



DME – 463

SPECIFICATION ON MANUALLY OPERATED
SHIP'S SYSTEM VALVES
FOR LOW PRESSURE FLUIDS

ISSUING AUTHORITY

DIRECTORATE OF MARINE ENGINEERING
IHQ MOD (NAVY)

2016

Conditions of Release

1. This DME 463 Specification has been prepared for the use of the Indian Navy and of its contractors in the execution of contracts for the Indian Navy.
2. This document is Indian Navy copyright and the information therein may be subjected to Indian Navy or third party rights.
3. It is not to be released, reproduced or published without written permission of the IHQ MoD(Navy)/ DME.
4. Indian Navy reserves the right to amend or modify the contents of this specification without consulting or informing any holder.
5. This specification may call for the use of processes, substances and procedures that may be injurious to health, if adequate precautions are not taken.
6. It refers only to technical suitability and in no way absolves either the supplier or the user from statutory obligations relating to health and safety at any stage of manufacture or use.
7. Where attention is drawn to hazards, those quoted may not necessarily be exhaustive.
8. This specification is the property of the Indian Navy and unless otherwise authorised in writing by the IHQ MoD(Navy), must be returned on completion of the contract or submission of the tender, in connection with which it is issued.
9. When the specification is issued in connection with a tender or contract, the user should ensure that he is in possession of the correct version of each document relevant to each particular tender or contract. Inquiries in this connection may be made from IHQ MoD(Navy)/ DME, Sena Bhawan, New Delhi.
10. Unless otherwise specified, reference in this specification to any document means the issue and all amendments to the document current at the date of issue or subsequent amendments to this specification.

Foreword

1. General requirements of Marine valves are laid down in various Naval Engineering Standards. Considering the large quantum of system valves fitted onboard ships, a requirement was felt to standardize and rationalize the component under induction, through a comprehensive specification.
2. With the given premise, Specification on 'Ship's System Valves for LP Fluids' (DME – 463) has been prepared by the Indian Navy/ Shivaji's Centre of Excellence, to achieve standardization in 'type', 'dimension', 'material aspects' and 'inspection test criteria', with an aim to enhance interchangeability, inventory reduction and quality compliance.
3. This document has been divided into two main sections, viz, Technical Description and Valves Selection Guidelines, as Parts A & B, respectively. While Part 'A' provides an insight to various types of valve, their material and dimensional considerations which serves as reference, Part 'B' outlines various selection guidelines with respect to system applicability, piping considerations, standardization of type, dimensions, material aspects and inspection & testing criteria. Further, based on the selection criteria defined in Part 'B' of the document, a Valve Selection Template has been prepared and included at Appendix A, along with suitable illustrative examples. The Template is required to be used for finalising the Valve Selection and applicable Test Criteria.
4. The comprehensive Specification would serve as a guiding document to valve manufacturers and those dealing with the design and selection of valves. System valves for LP Fluids being inducted or retrofitted are required to comply with this Specification. Deviation to guidelines in this specification, if necessitated, would warrant advance and formal approval from IHQ MoD (N)/ DME.
5. **DME 422** is hereby superseded.



(Sunil Kaushik)
Commodore
Principal Director Marine Engineering

INDEX

<u>Chapter</u>	<u>Description</u>	<u>Page No</u>
<u>Part A – Technical Description</u>		
1	Introduction	6
2	Types of Valve	9
3	Selection of Valve Material based on Piping Consideration	23
4	Valve Sizing Calculations	27
<u>Part B – Valve Selection Guidelines</u>		
5	Valve Type Selection	30
6	Standard Dimensions of Valves	36
7	Valve Material Selection	45
8	General Design Considerations	56
9	Inspection and Testing of Valves	61
<u>Part C – Glossary</u>		
10	Glossary	68

APPENDIX

<u>Appendix</u>	<u>Description</u>	<u>Page No</u>
A	Valve Selection Template	74
B	Weight Certificate	82
C	Shock Testing & IN Shock Grade Curve 'A'	83

PART - A
TECHNICAL DESCRIPTION

CHAPTER 1

INTRODUCTION

Aim

1.1 The aim of this Specification is to rationalise the range of Low Pressure (PN 10 rating), ship system valves and also to standardise types of valve to be used in service. It also provides guideline for selection in form, fit & material, inspection & testing criteria and design considerations in respect of Hull and System (Line) valves to be fitted in the following systems:-

- (a) Sea Water System
 - (i) Firemain System
 - (ii) Sea Water Cooling System
 - (iii) Bilge Pumping out System
 - (iv) Ballast and De-ballast System
 - (v) Salvage System
- (b) Fuel System
- (c) AVCAT System
- (d) Lub Oil System
- (e) Fresh Water System
- (f) Chilled Water System

1.2 This document supersedes DME 422.

Scope

1.3 This document has been divided into two main sections, viz, Part 'A'- Technical Description and Part 'B' – Valve Selection Guidelines. Part 'A' gives an insight in to various types of valve, their material and dimensional considerations, for the purpose of reference. Part 'B' outlines various selection guidelines with respect to system applicability, piping considerations, standardisation of type, dimensions, material aspects and inspection & testing criteria. Further, based on the selection criteria defined in Part B of the document, a Valve Selection Template has been prepared and included

at Appendix 'A', along with suitable illustrative examples. The Template is required to be used for selection of a particular type of Valve, arrive at their dimensional aspects, material composition and applicable Test Criteria.

List of Standards Referred

1.4 Various standards referred during preparations of this specification are as follows:-

<u>Ser</u>	<u>Standard</u>	<u>Description</u>
(a)	ASME B 16.34	Valves – Flange, Threaded and Welding End
(b)	ASME B 16.10	Face to Face & End to End Dimensions of Valves
(c)	ASME Section 5	Non-destructive Examination
(d)	ASME Section 8	Rules for construction of Pressure Vessel
(e)	AWWA C 504	Rubber seated Butterfly Valves
(f)	API 527	Seat tightness of Pressure Relief Valves
(g)	API 598	Valve Inspection & Testing
(h)	BS 2080	Face to face, centre to face, end to end and centre to end dimensions of valves
(j)	BS 5154	Specification for Copper alloy globe, Globe stop and check, Check and Gate valve
(k)	BS 5351	Steel ball valves for the Petroleum, Petrochemical and Allied Industries.
(l)	BS 6755 / BS EN 12266 Part 1 & 2 / API 607	Testing of Valves. Specification for production pressure testing requirements.
(m)	BS 21	Specification for Pipe threads for tubes and fittings where pressure-tight joints are made on the threads
(p)	BS 4504 Sec 3.1 & 3.3	Pipe Flanges Dimensions for Steel & Copper Alloys
(q)	BS 5146	Inspection and test of valves.
(r)	IS 10924	Shipbuilding Guidelines for selection of Marine Valves & Cocks.
(s)	IS 4038	Specification for Foot Valves of Water works purposes
(t)	ISO 14313	Petroleum & natural Gas Industries Pipelines Valves
(u)	NES 303	Lubrication Oil System for Propulsion & Power generation in Surface Ships & Submarines.
(v)	NES 319	Requirements for Aviation Fuel Systems in HM Ships
(w)	NES 320	Requirements for the Design and Installation of Fuel Systems for Gas Turbine Engines and Diesel Engines in HM Surface Ships and Submarines
(x)	NES 360	Guidance to the Selection of Low Pressure Metric

		Standard Valves
(y)	NES 375	Naval Engineering Standard Design and Manufacture of Naval Valves
(z)	NES 710	Fluid systems, general requirements
(aa)	NES 719	Sea Water Systems for HM Surface Ships
(ab)	NES 728	Requirements for Domestic Hot and Cold Fresh Water Systems
(ac)	NES 738	Metals And Corrosion Guide
(ad)	NES 747	NAB Specifications – Part 1,2,4 and 5 as relevant
(ae)	NES 833	Requirements for NAB
(af)	NSTM 505	Naval Ship's Technical Manual Chapter 505 Piping System
(ag)	MSS SP 55	Visual Inspection
(ah)	DGQA(WP) Guide Book on Hull & Line Valves	
(aj)	Handbook of Valves and actuators: Valve Manual International by Brian Nesbitt	

CHAPTER 2

TYPES OF VALVES

Introduction

2.1. A valve is a device that regulates flow of medium by opening, closing or partially obstructing various passages ways. Valves are technically pipe fittings which are operated locally or remotely. In general valves are categorised based on functional or constructional aspects. Functionality based categorisation of valves, considered in this Specification, for the purpose of rationalisation of inventory, is as depicted below.

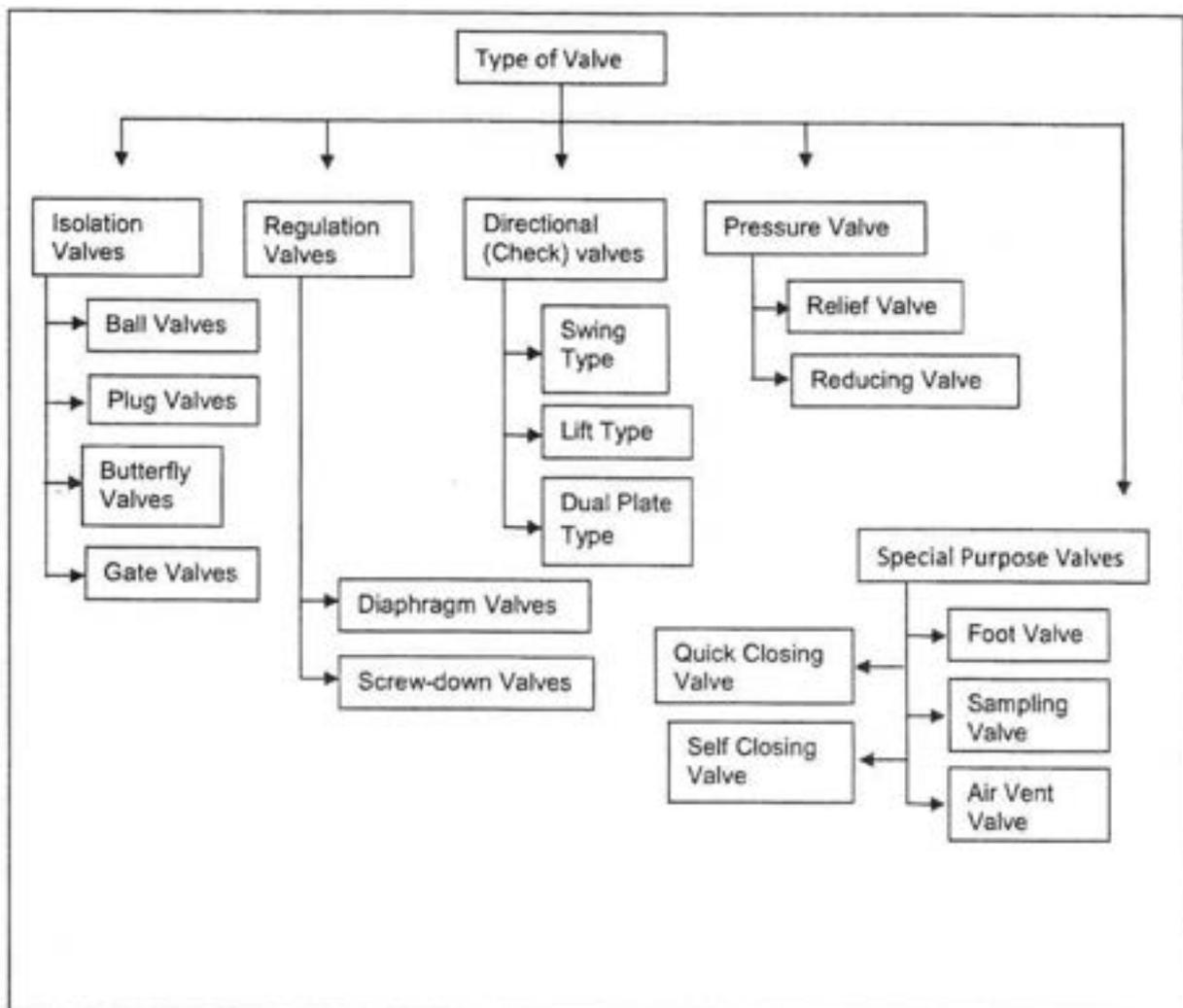


Fig. 2.1 - Types of Valve

Isolation Valves

2.2. Isolation valves are used in the system for flow 'On / Off' functions. Various types of valves under this category are Ball valves, Butterfly valves, Gate valves and Plug valves. Direction of flow does not have any effect on the function of valve. Ball, Plug and Butterfly valves are also called as 'Quarter-turn' valves as, with 90° rotation of valve handle, these can be either closed or opened.

2.2.1. **Ball Valve.** Various types of ball valves, their constructional aspects and utility are discussed in paragraphs below.

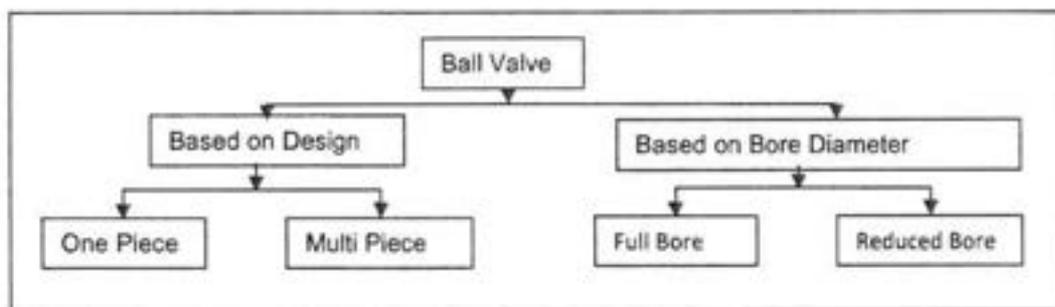


Fig. 2.2 - Types of Ball valves

(a) When Ball valve handle is operated to open, the ball rotates and the passage through the ball falls in-line with valve body inlet and outlet. While shutting the valve, the ball is rotated in such way that hole is now perpendicular to the direction of flow of valve body and flow is stopped. The valve opening and shutting is achieved through 90° rotation. Ball valves offer positive tight shut-off with quarter operation and low operating torque.

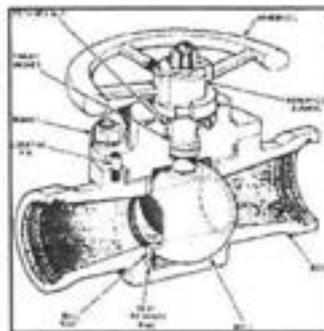


Fig. 2.3 - Typical Ball Valve

(b) One Piece Body Design. One piece Body type provides a rigid construction (refer Fig. 2.4, below). This particular design can further be categorised as 'Top' or 'Side-Entry' Type. 'Top entry' design provides major

advantage of in-situ repairs/ maintenance wherein ball and soft seats can be removed from the valve without taking the valve out from the system pipelines. It also has a compact design, reduces the need of body joints, thus eliminating a potential leak path.

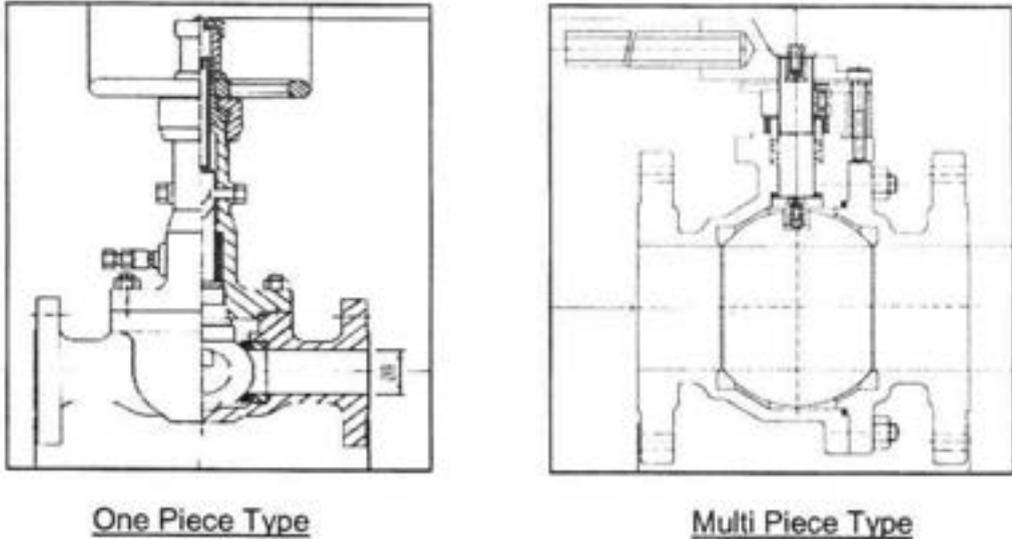


Fig. 2.4 - One Piece & Multi Piece Types of Ball Valve

(c) Multi Piece Body Design. Multi-piece Body design can be of 'two-piece' or 'three-piece (sandwich)' types.

(d) Further, based on bore diameter, ball valves can be classified as follows (refer Fig 2.5):-

(i) Full Bore. Full bore valves provides straight-through-flow with minimum of resistance.

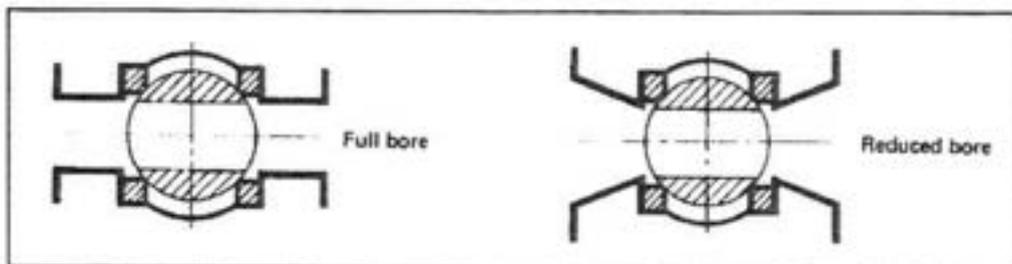


Fig. 2.5 - Full & Reduced Bore Pattern

(ii) Reduced Bore. Reduced bore designed valves are of venturi configuration having smooth transition from the flange bore to the throat.

The minimum throat dimensions as per BS 5351 / NES 375 for reduced bore valves are as indicated at Table no 2.1 below.

Nominal Size (NB)	10	15	20	25	32	40	50	65	80	100	125	150
Reduced bore (at throat) minimum Dia (mm)	6	9	12.5	17	23	28	36	50	57	75	95	111

Table 2.1 - Minimum Throat Dimensions

(d) Ball valves are generally considered to be most suited for straight 'on-off' duties. An important aspect of the ball valve is the inherent compactness of the design, making it easy to handle and maintain. Ball valves are normally fitted in ships systems such as Sea water, Fresh water, Sanitary, Drain, Lub oil transfer, Hydraulic etc.

(e) The maximum recommended size for ball valves is 80 NB.

2.2.2. Butterfly Valves.

(a) Butterfly valve consists of a circular disc or plate built with a stem through the middle or attached offset. When opened, disc pivots 90° in the valve bore, thus aligning with the flow and creating a nearly unrestricted flow path. Butterfly valves operate similar to ball valves in their 90° rotation and allow for quick shut-off.

(b) This valve is used on variety of systems onboard ship such as seawater, freshwater, chilled water, fuel system, lub oil, AVCAT system etc. The Butterfly valve is light in weight, relatively small and quick acting. It also offers low pressure drop across the valve and incorporates minimum moving parts.

(c) Butterfly valves are used for 'On/Off' duties in sizes 100 NB and above. Below this size, the valve provides restriction to flow due to excessive thickness of the disc. Butterfly valves are classified into following based on design/ construction consideration:-

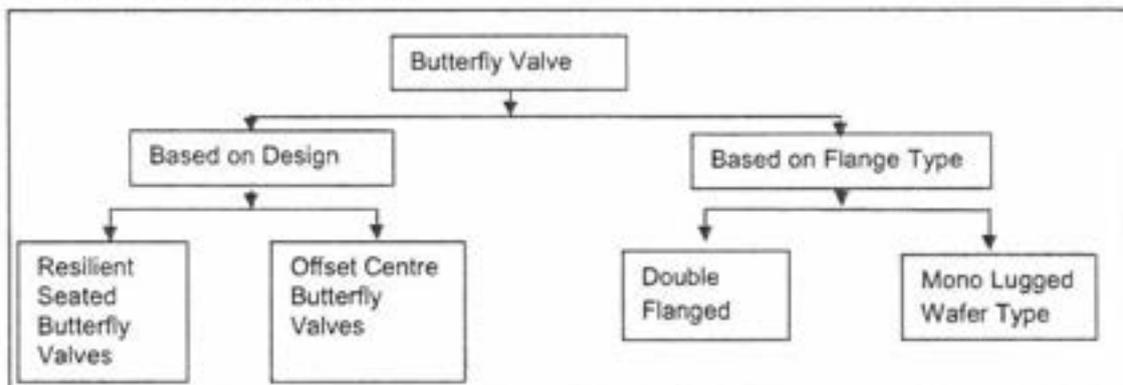


Fig. 2.6 - Types of Butterfly Valve

(d) Resilient Seated Butterfly Valves (RSBV). These are also termed as Centre Sleeve valves. The valves have three basic parts, viz, body, disc and seat. Sealing is achieved by means of mating of the disc edge with the rubber lining on valve body. The rubber seating offers a local sealing contact pressure higher than the line pressure. To seal against higher pressure, the edge of the disc would have to severely compress the rubber lining, resulting in higher operational torque and destructive wear of the liner. In closed position for an extended period of time under high pressure, the rubber tends to deform permanently, bulging out on both sides of the disc edge and making it difficult to open, which a common defect is observed in Rubber Seated Butterfly Valves.

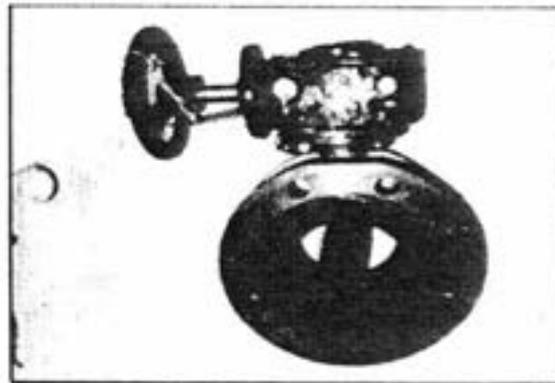
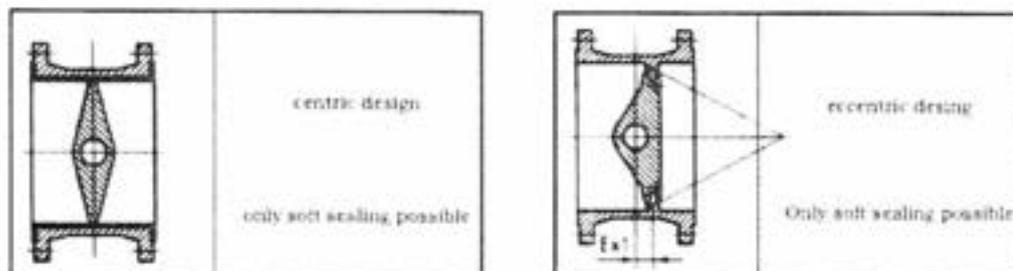


Fig. 2.7 - Resilient Seated Butterfly Valves

(b) Offset Centre Butterfly Valves. The single offset butterfly valve is designed with an offset seat. The second offset is achieved by locating the stem asymmetric to center-line of the seat. The combination of these two offsets creates a **camming effect** as the disc swings into and out of the seat. The disc lifts quickly out of the seat in the first few degrees of travel and does not contact the seat again until it is nearly closed. There are no wear points between the seat and disc, while operating torques are reduced and seat life is extended. Triple Offset design includes the double offset and incorporates a third offset at the seating surface. The concept of Offset design is depicted at Fig.2.8 below.



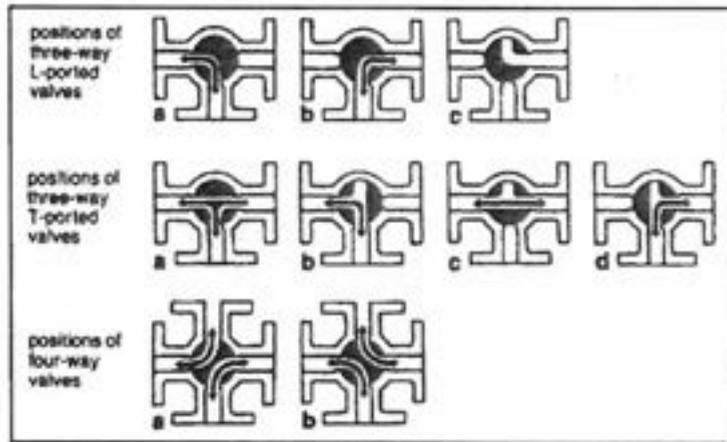


Fig. 2.10 - Multiport Configuration of Plug Valve

2.2.4. **Gate Valve.**

(a) The working of Gate valve is achieved through a gate - like disc that is moved at right angle across the axis of flow between matching seats in the valve body, thus opening or closing of the flow. These valves are not used for throttling or regulation purpose. Flow against a partly opened disk may cause vibrations leading to damage to the seating surfaces and throttling can further cause erosion of the disk. Based on the type of disc (gate) seating used, gate valve is categorised as follows:-

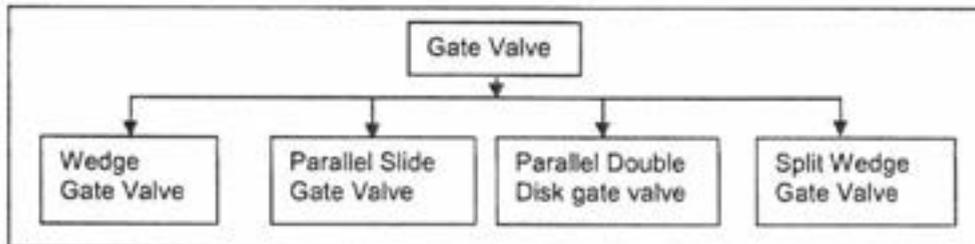


Fig. 2.11 - Types of Gate Valve

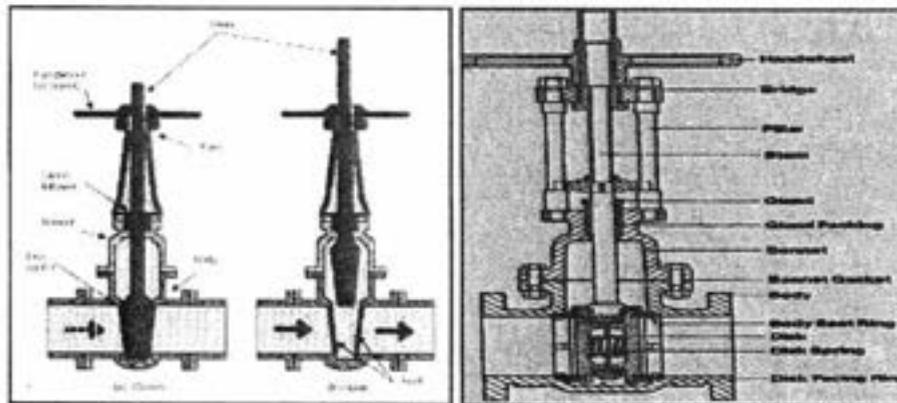


Fig. 2.12 - Wedge Type Gate Valve & Parallel Slide Gate Valve

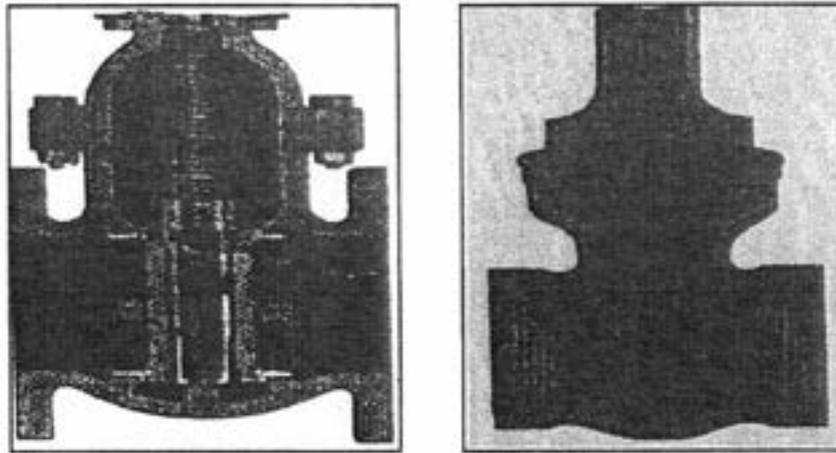


Fig. 2.13 - Parallel Double Disk & Split Wedge Gate Valve

(b) The above mentioned four types of gate valve can have either 'rising stem' or 'non-rising stem' as shown in Fig 2.14 below. In the non-rising stem gate valve, the stem does not move vertically but merely rotates. This design is particularly useful in constrained space application such as valves located in engine room bilges.

(d) The rising stem gate valve is further categorised as, 'inside screw' and 'outside screw'. In case of outside screw, stem threads are situated outside the valve body and are accessible for lubrication. As regards 'inside screw' design, stem threads are located inside the valve body and hence cannot be used in case of corrosive fluid application.

(e) Parallel double disc gate valves offers a more effective sealing in Low pressure applications.

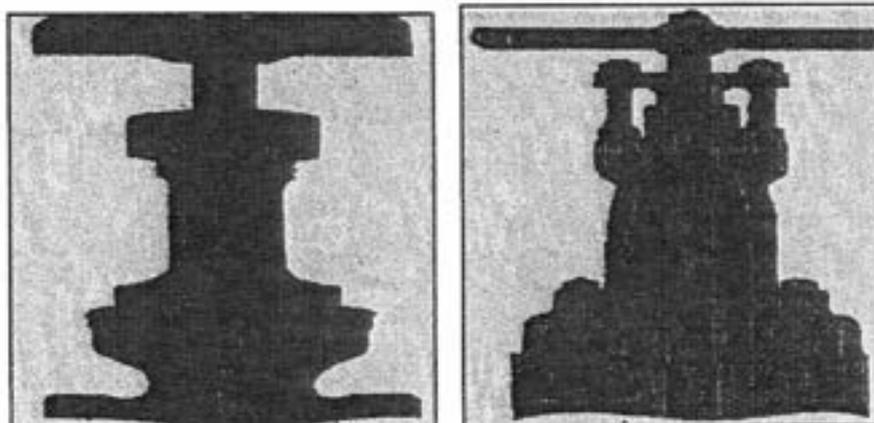


Fig. 2.14 - Rising Stem & Non Rising Stem

Regulation Valves

2.3. Primarily these valves are used in the system for 'flow control' / 'regulation' purpose and are of Screw-down (Globe) and Diaphragm types. However, based on system requirements Screw-down (Globe) and Diaphragm valves can also be used for isolation purpose.

2.3.1 Diaphragm Valve.

(a) The valve uses flexible diaphragm which is pressed against the body (the weir) or contoured bottom (straight through type valve) as shown in Fig 2.15. The flexible diaphragm isolates the fluid from valve spindle thus making ideal for use in corrosive fluids medium. These valves can be considered for isolation as well as regulation purpose, particularly where throttling of fluid is required or in vacuum lines to obviate leakage through spindle glands.

(b) Major components of the diaphragm valves are the body, diaphragm, stem and bonnet assembly. These are also called as '*Pinch Clamp*' valves. Two categories of diaphragm valves in use are namely '*Weir type*' and '*Straight through type*'.

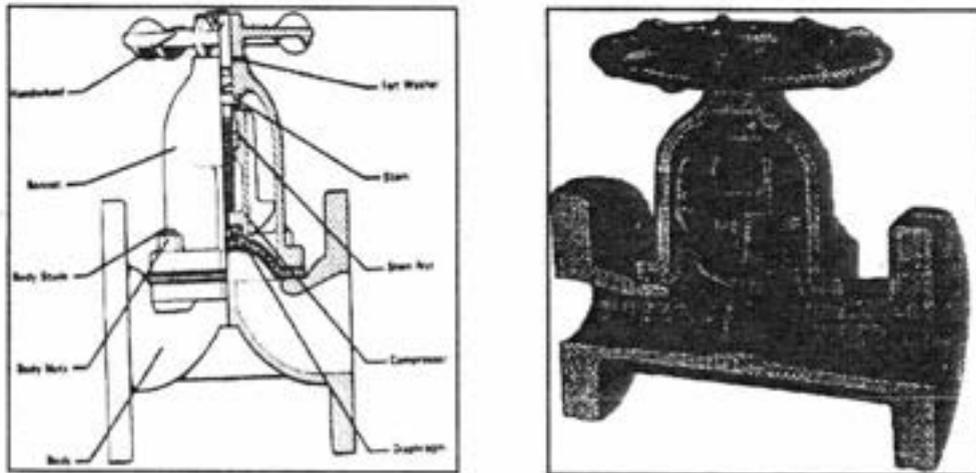


Fig. 2.15 - Weir Type and Straight through Type Diaphragm valve

2.3.2. Globe (Screw-down) Valve.

(a) The term 'globe' is derived from globular shape of the valve body. Globe valve can be used either for positive isolation or for flow regulation purpose. These are also called as Screw-down Valves. The inlet and outlet openings for globe valve can be arranged in three different fashions i.e. straight flow, angle flow, cross flow as shown Fig. 2.16. Globe valve is best suited as Hull valves.

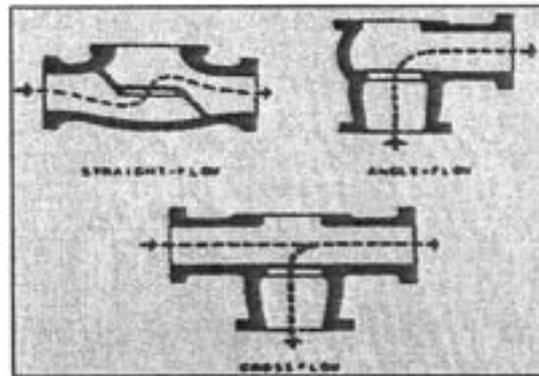


Fig. 2.16 - Types of Globe Valve Bodies

(b) The main features of this valve are the relatively short movement of the stem to open or close the valve and positive seating action. This valve also provides for in-situ repairs of body seat and disk. The pressure drop across this valve is higher compared to other type of valves due to change in flow path as fluid passes through the valve.

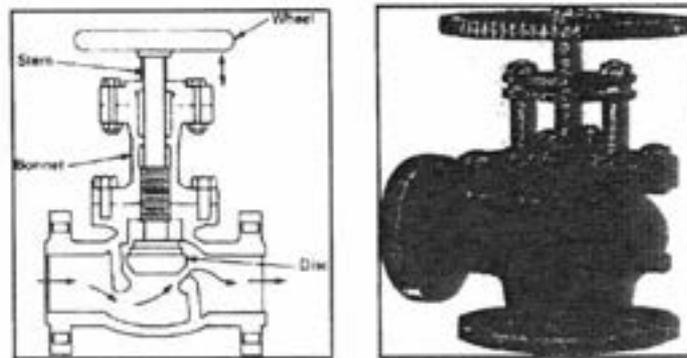


Fig. 2.17 - Types of Screwdown (Globe) Valves

Directional (Check) Valve

2.4. The purpose of check valve is to permit flow in one only. Check valves are also called as 'non-return' or 'back pressure' or 'retaining valves'. Various types of check valves based on movement of disc are discussed in succeeding paragraphs.

2.4.1 **Swing (Flap) Check.** As shown in Fig. 2.18, a hinged disc with soft seat is free to swing against a tilted seating face. In fully open position, very little flow obstruction is experienced and hence pressure drop across the valve is relatively less. This is most commonly used in discharge line of the pump such as Firemain System, Fuel System, AVCAT System, Freshwater pumps etc. This particular type of valve has to be fitted in such as manner so as to enable closure of flap by gravity.



Fig. 2.18 - Swing Check Type Valve

2.4.2. **Lift Check.** In this type of design, the disc sits on the mating face provided on a horizontal bridge wall across valve body. Like the swing check type, this particular type of valve has to be fitted in such a manner so as to enable closure of the flap by gravity. However, pressure drop across Lift Check Valve is greater. Fig. 2.19 depicts a typical Lift type Check Valve design. This particular valve could be of Lift Check with Dashpot and Screw-down stop & check valve. The screw-down lift type valve also permits positive isolation in closed position and therefore is suitable for applications which warrant the same.

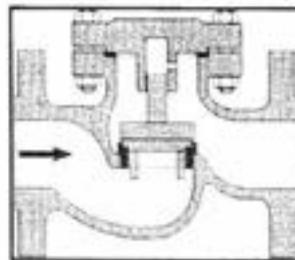


Fig. 2.19 - Typical Lift type check valve

2.4.3. **Dual Plate Check Valves.** The working principle of dual plate check valves is shown in Fig 2.20. The valve body is cylindrical in shape and the disk is in the form of two semicircular plates attached to central hinge pin located in the body. The disk plates are acted upon by one or more torsion springs mounted on the hinge and these hold the plates against a flat seating in the body. However, in this particular type there exists a possibility of fouling of torsion spring, leading to partial operation of the valve.

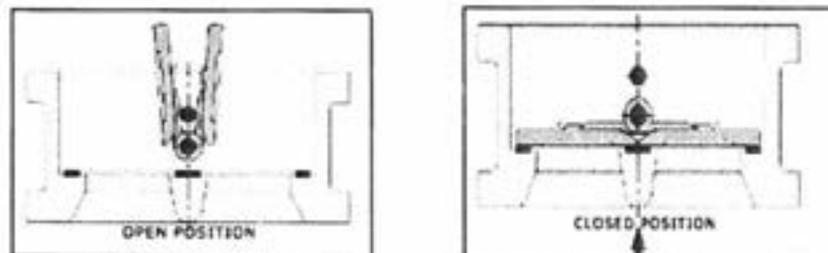


Fig. 2.20 - Basic working principle of Dual plate check valve operation

Pressure Valve

2.5. The function of relief valve is to prevent an undue rise in pressure in the system. 'Direct acting spring type' is most commonly used onboard. Two types of relief valves based on bore construction are as explained below.

2.5.1. Pressure Relief Valve Full Bore. The relief valve is designed to pass total flow of the system in which it is fitted when under conditions of pressure exceeding designed working pressure.

2.5.2. Pressure Relief Valve Partial Bore. A relief valve designed to pass fraction of the system flow which will under most, not necessarily all adverse conditions, ensure that designed working pressure is not exceeded.

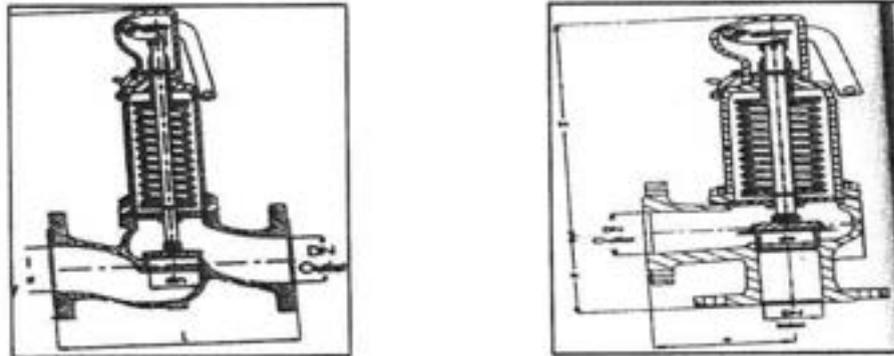


Fig. 2.21 - Various types of Pressure Relief Valves

2.5.3. Pressure Reducing Valve. These valves are installed where it is required to reduce pressure from one level to another. The valve is automatic in operation. Fig. 2.22 depicts typical construction details of pressure reducing valve.

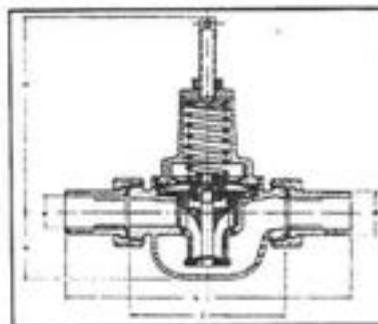


Fig. 2.22 - Pressure Reducing Valve

Special Purpose Valves

2.6. Valves discussed in succeeding paragraphs are termed as 'special purpose' due to their use in the system for a specific purpose. These include Foot valves, Sampling valves, Air Vent valves, Quick Closing valve and Self Closing valves. The details of constructional features are appended below.

2.6.1. **Foot Valves with Strainer.** These valves are manufactured in swing type or lift type configuration. These valves have integrated suction strainer. Typical cross-sectional diagram of lift type foot valves is shown below.

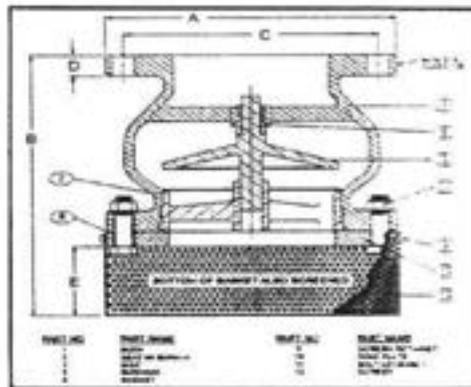


Fig. 2.23 - Cross Sectional View - Typical Foot Valve

2.6.2. **Sampling Valves.** These valves are fitted in Fuel, AVCAT and Lub Oil system so as to draw out sample from the system for tests/ inspection. These valves have push button for opening and close by spring pressure.

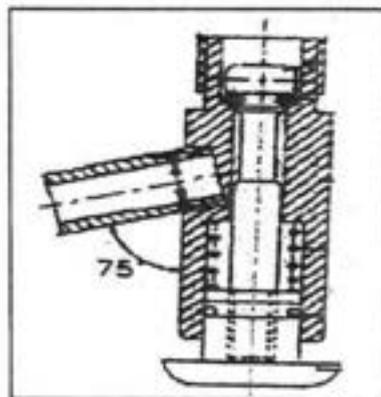


Fig. 2.24 - Cross Sectional View - Typical Sampling Valve

2.6.3. **Air Vent Valves.** These valves are generally fitted in fuel tanks vent piping system and are integrated with flame and particulate screen. The purpose of these valves is to vent (bleed) out excess vapour pressure within the tanks. Float ball is an integral part of the valve.

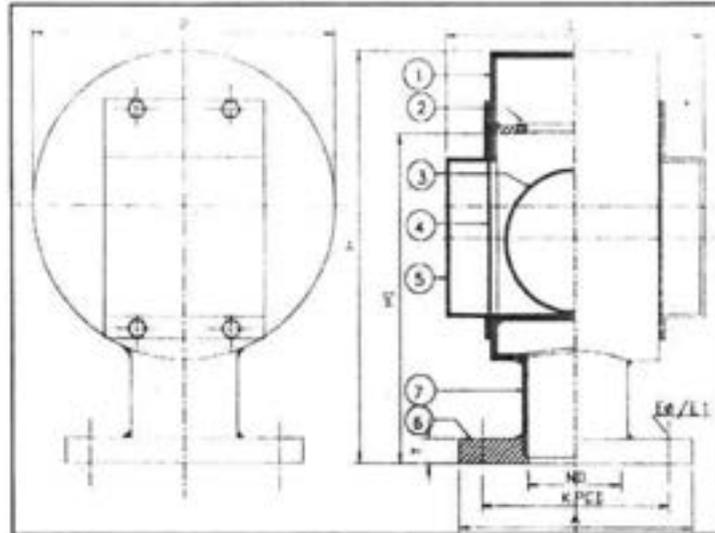


Fig. 2.25 - Cross Sectional View - Typical Air Vent Valve

2.6.4. **Quick Closing Valves.** These valves are fitted in filling / transfer system pipe lines of fuel and ballast tanks. The valve is generally kept in open condition and is closed in case tanks need to be isolated immediately (in case of emergency) by means of pneumatic / manual actuation. A typical design of quick closing valve is depicted below.

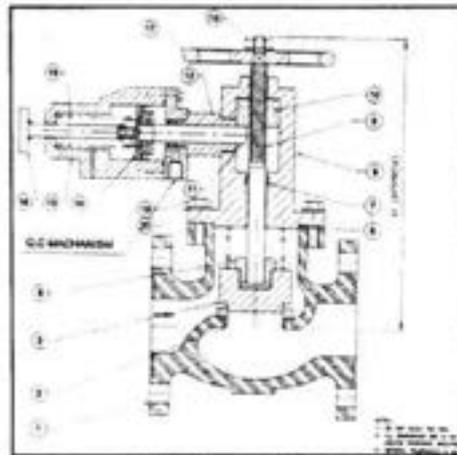


Fig. 2.26 - Cross Sectional View - Typical Quick Closing Valve

CHAPTER 3

SELECTION OF VALVE MATERIAL BASED ON PIPING CONSIDERATIONS

3.1. Selection of valve material is to be based on the primary consideration of system piping material.

3.2. System-wise specification for valve materials are enumerated in succeeding paragraphs.

3.3. **Seawater System.** NES 719 Chapter 11 specifies requirement Copper-Nickel: 90/10 for all sea water system pipes.

3.3.1. Accordingly, based on Galvanic series, Nickel-aluminum Bronze (NAB) is a preferred material for associated valves. It is particularly suitable for seawater service where its corrosion resistance, including resistance to chloride pitting is superior.

3.4. **Fuel System.** NES 320 Para 4.2 governs material specification of Ship's Fuel system and its associated fittings. Relevant extracts of the same are as follows:-

- (a) All fuel system valves are to be of 'fire-safe' design.
- (b) Fuel filling pipes outside storage tanks are to be of non-galvanised Carbon Steel conforming to BS 3602 Parts 1 and 2.
- (c) Fuel filling, transfer and stripping pipes inside storage tanks are to be:-
 - (i) Externally Galvanized Carbon Steel conforming to BS 3602 Parts 1 and 2 or 90/10 Cu/Ni, if the tank is to be water compensated or likely to be frequently water ballasted;
 - (ii) Non Galvanized Carbon Steel conforming to BS 3602 Parts 1 and 2, if pipes passes through the tank which is neither water compensated nor frequently water ballasted.
- (d) Fuel filling pipes in bilges likely to be immersed in bilge water are to be of 90/10 Cu/Ni conforming to NES 779 Part 3.
- (e) Fuel pipes in transfer, supply, stripping and fuel recovery systems are to be:-
 - (i) 90/10 Cu/Ni conforming to NES 779 Part 3 from the pre-filter discharge, with the exception of the circulating line from the filter / water separator.

- (ii) Non Galvanized Mild Steel for the remainder.
- (f) Air escape pipes for steel tanks are to be of Galvanised Mild Steel externally.
- (g) Sounding tubes shall be non-galvanized Mild Steel.

3.4.1. Fuel System Valve Material. For the purpose of standardisation and reduction in inventory, recommended valve materials (iaw NES 360) are as tabulated below:-

<u>System Piping</u>	<u>Valve Material</u>
Fuel filling, transfer and stripping pipes inside storage tanks	Carbon Steel - ASTM A 216 Gr WCB/ A 105, equivalent
Air escape pipes	Carbon Steel IS 2062 Gr B
Sounding Tubes	Carbon Steel - ASTM A 216 Gr WCB/ A 105, equivalent
All other pipe work including that passing through bilges, likely to be immersed in bilge water and high temperature applications	Stainless Steel ASTM A351 Gr CF8M/ A182 F316, equivalent
Note: - Suitable bimetallic joints are to be incorporated between Cu/Ni pipes and the valves.	

3.5. AVCAT System. NES 319 governs design of AVCAT system onboard. Relevant extracts of Para 3.2 of NES 319 related to material specification to be used for system piping and associated fitting is highlighted below.

- (a) Pipe work within tanks shall be made from non-galvanized Mild Steel.
- (b) Fuel pipe materials in systems outside tanks shall be:-
 - (i) 90/10 Copper-Nickel alloy to Def Stan 02-878 for pipes from the re-fuelling clean-up equipment discharge to the aircraft fuelling points, with the exception of drains, flushing/de-fuelling and re-circulating systems;
 - (ii) Non-galvanized Mild Steel for the remainder.
- (c) Sounding tubes shall be non-galvanized Mild Steel.
- (d) Air escape pipes shall be galvanized Mild Steel.
- (e) Valves shall be of 'fire safe' design.
- (f) Lubricated Plug valves are not to be used.

3.5.1 **AVCAT System Valve Material.** For the purpose of standardisation and reduction in inventory, recommended valve materials (iaw NES 360) are as tabulated below:-

<u>System Piping</u>	<u>Valve Material</u>
System pipe internal to tank space	Carbon Steel - ASTM A 216 WCB / 105, equivalent
Air escape pipes and sounding tubes	Carbon Steel - ASTM A 216 Gr WCB/ A 105, equivalent
Air escape pipes	Carbon Steel IS 2062 Gr B
Sounding Tubes	Carbon Steel - ASTM A 216 Gr WCB/ A 105, equivalent
All other AVCAT system piping	Stainless Steel ASTM A351 Gr CF8M/ A182 F316, equivalent
Note:- Suitable bimetallic joints are to be incorporated between CuNi pipes and the valves.	

3.6. **Lub Oil System.** NES 303 Section 4 lays down the material specification for Lub oil system piping and associated fittings. Pipes are to be 90/10 Copper Nickel alloy conforming to NES 779 Part 3.

3.6.1. **LO System Valve Material.** Accordingly, valve material for LO System should conform to Gunmetal BS 1400 LG 4C/ equivalent, iaw NES 360.

3.7. **Fresh Water System.** NES 728 Para 1.2 lays down the material specification of Fresh water system for each component as highlighted below.

- (a) **Steel Pipe Work.** Sounding tubes, air escapes and sections of suction pipes within FW tanks are to be of Carbon Steel material complying to BS 3602, Part 1, Hot Finished Seamless (HFS Grade 360) or Cold Finished Seamless (CFS Grade 360), galvanized internally and externally.
- (b) Non Ferrous fittings are not to be used in FW storage tanks.
- (c) Exposed non Ferrous piping in bathrooms, galleys and cabins is to be chromium plated.
- (d) All FW piping except that specified above is to be of Copper (6 bar, 200°C maximum temperature), conforming to NES 837.

3.7.1. FW System Valve Material. Accordingly, recommended valve materials (iaw NES 360) are as follows:-

<u>System Piping</u>	<u>Valve Material</u>
Sounding tubes, Air escapes and sections of Suction pipes within FW tanks	Carbon Steel conforming to ASTM A 216 WCB / 105, equivalent
All other Fresh Water system piping	Gunmetal conforming to BS 1400 LG 4C, equivalent

3.8 Chilled Water System. NES 102 Para 6.6 lays down requirement of CuNi 90/10 for Chilled Water System.

3.8.1 Chilled Water System Valve Material. Accordingly, valve material should conform to Gunmetal BS 1400 LG 4C/ equivalent, iaw NES 360.

CHAPTER 4

VALVE SIZING CALCULATIONS

4.1. Valve sizing is critical part of system design. Improper valve sizing can be both expensive and inconvenient. A valve that is too small will not pass the required flow and the process will be starved. An oversized valve will be more expensive and it may lead to instability and other problems.

4.2. To arrive at the valve diameter, it would be prudent to determine the pipe diameter upfront. Procedure followed for calculating the pipe diameter and the subsequent determination of valve diameter, is highlighted in succeeding paragraphs.

4.3. **Max Permissible Velocity.** The velocity of fluid flowing through the pipe is restricted by material used for piping. The material used for piping is based on applicable NES standards as been covered in the previous Chapter of this document. The maximum permissible velocity of fluid wrt the piping material is highlighted below:-

(a) **Cu-Ni 90/10.** Para 1129 of NES 719 lays down maximum permissible velocity for the given pipe material. Extract of same is tabulated below.

Avg Pipe Bore (in mm)	<10	10	14	18	22	27	35	41	54	72	84	100 & above
Max allowable vel. m/s	0.6	0.9	1.25	1.5	1.65	1.85	2.0	2.15	2.35	2.6	2.75	3.0

(b) **Carbon Steel.** Para 4.2.3.5 of NES 320 specifies maximum velocity considered for design calculation for fuel should be between 3 to 6 m/sec.

(c) **Copper.** Para 1.11.2 of NES 728 lays down maximum permissible velocity based on pipe diameters. Extract of same is tabulated below.

Avg Pipe Bore (in mm)	8	12	15	22	28	35	42	54	76.1	108	133
Velocity m/s	0.6	0.9	1.2	1.5	1.8	2.0	2.1	2.3	2.6	3.0	3.0

4.4. **Flow Rate.** The second factor considered to arrive at pipe diameter is Flow rate, which is decided by system designer based on filling rate, pump capacities etc. Thereafter, following equation is to be used for calculation of pipe diameter.

$$D = \frac{1}{1000} \sqrt{\frac{4Q}{\pi V}}$$

Where,

Q = Flow rate in m³/sec

V = velocity of fluid flowing through pipe m/sec

D = Internal Diameter of pipe in m

4.5 Illustrative Example for Determination of Valve Dia.

4.5.1. To illustrate by an example, assuming a fuelling rate of 250 TPH and considering max velocity of 4.5 m/s; the pipe diameter works out to 129.22 mm. Since this pipe diameter obtained by calculation is non-standard, the next higher pipe dia is adopted based on standard piping schedule viz, ASME B36.10M, which works out to 150 mm.

4.5.2. Accordingly, valve diameter of 150 NB would be used, for the said piping system.

4.6 **System Pipe Diameter.** Standard system pipe diameters to be used for various duties onboard ships are tabulated below. For purpose of selection of valve size, the system pipe size correlation is also to be ensured.

<u>FO Filling & Transfer</u>	<u>AVCAT</u>	<u>FO Stripping</u>	<u>Aux. SW Cooling</u>	<u>Firemain</u>	<u>Sea suction</u>	<u>LO System</u>	<u>Bilge & OWS</u>	<u>Salvage</u>	<u>Feed Water</u>
25 NB	ø 15	25 NB	ø 40	ø 20	ø 200	ø 15	ø 32	ø 15	10 NB
40 NB	ø 20	32 NB	ø 50	ø 25	ø 250	ø 25	ø 40	ø 50	15 NB
65 NB	ø 25	40 NB	ø 65	ø 32	ø 300	ø 40	ø 50	ø 200	20 NB
100 NB	ø 50		ø 80	ø 50	ø 350	ø 50	ø 80		25 NB
150 NB	ø 65		ø 200	ø 65		ø 65			32 NB
200 NB	ø 80			ø 80					40 NB
250 NB				ø 100					
				ø 150					

PART - B
VALVE SELECTION GUIDELINES

CHAPTER 5

VALVE TYPE SELECTION

Valve Selection Considerations

5.1 Selection criteria for a particular type of valve based on system application are enumerated in succeeding paragraphs. Valves can be broadly classified as either 'Hull Valves' and 'System (Line) Valves', with requirements/ application as highlighted at Art 5.2 and 5.3.

5.2 Hull Valves.

(a) As per NES 375, all valves intended for fitting to the ship's hull would be termed as Hull valves. Further, Naval Ship Technical Manual (NSTM) S9086-RK-STM-010/CH-505-9.19.1.1.2 classifies hull valves as *'the last valve to the hull penetration or sea chest for those systems which take suction from or discharge to the sea'*.

(b) Therefore, all valves intended for fitting to the hull including sea chest, sea tubes, Over-board Discharge (OBD), would be referred to as 'hull valves'.

(c) All hull valves are to be so fitted to enable operation both locally and remotely by rod gearing from the communication deck, over the compartment in which valves are sited. Hull valves shall not have locking facility. To differentiate hull valves from other valves of identical design the hull valve should be prominently marked 'HULL ONLY'.

(d) Given the criticality of Hull Valves and to address the requirement of higher reliability, these valves should comply to Class I casting quality as per NES 747 and IN Shock Grade A.

(e) Acceptable Severity Level wrt inconsistencies for Class I casting quality, is tabulated at Table 9.1 of this Specification.

5.3. Ship System (Line) Valves.

(a) These are non-hull valves and can also be termed as Line valves which are used in system for start / stop duties. These valves should confirm to Class II casting quality as per NES 747 and forging quality Class 2 as per NES 833 Part 2.

(b) Acceptable Severity Level wrt inconsistencies for Class II casting quality, is tabulated at Table 9.1 of this Specification.

(c) Fitment of Rod gearing for system (Line) valve operation is to be decided based on applicability / requirement.

5.4. The type of valve to be used for shipboard system application for various systems is tabulated below, taking into consideration requirement of rationalisation and standardisation. Any deviation from the stated type of valve to be used, will require prior approval of IHQ MoD(N).

<u>SHIP'S SYSTEM - SEA WATER SYSTEM</u>	
<u>System Application</u>	<u>Type of Valve</u>
Sea Water Inlet (Sea chest / Sea tubes) – Hull Valves.	Screw-down valve (outside screw) in conjunction with Parallel double disk Gate valve towards inboard end.
Stop & Check Duties at Pump Discharge end.	(a) Top entry, Full bore Ball valve for diameter 80 NB & below and Triple Offset Butterfly Valve for diameter 100 NB & above. (b) Swing Check valve (Flap Type) for non-return duties.
System section isolation duties; cross-connection; supply to particular Machinery for Emergency Cooling.	(a) Top entry, Full bore Ball valve for diameter 80 NB & below. (b) Triple Offset Butterfly valve for diameter 100 NB & above.
System Relief line	Spring Operated Relief Valve.
Pressure Reducing application	Spring Operated Pressure Reducing Valve.
Bilge pumping out system Power water valve	Top entry, Full bore Ball valve, since system piping diameter does not exceed 80 NB.
Bilge Pumping out system "Suction Valves".	(a) Screw-down valve (outside screw) to be fitted for common suction header design so as to render positive isolation. (b) Top entry, Full bore Ball valves for diameter 80 NB and below, if fitted for single pumping out system. (c) Triple Offset Butterfly valve for diameter 100 NB & above.

	(d) Foot valve with strainer to be fitted in each suction line preferably in the piping inside bilge well.
Heat exchanger, cooler inlet / outlet valves	(a) Top entry, Full bore Ball valves for diameter 80 NB & below. (b) Triple Offset Butterfly valve for diameter 100 NB & above.
Overboard Discharge duties (Hull Valve at only outboard end)	SDNR valve (outside screw) in conjunction with Parallel double disk Gate valve at inboard end.
Isolation valve prior Fire Hydrant	Screw-down valve (outside screw) to be used except for FB10X applications where Top Entry Full bore type Ball valve to be used.
Salvage System (Hull Valve at only outboard end)	Discharge lines connected to sea tubes to be fitted with Swing Check Valve and Triple Offset Double Flanged Butterfly Valve at outboard end.
Ballast & De-ballast System	(a) Top entry, Full bore Ball valves for diameter 80 NB & below. (b) Triple Offset Butterfly Valve for diameter 100 NB & above.
For Ballast tanks isolation, if required by system application.	Quick Closing Valve

SHIP'S SYSTEM - FUEL & AVCAT SYSTEMS

(Note : All valves to be of Fire-Safe design)

<u>System Application</u>	<u>Type of Valve</u>
Isolation duties for Filling Line; various sections of Transfer Line; Equipment Supply Line and Stripping Line	(a) Top entry, Full bore Ball valves for diameter 80 NB & below. (b) Triple Offset Butterfly Valve for diameter 100 NB & above.
System interconnection requirements viz, system between common storage and circulating/ RU tanks.	(a) Top entry, Full bore Ball valves for 80 NB and below. (b) Triple Offset Butterfly Valve for dia 100 NB & above.

System Relief Line	Spring Operated Relief Valve.
Pump Suction Line isolating valve	(a) Top entry, Full bore Ball valves for diameter 80 NB & below. (b) Triple offset Butterfly valve for diameter 100 NB & above
Stop & Check Duties for Pump Discharge.	(a) Top entry, Full bore Ball valves for diameter 80 NB & below and Triple offset Butterfly valve for diameter 100 NB & above. (b) Swing Check valve (Flap Type) for non return duties.
Tank Air Vent Valves	Storage tanks are to be provided with Air Vent Valves integral with flame arrester.
Tank Sounding Tube Valve	Since diameter not exceeding 80 NB, Top entry, Full bore Ball valve is to be used.
Sampling Points	Spring operated sampling valves to be fitted at sample collection points.
For fuel tanks isolation, if required by system application.	Quick Closing Valves
<u>SHIP'S SYSTEM - LUB OIL SYSTEM</u>	
<u>System Application</u>	<u>Type of Valve</u>
Pump Suction Line	(a) 'Lift type Foot valve with strainer' inside tank. (b) Suction lines isolating valves to be as follows:- (i) Top entry, Full bore Ball valves for diameter 80 NB & below. (ii) Triple offset Butterfly valve for diameter 100 NB & above.
Stop & Check Duties for Pump Discharge.	(a) Top entry, Full bore Ball valves for diameter 80 NB & below and Triple Offset Butterfly Valve for diameter 100 NB & above. (b) Swing Check Valve (Flap Type) for non-return duties.
System Relief Line	Spring Operated Relief Valve

System interconnection requirements viz, system between common storage and circulating/ RU tanks.	(a) Top entry, Full bore Ball valves or Multiport Tapered Plug Valve, as applicable, for 80 NB and below. (b) Triple Offset Butterfly Valve for dia 100 NB & above.
Isolation duties for Filling Line, various sections of Transfer Line, Equipment supply Line.	(a) Top entry, Full bore Ball valves for diameter 80 NB & below. (b) Triple offset Butterfly valve for diameter 100 NB & above.
Sampling points	Spring operated sampling valves for collection of Lub oil samples are per system requirement.

SHIP'S SYSTEM - FRESH WATER SYSTEM

<u>System Application</u>	<u>Type of Valve</u>
Pump Suction Line	(a) Lift type Foot valve with strainer inside tank. (b) Suction lines isolating valves to be as follows:- (i) Top entry, Full bore Ball valves for diameter 80 NB & below. (ii) Triple offset Butterfly valve for diameter 100 NB & above.
Stop & Check Duties at Pump Discharge end	(a) Top entry, Full bore Ball valve for diameter 80 NB & below and Triple offset Butterfly valve for diameter 100 NB & above. (b) Swing Check valve (Flap Type) for non-return duties.
System Relief Line	Spring Operated Relief Valve.
Isolation duties for Filling Line, various sections of Transfer Line, Equipment supply Line.	(a) Top entry, Full bore Ball valves for diameter 80 NB & below. (b) Triple offset Butterfly valve for diameter 100 NB & above.

<u>CHILLED WATER SYSTEM</u>	
<u>System Application</u>	<u>Type of Valve</u>
Pump Suction line	(a) Top entry, Full bore Ball valves for diameter 80 NB & below. (b) Triple Offset Butterfly valve for diameter 100 NB & above.
Stop & Check Duties at Pump Discharge end	(a) Top entry, Full bore Ball valves for diameter 80 NB & below and Triple Offset Butterfly valve for diameter 100 NB & above. (b) Swing Check valve (Flap Type) for non-return duties.
System Relief Line	Spring Operated Relief Valve
System Section isolation duties.	(a) Top entry, Full bore Ball valves for diameter 80 NB & below. (b) Triple Offset Butterfly Valve for diameter 100 NB & above.
External Shore AC connection valves	(a) Top entry, Full bore Ball valves for diameter 80 NB & below. (b) Triple Offset Butterfly Valve for diameter 100 NB & above.
Total Atmospheric Control System (TACS) Requirement	Main supply and return pipe lines of Chilled water system are to be fitted with two valves each (one would be manual operated and other remote operated) of following types for isolation purpose:- (i) Top entry, Full bore Ball valves for diameter 80 NB & below. (ii) Triple offset Butterfly valve for diameter 100 NB & Above.

Table No 5.1 - Selection of 'Type of Valve' vis-à-vis System Applicability

CHAPTER 6

STANDARD DIMENSIONS OF VALVE

Face-to-Face/ Centre-to-Face Dimension

6.1. **Isolation & Regulation Valves.** The face-to-face dimensions for valves tabulated below shall be strictly adhered to. In case of any deviation due to unavoidable circumstances, prior approval is to be sought from IHQ MoD(N), as a special case.

Valve Diameter (Nominal Size DN) (in mm)	Face to Face Dimension for Valve inclusive of Flange thickness ¹ (All values in mm)										
	Ball	Butterfly		Plug	Gate Valve	Screw down		Diaphragm valve	Union valve		
		Flanged Type	Wafer Type			Straight	Angle		Straight	Angle	Pressure Gauge
6									92	46/41	81
10	102	----	----	102	102	108	70	108	96	48/45	----
15	108	----	----	108	108	108	70	108	122	61/58	----
20	117	----	----	117	117	117	75	117	122	61/58	----
25	127	----	----	127	127	127	85	127	142	71/67	----
32	140	----	----	140	140	146	95	146	154	80/70	----
40	165	----	----	165	165	159	100	159	----	----	----
50	178	----	----	178	178	190	115	190	----	----	----
65	190	----	----	222	190	216	126	216	----	----	----
80	203	114	64	241	203	254	135	254	----	----	----
100	229	127	64	305	229	292	146	305	----	----	----
125	254	140	70	356	254	330	178	356	----	----	----
150	267	140	76	394	267	356	203	406	----	----	----
200	292	152	89	457	292	495	248	----	----	----	----
250	330	165	114	533	330	622	311	----	----	----	----
300	356	178	114	610	356	698	349	----	----	----	----
350	381	190	127	686	381	787	394	----	----	----	----
400	406	216	140	762	406	914	457	----	----	----	----
450	864	222	152	864	432	978	----	----	----	----	----
500	914	229	152	914	457	978	----	----	----	----	----
600	----	----	----	----	508	1295	----	----	----	----	----
650	----	----	----	----	559	1295	----	----	----	----	----
700	----	----	----	----	610	1148	----	----	----	----	----
750	----	----	----	----	610	1524	----	----	----	----	----

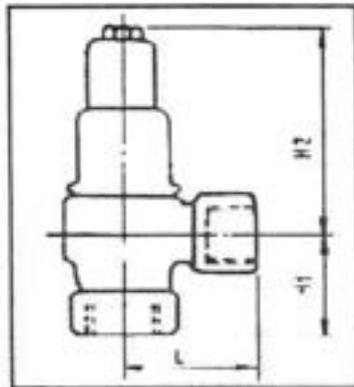
Table No 6.1 : Face-to-Face Dimensions - Isolation & Regulation Valves

6.2 **Check Valve.** The face-to-face dimensions for valves tabulated below shall be strictly adhered to. In case of any deviation due to unavoidable circumstances, prior approval is to be sought from IHQ MoD (N), as a special case.

Valve Dia (NB)	Face-to-Face Dimension of Valve (mm)		Centre-to-Face Dimensions (All values in mm)
	Conventional Swing (Flap) Type	Dual Plate Type	(Lift Type)
10	108	----	70
15	108	----	70
20	117	----	75
25	127	----	85
32	146	----	95
40	165	----	100
50	203	60	115
65	216	67	126
80	241	73	135
100	292	73	146
125	330	---	178
150	356	98	203
200	495	127	248
250	622	146	311
300	698	181	349
350	787	184	394
400	914	191	457
450	978	203	----
500	978	219	----
550	1067	----	----
600	1295	222	----
650	1295	----	----
700	1448	----	----

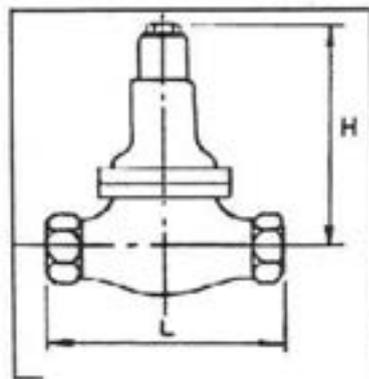
Table No 6.2 - Check Valves Face-to-Face Dimensions

6.3 **Pressure Relief Valve.** Standard guiding dimensions of pressure relief valves, as promulgated vide NES 360, are tabulated below. Their applicability would be governed by system requirements, including pressure rating.



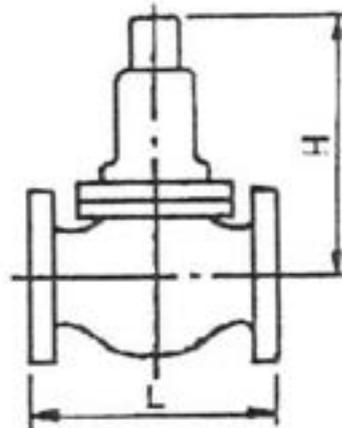
Valve Diameter (NB)	Dimension (mm)		
	L	H1	H2
15	44	44	124
20	48	48	124
25	67	67	191
32	83	83	191
40	89	89	228

Table No 6.3 - Angle Screwed Type (Pressure Relief Valves)



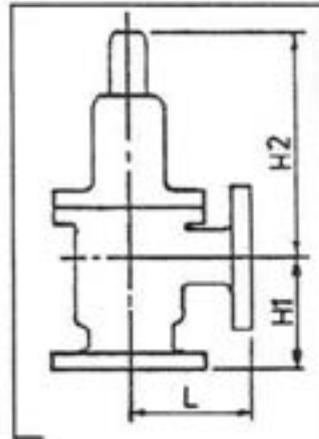
Valve Diameter (NB)	Dimension (mm)	
	L	H
15	89	138
20	92	138
25	127	213
32	152	213
40	178	260

Table No 6.4 - Straight Screwed Type (Pressure Relief Valves)



Valve Diameter (NB)	Dimensions (mm)	
	L	H
15	114	138
20	114	138
25	137	213
32	165	238
40	180	260
50	230	308
65	241	341
80	267	415
100	330	460
150	470	660

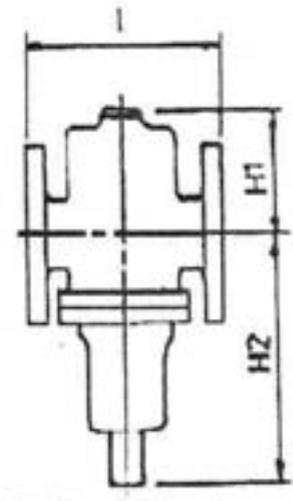
Table No 6.5 - Straight Flanged Type (Pressure Relief Valves)



Valve Diameter (NB)	Dimension (mm)		
	L	H1	H2
15	76	76	124
20	76	76	124
25	83	83	190
32	90	90	190
40	102	102	228
50	114	114	276
65	127	127	294
80	133	133	349
100	146	146	390
150	203	203	560

Table No 6.6 - Angled Flanged Type (Pressure Relief Valves)

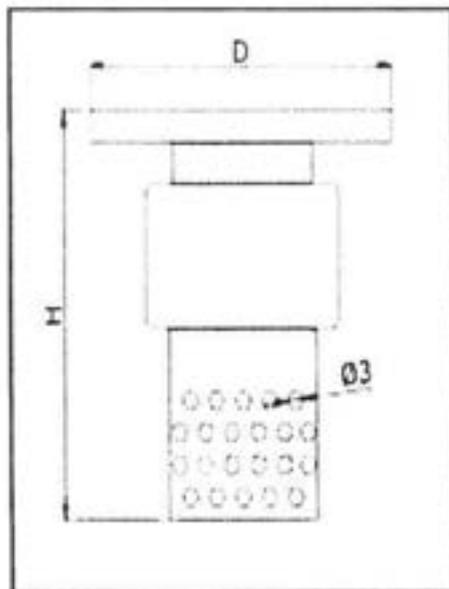
6.4 **Pressure Reducing Valve.** Standard guiding dimensions of Pressure Reducing Valve, as promulgated vide NES 360, are tabulated below.



Valve Diameter (NB)	Dimensions (mm)		
	L	H1	H2
15	158	76	155
20	174	92	162
25	177	92	162
32	212	100	237
40	280	148	290
50	304	174	354
65	305	165	412
80	305	162	536
100	406	222	655
125	460	240	675
150	508	248	672

Table No 6.7 - Pressure Reducing Valve

6.5 **Foot Valve.** Reference guiding dimensions are as tabulated below:-

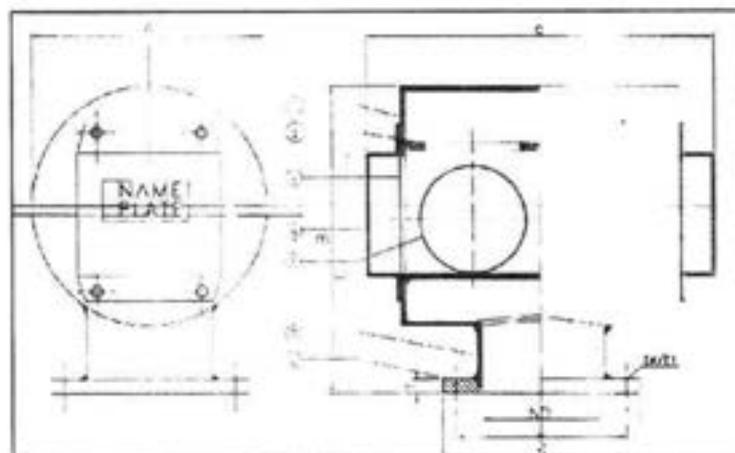


Valve Diameter (NB)	Dimensions (mm)	
	H	D
25	110	110
32	125	118
40	138	150
50	156	165
65	180	185
80	219	200
100	255	220
125	279	250
150	307	285
200	350	340
250	405	395
300	460	445

Note:- (i) The hole size of strainer 3mm
(ii) Plate thickness 3mm

Table No 6.8 - Foot Valve with Strainer

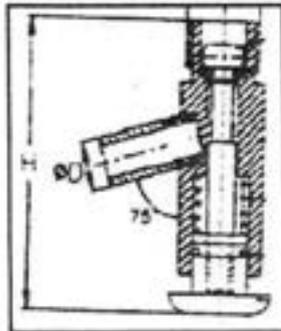
6.6 **Air Vent Valve.** Reference guiding dimensions are as tabulated below:-



Valve Diameter (NB)	Dimensions (mm)							
	A	B	C	E	K	L	T	EΦ/E1 Off
25	165	115	140	245	200	16	85	14/4
32	165	140	140	245	200	16	100	18/4
40	219	150	155	295	239	16	110	18/4
50	219	165	155	295	239	18	125	18/4
65	230	185	190	315	252	18	145	18/4
80	255	200	220	340	271	20	160	18/8
100	323	220	250	410	327	20	180	18/8
125	406	250	295	500	397	22	210	18/8
150	457	285	360	580	467	22	240	22/8
175	495	315	360	595	477	24	270	22/8

Table No 6.9 - Air Vent Valve

6.7 **Sampling Valve.** Reference guiding dimensions are as tabulated below:-

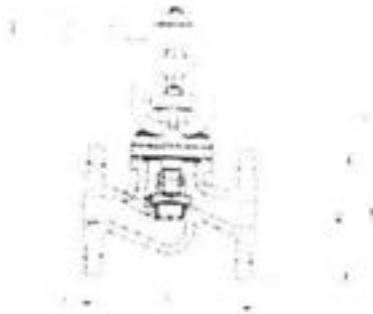


Valve Diameter (NB)	Dimensions (mm)		End Connection
	H	D	
15	195	9	¾" BSP
20	195	14	1" BSP
25	195	18	1 ¼" BSP
32	200	24	1 ¼" BSP

Table No 6.10 - Sampling Valve

6.8 **Self Closing Valve.**
below:-

Reference guiding dimensions are as tabulated



Valve Diameter (NB)	Dimensions (mm)		
	L	D	H
15	130	95	195
20	150	105	195
25	160	115	195
32	180	200	200

Table No 6.11 - Self Closing Valve

6.9 **Quick Closing Valve.** The basic type of valve used for 'quick closing' application, as required by system design would entail selection of one of the valve types, applicable for isolation duties. Therefore, face-to-face dimensions for quick closing valves shall be based on the particular type of valve selected, from the range at Table No 6.1.

6.10 **Union valve.** The union valve can be used either for positive isolation or flow regulation purpose. The inlet and outlet ends are threaded ends conforming to GOST 2822-78. There are different types ie. Straight SDSL / SDNR Valve, Angle SDSL / SDNR Valve & Pressure Gauge valve.

Minimum Bore Dia for Reduced Bore Ball Valve

6.10 The minimum bore diameter to be adhered to as per EN ISO 17292 for full bore valves PN 10 / Class 150 are as indicated at Table No 6.3 below.

Valve Size (NB)	8	10	15	20	25	32	40	50	65	80	100	150	200	250	300	350	400	450	500
Minimum bore Dia (mm)	6	9	11	17	23	30	37	49	62	74	98	148	198	245	295	325	375	430	475

Table No 6.12 - Minimum Bore Diameter (in mm) for Full Bore Ball Valve

End Connections

6.11 Valves are to be joined to the pipe line by screwed or flanged connection.

6.12 **Screwed Connection.** All valves 32 NB & below, shall have screwed connection, with the exception of FO, LO & AVCAT lines passing through main machinery compartments, system valves for which shall be of flanged connection irrespective of pipe diameter (NB).

6.12.1 For screwed connection, valve end threading shall be of internal type and threading shall be female BSP parallel type conforming to BS 21. Relevant extracts of Table No. 2 of BS 21, are tabulated for reference:-

Valve Diameter (NB)	Thread Size (inches)	Number of threads in one Inch (25.4 mm)	Pitch (P) (mm)	Depth of Thread (h) (in mm)	Basic Diameter of Gauge Plane (mm)		
					Major Gauge Dia (d)	Pitch (d2)	Minor (d1)
10	3/8	19	1.337	0.856	16.662	15.806	14.950
15	1/2	14	1.814	1.162	20.955	19.793	18.631
20	3/4	14	1.814	1.162	26.441	25.279	24.117
25	1	11	2.309	1.479	33.249	31.770	30.291
32	1 1/4	11	2.309	1.479	41.910	40.431	38.952

Table No 6.13 - Basic Dimensions for Female BSP Parallel Type Threads

6.13 **Flanged Connection.** All valves 40 NB & above shall have flanged connection, unless otherwise specified.

6.13.1 End flanges shall be integral with casting or forged valve body.

6.13.2 All flanges shall have raised face with serrated groove/ concentric grooves except for valves used in OBD & Hull duties.

6.13.3 Valves used in Hull/ OBD duties shall be flat faced with serrated or concentric grooves.

6.13.4 Flanges shall to comply to BS EN 1092, as follows:-

- (a) NAB & Gunmetal Valves. BS EN 1092 Part 3 Code 21 PN 10 rating.
- (b) Stainless Steel & Carbon Steel Valves. BS EN 1092 Part 1 Code 21 PN 10 rating.

6.13.5 Relevant extracts of BS EN 1092 Part 1 & 3 for PN 10 rating are tabulated at Table Nos. 6.14 and 6.15, for reference.

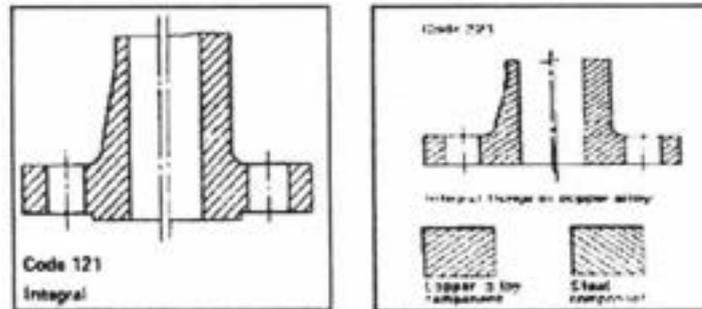


Fig. 6.1 - Sketch of Integral Flanges as per BS EN 1092 Part 1 & 3

Nominal Size (NB)	Outside Diameter (D)	PCD for Bolts (K)	Diameter of Bolt hole (L)	Bolting		Flange Thickness (C3)	Neck Dia (N3)	Raised Face Dia (D1)
				Number	Size			
10	90	60	14	4	M12	16	28	40
15	95	65	14	4	M12	16	32	45
20	105	75	14	4	M12	18	40	58
25	115	85	14	4	M12	18	50	68
32	140	100	18	4	M16	18	60	78
40	150	110	18	4	M16	18	70	88
50	165	125	18	4	M16	18	84	102
65	185	145	18	4	M16	18	104	122
80	200	160	18	8	M16	20	120	138
100	220	180	18	8	M16	20	140	158
125	250	210	18	8	M16	22	170	188

150	285	240	22	8	M20	22	190	212
200	340	295	22	8	M20	24	246	268
250	395	350	22	12	M20	26	298	320
300	445	400	22	12	M20	26	348	370
350	505	460	22	16	M20	26	408	430
400	565	515	26	16	M24	26	456	482
450	615	565	26	20	M24	28	502	532
500	670	620	26	20	M24	28	559	585
600	780	725	30	20	M27	34	658	685
700	895	840	30	24	M27	34	772	800

Table No 6.14 - Steel Flanges Dimensions (in mm)
(For Carbon Steel (CS) & Stainless Steel (SS) Valves)

Nominal Size (NB)	Outside Diameter (D)	PCD for Bolts (K)	Diameter of Bolt hole (L)	Bolting		Flange Thickness (C1)	Neck Dia (N3)	Raised Face Dia (D1)*
				Number	Size			
10	90	60	14	4	M12	12	16	41
15	95	65	14	4	M12	12	21	46
20	105	75	14	4	M12	12	28	56
25	115	85	14	4	M12	14	35	65
32	140	100	18	4	M16	15	42	76
40	150	110	18	4	M16	16	52	84
50	165	125	18	4	M16	17	64	99
65	185	145	18	4	M16	17	79	118
80	200	160	18	8	M16	19	94	132
100	220	180	18	8	M16	21	116	156
125	250	210	18	8	M16	22	159	184
150	285	240	22	8	M20	22	184	211
175	315	270	22	8	M20	24	211	242
200	340	295	22	8	M20	26	240	266
250	395	350	22	12	M20	28	292	319
300	445	400	22	16	M20	28	342	370
350	505	460	22	16	M24	30	396	429
400	565	515	26	20	M24	32	448	480
450	615	565	26	20	M24	32	498	530
500	670	620	26	20	M27	34	552	582
600	780	725	30	20	M27	36	654	629
700	895	840	30	24	M27	40	760	733

Note:- * Not applicable for Hull valves iaw Article Art. 6.13.2 of Specification.

Table No 6.15 - Copper Alloy Flanges Dimensions (in mm)
(For NAB & Gunmetal Valves)

CHAPTER 7

VALVE MATERIAL SPECIFICATION

Valve Material Considerations

7.1 All raw material used for manufacturing shall be of virgin material only.

7.2 All valves would be manufactured either by casting or forging process except Air Vent valve fitted in Fuel & AVCAT system, that are to be manufactured by fabrication, with material specified at Article 7.5.4 below.

7.3 **Casting.** All valves of diameter above 32 NB shall be manufactured by Casting process. Casting classification should comply with Class I quality for Hull Valves & Class II quality for System (line) Valves. Acceptable Severity Level wrt inconsistencies vis-a-vis casting quality, is tabulated at Table 9.1 of this Specification.

7.4 **Forging.** All valves of diameter 32 NB and below shall be manufactured by Forging process. Forging classification should comply with all requirements stipulated vide NES 833 Part 2 wrt Class 2 and as defined vide article 9.2(b) of this specification.

7.5 **Valve Material.** Valve material in respect of following (tabulated in succeeding articles in this chapter) should comply with the standards as indicated against each:-

7.5.1 **Gunmetal** - BS 1400 LG 4C, equivalent

7.5.2 **Carbon Steel** - ASTM A 216 Gr WCB / A105, equivalent

7.5.3 **Stainless Steel** - ASTM A351 Gr CF8M / A182 F316, equivalent

7.5.4 **Carbon Steel** - IS 2062Gr B, equivalent (applicable only for Air Vent Valves fitted in Fuel & AVCAT System.

7.5.5 **NAB Material** - In case of NAB valves, the chemical composition and mechanical properties should comply with that stated below:-

7.5.5.1 Ingot Analysis is to conform to the following chemical composition:-

Element	Percent by Weight	
	Not less than	Not more than
Aluminium	8.8	9.6

Iron*	4.0	5.0
Nickel*	4.5	5.5
Manganese	1.0	1.4
Copper (By Difference)	Remainder	
Impurities		
Zinc	-	0.05
Lead	-	0.01
Tin	-	0.05
Silicon	-	0.05
Magnesium	-	0.05
Chromium	-	0.01
Total Impurities	-	0.20
Note:- * Nickel must exceed Iron.		

Table No 7.1 – Chemical Composition of NAB (Ingot Analysis)

7.5.5.2 Casting Analysis is to confirm to the following chemical composition.

Element	Percent by Weight	
	Not less than	Not more than
Aluminium	8.8	9.5
Iron*	4.0	5.0
Nickel*	4.5	5.5
Manganese	0.75	1.3
Copper (By Difference)	Remainder	
Impurities		
Zinc	-	0.05
Lead	-	0.01
Tin	-	0.05
Silicon	-	0.10
Magnesium	-	0.05
Chromium	-	0.01
Total Impurities	-	0.25
Note:- * Nickel content is to be greater than the iron content.		

Table No 7.2 – Chemical Composition of NAB (Casting Analysis)

7.5.5.3 Mechanical Properties.

Tensile Strength (UTS)	0.2% Proof Stress (0.2% PS)	Elongation on 5.65 $\sqrt{S_0}$ Gauge Length
N/mm ²	N/mm ²	Percent
Min	Min	Min
620	250	15

Table No 7.3 – Mechanical Properties for NAB MaterialValve Material wrt System Applicability

7.6 Based on above considerations, valve material to be used wrt the ships system, as indicated, is as tabulated below:-

<u>System Piping</u>	<u>Valve Material</u>
<u>SEA WATER SYSTEM</u>	
All Sea Water System Piping	NAB conforming to Article 7.5.5 of this Specification, as applicable.
<u>CHILLED WATER SYSTEM</u>	
All Chilled Water System Piping	Gunmetal conforming to Article 7.5.1 of this Specification.
<u>LUB OIL SYSTEM</u>	
All Lub oil System Piping	Gunmetal conforming to Article 7.5.1 of this Specification.
<u>FRESH WATER SYSTEM</u>	
Sounding tubes, Air escapes and sections of Suction pipes within FW tanks.	Carbon Steel conforming to Article 7.5.2 of this Specification.
All other Fresh Water system piping	Gunmetal conforming to Article 7.5.1 of this Specification.
<u>FUEL SYSTEM</u>	
Fuel filling, transfer and stripping pipes inside storage tanks	Carbon Steel conforming to Article 7.5.2 of this Specification.
Air escape pipes	Carbon Steel conforming to Article 7.5.4 of this Specification.
Sounding Tube	Carbon Steel conforming to Article 7.5.2 of this Specification.
All other pipe work including that passing through bilges and likely to be immersed in bilge water.	Stainless Steel conforming to Article 7.5.3 of this Specification.

<u>AVCAT SYSTEM</u>	
System pipe internal to tank space	Carbon Steel conforming to Article 7.5.2 of this Specification.
Air escape pipes	Carbon Steel conforming to Article 7.5.4 of this Specification.
Sounding tubes	Carbon Steel conforming to Article 7.5.2 of this Specification.
All other AVCAT system piping	Stainless Steel conforming to Article 7.5.3 of this Specification.
Note: - Suitable bimetallic joints are to be incorporated between Cu Ni pipes and valves.	

Table No 7.4 - Material Specification for Ship System Valves

7.7 Low Magnetic Permeability. In case of specific requirement of low magnetic permeability based on ship's role (eg, MCMV), valves of material NAB, GM & SS are to be considered iaw NES 360.

Valve Internal Components

7.8 Material specification guidelines for valve internal components are tabulated below.

Ball / Plug Valves				
Name of Part	Valve Material Specification			
	NAB	Gunmetal	Stainless Steel	Carbon Steel
Body, Cover, Insert	NAB NES 747 Part 2 / NES 833 Part 2	Gun Metal BS 1400 LG 4C	Stainless Steel, ASTM A351 Gr CF8M /ASTM A276 Gr. 316	Carbon Steel ASTM A216 Gr WCB /A105
Ball / Plug	NAB (Solid) NES 747 Part 2 / NES 833 Part 2	NAB (Solid) NES 747 Part 2	ASTM A351 Gr CF8M / A182 F316	ASTM A351 Gr CF8M / A182 F316
Backseat	NAB NES 747 Part 2	NAB NES 747 Part 2	ASTM A351 Gr CF8M / A182 F316	Carbon Steel ASTM A216 Gr WCB / A182 F316
Stem / spindle	NAB NES 833 Part 2	NAB NES 833 Part 2	ASTM A 276 Gr. 316	ASTM A 276 Gr. 316
Gland	NAB NES 747 Part 2	NAB NES 747 Part 2	ASTM A351 Gr CF8M	Carbon Steel ASTM A216 Gr WCB

Bush	NAB NES 747 Part 2 / NES 833 PART II	NAB NES 747 Part 2 / NES 833 PART II	ASTM A 276 Gr. 316	ASTM A 276 Gr. 316
Nut	Phosphor Bronze BS 2874 PB 102	Phosphor bronze BS 2874 PB 102	SS TO ASTM A 276 Gr. 304	SS TO ASTM A 276 Gr. 304
Gland Packing	Graphite	Graphite	Graphite	Graphite
Seat	Reinforced PTFE	Reinforced PTFE	Reinforced PTFE	Reinforced PTFE
Stem seal, Body seal, Cover seal	Viton B With 68% Flourine	Viton B with 68% Flourine	Viton B with 68% Flourine	Viton B with 68% Flourine
Bolts, Nuts	NAB NES 862	NAB NES 862	Alloy Steel; ASTM A193 Gr B7(HDG) & A194 Gr 2H(HDG)	Alloy Steel; ASTM A193 Gr B7(HDG) & A194 Gr 2H(HDG)
Tab Washer	IS 8062 / ASTM A 240 Gr. 304	IS 8062 / ASTM A 240 Gr. 304	IS 8062 / ASTM A 240 Gr. 304	IS 8062 / ASTM A 240 Gr. 304
Handle	Stainless Steel ASTM A 240 Gr.304 (with PVC Grip)	Stainless Steel ASTM A 240 Gr.304 (with PVC Grip)	Stainless Steel ASTM A 240 Gr.304 (with PVC Grip)	Stainless Steel ASTM A 240 Gr.304 (with PVC Grip)
Antistatic device	Stainless Steel ASTM A 276 Gr.304	Stainless Steel ASTM A 276 Gr.304	Stainless Steel ASTM A 276 Gr.304	Stainless Steel ASTM A 276 Gr.304
Note:- Casting Quality Class 1 & 2 shall be applicable in accordance with NES 747 Part 2 for valves based on utilization in Hull and Line duties respectively.				

Table No 7.5 - Ball / Plug Valve Internal Component Material Specs

Butterfly Valves				
Name of Part	Valve Material Specification			
	Nickel Aluminum Bronze (NAB)	Gunmetal	Stainless Steel	Carbon Steel
Body / Cover	NAB NES 747 Part 2	Gun metal BS 1400 LG 4C	Stainless Steel ASTM A 351 Gr CF8M	Carbon Steel ASTM A216 Gr WCB
Disc	NAB (Solid) NES 747Part 2	NAB (Solid) NES 747 Part 2	Stainless Steel ASTM A 351 Gr CF8M	Stainless Steel ASTM A 351 Gr CF8M

Shaft / spindle	NAB NES 833 Part 2	NAB NES 833 Part 2	Stainless Steel ASTM A 276 316	Stainless Steel ASTM A 276 316
Clamp Ring	NABNES 747 Part 2	NAB NES 747 Part 2	Stainless Steel ASTM A 351 Gr CF8M	Stainless Steel ASTM A 351 Gr CF8M
Disc Pin	NAB NES 833 Part 2	NAB NES 833 Part 2	Stainless Steel ASTM A 276 316	Stainless Steel ASTM A 276 316
Body Sleeve	Reinforced PTFE	Reinforced PTFE	Reinforced PTFE	Reinforced PTFE
Bearing / Thrust Sleeve	Phosphor Bronze BS 2874 PB 102	Phosphor Bronze BS 2874 PB 102	SS 304 PTFE coated	SS 304 PTFE coated
Gland Flange	NAB NES 747 Part 2	NAB NES 747 Part 2	Stainless Steel ASTM A 351 Gr CF8M	Stainless Steel ASTM A 351 Gr CF8M
Gland Packing	Graphite	Graphite	Graphite	Graphite
Body Gasket	Asbestos Free BS 7531			
Bolts & Nuts	NAB NES 862	NAB NES 862	Alloy Steel ASTM A 193 Gr B7 (HDG) ASTM A 194 Gr 2H (HDG)	Alloy Steel ASTM A 193 Gr B7 (HDG) ASTM A 194 Gr 2H (HDG)
Handle/ Handwheel	Stainless Steel ASTM A 240 Gr.304 (with PVC Grip) / ASTM A 216 Gr. WCB	Stainless Steel ASTM A 240 Gr.304 (with PVC Grip) / ASTM A 216 Gr. WCB	Stainless Steel ASTM A 240 Gr.304 (with PVC Grip) / ASTM A 216 Gr. WCB	Stainless Steel ASTM A 240 Gr.304 (with PVC Grip) / ASTM A 216 Gr. WCB
Antistatic Device	Stainless Steel ASTM A 276 Gr.304			
Gearbox Casing	Gunmetal BS 1400 LG 4C	Gunmetal BS 1400 LG 4C	SG Iron BS 2789	SG Iron BS 2789
Gears	Phosphor Bronze BS2874 PB 102	Phosphor Bronze BS2874 PB 102	Forged Steel BS 970-316	Forged Steel BS 970-316
Worm & Worm Wheel Spindle	NAB, NES 833 Part II	NAB, NES 833 Part II	Forged Steel BS 970-316	Forged Steel BS 970-316

Note:- Casting Quality Class 1 & 2 shall be applicable in accordance with NES 747 Part 2 for valves based on utilization in Hull and Line duties respectively.

Table No 7.6 - Butterfly Valve Internal Component Material Specs

Name of Part	Straight / Angle Type Globe (SD/SDSL/SDNR) Valve & Gate Valves			
	Valve Material Specification			
	NAB	Gunmetal	Stainless Steel	Carbon Steel
Body / Bonnet	NAB NES 747 Part 2 Class 1 / 2	Gun metal BS 1400 LG 4C	Stainless Steel ASTM A351 Gr CF8M	Carbon Steel ASTM A216 Gr WCB
Disc/ Gate	NAB NES 747 Part 2 Class 1 / 2	NAB (Solid) NES 747 Part 2 Class 1 / 2	Stainless Steel ASTM A351 Gr CF8M	Carbon Steel ASTM A216 Gr WCB
Spindle	NAB NES 833 Part 2	NAB NES 833 Part 2	Stainless Steel ASTM A351 Gr CF8M/ ASTM A 276 Gr. 316	Stainless Steel ASTM A351 Gr CF8M/ ASTM A 276 Gr. 316
Back Seat	NAB NES 747 Part 2 Class 1 / 2	NAB NES 747 Part 2 Class 1 / 2	Stainless Steel ASTM A351 Gr CF8M	Carbon Steel ASTM A216 Gr WCB
Disc Seat	NAB NES 747 Part 2 Class 1 / 2	NAB NES 747 Part 2 Class 1 / 2	Stainless Steel ASTM A351 Gr CF8M/ ASTM A 276 Gr. 316	Stainless Steel ASTM A351 Gr CF8M/ ASTM A 276 Gr. 316
Soft Seat	Reinforced PTFE	Reinforced PTFE	Reinforced PTFE	Reinforced PTFE
Yoke / Yoke Sleeve	NAB NES 747 Part 2 Class 1 / 2	Gunmetal BS 1400 LG 4C	Stainless Steel ASTM A351 Gr CF8M / ASTM A 276 Gr. 316	Stainless Steel ASTM A351 Gr CF8M/ ASTM A 276 Gr. 316
Bearing (Bush)	Phosphor Bronze BS2874 PB 102	Phosphor Bronze BS2874 PB 102	SS 304 PTFE coated	SS 304 PTFE coated
Gland Flange End	NAB NES 747 Part 2 Class 1 / 2	NAB NES 747 Part 2 Class 1 / 2	Stainless Steel ASTM A 351 Gr CF8M	Stainless Steel ASTM A 351 Gr CF8M
Gland Packing	Graphite (Impregnated)	Graphite (Impregnated)	Graphite (Impregnated)	Graphite (Impregnated)
Body	Asbestos Free BS	Asbestos Free	Asbestos Free	Asbestos Free

Gasket	7531	BS 7531	BS 7531	BS 7531
Bolts, Nuts	NAB NES 862	NAB NES 862	Alloy Steel ASTM A 193 Gr B7 (HDG) ASTM A 194 Gr 2H (HDG)	Alloy Steel ASTM A 193 Gr B7 (HDG) ASTM A 194 Gr 2H (HDG)
Tab Washer	IS 8062 / ASTM A 240 Gr. 304	IS 8062 / ASTM A 240 Gr. 304	IS 8062 / ASTM A 240 Gr. 304	IS 8062 / ASTM A 240 Gr. 304
Hand Wheel	ASTM A 216 Gr. WCB	ASTM A 216 Gr. WCB	ASTM A 216 Gr. WCB	ASTM A 216 Gr. WCB
Note:- Casting Quality Class 1 & 2 shall be applicable in accordance with NES 747 Part 2 for valves based on utilization in Hull and Line duties respectively.				

Table No 7.7 - Screwdown (Globe) & Gate Valve Internal Component Material Specs

Swing (Flap) Type Check Valves				
Name of Part	Valve Material Specification			
	Nickel Aluminum Bronze (NAB)	Gunmetal	Stainless Steel	Carbon Steel
Body	NAB NES 747 Part 2	Gunmetal BS 1400 LG 4C	Stainless Steel ASTM A351 Gr CF8M	Carbon Steel ASTM A216 Gr WCB / A105
Cover	NAB NES 747 Part 2	Gunmetal BS 1400 LG 4C	Stainless Steel ASTM A351 Gr CF8M	Carbon Steel ASTM A216 Gr WCB / A105
Disc	NAB (Solid) NES 747 Part 2	NAB (Solid) NES 747 Part 2	Stainless Steel ASTM A351 Gr CF8M/ ASTM A 276 Gr. 316	Stainless Steel ASTM A351 Gr CF8M/ ASTM A 276 Gr. 316
Disc Seat	NAB NES 747 Part 2	NAB NES 747 Part 2	Stainless Steel ASTM A351 Gr CF8M/ ASTM A 276 Gr. 316	Stainless Steel ASTM A351 Gr CF8M/ ASTM A 276 Gr. 316
Seat Ring	NAB NES 747 Part 2	NAB NES 747 Part 2	Stainless Steel ASTM A351 Gr CF8M/ ASTM A 276 Gr. 316	Stainless Steel ASTM A351 Gr CF8M/ ASTM A 276 Gr. 316
Disc Retaining	NAB NES 862	NAB NES 862	Stainless Steel ASTM A 276 Gr.	Stainless Steel ASTM A 276 Gr.

Nut & Pin			316	316
Hinge	NAB NES 747 Part 2	NAB NES 747 Part 2	Stainless Steel ASTM A351 Gr CF8M/ ASTM A 276 Gr. 316	Stainless Steel ASTM A351 Gr CF8M/ ASTM A 276 Gr. 316
Hinge Pin	NAB NES 833 Part 2	NAB NES 833 Part 2	Stainless Steel ASTM A 276 Gr. 316	Stainless Steel ASTM A 276 Gr. 316
Soft Seat	Reinforced PTFE	Reinforced PTFE	Reinforced PTFE	Reinforced PTFE
Cover Seal	Asbestos Free BS 7531	Asbestos Free BS 7531	Asbestos Free BS 7531	Asbestos Free BS 7531
Bolts, Nuts	NAB NES 862	NAB NES 862	Alloy Steel ASTM A 193 Gr B7 9HDG) & A 194 Gr 2H(HDG)	Alloy Steel ASTM A 193 Gr B7 9HDG) & A 194 Gr 2H(HDG)
Tab Washer	IS 8062 / ASTM A 240 Gr. 304	IS 8062 / ASTM A 240 Gr. 304	IS 8062 / ASTM A 240 Gr. 304	IS 8062 / ASTM A 240 Gr. 304
Note:- Casting Quality Class 1 & 2 shall be applicable in accordance with NES 747 Part 2 for valves based on utilization in Hull and Line duties respectively.				

Table No 7.8 - Check Valve (Swing Type) Internal Component Material Specs

Lift Type Check Valves				
Name of Part	Valve Material Specification			
	Nickel Aluminium Bronze (NAB)	Gunmetal	Stainless Steel	Carbon Steel
Body	NAB NES 747 Part 2	Gunmetal BS 1400 LG 4C	Stainless Steel ASTM A351 Gr CF8M/ ASTM A 276 Gr. 316	Carbon Steel ASTM A216 Gr WCB / A105
Cover	NAB NES 747 Part 2	Gunmetal BS 1400 LG 4C	Stainless Steel ASTM A351 Gr CF8M/ ASTM A 276 Gr. 316	Stainless Steel ASTM A351 Gr CF8M/ ASTM A 276 Gr. 316
Disc	NAB (Solid) NES 747 Part	NAB (Solid) NES 747 Part 2	Stainless Steel ASTM	Stainless Steel ASTM

	2		A351 Gr CF8M/ ASTM A 276 Gr. 316	A351 Gr CF8M/ ASTM A 276 Gr. 316
Spring	Spring Steel to IS 4454	Spring Steel to IS 4454	Spring Steel to IS 4454	Spring Steel to IS 4454
Disc Seat	NAB NES 747 Part 2	NAB NES 747 Part 2	Stainless Steel ASTM A351 Gr CF8M/ ASTM A 276 Gr. 316	Stainless Steel ASTM A351 Gr CF8M/ ASTM A 276 Gr. 316
Seat Ring	NAB NES 747 Part 2	NAB NES 747 Part 2	Stainless Steel ASTM A351 Gr CF8M/ ASTM A 276 Gr. 316	Stainless Steel ASTM A351 Gr CF8M/ ASTM A 276 Gr. 316
Soft Seat	Reinforced PTFE	Reinforced PTFE	Reinforced PTFE	Reinforced PTFE
Cover Seal	Asbestos Free BS 7531	Asbestos Free BS 7531	Asbestos Free BS 7531	Asbestos Free BS 7531
Bolts, Nuts	NAB NES 862	NAB NES 862	Alloy Steel ASTM A 193 Gr B7 9HDG) & A 194 Gr 2H(HDG)	Alloy Steel ASTM A 193 Gr B7 9HDG) & A 194 Gr 2H(HDG)
Tab Washer	IS 8062 / ASTM A 240 Gr. 304	IS 8062 / ASTM A 240 Gr. 304	IS 8062 / ASTM A 240 Gr. 304	IS 8062 / ASTM A 240 Gr. 304
Note:- Casting Quality Class 1 & 2 shall be applicable in accordance with NES 747 Part 2 for valves based on utilization in Hull and Line duties respectively.				

Table No 7.9 - Check valve (Lift Type) Internal Component Material Specs

Pressure Relief / Pressure Reducing Valves			
Name of Part	Valve Material Specification		
	Nickel Aluminum Bronze (NAB)	Gunmetal	Stainless Steel
Body	NAB NES 747 Part 2	Gunmetal BS 1400 LG4C	Stainless Steel ASTM A 351 CF8M
Bonnet	NAB NES 747 Part 2	Gunmetal BS 1400 LG4C	Stainless Steel ASTM A 351 CF8M
Body Seat	NAB NES 747 Part 2 1	NAB NES 747 Part 2	Stainless Steel ASTM A 351 CF8M
Spindle	NAB NES 833 Part 2	NAB NES 833 Part 2	SS ASTM A276 Gr.316
Spring	Spring Steel to IS	Spring Steel to IS	Spring Steel to IS 4454

	4454	4454	
Spindle Nut	NAB NES 833 Part 2	NAB NES 833 Part 2	SS ASTM A276 Gr.316
Seat securing Screw	NAB NES 833 Part 2	NAB NES 833 Part 2	SS ASTM A276 Gr.316
Washer	NAB NES 833 Part 2	NAB NES 833 Part 2	SS ASTM A276 Gr.316
Piston	NAB NES 833 Part 2	NAB NES 833 Part 2	SS ASTM A276 Gr.316
Bolts, Nuts	NAB NES 862	NAB NES 862	Alloy Steel ASTM A 193 Gr B7 9HDG) & A 194 Gr 2H(HDG)
Tab Washer	IS 8062 / ASTM A 240 Gr. 304	IS 8062 / ASTM A 240 Gr. 304	IS 8062 / ASTM A 240 Gr. 304
Note:- Casting Quality Class 1 & 2 shall be applicable in accordance with NES 747 Part 2 for valves based on utilization in Hull and Line duties respectively.			

Table No 7.10 - Pressure Relief / Pressure Reducing Valve Internal Component Material Specs

Lift Type Foot Valve		
Name of Part	Valve Material Specification	
	Gunmetal	Carbon Steel
Body / Cover	Gunmetal BS1400 LG 4C	Carbon Steel ASTM A216 Gr WCB
Bottom Flange	Gunmetal BS1400 LG 4C	Carbon Steel ASTM A216 Gr WCB
Disc	AB BS 2874 CA 104 (with elongation 17%)	SS ASTM A276 Gr.316
Disc Seat	NAB NES 747 Part 2	SS ASTM A276 Gr.316
Body Seat	NAB NES 747 Part 2	SS ASTM A276 Gr.316
Back Seat	AB BA 2874 CA 104 (with elongation 17%)	SS ASTM A276 Gr.316
Body Gasket	Asbestos Free BS 7531	Asbestos Free BS 7531
Soft Seat	Viton B (with 68% Flourine)	Viton B (with 68% Flourine)
Strainer	Monel K300, BS 3072-3075	SS plate equivalent to ASTM A 182
Bolts, Nuts	NAB BS 2871-CA104 (with elongation 17%)	Alloy Steel ASTM A 193 Gr B7 9HDG) & A 194 Gr 2H(HDG)
Tab Washer	IS 8062 / ASTM A 240 Gr. 304	IS 8062 / ASTM A 240 Gr. 304

Note:- Casting Quality Class 1 & 2 shall be applicable in accordance with NES 747 Part 2 for valves based on utilization in Hull and Line duties respectively.

Table No 7.11 - Foot Valve Internal Component Material Specs

<u>AIR VENT VALVE WITH INTEGRAL FLAME ARRESTER</u>	
<u>Name of Part</u>	<u>Valve Material Specification</u>
	<u>Carbon Steel</u>
Housing	Carbon Steel conforming to Article 7.5.4 of this document
Valve Seat	Neoprene Rubber, equivalent
Float Ball	Rigid PVC, equivalent
Flame And Insect screen	SS Conforming to ANSI 304, equivalent
Screen Guard	Carbon Steel conforming to Article 7.5.4 of this document
Flange	Carbon Steel conforming to Article 7.5.4 of this document
Body Gasket	Asbestos Free BS 7531, equivalent
Bolts, Nuts	Alloy Steel ASTM A 193 Gr B7 9HDG) & A 194 Gr 2H(HDG) / ASTM A 193 Gr B8M / 8M, equivalent
Note: - Air vent valve with integral flame arrester to be fabricated as per design requirement & type approved by competent authority.	

Table No 7.12 - Air Vent Valve with Flame Arrester Internal Component Material Specs

<u>SAMPLING / SELF CLOSING VALVE</u>	
<u>Name of Part</u>	<u>Valve Material Specification</u>
Body & Cover	Gunmetal conforming to Article 7.5.1 of this document
Stem /Spindle	NAB conforming to Article 7.3/7.4, in conjunction with 7.5.5 of this Specification, as applicable.
Disc / Plate	NAB conforming to Article 7.3/7.4, in conjunction with 7.5.5 of this Specification, as applicable.
Seat Ring	Aluminum Bronze BS 1400AB2, equivalent
Gland Flange	NAB conforming to Article 7.3/7.4, in conjunction with 7.5.5 of this Specification, as applicable.
Gland Packing	Viton B with 68% Flourine, equivalent
Body Gasket	Asbestos Free, equivalent
Spring	Monel K400, equivalent

Gasket	Asbestos Free, equivalent
Bolts/ Nuts	NAB NES 862, equivalent

Table No 7.13 - Sampling / Self Closing Valve Internal Component Material Specs

7.9. Although diaphragm vales have not been considered for utilization in the Chapter-5, their internal material guidelines are tabulated below, to serve as reference

Diaphragm Valve				
Name of Part	Valve Material Specification			
	NAB	Gunmetal	Stainless Steel	Carbon Steel
Body & Bonnet	NAB NES 747 Part 2	Gun metal BS 1400 LG 4C	Stainless Steel ASTM A 351 Gr CF8M	Carbon Steel ASTM A216 Gr WCB / A105
Compressor	NAB NES 833 Part 2	NAB NES 833 Part 2	Stainless Steel ASTM A 276 T410	Stainless Steel ASTM A 276 T410
Spindle	NAB NES 833 Part 2	NAB NES 833 Part 2	Stainless Steel ASTM A 276 T410	Stainless Steel ASTM A 276 T410
Diaphragm	Butyl reinforced with Nylon BS 3227 Gr B-70	Butyl reinforced with Nylon BS 3227 Gr B-70	Butyl reinforced with Nylon BS 3227 Gr B-70	Butyl reinforced with Nylon BS 3227 Gr B-70
Thrust bearing	Steel	Steel	Steel	Steel
Pad lock plate	Brass BS 2871 CZ 121 3 Pb	Brass BS 2871 CZ 121 3 Pb	Brass BS 2871 CZ 121 3 Pb	Brass BS 2871 CZ 121 3 Pb
Diaphragm Stud	NAB NES 833 Part 2	NAB NES 833 Part 2	Stainless Steel ASTM A 276 T410	Stainless Steel ASTM A 276 T410
Hand wheel Pin	NAB NES 833 Part 2	NAB NES 833 Part 2	Stainless Steel ASTM A 276 T410	Stainless Steel ASTM A 276 T410
Bolts & Nuts	NAB NES 862	NAB NES 862	Alloy Steel ASTM A 193 Gr B7 (HDG) ASTM A 194 Gr 2H (HDG)	Alloy Steel ASTM A 193 Gr B7 (HDG) ASTM A 194 Gr 2H (HDG)
Tab Washer	IS 8062 / ASTM A 240 Gr. 304	IS 8062 / ASTM A 240 Gr. 304	IS 8062 / ASTM A 240 Gr. 304	IS 8062 / ASTM A 240 Gr. 304
Handle/ Handwheel	Stainless Steel ASTM A 240 Gr.304 (with PVC Grip) / ASTM A 216 Gr.	Stainless Steel ASTM A 240 Gr.304 (with PVC Grip) / ASTM A 216	Stainless Steel ASTM A 240 Gr.304 (with PVC Grip) / ASTM A 216 Gr.	Stainless Steel ASTM A 240 Gr.304 (with PVC Grip) / ASTM A 216

	WCB	Gr. WCB	WCB	Gr. WCB
Note:- Casting Quality Class 1 & 2 shall be applicable in accordance with NES 747 Part 2 for valves based on utilization in Hull and Line duties respectively.				

Table No 7.14 - Diaphragm Valve Internal Component Material Specs

Union valve	
Name of Part	Valve Material Specification
	Nickel Aluminum Bronze (NAB)
Body	NAB TO NES 833 PART 2
Bonnet	NAB TO NES 833 PART 2
Cover	NAB NES 747 Part 2
Spindle	NAB TO NES 833 PART 2
Disc	NAB TO NES 833 PART 2
O-Ring	VITON - B
Gland Packing	Graphite (Impregnated)
Hand Wheel	ASTM A 216 Gr. WCB
Wire	SS ASTM A 493 Gr. 304
Bolts, Nuts	NAB NES 862
Tab Washer	IS 8062 / ASTM A 240 Gr. 304
Note:- Casting Quality Class 1 & 2 shall be applicable in accordance with NES 747 Part 2 for valves based on utilization in Hull and Line duties respectively.	

Table No 7.15 - Union Valve Internal Component Material Specs

CHAPTER 8

GENERAL DESIGN CONSIDERATIONS

- 8.1 Important general design considerations to be adhered to are as follows:-
- (a) All LP Fluid valves are to be designed for operating pressure of 10 Kg/cm² (PN 10 rating) and maximum continuous operating temperature of 120°C.
 - (b) The valves are to be designed to offer minimum pressure drop during flow. Flow coefficient (Cv) needs to be as low as possible. The manufacturer is to submit Flow coefficient (Cv) for each type of valve for reference.
 - (c) To arrive at the minimum valve body thickness, in accordance with ASME B 16.34 for Class 150, the valve designer should suitably incorporate applicable tolerance based on standard corrosion / manufacturing allowance. The valves are to be designed in accordance with prevalent international standards such as API/BS EN/ ISO/ ASME Section VIII.
 - (d) The valve should be able to operate smoothly under tropical marine conditions. It shall withstand contamination through air, oil, salt water and other contaminants associated with the marine environment. The valves shall be capable of efficient and unrestricted operation without any deviation from its normal operating parameters under the following seaway conditions:-
 - (i) Static trim of 5 degree without any limitations on time.
 - (ii) Dynamic trim of 15 degrees.
 - (iii) Static roll of 15 degrees without any limitation on time
 - (iv) Dynamic roll of 45 degrees.
 - (v) Pitch of +/- 7 degrees.
 - (e) Stops should be provided to ensure positive alignment of valve with the ports, for quick operating valves.
 - (f) Valves are to be provided with local indicators for indicating the open/ shut-off position of the assembly.
 - (g) All **System (Line)** valves of 100 mm and above should be provided with locking arrangement.
 - (h) Suitable 'back seat provision' should be catered for in design of Ball and Butterfly valves to enable renewal of gland packing/ seal, where applicable.

(j) Springs, where used, manufacturer should provide data indicating spring type, spring constant and material. Only Helical Compression springs shall be used. The springs in valves are not to be in contact with the fluid enclosed. For spring type valves, coefficient of flow is to be calculated as per BS 4740 / API 526 and is to be indicated in drawing. The proportional band & degree of stability on step change of demand are also to be indicated.

(k) Valves are to be designed in such a manner that a steady single arm clear pull of not more than 140N is required from the operator or 70N from each hand. For initial jerk operation, these figures may be doubled.

(l) All fasteners/ pins etc are to have positive locking devices to ensure that they do not open while in use.

(m) All valves 100 NB & above shall be provided with permanent lifting arrangement for ease of handling on board the ship.

(n) Valve Operation. Valves are to be operated either locally (by hand/ gear operated) or remotely (by rod gearing/ actuator mechanisms), as elaborated below.

(i) Local Operation.

(aa) Ball / Plug / Butterfly valves upto valve diameter 125 NB (including) in size shall be lever operated, unless otherwise specified.

(ab) Ball / Plug / Butterfly valves for valve diameter above 150 NB and above shall be gear operated.

(ac) The gearboxes (worm & worm wheel) fitted on these valves shall be considered as integral part of valve & designed for anti-corrosion & shock requirements of the valve itself. All gear boxes are to be water tight at 10 meters water column.

(ad) For Gate /SD /SDSL /SDNR valves, incorporation of suitable gearing arrangement beyond 125 NB dia, would be governed by system application/requirements and would be specified accordingly.

(ii) Remote Operation - Rod Gearing.

(aa) Valves required to be operated by rod gearing shall be fitted with spindle (extended beyond hand wheel position) 75 mm longer

than the normal valve spindle. The extended portion of spindle should have 25 mm round/ square section. The valve is to be provided with hand wheel in addition to extended spindle.

(ab) The extended spindle shall be of single piece in construction. Extending the spindle by welding clamping or other means of attachments is not acceptable.

(iii) Remote Operation by means of Electric / Pneumatic Actuators would be defined as per system requirement.

(s) The valves are to be closed by clockwise movement of the hand-wheel / lever when viewed from the hand-wheel / lever side.

(t) Hand-wheels/ levers / gearboxes shall be marked to indicate the direction of opening & closing.

(u) Identification. All the valves subject to this specification are to have the following embossed on the body (if this is impracticable, the required information is to be on the identification plate permanently fastened to the body or cover):-

- (i) Nominal Size.
- (ii) Maker's name.
- (iii) Type approval drawing number.
- (iv) An arrow indicating the direction of flow when this is unique.
- (v) Body Test Pressure.

(v) Galvanizing Galvanising of any the parts required shall be Hot Dip Galvanised conforming to NES 764 / BS 729.

(w) Anti-static Design. All applicable valves (Ball / Butterfly) shall have anti-static arrangement to ensure electrical continuity between stem and body of valves.

(x) Fire Safe Design. Fuel & AVCAT valves are to be designed to 'fire safe' requirements as per BS 5146/BS 6755 part II/ API 607/ BS EN 10497.

(y) Anti Blow Out Stem. All valves shall be designed to ensure that in the event of the gland being removed while the valve is under pressure, the stem does not blow out of the body.

(z) Drawing. The drawings are to conform to NES 722 and shall include following:-

- (i) Principal dimensions of valve, flange details, details of each part, tally plate.
- (ii) Details of gearboxes, actuators with part details.
- (iii) Part identification list showing parts & material specifications.
- (iv) Design & Testing details as per NES 375/ API 598/ International specifications as applicable.
- (vi) Weight of the valve including all internal fittings (+ 5%)
- (vii) Torque required for operation.
- (viii) Coefficient of flow & pressure drop.
- (ix) Valve body markings.
- (x) Project / Order No.
- (xi) Reference of Type test details, if applicable.

(aa) Warranty. Suitable warranty clause shall be applicable for following:-

- (i) Warrant all material & equipment to be free from defects in design, material and workmanship.
- (ii) Warrant that all items will satisfy the requirements of intended use and be suitable for the application.
- (iii) To repair or replace partly or wholly any item under this warranty which proves to be guarantee defect for stipulated performance as per purchaser commercial STACS.

(ab) Responsibility. Final testing & approval made by the *IN* representative / inspector shall not relive the manufacturer from his own responsibility & contractual obligations.

(ac) Product Support. Supplier should conform for product support service for next 20 years for all items supplied by them, from the date of supply.

(ad) Preservation.

- (i) Full face flange protectors of waterproof plywood/ weather resistant pressboard or plastic, of at least the outside diameter of the flange, shall be fastened to the flange to protect both flange & valve interior. Valves larger than 100 NB shall be bolted or otherwise fastened to skids to avoid damage in subsequent handling.
- (ii) Moisture/ Corrosion Protection. Only VCI treated materials shall be used in direct contact with metallic items during packing. Appropriate class of VCI material shall be used for ferrous / non-ferrous items. Adequate measures to be taken to preserve soft material fitted inside valves and supplied as spares.
- (iii) Initial preservation / packing is to be carried out at the manufacturer's works for a minimum period of 24 months and made suitable for storing in tropical condition. Supplier should provide

preservation procedure to be adopted for storing of vales beyond the initial.

(ae) Packing.

(i) In addition to the basic function of containment, packaging should provide protection & identification and convenient handling / transportation. Products may suffer from the injurious effects of physical, chemical, environmental hazards. The role of packaging is to prevent, or at least minimize, any of these which may lead to undesirable changes in the product.

(ii) Packing Cases. Wooden Packing cases used for packaging shall conform to IS: 1503-1988, subject to additional provisions prescribed herein. The items supplied against Shipyard/ Indian Navy orders shall be classified as "Difficult Loads" (Para A-4, Appendix-A of IS: 1503-1988). Every manufacturer shall, to the extent feasible, supply items in boxes of uniform size.

(af) Transportation. Adequate load-spreading, blocking, bracing and cushioning measures are to be adopted while packing & transporting the items in the cases, to prevent damage to the contents during placement, transportation and storage.

CHAPTER 9

INSPECTION AND TESTING OF VALVES

9.1 **Casting.** Casting classification of valves is based on NES 747 w.r.t severity of damage caused in cases of failure. Relevant extracts of the same are highlighted below:-

- (a) Class I. A casting whose failure would lead to uncontrollable flooding, the total immobilization of the vessel or serious hazard to personnel. This class of casting has '*very high standards of inspection & acceptance*'.
- (b) Class II. This type of casting is whose failure would lead to severe but controllable flooding, the serious disruption of weapon system, main propulsion machinery, or attendant auxiliaries including generators.
- (c) Class III. All other type castings.

9.1.2 For the purpose of standardisation and to achieve high reliability all Hull valves shall be of Class I Casting Quality and all System (Line) valves shall be of Class II Casting Quality.

9.1.3 Any casting may be rejected for defects discovered during subsequent machining notwithstanding that the casting had been passed previously.

9.1.4 Rectification of surface & sub-surface defects by welding is not permitted.

9.1.5. Impregnation will not be accepted as a recovery procedure.

9.2. **Forging.** The forging classification of valves based on NES 833 Part 2 defined based on severity of damage caused in case of failure is mentioned below:-

- (a) Class 1. A forging whose failure would lead to uncontrollable flooding, the total immobilization of the vessel or serious hazard to personnel.
- (a) Class 2. A forging whose failure would lead to severe but controllable flooding, the serious disruption of weapon systems, main propulsion machinery, or its attendant auxiliaries including generators.
- (c) Class 3. A forging whose failure does not constitute an immediately significant hazard.

9.2.1. For the purpose of standardisation and to achieve high reliability, all System valves (Line) manufactured by forging shall be of Class 2 quality as per NES 833 Part 2.

9.2.2 Any forging may be rejected for defects discovered during subsequent machining not withstanding that the forging had been passed previously.

9.2.3 Rectification of defects by welding is not permitted.

9.2.4 Surface defects may be removed by grinding, in accordance with NES 833 Part 2.

Stage Inspection

9.3 All valves shall be thoroughly inspected through following stages, prior dispatch:-

(a) Raw Material Inspection. It shall include inspection of cast material pouring and material tests, as applicable, wrt their chemical and physical properties, to ensure compliance with this Specification. All raw material used for manufacturing shall be virgin material only.

(b) In-Process Inspection. On completion of raw material inspection, applicable in-process inspection shall be carried out, to ensure compliance with this Specification.

(c) Final Inspection. Final inspection shall include dimensional inspection, weight checks, functionality checks of valve viz, Hydrostatic & Pneumatic testing. All sub-assemblies provided with valves are to be checked for their functions and standards.

Testing

9.4 Marine valves are required to be subjected to various types of test for checking their functionality and reliability of operation. Testing of valve is divided into two categories as 'Type Tests' and 'Bulk Production Tests'. The same is elaborated in succeeding paragraphs.

9.4.1 Type Tests, shall include following, through applicable stages of inspection:-

(a) Chemical Composition & Mechanical Properties Tests for raw material.

(b) Non-destructive Tests such as RT, LPT and UT, as applicable.

(c) Visual inspection.

(d) Dimensional Inspection including weight check. Format for weight certificate is placed at **Appendix 'B'**.

(e) Pressure (Hydrostatic & Pneumatic) test.

- (f) Method of Rubber Bonding test.
- (g) Disk Strength Test for Butterfly valves.
- (h) Seat Tightness Test for Pressure Relief valve iaw API 527.
- (j) Low pressure testing (less than 50 psi).
- (k) Pressure Drop Measurement & Capacity and Flow Rate Assessment (Cv determination).
- (l) Shock Test (Hydrostatic test is to conducted Pre & Post Shock Testing).
- (m) Noise Measurement.
- (n) Initial Torque Test (viz stated designed torques).
- (p) Delayed Torque Test (after period in shut position).
- (q) Pipe Wracking Test.
- (r) Cyclic Test followed by Strip test (Complete strip & DI checks & wear resistance of seating).
- (s) Fire Safe Test (applicable for fire safe valves only)..
- (t) Anti-static Test.
- (u) Maintenance Evaluation of Disassembly & Reassembly.

9.4.2 Bulk Production Tests. Bulk Production Tests, shall include following, through applicable stages of inspection:-

- (a) Chemical Composition & Mechanical Properties Tests for raw material.
- (b) Non-destructive tests such as RT, LPT and UT, as applicable.
- (c) Visual inspection.
- (d) Dimensional inspection including weight check.
- (e) Pressure (Hydrostatic & Pneumatic) test.
- (f) Method of Rubber Bonding test.

- (g) Disk Strength test for Butterfly valves.
- (h) Seat tightness test for Pressure Relief valve iaw API 527
- (j) Low pressure testing (less than 50 psi)
- (k) Repeatability Test (25 cycles followed by Hydrostatic test).

Conduct of Inspection & Tests

9.5 Inspection and tests listed shall be governed by relevant standards. Important inspection and testing requirements, based on relevant standards are highlighted below.

9.5.1 Chemical Composition. Chemical analysis of ingots and casting is to be carried out by suitable NABL labs/ competent third party, based on mutual agreement. In addition to the normal melt control analysis, a full chemical analysis is to be made from a sample piece taken from each cast for ingots and for castings.

9.5.2 Mechanical Properties. To measure Mechanical properties, a full analysis is to be made from each batch of ingots, cast and forging lot.

9.5.3 Non Destructive Tests. Various NDT tests and standards to be referred are as mentioned below:-

9.5.3.1 Dimensional Checks. All castings and forgings are to be dimensionally checked for compliance against approved manufacturing drawings and recorded.

9.5.3.2 Visual Examination. All forgings and castings are to be 100% visually examined for imperfections. Visual inspection / examination should be carried out in accordance with MSS SP 55 / Article 9 of ASME section V. All casting / forgings should be free from cracks, blow holes and discontinuities. The surface finish should be assessed as per IS - 3073 and is to be accepted in accordance with approved drawings.

9.5.3.3 Liquid (Dye) Penetrant Examination (LPE). 100% liquid penetrant examination in accordance with ASME B16.34 Annexure 'D'/ ASTM E 165 / NES 729 Part 4 is carried out on castings and forgings.

9.5.3.4 Radiography (RT). Critical Test Regions and Test Regions are to be subjected to 100% Radiography in accordance with ASME B 16.34 Annexure 'B'/ ASME Section V – SE 1030/ ASTM E 94/ ASTM E 142/ ASTM E 272, for valves manufactured through casting. Permissible degree of 'Severity Levels' in respect of various inconsistencies, for Class I and II casting qualities, are tabulated below:-

<u>Ser</u>	<u>Type of Discontinuities/ Defect</u>	<u>Category</u> (ASME B16.34)	<u>Permissible Severity Levels</u>	
			<u>Class I</u>	<u>Class II</u>
(a)	Gas Porosity	A	2	3
(b)	Sand & Slag Inclusions	B	2	3
(c)	Shrinkage Type 1	CA	1	2
(d)	Shrinkage Type 2	CB	1	2
(e)	Shrinkage Type 3	CC	1	2
(f)	Shrinkage Type 4	CD	1	2
(g)	Crack	D	No defect acceptable	
(h)	Hot Tear	E		
(j)	Insert (Chills, Chaplets)	F		
(k)	Mottling	G		

Table No. 9.1 – Permissible Severity Levels

9.5.3.5 Ultrasonic Test.

(a) Forging quality Class 2 are to be subjected to 100% Ultrasonic Test (UT). Areas of the valve where UT is not feasible, is to be subjected to 100% RT.

(b) UT is to be undertaken in accordance with Para 8.3.2 of ASME B16.34/ ASTM A 388/609/ NES Part 5.

(c) Acceptance standards for UT examination shall be applicable in accordance with ASME Annexure E, ASTM A 609 and NES 833 Part 2. Relevant extracts of NES 833 Part 2 are appended below, for reference:-

(i) Extruded, Rolled, Forged & GFM Forged Rods and Sections. In accordance with Art. 8.2.4 of NES 833 Part 2, any defect which causes a Compression Wave examination signal either equal to or greater than the signal produced by the calibration standard, having made allowance for the differences in attenuation between test block and the material under test, is to be rejected.

(ii) Forgings. Any Class 2 forging with transverse defects is to be rejected. For either compressional wave or shear wave examination, any defect which, having made allowance for any difference of attenuation between the test block and material under test that may exist and corrected for depth, causes a signal which is:-

(aa) less than the reference level is acceptable;

(ab) equal to the reference level and not more than 6dB in excess of this standard may be recorded and referred to the QA authority for discussion, or is to be rejected;

(ac) in excess of 6dB above the reference is to be rejected.

(ad) See Clauses 8.2.5c. and 8.2.6a. regarding the assessment of suitability for ultrasonic examination.

9.5.4 Pressure (Hydrostatic & Pneumatic) Tests. The pressure testing of valves is governed by EN BS 12266 Part 1 and all valves shall be mandatorily tested for Hydrostatic & Pneumatic test for Rate 'A'. For Butterfly valves, Disk Strength test to be conducted as per EN BS 12266 Part 1. Further for pressure relief/reducing valves seat tightness tests are to be carried out. Low Pressure Testing (less than 50 psi) for applicable valves such as Check valves is to be also undertaken.

9.5.5 Rubber Bonding Test. Method of rubber bonding should be tested iaw ASTM B429 for soft seated valves.

9.5.6 Noise Level Measurement. Noise level measurement for valves as Type-II category equipment as mentioned in MIL-STD-740-2(SH) is to be undertaken.

9.5.7 Shock and Vibration Testing. All Hull valves are to comply with *IN* Shock Grade 'A'. Shock test is to be conducted iaw *IN* policy currently in force. Relevant extracts of the document is placed at **Appendix 'C'**. Shock calculations and physical shock testing results is required to be ratified by NSTL (V) / competent authority, and submitted to *IN* for reference.

9.5.8 Fire Safe Test. This test shall be performed in accordance with API 607 / EN BS 10497. The fire safe testing shall be undertaken for all applicable valves fitted in the Fuel & AVCAT systems.

9.5.9 Anti-Static Characteristics. This test shall be performed in accordance with BS EN 12266-2 for all applicable valves.

9.5.10 Pressure Drop & Flow Capacity. Pressure Drop & Flow capacity (Cv / Kv) Measurement test is to be carried out as part of Type Tests iaw ANSI / ISA 75 - 02 standard.

9.5.11 Cyclic Testing.

(a) The manufacturer must demonstrate adequacy of each type of valve offered to perform, under design parameters, within applicable rating of the valve and for a sufficient number of operations to simulate a full service life. The adequacy is to be demonstrated by testing valves selected to represent each

type of seat design in each applicable size groups. The required number of cycle law AWWA standard C504 is given below, as reference:-

<u>Sl</u>	<u>Valve Dia Range (NB)</u>	<u>No of Cycles</u>
(i)	75 – 500	10,000
(ii)	600 -1050	5,000
(iii)	1200 - 1800	1,000

Table No 9.1 – Cycle Test wrt Valve Dia (NB)

(b) Every cycle shall consist of applying rated differential pressure to Ball / Plug / Flap / Disc in the closed position then opening the valve to wide open position and then closing the disc.

(c) On completion of cyclic testing, the valve shall be drop tight (leak tight) in both directions under rated differential pressure.

(d) Post completion of test at serial above (c), Strip test (Complete strip & DI checks & wear resistance of seating surface material) shall be checked.

9.5.12 Torque and Pipe Wracking Tests. Initial Torque test (viz stated design torques), Delayed Torque test (after period in shut position), Pipe wracking test shall be carried out in accordance with NES 375 for all applicable valves.

9.5.13 Repeatability Test. Repeatability test (25 Cycles of valve opening/ closing) is to be undertaken as part of Bulk Production testing, followed by hydrostatic test as mentioned at Article 9.5.4 of specification.

9.5.14 Maintenance Evaluation. Maintenance Evaluation of Disassembly & Reassembly is to be undertaken to ascertain maintainability of Valve.

9.5.15 The abovementioned tests/ inspections during valve manufacturing should ensure reliable operation of class I underwater hull valves, essentially, for at least five year duration commensurate with the extant policy of underwater paint scheme.

PART - C
GLOSSARY

0 0 0 0

CHAPTER 10

GLOSSARY

Absolute Pressure. The total pressure measured from absolute zero, i.e., from an absolute vacuum. It equals the sum of gauge pressure and atmospheric pressure corresponding to the barometer (expressed in pounds per square inch).

Absolute Temperature. Temperature measured from absolute zero, a point of temperature, theoretically equal to minus 273.18° C or minus 459.72° F; the hypothetical point at which a substance would have no molecular motion and no heat.

Absolute Zero. Zero point on the absolute temperature scale; a point of total absence of heat. Equivalent to minus 459.72° F or minus 273.18° C.

Angle Valve. A variant of the globe valve design, having pipe openings at right angles to each other. Usually one opening on the horizontal plane and one on the vertical plane.

Bonnet. That part of a valve which connects the valve actuator to the valve body; may also contain the stem packing in some valves.

Bolted Bonnet. A bonnet which is connected to the body neck flange by bolts.

Bubble Tight. The description of a valve seat that, when closed, prohibits the leakage of visible bubbles.

Ball Valve. A quick opening valve providing very tight shutoff. The name derived from its spherical shaped ball.

BPS. British Standard Pipe (BPS is family of standard screw thread size).

Butterfly Valve. A valve deriving its name from the wing like action of the disc which operates at right angles to the flow.

Cavitation. A localized gaseous condition that is found within a liquid stream.

Check Valve. A valve which automatically stops back flow when the fluid in the line reverses.

Control Valve. A valve which regulates the flow or pressure of a medium which affects a controlled process.

Cooler. A heat exchanger which removes heat from a fluid or gas.

Corrosion. Effect of deterioration of materials because of chemical action.

Diaphragm. A flexible disc used to separate the control medium from the controlled medium and which actuates the valve stem.

Diaphragm Valve. A valve that is actuated by diaphragm, or one having a Spring Diaphragm actuator.

Disc. That part of a valve which actually closes off the flow.

Double Disc. A two piece disc used in the gate valve. Upon contact with the seating faces in the valve, the wedges between the disc faces force them against the body seats to shut off the flow.

Drop Tight. A term signifying that a valve shall not pass water or air droplets when it is closed.

End Connection. A reference to the method of connecting the parts of a piping system, i.e., threaded, flanged, butt weld, socket weld, etc.

Face-to-Face Dimensions. The dimensions from the face of the inlet port to the face of the outlet port of a valve.

Flange. A rim on the end of a pipe, valve or fitting for bolting to another pipe element.

Flange Ends. Refers to a valve or fittings having flanges for joining to other piping elements. Flanged ends can be plain faced, raised face, large male and female, small male and female, large tongue and groove, small tongue and groove and ring joint.

Flow Characteristic. Relation between flow through a valve and the percent of valve stem travel required for a given flow.

Flow Coefficient. Indicated as Cv. The number of U.S. gallons per minute of 60° F water that will flow through a valve with a one psi pressure drop under stated conditions.

Flow Rate. The volume, mass, or weight of a fluid passing through any pipe per unit of time.

Fluid. That which is not solid and can flow; able to move and change shape without separating when under pressure.

Head. The height of a column above a given point expressed in linear units, i.e., feet of water, inches of mercury, etc. Used interchangeably with "pounds of pressure".

Header. The length of pipe or vessel to which two or more pipe lines are joined to carry fluid from a common source to various points of use.

Heat Exchanger. A device which transfers heat through a conducting wall from one fluid to another.

Inlet Port. The port which is connected directly to the upstream pressure of a fluid system.

Inside Screw, Non-Rising Stem. A type of stem usually found in gate/ globe valves. The disc rises on the threaded part of the stem instead of the stem rising through a threaded portion of the bonnet.

Inside Screw, Rising Stem. A stem normally found on gate/ globe valves. The stem rises as the handwheel is turned. The term inside screw means that the threads are inside of the bonnet.

Isolating Valve. Valves used in the system for flow 'On/Off' duties.

Lapping. Rubbing and polishing a surface such as disc face to obtain a smooth bearing with the body seat rings.

Lift Check Valve. Type of check valve in which vertically rising flow lifts/ opens disc and a reverse pressure causes disc to drop back into its closed position to stop the reverse flow.

Manifold. A branch of pipe that provides for multiple connection ports.

Multi-Port Plug Valve. A plug valve that has two or more port openings.

Non-Rising Stem. A type of valve stem which turns but does not rise when the valve is operated.

NB. Nominal Bore referred for inside diameter of the pipe / valve/associated fittings.

Packing. A sealing device consisting of deformable material or one or more mating deformable elements. Reshaped by manually adjustable compression to obtain or maintain effectiveness of a leak-proof seal.

Packing Box Assembly. The part of the bonnet assembly used to seal against leakage around the valve stem.

Percentage Flow Characteristic. An inherent flow characteristic which, for equal increments of rated plug travel, will give equal percentage changes of the existing flow.

Piping. General term for pipe and fittings used in pipe lines. A complete piping system.

PN. Nominal Pressure, it is generally the working pressure of the system.

Plug. That part of a valve which closes the inlet port/ orifice to stop the flow.

Plug Type Disc. A type of disc used in valves; tapered plug disc and cone shaped seat having wide bearing seating surface.

Port. An internal / external terminus of a passage in a component. The inlet or outlet of a valve.

Pressure Differential. The difference in pressure between any two points of a system or a component. Also known as pressure drop or ΔP .

Quick Opening. An inherent flow characteristic of a valve in which there is a maximum flow with minimum travel.

Rated Cv The value of Cv of a valve at the rated full open position.

Rated Travel. Linear movement of the valve plug from the closed position to the rated full open position.

Rate of Flow. An expression of measurement of the medium flowing through a given space in a given time; expressed as TPH (Tons Per Hour GPM (Gallons per Minute), CFH (Cubic Feet per Hour), LBH (Pounds per Hour), etc.

Seal, Diaphragm. A relatively thin, flat sealing device fastened and sealed at its periphery with its inner portion free to move.

Seat. That portion of a valve against which the ball/plug/disc/gate presses to effect shut-off.

Seating Action. A valve design in which flow is stopped by a seated obstruction in the flow path.

Seating Action, Ball. A seating action valve design which utilizes a spherical ball to obstruct the flow path.

Seating Action, Diaphragm. A seating action valve design which utilizes a diaphragm to obstruct the flow path.

Seating Action, Disc. A seating action valve design which utilizes a disc to obstruct the flow path.

Seating Action, Disc, Swing Check. A seating action valve design which utilizes a hinged disc to obstruct the flow path.

Seating Action, Plug. A seating action valve design which utilizes a plug to obstruct the flow path.

Seat Ring. A separate piece inserted in the valve body to form a valve body part.

Throttling. Regulation of flow through a valve.

Valve. A device which controls flow direction, pressure, or flow rate of fluid.

Valve Body. The main part of a valve which contains passageway for medium and seating surfaces for ball/plug/disc/gate which control the amount of flow.

Valve Plug Guide. A guide in a valve bonnet or body which aligns the plug to assure positive seating.

Valve Plug. The movable part of a valve which moves to restrict the port through which the medium travels.

Pressure Reducing Valve. A valve whose primary function is to limit outlet pressure.

Pressure Relief Valve. A pressure control valve whose primary function is to limit system pressure.

ASME. American Society of Mechanical Engineers

ASTM. American Society for Testing Material

AWWA. American Water Works Association

API. American Petroleum Institute

BS. British Standards

BS EN. British Standard European Norm

NES. Naval Engineering Standards

IS. Indian Standards

ISO. International Organisation for Standardisation

MSS. Manufacturers Standardisation Society

Appendix 'A'
(Refer to Para 1.3)

VALVE SELECTION TEMPLATE

<u>INPUT DATA</u>			
<u>Ser</u>	<u>Description</u>	<u>Particulars to be Filled</u>	<u>Remarks</u>
1	Ship's System	: _____	(SW/FW/CW/LO/Fuel/AVCAT)
2	Determination of System Application	: _____	Table No. 5.1 of Specification
3	Location of Valve	: _____	[Hull/ System (Line) Valve]
4	Pipe Diameter (NB)	: _____	As per system design.
<u>OUTPUT DATA</u> <i>(based on this Specification)</i>			
5	Valve Dia (NB) (based on Pipe Dia)	: _____(mm)	Chapter 4 of Specification
6	Applicable Manufacturing Process	: _____	Art. 7.3/ 7.4 of Specification
7	<u>Applicable Class Quality</u>		Art. 7.3/ 7.4 of Specification
	(a) Casting (Class I/II)	: _____	If applicable, else NA.
	(b) Forging (Class 2)	: _____	If applicable, else NA.
8	Type of Valve, as applicable	: _____	Art. 5.4 and Table No. 5.1 of Specification
9	Face-to-Face/ Centre-to-Face Dimension	: _____(mm)	Art. 6.1-6.9 of Specification
10	Minimum Bore Diameter (for Ball Valve only)	: _____(mm)	Art. 6.10 of Specification
11	Valve Material	: _____	Art. 7.6 of Specification
12	Internal Component Material	: _____	Art. 7.8 of Specification
13	End Connection (Screwed/ Flanged)	: _____	Art. 6.12/ 6.13 of Specification, as applicable

(a)	<u>Screw end Connection Particulars</u>		Table No. 6.13 of Specification
	(i)	Valve Dia (NB) : _____ (mm)	
	(ii)	Thread Size : _____ (inch)	
	(iii)	No. of Threads/ inch : _____	
	(iv)	Pitch (P) : _____ (mm)	
	(v)	Depth of Thread (h) : _____ (mm)	
	(vi)	Major Gauge Dia (d) : _____	Basic Diameter of Gauge Plane (in mm)
	(vii)	Pitch (d2) : _____	
(viii)	Minor (d1) : _____		
(b)	Flange Particulars, if applicable		Table No. 6.14 & 6.15 of Specification
	(i)	Nominal Size (NB) : _____ (mm)	
	(ii)	Outside Dia (D) : _____ (mm)	
	(iii)	PCD for Bolts (K) : _____ (mm)	
	(iv)	Diameter of Bolt Hole (L) : _____ (mm)	
	(v)	No. of Bolts : _____	
	(vi)	Bolt Size : _____	
	(vii)	Flange Thickness (C1) : _____ (mm)	
	(viii)	Neck Dia (N3) : _____ (mm)	
(ix)	Raised Face Dia (D1) : _____ (mm)	[Applicable only for System (Line) Valves]	
14	Valve Actuation Mechanism	: _____	Art. 8.1(n) of Specification
15	Rod Gearing, if applicable	: _____ (Y/N)	Art.5.2(c)/5.3(c), as applicable
16	Fire Safe, if applicable	: _____ (Y/N)	Art. 8.1 (x) of Specification
17	Standard Design Considerations, as defined in Chapter 8 of Specification to be complied with.		
18	Acceptance Test Criteria, as defined in Chapter 9 of Specification, to be complied with.		

VALVE SELECTION TEMPLATE – ILLUSTRATIVE EXAMPLE NO. 1

INPUT DATA			
Ser	Description	Particulars to be Filled	Remarks
1	Ship's System	: <u>Sea Water System</u>	(SW/FW/CW/LO/Fuel/AVCAT)
2	Determination of System Application	: <u>Sea Water Inlet (Sea Tube)</u>	Table No. 5.1 of Specification
3	Location of Valve	: <u>Hull Valve</u>	[Hull/ System (Line) Valve]
4	Pipe Diameter (NB)	: <u>250 mm</u>	As per system design.
OUTPUT DATA (based on this Specification)			
5	Valve Dia (NB) (based on Pipe Dia)	: <u>250 mm</u>	Chapter 4 of Specification
6	Applicable Manufacturing Process	: <u>Casting</u>	Art. 7.3/ 7.4 of Specification
7	Applicable Class Quality		Art. 7.3/ 7.4 of Specification
	(a) Casting (Class I/II)	: <u>Class I</u>	If applicable, else NA.
	(b) Forging (Class 2)	: <u>NA</u>	If applicable, else NA.
8	Type of Valve, as applicable	: <u>Hull Valve, Screw-down (outside screw)</u>	Art. 5.4 and Table No. 5.1 of Specification
9	Face-to-Face/ Centre-to-Face Dimension	: <u>Straight Type - 622 mm/ Angle Type - 311 mm</u>	Art. 6.1-6.9 of Specification
10	Minimum Bore Diameter (for Ball Valve only)	: <u>NA</u>	Art. 6.10 of Specification
11	Valve Material	: <u>NAB</u>	Art. 7.6 of Specification
12	Internal Component Material	: <u>Refer Table 12A, below.</u>	Art. 7.8 of Specification
13	End Connection (Screwed/ Flanged)	: <u>Flanged</u>	Art. 6.12/ 6.13 of Specification, as applicable
	(a) <u>Screw end Connection Particulars</u>		Table No. 6.13 of Specification

	(i)	Valve Dia (NB)	: _____ (mm)	
	(ii)	Thread Size	: _____ (inch)	
	(iii)	No. of Threads/ inch	: _____	
	(iv)	Pitch (P)	: _____ (mm)	
	(v)	Depth of Thread (h)	: _____ (mm)	
	(vi)	Major Gauge Dia (d)	: _____	Basic Diameter of Gauge Plane (in mm)
	(vii)	Pitch (d2)	: _____	
	(viii)	Minor (d1)	: _____	
	(b)	Flange Particulars, if applicable		Table No. 6.14 & 6.15 of Specification
	(i)	Nominal Size (NB)	: <u>250 mm</u>	
	(ii)	Outside Dia (D)	: <u>395 mm</u>	
	(iii)	PCD for Bolts (K)	: <u>350 mm</u>	
	(iv)	Diameter of Bolt Hole (L)	: <u>22 mm</u>	
	(v)	No. of Bolts	: <u>12</u>	
	(vi)	Bolt Size	: <u>M20</u>	
	(vii)	Flange Thickness (C1)	: <u>28 mm</u>	
	(viii)	Neck Dia (N3)	: <u>292 mm</u>	
	(ix)	Raised Face Dia (D1)	: <u>NA</u>	[Applicable only for System (Line) Valves]
14		Valve Actuation Mechanism	: <u>Local with Handwheel</u>	Art. 8.1(n) of Specification
15		Rod Gearing, if applicable	: <u>Yes</u> (Y/N)	Art.5.2(c)/5.3(c), as applicable
16		Fire Safe, if applicable	: <u>NO</u> (Y/N)	Art. 8.1 (x) of Specification
17		Standard Design Considerations, as defined in Chapter 8 of Specification to be complied with.		
18		Acceptance Test Criteria, as defined in Chapter 9 of Specification, to be complied with.		

INTERNAL COMPONENT MATERIAL

<u>Name of Part</u>	<u>Valve Material Specification</u>	
	<u>NAB</u>	
Body, Bonnet	NAB conforming to Article 7.3, in conjunction with 7.5.5 of this Specification.	
Disc / Gate	NAB (Solid) conforming to Article 7.3, in conjunction with 7.5.5 of this Specification.	

Back Seat	NAB conforming to Article 7.3, in conjunction with 7.5.5 of this Specification.
Spindle	NAB conforming to Article 7.4 of this Specification.
Disc Seat	NAB conforming to Article 7.3, in conjunction with 7.5.5 of this Specification, as applicable.
Yoke, Yoke Sleeve	NAB conforming to Article 7.3, in conjunction with 7.5.5 of this Specification.
Bearing (Bush)	Phosphor Bronze BS2874 PB 102, equivalent
Gland Flange End	Phosphor Bronze BS2874 PB 102 / NAB conforming to Article 7.4 of this document
Bolts, Nuts	NAB NES 862, equivalent
Soft Seat	Reinforced PTFE, equivalent
Gland Packing	Graphite (Impregnated) / Asbestos Free Graphite, equivalent
Body Gasket	Asbestos Free BS 7531, equivalent
Hand Wheel	Forged Steel ASTM A182 F316 / A 276 T410 / A105/ Cast Steel ASTM A351 Gr CF8M / A216 Gr WCB , equivalent

Table 12A. Internal Component Material

VALVE SELECTION TEMPLATE – ILLUSTRATIVE EXAMPLE NO. 2

<u>INPUT DATA</u>			
<u>Ser</u>	<u>Description</u>	<u>Particulars to be Filled</u>	<u>Remarks</u>
1	Ship's System	: <u>Fuel System</u>	(SW/FW/CW/LO/Fuel/AVCAT)
2	Determination of System Application	: <u>Isolation Duties - Filling Line</u>	Table No. 5.1 of Specification
3	Location of Valve	: <u>System (Line) Valve</u>	[Hull/ System (Line) Valve]
4	Pipe Diameter (NB)	: <u>150 mm</u>	As per system design.
<u>OUTPUT DATA</u> <u>(based on this Specification)</u>			
5	Valve Dia (NB) (based on Pipe Dia)	: <u>150 mm</u>	Chapter 4 of Specification
6	Applicable Manufacturing Process	: <u>Casting</u>	Art. 7.3/ 7.4 of Specification
7	<u>Applicable Class Quality</u>		Art. 7.3/ 7.4 of Specification
	(a) Casting (Class I/II)	: <u>Class II</u>	If applicable, else NA.
	(b) Forging (Class 2)	: <u>NA</u>	If applicable, else NA.
8	Type of Valve, as applicable	: <u>Triple Offset Butterfly Valve</u>	Art. 5.4 and Table No. 5.1 of Specification
9	Face-to-Face/ Centre-to-Face Dimension	: <u>Double Flanged - 140 mm/ Wafer Type - 76 mm</u>	Art. 6.1-6.9 of Specification
10	Minimum Bore Diameter (for Ball Valve only)	: <u>NA</u>	Art. 6.10 of Specification
11	Valve Material	: <u>Carbon steel conforming to ASTM A 216 Gr WCB/ A105</u>	Art. 7.6 of Specification
12	Internal Component Material	: <u>Refer Table 12.B, below.</u>	Art. 7.8 of Specification
13	End Connection (Screwed/ Flanged)	: <u>Flanged</u>	Art. 6.12/ 6.13 of Specification, as applicable

(a)	Screw end Connection Particulars		Table No. 6.13 of Specification
	(i) Valve Dia (NB)	: _____ (mm)	
	(ii) Thread Size	: _____ (inch)	
	(iii) No. of Threads/ inch	: _____	
	(iv) Pitch (P)	: _____ (mm)	
	(v) Depth of Thread (h)	: _____ (mm)	
	(vi) Major Gauge Dia (d)	: _____	Basic Diameter of Gauge Plane (in mm)
	(vii) Pitch (d2)	: _____	
(viii) Minor (d1)	: _____		
(b)	Flange Particulars, if applicable		Table No. 6.14 & 6.15 of Specification
	(i) Nominal Size (NB)	: <u>150 mm</u>	
	(ii) Outside Dia (D)	: <u>285 mm</u>	
	(iii) PCD for Bolts (K)	: <u>240 mm</u>	
	(iv) Diameter of Bolt Hole (L)	: <u>22 mm</u>	
	(v) No. of Bolts	: <u>08</u>	
	(vi) Bolt Size	: <u>M20</u>	
	(vii) Flange Thickness (C1)	: <u>22 mm</u>	
	(viii) Neck Dia (N3)	: <u>190 mm</u>	
	(ix) Raised Face Dia (D1)	: <u>212mm</u>	[Applicable only for System (Line) Valves]
14	Valve Actuation Mechanism	: <u>Local with Gearbox</u>	Art. 8.1(n) of Specification
15	Rod Gearing, if applicable	: <u>Yes, for remote operation</u>	Art.5.2(c)/5.3(c), as applicable
16	Fire Safe, if applicable	: <u>Yes (Y/N)</u>	Art. 8.1 (x) of Specification
17	Standard Design Considerations, as defined in Chapter 8 of Specification to be complied with.		
18	Acceptance Test Criteria, as defined in Chapter 9 of Specification, to be complied with.		

INTERNAL COMPONENT MATERIAL

<u>BUTTERFLY VALVES</u>	
<u>Name of Part</u>	<u>Valve Material Specification</u>
	<u>Carbon Steel</u>
Body / Cover	Carbon Steel conforming to Article 7.5.2 of this Specification
Disc	Stainless Steel ASTM A 351 Gr CF8M, equivalent
Shaft / spindle	Stainless Steel ASTM A 276 T410 (Single Piece) , equivalent
Clamp Ring	Stainless Steel ASTM A 351 CF8M / A182 F316 /A276 T410/ Gr316, equivalent
Disc Pin	Stainless Steel ASTM A 276 T410, equivalent
Bearing	SS 304 PTFE coated, equivalent
Gland Flange	Stainless Steel ASTM A 351 Gr CF8M, equivalent
Bolts & Nuts	Alloy Steel ASTM A 193 Gr B7 (HDG) ASTM A 194 Gr 2H (HDG) / ASTM A 193 Gr B8M / 8M, equivalent
Soft Seat (if applicable), Body Sleeve	Reinforced PTFE, equivalent
Gland Packing	Graphite (Impregnated), equivalent
Body Gasket	Asbestos Free BS 7531, equivalent
Handle/ Handwheel	Forged Steel ASTM A182 F316 / A 276 T410/ A105 / Cast Steel ASTM A351 Gr CF8M / A216 Gr WCB , equivalent
Antistatic Device	Stainless Steel AISI 304, equivalent
Gearbox Casing	SG Iron BS 2789, equivalent
Gears	Forged Steel BS 970-316 / EN 19, equivalent
Worm & Worm Wheel Spindle	Forged Steel BS 970-316 / AISI 316, equivalent

Table 12B. Internal Component Material

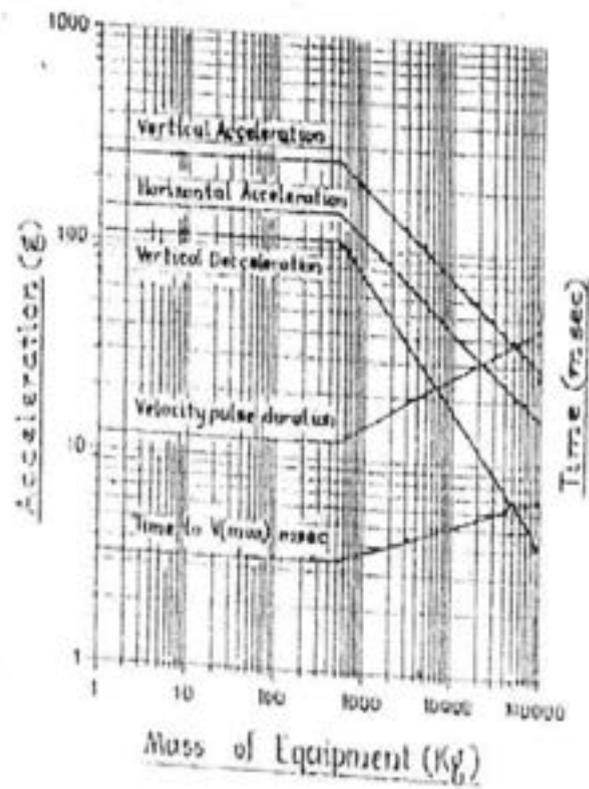
Appendix 'B'
(Refer to Art. 9.4.1 (d))

WEIGHT CERTIFICATE

Equipment Description		Equipment No	
The form has to be completed by Vendor & to be supplied along with the equipment			
Vendor's Name			
Address		Ref Drg no	
Telephone No		Part No	
Order No		Eqpt No	
Method Of Weighing : Vendor to prescribe Method & Equipment used.			
	Date of last Calibration	Specified accuracy requirement	
	Note :-		
Result of Weighing Total Equipment Dry Weight (Exclude packing, temporary protection etc)			
Allocated Weight (Weight estimate agreed by Purchaser and vendor based on order specs)			
Reasons for variations between allocated weight & Certified weight :			
Weighing Address	Witnessed by		
	For Vendor	For Purchaser	
	Representative	Representative	
Date	Sign / Date / Seal	Sign / Date / Seal	

Appendix 'C'
(Refer to Art. 9.5.7)

I N SHOCK GRADE 'A' CURVES



SHOCK TESTING PROCEDURE

1. Scope of testing.

The equipment which is shock tested would be complete with all accessories viz. interconnecting pipes, sensors, transmitters, indicators, gauges etc. In the case of electrical/electronic equipments, which are mounted separately, the same would be subjected to shock loads as stipulated in JSS 55555.

2. Sequence of Testing.

The equipment which is earmarked for shock test shall under go the following tests (in that sequence): -

- (a) Visual inspection to identify apparent defects
- (b) Proving run or endurance run as per the duration and modes specified in procurement specifications.
- (c) Shock test of the equipment to levels specified in procurement specifications.
- (d) Visual inspection for apparent defects/looseness, which would have occurred due to shock loads.
- (e) Disassembly of the equipment into components and visual inspection.
- (f) NDT (DPT) of critical components.
- (g) Assembly and proving run of the equipment

3. The equipment is considered to have passed the shock test if the following conditions are satisfied: -

(a) There are no mechanical damages/failures.

(b) There is no deterioration of performance of the equipment when compared to pre-shock test status.

(c) There are no cracks, leakages of working medium/control medium or any other defects that may lead to degradation of characteristics of the article.

(d) There is no change in status of switches (on/Off) or malfunctioning of equipment/skid-mounted sensors, transducers gauges etc.

Enclosure 4 to JHQ MoD(N) letter
policy dated 11 May 07

GUIDELINES FOR S
CALCULATIONS

BY SHOCK

1. The following shall be considered explicitly in the calculations, which shall be made for each of the principle axes separately.
 - (a) The mass of the equipment.
 - (b) The strength and stiffness of the foundation.
 - (c) The response of the sub components of the equipment.
 - (d) The duration of the shock loading.
2. The calculation/ method employed for evaluation of the centre of gravity of the complete equipment and individual components are to clearly indicated.
3. The complete material and physical properties of the components of the equipment are to be indicated.
4. The natural frequency of the equipment as mounted on the ship is to be either calculated or determined by tests. On evaluation of the natural frequency, the equipment/components are to classified as either rigid/ flexible as per guidelines in BR 3021(I).
5. A Non-Linear Lumped Mass Modelling is to be adopted for evaluation of the characteristics of the equipment. The Boundary conditions and constraints applicable to the equipment are to be clearly specified in the model. Advanced techniques such as Finite Element Analysis and tools such as ANSYS/PAFEC code may be used for the analysis clearly specifying the number of Nodes and Elements used for discretizing the equipment.
6. The "frequency ratio" of the natural frequency of the equipment to the Shock input frequency is to be evaluated as per guidelines in BR-3021(I).

7. The "shock amplification factor" is to be evaluated as per guidelines in BR-3021(1).
8. The acceleration, Velocity, Time period values as applicable for the calculations are to be obtained as per guidelines in BR- 3021(1).
9. The permissible shock design stresses are to be obtained as per guidelines in BR - 3021(1)
10. The Bending Moment, Shear force, Bending Stresses and Displacement as obtained in the calculations are to be clearly specified for the equipment and each individual component of the equipment. The effect on various clearances of the equipment / components is to be clearly stated in the calculations.
11. A flow chart indicating the steps to be undertaken for design/ verification checks for shock is highlighted in the next page.

DETAILS OF TEST FACILITIES

1. **Test Facilities Available at NSTL Visakhapatnam.** The following infrastructure/ facilities are available for undertaking actual shock testing of equipment: -

S.NO.	TEST FACILITY	PAYLOAD	PAYLOAD SIZE	REMARKS
(a)	Test machine (Drop test /free fall machine)	Upto 600 kg	1m x 1m	600 kg - 90 g 90 kg - 600 g
(b)	Test machine (Drop test/free fall machine)	Upto 1000 kg	1.5m x 1.5m	Max acceleration - 600g Min. weight - 200 kg
(c)	Floating Shock Platform (FSP-I small)	Upto 2000 kg	2.5x 1.5x 1.5m	The platform is floated in NSTL Shock tank of size 15mx12mx10m and explosives are used in the tank to create the required shock levels
(d)	Floating Shock Platform (FSP-II Large)	Upto 15000 kg	8 x 3x2m	The platform is floated in NSTL Shock tank of size 15mx12mx10m or in open water and explosives are used in the tank to create the required shock levels
(e)	Shock tubes	Shock tubes are fabricated to accommodate any size of equipment. Very high levels of shock pulses are channelised in the shock tubes and applied on the test equipment.		

2. **Test Facility at DMDE, Secunderabad.** DMDE has an impact-testing machine (K- 200M) for subjecting equipment weighing upto 200 kgs to impact loads.

FLOWCHART FOR DESIGN/VERIFICATION CHECKS FOR SHOCK

