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The Engineering Resource For Advancing Mobility®

400 COMMONWEALTH DRIVE, WARRENDALE, PA 15096

AEROSPACE STANDARD

AS 1290A

Issued: 7-75

Revised: 5-86

Submitted for recognition as an American National Standard

GRAPHIC SYMBOLS FOR AIRCRAFT HYDRAULIC AND PNEUMATIC SYSTEMS

AS 1290A

PREPARED BY

SAE COMMITTEE A-6, AEROSPACE FLUID POWER AND CONTROL TECHNOLOGIES

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FOREWORD

In 1963, when only token usage was being made of the only existing standard for aircraft hydraulic symbols, MIL-STD-17B-2, a study was made by SAE Committee A-6 to determine if the then ASA (JIC) standards could be adopted to meet the complex needs of the aerospace industry for hydraulic and pneumatic systems. As a result, although it seemed that only the combination diagram approach would meet these needs, it was recommended, when a cutaway or pictorial diagram was not required, that the graphic symbols of ASA be adopted. This was especially for the selector, check and restrictor valves, together with the proposed European concept of indicating the in-transit position for selector valves (since incorporated in USAS Y32.10, the successor document to ASA, JIC).

In 1966, while developing the hydraulic system for the Galaxie C-5 aircraft, the contractor had tried to utilize the symbols of MIL-STD-17B-2. The desired system complex was, however, of such a magnitude in comparison with other contemporary systems that it was decided to adapt the ASA Y32.10 symbols and use a modified graphic symbol, single line approach. This task resulted in schematics easy to prepare, understand and maintain. They showed how the functioning components are tied together in a system, their operational options and the coding of single lines to describe the function, diameter, etc. to give all essential data. A deviation recommended by the C-5 contractor was the desirability, from a functional standpoint, to distinguish between high and low pressure lines accomplished by the use of light pressure lines and heavy return, or low pressure, lines giving an orientation toward electrical symbology. Although other deviations of a detail nature were made, the success in the use of this symbology resulted in a firm endorsement by the contractor.

In late 1966, the International Organization for Standardization (ISO), through ISO/TC 20, issued for review Draft ISO Recommendation No. 1141 "Graphical Symbols for Aircraft Flow Systems". Committee A-6, requested to review this document by the SAE Aerospace Council as the U.S. National Committee to ISO/TC 20, voted for its disapproval. This review action not only pointed out that there was no existing acceptable standard but also, through ISO, the expressed interest of the international community in such a standard.

In 1968, Committee A-6 formed a study group to investigate various symbol systems in use. This resulted in the recommendation to use USAS Y32.10-1967 as the primary document and ISO/TC 10 Draft Recommendation No. 1219, December 1966, a similar document, as a supporting one for symbol systems suitable for aircraft hydraulic and pneumatic systems. A survey followed which gave general support to these recommendations and this, in turn, was followed by the first draft of a proposed SAE Aerospace Standard (AS) in 1971. For

the latter, reliance was also placed on the C-5 contractor's company standards, made available to the study group, as the first application of this system on a large scale. Although some items of ASA symbology were superseded by the two basic documents, problem areas and outreach beyond their scope were pointed up. Tentative standards of another contractor for a new system were also found useful.

Following release of the second draft of the proposed AS in early 1972, which included recognition of a trend toward single page schematics for large, complex systems, a decision was made to reverse the deviation made by the C-5 contractor and make pressure lines heavy and return lines light. Liaison was established with the National Fluid Power Association (NFPA) which rendered assistance in interpreting certain areas of USAS Y32.10 and also affirmed the importance of ISO Recommendation R 1219, First Edition, April 1970. Changes arising from the foregoing were incorporated in the third draft.

In 1972, the symbols group was expanded and their activities resulted in a fourth draft for Committee A-6 survey, although all sections were not fully completed. This was approved with some changes and the same unfinalized draft was sent to ISO/TC 20, identified as document N 1334, as a preliminary proposal; some TC 20 members offered comments which were received during 1973. To consolidate all the unresolved areas, including those where additional explanation was considered necessary, portions of the document, including the introductory pages, were re-written, symbols redrawn and a considerable number added together with a new section on composite symbols and circuits. This consolidation, represented by a fifth draft, was given limited distribution in early 1974, including ISO/TC 20 as Document N 1434. The final draft, including some further changes and additions was prepared for release as this Aerospace Standard, AS 1290.

PREFACE TO REVISED EDITION

Following release in 1975, the document proceeded through ANSI review and received approval in 1977. Some documentary errors and queries were tabled for resolution in this revised issue.

Also, in this period, it received a significant "baptism of fire" in that the hydraulic system of a large commercial jet transport aircraft was transposed from a pictorial/outline type of schematic to a functional type using AS 1290 symbology (by computer-graphic technique) with the scope of the document found to be basically adequate. Examination of this and several other schematics provided useful data for this revised issue.

Again, in 1976, a new document ISO/TC 20/N 1542 was created as a U.S. Draft Proposal to replace N 1434. This document was essentially identical to AS 1290 but with some editorial corrections and variations.

In 1978, it was revealed to SAE A-6 that U.S. Committee TC 131 would not be updating USAS Y32.10 as had been anticipated, but would be concentrating its effort on ISO 1219, 1st Edition, 1976-08-01. A scrutiny revealed few changes from the previous issue and, therefore, no incentive to eliminate USAS Y32.10 as a basic document for this revised issue, however, this shift of emphasis by U.S. TC 131 would mean consideration of ISO 1219 alternatives.

In view of the foregoing, plus the fact that other discrepancies had been revealed in the first issue, it was decided to consolidate these into a revised update draft. This was processed through SAE A-6 panel survey from which a number of useful comments and corrections were identified. The draft was revised to accommodate these inputs, including the addition of a detail index, some obvious improvements and further ISO 1219 alternatives, the latter document now being integrated into NFPA standards.

In 1980, this draft was submitted to SAE A-6 subcommittee survey and comments also invited from a spokesman for U.S. TC 131 through an established liaison channel. It received approval from the subcommittee with useful comments from some of its members and from the TC 131 spokesman.

This draft was also submitted to a lately formed ISO body, ISO/TC 20/SC 10/WG 5 as an updated version of N 1542 which had been placed under this body's custodianship. At a meeting, however, in view of the

stated preference of the European members for ISO 1219, it was voted to request the U.S. to prepare a list of recommended changes to that document, making it suitable for aircraft use so that this could then be submitted to ISO/TC 10 Committee 131. This task resulted in frustration for the result intended as it highlighted areas of conflict between USAS Y32.10 and ISO 1219 and also the extensive number of aircraft-oriented components identified in AS 1290.

Later in 1980, a new document, ISO/DP 1219/1, was received by SAE A-6 through the U.S. TC 131 contact as a draft version of an ISO 1219 update. Although there was a previous awareness of an impending change, such appeared to be more extensive than anticipated, with the basic symbology being rewritten into a Vol. 1 (ISO/DP 1219/1) and with assembly and circuit symbology into a Vol. 2 (ISO/DP 1219/2). At a follow-on meeting of ISO/TC 20/SC 10B, as the successor body to ISO/TC 20/SC 10/WG 5, the U.S. was requested to substitute ISO/DP 1219/1 for ISO 1219 in the task previously voted on, the European members having also received copies of ISO/DP 1219/1.

In early 1981, this review of ISO/DP 1219/1 was undertaken, confirming a more comprehensive document than ISO 1219 and resolving a number of frustrations but obsoleting some of the ISO 1219 changes already proposed in the revision draft of AS 1290. Also, significnt problems still remained as in the previous review due to the entrenchment of USAS Y32.10 symbology already in use by industry for aircraft components. Coincident with this review was a liaison activity with a member of the German delegation and focusing on ISO/DP 1219/1 and in 1982, a communication was received from the German National Working Group 3.3.1, the counterpart of SAE A-6, outlining their recommendations with respect to alterations to ISO/DP 1219/1 for aircraft suitability. This was also reviewed and responded to.

In view of the long delay incurred by the above activities since the previous survey and the fact that USAS Y32.10 was ANSI Reaffirmed in 1979, it was considered that the best course of action was to integrate such symbology from ISO/DP 1219/1 and the liaison exchanges as were compatible into the SAE A-6 survey draft of AS 1290, with the added recommendation that, since ISO/DP 1219/1 was not a finalized document and ISO/DP 1219/2 not yet formulated, these should be actively studied, when released in their final formats (as ISO 1219/1 and ISO 1219/2) as a long-term preparation for the next update of AS 1290. In this way, the current update revision would represent the best that could be done at this time, as a further step in the on-going standardization process. It was further decided that the U.S. position with respect to ISO/DP 1219/1 would be formulated only after the release of this revised issue of AS 1290.

Accordingly, in 1982, the revised draft was prepared and processed through SAE A-6 survey, receiving approval with a number of comments which were then integrated into final masters for review by the SAE Aerospace Council. Prior to the latter submittal, a special meeting with representatives of U.S. TC 131 Committee was convened by the SAE A-6 liaison representative, at which the then-current status of the various documents involved was reviewed, in particular that few changes to ISO/DP 1219/1 had been proposed and with the general opinion that the current AS 1290 approach was valid and could, in itself, be a position paper to ISO/TC 10 Committee 131. With only minor changes resulting from this meeting, final masters were sent to the Aerospace Council, receiving approval in 1983.

In preparation for release, it was evident that completely new masters would be required for good quality, formalized presentation of graphic symbol standard models. This, in itself, was an extensive task and accomplished with the aid of computer-graphic techniques accompanied by a final editorial review. In 1984, the document then being considered 95% complete in this processing, an Advance Copy was presented at the 13th Plenary Meeting of ISO/TC 20/SC 10 for review by SC 10B/WG 5 and in response to subsequent comments by European members, some significant changes in text were integrated.

Because of the many changes arising from these latter activities, such were incorporated in a Meeting Copy which was given approval by Committee A-6 at Meeting No. 99 in 1985 following which the document was brought to final editorial completion, re-submitted to the SAE Aerospace Council, approved and released in 1986 as AS 1290A.

CONTENTS

1. INTRODUCTION:

1.1 Application: This standard presents a system of graphic symbols intended primarily for usage in fluid power hydraulic and pneumatic system schematic diagrams for aircraft of all types. It is also considered suitable for marine vehicles and other applications and for ancillary documents where schematics are required. Individual graphic symbols shown herein are also considered suitable for use in conjunction with other types of symbols.

1.2 Basic Documents and Scope: A basic document from which these symbols are derived is USAS Y32.10 1967 (R 1979) "Graphic Symbols for Fluid Power Diagrams", published by the American Society of Mechanical Engineers, United Engineering Center, New York, N.Y.

A parallel document is ISO/DP 1219 Part 1 (or DP 1219/1), 2nd Edition, 1980 "Fluid Power Systems and Components - Graphic Symbols", formulated by ISO/TC 10 Committee 131.

From these basic documents, symbols have been selected as being the most suitable to represent items in common usage and as a basis for new units. Recognition is made of the increasing emphasis on ISO standards, however, the technical scope of aircraft systems has required outreach to other standards and in the creation of new symbols where no precedent is evident.

1.3 Types of Symbols Commonly Used (Pictorial, Cutaway, Graphic): Pictorial symbols are useful for showing actual interconnection of components. They are difficult to standardize from a functional standpoint.

Cutaway symbols emphasize construction. They are complex to draw and often the functions are not readily apparent.

Graphic symbols emphasize the function and method of operation. Symbol elements are easy to draw and, in most cases, the function and method of operation are obvious; they differentiate between hydraulic and pneumatic fluid power media and those herein between modular and non-modular components.

Viable standards to cover the wide variation that occurs in functional operation are a matter of continuing development. Nevertheless, current symbology is adequate to facilitate the design, analysis, procurement, fabrication and service of fluid power circuits and components. It also permits rapid alteration of schematic drawings and is capable of crossing language barriers.

1.4 Compatibility: Graphic symbol terminology used herein is compatible with ARP 243B "Nomenclature - Aircraft Hydraulic and Pneumatic Systems" as are port identification abbreviations used to enhance symbol understanding.

1.4 Compatibility: (continued)

Graphic symbols are suitable for single page subcircuit breakdown, especially for complex and extensive systems, similar to that specified for electrical circuits in ATA Specification 100 "Air Transport of America Specifications for Manufacturers Technical Data".

Graphic symbols noted herein are compatible in areas of functional similarity with ARP 993A "Fluidic Technology" and MIL-STD-1306A "Fluerics, Terminology and Symbols".

It is the purpose of this standard to provide, where possible, symbols which are internationally recognized and to promote industry-wide acceptance and understanding of uniform standards. Thus, familiarity with ISO/DP 1219/1 is also encouraged.

2. GENERAL SYMBOL RULES:

2.1 Description and Method:

2.1.1 Elementary forms of symbols are -

Circles	Triangles	Lines
Squares	Arcs	Dots
Rectangles	Arrows	Crosses

2.1.2 Some symbols (such as selector valves) appear as logic configurations, with no resemblance to components, others (such as actuators and accumulators) are shape-oriented for symbolic representation. In all cases, component function is emphasized by the symbol.

2.1.3 Symbols show connections, flow paths, functions and method of operation of the component represented. They can indicate the condition occuring during transition from one flow path to another. They may be rotated or reversed without altering their meaning except in the case of reservoirs or similar as specified. They distinguish between modular and non-modular components, liquid and gaseous fluid media and fluid line functions.

2.1.4 Symbols do not indicate construction, location or identification of ports as on the component, direction of shifting spools or positions of actuators on actual components. They do not indicate values such as pressure, flow rate or other component settings and do not indicate actual liquid levels or system conditions by symbolic instrument needle positions.

2.1.5 External ports are indicated where the flow lines connect to the basic symbol except where a component enclosure symbol is used, in which case the port is at the intersection of the flow line and enclosure. Flow lines shall cross enclosure lines without loops or dots and usually without change in line thickness.

2.1.6 Although some symbols using words are as noted herein, symbols without words or letters predominate to facilitate a symbol system capable of crossing language barriers.

2.1.7 Complete graphic symbols are those which give symbolic representation of the component and all of its features which are pertinent to the circuit diagram. They are often included herein to clarify simplified symbols and to act as models for new variants.

2.1.8 Simplified graphic symbols are stylized versions of complete symbols and are the most frequently used in system schematics.

2.1.9 Composite graphic symbols are an organization of simplified or complete symbols. They usually represent a complex component and may be distinguished by the enclosure as modular or non-modular type.

2.1.10 General graphic symbols are usually simplified symbols where only the basic function is represented and accessory functions are not included, or where controls or loadings are generalized or incomplete. They are useful in circuits where more specified detail is not relevant and maximum flexibility or simplicity is desired such as preliminary diagrams or manuals.

2.1.11 In multiple envelope symbols, the flow condition shown nearest a control (or operator) takes place when that control is caused or permitted to actuate, except in some cases as otherwise noted.

2.1.12 Each symbol is drawn to show the normal, at rest, or neutral condition of the component when the main system is unpressurized, unless otherwise noted. For complete symbols and all selector valves, a control symbol is to be shown for each flow path condition possessed by the component.

2.1.13 Symbol drawings shall be clear and sharp.

2.1.14 The expression "in situ" which appears in the explanation of some symbols means "from the aircraft", i.e., the item may be removed directly from the aircraft without disturbing its associated items in the same enclosure.

2.2 Subcircuits:

2.2.1 Where single page subcircuits are used, electrical practice shall be followed in that the forward end of the aircraft is at the left side of the page for the main supply and return line runs (Ref. ATA 100-2-2). In addition, location of components and lines shall be laid out as to minimize line bends and crossings (without regard to actual relative positions) to promote simplicity and to facilitate functional understanding.

2.3 Nomenclature and Degree of Symbolic Representation:

2.3.1 It is common practice for component nomenclature to express the purpose the component serves in the circuit. Such nomenclature often varies considerably for components serving the same purpose due to local usage conventions. In use for aircraft hydraulic and pneumatic systems, ARP 243B provides the nomenclature for most of the common components referenced herein. In some cases, such may differ from that used in the basic documents.

2.3.2 Functionally identical components often serve more than one purpose in system circuits and, consequently, may have varying nomenclature aligned with that purpose. The symbols, pictorially representing the internal action (i.e., function), will not vary and the only distinguishing difference may be in the external flow lines. There are, however, some significant areas of overlapping symbology where an alternate symbol can represent an internal action. The symbol system herein, where possible, provides such variants to identify with particular nomenclature as an aid in component identification.

2.3.3 Component configuration and function are so widely varied that there is often an inherent problem in the degree that such can, or should be symbolically represented consistent with pictorial simplicity. The symbol system herein has an adequate range of symbols from simplistic general symbols to complex composite symbols to provide the designer with choices to identify the components of the circuit to suit his purpose. Where new symbols are required, or new functional elements added to established symbols, there is also guidance and examples to generate such consistent with the overall concept and symbol rules.

2.4 Symbol Coding:

2.4.1 The purpose of coding symbols or groups of symbols and their descriptions is to identify their origins, as such may be significant where new symbols or changes are considered.

2.4.2 There are three categories of letter codes to identify these origins as external to this document and no code indicating its origin within this document. These may be supplemented by a number identifying a note number in Sec. 11.

The three letter codes are -

Code A, or abbreviated, A - Basic document identified in 1.2 paragraph 1.
Code B, or abbreviated, B - Basic document identified in 1.2 paragraph 2.
Code C, or abbreviated, C - Other standards as noted in Sec. 11

2.4.3 Each symbol, or group of symbols, shown on the left side of each page and the descriptions shown on the right, may each have code letter(s) or number(s) to the standard noted. Thus, it is possible, for instance, to indicate that the graphic portion is compatible with a standard and the symbol description is unique to this AS.

2.4.4 Symbols with Codes A and B in both graphic and descriptive portions represent optimum compatibility with accepted Industry and International Standards.

2.5 Line Thickness and Symbol Envelope Size:

2.5.1 The purpose of varying line thickness is to facilitate identification of components and tubing runs in complex circuits. Enclosure thicknesses are recommended maximums to give the desired degree of emphasis to suit the schematic.

2.5.2 The minimum line thickness, designated as "t" and used primarily for low pressure lines, flow lines within valve envelopes and small valve enclosures, directional arrows, is established at 0.25 mm (0.010 inch) representing an as-drawn schematic. Other types of schematic, or those of special size may have line thickness adjusted proportionally.

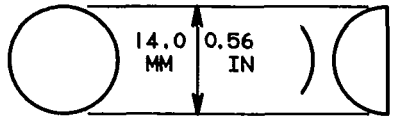
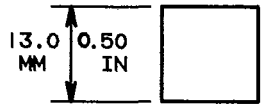
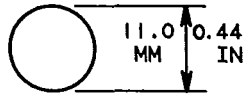
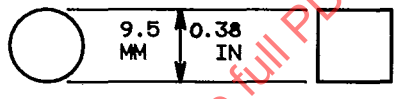
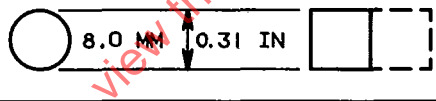
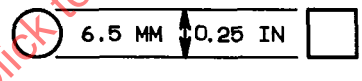
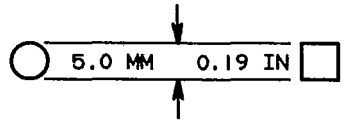
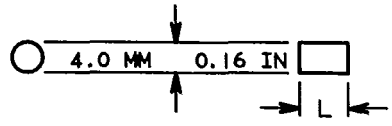
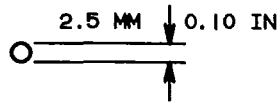
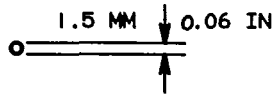
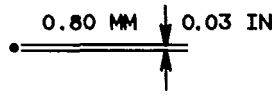
2.5.3 In the sections following on Basic Symbols, the line thickness as a multiple of "t" is designated in the upper right hand portion in the graphic section and the most commonly used line thickness' are -

t = 0.25 mm (0.010 inch) - low pressure lines, etc.
1.5t = 0.4 mm (0.015 inch) - enclosures and envelopes
3t = 0.75 - 0.64 mm (0.030 - 0.025 inch) - high pressure lines

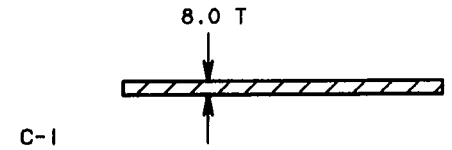
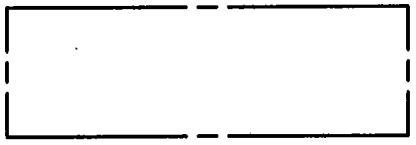
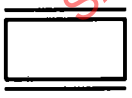
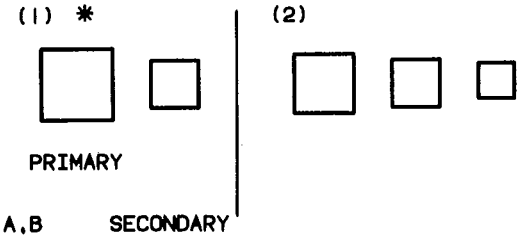
2.5.4 Symbol envelope relative sizes can be used to differentiate various component types to offset symbol uniformity as a general aid in identification, particularly in complex circuits. Although actual sizes are dependent on document type, the sizes following are intended to be consistent with the criteria of 2.5.2.

(Continued on next page).

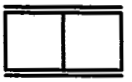
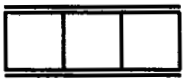
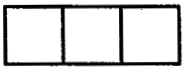
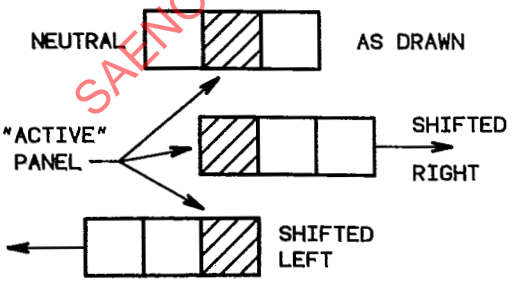
2.5 LINE THICKNESS AND SYMBOL ENVELOPE SIZE (CONT'D)

2.5.4.1	ENERGY CONVERSION, PUMPS, MOTORS, MASTER CYLINDERS (PRIMARY UNITS)		ROTARY ACTUATORS, RESTRICTORS
2.5.4.2			HEAT EXCHANGERS, (COOLERS, HEATERS, TEMPERATURE CONTROLLERS)
2.5.4.3	ELECTRIC MOTORS, AIR TURBINES, AIR RECEIVERS, GENERATORS		
2.5.4.4	SECONDARY PUMPS, MOTORS, REMOVABLE FILTER ELEMENTS, SWIVEL FITTINGS		PRESSURE CONTROL, HEAT ENGINES, FILTERS
2.5.4.5	ELECTRIC MOTORS FOR VALVES, ACCUMULATORS, GAS BOTTLES		CONTROL VALVES, CHECK TYPE VALVES, FLOW REGULATOR VALVES
2.5.4.6	GAUGES, INDICATORS		SECONDARY PRESSURE CONTROLS, PRESSURE, TEMP., ETC. SWITCHES, TRANSDUCERS
2.5.4.7	LINE CHECKS, BY-PASS VALVES, TURBINES AND ENGINES (INNER)		PILOT VALVES, FILTER ACCESSORIES (ALT. 6.5 MM)
2.5.4.8	COMPONENT CHECKS, HANDLES, ROLLERS, DISCONNECTS		OPERATORS - L = 6.5 MM (.25 IN) FOR SOLENOIDS, THERMAL; L = 8.0 MM (.31 IN) FOR PILOTS, DUAL-COIL TORQUEMETERS
2.5.4.9	H.P. LINE JUNCTIONS, SECONDARY DISCONNECTS		
2.5.4.10	L.P. LINE JUNCTIONS, PIVOTS		
2.5.4.11	INSTRUMENT CONTACTS, TEMPERATURE BULBS (MIN), CAPILLARY LINES		

3.1 BOUNDARIES, ENCLOSURES, AND ENVELOPES

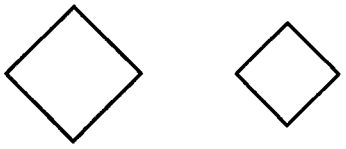
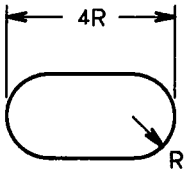
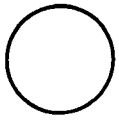
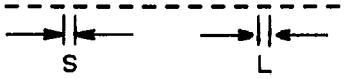
3.1.1		MAJOR DIVISIONAL PARTITION IN AIRCRAFT GENERALLY SEPARATING LARGE GROUPS OF COMPONENTS; I.E., CARGO AREA, WHEEL WELL AREA, ETC. 18
3.1.2		BOUNDARY GROUPING OF COMPONENTS ON A PANEL, DOOR,MAINTENANCE STATION, ETC. 18
3.1.3		ENCLOSURE FOR AN ASSEMBLY. USED TO BORDER A GROUP OF SYMBOLS WHERE THE COMPONENT EXTREMITY IS NOT OBVIOUS BY THE CONNECTING SYMBOLOGY. ELEMENTS ARE NOT REMOVABLE IN SITU. 3,5
3.1.3.1		ENCLOSURE REPRESENTING A MANIFOLD FOR EITHER MODULAR OR BOLT-ON COMPONENTS WHICH ARE REMOVABLE IN SITU. MAY BE USED TO BORDER A MODULAR COMPONENT IN A NON-MODULAR ASSEMBLY. 3,5
3.1.4		ENCLOSURE FOR SMALL VALVE ASSEMBLIES CONSISTING OF MORE THAN ONE FUNCTIONAL ELEMENT AND FOR SOME TYPES OF FLOW CONTROL VALVE.
3.1.5		ENCLOSURE FOR COMMON FLOW CONTROL VALVES.
3.1.5.1		INFINITE POSITIONING DUE TO FLOW CHARACTERISTICS.
3.1.6	1.5 T	ENVELOPES-VALVES
3.1.6.1		SINGLE ENVELOPE (1) INFINITE POSITION FOR CONTROL OF AND OPERATED BY PRESSURE AND MAY HAVE TWO OR THREE FLOW PATH OPTIONS. SEE 3.1.6.4 . (2) USED FOR OTHER TYPES OF VALVES AND COMPONENTS BUT NOT GENERALLY FOR SELECTOR VALVES. 4

3.1 BOUNDARIES, ENCLOSURES, AND ENVELOPES (CONT'D)

3.1.6.2	 A,B	MULTIPLE ENVELOPE TWO POSITIONS EACH ENVELOPE REPRESENTING ONE FINITE FLOW PATH OPTION. COMMONLY APPLICABLE TO SELECTOR VALVES. ELONGATED ENVELOPE APPLICABLE TO MULTIPLE PORT VALVES.
3.1.6.3	 B	MULTIPLE ENVELOPE TWO POSITIONS REPRESENTING TWO FINITE FLOW PATHS WITH AN "IN-TRANSIT" POSITION SPECIFIED IN THE CENTER ELEMENT.
3.1.6.4	 * A	MULTIPLE ENVELOPE VALVE, INFINITE POSITIONING WITH TWO FLOW PATHS; APPLICABLE TO VALVES WHERE THERE IS NO TRANSITION ZONE BETWEEN OPTIONS.
3.1.6.5	 * B	MULTIPLE ENVELOPE VALVE, INFINITE POSITIONING WITH TWO FLOW OPTIONS; APPLICABLE TO THREE OR MORE PORT VALVES WHERE THERE IS A TRANSITION ZONE BETWEEN THE TWO FLOW PATH OPTIONS WHERE ALL PORTS ARE THROTTLED TO CLOSURE EXCEPT FOR LEAKAGE FLOW.
3.1.6.6	 B	AS 3.1.6.5 EXCEPT THAT THE TRANSITION ZONE IS MORE SIGNIFICANT TO SYSTEM OPERATION AND MAY BE CONSIDERED A THIRD FLOW PATH OR NEUTRAL POSITION; COMMONLY APPLICABLE TO SERVO VALVES.
3.1.6.7	 A,B	MULTIPLE ENVELOPE VALVE INDICATING THREE FINITE FLOW PATH OPTIONS; USED FOR SELECTOR VALVES.
3.1.6.8		MULTIPLE ENVELOPE VALVE INDICATING MORE THAN THREE FLOW PATH OPTIONS OR VALVES JOINED TOGETHER WITH ONE SET OF CONTROLS.
3.1.6.9	 A	NOTE: IN ALL THE ABOVE VALVES, THE ENVELOPE IS IMAGINED TO MOVE TO ILLUSTRATE HOW PRESSURE AND FLOW CONDITIONS ARE CONTROLLED AS THE VALVE IS OPERATED. REF CODE A, PARA 10.1 AND 10.2 .

* ENVELOPE 3.1.6.1 (1), USED AS INFINITE POSITIONING IS SIMILAR IN FUNCTION TO 3.1.6.4 AND 3.1.6.5. THESE ALTERNATIVES WIDEN THE SCOPE OF SYMBOLIC REPRESENTATION.

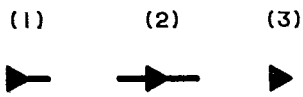
3.1 BOUNDARIES, ENCLOSURES, AND ENVELOPES (CONT'D)

3.1.7	(1) (2)  A,B	ENVELOPE FOR PRIMARY CONDITIONING DEVICES, WHICH CONTROL THE PHYSICAL CHARACTERISTICS OF THE FLUID. (1) HEAT EXCHANGERS. (2) FILTERS AND SEPARATORS.
3.1.8	 B	A NUMBER (OR LETTER) INSIDE AN ENVELOPE OR ENCLOSURE INDICATES THAT FULL DETAILS ARE SHOWN ELSEWHERE. THE GENERAL SYMBOL ⊕ INDICATES THAT DETAILS ARE NOT COMPLETE.
3.1.9	 	AIR RESERVOIRS, ACCUMULATORS, GAS BOTTLES. R - 5.50 MM (0.220 IN) - AIR RESERVOIRS. R - 4.00 MM (0.160 IN) - ACCUMULATORS, GAS BOTTLES.
3.1.10	 A,B	PRIMARY ENVELOPE OF ROTATIVE ENERGY CONVERSION DEVICES (PUMPS AND MOTORS), ALSO HANDPUMPS, MANUAL BRAKE VALVES.
3.1.10.1	 A,B	ENVELOPES FOR AUXILIARY DEVICES, ROTATIVE DEVICES, REPLACEABLE FILTER ELEMENTS, SIMPLIFIED CHECK VALVES, ROLLERS, PIVOTS, ETC.
3.1.10.2	 B	OSCILLATING DEVICES.
3.1.11	 	TRANSITION PORTION OF ENVELOPE. SEE 3.1.6.3 -.4 . FILTER ELEMENT. SEE 5.1.1 . DIMENSIONS S AND L TO SUIT.

3.2 FLUID FLOW LINES - GENERAL

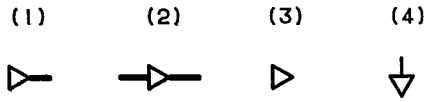
3.2.1 FLOW - SOURCES AND DIRECTION

3.2.1.1



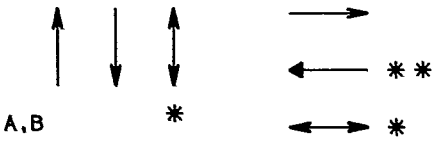
(1) INDICATION OF HYDRAULIC PRESSURE SOURCE.
(2) DIRECTION OF HYDRAULIC FLOW.
(3) INTERNAL HYDRAULIC PILOT VALVE; PUMP OR MOTOR ELEMENT.

3.2.1.2



(1) INDICATION OF PNEUMATIC PRESSURE SOURCE.
(2) DIRECTION OF PNEUMATIC FLOW.
(3) INTERNAL PNEUMATIC PILOT VALVE, PUMP OR MOTOR ELEMENT; GAS PRESSURE.
(4) PNEUMATIC EXHAUST PORT, OR ATMOSPHERIC TERMINATION OF FLUID DRAIN LINE.

3.2.1.3



NORMAL DIRECTION OF FLOW IN LINES OR VALVES.

* FLOW IN EITHER DIRECTION IS POSSIBLE.
* * ALTERNATE ARROW HEAD CONFIGURATION.

4,C-6

3.2.1.4

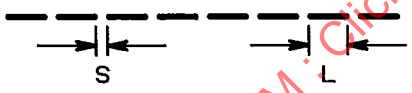
DIRECTION OF FREE FLOW; USUALLY PLACED UNDER A SYMBOL ENVELOPE, TO INDICATE A FREE-FLOW ARROW MARKED ON COMPONENT BODY. 4,C-6

3.2.2 * HIGH PRESSURE (ALL PRESSURE LEVELS HIGHER THAN RETURN PRESSURE)

3.2.2.1

HIGH PRESSURE LINES.

3.2.2.2



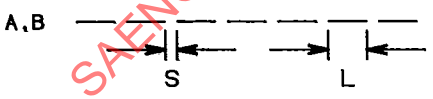
* * HIGH PRESSURE PILOT LINES.

3.2.3 * LOW PRESSURE

3.2.3.1

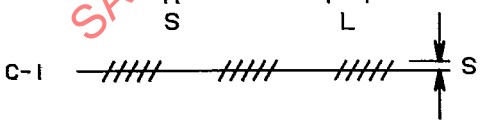
RETURN LINES; ALL FLOW AND DRAIN LINES CONNECTED TO THE RESERVOIR.

3.2.3.2



* * LOW PRESSURE PILOT LINES, AND DRAIN LINES VENTING TO ATMOSPHERE.

3.2.3.3



SUCTION LINES; (LINES CONNECTING THE RESERVOIR TO THE PUMP INLET PORT).

S - 1.25 MM (OR 0.05 IN), APPROXIMATELY.

L - 5.0 MM (OR 0.19 IN), APPROXIMATELY.

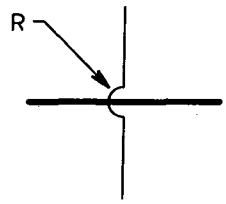
* FOR LINE TERMINATIONS, SEE 2.1.5 . ALSO, 3.2.3.1 (1.0 T) LINES ARE USED WITHIN SMALL VALVE ENCLOSURES (3.1.4, 3.1.5, 3.1.5.1) AND ENVELOPES (3.1.6).

* * IN SOME CASES, PILOT LINES DRAWN AS 3.2.2.1 OR 3.2.3.1 MAY BE DESIRABLE, I.E.; FOR FLUIDIC INTERFACE.

3.2 FLUID FLOW LINES - GENERAL (CONT'D)

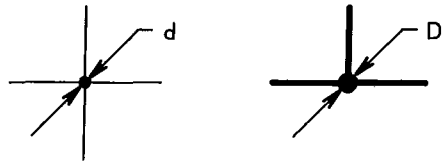
3.2.4 CROSSING/JOINING

3.2.4.1



LINES CROSSING. R - 2.0 MM (OR 0.08 IN.) 7

3.2.4.2

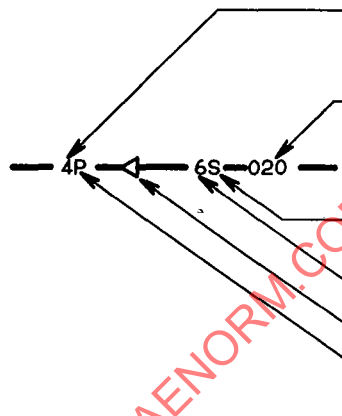


LINES JOINING. d - 1.5 MM (OR 0.06 IN)
D - 2.5 MM (OR 0.10 IN)

A,B,C-1

D AND d MAY BE REDUCED WITHIN ENCLOSURES.

3.2.5 LINE CODING



FLUID SYSTEM NO. 1,2,3,4, ETC. (OR A,B,C,D, ETC.)

TUBE WALL THICKNESS IN MM, OR IN THOUSANDTHS-OF-AN-INCH (AS SHOWN)

TUBE MATERIAL - A - ALUMINUM ALLOY
S - STEEL (CORROSION RESISTING)
T - TITANIUM

TUBE OUTSIDE DIAMETER IN MM OR ST'D TUBE SIZE (AS SHOWN)

PRIMARY FLOW DIRECTION AND FLUID (GAS OR LIQUID)

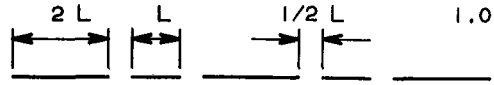
LINE FUNCTION

P - PRESSURE R - RETURN S - SUCTION ETC.

OTHER LINES (UP, DOWN, ETC.) MAY BE DESIGNATED AS REQUIRED. 18

C-1,C-2

3.2.6

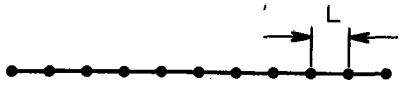


L - SEE 3.2.2.2

FUEL LINE, TO COMPLETE OIL-FUEL HEAT EXCHANGER SYMBOL WHERE NO OTHER FUEL LINE STANDARD EXISTS. 18

C-1

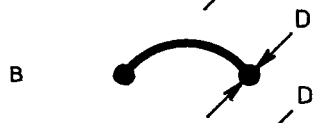
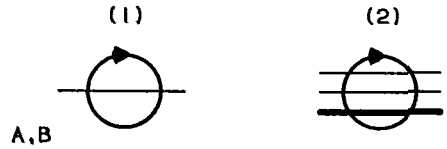
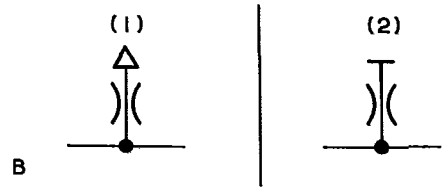
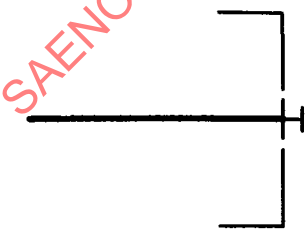
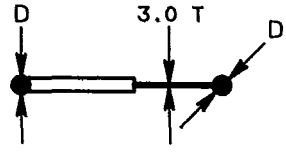
3.2.7



L - SEE 3.2.2.2

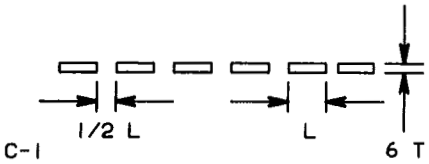
CAPILLARY LINE. 18

3.3 CONNECTIONS, FLEXIBLE LINES

3.3.1		1.5 T	FLEXIBLE LINE (GENERAL SYMBOL). d - SEE 3.2.4.2
3.3.1.1		4.0 T	FLEXIBLE HOSE. D - SEE 3.2.4.2 18
3.3.1.2		3.0 T	COILED TUBING, OR TUBING DESIGNED FOR TORSION OR FLEXURE.
3.3.2			ROTARY OR SWIVEL CONNECTOR, OR JOINT (1) SINGLE FLOW LINE. (2) MORE THAN ONE FLOW LINE REPRESENTS CONCENTRIC, BUT SEPARATE, FLOW PATHS IN ROTARY CONNECTOR. A,B
3.3.3			BLEEDER FITTING - (1) CONTINUOUS (2) TEMPORARY B
3.3.4			JOINTS
3.3.4.1			PERMANENT JOINT } NEED ONLY BE SHOWN AT IMPORTANT POINTS.
3.3.4.2			RECONNECTABLE JOINT } NEED ONLY BE SHOWN AT IMPORTANT POINTS.
	C-2		
3.3.4.3			PLUGGED PORT, FILL PORT, PRESSURE CAP, DUST CAP.
3.3.4.4	B 		CAPPED LINE
3.3.5			EXTENSION FITTING SIMPLIFIED SYMBOL. (PRESSURE AND VOLUME BALANCED). D - SEE 3.2.4.2

3.4 MECHANICAL, ELECTRICAL AND FUNCTIONAL

3.4.1



MECHANICAL LINKAGE.

DIMENSION L AS IN 3.2.2.2 .

18

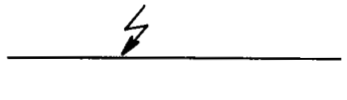
3.4.2

SHAFT OR PISTON ROD.

USE SINGLE LINE FOR VALVE SHAFTS.

9

3.4.3



ELECTRICAL LINE.

B

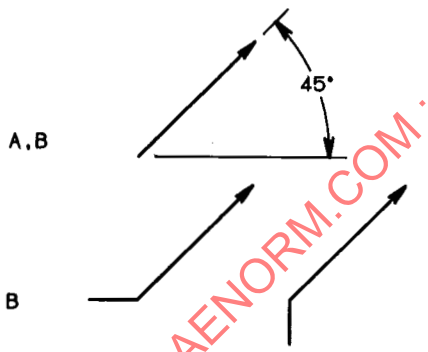
3.4.4

DIRECTION OF ROTATION.

FOR SHAFTS, THE ARROW IS CONSIDERED TO BE ON THE NEAR SIDE.

A,B

3.4.5



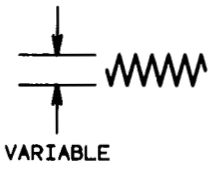
FACILITY FOR VARIABLE CONTROL OF PUMP, SPRING, SOLENOID, ETC. GENERAL SYMBOL.

THE ARROW MAY BE BENT, AS SHOWN, TO ADD THE METHOD OF VARIABILITY. B

FOR AIRCRAFT APPLICATIONS, THE MOST LIKELY COMMON USAGE IS IN THE SYMBOL FOR A VARIABLE DELIVERY PUMP, WHERE THE ADDED PRESSURE COMPENSATION SYMBOL INDICATES AUTOMATIC VARIATION BETWEEN WIDE LIMITS OF FLOW WITH A NARROW VARIATION IN PRESSURE. 4,8

ADJUSTABILITY FOR FACTORY SETTING OF RELIEF VALVES, ETC., IS NOT SYMBOLIZED.

3.4.6



SPRING USED AS A MECHANICAL LINK, CYLINDER INTERNAL RETURN SPRING, ETC.

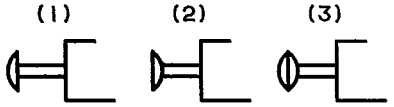
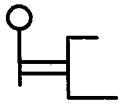
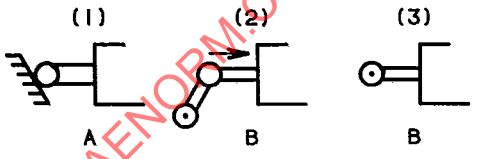
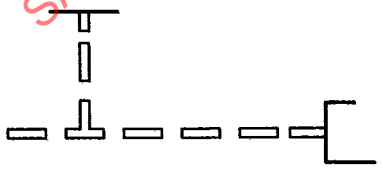
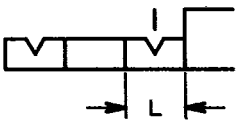
3.4.7

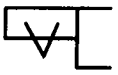
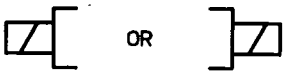
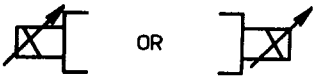
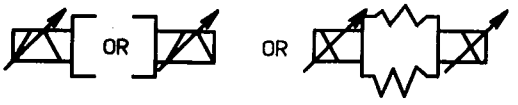
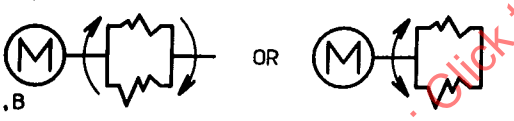
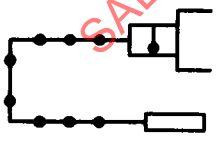
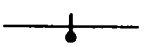
PIVOTING DEVICE WITH FIXED FULCRUM. GROUND OR EARTHING POINT.

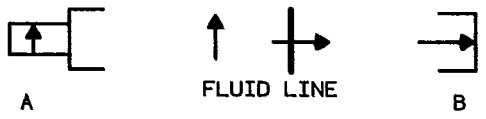
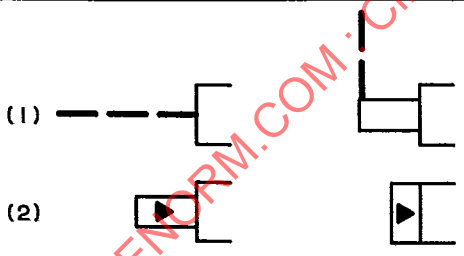
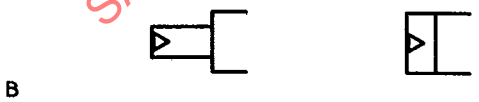
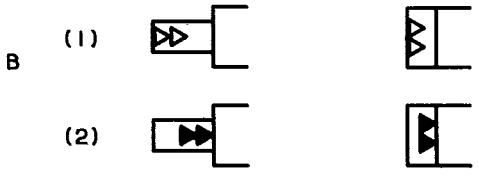
TO INDICATE, IN MOVING BODY COMPONENTS, WHICH PART IS FIXED TO STRUCTURE.

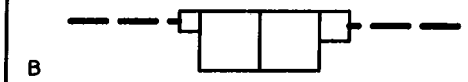
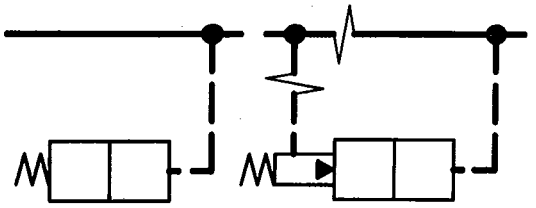
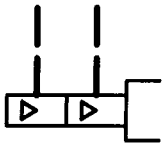
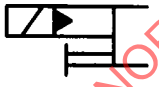
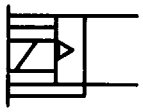
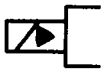
3.4.8

PRESSURE COMPENSATION, GAUGE NEEDLE, OR TRANSDUCER ARM.

3.5	CONTROLS	ALL 1.5 T, EXCEPT AS NOTED.
3.5.1		MECHANICAL OR MUSCULAR (MANUAL)
3.5.1.1		SPRING FOR VALVE CONTROL.
3.5.1.2	 B	MANUAL CONTROL - GENERAL SYMBOL. B
3.5.1.3	 B	(1) PUSH BUTTON. (2) PULL BUTTON. (3) PUSH-PULL BUTTON. B
3.5.1.4	 B	LEVER. B
3.5.1.5		(1) PEDAL. (2) TREADLE.
3.5.1.6		(1) MECHANICAL - GENERAL SYMBOL. (2) PLUNGER.
3.5.1.7		(1) MECHANICAL - ROLLER. (2) MECHANICAL - ROLLER - ONE DIRECTION. (3) MECHANICAL - ROLLER - TWO DIRECTIONS.
3.5.1.8	 1.0 T	REMOTE MANUAL OR MECHANICAL, OR A MECHANICAL RELATIONSHIP BETWEEN UNITS OR ELEMENTS. (SEE 3.4.1) 18
3.5.1.9	 A,B	DETENT. SHOW A NOTCH FOR EACH DETENT IN THE ACTUAL COMPONENT BEING SYMBOLIZED. A SHORT LINE INDICATES WHICH DETENT IS IN USE. DETENT MAY, FOR CONVENIENCE, BE POSITIONED ON EITHER END OF SYMBOL. NOTCH USED IN ACTUATORS INDICATES AN INTERNAL LOCK. L = 5.0 MM (0.19 IN) TO 8.0 MM (0.31 IN)

3.5	CONTROLS (CONT'D)	
3.5.1		MECHANICAL OR MUSCULAR (CONT'D)
3.5.1.10	 B	PREVENTS STOPPING IN DEAD CENTER. B
3.5.2		ELECTRICAL
3.5.2.1	 A,B	SOLENOID, SINGLE WINDING, FINITE CURRENT INPUT A,B
3.5.2.2		TORQUEMOTOR, SINGLE COIL - VARIABLE CURRENT INPUT
3.5.2.3		TORQUEMOTOR, DUAL COIL.
3.5.2.4	 A,B	REVERSING MOTOR A,B
3.5.3		TEMPERATURE
3.5.3.1	 A B	TEMPERATURE (OR THERMAL) - LOCAL SENSING
3.5.3.2		REMOTE SENSING 18
3.5.3.3	FLUID LINE  A,B	TEMPERATURE COMPENSATED (WHEN APPEARING WITHIN A COMPONENT ENCLOSURE)
3.5.4		BLANK
3.5.5		BLANK

3.5	CONTROLS (CONT'D)	
3.5.6	SEE NOTE •	PRESSURE (SEE ALSO 8.6.1.2 AND 8.6.1.3)
3.5.6.1		(1) PRESSURE COMPENSATED (COMPLETE SYMBOL). (2) AS (1) (SIMPLIFIED SYMBOL WITHIN COMPONENT ENCLOSURE). (3) ALTERNATE FOR FLOW REGULATORS (CODE B).
3.5.6.2	PILOT OPERATION: THE TERM "PILOT" CAN MEAN - (1) A VALVE SPOOL END AS A PISTON FOR SHIFTING THE SPOOL (NOT USUALLY SYMBOLIZED; SEE 3.1.6.9). (2) A SEPARATE PISTON MECHANICALLY CONNECTED TO A SPOOL, CHECK, POPPET, ETC; SLAVE UNIT. (3) A MINIATURE 2-, 3-, OR 4-PORT VALVE USED TO DIRECT PRESSURE TO THE SPOOL END(S) OF THE MAIN SELECTOR VALVE. (SEE 8.1.6.1, 8.2.1.1, 8.2.2.1 FOR COMPLETE SYMBOLS). (4) A MINIATURE SPRING-LOADED POPPET ACTING AS A PRESSURE LIMITER TO CREATE A PRESSURE UNBALANCE FOR UNSEATING A MAIN POPPET. (5) A FLAPPER-NOZZLE OR SIMILAR PORTION OF THE FIRST STAGE OF AN ELECTROHYDRAULIC SERVOVALVE.	
3.5.6.3	THE TERM "DIFFERENTIAL PILOT" CAN MEAN - (1) AN UNEQUAL AREA PISTON MECHANICALLY CONNECTED TO A SPOOL, POPPET, ETC., WITH CONSTANT PRESSURE ON THE SMALLER. (2) A SENSING PISTON OF GREATER AREA THAN AND MECHANICALLY IN SERIES WITH A PILOT POPPET AS 3.5.6.2 (4) BUT PROVIDING A WIDER DIFFERENTIAL BETWEEN OPENING AND CLOSING.	
3.5.6.4		(1) OPERATED FROM ONE REMOTE PRESSURE SOURCE, OR FROM ELSEWHERE WITHIN THE COMPONENT. (2) TERMINATION OF (1) FOR TWO PILOTS IN SERIES (AS 3.5.8.1). GENERAL PILOT SYMBOL WHERE DIRECTION OF PRESSURE IS UNSPECIFIED.
3.5.6.5		PILOT SUPPLIED INTERNALLY, OPERATED BY PRESSURE APPLICATION WHEN ACTIVATED BY ANOTHER CONTROL. APPLICABLE TO 3.5.6.2 (2), AND WHEN NORMALLY CLOSED (3).
3.5.6.6		PILOT SUPPLIED INTERNALLY, OPERATED BY PRESSURE RELEASE WHEN ACTIVATED BY ANOTHER CONTROL. APPLICABLE TO 3.5.6.2 (2), AND WHEN NORMALLY OPEN, -(3).
3.5.6.7		(1) OPERATING IN TWO SUCCESSIVE PILOT PRESSURE APPLICATION STAGES (ONE PILOT CAUSES SECOND PILOT OPERATION). (2) OPERATING IN TWO SUCCESSIVE PILOT PRESSURE RELEASE OR LIMIT STAGES. APPLICABLE AS 3.5.6.6, WITH 3.5.6.2 (2) WHERE THE LATTER IS FOR SPOOL CENTERING OR TO 3.5.6.3 (2).

3.5	CONTROLS (CONT'D)	
3.5.6	SEE NOTE •	PRESSURE (CONT'D)
3.5.6.8	 B	DIFFERENTIAL PILOT. APPLICABLE TO 3.5.6.3 (1) AND SIMILAR.
3.5.6.9	 (1) (2)	DIRECT PILOT AND COMPOUND PILOT OPERATION. IN BOTH (1) AND (2), WHEN PRESSURE EXCEEDS SPRING FORCE, R.H. PANEL OPERATES. (2) APPLICABLE TO 3.5.6.2 (4) (PRESSURE LIMITER).
3.5.7		FOR NEW SYMBOLS OR FOR SPECIAL EMPHASIS, WRITTEN CONTROL OPTIONAL.
3.5.8	SEE NOTE •	COMPOSITE CONTROLS (AND, OR, AND/OR)
3.5.8.1	 A	AND; ONE SIGNAL, AND A SECOND SIGNAL, BOTH CAUSE THE DEVICE TO OPERATE. A
3.5.8.2	 A,B	OR; ONE SIGNAL, OR THE OTHER SIGNAL, CAUSE THE DEVICE TO OPERATE. A
3.5.8.3	 A,B	AND/OR; THE SOLENOID AND THE PILOT, OR THE MANUAL OVERRIDE ALONE, CAUSE THE DEVICE TO OPERATE. A
3.5.8.4		AND/OR; THE SOLENOID AND THE PILOTS, OR THE MAMUAL OVERRIDE AND THE PILOTS, CAUSE THE DEVICE TO OPERATE (PRESSURE CENTERED).
3.5.8.5	 A,B	AND/OR; THE SOLENOID AND THE PILOT, OR THE MANUAL OVERRIDE AND THE PILOT, OR A MANUAL OVERRIDE ALONE, CAUSE THE DEVICE TO OPERATE. A
3.5.8.6		AND; GENERAL SYMBOL FOR SOLENOID-OPERATED PILOT (3.5.2.1 INTEGRATED WITH 3.5.6.4 (2)).

NOTE • FOR ALL EXAMPLES SHOWN, THE ▶ (HYDRAULIC) OR ▷ (PNEUMATIC) PILOT ELEMENTS WERE RANDOMLY SELECTED, AND ARE INTERCHANGEABLE WITHIN THE CONTROL SYMBOL.

SEE 3.2.3.1(3) AND 3.2.3.2(3) .

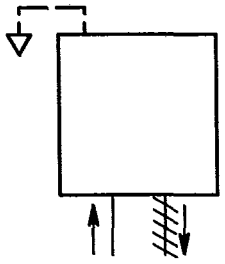
4.1 RESERVOIRS

THE FOLLOWING ARE BASIC SYMBOLS FOR VARIOUS TYPES OF RESERVOIRS SHOWING THE ESSENTIAL FEATURES. THE BASIC CONNECTING LINES ARE AS SHOWN: HOWEVER, OTHER ITEMS SUCH AS LEVEL INDICATORS, RELIEF VALVES,DRAIN VALVES, FILLER CAPS, BLEED VALVES, ETC., MAY BE ADDED AS APPLICABLE. OTHER TYPES AND VARIANTS SHALL SHOW SIMILAR SYMBOLS, COMPATIBLE WITH THE DESIGN.

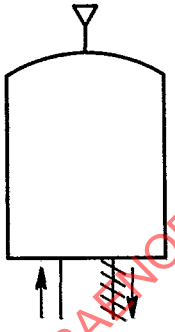
ON INSTALLATION SCHEMATICS, RESERVOIRS SHALL BE ORIENTED AS IN THE AIRCRAFT.

ALL ENVELOPES 1.5 T.

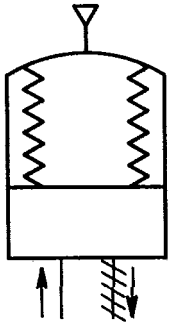
4.1.1 RESERVOIR OPEN TO ATMOSPHERE



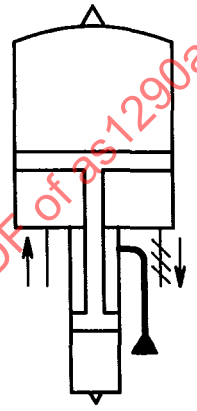
4.1.2 PRESSURIZED (AIR-OIL INTERFACE)



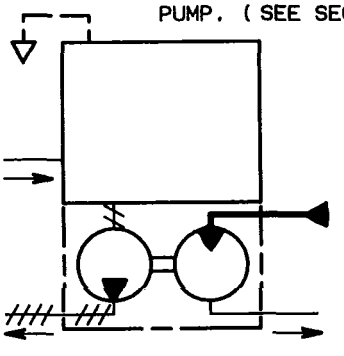
4.1.3 BELLOWS TYPE (AIR AND OIL SEPARATED)



4.1.4 PRESSURE OPERATED (OR BOOTSTRAP TYPE) RESERVOIR



4.1.5 OPEN RESERVOIR WITH ATTACHED HYDRAULIC MOTOR-DRIVEN BOOSTER PUMP. (SEE SEC. 7)



4.1.6 OPEN RESERVOIR - GENERAL SYMBOL

OVERFLOW RESERVOIR, OR RESERVOIR IN A COMPONENT.

NOTE: SYMBOL FOR RESERVOIR ANALOGOUS TO AN ELECTRICAL GROUND SYMBOL IS NOT APPLICABLE TO AIRCRAFT APPLICATIONS FOR LINES RETURNING TO A MAIN RESERVOIR. (SEE 3.2.3.1, 8.6.2). (REF. ITEM 4.1.2 OF CODE A).

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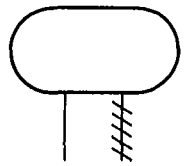
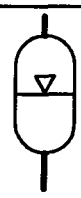
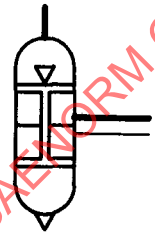
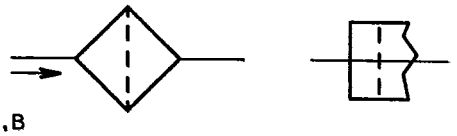
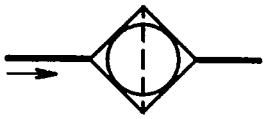
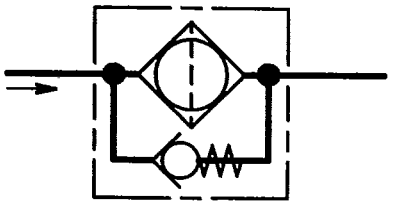
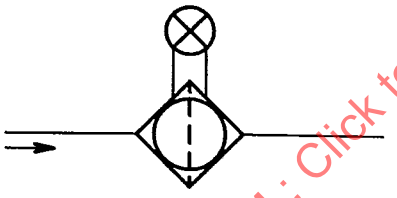
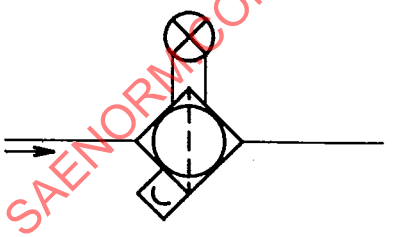
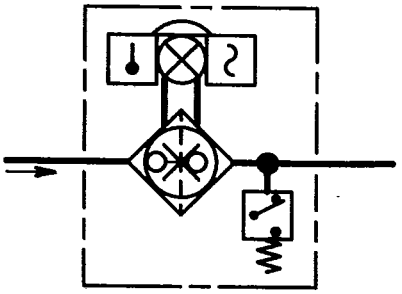
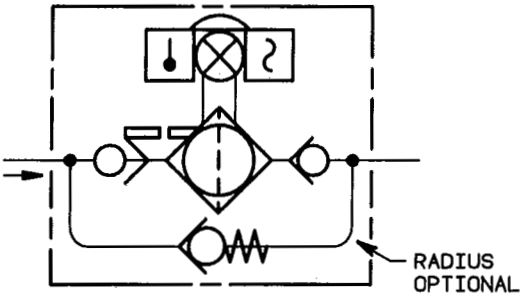
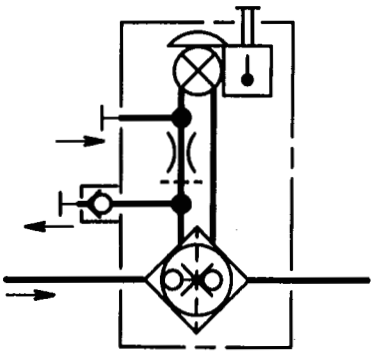
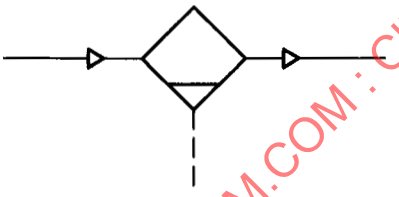
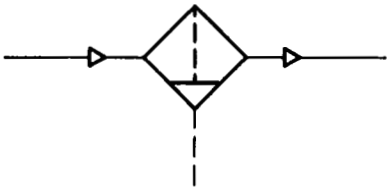
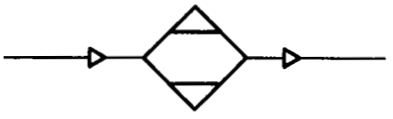
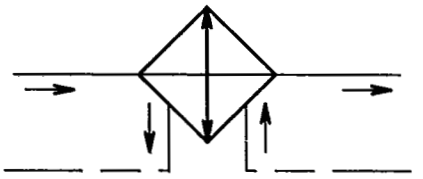
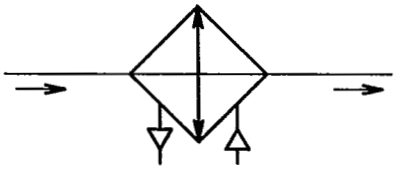
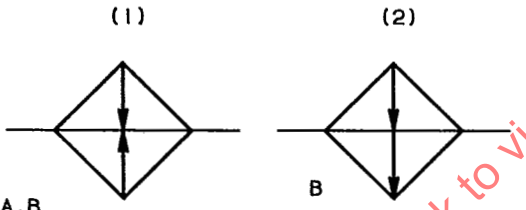
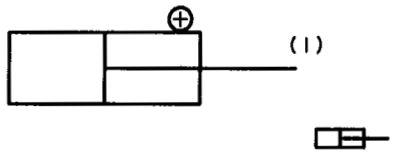
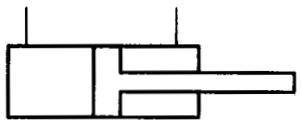
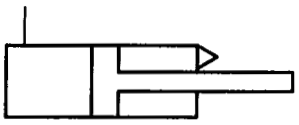
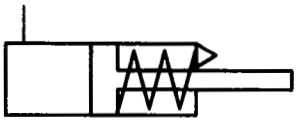
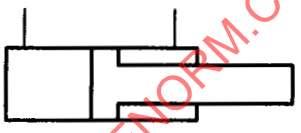
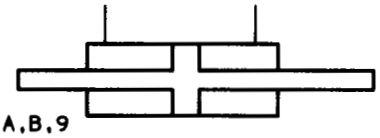
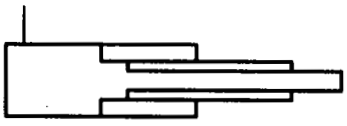
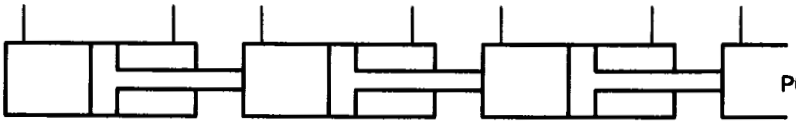
4.1	RESERVOIRS (CONT'D)	ALL 1.5 T .
4.1.7	 B	PRESSURIZED RESERVOIR - GENERAL SYMBOL SHOW IN HORIZONTAL POSITION. ENVELOPE PER 2.5.4.3 AND 3.1.9 . B
4.1.8	 A,B	AIR RECEIVER FOR PNEUMATIC SYSTEMS. SHOW IN HORIZONTAL POSITION. ENVELOPE PER 2.5.4.3 AND 3.1.9 . B
4.2	ACCUMULATORS	ALL 1.5 T . ENVELOPE PER 2.5.4.5 AND 3.1.9, EXCEPT AS NOTED.
4.2.1	 A,B	ACCUMULATOR - GENERAL SYMBOL WITHOUT INDICATION OF ENERGIZING DEVICE.
4.2.2	 A,B	ACCUMULATOR, HYDRO-PNEUMATIC THE SYMBOL APPLIES TO BOTH FLEXIBLE DIAPHRAGM (USUALLY SPHERICAL) TYPES, AND TO PISTON (CYLINDRICAL) TYPES.
4.2.3		ACCUMULATOR, COMPENSATING (SELF-DISPLACING ACCUMULATOR, OR RETURN-FLOW ACCUMULATOR) AN EQUAL VOLUME OF OIL IS DISPLACED IN THE LOW PRESSURE (LOWER) OIL CHAMBER, TO THAT DISPLACED IN THE HIGH PRESSURE (UPPER) OIL CHAMBER. THE LOWEST CHAMBER (BENEATH THE LOW PRESSURE OIL CHAMBER) IS VENTED TO ATMOSPHERE. NON-STANDARD ENVELOPE.
4.2.4	 A.B	SPRING ENERGIZED ACCUMULATOR FOR APPLICATION, SEE 10.2 .
4.3	 B	BOTTLE, GAS STORAGE THE SYMBOL APPLIES TO BOTH SPHERICAL AND CYLINDRICAL TYPES. APPLICATION: EMERGENCY GAS BOTTLE, OR AUXILIARY GAS BOTTLE FOR ACCUMULATOR.

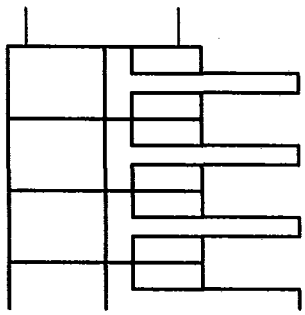
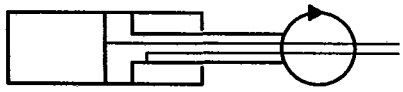
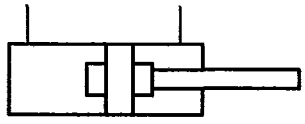
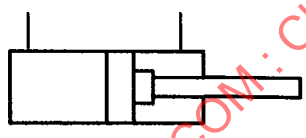
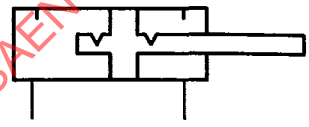
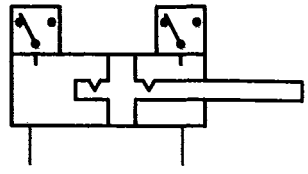
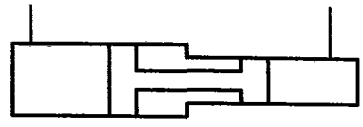
5.1	FILTERS	ENVELOPE - 2.5.4.4, 3.1.7, AND 9.13 .
5.1.1	(1) (2)  A,B	(1) FILTER OR SCREEN, WITH ELEMENT NOT REMOVABLE IN SITU OR WHERE THIS IS NOT SIGNIFICANT TO CIRCUIT FUNCTION. MAY BE USED AS GENERAL SYMBOL (SEE 3.1.8). (2) SIMPLIFIED SYMBOL FOR SCREEN IN RESTRICTOR VALVES, ETC.
5.1.2		FILTER, WITH ELEMENT REMOVABLE IN SITU, REGARDLESS OF ENCLOSURE TYPE.
5.1.3		FILTER, WITH REMOVABLE ELEMENT AND WITH BY-PASS. PER MIL-F-5504, LINE-TYPE, AS SHOWN. SEE 8.6.2.2 (B) . C-14
5.1.4		FILTER, WITH REMOVABLE ELEMENT AND WITH ΔP INDICATOR. C-14
5.1.4.1		AS 5.1.4, WITH ADDED CHIP DETECTOR.
5.1.5		FILTER, WITH REMOVABLE ELEMENT, WITH AUTOMATIC LINE SHUT-OFF ON BOWL REMOVAL, WITH ΔP INDICATOR HAVING THERMAL LOCKOUT, SURGE ARRESTOR, MANUAL RE-SET BUTTON, AND WITH INTEGRAL PRESSURE SWITCH.

5.1	FILTERS (CONT'D)	
5.1.6		FILTER, WITH REMOVABLE ELEMENT, WITH AUTOMATIC LINE SHUT-OFF ON BOWL REMOVAL (SHOWN AS COMPLETE SYMBOL, AS ALTERNATIVE TO 9.13.5), WITH BY-PASS RELIEF VALVE, AND WITH ΔP INDICATOR HAVING THERMAL LOCKOUT, SURGE ARRESTOR, AND MANUAL RESET BUTTON. PER MIL-F-8815 STYLE A, AS SHOWN.
5.1.7		FILTER, WITH REMOVABLE ELEMENT, WITH AUTOMATIC LINE SHUT-OFF ON BOWL REMOVAL, WITH ΔP INDICATOR HAVING MANUAL RE-SET BUTTON AND THERMAL LOCKOUT HAVING MANUAL OVERRIDE, WITH IN SITU FUNCTIONAL TEST PORT (SHOWN NORMALLY PLUGGED), AND WITH SAMPLING PORT (SHOWN NORMALLY PLUGGED).
5.2.	WATER SEPARATORS AND FILTER-SEPARATORS	
5.2.1		WATER SEPARATOR WITH MANUAL DRAIN. A,B
5.2.2		WATER SEPARATOR WITH AUTOMATIC DRAIN. A,B
5.2.3		FILTER-SEPARATOR WITH MANUAL DRAIN. FOR AUTOMATIC DRAIN, SEE 5.2.2 . A,B
5.2.4		CHEMICAL DRIER. A,B

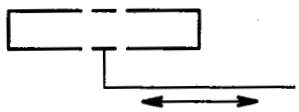
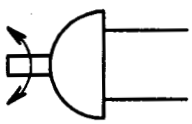
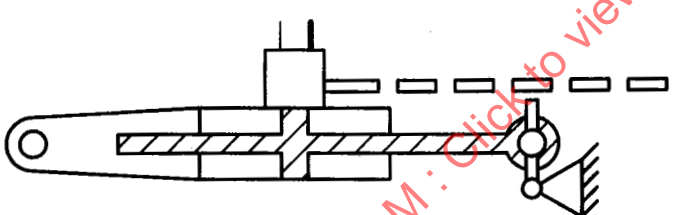
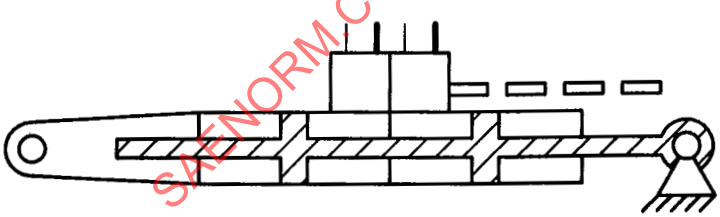
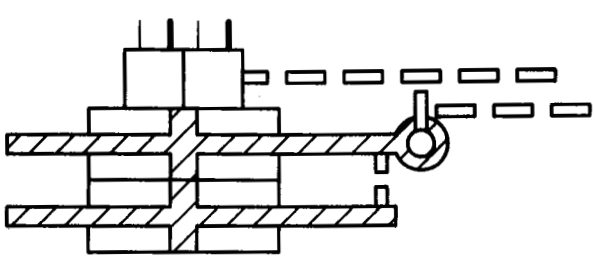
5.3	HEAT EXCHANGERS	THESE ARE DRAWN WITH A LARGER ENVELOPE THAN FOR FILTERS, AS AN AID IN IDENTIFICATION. (SEE 2.5.4.2 AND 3.1.7)
5.3.1	 A,B	HYDRAULIC FLUID-TO-FUEL HEAT EXCHANGER. (REFERRED TO, IN CODES A AND B, AS "COOLER") OUTSIDE LINES INDICATE LIQUID COOLING MEDIUM SEE 3.2.6 .
5.3.2	 A,B	HYDRAULIC FLUID-TO-AIR HEAT EXCHANGER. (REFERRED TO IN CODES A AND B AS "COOLER") OUTSIDE TRIANGLES INDICATE THAT AIR IS THE COOLING MEDIUM.
5.3.3		UNITS REPRESENTED ARE (1) HEATERS, AND (2) TEMPERATURE CONTROLLERS. ALTHOUGH NOT COMMON IN AIRCRAFT CIRCUITS, UNITS ARE INCLUDED FOR SYMBOLIC REPRESENTATION OF HEAT INFLOW AND OUTFLOW. EXTERNAL MEDIA NOT SHOWN.

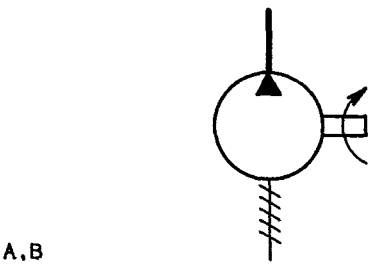
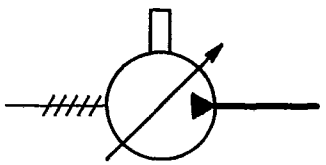
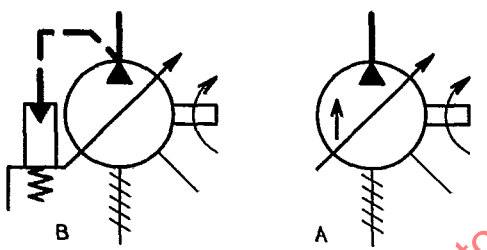
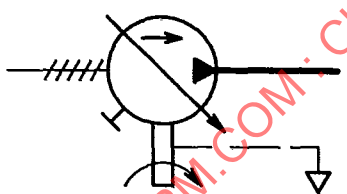
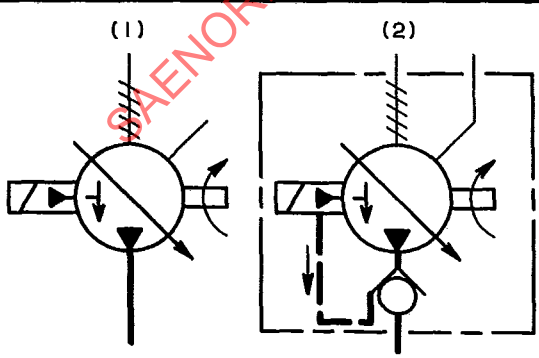
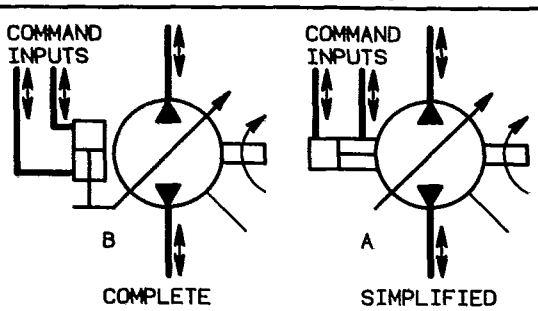
THE ACTUATING CYLINDERS SHOWN ARE SOME TYPICAL VARIANTS AND ARE NOT INTENDED AS A COMPLETE REFERENCE. (SEE NOTE 9, SEC.11)
ALL FLUID LINES ARE LOW PRESSURE TO DEMONSTRATE POSITION ONLY.

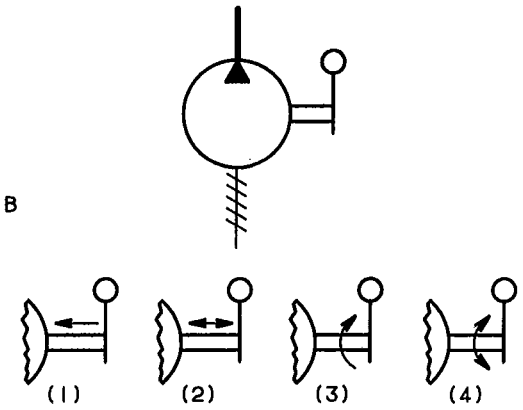
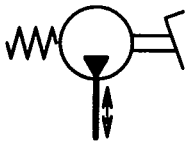
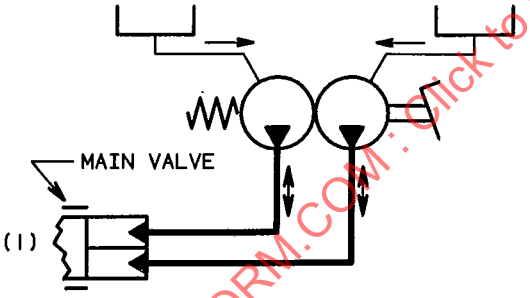
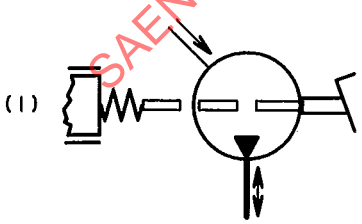
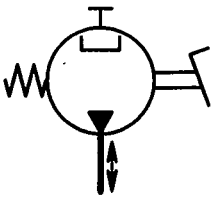
6.1	LINEAR ACTUATORS (CYLINDERS).	ALL 1.5 T.
6.1.0	 A,B,9	(1) ACTUATING CYLINDERS GENERAL SYMBOL FOR USE IN PRELIMINARY CIRCUITS; ⊕ OPTIONAL. (2) SMALL CYLINDERS AS COMPONENT ELEMENTS. NOTE: BOTH ABOVE ARE EXCEPTIONS TO NOTE 9. 17
6.1.1	 A,B,9	DOUBLE ACTING.
6.1.2	 A,B,9	SINGLE ACTING. ALTERNATIVELY, PRESSURE MAY ENTER AT ROD END WITH HEAD END VENTED.
6.1.3	 A,B,9	SINGLE ACTING WITH SPRING RETURN.
6.1.4	 A	DIAMETER OF ROD COMPARED TO DIAMETER OF BORE IS SIGNIFICANT TO CIRCUIT FUNCTION.
6.1.5	 A,B,9	DOUBLE ENDED. PISTON RODS MAY BE EQUAL (SHOWN) OR UNEQUAL DIAMETERS. 4
6.1.6	 B	TELESCOPIC CYLINDER-SINGLE ACTING.
6.1.7	 A	POSITIONING CYLINDERS

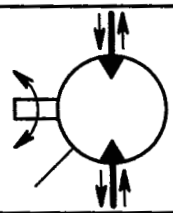
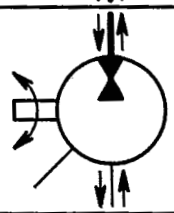
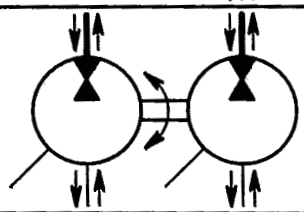
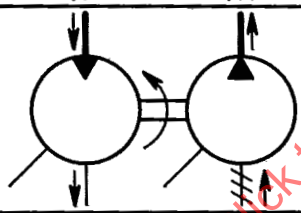
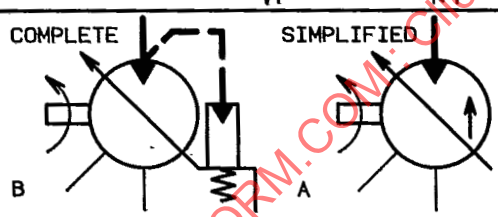
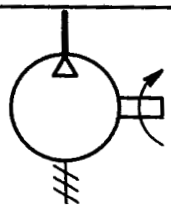
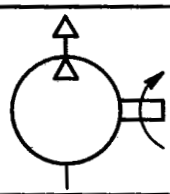
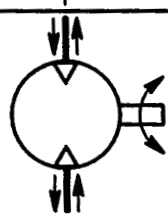
6.1	LINEAR ACTUATORS (CYLINDERS). (CONT'D).	
6.1.8		SIDE-BY-SIDE CYLINDERS WITH COMMON BODY AT PORTINGS.
6.1.9		SWIVEL-END CYLINDER, DOUBLE PORT SWIVEL AT ROD END.
6.1.10	 A,B,9	CYLINDER WITH DASHPOT (CUSHION) AT BOTH ENDS. A,B
6.1.11	 A,B,9	CYLINDER WITH DASHPOT (CUSHION) AT ONE END. ROD END SHOWN. A,B
6.1.12		CYLINDER WITH LOCKS AT HEAD AND ROD ENDS. GENERAL LOCK SYMBOL. SYMBOL APPLIES TO EITHER PISTON OR COLLET (ROD) TYPE LOCKS.
6.1.13		CYLINDER WITH LOCKS AND LOCK INDICATORS AT HEAD AND ROD ENDS. (INDICATOR DETAILED IN SEC. 9).
6.1.14	 A,B,9	PRESSURE INTENSIFIER.

6.1 LINEAR ACTUATORS (CYLINDERS) (CONT'D)

6.1.15		BRAKE ACTUATOR SIMPLIFIED SYMBOL.
6.2	OTHER-THAN-LINEAR ACTUATORS	
6.2.1		ROTARY OR OSCILLATING ACTUATOR
6.3	FLIGHT CONTROL CYLINDERS FLIGHT CONTROL CYLINDERS ARE MADE DISTINCTIVE BY CROSS-HATCHING OF CYLINDER ROD AND PISTON, INCLUSION OF END BEARINGS, AND USUALLY HAVING ATTACHED VALVE (DETAILED IN SEC. 8) AS AN ACTUATOR PACKAGE. GROUND-POINT SYMBOL SHOWS ATTACHMENT TO FIXED STRUCTURE FOR MOVING-BODY CYLINDERS. MECHANICAL LINKAGES ARE STYLIZED REPRESENTATIONS OF USUALLY COMPLEX SYSTEMS.	
6.3.1		MOVING BODY BOOST ACTUATOR GROUND POINT, CONNECTED TO INPUT, PROVIDES PROPORTIONAL-LOAD FEEDBACK.
6.3.2		MOVING BODY, FULL POWER, TANDEM ACTUATOR
6.3.3		FIXED BODY, FULL POWER, SIDE-BY-SIDE, DUAL ACTUATOR

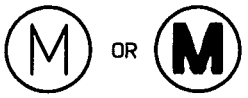
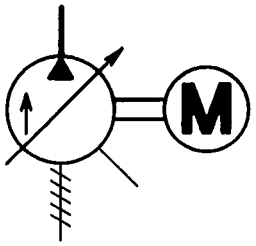
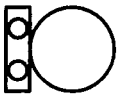
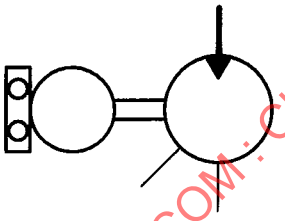
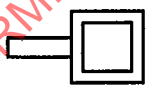
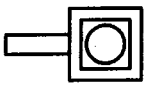
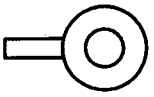
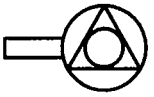
7.1	PUMPS - HYDRAULIC	THE INTERNAL TRIANGLE(S) POINT OUTWARD.
7.1.1		PUMPS - HYDRAULIC - POWER DRIVEN
7.1.1.1	 A,B	FIXED-DISPLACEMENT PUMP, WITH ONE DIRECTION OF FLOW, AND WITH CASE DRAIN INTERNALLY CONNECTED TO PUMP INLET ENVELOPE 2.5.4.1 (TYPICAL).
7.1.1.2	 B	GENERAL SYMBOL FOR VARIABLE-DISPLACEMENT PUMP, WITH ONE DIRECTION OF FLOW, WHERE IT IS NOT IMPORTANT TO SPECIFY VARIABILITY CONTROL CASE DRAIN AND ROTATION OPTIONAL.
7.1.1.3	 B COMPLETE A SIMPLIFIED	VARIABLE-DISPLACEMENT, PRESSURE-COMPENSATED PUMP, WITH ONE DIRECTION OF FLOW, AND CASE-DRAIN LINE CONNECTION SYMBOL FOR MIL-P-19692, OR ISO/DIS 8278, PUMP.
7.1.1.4		AS 7.1.1.3, EXCEPT WITH CASE DRAIN PORT BLOCKED, AND WITH SHAFT-SEAL LEAKAGE VENTED TO ATMOSPHERE.
7.1.1.5	 (1) (2)	(1) AS 7.1.1.3, EXCEPT WITH ADDED SOLENOID-OPERATED DEPRESSURIZATION VALVE. (2) AS (1), EXCEPT WITH ADDED BLOCKING VALVE; SEE 8.5.3 .
7.1.1.6	 COMMAND INPUTS COMMAND INPUTS B COMPLETE A SIMPLIFIED	BASIC VARIABLE-DISPLACEMENT SERVO PUMP, WITH BI-DIRECTIONAL FLOW (OVER-CENTER PUMP), SINGLE DIRECTION OF ROTATION, AND WITH CASE DRAIN

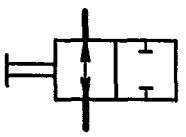
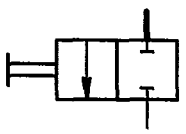
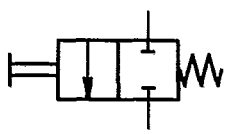
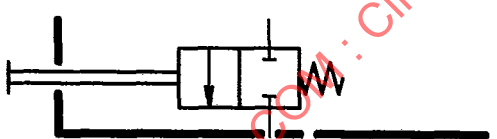
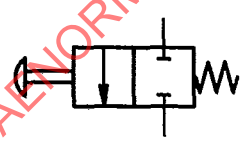
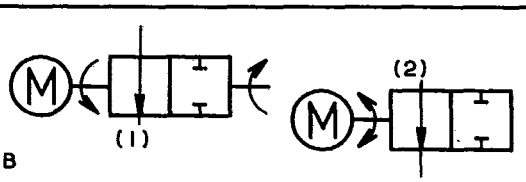
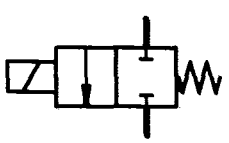
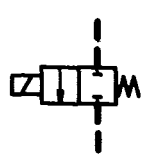
7.1.2		PUMPS - HYDRAULIC, MUSCULAR ENERGY DRIVEN
7.1.2.1		HAND PUMP - GENERAL SYMBOL (1) LINEAR - SINGLE-ACTING. (2) LINEAR - DOUBLE-ACTING. (3) ROTARY - SINGLE-ACTING. (4) ROTARY - DOUBLE-ACTING.
7.1.2.2		FOOT-OPERATED PUMP (OR CONTROL, OR MASTER CYLINDER) OF MASTER/SLAVE UNIT ENVELOPE 2.5.4.4. PUSHING ON PEDAL CAUSES OUTWARD FLOW TO SLAVE UNIT, AND RELEASE OF PEDAL PERMITS RECHARGE THROUGH THE SAME LINE.
7.1.2.3		DUAL-CONTROL CYLINDERS WITH REMOTE RESERVOIRS, AND WITH SLAVE UNITS AS OPERATORS OF MAIN VALVE (1) EITHER MASTER/SLAVE UNIT WILL OPERATE THE MAIN VALVE.
7.1.2.4		EMERGENCY-BACKUP BRAKE MASTER CYLINDER FOOT CONTROL THROUGH MECHANICAL LINKAGE TO MAIN VALVE (1); FOOT MUSCULAR CONTROL FOR MASTER CYLINDER OPERATION; ADDED RETURN LINE PORT FOR UNIT REPLENISHMENT BY SYSTEM RETURN.
7.1.2.5		MASTER BRAKE CYLINDER (OR UNIT) WITH RETURN FLOW TO INTERNAL RESERVOIR, AND WITH EXTERNAL FILL PORT

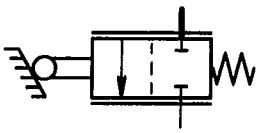
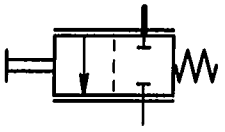
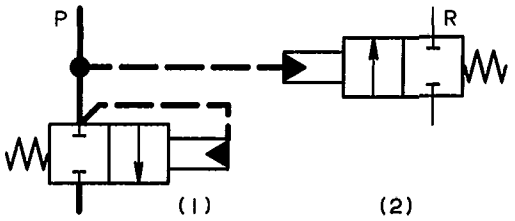
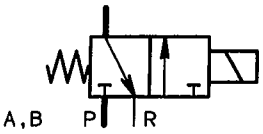
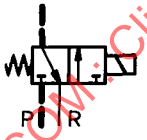
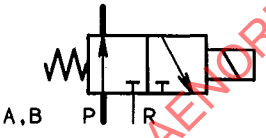
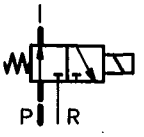
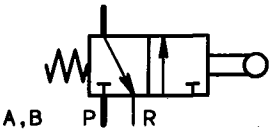
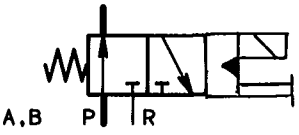
7.2	MOTORS, PUMP-MOTORS, POWER TRANSFER UNITS	
7.2.1	 A,B	FIXED-DISPLACEMENT, BI-DIRECTIONAL HYDRAULIC MOTOR, WITH CASE DRAIN NOTE: FOR MOTORS, THE INTERNAL TRIANGLES POINT INWARD. A,B
7.2.2	 A,B	PUMP MOTOR OPERATES IN ONE DIRECTION AS A PUMP, AND IN OTHER DIRECTION AS A MOTOR. A,B
7.2.3		POWER TRANSFER UNIT THE POWER TRANSFER UNIT-HALF WITH THE GREATER ENERGY INPUT OPERATES AS A MOTOR AND DRIVES THE OTHER UNIT-HALF AS A PUMP.
7.2.3.1		POWER TRANSFER UNIT SINGLE DIRECTION OF POWER TRANSFER, AND SINGLE DIRECTION OF ROTATION.
7.2.4		VARIABLE-DELIVERY PRESSURE-COMPENSATED MOTOR, WITH ONE DIRECTION OF FLOW, AND CASE DRAIN.
7.3	PNEUMATIC PUMPS, COMPRESSORS, MOTORS	
7.3.1	 A,B	FIXED-DISPLACEMENT AIR COMPRESSOR A
7.3.2	 A	VACUUM PUMP A
7.3.3	 A,B	PNEUMATIC MOTOR, BI-DIRECTIONAL

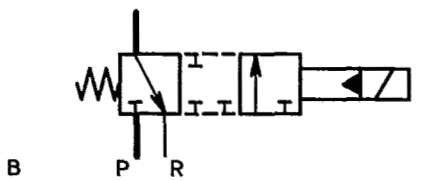
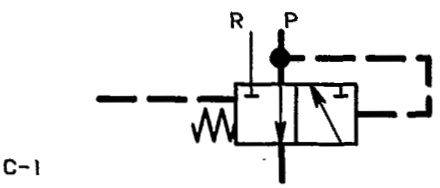
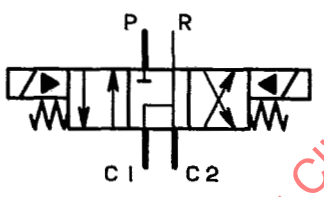
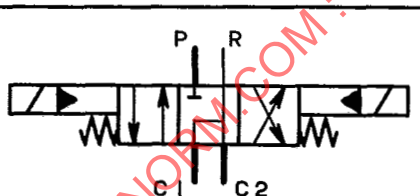
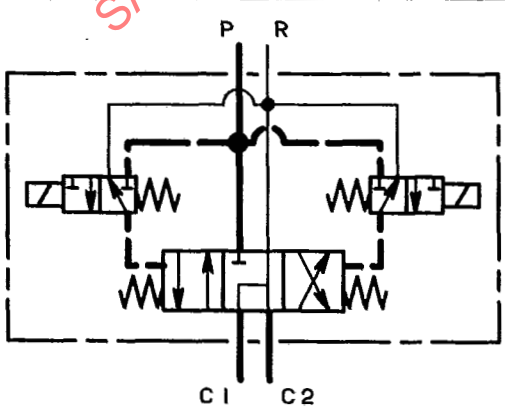
7.4 DRIVING AND DRIVEN UNITS

I.E., ELECTRIC MOTORS, GENERATORS, ENGINES, AIR TURBINES

7.4.1	 A,B	ELECTRIC MOTOR ENVELOPE 2.5.4.3 A,B
7.4.1.1	 A	MOTOR PUMP ELECTRIC MOTOR-DRIVEN VARIABLE-DISPLACEMENT PUMP.
7.4.2	 C-10	GENERATOR ENVELOPE DIA. 2.5.4.3
7.4.2.1		HYDRAULIC MOTOR-DRIVEN GENERATOR
7.4.3	 A	HEAT ENGINE, PISTON TYPE. 4
7.4.4		HEAT ENGINE, GAS-TURBINE TYPE
7.4.5		AIR TURBINE.
7.4.6		RAM AIR TURBINE.

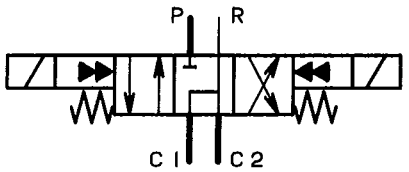
8.1	TWO-PORT SELECTOR	
8.1.1	 A	SHUT-OFF VALVE, MANUALLY OPERATED, GENERAL SYMBOL SYMBOL USED WHEN THE VALVE TYPE, OR THE INDICATION OF NORMAL FLOW OPTION, IS NOT SIGNIFICANT TO CIRCUIT FUNCTION.
8.1.1.1	 A	SHUT-OFF VALVE, REVERSIBLE (OPERATED WITH PRESSURE AT EITHER PORT), MANUALLY OPERATED, SHOWN OPEN. SEE NOTE.
8.1.1.2		SHUT-OFF VALVE, NON-REVERSIBLE (NORMALLY PRESSURIZED AT ONLY ONE PORT), MANUALLY OPERATED, SHOWN CLOSED. SEE NOTE. NOTE: ONLY ONE MANUAL CONTROL NEED BE SHOWN.
8.1.2	 C-1	ACCUMULATOR AIR-CHARGING VALVE, SHOWN WITH CAP.
8.1.3	 A,B	SHUT-OFF VALVE, MANUALLY OPERATED, SPRING RETURN, NORMALLY CLOSED.
8.1.3.1		MANUAL SYMBOL MAY BE EXTENDED TO OUTSIDE MANIFOLD OF COMPOSITE SYMBOL.
8.1.4	 A,B	PUSH-BUTTON VALVE, SPRING RETURN, NORMALLY CLOSED APPLICATION; BLEED VALVE.
8.1.5	 B	(1) MOTOR OPERATED SHUT-OFF VALVE, SHOWN OPEN WITH FULL COUNTERCLOCKWISE SHAFT ROTATION, AND CLOSED WITH FULL CLOCKWISE ROTATION. (2) RELATED DIRECTION OF ROTATION NOT SIGNIFICANT.
8.1.6		SOLENOID-OPERATED SHUT-OFF VALVE DIRECT-OPERATING SOLENOID VALVE, NORMALLY CLOSED.
8.1.6.1	 A,B	PILOT VALVE (COMPLETE SYMBOL) USED IN COMPLETE VALVE SYMBOLS, PARTICULARLY FOR MODULAR ASSEMBLIES, WHERE IT MAY BE REMOVED IN SITU FROM THE MAIN VALVE IT SERVES. ENVELOPE 2.5.4.7 .

8.1	TWO-PORT SELECTOR (CONT'D)	
8.1.7		MECHANICALLY-OPERATED VALVE, INFINITELY-VARIABLE POSITION, NORMALLY CLOSED. (TRACER VALVE) FLOW IS AN LOGOUS TO OPERATOR POSITION.
8.1.7.1		NEEDLE VALVE FLOW IS AN LOGOUS TO OPERATOR POSITION. ONLY ONE MANUAL CONTROL NEED BE SHOWN.
8.1.8		PRESSURE-OPERATED VALVES, SEE 3.5.6.2(2). (1) INTERNALLY OPERATED. (2) EXTERNALLY OPERATED. APPLICATION: LOCKOUT VALVES (PRESSURE DROP THROUGH VALVE IS INDEPENDENT OF ACTUATION PRESSURE).
8.2	THREE-PORT SELECTOR	
8.2.1		DIRECT-ACTING SOLENOID VALVE, NORMALLY CLOSED. APPLICATION: SHUT-OFF VALVE.
8.2.1.1		PILOT VALVE (COMPLETE SYMBOL) USED IN COMPLETE VALVE SYMBOLS, PARTICULARLY FOR MODULAR ASSEMBLIES, WHERE IT MAY BE REMOVED IN SITU FROM THE MAIN VALVE IT SERVES. ENVELOPE 2.5.4.7 .
8.2.2		DIRECT-ACTING SOLENOID VALVE, NORMALLY OPEN. APPLICATION: BRAKE ANTI-SKID VALVE.
8.2.2.1		PILOT VALVE (COMPLETE SYMBOL) USED IN COMPLETE VALVE SYMBOLS, PARTICULARLY FOR MODULAR ASSEMBLIES, WHERE IT MAY BE REMOVED IN SITU FROM THE MAIN VALVE IT SERVES. ENVELOPE 2.5.4.7 .
8.2.3		MECHANICALLY-OPERATED VALVE, NORMALLY CLOSED. APPLICATION: SEQUENCE VALVE.
8.2.4		SOLENOID- OR MANUALLY-OPERATED VALVE, PLUS PILOT, NORMALLY OPEN.

8.2	THREE-PORT SELECTOR (CONT'D)	
8.2.5		NORMALLY CLOSED. OPERATOR - SOLENOID PLUS PILOT. CENTER SQUARE INDICATES ALL PORTS CLOSED, DURING TRANSIT FROM OPEN TO CLOSE (NON-INTERFLOW). SEE 3.1.6.3 . OPERATORS 3.5.6.5, 3.5.2.1 SHOWN. ALTERNATIVE OPERATOR 3.5.8.6.
8.2.6		NORMALLY OPEN. OPERATOR - EXTERNAL PILOT TO OPEN, INTERNAL PILOT TO CLOSE. APPLICABLE TO DIRECT CONTROL MODULAR VALVES.
8.3	FOUR-PORT SELECTOR, MULTI-PORT SELECTOR, AND MULTI-PANEL SELECTOR	
8.3.1		SOLENOID/PILOT OPERATED, WITH OPEN NEUTRAL. THE GENERAL SYMBOL FOR THE OPERATOR (3.5.8.6) INDICATES THAT IT IS NOT SIGNIFICANT TO CIRCUIT FUNCTION TO SPECIFY OPERATION BY APPLIED OR RELEASED PRESSURE. C-17
8.3.2		SOLENOID PLUS INTERNAL PILOT OPERATED, ONLY SPRING CENTERED (ACTUATION BY APPLIED PRESSURE), WITH OPEN NEUTRAL. SIMPLIFIED SYMBOL. OPERATOR 3.5.6.5 IN CONJUNCTION WITH 3.5.2.1 TO EMPHASIZE IMPORTANCE OF SPRING ONLY CENTERING. B
8.3.2.1		FUNCTIONALLY AS 8.3.2 . NON-MODULAR VALVE. COMPLETE SYMBOL. SEE 8.2.1.1 . OPERATOR 3.5.6.4(1).

8.3 FOUR-PORT SELECTOR, MULTI-PORT SELECTOR, MULTI-PANEL SELECTOR (CONT'D)

8.3.3

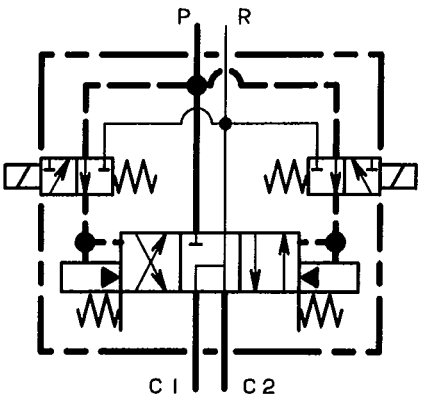


SOLENOID PLUS INTERNAL PILOT OPERATED, AND SPRING PLUS PRESSURE CENTERED (ACTUATION BY RELEASED PRESSURE), WITH OPEN NEUTRAL.

SIMPLIFIED SYMBOL.

OPERATOR 3.5.6.7 (2), IN CONJUNCTION WITH 3.5.2.1 TO EMPHASIZE IMPORTANCE OF SPRING AND PRESSURE CENTERING.

8.3.3.1



FUNCTIONALLY AS 8.3.3 .

MODULAR VALVE WITH SOLENOID PILOT VALVE AND MAIN VALVE SEPARATE AND REMOVABLE SEPARATELY FROM MODULE. SEE 8.2.2.1 .

SOLENOIDS SHOWN OPTIONALLY OUTSIDE OF ENVELOPE.

CONTAINS CENTERING PISTONS, AND OPERATORS 3.5.6.4(1) AND 3.5.6.6 .

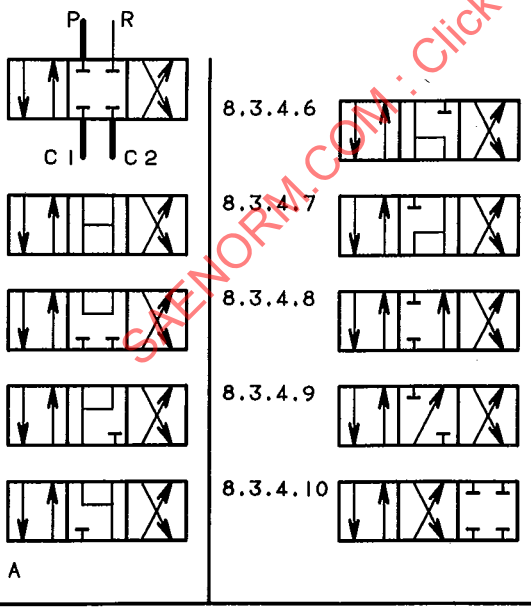
COMPLETE SYMBOL.

NOTE: APPARENT REVERSAL OF MAIN VALVE FLOW PATH COMPARED TO THAT OF SIMPLIFIED SYMBOL IS DUE TO LEFT-HAND SOLENOID VALVE OPERATION DIRECTING HIGH PRESSURE FLOW TO PORT C1 (AND RIGHT HAND SOLENOID VALVE TO PORT C2).

8.3.4

FLOW DIRECTION OPTIONS

8.3.4.1

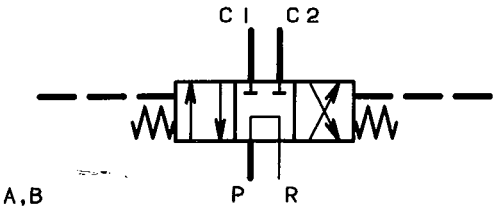


SHOWING VARIETIES OF FLOW DIRECTION CONTROL, WHICH MAY BE OBTAINED WITH FOUR-PORT VALVES.

THESE SYMBOLS DO NOT ILLUSTRATE COMPLETE FOUR-PORT VALVES, AS OPERATORS ARE NOT SHOWN.

P, R, C1, AND C2 SHOWN FOR 8.3.4.1 ARE TYPICAL FOR ALL OTHERS.

8.3.5



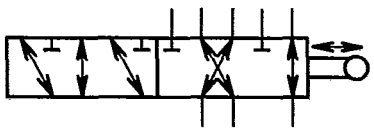
SELECTOR VALVE.

FOUR-PORT, THREE-POSITION, PILOT-OPERATED, OPEN-CENTER.

FOR USE IN OPEN-CENTER SYSTEMS.

8.3 FOUR-PORT SELECTOR, MULTI-PORT SELECTOR, MULTI-PANEL SELECTOR (CONT'D)

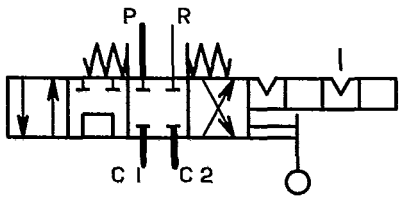
8.3.6



PHASE-CONTROL VALVE (ONLY ONE CONTROL SYMBOL REQUIRED).

EXAMPLE OF A MULTI-PORT VALVE.

8.3.7



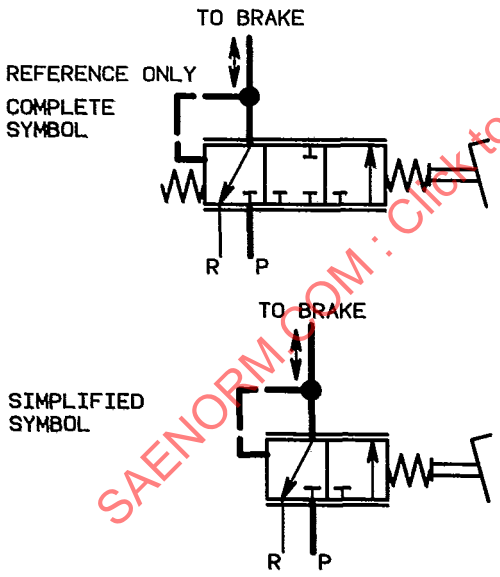
MULTI-PANEL VALVE

THE VALVE IS DETENTED IN THE FIRST PANEL POSITION, AND DETENTED AND SPRING-CENTERED IN THE THIRD PANEL POSITION WHICH IS THE NORMAL STAND-BY POSITION.

ONLY A SINGLE CONTROL IS REQUIRED.

8.4 INFINITE-POSITION SELECTOR - POWER-BRAKE VALVES, SERVOVALVES, SERVO PACKAGES

8.4.1



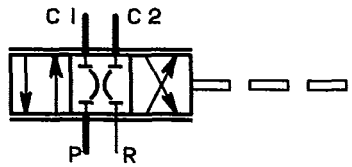
POWER-BRAKE VALVE

BRAKES OFF - L.H. PANEL.

BRAKES ON - R.H. PANEL.

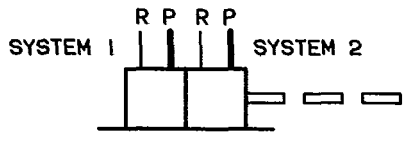
BRAKES HOLD - TRANSITION ZONE WHERE BRAKE PRESSURE, VIA PILOT LINE, BALANCES PEDAL LOAD, CLOSING ALL PORTS, REF. 3.1.6.5 .

8.4.2



MECHANICAL SERVOVALVE, WHERE NEUTRAL HAS DEFINED PRESSURE GAIN AND LEAKAGE REQUIREMENTS, AS MIGHT BE USED IN FLIGHT CONTROL SYSTEMS.

8.4.3

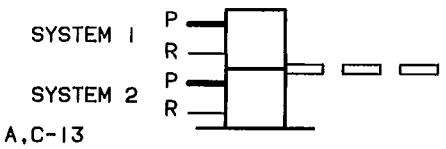


SIMPLIFIED SYMBOL FOR MECHANICAL TANDEM-CONTROL SERVOVALVE, WITH DUAL SYSTEM INLETS AND OUTLETS, AS MIGHT BE MOUNTED ON FLIGHT CONTROL CYLINDERS.

A.13

8.4 INFINITE-POSITION SELECTOR - POWER-BRAKE VALVES, SERVOVALVES, SERVO PACKAGES (CONT'D)

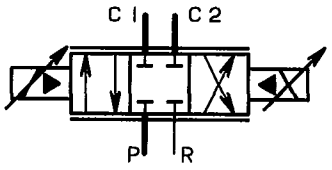
8.4.1.4



A,C-13

SIMPLIFIED SYMBOL FOR SIDE-BY-SIDE VALVE, WITH DUAL SYSTEM INLETS AND OUTLETS, AS MIGHT BE MOUNTED ON FLIGHT CONTROL CYLINDERS.

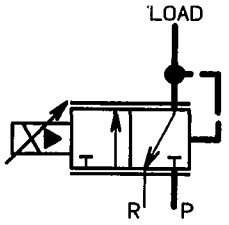
8.4.1.5



SIMPLIFIED SYMBOL FOR ELECTROHYDRAULIC PILOT-CONTROLLED FLOW-CONTROL SERVOVALVE.

OPERATORS 3.5.2.3 COMBINED WITH 3.5.6.4 .

8.4.1.6



SIMPLIFIED SYMBOL FOR ELECTROHYDRAULIC PILOT-CONTROLLED PRESSURE-CONTROL SERVOVALVE.

OPERATORS 3.5.2.2 COMBINED WITH 3.5.6.4(2) .

8.4.1.7

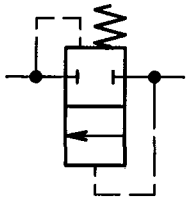
C-1

SIMPLIFIED SYMBOL FOR COMPLEX SERVO-PACKAGE, AS MIGHT BE MOUNTED ON FLIGHT CONTROL CYLINDER.

8.5 AUTOMATIC AND SEMI-AUTOMATIC - CHECK-TYPE

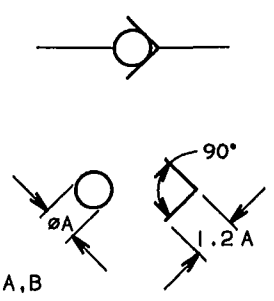
8.5.1

COMPLETE SYMBOL



A

SIMPLIFIED SYMBOL



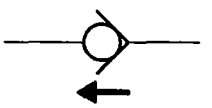
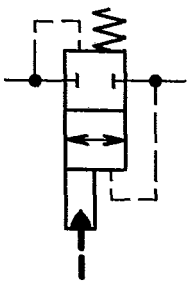
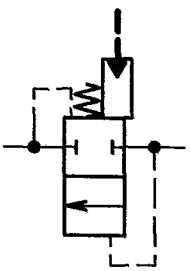
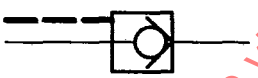
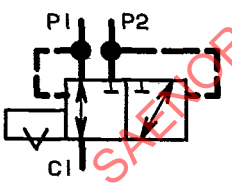
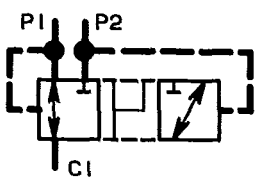
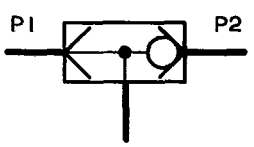
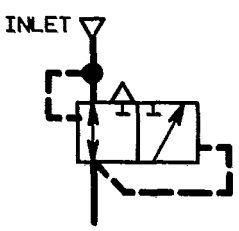
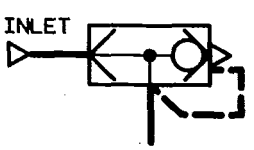
A,B

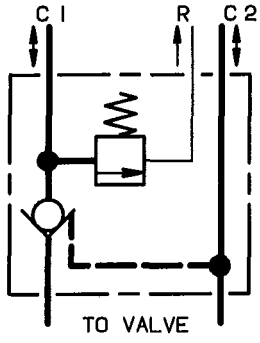
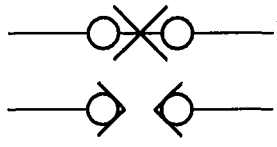
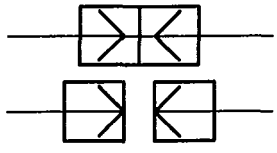
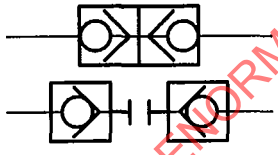
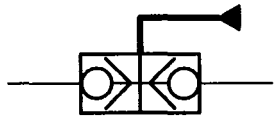
CHECK VALVES

FLOW FROM THE LEFT ACTS IN THE SAME DIRECTION AS THE SPRING TO CLOSE THE VALVE. FLOW FROM THE RIGHT COMPRESSES THE SPRING, AND OPENS THE VALVE. THE SPRING IS USUALLY LIGHT, AND IS OMITTED FROM SIMPLIFIED SYMBOLS.

NOTE: SPRING-LOADED CHECK VALVES ARE CONSIDERED TO BE RELIEF VALVES. SEE 8.6.2.2(B) 4

8.5 AUTOMATIC AND SEMI-AUTOMATIC - CHECK-TYPE (CONT'D)

8.5.1.1	COMPLETE SYMBOL	SIMPLIFIED SYMBOL  C-6	IN LINE-MOUNTED CHECK VALVE SYMBOLS (E.G., AN 6807, AN 6249, MIL-V-19069) FREE FLOW ARROW (3.2.1.4) SHOULD ALWAYS BE SHOWN TO AVOID POSSIBLE CONFUSION OF THE FREE FLOW ARROW ON THE ACTUAL COMPONENT BODY, WITH THE SIMPLIFIED VALVE SEAT SYMBOL WHICH RESEMBLES AN ARROW HEAD. ENVELOPE 2.5.4.7 . 4
8.5.2		 A,B	PILOT-OPERATED CHECK VALVE, PILOT OPERATED TO OPEN OPERATES AS A SIMPLE CHECK VALVE UNTIL PILOT PRESSURE IS APPLIED, WHICH OPENS THE VALVE TO PERMIT TWO-WAY FLOW. IN THE SIMPLIFIED SYMBOL, THE PILOT PRESSURE OPERATES THE VALVE IN THE SAME MANNER AS THE ADJACENT FLOW LINE. ENVELOPE 2.5.4.5 AND 2.5.4.8 . 4
8.5.3		 A,B	PILOT-OPERATED CHECK VALVE, PILOT OPERATED TO CLOSE OPERATES AS A SIMPLE CHECK VALVE UNTIL PILOT PRESSURE IS APPLIED, WHICH CLOSES THE VALVE AND PREVENTS OPENING. IN THE SIMPLIFIED SYMBOL, THE PILOT PRESSURE OPERATES THE VALVE IN THE SAME MANNER AS THE ADJACENT FLOW LINE. 4
8.5.4			SHUTTLE VALVE (MIL-V-19068) TWO PRESSURE SOURCES, NON-INTERFLOW; TWO-WAY FLOW PERMITTED; PREVENTED FROM STOPPING IN DEAD CENTER.
8.5.4.1	 A,B	 A,B	SHUTTLE VALVE, INTERFLOW TYPE, TWO-WAY FLOW GENERAL (SIMPLIFIED) SYMBOL, WHERE INTERFLOW IS NOT SIGNIFICANT TO CIRCUIT FUNCTION.
8.5.4.2		 B	RAPID EXHAUST VALVE WHEN INLET IS UNLOADED, OUTLET IS FREELY EXHAUSTED.

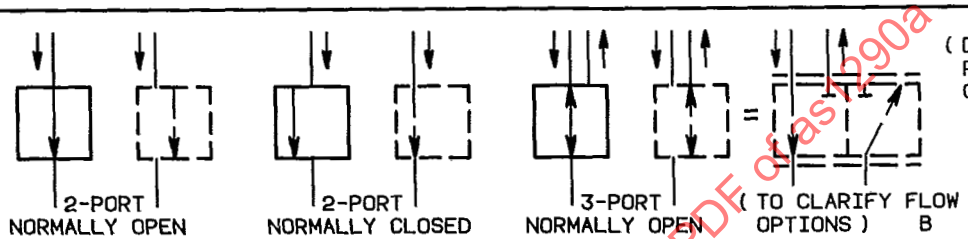
8.5	AUTOMATIC AND SEMI-AUTOMATIC VALVES - CHECK TYPE (CONT'D)	
8.5.5		CYLINDER LOCK VALVE, SINGLE, WITH THERMAL RELIEF WHEN C2 IS PRESSURIZED, THE CHECK VALVE IS HELD OPEN, PERMITTING C1 FLOW (THEN AT LOW PRESSURE) TO THE VALVE. SEE 8.5.2, AND 8.6.2.3 .
8.5.6		DISCONNECTS
8.5.6.1		THE COUPLING HALVES ARE JOINED BY SOME TYPE OF STANDARD CONNECTION, OR ARE INTEGRATED AS PART OF A DETACHABLE LARGER UNIT.
8.5.6.2		THE COUPLING HALVES ARE JOINED BY A CONNECTION SPECIALLY DESIGNED FOR RAPID OR FREQUENT DISCONNECTION (QUICK DISCONNECT).
8.5.6.3		THIS TYPE IS COMMONLY REFERRED TO AS A "QUICK DISCONNECT", AND IS USUALLY USED AS A GROUND-SUPPORT CONNECTION, WHERE ONLY THE COUPLING-HALF THAT IS PERMANENTLY ATTACHED TO THE AIR VEHICLE IS SHOWN AS PART OF THE AIRBORNE SYSTEM. THIS QUICK-DISCONNECT DESIGN MAY INCORPORATE PUSH-PULL, THREADED, RACK-AND-PINION, ETC. MECHANISIMS. DISCONNECTED UNIT SHOWN WITH ADDED DUST CAPS.
8.5.6.4		REMOTELY-OPERATED DISCONNECT HYDRAULICALLY-ACTUATED VERSION SHOWN. MAY ALTERNATELY HAVE MECHANICAL, ELECTRICAL, ETC, OPERATOR.
8.5.6.5		FOR OTHER THAN GROUND-SUPPORT CONNECTIONS (I.E., BRAKE DISCONNECTS) 8.5.6.1, ETC. MAY BE AS SHOWN, BUT TO A SMALLER SCALE.

8.6 AUTOMATIC AND SEMI-AUTOMATIC VALVES - PRESSURE CONTROL

8.6.1 SINGLE ENVELOPE VALVES FOR PRESSURE CONTROL

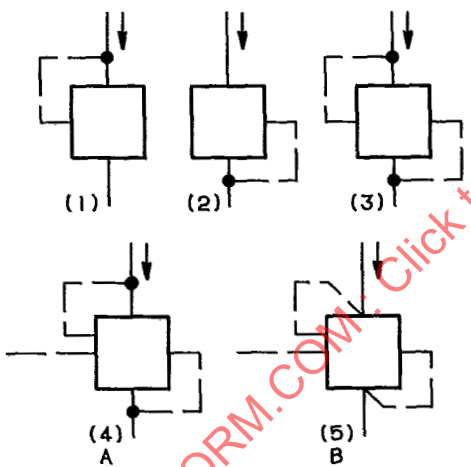
IN INFINITE-POSITION, SINGLE-ENVELOPE VALVES, THE ENVELOPE IS IMAGINED TO MOVE TO ILLUSTRATE HOW PRESSURE AND FLOW CONDITIONS ARE CONTROLLED AS THE VALVE IS ACTUATED. THE TERM "INFINITE POSITION", AS APPLIED HERE, MEANS THE RANGE BETWEEN FULL-FLOW AND RE-SEAT CONDITIONS FOR AUTOMATIC VALVES (CONTROLLED ENTIRELY BY THE FLUID PRESSURE IT IS SUBJECTED TO). HOWEVER, IN SEMI-AUTOMATIC VALVES (AUTOMATIC OPERATION SUBJECT TO EXTERNAL CONTROL), THE EXTERNAL CONDITION MAY MODIFY THE "INFINITE POSITION" CONDITION TO THE EXTENT THAT THERE IS ALSO FULL "ON" OR FULL "OFF" OPTIONS. THE FOLLOWING SYMBOLS DO NOT REPRESENT COMPLETE VALVES, AND ALL FLUID LINES ARE LOW PRESSURE FOR DEMONSTRATION PURPOSES.

8.6.1.1



(DASH-LINED SYMBOLS REPRESENT IMAGINARY OPERATED POSITIONS)

8.6.1.2



(1) AFFECTED INTERNALLY BY UPSTREAM PRESSURE.

(2) AFFECTED INTERNALLY BY DOWNSTREAM PRESSURE.

(3) AFFECTED INTERNALLY BY UPSTREAM AND DOWNSTREAM PRESSURES; I.E., DIFFERENTIAL PRESSURE.

(4) AS (3) PLUS EXTERNAL PILOT (SEMI-AUTOMATIC VALVE), AND ALSO APPLIES TO (1) AND (2).

NOTE: ALL THE ABOVE ARE GENERAL SYMBOLS INDICATING EITHER DIRECT-ACTING OR PILOT-OPERATED VALVES.

(5) ALTERNATIVES TO (4) TO INDICATE DIRECT-ACTING ONLY VALVES; I.E., NO PILOT, OR THE PILOT IS SHOWN SEPARATELY.

8.6.1.3 NOTE

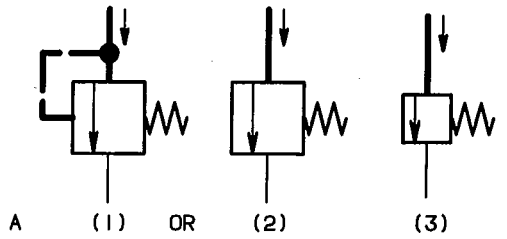
VARIOUS TYPES OF PRESSURE CONTROL VALVES HAVING UNIQUE NOMENCLATURE (I.E., "RELIEF", "REDUCER", "UNLOADING", "COUNTERBALANCE") HAVE CONSTRUCTIONAL AND FUNCTIONAL SIMILARITIES SUCH THAT FOR INDUSTRIAL VALVES, MINOR CHANGES CAN TRANSPOSE ONE TO ANOTHER (SEE 2.3.2). THUS, PICTORIAL DIFFERENCES IN SYMBOLOGY MAY SOMETIMES BE MORE SUBTLE THAN IMPLIED BY THE NOMENCLATURE. ALSO, THE CONTROLS NOTED IN 8.6.1.2 ARE APPLICABLE TO OTHER TYPES OF VALVES.

8.6.2 RELIEF VALVES

THERE ARE VARIOUS COMMON TYPES OF RELIEF VALVE CONSTRUCTION, INCLUDING DIRECT-ACTING, TWO-STAGE (OR COMPOUND, OR PILOT-OPERATED) VALVES, SUCH AS BALANCED-PISTON OR DIFFERENTIAL-AREA-PISTON TYPES (THE LATTER HAVING THE PISTON AREA REDUCED TO ACHIEVE A SMALLER SPRING SIZE), WHEREBY THE VALVES PERFORM THE SAME BASIC FUNCTION ALTHOUGH THERE MAY BE SIGNIFICANT DIFFERENCES IN DYNAMIC PERFORMANCE. ALL THE ABOVE ARE, IN FACT, DIFFERENTIAL PRESSURE VALVES, WHERE THE SETTING IS AFFECTED (AND SUCH AMPLIFIED BY THE DIFFERENTIAL-PISTON TYPE VALVE) BY INHERENT AND RELIEVING FLOW BACK-PRESSURE CAUSED BY THE LENGTH AND/OR DIAMETER OF RETURN LINES IN CLOSED CIRCUITS. IN CODE A, THE SIMPLIFIED SYMBOL IS CONSTRUED TO MEAN ANY OF THE ABOVE TYPES, AND THE DOWNSTREAM PILOT LINE IS OMITTED SINCE THE SMALL TANK SYMBOL IMPLIES CLOSE PROXIMITY SUCH THAT BACK-PRESSURE EFFECTS ARE NOT SIGNIFICANT. IN AIRCRAFT CIRCUITS, ALTHOUGH THIS PILOT LINE IS ALSO OMITTED FROM SIMPLIFIED SYMBOLS, THE PRESENCE OF BACK-PRESSURE IS IMPLIED BY THE CONTINUOUS LINE FROM THE OUTLET PORT. A BALANCED RELIEF VALVE, WHERE INLET PRESSURE IS UNAFFECTED BY DOWNSTREAM PRESSURE, IS ALSO USED IN AIRCRAFT CIRCUITS, AND IS SYMBOLICALLY SHOWN HEREIN.

8.6 AUTOMATIC AND SEMI-AUTOMATIC PRESSURE CONTROL (CONT'D)

8.6.2.1



RELIEF VALVE.

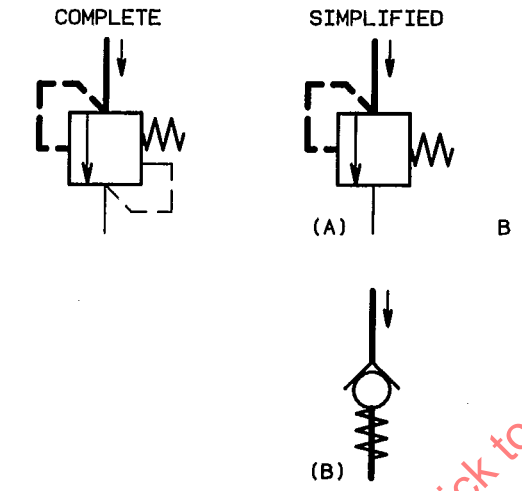
GENERAL SYMBOL FOR DIRECT OR COMPOUND (PILOT-OPERATED) DIFFERENTIAL PRESSURE, ETC. TYPES.

(1) PRIMARY.

(2) PRIMARY.

(3) SECONDARY.

8.6.2.2



RELIEF-TYPE VALVES
DIFFERENTIAL PRESSURE
DIRECT ACTING

VALVE OPENS WHEN THE INLET PRESSURE IS GREATER THAN THAT REQUIRED TO OVERCOME THE SPRING LOAD, PLUS THE OUTLET PRESSURE.

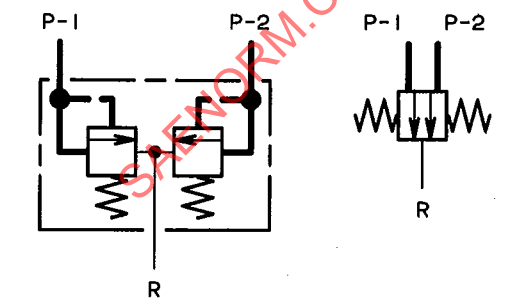
THE COMPLETE SYMBOL, OR SIMPLIFIED SYMBOL (A), IS RECOMMENDED FOR CIRCUIT PROTECTION VALVES WHERE THE CONSTANTLY CLOSED POSITION REPRESENTS THE NORMAL SYSTEM CONDITION, AND RELIEVES PRESSURE FROM A HIGH-PRESSURE TO A LOW-PRESSURE LINE (REFERENCE MIL-V-5523, MIL-V-8813, AND MIL-V-5527).

THE SIMPLIFIED SYMBOL (B) IS RECOMMENDED FOR VALVES WHERE THE OPEN POSITION REPRESENTS A FREQUENT SYSTEM CONDITION, OR FOR A LOCAL BY-PASS VALVE WITHIN A COMPONENT SYMBOL (REPRESENTING SPASMODIC OPERATION) AND PRESSURE RELIEF IS USUALLY TO A LINE OF SIMILAR PRESSURE LEVEL.

APPLICATION: BACK-PRESSURE VALVE, FILTER BY-PASS VALVE, HIGH-OPENING-PRESSURE CHECK VALVE, ETC.

4,12,C-14

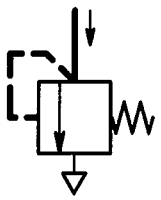
8.6.2.3



DUAL THERMAL RELIEF VALVE

TWO SMALL-FLOW CAPACITY PRESSURE RELIEF VALVES, EACH ACTING INDEPENDENTLY WITH A COMMON RETURN LINE, TO RELIEVE EXCESSIVE PRESSURE IN EITHER OF TWO BLOCKED LINES, DUE TO TEMPERATURE INCREASE.

8.6.2.4

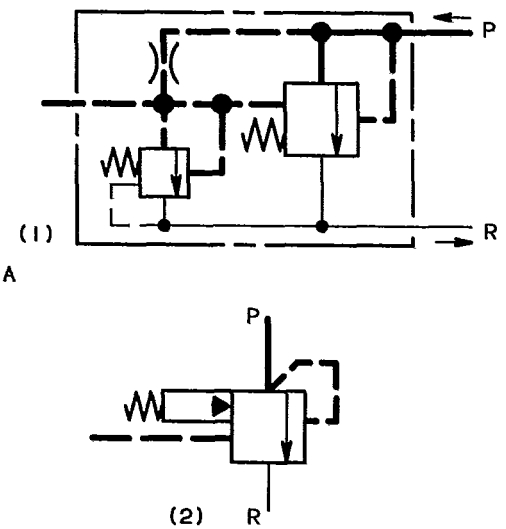


RELIEF VALVE - VENTED TO ATMOSPHERE (BLOW-OFF VALVE)

DIRECT ACTING.

8.6 AUTOMATIC AND SEMI-AUTOMATIC PRESSURE CONTROL CONT'D

8.6.2.5



PILOT-OPERATED BALANCED-PISTON RELIEF VALVE, WITH INTERNAL AND REMOTE PILOT OPERATION.

WITH REMOTE PILOT BLOCKED, PRESSURE RISE INITIALLY CAUSES THE PILOT TO UNSEAT, AND THEN PRESSURE UNBALANCE ACROSS THE MAIN VALVE PISTON (THROUGH THE THROTTLING ACTION OF THE RESTRICTOR), CAUSES IT TO OPEN.

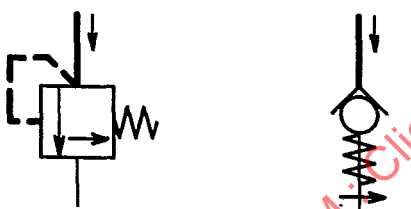
PRESSURE UNBALANCE CAN BE CAUSED DIRECTLY BY REMOTE PILOT PRESSURE DECREASE AT ANY LESSER PRESSURE THAN THE PILOT SETTING TO THE EXTENT OF COMPLETE UNLOADING.

SEE 8.6.1 . 4

(1) COMPLETE SYMBOL.

(2) SIMPLIFIED SYMBOL.

8.6.3

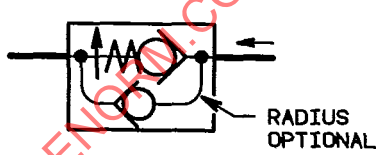


BALANCED RELIEF VALVE

COMPONENT IS PRESSURE-COMPENSATED AT OUTLET SIDE TO OPEN AT A CONSTANT INLET PRESSURE IRRESPECTIVE OF OUTLET PRESSURE.

USAGE UNDER 8.6.2.2 APPLIES.

8.6.4



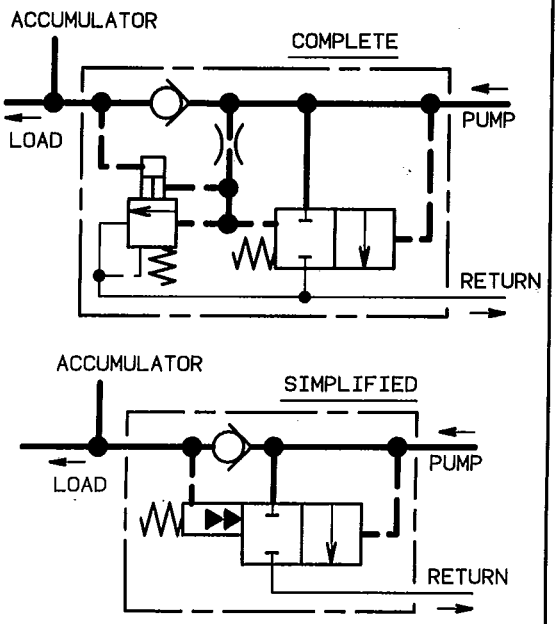
PRIORITY VALVE

AS 8.6.3 WITH ADDED FREE REVERSE FLOW.

SEE ARP 243 B FOR DEFINITION AND USAGE OF PRIORITY VALVES.

8.6 AUTOMATIC AND SEMI-AUTOMATIC PRESSURE CONTROL (CONT'D)

8.6.5



PRESSURE REGULATING (UNLOADING) VALVE

DIFFERENTIAL-PRESSURE, PILOT OPERATED.

LOADING (OR CUT-IN) -
MAIN SYSTEM VALVE, AND SYSTEM SENSING PISTON, ARE EACH PRESSURE BALANCED; PILOT VALVE SPRING KEEPS PILOT VALVE CLOSED AGAINST SENSING PRESSURE.

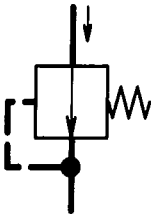
UNLOADING (OR CUT-OUT) -
A RISE IN PRESSURE CRACKS OPEN THE PILOT VALVE UNBALANCING THE SENSING PISTON TO COMPLETELY OPEN PILOT VALVE, THUS UNBALANCING THE MAIN VALVE WHICH SHIFTS TO UNLOAD THE PUMP, AND THE CHECK VALVE CLOSES. THE DIFFERENTIAL BETWEEN CUT-IN PRESSURE AND CUT-OUT PRESSURE (NORMALLY ABOUT 15 %) IS DUE TO THE LARGER AREA OF THE SENSING PISTON AS COMPARED TO THE AREA OF THE PILOT POPPET.

SEE 3.5.6.7 (2).

NOTE:
A TWO-PANEL SYMBOL IS USED FOR THE MAIN VALVE TO BE COMPATIBLE WITH THE AUTOMATIC SNAP-ACTION OPERATION (NO THROTTLING).

SEE 3.1.6.2 , AND 3.5.6.9 .

8.6.6



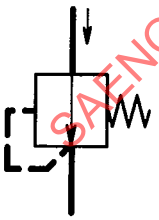
A

REDUCING VALVE (PRESSURE REDUCER)

GENERAL SYMBOL FOR DIRECT-ACTING, OR PILOT OPERATED.

BASIC FUNCTION AS 8.6.6.1 .

8.6.6.1



B

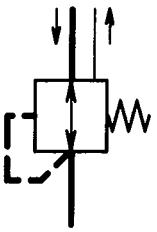
REDUCING VALVE (PRESSURE REDUCER)

TWO-PORT, DIRECT-ACTING.

SUBSTANTIALLY CONSTANT OUTLET PRESSURE IS PROVIDED WITH VARIABLE INLET PRESSURE, IF INLET PRESSURE IS MAINTAINED ABOVE THE OUTLET PRESSURE.

IF THE OUTLET LINE IS BLOCKED, OUTLET PRESSURE WILL USUALLY RISE TO THE LEVEL OF THE INLET PRESSURE, DUE TO VALVE INTERNAL LEAKAGE. 4

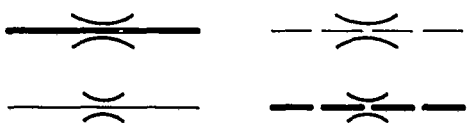
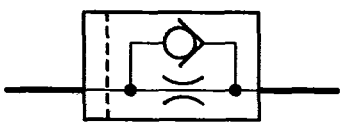
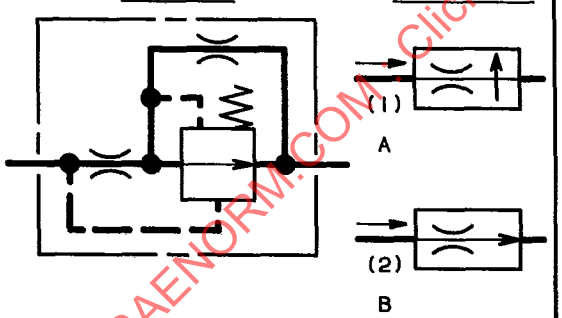
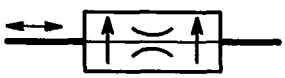
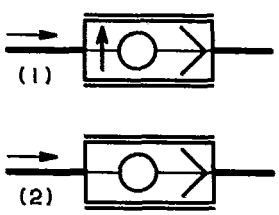
8.6.6.2



B

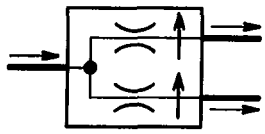
THREE-PORT, DIRECT-ACTING.

EXCESS DOWNSTREAM PRESSURE WILL RELIEVE TO RETURN, AND DOWNSTREAM PRESSURE WILL BE MAINTAINED AT A LEVEL CLOSE TO THE REDUCED-PRESSURE SETTING (MIL-V-7909). SEE 8.6.1.1 .

8.7	AUTOMATIC AND SEMI-AUTOMATIC FLOW CONTROL	
8.7.1	 A	RESTRICTION SYMBOL FOR REDUCED FLOW AREA IN COMPONENT, OR FITTING, FOR CONTROL OF FLOW OR PRESSURE. GENERAL SYMBOL, WHEN SHOWN AS A LINE RESTRICTOR WITHOUT AN ENVELOPE.
8.7.1.1	 A	VARIABLE RESTRICTOR NOT COMMONLY USED IN AIRCRAFT CIRCUITS. IF USED, THE SYMBOL INDICATES THAT THE RESTRICTOR CANNOT BE ADJUSTED TO COMPLETE CLOSURE.
8.7.2	 A	SCREENED TWO-WAY RESTRICTOR
8.7.3	 A	SCREENED ONE-WAY RESTRICTOR
8.7.4	COMPLETE SIMPLIFIED  (1) A (2) B	FLOW REGULATOR (FLOW LIMITER) PRESSURE COMPENSATED. SUBSTANTIALLY CONSTANT FLOW RATE IS PROVIDED WITH VARIABLE INLET PRESSURE, IF INLET PRESSURE IS MAINTAINED ABOVE THE OUTLET PRESSURE BY NOT LESS THAN THE MINIMUM REQUIRED INCREMENT. REVERSE FLOW RESTRICTED ONLY. VALVE CANNOT CLOSE COMPLETELY. (1) PREFERRED FOR MAXIMUM CLARITY. (2) IN CODE B, THE ARROW IN THE ENVELOPE INDICATES CONSTANT OUTLET FLOW RATE.
8.7.4.1		TWO-WAY FLOW REGULATOR (TWO-WAY FLOW LIMITER) PRESSURE COMPENSATED TO PROVIDE CONSTANT FLOW RATE IN EITHER DIRECTION.
8.7.5	SIMPLIFIED SYMBOLS  (1) (2)	LINE FUSE (HYDRAULIC FUSE) QUANTITY MEASURING TYPE (MIL-F-5508). FLOW FROM THE LEFT IS IMAGINED TO PROGRESSIVELY MOVE THE BALL TO THE RIGHT UNTIL IT SEATS AND STOPS FLOW. (1) TYPE 1 - SELF RESETTING ON PRESSURE EQUALIZATION; FREE REVERSE FLOW. (2) TYPE 2 - RESETS ONLY ON REVERSE FLOW.

8.7 AUTOMATIC AND SEMI-AUTOMATIC FLOW CONTROL (CONT'D)

8.7.6

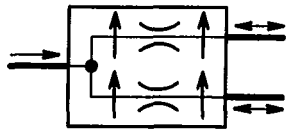


FLOW DIVIDER

FLOW FROM THE LEFT IS PROPORTIONED BETWEEN THE OUTLET LINES, WITH ACCURACY.

REVERSE FLOW IS LESS ACCURATE.

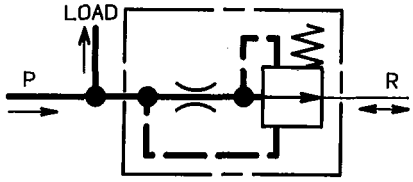
8.7.6.1



FLOW DIVIDER AND COLLECTOR

FLOW IN EITHER DIRECTION IS PROPORTIONED WITH ACCURACY.

8.7.7



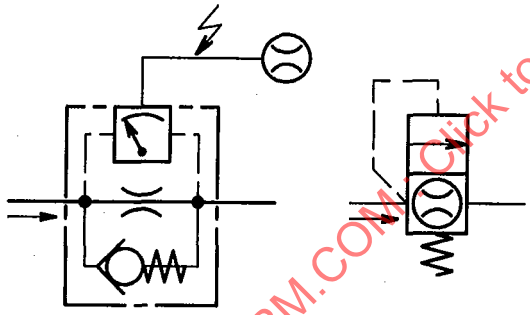
FLOW SENSITIVE VALVE

LOW FLOWS PASS TO RETURN. AS FLOW INCREASES, THE DIFFERENTIAL PRESSURE PROGRESSIVELY INCREASES, THROTTLING TO CLOSURE.

SELF-RESETTING ON PRESSURE EQUALIZATION.

APPLICATION - RAM AIR TURBINE REGULATOR.

8.7.8



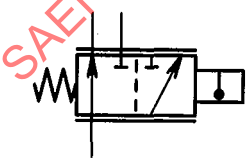
FLOWMETER VALVE

A DIFFERENTIAL PRESSURE TRANSDUCER (LINEAR) SENSES THE PRESSURE DROP ACROSS THE RESTRICTOR, AND A REMOTE GAUGE IS CALIBRATED IN FLOW-RATE UNITS.

DURING OPERATING CONDITIONS, WITH HIGH FLOW RATES BEYOND THE CALIBRATED RANGE OF THE TRANSDUCER, THE BY-PASS CONDITION PREVAILS.

17

8.7.9



THERMALLY OPERATED VALVE
(TEMPERATURE CONTROL VALVE)

WHEN IN THE TEMPERATURE-CONTROL RANGE, THE VALVE IS ACTUATED IN A MODULATING MANNER FROM ONE POSITION TO THE OTHER, IN RESPONSE TO THE SENSING-UNIT CONTROL. THE VALVE CANNOT CLOSE.

APPLICATION: TO CONTROL FLUID FLOW THROUGH A HEAT EXCHANGER.