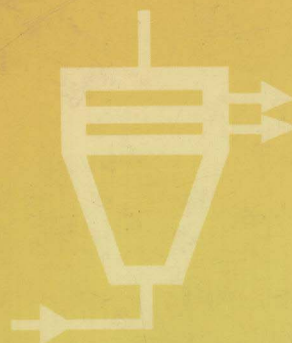
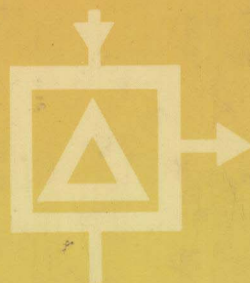
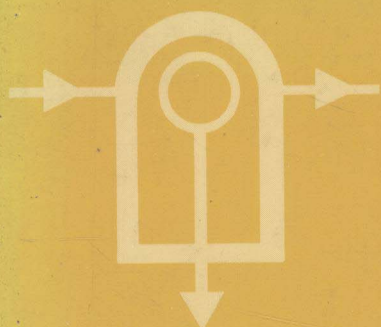


D.G. AUSTIN

CHEMICAL ENGINEERING DRAWING SYMBOLS



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Halsted Press

Chemical Engineering Drawing Symbols

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Chemical Engineering Drawing Symbols

D. G. Austin

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Foreword

Throughout all stages of the design of a chemical plant, engineers of many disciplines communicate by reference to diagrams ranging from the simple block diagram, where process alternatives are screened and developed, to the comprehensive engineering line diagrams from which the plant is planned and fabricated. The graphic symbols employed in these diagrams need to be relatively simple and versatile, so that they may be easily modified to suit the particular design requirement; also their form should be representative of the equipment they describe.

This useful reference book has collected together graphic symbols from many standard documents and other sources and these have been arranged so that the selection of the appropriate symbol for formulation or interpretation of the many different flowsheets is easily accomplished. The existence of alternative symbols for the same item emphasises the need for further standardisation in this area and it is hoped that this publication has made a valuable contribution in this respect.

This book is recommended for undergraduate chemical engineering students, especially those embarking on design project work, and it is believed that it will also be useful to draughtsmen and process engineers employed in plant design offices in the chemical industry.

*Department of Chemical Engineering
The University of Aston in Birmingham*

G. V. Jeffreys

Preface

Process flow (PFD) and engineering line (ELD) diagrams are the chemical and process engineer's basic means of communication during the development, process and project engineering of plants. However, difficulties are frequently encountered in interpreting or formulating these diagrams. Such problems are primarily associated with the layout and use of graphic symbols employed to represent plant items and ancillary equipment, including control and instrumentation features of the process.

The types of question that arise are:

What does this symbol represent?

Which type of internals is employed in this distillation column?

Does a recognised symbol exist for a plate heat exchanger?

Two symbols are available for a diaphragm valve: which is preferred, and why?

Can it be shown graphically how the valve is actuated, with the type of fittings for connection to pipelines?

Frequent reference to the various different published systems of symbols to answer these questions distracts the designer from the continuity of the flowsheet. Moreover, confusion over symbol use and interpretation, as well as being time-consuming, can lead to serious mistakes which may be costly to rectify and, if they remain undetected, can result in inefficient or even unsafe plant.

Although flowsheets fulfil diverse functions, their chief use is to communicate a process design clearly and accurately with the minimum of effort on the part of those engaged in producing and interpreting them. The principal objective in compiling this book has been to ease these tasks by providing a comprehensive list of graphic symbols with examples to illustrate the way they are used.

Birmingham
October, 1978

DGA

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I would also like to thank the Institution of Chemical Engineers for permission to include the process flow diagram for a plant design to produce MEK from 2-Butanol.

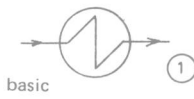

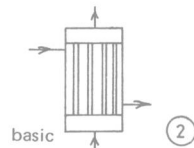
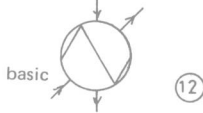
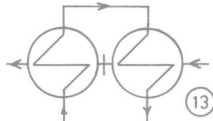
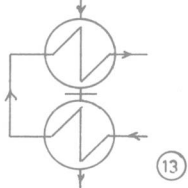
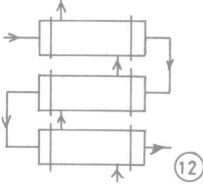
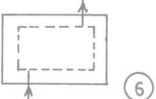

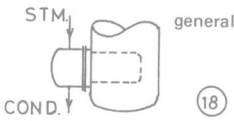
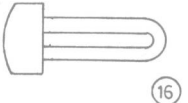
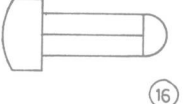
D.G. Austin

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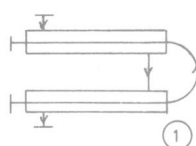
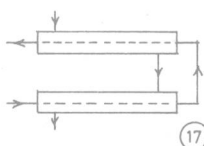
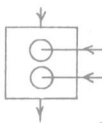
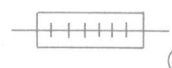
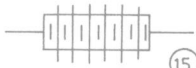
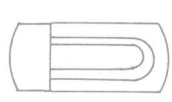
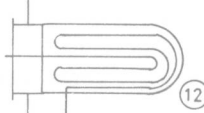
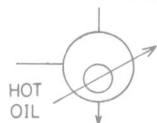
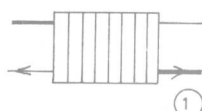
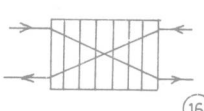
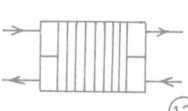
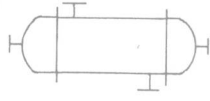
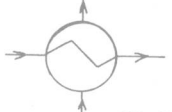
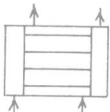
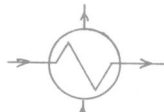
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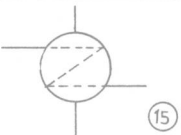
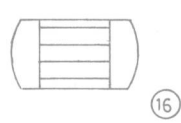
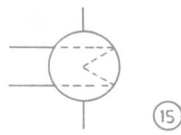
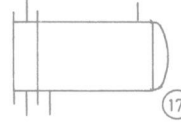
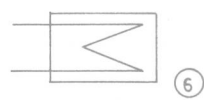
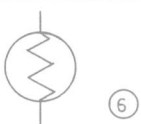
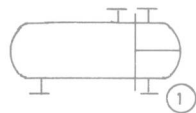
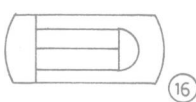
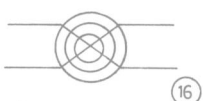
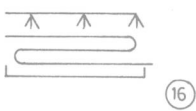
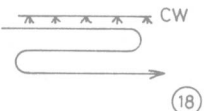
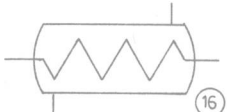

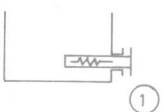
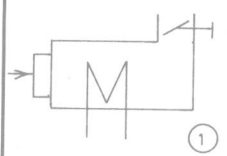
PART ONE

General Equipment

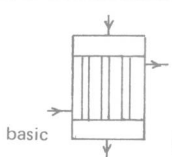
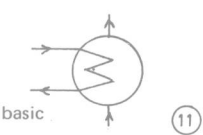
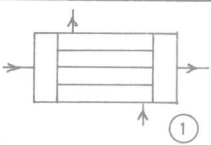
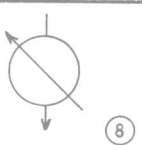
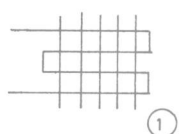
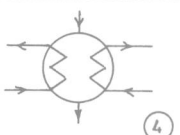
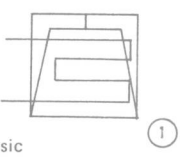
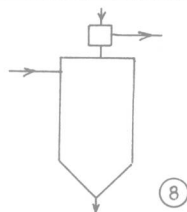
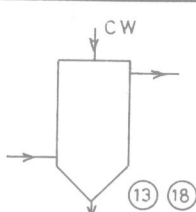
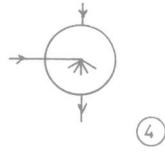
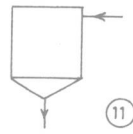
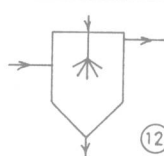
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Heat exchanger	 basic ①  basic ①  basic ②		 basic ⑫	
Rack or bank exchanger			 ⑬	
horizontally stacked vertically stacked <i>Relative positions of connections to be shown.</i>			 ⑬	 ⑫
Annular type (concentric tube)	 horizontal ⑥			
vertical See also Double pipe type.	 ⑥			
Bayonet (immersion) type			 STM _i COND. ⑱	
with hairpin tubes			 ⑯	
with floating end plate			 ⑯	

4 HEAT TRANSFER
Heat exchangers (general)

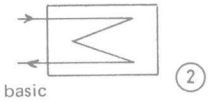
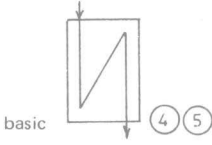
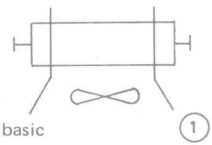
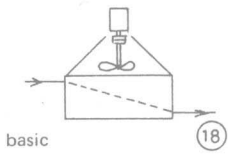
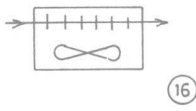
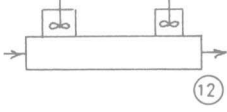
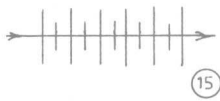
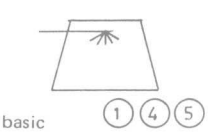
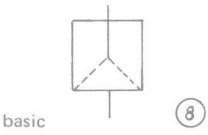
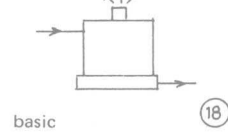
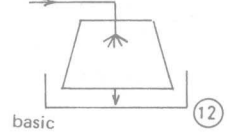
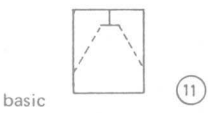
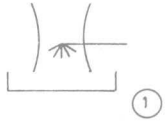
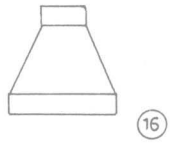
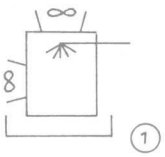
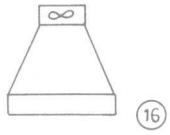
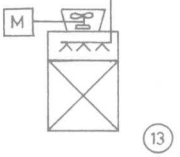
	BS	ANSI(ASA)	Alternative	Alternative
Coil (heating/cooling)	 basic			
half pipe			 ⑬	
full pipe			 ⑭	
immersion coil			 ⑮	
Double pipe type	 ①		 ⑰	 ⑬ ⑮
Finned tube type			 ⑯	 ⑮
Hairpin (U-tube) type <i>Relative positions of connections to be shown.</i>			 ⑯	 ⑫
Kettle type			 ⑱	
Plate type	 ①		 ⑯	 ⑫
Shell and tube fixed tube sheet	 ①	 ⑧ ⑪	 ⑫	 ⑬

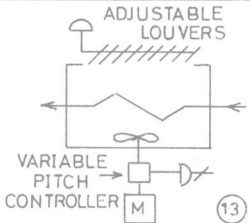
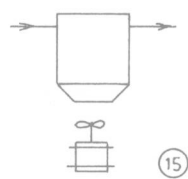
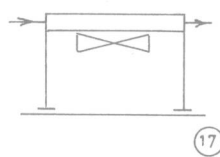
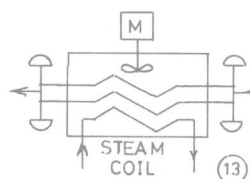
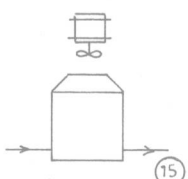
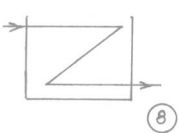
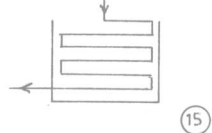
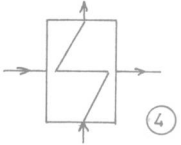
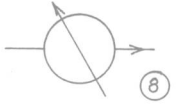
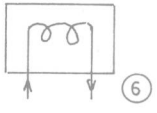
	BS	ANSI(ASA)	Alternative	Alternative
<p>fixed tube sheet</p> <p><i>Baffles to be added where necessary.</i></p>			 	 
horizontally mounted				
vertically mounted				
floating head (U-tube)				
Spiral type				
<p>Spray type</p> <p>See also Water-cooled exchanger.</p>			 	
Tube coil type				
Electrical heater	 <p>basic</p>			
Tank heater				
Cabin heater				

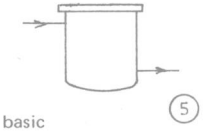
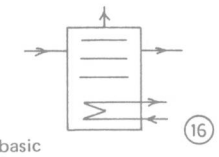
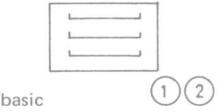


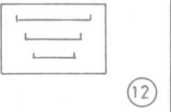
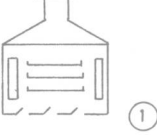
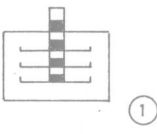
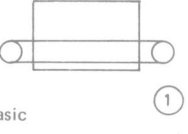

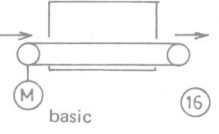
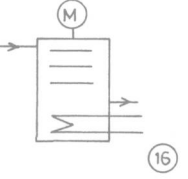
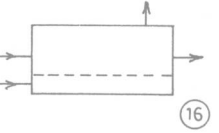

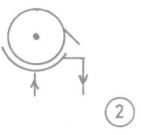
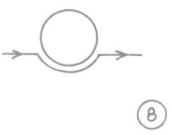
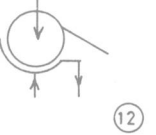
Condensers

	BS	ANSI(ASA)	Alternative	Alternative
Surface condenser shell and tube type Steam flows in cross-flow arrangement over tubes.	 basic ②	 basic ⑪		
water-cooled	 ①	 ⑧		
air-cooled Natural/forced draft.	 ①			
water-cooled Divided on water side.	 ④			
Evaporative	 basic ①			
barometric type Used with steam jet ejectors for generation of vacuum.		 ⑧	 ⑬ ⑱	
jet type Water sprayed directly into evacuated chamber.	 ④	 ⑪	 ⑫	

Coolers

	BS	ANSI(ASA)	Alternative	Alternative
Cooler				
Air-cooled exchanger	 			
finned pipe type			  	
Water cooler (cooling tower) Direct contact between water and air flowing countercurrently — draft may be forced, induced or natural.	    			
natural draft				
forced draft Show position of fan for forced draft (fan at air outlet) or induced draft (fan at air inlet).			 	

	BS	ANSI(ASA)	Alternative	Alternative
Air cooler				
				
				
Box-type cooler				
Oil cooler				
Water-cooled exchanger				
Refrigeration exchanger				

	BS	ANSI(ASA)	Alternative	Alternative
Dryer	 basic ⑤		 basic ⑯	
Batch tray dryer Reheated, recirculated air passed over material placed on trays, which may be heated by steam coils.	 basic ① ②	 basic ⑧	 basic ⑱	 basic ⑫
drying oven	 ①			
hot gas dryer with trays	 ①			
Belt (continuous tunnel) dryer Material carried on belt or series of trays: suitable for vacuum unit.	 basic ①	 basic ⑧	 basic ⑯	
Disc dryer			 ⑯	
Fluidized bed dryer			 ⑯	
Rotary dryer	 basic ①			
rotary film dryer or flaker Used for solutions or slurries which are fed onto a steam-heated drum; dried product removed from drum using knife.	 ②	 ⑧	 ⑫	