm. The general requirements in Table 3.1 apply.

Guidance on selection of steel grades to certain recognized standards equivalent to hull structural steel grades specified in Classification Societies rules is given in Table 3.2.

3.5 GENERAL REQUIREMENTS TO WELDING

3.5.1 Correlation Of Welding Consumable With Hull Structural Steels.

For the different hull structural steel grades welding consumable are to be selected in accordance with IACS UR W17 [8]

3.5.2 General Requirements To Pre-heating And Drying Out

The need for pre-heating is to be determined base on the chemical composition of the materials, welding process and procedures and degree of joint restraint.

A minimum pre-heat of 50°C is to be applied when ambient temperature is below 0°C. Dryness of the welding zone is in all cases to be ensured.

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A minimum pre-heat of 50°C is to be applied when ambient temperature is below 0°C.

Dryness of the welding zone is in all cases to be ensured.

Guidance on recommended minimum pre-heating temperature for higher strength steel is given in table 3.3. For automatic welding processes utilizing higher heat input e.g. sub-merged arc welding, the temperatures may be reduced by 50°C. For re-welding or repair of welds, the stipulated values are to be increased by 25.

Table 3.1: Minimum extent and requirements to assessment of equivalency between normal or higher strength hull structural steel grades

Items to be consider	Requirements	Comments
Chemical composition	• C ; equal or lower • P and S ; equal or lower • Mn ; approximately the same but not exceeding 1,6% • Fine grain elements ; in the same amount • De-oxidation practice	The sum of the elements, e.g. Cu, Ni, Cr and Mo should be not exceed 0,8%
Mechanical properties	• Tensile strength ; equal or higher • Yield strength ; equal or higher • Elongation ; equal or higher • Impact energy ; equal or higher at same or lower temperature, where applicable	Actual yield strength should not exceed Classification Society Rule minimum requirements by more than 80 N/mm ²
Condition of supply	Same or better	Heat treatment in increasing order ; • As rolled (AR) • Controlled rolled (CR) • Normalized (N) • Thermo-mechanically rolled (TM¹) • Quenched and tempered (QT¹) 1) TM- and QT- steels are not suitable for hot forming
Tolerances	- Same or stricter	Permissible under thickness tolerances; • Plates : 0,3 mm • Sections : according to recognized standards

3.5.3 Dry Welding On Hull Plating Below The Waterline Of Vessels Afloat

Welding on hull plating below the waterline of vessels afloat is acceptable only on normal and higher strength steels with specified yield strength not exceeding 355 MPa and only for local repairs. Welding involving other high strength steels or more extensive repairs against water backing is subjected to special consideration and approval by the Classification Society of the welding procedure.

Low-hydrogen electrodes or welding processes are to be used when welding on hull plating against water backing. Coated low-hydrogen electrodes used for manual metal arc welding should be properly conditioned to ensure a minimum of moisture content.

In order to ensure dryness and to reduce the cooling rate, the structure is to be pre-heated by a torch or similar prior to welding, to a temperature of minimum 5°C or as specified in the welding procedure.

Table 3.2 Guidance on steel grades comparable to the normal and high strength steel grades given in Classification Society rules

Steel grades according to Classification Society's rule [8]						Comparable steel grades			
Grade	Yield stress R_{eH} min. N/mm ²	Tensile strength R_m N/mm ²	Elongation A_5 min. %	Average impact energy Temp. °C	Impact J, min. L T	ISO 630 – 80 4950/2/3 1981	EN EN 10025-93 EN10113-93	ASTM A131	JIS G 3106
A				+20	-- --	Fe 360B	S235JRG2	A	SM41B
B				0	27 20	Fe 360C	S235J0	B	SM41B
D	235	400 - 502	22	-20	27 20	Fe 360D	S235J2G3	D	(SM41C)
E				-40	27 20	--	S275NL/ML	E	--
A27				0		Fe 430C	S275J0G3	--	--
D27	265	400 - 530	22	-20	27 20	Fe 430D	S275N/M	--	--
E27				-40			S275NL/ML	--	--
A32				0		--	--	AH32	SM50B
D32				-20		--	--	DH32	(SM50C)
E32	315	440 - 590	22	-40	31 22	--	--	EH32	--
A36				0		Fe 510C	S355N/M	AH36	SM53B
D36				-20		Fe510D	S355N/M	DH36	(SM53C)
E36	355	490 - 620	21	-40	34 24	E355E	S355NL/ML	EH36	--
A40				0		E390CC	S420N/M	AH40	(SM 58)
D40				-20		E390DD	S420N/M	DH40	--
E40	390	510 - 650	20	-40	41 27	E390E	S420NL/ML	EH40	--

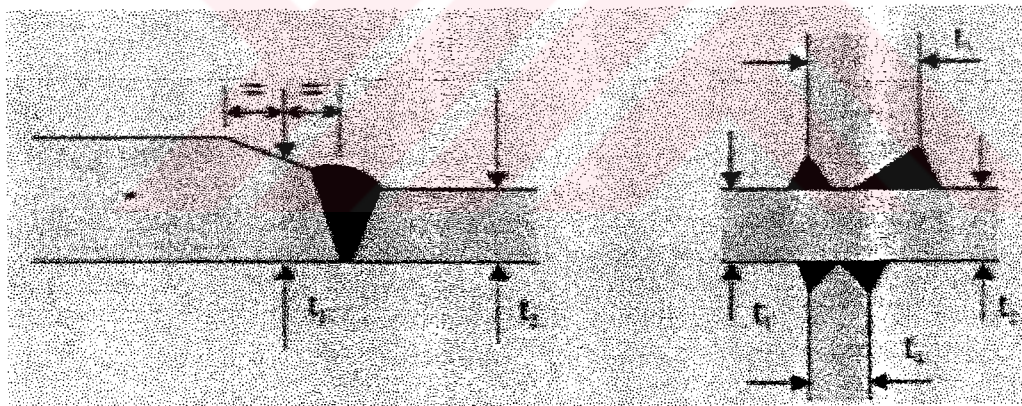
Note: In selection comparable steels from this table, attention should be given to the requirements of Table 3.1 and the dimension requirements of the product with respect to Classification Society rules

Table 3.3 Pre-heating temperature

Carbon equivalent ²⁾	Recommended minimum pre-heat temperature (°C)		
	$t_{\text{comb}} \leq 50\text{mm}^{\text{3)}$	$50\text{mm} \leq t_{\text{comb}} \leq 70\text{mm}^{\text{3)}$	$t_{\text{comb}} \geq 70\text{mm}^{\text{3)}$
$\text{Ceq} \leq 0,39$	--	--	0
$\text{Ceq} \leq 0,41$	--	--	7
$\text{Ceq} \leq 0,43$	--	50	100
$\text{Ceq} \leq 0,45$	50	100	125
$\text{Ceq} \leq 0,47$	100	125	150
$\text{Ceq} \leq 0,50$	125	150	175

Notes :

$$\text{Ceq} = \text{C} + \frac{\text{Mn}}{6} + \frac{\text{Cr} + \text{Mo} + \text{V}}{5} + \frac{\text{Ni} + \text{Cu}}{15} \quad (\%) \quad [2]$$

Combined thickness $t_{\text{comb}} = t_1 + t_2 + t_3 + t_4$, see figure 3.1**Fig. 3.1 Pre-heating temperature application**

3.6 Repair Quality Standard

3.6.1 Welding , general

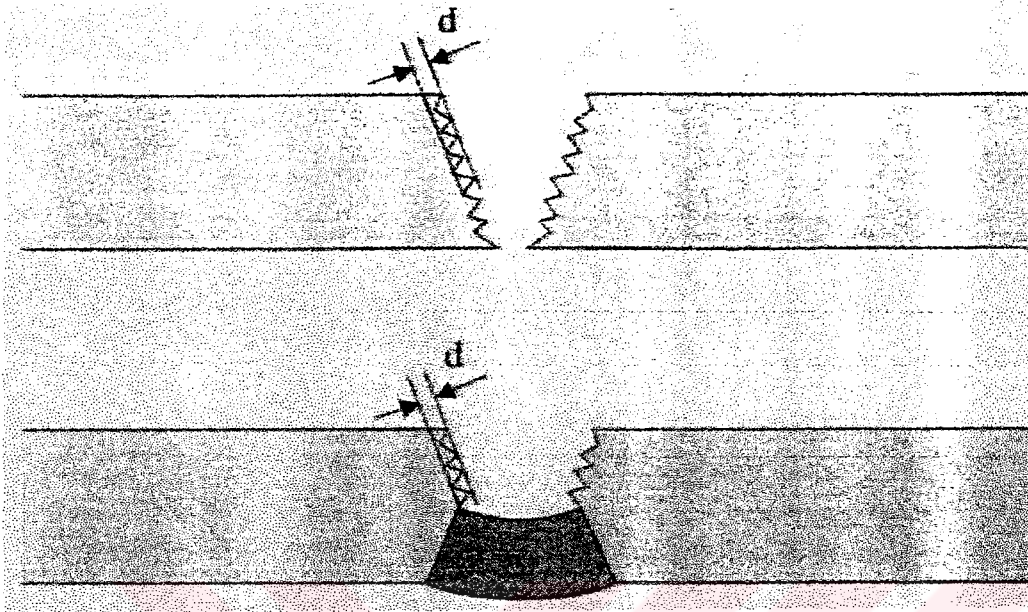


Fig.3.2 Groove roughness

Roughness of the groove should be shown in fig 3.2 and the details shown in table below.

Item	Standard	Limit	Remarks
Material grade	Same as original or higher		See Section 3.4
Welding Consumable	IACS UR-W17 [11]	Approval according to equivalent international standard	
Groove / roughness	See note and Fig. 3.2		Grind smooth
Pre-heating	See Table 3.3	Steel temperature not lower than 5°C	
Welding with water on outside	See Section 3.5.3	Acceptable for normal and high strength steel	Moisture to be removed by a heating torch
Alignment	As for new construction		
Weld finish	IACS guide for Inspection of ship hull		
NDE	IACS guide [10]	At random with extent to be agreed with attending surveyors	

Note: Slag, grease, loose mill scale, rust and paint, other than primer, to be removed

3.6.2 Renewal Of Plates

During the plate renewal deformation will take place unless sequence is not followed.

The welding sequence for inserts shown fig.3.3.

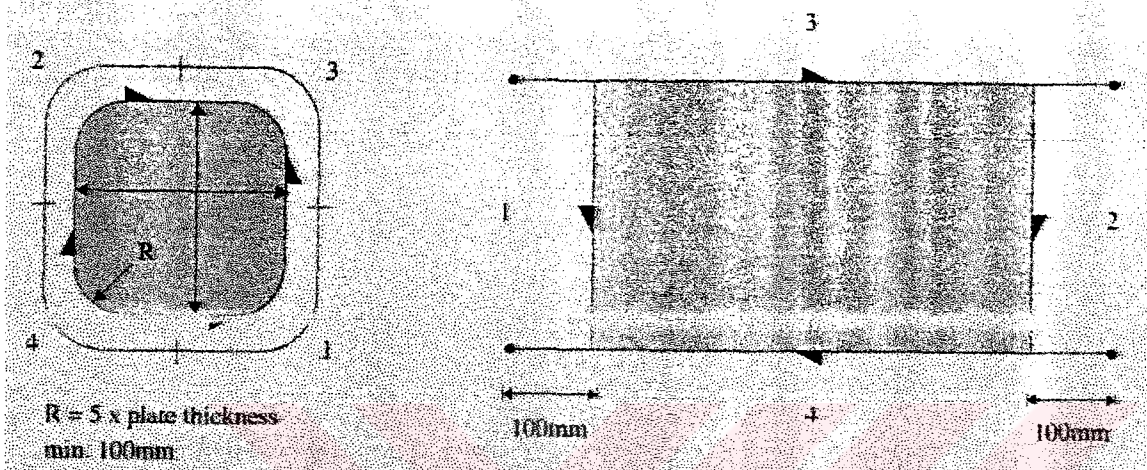


Fig. 3.3 Welding sequence for inserts

Item	Standard	Limit	Remarks
Size insert	Min. 300 x 300 mm R = 5 x thickness Circular inserts; D _{min} = 200mm	Min. 200 x 200 mm Min R = 100 mm	
Material grade	Same as original or higher		See Section 3.4
Edge Preparation	As for new construction		In case of non compliance increase the amount of NDE
Welding sequence	See fig. 3.3 Weld sequence is 1 → 2 → 3 → 4		For primary members sequence 1 and 2 traverse to the main stress direction
Alignment	As for new construction		
Weld finish	IACS guide for inspection of ship hull welds [10]		
NDE	IACS guide [10]		

3.6.3 Doubler On Plating

Local doublers are normally only allowed as temporary repairs, except as original compensation for openings, within the main hull structure.

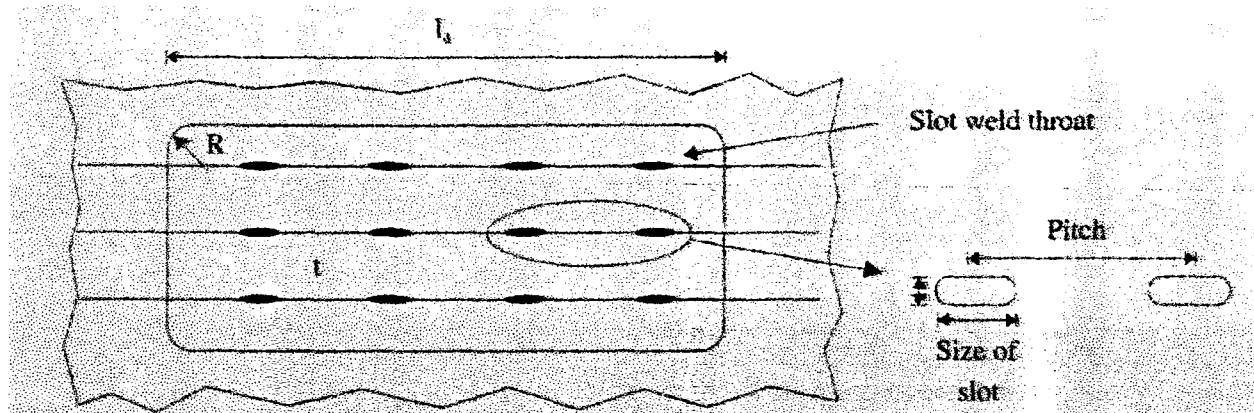


Fig. 3.4 Doublers on plates

Item	Standard	Limit	Remarks
Existing plating		General : $t \geq 5\text{ mm}$	For areas where existing plating is less than 5 mm plating a permanent repair by insert is to be carried out.
Extent / size	Rounded off corners	Min. 300 x 300 mm $R \geq 50\text{ mm}$	
Thickness of doubler (t_d)	$t_d \leq t_p$ (t_p = original thickness of existing plating)	$t_d > t_p/3$	
Material grade	Same as original plate		See Section 3.4
Edge preparation	As for [new building] new construction		Doublers welded on primary strength members : (Le: Leg length) when $t > L_e + 5\text{ mm}$, the edge to be tapered
Welding	As for [new building] new construction		Welding sequence similar to insert plates
Weld size (throat thickness)	Circumferencial and in slots : $0,6 t_d$		
Slot welding	Normal size of slot : $(80 - 100) \times 2 t_d$ Distance from doubler edge and between slots: $d \leq 15 t_d$	Max pitch between slots 200 mm $d_{\text{Max}} = 500\text{ mm}$	For doubler extended over several supporting elements, see fig.3.4
NDE	IACS Recommendation 20 [10]		

3.6.4 Renewal Of Internals / Stiffeners

To avoid deformation during the renewal of stiffeners, sequence has to be followed, fig.3.5

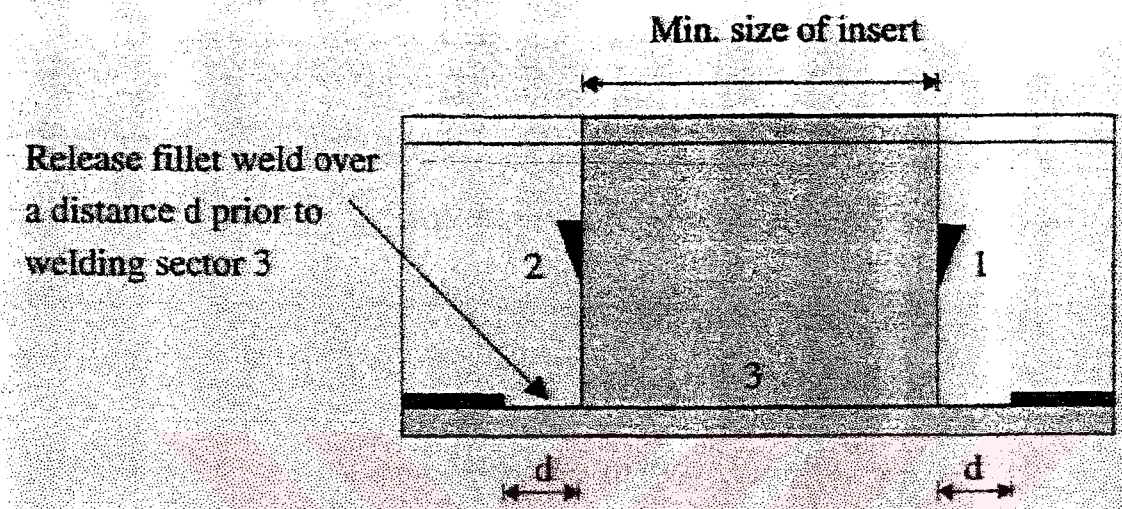


Fig. 3.5 Welding sequence for inserts of stiffeners

Item	Standard	Limit	Remarks
Material	Min. 300mm	Min. 200 mm	
Material grade	Same as original		See Section 3.4.
Edge preparation	As for [new building] new construction. Fillet weld stiffener web/plate to be released over min. $d = 150$ mm		
Welding sequence	See fig.3.5 weld sequence is 1 $\rightarrow$ 2 $\rightarrow$ 3 $\rightarrow$ 4		
Alignment	As for new construction		
	IACS guide for inspection of ship hull welds [10]		
NDE	IACS Recommendation 20 [10]		

3.6.5 Renewal Of Internals / Stiffeners – Transitions Inverted Angle/Bulb Profile

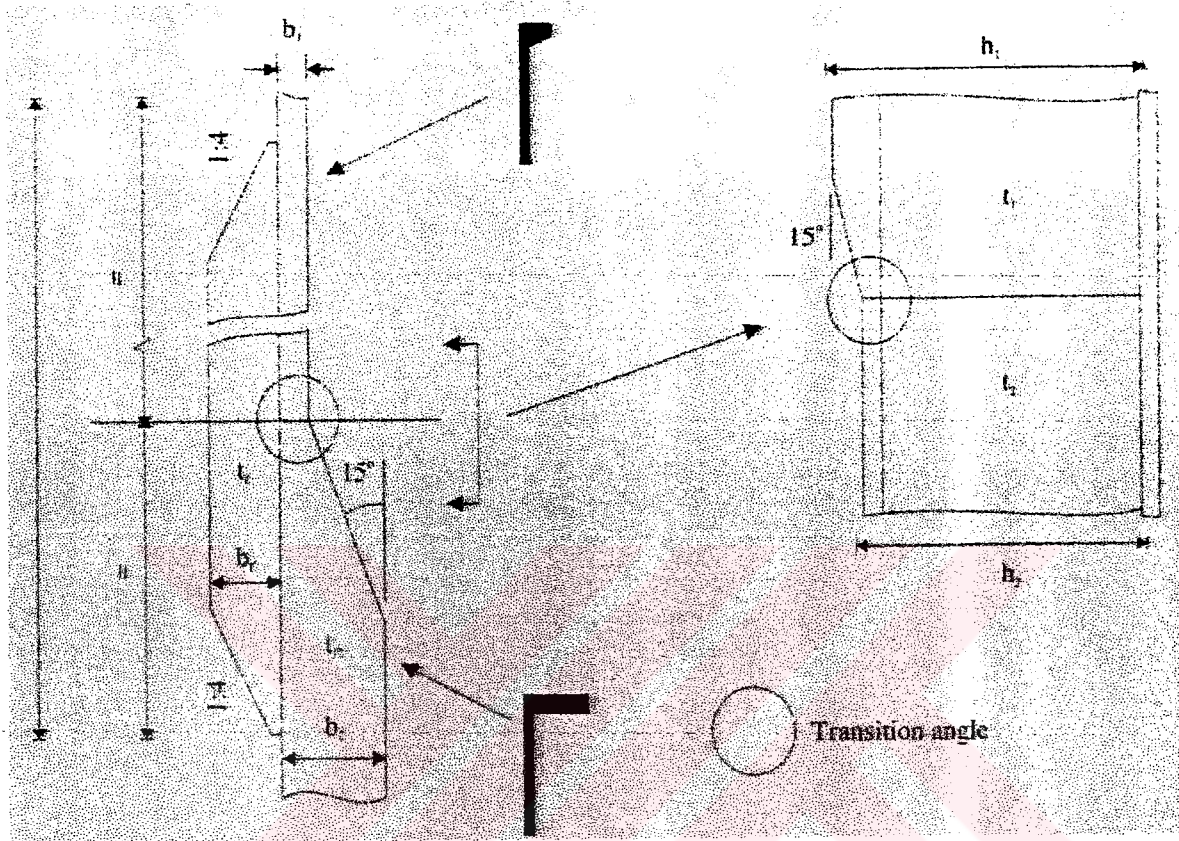


Fig. 3.6 Transition between inverted angle and bulb profile

Item	Standard	Limit	Remarks
$(h_1 - h_2)$	$\leq 0,25 \times b_1$		
$ t_1 - t_2 $	2 mm		Without tapering transition
Transition angle	15 degrees		At any arbitrary section
Flanges	$t_f = t_{f2}$ $b_f = b_{f2}$		
Length of flat bar	$4 \times h_1$		
Material			See Section 3.4

3.6.6 Termination Of Straps

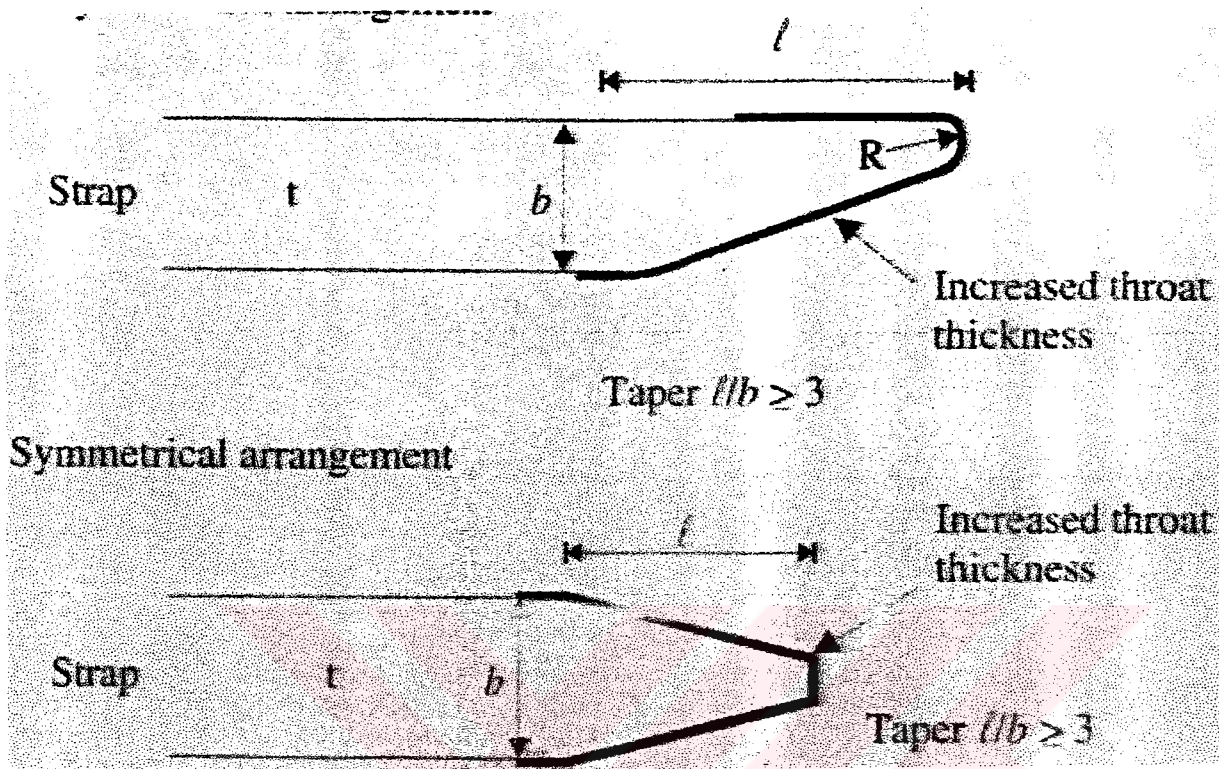


Fig. 3.7 Termination of straps

Item	Standard	Limit	Remarks
Tapering	$lb > 3$		Special consideration to be drawn to design of strap termination's in fatigue sensitive areas.
Radius	$0,1 \times b$	Min. 30 mm	
Material			See section 3.4.1 General requirements for material
Weld size			Depending on number and function of straps. Throat thickness to be increased 15% toward ends.
Welding	Welding sequence from middle towards the free ends		See sketch. For welding of length $> 1.000\text{mm}$ step welding to be applied

3.6.7 Welding Of Pitting Corrosion

Filling of pits by welding shown in fig.3.8

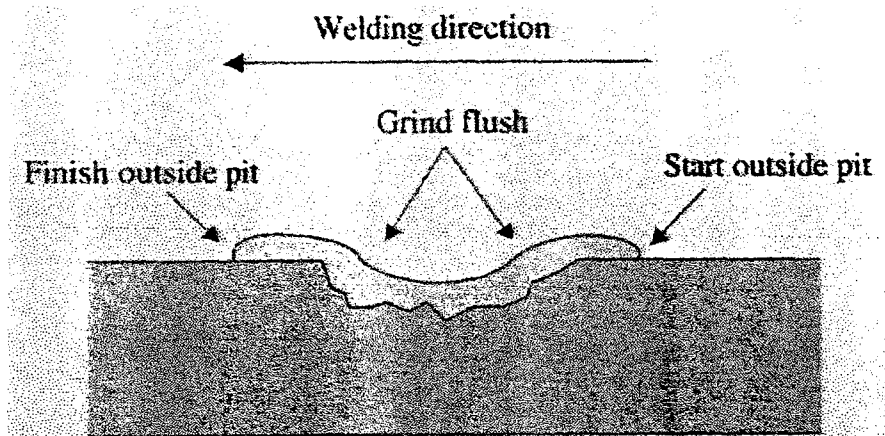


Fig. 3.8 Welding of pits

Item	Standard	Limit	Remarks
Extent/depth	Pits/grooves are to be welded flush with the original surface.	If deep pits or grooves are clustered together or remaining thickness is less than 6 mm, the plate should be renewed	See also IACS recommendation 12 [11]
Cleaning	Heavy rust to be removed		
Pre-heating	See Table 3.3	Required when ambient temperature < 5°C	Always used propane torch or similar to remove any moisture
Welding sequence	Reverse direction for each layer		See also IACS guide no.12
Weld finish	IACS guide for inspection of ship hull welds [10]		
NDE	IACS guide [10]	Min. 10% extent	Preferably MPI

Notes: Shallow pits may be filled by applying coating or pit filler. Pits can be defined as shallow when their depth is less than 1/3 of the original plate thickness.[5 & 6]

3.6.8 Welding Repair Of Cracks

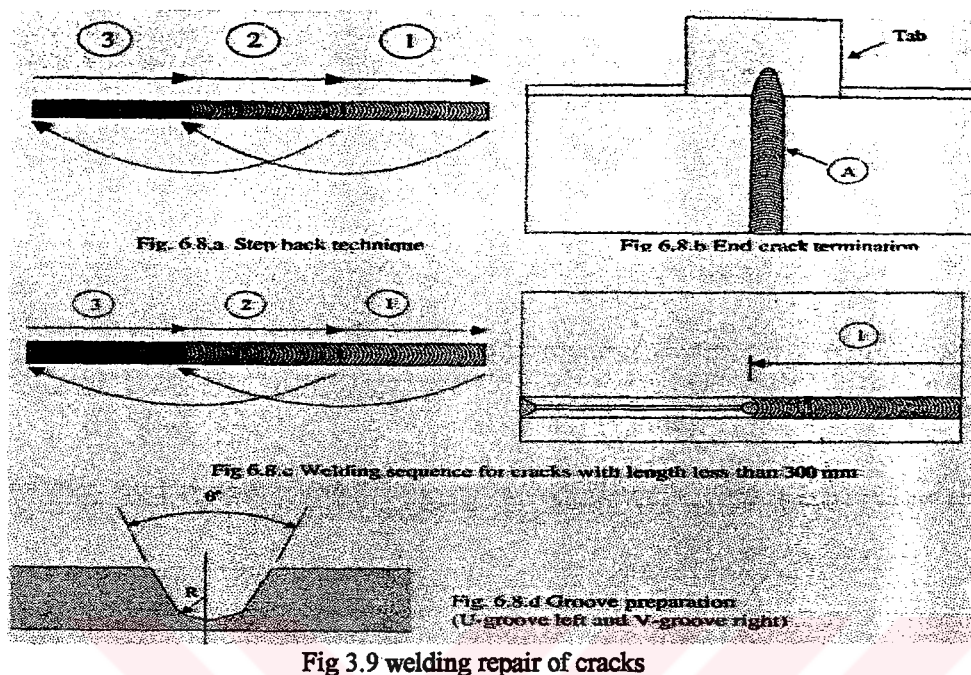


Fig 3.9 welding repair of cracks

Item	Standard	Limit	Remarks
Groove preparation	$\theta = 45 - 60^\circ$		For through plate cracks as for new building. Else see fig.3.9d
Termination	Termination to have slope 1:3		For cracks ending on edges weld to be terminated on a tab see fig.3.9b
Extent	On plate max. 400 mm length. Vee out 50 mm past end of crack	On plate max. 500 mm. Linear crack, not branched	
Welding sequence	See fig.3.9c for sequence and direction	For cracks longer than 300 mm step-back technique should be used fig.3.9a	Always use low hydrogen welding consumable
Weld finish	IACS guide for inspection of ship hull welds. [10]		
NDE	IACS guide [10]	100% MP or PE of groove	100% surface crack detection + UE or RE for butt joints

3.6.9 Grinding Of Shallow Cracks

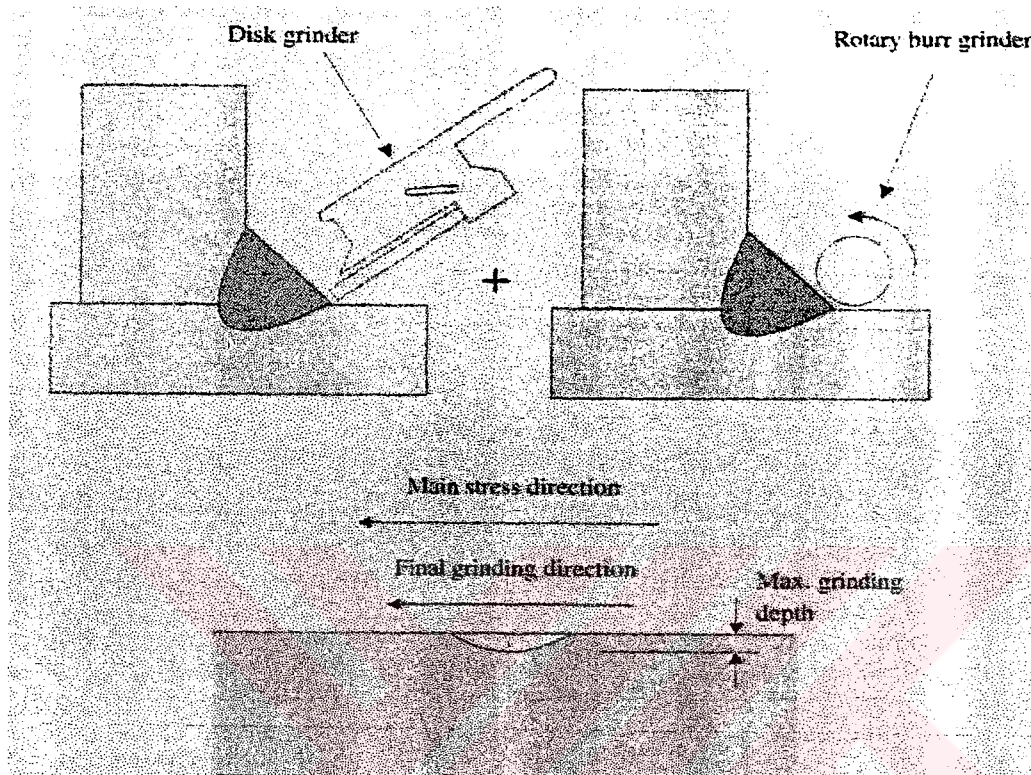


Fig. 3.10 Grinding

Item	Standard	Limit	Remarks
Extent	For short cracks only max. 4 t t = Plate thickness	Max. length 100 mm	See also IACS recommendation 12 [12]
Grinding direction	Final grinding micro-groves parallel to main stress direction		Grinding always to be finished by rotating burr and not a disk grinder
Grinding depth	Max. 0,2t t = plate thickness		Always smooth transition
NDE	IACS guide [10]		100% MPI

CHAPTER 4

MAJOR PROCESSES OF SHIP - BUILDING

4.1 CUTTING / FORMING PROCESS

4.1.1 Control Of Steel Materials

When steel materials are transferred to shot blasting/priming process from steel stock area, the designed steel materials are correctly selected and supplied by comparing the identification numbers of the steel materials with the “Cutting Specification”

After blasting/priming, the necessary identifications such as project no., block no., grade and applied cutting station no., are marked down on the primed steel materials.

At the cutting stage, the part numbers of each cut steel pieces are clearly marked according to the cutting drawing.

Accuracy control of steel members is always exercised in process to minimize welding gaps.

Following items are to be checked in this process.

Stage	Check Point	Remarks
Blasting/priming	a. Thickness and grade of plates, bars and shaped angles, etc. b. Surface defects such as pitting or flaking	For random
Marking	a. Arrangement of elements b. Precision of mould line c. Drawing information	
Gas cutting	a. Condition of cutting surface Slag removal Notch b. Dimensions after cutting for random	For random

4.1.2. Forming

- Mechanical bending

Shell plates having cylindrical shapes are generally formed by a hydraulic press using universal jigs with template tables.

- Hot bending

The plate having compound curves is firstly formed by the mechanical bending and finally formed by hot bending with line-heating or spot-heating.

The applied temperature in hot bending is controlled by mean of temperature sensitive chalk (Templistic) according to the following table.

Steel type	Cooling method	Standard range (°C)
High tensile 50kg/mm ² grade	Water cooling Air cooling	
Steel A to D grade	Water cooling or air cooling	
Steel E grade	Water cooling or air cooling	

- Major check points
 - a. Heating temperature
 - b. Accuracy of bending

4.2 ASSEMBLY

4.2.1 Sub-assembly

For good working access in block assembly, internal structures such as floor, bulk head deck and large brackets, etc. are built up prior to block assembly.

After completion of sub-assembly work, the sub-assembly is inspected in the presence of Classification surveyor and Client's representative, if necessary. Then necessary leakage tests on the fillet weld parts where water-tight is required are carried out by means of fillet air test, vacuum test or other method which are provide the tightness of welded part.

4.2.2 Assembly

Generally, flat shell plates are welded by automatic welding machine and curved shell plates are welded by manual welding and/or semi-automatic welding machines. The completion of blocks such as fore and aft parts should be assembled with great care to acquire the acceptable accuracy of dimensions.

After completion of assembly work, the assembly is inspected in the presence of Classification surveyor and Client's representative. Then, necessary leakage tests on the fillet weld parts where water-tight is required are carried out by means of fillet air test, vacuum test or other method which proved the tightness of welded part.

4.2.3 Major Check Points At Assembly Process

- a) Shape of cutting surface.

- b) Accuracy of dimensions as single part.
- c) Precision of 100 mark for fitting.
- d) Position alignment of part to the principle line/right angle.
- e) Position of scallops or butt line in way of bracket toe.
- f) Collar or carling as per drawing.
- g) Position and size of lighting holes, air holes, etc.
- h) Any damages caused by cutting.
- i) Amount, direction of cutting allowance.
- j) Removing unnecessary pieces.
- k) Lapped-length of lap joint.
- l) Radius in way of square hole.
- m) Precision of centerline, water line, buttock line and/or control line.
- n) Welding condition (refer to Para.3.5. "Welding Control")
- o) Basic dimension as final.

4.2.4 Fillet Air Test

After completion of welding, compressed air is injected to the fillet/p.p weld joints through plug piece, and inside air pressure should be checked with pressure gauge as shown on the following figure 4.1. Leakage can be detected by spraying soapy water solution on the weld joints

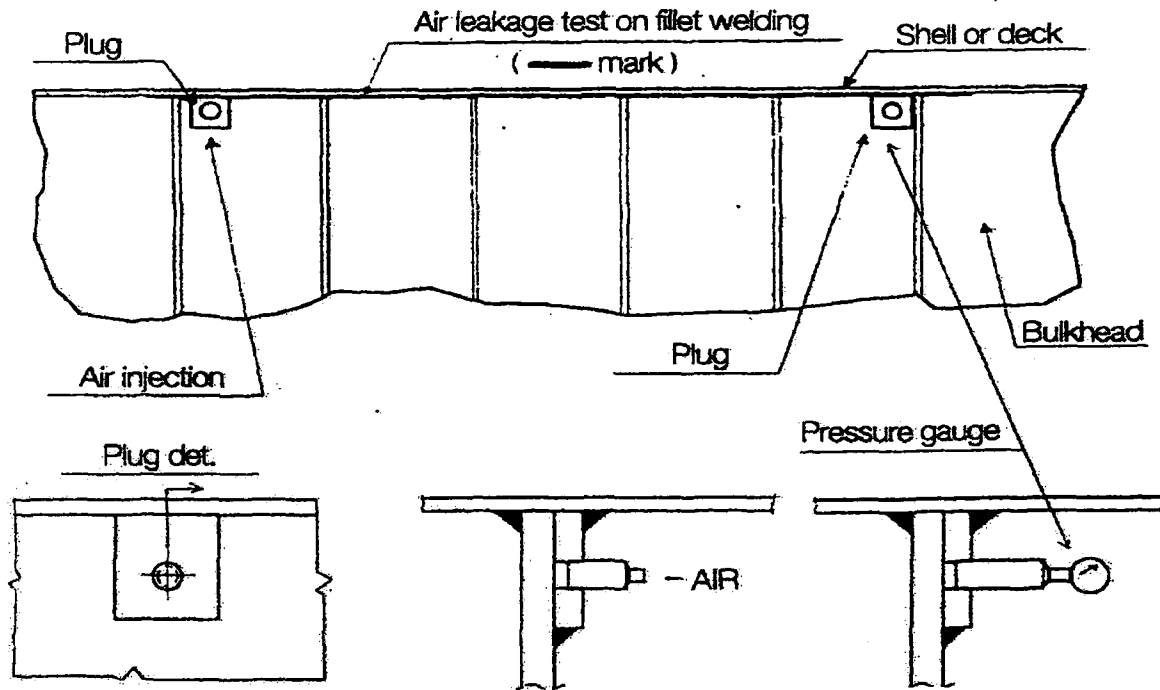


Fig. 4.1 fillet air test

4.3 ERECTION PROCESS.

4.3.1 Pre-Erection / Erection

The unit blocks are welded together at the dock side and in the building dock with regular checks of the hull dimensions. After completion of pre-erection/erection work, the final inspection is carried out by classification surveyor and Client's representative.

Welded joints of deck plates, bottom and side shell plates are subjected to NDE (Non-Destructive Examination) with radiographic test or ultrasonic flaw detector, etc. in accordance with NDE plan which is approved by the Classification Society.

At pre-erection/erection stage, followings are to be carefully checked

Check Point	Remarks
a) Height and indication of block and its position b) Amount of cocking-down c) Centerline and water line of each block d) Reference line and/or distance between adjacent frames in way of block joint e) Arrangement of temporary pieces such as strong backs f) Alignment of structural member g) Any structural inconsistency h) Center line of stern boss/gudgeon at stern block i) Welding condition (refer to Para.3.5. "Welding Control") j) Other necessary items.	Wooden blocks to be arranged to bear local compression.

4.3.2 Staging Pieces And Lifting Lugs

Staging pieces, lifting lugs for erection of blocks are to be left in the position where they do not interfere with the function of the ship, because they are useful for examination during ship operation.

However, those in the following location are to be removed.

- a) Exposed part of the ship where they are likely to spoil the appearance .
- b) Passage where they may cause danger for ship's crew.
- c) Other part designated by design as high stress area.

In case of removal of fitting lug on flat deck, the finishing work by milling machine may be carried out after hand cutting in order to prevent paint damage under deck.

❖ Details is referred to chapter 3 Quality Standards,

4.3.3 Temporary Access Opening

When the temporary access openings are required on the shell plates, decks, bulk head, tank top of double bottom for passages of hull work, outfitting work and ventilation, they are to be applied according to Builder's practice.

The shape of the openings and the method of closing are referred to chapter 3. Quality Standards.

4.3.4 Welding Control

Since welding is an important work directly related to hull strength, it should be carefully controlled according to the welding procedure with the specified welding parameters and the repair methods for the welding gaps over the tolerance limit also should be tightly controlled.

When a new welding procedure is necessarily applied, it shall be approved by the Classification Society.

1) Preparation before welding

All parts to be welded are fitted with sufficient care to their accuracy. Edge preparation, angle of bevel, alignment of intercostal plates and fitting angles are controlled within the accuracy range specified in the chapter 3. Quality Standards.

Welding parts shall be free from moisture, loose mill scale, excessive rust or harmful paint.

Tack welding is carried out after completion of preparation for welding.

2) Welding

After confirming the above preparation, welding is carried out according to the welding procedure describe in the "Welding Procedure Specification" to minimize deformation and residual stress.

Electrodes, welding method, welding condition shall be in accordance with "Welding Procedure Specification" and requirements of the Classification Society.

After completion of welding, if necessary, the weld lines are touched up with a zinc epoxy primer to prevent rusting.

3) Inspection on weld parts

Following inspections are carried out to verify the quality of weld parts.

-Visual inspection

Visual inspection is carried out on all beads. Any defects parts found are marked on the block and properly corrected. The welding throat of fillet weld is to be checked by random sampling.

- Non - destructive examination

Welded joints of strength deck plates, bottom and side shell plates are tested by the radiographic examination or ultra sonic flaw detector according to NDE plan which is approved by the Classification Society.

Magnetic particle test or dye-penetration test is to be adopted for detection the surface defect

4) Major check points

- a) Dimension and shape of edge preparation
- b) Alignment of welding part
- c) Arrangement against deformation such as strong back
- d) Amount of pre-heating if specified
- e) Fitness of electrode and consumable used
- f) Welder's qualification
- g) Gap before welding
- h) Weld throat in fillet weld/leg length in P.P., D.P., F.p. weld
- i) Uniformity of beads, intervals in intermittent welding
- j) Surface defection on weld such as crack, under-cut, crater. Etc.

- k) Slag, porosity, inclusion
- l) Soundness of turn-round weld such part as bracket toe
- m) Position of water-stop hole
- n) Other necessary items

4.4 PIPE PROCESS

4.4.1 Pipe Bending

As a standard for steel and non ferrous pipes, bending are to be carried out by the cold bending machine having the bending radius of approximately $2 \div 2,5$ times of the out side diameter of the pipe and by the hot bending machine having the radius of $2,5 \div 3$ times of the out side of the pipe.

Ellipticity, swell and rumbles caused by bending of pipe shall not exceed the quality standard ranges of chapter 3.

In case the regular pipe bending as mentioned above cannot be applied due to following reasons, commercial bending pieces are to be used.

- a- when the capacity of existing bending machine is not enough to bend
- b- when the non-standard bending radius is necessary to facilitate the piping arrangement

In case the arrangement is difficult to use the commercial bending pieces, then the miter welding pipe having a radius approximately equal to the nominal pipe diameter are to be applied. However, the miter welding method is to applied only to low pressure and large size pipes such as exhaust gas, sea water, exhaust stem piping, etc.

For adjustment of pipe alignment during pipe installation stage hot process could be restrictively applied.

4.4.2. Finish Of Weld Parts After Pipe Fabrication

Weld beads on inside surface of fabricated pipes shall be finished to suit the intended purpose of the respective piping system in accordance with the following three grades;

- < GRADE A>

Welded beads of pipe inside shall be finished smoothly and welding spatters and slag shall be removed.

This grade applies to lubricating oil pipes, hydraulic oil pipes, fuel oil injection pipes after the 2nd filter for main diesel engine, turbine steam pipes and for synthetic rubber plastic lined pipes.

- <GRADE B>

Welding spatters and slag shall be removed and welded beads shall be cleaned.

This grade applies to power steam pipes, turbine exhaust pipes, fuel oil service pipes, drinking water pipes, nozzle cooling pipes, feed water pipes, condensate water pipes, sea water cooling pipes, compressed air pipes, tank cleaning pipes and vent pipes for cargo tanks.

- <GRADE C>

Welded beads of pipe insides could not be finished.

This grade applies to all other pipes which are not specified in GRADE A and GRADE B and open ended lines like drains, over flows, vents and boiler escape pipes.

4.4.3 Flange Fitting In Shop

When the pipe is inserted into the flange for joining, inserting depth should be controlled so that welding bead will not overpass the flange face. The flange face is usually not finished by grinding but welding spatters and slag on flange face shall be removed.

4.4.4 Pipe Joints

In general, the free ends of the pipes are protected by a plastic thin sheet, plastic covers or other methods.

In general, pipe joints are grouped as follows by their use;

- **Sleeve Joint and Butt Joints**

Generally, sleeve welded joints and butt welded joints are to be used for permanent joints, unless other joints are specified in the building specification, in space such as tanks, cargo holds, cofferdams, void spaces, ducts, store spaces, accommodation spaces, hatch side spaces, etc.

Butt welded joints may be applied to the commercial bend pieces and T-piece.

- **Flange Joints and Union Joints**

Flange joints, union joints and other separable joints are to be used in the engine room, pump room, steering gear room, other machinery spaces and on exposed decks for facilitating to remove the pipes whenever required.

Flanges or screwed union joints are to be used at connections to all pipe fittings, machinery and equipment for maintenance or overhaul purposes.

- **Joints for Non-Ferrous Pipes**

Pipe joints for non-ferrous pipes are to be applied similar to those for steel pipes. However, for joining of plastic pipes, it has to be followed the Classification Society requirements unless otherwise specified in the Specification.

- Gaskets

Universal heat and oil resisting non-asbestos joint sheets shall be used generally in all piping system.

4.4.5 Adjusting Pipes

Adjusting pipes are to be generally used for connections between pipe and equipment pipes already fitted on the blocks. The flanges of the adjusting pipe may be welded on board in special cases. In general, the adjusting pipe shall be finally galvanized after on board adjusting.

For connection of alignment for pipe connection, the spot heating process could be applied. However, this method can not be applied to lubricating and hydraulic oil pipes.

4.4.6 Pipe Galvanizing

In general, it has to be done in application of zinc coating by hot-dip process. Galvanizing carried out after fabrication of pipes shall be kept without any burn damage. However, welding work is inevitably carried out on the galvanized pieces during installation process, such as following cases, the external of the damage parts are to be touched up with zinc rich solution paint of high purity:

- a- Socket/butt welded joints or welded sleeve joint on board.
- b- Middle flanges of penetrating piece adjusted on board
- c- Anchoring pieces welded on galvanized pipe after adjusting on board.

4.4.7 Pipe Pickling By Acid

After fabrication of the steel pipes, following pipes are to be acid pickled and coated with suitable oil before installation on board:

- a- Lubrication oil pipes except oily bilge pipes and air vent. Pipes.
- b- Fuel oil service pipes for main engine, diesel generators and boiler burning line, etc.
- c- Hydraulic oil steel pipes.

4.4.8 Bolts For Pipe Flange Joint

The enclosed standard hexagonal head bolts and nuts of galvanized steel is to be used for pipe flange joints. Non-galvanized bolts and nuts are to be generally used in oil tanks.

The length of bolts protruding beyond the nuts after tightening is to be between zero and three threads.

4.4.9 Pipe Supports

In general, steel supports and U-type bolts are to be applied to pipe lines at suitable intervals. Pipe supports for non-ferrous are to be lined with copper, brass or lead plate, plastic or synthetic rubber.

The length of screw part of the U- type bolts protruding beyond the nuts after tightening is to be between zero and one time the bolt diameter.

4.4.10 Hydrostatic Test Of Piping

The piping system are to be hydrostatic/leakage tested using suitable medium at completion of the installation to check the strength and/or leakage in the system.

4.4.11 Non-Destructive Test For Welded Joints Of Piping

The following non-destructive test shall be applied to welded joints designated by the Classification Society according to rules and/or any other parts where mutually agreed upon:

- a- Radiographic examination
- b- Magnetic particle examination
- c- Ultrasonic test
- d- Penetration test

4.4.12 Flushing/Cleaning Of Piping System

Following piping system are to be flushed/cleaned after completion of the piping system on board.

For flushing by oil, the temporary filters and magnets are to be fitted in strainers.

The flushing is to be completed when the filters have maintained constantly clean condition for over two hours of flushing.

Piping	System applied	Flushing/cleaning method
Lub. Oil piping	M/E L.O & C.S.L.O	Flushing oil or system oil
	CYL.L.O. engine	Comp. Air or system oil
	Generator engine (DG.TG)	Flushing oil or system oil
	L.O. transfer, L.O. purifier, S/TL.O	Flushing oil or system oil
	L.O. filling	Compressed air
Compressed air	Main engine, starting air, auxiliary diesel engine starting air & control air	Compressed air
Hydr. Oil piping	Steering engine & deck machinery	Flushing oil or system oil
	V.R.C. main line	Flushing oil
	V.R.C. main line	Nitrogen or system oil
Steam piping	Stem supply line for steam driven machinery	Steam

4.5 PRE-OUT FITTING PROCESS

4.5.1 Outfitting During Block Assembly

Outfitting works on the hull blocks are to be generally carried out in parallel with the block assembling work. Fittings of pipes, supports, trunks, electric cable trays, hand grip and steps, etc. are to be fitted on hull blocks as far as practical at the assembling site.

4.5.2 Outfitting During Block Erection

In general, installation of machinery and electrical equipment, etc. are to be carried out in parallel with the hull construction works at erection stage at dock side or in the dock.

4.5.3 Unit Assembly

In general, aux. Machinery are to be assembled into appropriate units together with their seats or beds, pipes, valves, etc. in the shop and then installed on the vessel.

After installing these assembled units on the vessel the centering of the aux. Machinery is to be checked and corrected, if necessary, by use of shims.

4.5.4 Outfitting Of Superstructure

Outfitting such as post, piping, ducting, paneling, ceiling, flooring, cabling, etc. are to be done as far as practical at the assembling site.

In connection with the outfitting works, hydraulic or water flooding test of piping may be carried out individually at each block and then connection joint parts are to be checked onboard after the whole installation has been completed.

4.5.5 Galvanizing Of Fittings

Galvanized surfaces must be practically smooth and free from conspicuous defects such as bare spots.

Damaged parts caused by gas cutting or welding are to be generally touched up by a zinc rich solution paint.

4.6 MACHINERY FITTING PROCESS

4.6.1 Shafting And Propeller

4.6.1.1 Pre-sighting and stern tube boring

4.6.1.1.1 Conditions of pre-sighting

- a. Pre-sighting is to be carried out after stern boss block is assembled and welded to engine room tank top block (see fig.4.2).
- b. Pre-sighting is to be carried out at pre-erection area or in the dock.

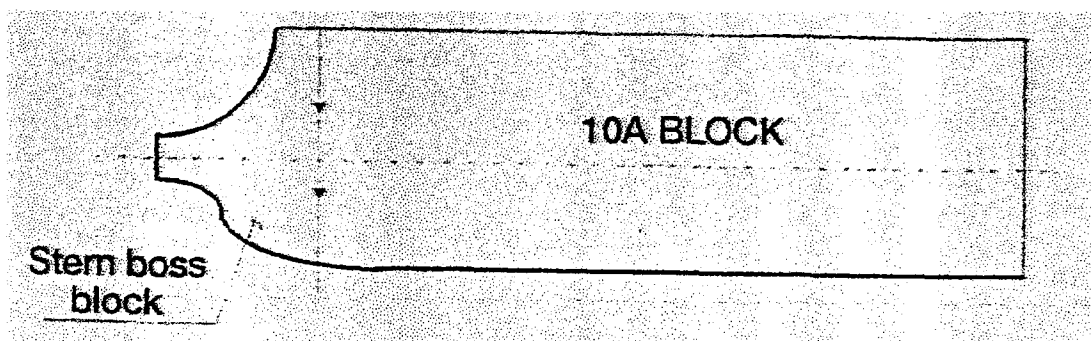


Fig. 4.2 Stern boss block assembly

4.6.1.1.2. Procedure of pre-sighting and stern tube boring

- After above mentioned condition is completed, pre-sighting is to be carried out.
- Fix the center line level between stern boss and main engine (see fig.4.3)
- Measure and mark down the distance of shaft length and the dimension of engine bed according to the Shaft Plan.
- Bore the AFT & FWD stern boss.
- Measure inside diameter of stern tube after boring and fit the bushes, which had been machined according to the inside diameter of stern tube.

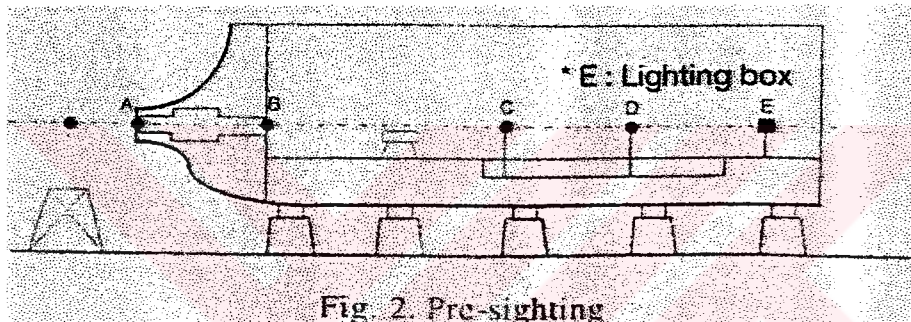


Fig. 2. Pre-sighting
Fig. 4.3 Pre - sighting

4.6.1.2 Rudder horn boring and final sighting

4.6.1.2.1 Condition of final sighting

Final sighting is to be carried out after that rudder horn block (A.P tank), E/R block and steering gear deck are assembled together and all strength members of hull structure are welded (see fig.4.4)

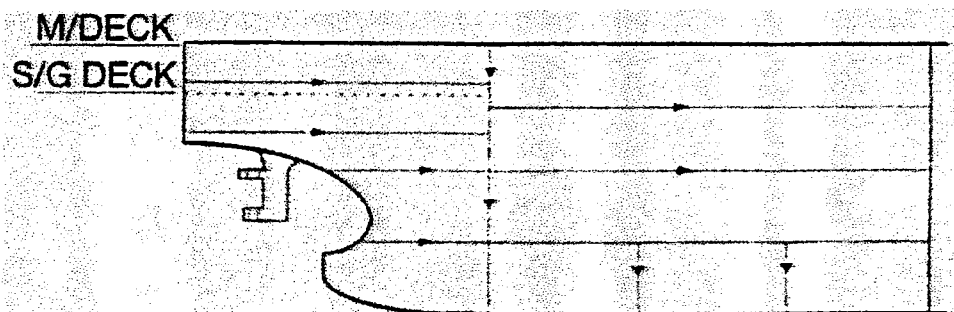
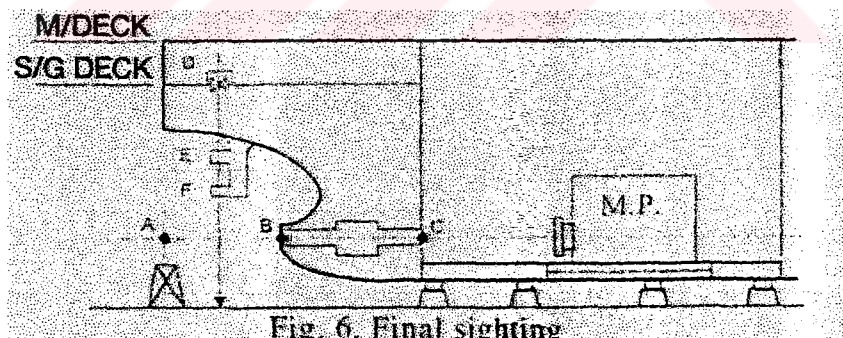


Fig. 4.4 Condition of final sighting

4.6.1.2.2 Procedure of final sighting

- a. After above, mentioned condition is completed, final sighting is to be carried out.
- b. Install the piano wire at the shaft center line from center of forward stern boss to A.P center line based on the mark made at pre-sighting.
- c. Install the piano wire from center of rudder horn perpendicularly to the ground, and then measure the deviation from the shaft center line.
- d. Measure the dimension of rudder horn and the height up to steering gear deck.
- e. Bore rudder horn bosses and measure inside diameter of the machined holes. (In some cases, boring and measuring the rudder horn bosses are to be finished at pre-erection stage).
- f. Measure the dimensions of machined pintle bushes and rudder horn bosses at the same temperature condition and fit the pintle bushes chilled by dry ice.



4.6.1.3 Fitting of stern bush

The installation of stern bush is to be carried out by using hydraulic oil jack as below figure 4.6

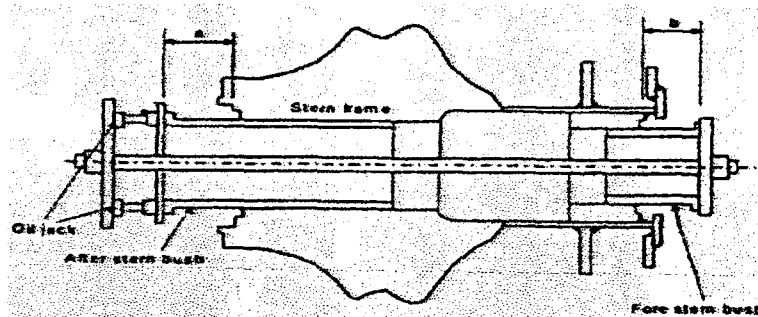


Fig. 4.6 Fitting the stern bush

Pressure of the hydraulic power load is to be measured against inserting distance of the bush.

The measurement is to be recorded at the last 100 mm. (b) drive for forward bush and at the last 250 mm (a) drive for the aft bush.

Insertion load to be applied is as following figures 4.7;

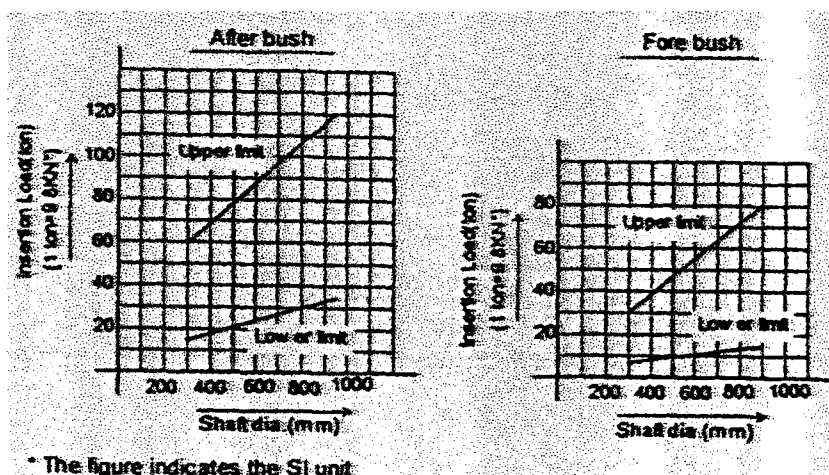


Fig 4.7 Insertion loads against shaft dia.

Note: This insertion load is just as an aim, reference is to be made to the calculation for the particular ship.

4.6.1.4 Contact conditions of propeller shaft and propeller

The contact condition is to be checked by contacting the propeller's boss and shaft with coating the blue or red paint on cone-part of the shaft.

When the keyed propeller is provided, after the key to propeller shaft, the contact condition of the cone-part is to be checked.

Acceptable contact ratio of the cone-part is at least 70% of matching surface.

4.6.1.5 Fitting of propeller

The push-up distance is decided in consider of temperatures of the propeller boss and shaft cone at fitting stage.

4.6.1.6 Tightening-up of propeller nut

The propeller nut is to be tightened up to following final torque. Fig 4.8 shows that the tightening up loads against the shaft diameter.

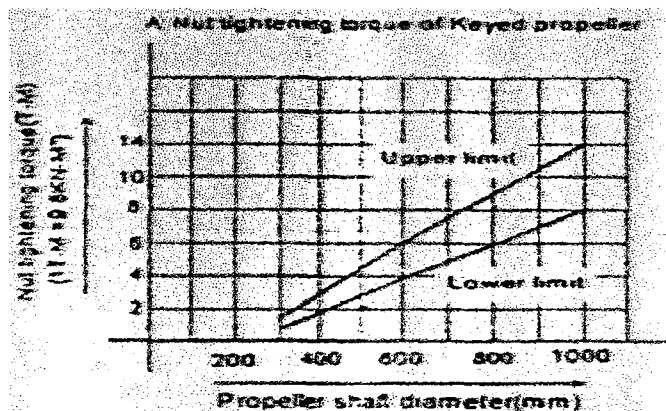


Fig 4.8 tightening up load against propeller shaft dia.

4.6.1.7 Tightness test of oil seal

- (1) After installation of the seals at the fore and aft part of the stern bearing, the oil is to be poured to the stern bearing and the head tank up to the level corresponding to the ship's full loaded condition. Then the oil is to be maintained for at least 4 hours to check if the oil level is moved down due to any leakage.
- (2) The tightness of the seals is to be checked after detaching the bottom plugs of the seal.

4.6.1.8 Installation of shaft

- (1) The main engine and the intermediate shaft bearings are to be temporarily installed and then the shaft is to be fixed in such away that it indicates the off - set value in the design stage.
- (2) After adjusting the off - set, the shaft is to be connected by the coupling bolts.
- (3) The coupling reamer bolts is to be fitted by using the hydraulic jack (Insertion load: 3-20tons), or chilled bolt fitting or other methods such as hammering.
- (4) After tightening the coupling bolts, each shaft bearing may be jacked up according to the drawing to check whether the load is within the allowable limit.

4.6.1.9 Mounting of shaft coupling

- (1) The centering of both the propeller shaft and intermediate shaft are to be checked.

- (2) After centering the both ends, the clearance at four places of top, bottom, port and starboard between the propeller shaft and intermediate shaft are to be measured.

4.6.2 Main Diesel Engine & Appurtenant Equipment

4.6.2.1 Procedure of M/E foundation and installation

- (1) Mark down the position of engine foundation after pre-sighting
- (2) Cut the hole for engine foundation.
- (3) Fit up and weld the side stoppers.
- (4) Clean engine foundation and apply de-rusting treatment.
- (5) Install and fix the M/E.

4.6.2.2. Force of holding-down reamer bolts

Reamer bolts and holes are to be coated with Molly Coat or equal, in then the bolts are to be forced into the holes by using the hydraulic jack with force of 1,5 / 1,5 tons or by other suitable methods such as chilled fitting or hammering.

4.6.2.3. Installation of main engine

- (1) Bedding of chocks is to be verified by hammering to confirm that the chock liners and foundation bolts are fitted in good condition. The clearance of the chock liners is to be confirmed by the filler gauge of 4/100 mm. tightness and the filler gauge shall not be entered more than 10 mm. at thickness and the filler gauge shall not be entered more than 10 mm. at any point.

- (2) In case the Epoxy Resin applied, the hardness is to be confirmed according to manufacturer's recommendation.
- (3) The deflection of crankshaft is to be measured by turning the crankshaft ahead using the turning gear, if necessary. The deflection is to be limited in accordance with the engine manufacturer's recommendation.

4.6.2.4. Installation of reduction gear

- (1) After adjusting the tooth contact condition of the reduction gear according to the installation guidance by design plan, all the adjusting liners of the reduction gear are to be inserted.
- (2) All bolts of the reduction gear are to be fitted and tightened, and then the tooth contact condition is to be checked.

4.6.3 Boiler

- (1) If the boiler unit is assembled at shop, the hydrostatic test is to be carried out at shop according to the rules of the Classification Society. Any hydrostatic test for boilers shall not be performed on board except the hydrostatic test is not carried out at shop for any reason.
- (2) If necessary, soda boiling is to be carried out to remove oil, grease, paint or alkaline formation at shop.

4.6.4 Auxiliary Machinery

4.6.4.1. Diesel generator

- (1) Fitting condition of chock liners and tightening condition of holding down bolts are to be checked. In case the Epoxy Resin applied, the hardness is to be confirmed according to manufacturer's recommendation. Crankshaft deflection is

to be measured to confirm that it is within the allowable limit recommended by the engine manufacturer.

- (2) Before filling the system oil, cleaning condition is to be confirmed if there is any foreign matter in the crankcase. It is not to be necessary to remove the anti-rust stuff coated by the engine manufacturer.

4.6.4.2. Turbo generator

- (1) The alignment shall be adjusted in accordance with the manufacturer's recommendation. In case of three point supported turbo-generator set, only the gear tooth contact shall be checked.
- (2) The fitting conditions of chock liners and the tightening condition of holding down bolts shall be checked.
- (3) After sea trial, the tooth contact of the reduction gears shall be examined by visual checking through peep holes.

4.6.4.3. Turbo driven cargo oil pumps & ballast pumps

- (1) Fitting conditions of chock liners and tightening condition of holding down bolts are to be checked.
- (2) The alignment of the coupling is to be confirmed by using a dummy or working intermediate shaft. The allowable alignment limit's are:
 - For horizontal type : 0,5 mm. by rim reading and 0,25 mm. by face reading.
 - For vertical type : 1,00 mm. by rim reading and 0,5 mm, by face reading.

❖ If there is the allowable limit recommended by maker, it shall prevail.

4.6.4.4 Shaft alignment of turbine driven and motor driven auxiliaries

The allowable limit of the shaft alignment is referred to part III. Quality Standards Para.15.”Auxiliary Machinery”.

4.6.4.5 Installation of auxiliary machinery

Installation of aux. Machinery is to be checked as followings;

(1) Grade “A” Auxiliary Machinery

The tightness of chock liners is to be checked by hammering after tightening the holding down bolts and gap is to be checked by a filler gauge of 4/100mm thickness. The filler gauge should not be inserted more than 10 mm.

- Grade “A”; Generator set, plumber blocks, steering gear and aux. Turbines.

(2) Grade “B” Auxiliary Machinery

The tightness of chock liners is to be checked by hammering after tightening the holding down bolts.

- Grade “B” : Pumps, ref. machines, emergency diesel generator and other rotating or reciprocating aux. Machinery.

(3) Grade “C” Auxiliary Machinery

The tightness of chock liners is to be checked by hammering after tightening the holding down bolts. If auxiliary and the seats are assembled in a unit at the shop, such checking is to be performed at the shop.

- Grade “C” : Strainers, heaters, coolers, electric apparatus and other static aux. machinery, exh. gas boiler and portable tanks.

4.6.5 Overhauling

After completion of the sea trial, main engine is to be overhauled for one cylinder unit and checked to confirm that major parts are in normal condition.

Following major parts are carefully investigated;

- (1).Piston complete
- (2).Cross head pin and bearing
- (3).Crank pin bearing
- (4).Upper and lower shells of main bearing

4.7 PAINTING PROCESS

4.7.1 General

Painting work will be carried out basically according to the Builder's standard of QSP (Quality Standard for Painting) and the Paint Manufacturer's recommendation. Paint work is also proceeded according to the Builder's building schedule for smooth construction progress.

All painting work are inspected in accordance with the painting specifications, drawings and QSP.

4.7.2 Surface Preparation

Details of de-rusting standards and surface cleaning standard are to be referred to QSP Para. 3., "Primary Surface Preparation Standard".

4.7.3 Repair Priming At Assembly Shops

Burn damage parts of shop primer by welding are to be mechanically cleaned to QSP St 2-3 (Swedish Standard St 2-3) immediately primed with a primer approved by Owner.

4.7.4 Hull Block Painting

After finish the hull block construction works, coating is to be applied. If the surface cleaning work of the block is partially proceeded and not completed on the whole block for some reason, the coating could be applied to the cleaned surface only before it becomes rusting.

Outfitting works on the hull block are to be carried out before or after application of the coating according to the construction schedule.

4.7.5 Correction Of Trivial Defects

Trivial defects or damages which are not detected at block inspection but found after surface preparation (sand blasting, etc.) are to be corrected by welding, chipping and/or grinding and then touch up with paint.

Repair work of paint is to be carried out in accordance with the Builder's practice and inspection standards.

4.7.6 Finish Of Free Edges Of Steel And Welded Beads

Free edges of steel members cut by gas cutting and irregular welding beads in heavy corrosive area such as water ballast tank and fresh water tanks are to be carefully treated in accordance with Builder's practice.

4.7.7 Dry Film Thickness

Measuring method, points and instruments of dry film thickness are referred to QSP Para.8., "Dry Film Thickness Measurement Standard".

4.7.8 Surface Of Final Coat

Surface of final coat is referred to QSP Para. 6., "Coating Standard".

4.7.9 Inspection Items Subject To Attendance Of Client's Representative

Inspection item of Client representative are referred to QSP Para. 10., "Inspection and Control".

CHAPTER 5

INSPECTION AND TEST ITEMS

5.1 GENERAL PROCEDURE FOR INSPECTION /TEST

5.1.1 Mandatory Inspection And Test

The inspection and test items listed herein are the fundamental inspection/witness points of the Client and the Classification Societies based on the Classification Society's rules.

For those inspections and tests which are not listed, however, the Client's representative and the Classification surveyor can free access and inspect all works during process unless additional staging or work stop is required.

In principle, inspection/test to be carried out in accordance with The Builder's working schedule. For smooth construction of the vessel, the inspection parties shall not refuse to inspect the parts designated by the builder even if some minor works remain which can be completed and subjected to inspection at later stage.

5.1.2 Request For Inspection / Test

The builder shall request the attendance of the Client's representative and the Classification surveyor for the relevant inspections/tests by the "Daily inspection schedule" sheet or the facsimile.

The request of inspection/tests is to be noticed as followings:

- For the inspection to be carried out during normal working days, notice will be given not later than 17:00o'clock on the day prior.
- For the inspection to be carried out on outside working days, the notice will be given no later than 12:00o'clock on the day prior.

For painting inspection, however, the notice will be given to the Client's representative in the morning of each inspection day due to variable uncertain conditions of weather, etc.

For some reason, if the daily inspection schedule is delayed, the Client and The Classification office are not to be notified as soon as possible.

In the event of urgent inspection required, Builder shall notice and discuss with the Client's representative and the Classification Society.

5.1.3 Inspection Cancellation, Postponement, Non Attendance

For any reason, if the inspection schedule is canceled or postponed, the concerned parties are to be informed as soon as possible

If the Client's representative fails to attend the inspection, it is to be deemed to waive his right and he will accept the results or inspection performed by Classification surveyor and/or Builder's Q.C inspector.

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5.1.4 Inspection/Test Record

The builder shall submit the "Inspection/test Record" from containing the necessary information of the inspection items to the Client's representative and Classification surveyor.

After completion of the inspection/tests, the Client's representative and/or the Classification surveyor shall make confirmation signature on the inspection/test record, with the comments if any, and return to Builder's Q.C inspector.

Inspection results shall be clearly judge as follows;

- a. AA :Accepted in the existing condition.
- b. QCC :Accepted with comments to be confirmed by Builder's QC
- c. OWC(CLC) :Accepted with comments to be confirmed by Owner (class.) after correcting the comments given in writing.
- d. NA :Not accepted, and subjected to re-inspection.

Copy of the major inspection and test records including the on board test result are to be submitted to Client's representative and Classification surveyor at the ship's delivery stage.

5.1.5 Repair Work

Repair work shall be basically carried out in accordance with builder's working practice and Classification Rules.

When re-inspection is required, this will normally be include in the "Daily-Inspection Schedule" and shall follow the procedure described in the preceding paragraphs.

5.1.6 Other Quality Standard

In general, other quality standard except various quality standard describe in this booklet are applied to D.M.H.I.'s technical standards, and they are maintained in accordance with D.M.H.I.'s standard control system.

For technical field of D.M.H.I., the technical standards applied to the material, component, design, inspection are classified as follows;

a. Regulation

Document, which is defined as a standard for a specific character, efficiency, dimensions requiring on the producing product, part product, raw material and purchasing product and a term, abbreviations, symbol units, system related to the technical fields

b. Procedure

Document, which is fully defined the efficient and effective means, methods and sequence on the design, working, inspection, testing, purchasing and equipment of the engineering and manufacturing.

c. Job instruction

Document, which is describe as a diagram, symbol and sentence after standardizing the job sequence, job method, standard time and job caution item for all of works performing in each working group.

REMARKS

Marks of O, C and R in the list of inspection/test items mean as follows;

C : To be witnessed by the Classification surveyor

O : To be witnessed by the Client's representative

R : Test records and/or Classification certificate are required and they are to be submitted to the Client's representative.

- Details for testing are to be specified in the “On-board Test Procedure” and “Mooring/Sea Trial Procedure” which are separately prepared for each system testing.
- The inspections of the Regulatory body or Government body specified in the contract or specifications are to be separately scheduled.

5.2 CATEGORIES OF INSPECTION AND TEST ITEMS

1. Hull Structure part	C	O	R	Remarks
1.1 Block inspection for hull structure below main deck	○	○		▪ Block section is made for each block after completion of hull structure work
1.2 Block inspection for hull structure above main deck		○		
1.3 Erection inspection for pre-erected lines or tank space below main deck including accommodation	○	○		▪ Erection inspection is made after completion of block erection work
1.4 Erection inspection for erection lines tank spaces below main deck	○	○		
1.5 Erection inspection for erection lines or space above main deck		○		
1.6 Tank hydrostatic test according to “tank testing plan”	○	○		▪ NDE plan is made to show kinds and locations of NDE items with Class. Society’s approval
1.7 Air leakage test or vacuum test for weld joint at tight boundary of tanks	○	○		
1.8 Non-destructive examination according to the Classification Society’s rule	○			
1.9 L x B x D measurement at ship center and midship	○	○	○	
1.10 Draft mark inspection	○	○		▪ Check at the marked cond.
1.11 Free-board mark inspection	○			
1.12. Bottom survey for launching	○	○		
1.13 Inclining experiment and deadweight measurement	○	○	○	▪ Check the closing of sea chest, bottom plug, etc.

2. Hull Outfitting part	In Shop			On Board			Remarks
	C	O	R	C	O	R	



2.1 Mooring arrangement							
1. Anchor and chain							
- Drop and proof test	○		○	○	○		
- Identification of marking	○		○				
2. Stopper							
- Fabrication inspection	○						
3. Windlass							
- Running test (no load)	○		○	○	○	○	* During sea trial
- Anchoring test							
4. Mooring winches							
- Running test (no load)	○		○	○			In scope of Rule Required
2.2 Hatch cover and door							
1. Cargo hatch cover							
- Final inspection	○		○	○	○		*1) Detail is Referred to part III, Para 17.6
- Hose test (*1)					○		
- Operation test					○		
2. Water tight hatch and door							
- Hose test (*1)				○	○		
2.3 Side scuttle and window							
- Hose test (*1)				○	○		
2.4 Cargo gear and lifting appliance							
1. Crane and davit							
- Fitting material test	*○		*○	*○	○	○	* Cargo gear cert. Builder/Class cert. Shall be issued acc. To the contract spec. • Less than 1.0 ton (S.W.L.)
- Operation and load test	○	○	○				
2. Small davit					○		
- Operation test							

2. Hull Outfitting part			In Shop			On Board			Remarks
			C	O	R	C	O	R	

2.5 Life saving and fire fighting equipment							• Solas item
1. Boat davit and winch	○		○	○	○	○	
- Operation and load test							
2. Life and rescue boat	○	○	○	○	○	○	• Rescue boat at sea trial, if required by Class Society
- Running test				○	○	○	
- Launch test				○	○	○	
3. Safety equipment							
- Confirmation inspection				○	○		
4. Fire fighting system				○	○		
- Confirmation inspection				○	○		
5. Fire damper				○	○		
- Operation test							
2.6 Accommodation space							
1. A – 60 and draught stop				○	○		
- Installation inspection							
1. Galley and laundry equipment					○		
- Operation test							
2.7 Air condition system							
- Volume check in cabin				*○	○	○	*If crew accom. Cert. Required from Classification Society
- Cooling and heating test					○	○	
2.8 Inert gas generating system							
- Safety device function test				○	○	○	• During sea trial
- Blower capacity test				○	○		
2.9 Accommodation ladder							
- Proof load test	○		○	*○	○		*Combining test with pilot ladder
- Operation test							
2.10 Oil discharge monitoring system							
- Function test				○	○		• During sea trial
- Flow meter calibration				○	○		
2. Hull Outfitting part							Remarks
	C	O	R	C	O	R	

2.11 Cargo turbine/pump and water ballast pump							
-	Shaft alignment check			○	○	○	
-	Safety device test			○	○	○	
-	Capacity check						
2.12 Stripping pump							
-	Operation test				○		
2.13 Crude oil washing system							
-	Operation test			○	○		
				○	○		
2.14 Thruster							
-	Seal leakage test				○		
-	Blade gap check				○	○	
-	Shaft alignment check			○	○	○	
-	Operation test						
2.15 Others							
1.	Tank level gauge/cargo monitoring system			○	○		
-	Function test						
2.	Draft gauge				○		
-	Function test						
3.	Loading computer			○	○		
-	Function test						
4.	Valve remote control system				○		
-	Operation test						

3. Machinery part				In Shop			On Board			Remarks
				C	O	R	C	O	R	

3.1 Shaft and propeller							
1. Intermediate/propeller shaft - Final inspection	☐		☐				
2. Coupling bolts/holes - Dimension check - Fitting inspection	☐		☐	☐	☐		
3. Propeller shaft with propeller - Contact inspection	☐	☐	☐				
4. Stern boss/rudder horn casting - Final inspection	☐		☐				
5. Sighting - Measurement inspection				☐	☐	☐	• Pre/final sighting
6. Stern tube bush - Fitting inspection - Clearance check				☐	☐	☐	
7. Propeller - Fitting inspection				☐	☐	☐	
8. Propeller shaft - Wear down check				☐	☐	☐	
9. Stern tube seal - Leak test				☐	☐		
10. Shafting - Alignment check - Reaction test				☐	☐	☐	
3.2 Rudder							
1. Stock - Final inspection - Fitting inspection - Reamer bolt fitting	☐	☐		☐	☐	☐	• Taper type • Flange type
2. Tiller - Contact inspection - Fitting inspection	☐	☐	☐	☐	☐	☐	• Between stock & tiller
3. Rudder horn bush - Fitting inspection				☐	☐	☐	
3. Machinery part	In Shop			On Board			Remarks
	C	O	R	C	O	R	

4 Rudder pintle							
- Final inspection	○	○	○				
- Contact inspection							
5 Rudder carrier/hosing							
- Final inspection	○	○	○				
- Contact inspection	○	○					
6 Rudder							
- Fabrication and air test	○	○					
- Alignment inspection	○	○					• Before covering plate
- Swing test				○	○		• With stock and pintle
7 Rudder jumping stopper				○	○		
- Clearance check							
3.3 Main Engine							
1 Major components							
- Final inspection	○		○				
2 Chock fast/liner				○	○		
- Installation condition check							
3 Holding down bolts				○	○		
- Tightening inspection							
4 Crank shaft							
- Deflection	○		○	○	○	○	
5 Shop test	○	○	○				
6 Safety device							
- Function test	○	○	○	○	○	○	
7 Mooring trial				○	○	○	
8 Overhaul inspection	○	○	○	○	○		
3.4 Reduction Gear							
- Manufacturing inspection	○	○	○	○	○	○	
- Gear tooth contact	○	○	○	○	○	○	
- Running test	○	○	○	○	○	○	
- Safety device	○	○	○	○	○	○	

3. Machinery part	In Shop			On Board			Remarks
	C	O	R	C	O	R	

3.1 Shaft and propeller							
1. Intermediate/propeller shaft							
- Final inspection	○		○				
2. Coupling bolts/holes							
- Dimension check	○		○				
- Fitting inspection				○	○		
3. Propeller shaft with propeller							
- Contact inspection	○	○	○				
4. Stern boss/rudder horn casting							
- Final inspection	○		○				
5. Sighting							
- Measurement inspection				○	○	○	• Pre/final sighting
6. Stern tube bush							
- Fitting inspection				○	○	○	
- Clearance check				○	○		
7. Propeller							
- Fitting inspection				○	○	○	
8. Propeller shaft							
- Wear down check				○	○	○	
9. Stern tube seal							
- Leak test				○	○		
10. Shafting							
- Alignment check				○	○	○	
- Reaction test				○	○	○	
3.2 Rudder							
1. Stock							
- Final inspection	○	○		○	○	○	• Taper type
- Fitting inspection				○	○	○	• Flange type
- Reamer bolt fitting							
2. Tiller							
- Contact inspection	○	○	○	○	○	○	• Between stock & tiller
- Fitting inspection							
3. Rudder horn bush							
- Fitting inspection				○	○	○	
3. Machinery part							
In Shop			On Board			Remarks	
	C	O	R	C	O	R	

4 Rudder pintle							
- Final inspection	○	○	○				
- Contact inspection							
5 Rudder carrier/hosing							
- Final inspection	○	○	○				
- Contact inspection	○	○					
6 Rudder							
- Fabrication and air test	○	○					
- Alignment inspection	○	○					• Before covering plate
- Swing test				○	○		• With stock and pintle
7 Rudder jumping stopper				○	○		
- Clearance check							
3.3 Main Engine							
1 Major components							
- Final inspection	○		○				
2 Chock fast/liner				○	○		
- Installation condition check							
3 Holding down bolts							
- Tightening inspection				○	○		
4 Crank shaft							
- Deflection	○		○	○	○	○	
5 Shop test	○	○	○				
6 Safety device							
- Function test	○	○	○	○	○	○	
7 Mooring trial				○	○	○	
8 Overhaul inspection	○	○	○	○	○		
3.4 Reduction Gear							
- Manufacturing inspection	○	○	○				
- Gear tooth contact	○	○	○	○	○	○	
- Running test	○	○	○	○	○	○	
- Safety device	○	○	○	○	○	○	

3. Machinery part	In Shop			On Board			Remarks
	C	O	R	C	O	R	

3.5 Steering Gear							
- Hydraulic pipe/actuator Hydr. Test	○		○				• During sea trial
- Safety valve setting	○	○	○	○	○	○	
- Running test (no load)	○		○	○	○	○	
- Alignment inspection				○	○	○	
- Operation test							
3.6 Auxiliary Boiler							
- Hydraulic test	○	○	○	○	○	○	
- Safety device				○	○	○	
- Safety valve popping test							
3.7 Economizer							
- Hydraulic test	○		○	○	○	○	
- Safety valve popping test							
3.8 Generator Engine							
- Shop test	○	○	○				
- Overhaul inspection	○	○	○				
- Crank shaft deflection check				○	○	○	
- Safety device test	○	○	○	○	○	○	
3.9 Emergency Generator Engine							
- Shop test	○	○	○				
- Safety device test	○	○	○	○	○	○	
3.10 Air Compressor and Air Reservoir							
1. Air compressor device							
- Safety device test	○	○	○				
- Air charging test	○	○	○	○	○	○	
2. Air reservoir							
- Hydraulic test	○		○				
- Safety valve popping test				○	○	○	

3. Machinery part				In Shop			On Board			Remarks
				C	O	R	C	O	R	

3.11 Heat Exchanger							
– Hydraulic test	○	○	○				
3.12 Air Cond. And Provision Refrigeration plant							
– System vacuum test					○	○	
– Control device test					○		
– Running test					○		
3.13 Incinerator							
– Operation and safety device test	○	○	○	○	○	○	
3.14 Oil Water Separator							
– Operation test				○	○	○	
3.15 Oil Purifier							
– Operation test					○	○	
3.16 Overhead Crane							
– Fitting material test	○		○	○	○	○	* Cargo gear cer. Builder or Class shell be issued acc. To the contract spec.
– Operation and load test				○	○	○	
3.17 Sewage Treatment Plant							
– Operation Test				○	○	○	
3.18 Bilge Suction Test							
– Operation Test				○	○		E/R and hold
3.19 Quick Closing Valve for Oil Tank				○	○		
– Operation Test				○	○		
3.20 Power Pack for Hydr. Oil System							
– Safety device test					○	○	
3. Machinery part	In Shop			On Board			Remarks
	C	O	R	C	O	R	

3.21 Elevator (personnel lift)							
- Operation and load test - Safety device				○ ○	○ ○	○ ○	* In scope of rule/regulation requirement
3.22 Work shop Machinery							
- Operation test					○		
3.32 Ship Side Valve							
- Operation Test				○	○	○	• Only for power system



4. Piping part	In Shop			On Board			Remarks
	C	O	R	C	O	R	

4.1 Pipe pieces							
– Fabrication and Hydr test	O	O					• In scope of rule requirement
4.2 Steam Line							
– Installation and Hydr test				O	O		
4.3 Compressed Air Line							
– Installation and Hydr test				O	O		
4.4 Hydraulic Oil Line							
– Installation and Hydr test				O	O		
4.5 Fuel Oil Line							
– Installation and Hydr test				O	O		
4.6 Heating Coil in Tanks							
– Installation and Hydr test				O	O		
4.7 Fire Line							
– Installation and Hydr test				O	O		
4.8 CO₂ Fire Extinguish Line							
– Installation and Hydr test				O	O		• For manifold
4.9 Bilge Line							
– Installation and Hydr test				O	v		* DNV only
– Suction test				O	v		
4.10 Ballast Line							
– Installation and Hydr test					O		

4. Piping part	In Shop			On Board			Remarks
	C	O	R	C	O	R	

4.11 Heeling and Trim Line							
– Installation and Hydr test				○	○		
4.12 Liquid Cargo, Stripping, Crude Oil Washing Line							
– Installation and Hydr test				○	○		
4.13 Sanitary, Scraper Line							
– Flooding test				○	○		* Load line requirement is to be confirmed
4.14 F.O., L.O., D.O. Transfer Line							
– Hydr or leak test				○	○		• Main deck only
4.15 OX/AC Line							
– Installation and leak test				○	○		
4.16 Boiler Feed Water Line							
– Installation and Hydr test				○	○		
4.17 L.O. Line for M.E.							
– Flushing inspection				○	○		
4.18 Hydraulic Oil Line							
– Flushing inspection				○	○		• For deck machinery and hatch cover

5 Electric part	In Shop			On Board			Remarks
	C	O	R	C	O	R	

5.1 Main Generator							
- Shop test	○	○	○				
- Installation resistance test				○	○	○	
- Parallel operation test				○	○	○	
- Governor test				○	○	○	
- Full load test				○	○	○	
- Load characteristic test							
5.2 Main Switch Board							
- Fabrication and shop test	○	○	○				
- Auto. Control device test				○	○	○	
- Over current trip test				○	○	○	
- Reverse power trip test				○	○	○	
- Preferential trip test				○	○	○	
- Under voltage trip test				○	○	○	
- Frequency high/low test				○	○	○	
- Voltage high/low test				○	○	○	
- Blackout test				○	○	○	
- Interlock device				○	○	○	
5.3 Shaft Generator							
- Shop test	○	○	○				
- Safety device test				○	○	○	
- M/E holding R.P.M. check				○	○	○	
- Parallel operation test				○	○	○	
- Frequency converter device test							
5.4 Emergency Generator							
- Shop test	○		○				
- Installation resistance test				○	○	○	
- Governor test				○	○	○	
- Load characteristic test							

5. Electric Part	In Shop			On Board			Remarks
	C	O	R	C	O	R	

5.5 Emergency switch board – Fabrication & shop test – Over current trip test – Under voltage trip test 5.6 Thruster – Safety device test – Pitch control test 5.7 Battery charging device – Operation test 5.8 Motor and control gear (1) Emergency stop of motor/fan – Operation test (2) Sequential starting for maneuvering – Operation test (3) Automatic change over for maneuvering – Operation test (4) Blocking of heavy consumer starting – Operation test (5) Transfer pump control by level – Operation test (6) Steering gear alarm system – Operation test	☐	☐	☐	☐	☐	☐	
				☐	☐	☐	
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5. Electric Part	In Shop			On Board			Remarks
	C	O	R	C	O	R	

5.9 Insulation resistance for power circuit – Measurement test				☐	☐	☐	
5.10 Lighting equipment							
(1) Navigation and signal light – Function test				☐	☐		
(2) Emergency light – Function test				☐	☐		
(3) Day signal light – Function test				☐	☐		
5.11 Communication equipment and alarm system							
(1) Auto. Telephone – Function test					☐		
(2) Sound powered telephone – Function test				☐	☐		
(3) Public address system – Function test					☐		
(4) Engine order telegraph – Function test				☐	☐		
(5) Rudder angle indicator – Function test				☐	☐		
(6) Engineer call system – Function test				☐	☐		
(7) Communal aerial system – Function test					☐		
(8) Extension alarm – Function test				☐	☐		

5. Electric Part	In Shop			On Board			Remarks
	C	O	R	C	O	R	

(9) Fire/general alarm - Function test				○	○		
(10) CO ₂ alarm - Function test				○	○		
5.12 Navigation and searching equipment							
(1) Whistle - Function test				○	○		
(2) Magnetic compass - Function test					○		
(3) Gyro compass and auto - pilot - Function test					○		
(4) Echo sounder - Function test					○		
(5) Speed log - Function test					○		
(6) Radar - Function test					○		
(7) Direction finder - Function test					○		
(8) Marine navigator - Function test					○		
5.13 Reduction Gear							
(1) Radio plant - Function test				*○	○		* On behalf of government
(2) V.H.F. telephone - Function test				*○	○		*On behalf of government

6. Remote control/automation part	In Shop			On Board			Remarks
	C	O	R	C	O	R	

6.1 Main propulsion plant and its essential auxiliaries – Function test 6.2 Integrated automation system – Function test 6.3 Main propulsion system – Endurance test 6.4 E/R sys. Automation system (E.O./U.M.S.) – Function test 6.5 Ship speed test – Function test 6.6 Maneuvering test 1) Turning circle test 2) Stopping inertia test 3) Crash stop, ahead/astern test 4) Bridge maneuvering test				☐	☐	☐	
				☐	☐	☐	
				☐	☐	☐	• During sea trial
				☐	☐	☐	• During sea trial
				☐	☐	☐	• During sea trial
				☐	☐	☐	• During sea trial
				☐	☐	☐	
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				☐	☐	☐	
				☐	☐	☐	

7. Painting Part				In Shop			On Board			Remarks
				C	O	R	C	O	R	

7.1 Painting - Refer Q.S.P.							
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CHAPTER 6

QUALITY ASSURANCE MANUAL FOR AN EXAMPLE COMPANY (A.D.İ.K.)

6.0.1 Revision Sheet for Quality Assurance Manual

Revision No.	Chapter/Section No.	Page No.	Date	Remarks	Signature

6.0.2 Quality Assurance Manual Distribution List

Distributed	Date	Holder	Signature
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Anadolu Deniz İnşaat Kızakları Sanayi ve Ticaret Limited Şirketi. is a major ship building and repair company in Turkey. Company was founded in 1954 and the name changed in 1971 to the name which is still called the same as today. In 1986 place of the company was changed from Büyükdere to Tuzla Tersaneler bay The major activities of the company are as follows;

- New building of all kind vessel,
- Repair of all kind of vessel,
- Company specialized on chemical tanker repair and new build,
- Dry docking the vessel up to 1.200DWT

The personnel of the company is about 20, which includes Marine Chief Engineer, Mechanical engineers, Naval Architects and Marine Engineers and technicians.

The company placed in Tuzla bay and has about 40.000 m² area. Also in this area one slip way (for 5.500 DWT), 2 closed area, one is about 4.000 m² the other is about 3.000 m².

6.2. Definition

Definitions given in the International Standard ISO 8402-1988 and TS 90005-1991 are used in this Quality Assurance Manual. However there are special terms related to servicing call for more precise definition.

6.3.00 Customer's right to Find Out the Quality System and Copyright

6.3.1 Customer's right to Find Out the Quality System

If requirements of the International Standard ISO 9002 are related to in customer's order, The customer or his representative has the right to examine the Quality Assurance System of Anadolu Deniz İnşaat Kızakları Sanayi ve Ticaret Limited

Şirketi. This includes the right; to inspect service and supervise testing, to have to documents related to the Quality Assurance.

Special point classified as service secrets are not available for inspection,

Also the right to inspect the systems and production processes is restricted about to order concerned.

6.3.2 Copyright

This manual or any part shall not be reproduced, published without written permission of Anadolu Deniz İnşaat Kızakları Sanayi ve Ticaret Limited Şirketi.

6.4. ISO 9002 Quality System

6.4.1 Management responsibility

6.4.1.1 Quality Policy

Management of Anadolu Deniz İnşaat Kızakları Sanayi ve Ticaret Limited Şirketi. determines and implements quality policy in all activities pertaining to quality of a service which involves all phases from initial identification to final satisfaction of requirements and customer expectations which may include, marketing, procurement, process planning, service inspection and storage sales and distribution.

The company is totally committed to achieve the highest management standards with particular emphasis placed upon assuring quality and the protection of the environment.

Our personnel at all levels is responsible to meet customer's demands and expectation of the order to provide it on time with cost effective operations and economic profitability.

Quality system is planned to meet the requirements of standard ISO 9002: 1994, All the quality policies are understood, maintained and implemented at all levels of the organization.

6.4.1.2 Organization Charts

6.4.1.2.1 General

The organization charts and functionaries confirmed by directives from the General Manager of the works are described. Each department is responsible for the renewal of its own organization chart, when the organization is reformed. General Manager with his signature.

6.4.1.2.2 Overall Organization Chart of ANADOLU DENİZ İNŞAAT KIZAKLARI SANAYİ VE TİCARET LİMİTED ŞİRKETİ

The overall organization chart of the ADİK is shown fig.6.1

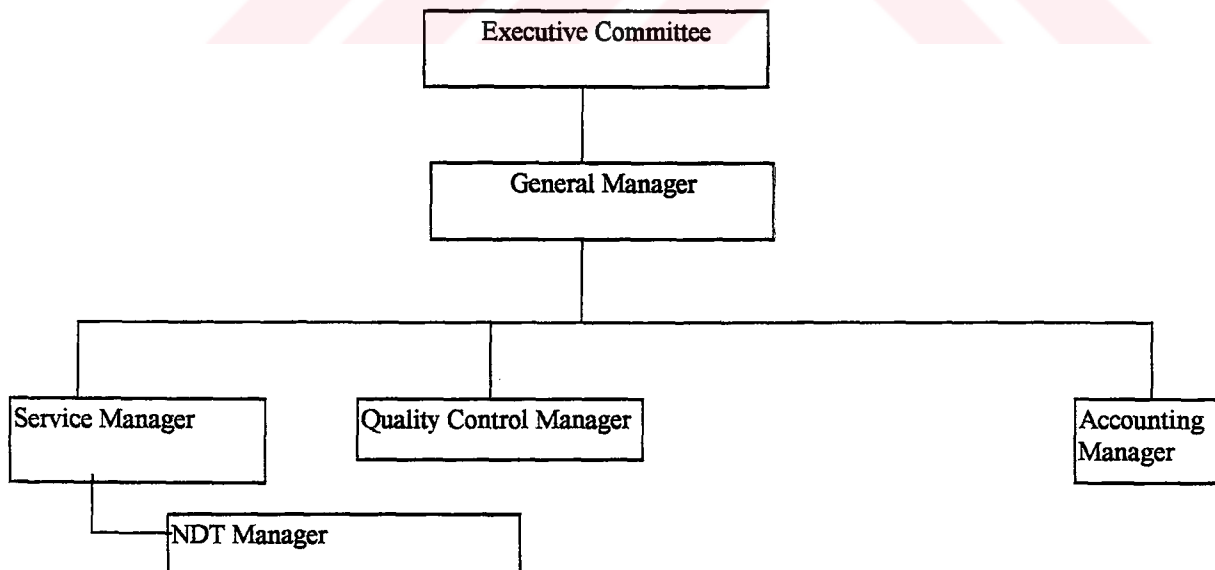


Fig 6.1 General organization chart

6.4.1.3 Responsibility and authority

Organization of the department and functions is defined and issued by a directive from the General Manager at ADİK. Division of jobs, responsibilities and authorities refer to activities affecting quality are explained in a general way in this Quality Assurance Manual and more detail in the descriptions and directions pertaining to the different activities.

Personal responsibilities and authorities are defined in the job descriptions of salaried employees.

6.4.1.3.1 Resources

Service is carried out in accordance with documented procedures and operation instructions with trained personnel at all levels is responsibility and authority is defined to meet the requirements of standard ISO 9002.

Quality System verification activities is carried out by personnel independent of those having direct responsibility for the department an internal audits.

6.4.1.3.2 Management Representative

Ibrahim Hami BALMUMCU (Mech. Eng. Msc.) is the management representative having authority and responsibility for ensuring that the requirements of quality matter at ADİK.

6.4.1.3. Quality responsibility

Quality responsibility is not separated in the organization of ADİK. Each department and each individual section shall be responsible for quality. Quality system is reviewed January & July a year by the senior management to ensure its continuing suitability

and effectiveness. Quality Assurance Coordinator shall be responsible for the quality purpose at the senior management level.

Quality control responsibility & Overall inspection responsibility for the final approval of product lies with the Quality control Department of ADİK. This functions is carried out by giving planning servicing, and inspection instructions, by carrying out absolutely free from other departments.

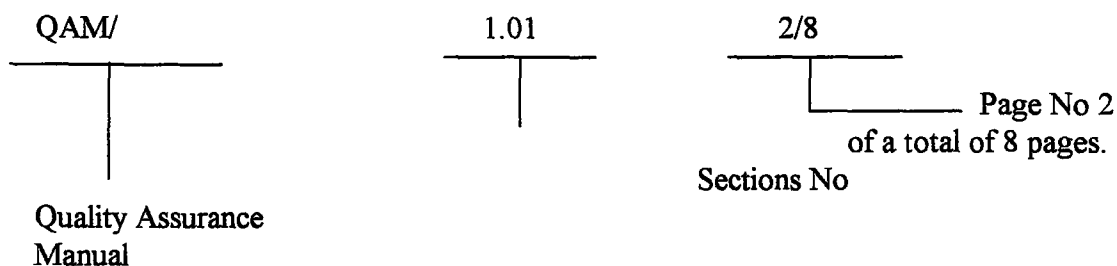
6.4.1.4- Management Review

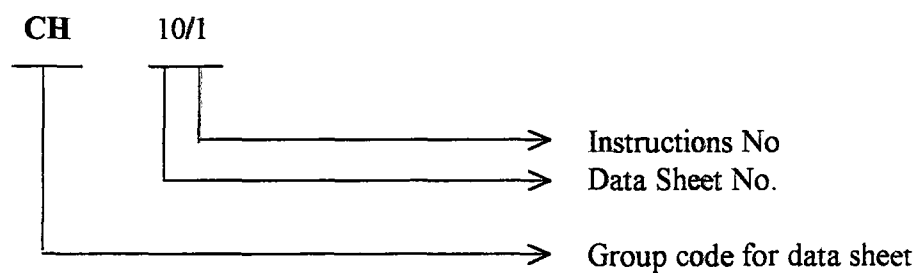
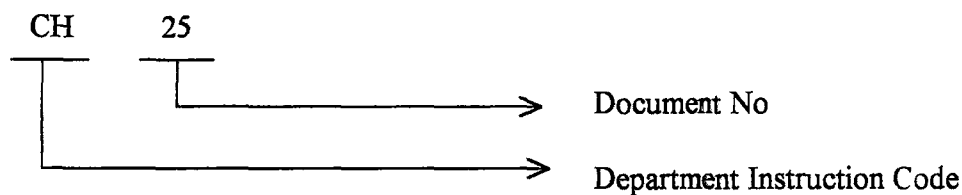
The quality system are reviewed by the management February and August per year in ADİK.

The purpose of the management review of this quality system is done by reviewing of the quality system and quality feedback to ensure the necessary improvement in the quality system.

Generally following items will be considered:

- 1- Review system and effectiveness to reach the aims.
- 2- Verify that corrective and preventive action procedures are effective
- 3- Type of customer complaints.
- 4- Non-confirmed services
- 5- Results of internal and external audits.
- 6- Feedback of the system performance.
- 7- Development of new technology and the market strategy.
- 8- Checking the other necessary subjects.



Example 2 “Quality Data Sheet”Example 3 “Work Instruction “

Identification of service is made on the base of heat no and remain intact from the time of initial receipt to delivery to final destination. Detail of service identification is given in section.

6.4.8 as Service identification and tractability.

6.4.2.6 Dealing with complaints

Responsible service receives Customer complaints. Customer complaints is sent to Quality Assurance Coordinator as soon as the complaints arrives. Quality Assurance Coordinator carefully analysis the complaints by using the quality records. Final decision is given after comparing services quality with the requirements specified in the customer's order. Two possibilities are available in this case;

- The case Customer is right: In this case Quality Assurance Coordinator gives a summary report to the General Manager and Service Department about the type of the cause of the complaint, for information and corrective action in order to prevent recurrence.

- The Customer is not right: Quality Assurance Coordinator gives a clear report to the Service Department about the complaint in order to make a contract to the customer.

6.4.3 Contract Review

6.4.3.1 General

The Sales Department shall receive the pre-order specification from abroad & domestic customers. For an ordinary quality service's and product's order confirmation shall be given to the customer by Responsible Sales Department and Plant Manager.

If customer's pre-order requirements need on additional technic verification at that time the Quality Control Department shall be received the Customer's requirements and determine whether servicing or manufacturing is possible in accordance with the order specification. The Quality Control Department Manager shall transmit the determination status to the Sales Department through the Service Manager to inform the customer.

6.4.3.2 Review

The main order confirmation of works is given with in the flow chart as;

- Order receive from foreign customer, shown in fig 6.2

6.4.3.3 Amendment to Contract

When the amendment is made an contract, the Sales Department correctly transferred it to the Quality Control Department through the Service Manager.

6.4.3.4 Records

Sales Department contract review records are saved in files and kept at least for 1 year.

- The flow chart of the contract review for on order receive from foreign & domestic customer

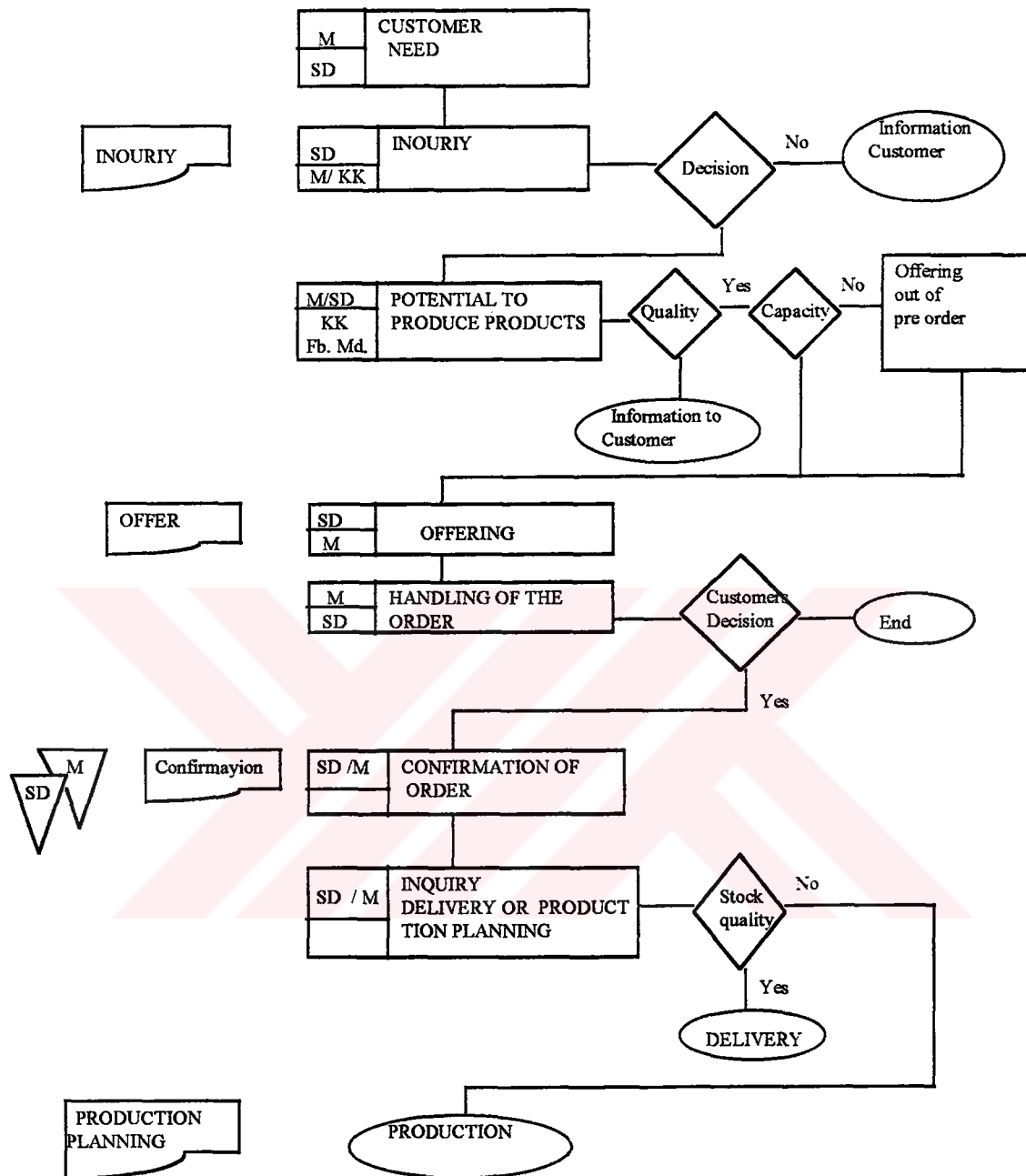


Fig. 6.2 contract review for on order receive foreign and domestic customer

6.4.4 Design Control

The scope of design control is not used in our quality system and this action of ISO 9002 does not apply.

6.4.5 Document and Data Control

6.4.5.1 General

The procedures are established and maintained to control all documents and data that relate to the servicing activities affecting quality. Most of the time the following principles are applied:

- Service Manager is responsible for maintaining and identifying the documents concerned with quality.
- The responsibility of a document preparation changing, revision, cancellation and distribution is belonging to the person who has prepared and approved the original review and approval unless specifically designated otherwise.
- Documents are filed according to ADIK Regulation in folders for one year.
- All the quality documents are reviewed and controlled yearly.

6.4.5.2 Permanent control of document and data

6.4.5.2.1 Quality assurance manual

The QAM shall be reviewed and controlled by **Management Representative** If necessary, changes are made to the relevant sections. When revised sections are issued holders of the copies are revised and updated obsolete pages are requested to return to the Quality Department to ensure that no absolute versions are in use.

6.4.5.2.2 Quality Data Records

All quality instructions are maintained and kept in concerned department for specified period.

Quality Department is responsible for all quality instructions which are used at ANADOLU DENİZ İNŞAAT KIZAKLARI SANAYİ VE TİCARET LİMİTED ŞİRKETİ. The instructions are reviewed and approved for adequately by the quality Department and by the Department involved to issue.

6.4.5.2.3 Procedures

The procedures of ADİK give more detailed description of the activities than the Quality Assurance Manual. They are included the description of activities affecting the quality for each unit is the service chain such as Working Procedures

The procedures are prepared by the organization co-ordinates the activity and approved. Procedures copy are sent to the Quality Department.

6.4.5.2.4 Work instructions

Each Department has the responsibility for the preparation, approval and updating at work instructions. Work instruction folders kept by the departmental offices and The Quality Department office. Each Department Manager is responsible for maintaining and identifying the work instructions.

6.4.5.3 Control of order documents

Responsible Sales Department feed the customer's requirements into the works information system as described in section 6.4.3 Inquiry, offers and quality specifications are filed by related Sales Department..

Sales Department supplies the customer using the order confirmation from the information system. At the same time, internal works order is made for internal use

by the Quality Department. Work's order, order confirmation and shipping documents are filed by the Sales Department.

6.4.6 Purchasing

4.6.6.1 General

The Quality System of ADİK is considered that purchase materials, components and assemblies directly affect the quality of services. So ADİK Quality System ensures that purchased products and service shall confirm to specified requirements, services and delivery accuracy of the subcontractor products and services.

Generally the following materials are acquired from the suppliers

- Product materials, alloys and alloying elements, additions and refractories
- Measuring and testing equipment
- Engineering Services
- Transportation Services
- Educational Services
- Observation Services

A clear definition of the technical specification of purchased product and service are filed by Account Department and Service Department and Quality Department.

Responsible department gets contact to the subcontractors for acquired materials and services through Department Manager.

6.4.6.2 Specification of requirements product and service to of acquired

The Quality requirements for purchase materials are defined by pertinent Department which will virtually utilize the materials assisted by Quality Department.

6.4.6.3 Evaluation of subcontractors

Selection of Subcontractors shall be made in accordance with to secure competition at least between two subcontractors at any time by the purchasing department in consideration of the quality price and delivery.

In long term the approval of subcontractors has done with the combination of the following information's.

- Evaluation of subcontractor capability
- Evaluation of test results of similar subcontractor
- Past history with similar subcontractor
- The service experience

Before getting into the approved list, each subcontractor to answer an inquire about his quality. Also certain products such as alloying elements and additions is assured by using reliable agent with receiving inspections.

On the basis at information collected from user experience, receiving inspections, and delivery accuracy is followed the decisions about the subcontractor and changes to receive inspection quality agreement are made in purchasing files.

6.4.6.4 Purchasing data

The main purchasing are made on a long-term basis. The technical specifications of purchased product and service are defined by the plant. The technical specifications are written and approved by the relevant department.

The offers of sub-contractors are examined by the Purchasing Department commercial basis and by the Plant on the technical basis.

All purchasing data's are recorded in the information system to make inquiries to potential subcontractors which are used to select to subcontractor new purchase orders.

6.4.6.5 Varification of purchased product and service

Appropriate receiving inspection is established to ensure that purchased product and services which have been received are properly controlled by different organizations with adequately trained personnel, depending on the type of materials.

Most of the foreign purchased product and service verification are made by an independent inspection company due to the contract.

When the purchased product and service is not confirmed to specified requirement on the order a complaint is made after that the product and service is returned to the suppliers or used for another purpose.

The Purchasing Department is in charge of contacts with the subcontractor about a complaint.

The customer verification of subcontracted product and service item is not used by ADİK

6.4.7 Control of customer supplied product

Customer-supplied product is not used by ADİK and this action of ISO 9002 does not apply.

6.4.8 Product identification and traceability

6.4.8.1 General

All services & materials identified from initial stage to final product delivered to the customer. The control of the identification system established and maintained

procedures for identifying the products during servicing. These systems may include the following checks:

- Correct identification occurs during manufacturing
- Materials are use correctly
- The planned production and inspection are taken
- Packaging, handling and storage are done according to the given instructions.

The Quality Control Department is responsible the control the identification system.

6.4.8.2 Identification during servicing

Purchased materials, equipment, goods and services are identified by and traceable to; purchase orders; requisitions, delivery notes and commercial invoices.

The degree of traceability is dependent upon the specific items and its importance with regard to quality, vessel operations, safety and the environment.

Equipment requiring certification is clearly identified in order to provide ready traceability to the appropriate certificate.

6.4.9 Process control

6.4.9.1 General

The Service planning, manufacture, inspections and dispatch activities are carried out under controlled conditions at Anadolu Deniz İnşaat Kızakları Sanayi ve Ticaret Limited Şirketi.. Control of production and dispatching are carried out by production planning. Data changing from item to item are input by he order and inspection of products, reporting of non-conformance's, control of corrective action are defined.

6.4.9.2 Service planning

Appropriate written procedures are available to all relevant personnel in order to ensure that those activities appertaining to their respective responsibilities, are carried out in a uniform and consistent manner at all times. These procedures and instructions describe the core activities of Service operations.

Where necessary, and to ensure that quality and safety services are maintained, formal work instructions and guidance notes have been issued to personnel to assist in the performance of their duties.

Instructions and guidance documentation supplement the quality and safety procedures and may be generally or specifically, applicable to the requirements of operations, maintenance, safety, manning, contracting and other related activities.

All personnel are responsible for ensuring their work is in accordance with Company quality Assurance management procedures and instructions.

Department Managers have specific responsibilities for checking and verifying work or services for which they are responsible as specified in Company procedures and instructions.

6.4.10 Inspection and testing

6.4.10.1 Inspection and testing

All entry material properties are inspected, by comparing taken based on the specified requirements of the purchasing documents.

Each purchasing materials which is used for production should be controlled before using. Materials are ordered according to specification and quality which is determined.

Materials which is continuously used in the production is purchased according to the specification and quality which is determined.

Materials which is continuously used in the production is purchased according to the specification and standards. Also see chapter 5

6.4.10.2 Inspection and test records

The measurements made in servicing process are kept in the test records.

Materials supplier certificate are given in addition to internal report. The chemical composition and mechanical test results, supplier, buyer, material type are written on quality documents.

Also a copy of the certificates are kept in the Quality Department records.

Material certificate type and material standards will determine the inspections and testing amount. Inspection and testing requirements are specified in the standards.

6.4.11 Control of inspection measuring and test equipment

6.4.11.1 Measuring and test equipment

All chemical and mechanical analysis are made in the Quality Control Laboratories.

6.4.11.2 Registration storing and using

All measuring equipment used in servicing & production which effects the service & product quality is recorded in lists. On these lists, the equipment type calibration frequency, measuring range and accuracy is indicated along with the responsible person for calibration.

Quality Department is responsible for records and recordings, use, calibration of test equipment and storing. Usage of equipment's and training of users are done according to written instructions.

Measuring and testing equipment is used by only qualified personnel.

6.4.11.3 Measuring and test equipment calibration

6.4.11.3.1 General

The equipment for the measurement of the properties of semi and final products are ensured to fit for use by Quality Control Department.

The Quality Control Department is responsible for systematic equipment calibration and record.

4.11.3.3 Mechanical workshop equipment

The mechanical properties of product are tested in Quality Mechanical testing Laboratory. The annual calibration of mechanical testing machine is made by Turkish Standard Institute.(TSE)

The calibration records are filed by the Department. In addition, internal calibrations are carried out at prescribed intervals.

6.4.12 Inspection and test status

6.4.12.1 Record inspection

The record inspection status of equipment is readily available by reference to the appropriate survey certificates, inspection reports, planned maintenance data, records, logs, and results of internal quality and safety audits.

The inspection status of purchased goods, materials, equipment and services is readily available by reference to receipt records.

6.4.13 Control of non conforming product

The main idea is to keep the specification of intermediate and final services and products are based on customer request in order. Services or Products which do not comply with the specified requirements at semi or final inspections are directed to reinspection regarding or scrapping. All rejected products are recorded and deleted from the order and Quality Control Department starts the production of a substitute product.

Inspection staff has got the sufficient instructions about the correctness of acceptance and rejection limits from Quality Control Department .

The reason for rejection or scrapping is recorded. Also minor defects do not effect in rejection are reported. Related order information is got out from the rejected product, by canceling the quality and inspection tags. The instruction for regarding are in the responsibility of the Quality Department.

Finding nonconformity's during testing are held in accordance with resetting rules according to the standards. If a product has a minor defect which does not essentially effect its quality such a dimensional deviation and surface quality, Sales Department will contact to the customer to find out whether such a product is useable or not. Further action will be taken according to the customer decision.

6.4.14 Corrective and preventive actions

6.4.14.1 General

It is important that the causes of nonconformity are investigated for both the and ADİK Works. Recurrence of non-conformities are only prevented by eliminating and detecting the causes of non-conforming service.

As soon as the individual non-conformities are seen which is given serious economic results are immediately deal with at meetings between related departments for searching the causes. After investigating the cause and statues of non-confirming the usual procedures is to written a report to take a paper action for correction. The suggesting report is gives to the related units.

All non-conformity reports are deal with at regular monthly quality meeting.

6.4.14.2 Work process and analysis of processes

Quality of products are partly dependent on the condition of production equipment. Related Departments are responsible for process control, control of process parameters and corrective action. The Quality Control Department is responsible to ensure he necessary requirement placed on the manufacturing process parameters for the controlling the product quality according to the customer requirements.

If the corrective action is required the decision about investigating the cause of nonconformity and the corrective actions is made by the person in charge of the activity together with the responsible Quality Control Department person.

Day Shift engineer are responsible for unification of the work methods at he different shifts.

6.4.14.3 Analysis of products

Non-conforming products are rejected or regretted non-conforming products are controlled by the Quality Department by means of statistical measurement and testing reports. Therefore corrective action and changing in the manufacturing instructions are done correctly.

6.4.14.4 Corrective action

6.4.14.4.1 Corrective action on processes

Reporting, corrective action and the planning to repair for process equipment have been done with using the preventive information system.

Ordering department is responsible for the order supervision and approval of the report. Big changing on the equipment's are done by Investment Department coordination and plans approved by the Plant Manager.

Operation defects come into existence in working process due to wrong work methods and faulty instructions from unknowledgement. Necessary corrective activities are decided in a meeting between the Quality Control Department and related Department. Related Department is responsible for the preparation, checking, approval and implementation of a new instructions and procedure.

6.4.14.4.2 Corrective action on products

The functions of effected quality and relevant instructions are usually done by the Quality Control Department. The function of Quality Control Department is to start the corrective action and ensure that the necessary changes are carried out. Changes are planned and carried out by the personnel who is responsible in the production line organization. Big changes are planned, decided and documented in CO-operation with affinity departments of the works.

6.4.14.5 Preventive action

The quality-related problem or causes are determined before occurring the nonconformity's on product. This required careful analysis of the product specification and all related processes operations, quality records, and customer complaints.

Appropriate steps are taken and used to eliminate potential causes of nonconformity's. The results of the investigation is recorded.

6.4.15 Handling, storing, packaging, preservation and delivery

6.4.15.1- Handling

Handling methods and equipment's for products are chosen safety. The basic handling equipment's are crane or lifting machines as such as forklift.

6.4.15.2 Storage and packaging

Storage areas for finished products are located under the same place with rolling mill products. Storage is controlled and reported.

Packaging is done partly by automatic machines and manually. According to customer's requirements every bundle is securely tied with 6-8 mm wire rods or steel straps.

6.4.15.3 Preservation

Stored product are controlled for preservation at product according to quality and safely in closed area using metallic tags.

6.4.15.4 Delivery

Delivering of products is based on agreed delivery orders. Quality Department is responsible for planning to delivery. The execution of deliveries is the responsibility of affinity. Sales and Deliveries Department.

Delivery documents and loading instructions can only be obtained when all the planned inspections and tests have been carried out. Material certificates for each lot to be delivered is given by Quality Department.

6.4.16 Control of quality records

6.4.16.1 General

ADİK has placed definite necessary requirements on documentation. Documentation's will show that,

- The service and product has been manufactured in conformity with order specifications.
- Auditing of cap, alloying addition and additive suppliers has been properly carried out
- The qualified personnel, work methods and equipment meet the requirements
- Corrective or other actions on non-confirming products have been taken it right away
- Necessary attention has been paid to prevent the products defects.

The quality dais are recorded

The summary reports are made systematically at agreed intervals.

General directions for the filling at documents are given in the company's filling works.

6.4.16.2 Production records

Production of the steel industry are of a continuous nature, so the control systems must have continuous reporting facilities. Also Reports are include Quality data. Inspected records are used manufacturing process to control and development.

The manufacturing process records are saved in files by heat number and are kept for 1 year.

6.4.16.3 Quality inspection and assurance records

The direct surveillance and measurement results are recorded on paper documents. The information needed id find out easily by the heat number. These records are kept for 1 year. Surveillance and rejections due to nonconformity are registered analyzed and reported.

The most important data for the customer's is inspection and testing data which show that the specified requirements are met. The Quality Control Department is responsible for the collection and filing data.

Material Certificates are made directly by the Quality Control Department.

6.4.16.4 Educational records

The educational records are at the each personal departments. The educational records which we outside at the plant, can be final educated.

The material certificate and the surrounded inspection reports show that the material meets the specified requirements. the material certificate is kept 1 year as copy paper.

Calibration records are filed by the Quality Department. also the reports of external quality audits are filed by Quality Department. All files have numerical codes and these are even below

KKK	Quality Control Books
KKD	Quality Control Documents
GMCH	Raw Material Quality Control Documents
YMCH	Steel Shop Quality Control Documents
KKR	Laboratories Quality Control Documents
MDHH	Rolling Mill Quality Control Documents
CDHH	Quality Control Certificate Documents
GT.	Personal Work Definition
KP	Working Procedures
IT	Equipment Work Instructions
ED	Training Documents
KD	Calibration Documents
SKD	Order Acceptance Quality Control Documents
MSD	Customer Complaints
DFD	Preventive/Corrective Action
AD	Internal Quality Audits

Quality system is planned to meet the requirements of standard ISO 9002: 1994, All the policies are understood, maintained and implemented at all levels of the organization.

6.4.17 Quality audits

6.4.17.1 Planning of internal audits

Internal quality audits at ADIK are planned to be carried out in conformity with an annual plan made for each year. In the audit plan according to be Work's activities are made once year for each unit.

The Corporate Quality Coordinator is responsible for the preparation of internal audit annual plan and the audit personnel is selected by evaluation panel which consists plant manager, Quality Control and management representative. The audit was

carried out upon the basis of Quality Assurance Manual ISO 9002 1st August, 1994 dated and ISO 10011 1992 dated Standards.

6.4.17.2 Conduct of audits

Internal quality audits are usually provided in Co-operation with the department audited.

During the audit the plant are visited and working methods and work instructions evaluated in practice. Internal audit are normally carried out in working time.

During the internal audit deficiencies are found and identified. Then an audit reports is written and given to the affinity department.

6.4.17.3 Follow up corrective action

The Quality Control Department find out effectiveness of corrective action is not taken by the time fixed, a new schedule is agreed upon and the corrective action concerned will be put under special monitoring. A lots of delayed corrective is prepared and disturbed to the managers of the responsibility concerned and where necessary presented at the plant manager.

6.4.17.4- Evaluating auditor

Candidates at ADİK are made after at least four audits together with lead auditor.

6.4.17.5 External quality audits

An audits of the Quality System of ADİK are carried out annually by certified persons, authorities and customer's. This societies carry out regular audits of the whole Quality Assurance System.

6.4.18 Training

6.4.18.1 Basic education and initiation

Basic Education and initiation the workers of ADİK, especially those having jobs in production or quality inspection have received basic occupational education.

Before starting independent work, a new worker who is changing jobs is given occupational guideline by a trained engineer.

6.4.18.2 Further training

A training strategy for different categories of personnel is prepared annually by the Quality Control Department. Training is given partly by external trainer organization and partly within the company. The number of training days varies from 5-10 days a year depending on the personnel category.

6.4.19 Servicing

Servicing is not used by ADİK and this action of ISO 9002 does not apply.

6.4.20 Statistical techniques

6.4.20.1 Statistical sampling

Product's samples are taken according to the Customer requirements and Standards. Mechanical testing and chemical analysis are determined by using these samples.

Chemical analysis written in the mill's test certificate is got from the sample which is taken after cutting is Continuous casting. Each heat is carried out with one determined composition. Also final product's analysis can be checked on the heat basis.

Mechanical test results such as, tensile strength, yield strength, elongation, bending and re-bending are carried out according to the rules of the standards are used in a manufacturing program.

6.4.20.2 Analysis of quality data

All the test results and measurement explanations for the reject of the product are recorded. The statistical analysis which is got from these records are summarized monthly and yearly reports.

Quality Control cards which are held for daily purposes are statically analysed and used for monitoring process and quality control.

6.4.20.3 Statistical quality control

Specific statistical quality control methods have been used for each production stage by the Quality Control Department. By having statistical quality control get feedback about the works and so that most productive work is done for the achievement of qualify products.

LAST WORD

This thesis has applied to a private shipyard, and quality control of the each stage of the blocks for the ship has become very efficient on work and the quality was very good. Also, office site of the shipyard became very efficient on work and every work has be come traceable on every stage.

Applying the standards to a existing ship which means that the repair work, the work finished quicker and quality of work is better.

On the other hand, skilled man quantity in the shipyard is increased dramatically. Because system requires skilled personel.

Also the finished job quality is good as European shipyards. This means that, we are able to compete with them, whenever we follow standards and way of operation methods.

- [1] **ARNOLD ,KENNETH L.** The Manager's Guide to ISO 9000. Newyork: Macmillan, 1994.
- [2] **JOHNSON PERRY L.** ISO 9000. Newyork: McGraw-Hill, 1993.
- [3].5 **JAMES L .** ISO 9000: preparing for registration. Milwaukee, WI: ASQC Quality Press, 1992.
- [4] A cross reference list of all these 20 quality system elements can be got from different ISO 9000 books. For ex. the book "ISO 9000: preparing for registration" by **LAMPRECHT , JAMES . L** (1992) contains the cross reference list.
- [5] **IACS** "Bulk Carriers - Guidelines for Surveys, Assessment and Repair of hull structure"
- [6] **TSCF** "Guidelines for the inspection and maintenance of double hull tanker structures"
- [7] **TSCF** "Guidance manual for the inspection and condition assessment of tanker structures"
- [8] **IACS UR W7** "Hull and machinery steel forging"
- [9] **IACS UR W8** "Hull and machinery steel castings"
- [10] **IACS UR Z10.1**"Hull surveys of oil tankers" and **Z10.2** "Hull surveys of bulk carriers" Annex1
- [11] **IACS Recommendation No.20** "Guide for inspection of ship hull welds"
- [12] **IACS UR W17** "Approval of consumable for welding normal and higher strength hull structural steels"
- [13] **IACS Recommendation No.12** "guidelines for surface finish of hot rolled plates and wide flats"

SECRET

Tez sahibi İBRAHİM HAMİ BALMUMCU 01/04/1970 İstanbul doğumlu. İlk öğrenimini Şair Behçet Kemal Çağlar İlkokulu'nda başlayıp daha sonra ortaokulu Etiler Lisesi'nde okumuştur. Maçka Teknik Lisesi Elektrik bölümünden 1998 yılında mezun olduktan sonra, eğitimine İngiltere'de devam etmiştir. Sırasıyla, bir sene yabancı dil, iki sene ön lisans genel mühendislik, iki senede Portsmouth Üniversitesi'nde makina mühendisliği öğrenimi görüp İstanbul Teknik Üniversitesi Denizcilik Fakültesi Makina Bölümü üçüncü sınıfa 1993 yılında yatay geçiş yapmıştır. 1995 yılında denizcilik fakültesinden mezun olduktan sonra ortak olduğu bir tersanede çalışmaya, mezun olduğu fakülte ve ana bilim dalında yüksek lisans yapmaya başlamıştır.

203. "SECRET" - CONTINUED
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