

*Control de Procesos Químicos*

## **Tema 5 – Representación**

Diagramas de tuberías e instrumentos  
Diagramas lógicos de control

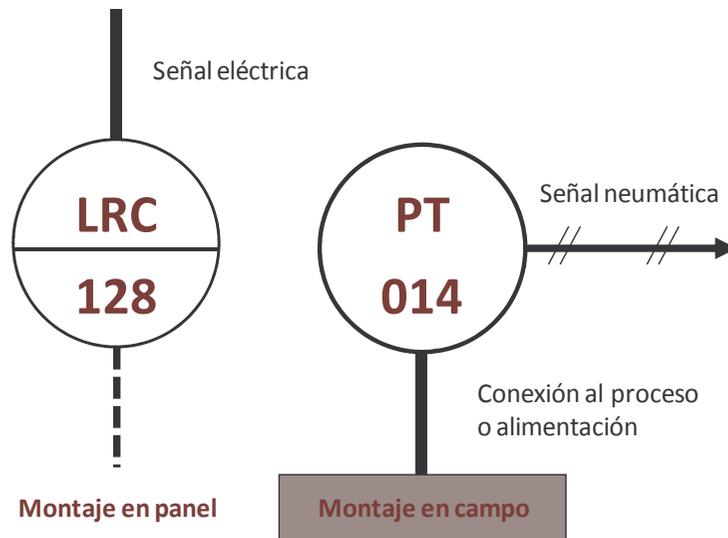
## Diagramas P&I

Los diagramas P&I (Piping and Instrumentation) representan al proceso, las operaciones unitarias de las que se componen y el sistema de control implementado sobre el mismo. En éste se incluyen:

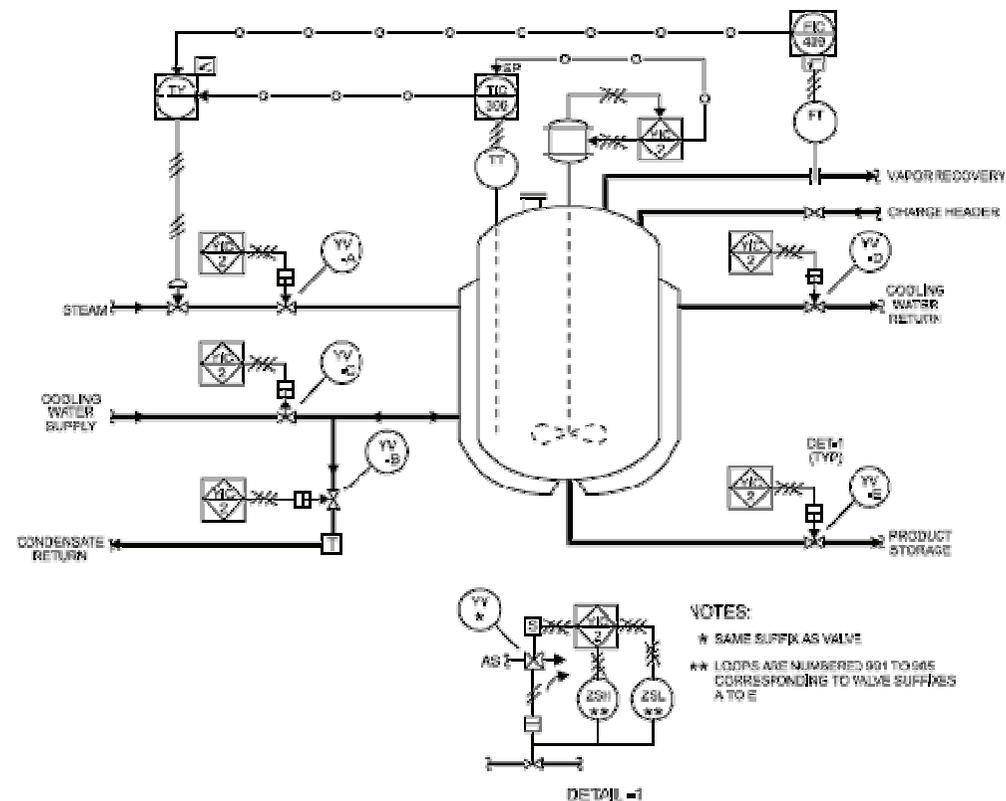
- Instrumentos de medida
- Actuadores que implementan la estrategia de control
- Bloques de función que proporcionan la lógica de control

Existen normativas específicas de representación de equipos e instrumentos.

- ISA: Sociedad Internacional para la Medición y el Control
- SAMA: Asociación de Fabricantes de Aparatos Científicos



Las letras indican la variable leída, controlada o manipulada y la acción que realiza el instrumento. El número es el mismo en todos los instrumentos de un mismo lazo de regulación.



Diagramas P&I

A	análisis
D	densidad
E	voltaje
F	caudal
I	corriente
J	potencia
L	nivel
M	humedad
P	presión
S	velocidad
T	temperatura
V	viscosidad
W	Peso
Z	posición

1ª letra: **Variable medida o relacionada**

2ª letra: **Puede cualificar a la primera**

D      diferencial

F      relación

S      seguridad

Q      integración

3ª y sig: **Función del Instrumento**

I      indicador

R      registro

C      control

T      transmisor

V      válvula

Y      cálculo

H      alto

L      bajo

Diagramas P&I

LETRA	<u>1ª LETRA:</u> VARIABLE O ACTUACIÓN	<u>2ª LETRA:</u> TIPO DE LECTURA U OTRA FUNCIÓN	<u>3ª LETRA:</u> FUNCIÓN ADICIONAL
A		ALARMA	ALARMA
C	CONDUCTIVIDAD	REGULACIÓN AUTOMÁTICA	REGULACIÓN AUTOMÁTICA
D	DENSIDAD		
E		ELEMENTO PRIMARIO	
F	CAUDAL		
G		VIDRIO	
H	ACTUADO A MANO		
I		INDICACIÓN	
L	NIVEL		
M	HUMEDAD		
P	PRESIÓN		
R		REGISTRO	
S	VELOCIDAD	SEGURIDAD	
T	TEMPERATURA		
V	VISCOSIDAD		VÁLVULA
W	PESO	FUNDA PROTECTORA	
Z	POSICIÓN		

Diagramas P&I

		CONTROL				MEDIDA				
CONBINACIÓN IMPOSIBLE		REGISTRADOR	INDICADOR	CIEGO	VÁLVULAS DE REGULACIÓN AUTOACCIONADAS	REGISTRDORES	INDICADORES	VÁLVULAS DE SEGURIDAD	DISPOSITIVOS DE CRISTAL	VAINAS
COMBINACIÓN IMPROBABLE										
TEMPERATURA	T	TRC	TIC	TC	TCV	TR	TI	TSV		TW
CAUDAL	F	FRC	FIC	FC	FCV	FR	FI	FSV	FG	
NIVEL	L	LRC	LIC	LC	LCV	LR	LI		LG	
PRESIÓN	P	PRC	PIC	PC	PCV	PR	PI	PSV		
DENSIDAD	D	DRC	DIC	DC		DR	DI			
MANUAL	H		HIC	HC	HCV					
CONDUCTIVIDAD	C	CRC	CIC	CC		CR	CI			
VELOCIDAD	S	SRC	SIC	SC	SCV	SR	SI	SSV		

## Diagramas P&I

(1) INSTRUMENT SUPPLY \*  
OR CONNECTION TO PROCESS

(2) UNDEFINED SIGNAL

(3) PNEUMATIC SIGNAL \*\*

(4) ELECTRIC SIGNAL

(5) HYDRAULIC SIGNAL

(6) CAPILLARY TUBE

(7) ELECTROMAGNETIC OR SONIC SIGNAL \*\*\*  
(GUIDED)

(8) ELECTROMAGNETIC OR SONIC SIGNAL \*\*\*  
(NOT GUIDED)

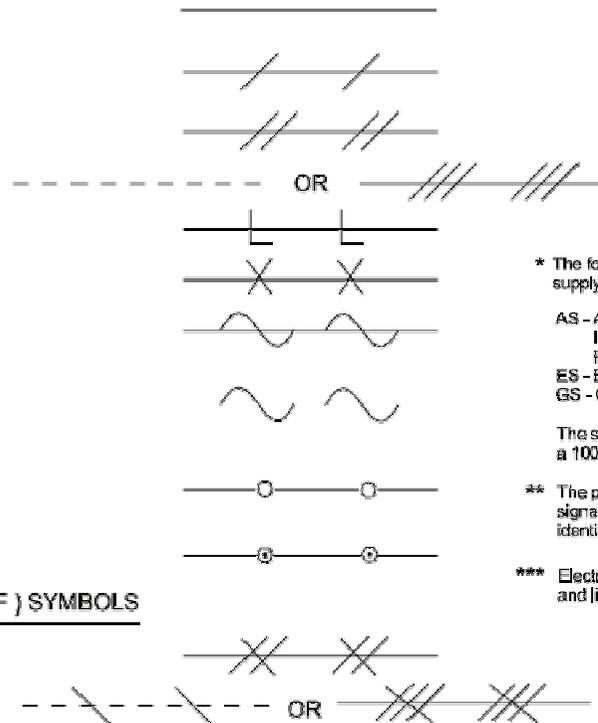
(9) INTERNAL SYSTEM LINK  
(SOFTWARE OR DATA LINK)

(10) MECHANICAL LINK

### OPTIONAL BINARY ( ON-OFF ) SYMBOLS

(11) PNEUMATIC BINARY SIGNAL

(12) ELECTRIC BINARY SIGNAL



\* The following abbreviations are suggested to denote the types of power supply. These designations may also be applied to purge fluid supplies.

AS - Air Supply	} Options	HS - Hydraulic Supply
IA - Instrument Air		NS - Nitrogen Supply
PA - Plant Air		SS - Steam Supply
ES - Electric Supply		WS - Water Supply
GS - Gas Supply		

The supply level may be added to the instrument supply line, e.g., AS-100, a 100-psig air supply; ES-24DC, a 24-volt direct current power supply.

\*\* The pneumatic signal symbol applies to a signal using any gas as the signal medium. If a gas other than air is used, the gas may be identified by a note on the signal symbol or otherwise.

\*\*\* Electromagnetic phenomena include heat, radio waves, nuclear radiation, and light.

## Diagramas P&I

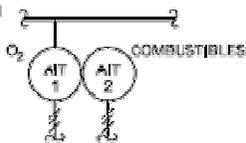
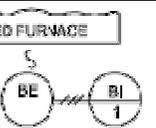
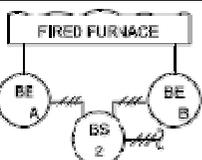
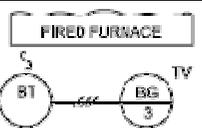
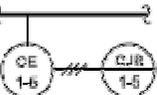
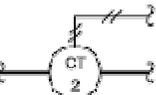
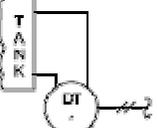
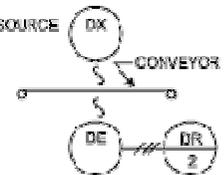
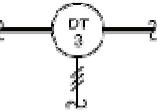
	PRIMARY LOCATION ***NORMALLY ACCESSIBLE TO OPERATOR	FIELD MOUNTED	AUXILIARY LOCATION ***NORMALLY ACCESSIBLE TO OPERATOR
DISCRETE INSTRUMENTS	1 * IP1** 	2 	3 
SHARED DISPLAY, SHARED CONTROL	4 	5 	6 
COMPUTER FUNCTION	7 	8 	9 
PROGRAMMABLE LOGIC CONTROL	10 	11 	12 

\* Symbol size may vary according to the user's needs and the type of document. A suggested square and circle size for large diagrams is shown above. Consistency is recommended.

\*\* Abbreviations of the user's choice such as IP1 (Instrument Panel #1), IC2 (Instrument Console #2), CC3 (Computer Console #3), etc., may be used when it is necessary to specify instrument or function location.

\*\*\* Normally inaccessible or behind-the-panel devices or functions may be depicted by using the same symbol but with dashed horizontal bars, i.e.



ANALYSIS	1  DUAL ANALYSIS INDICATING TRANSMITTER FOR OXYGEN AND COMBUSTIBLES CONCENTRATIONS	2	3
	1  ONE BURNER ULTRAVIOLET FLAME DETECTOR CONNECTED TO ANALOG-TYPE FLAME INTENSITY INDICATOR	2  TWO BURNER FLAME ROD SENSORS CONNECTED TO COMMON SWITCH	3  TELEVISION CAMERA AND RECEIVER TO VIEW BURNER FLAME
BURNER/COMBUSTION	1  CONDUCTIVITY CELL CONNECTED TO POINT 5 OF MULTIPoint SCANNING CONDUCTIVITY RECORDER	2  INLINE CONSISTENCY TRANSMITTER	3
	1  DENSITY TRANSMITTER, DIFFERENTIAL-PRESSURE TYPE, EXTERNALLY CONNECTED	2  RADIOACTIVE TYPE DENSITY ELEMENTS CONNECTED TO RECORDER ON PANEL	3  SPECIFIC GRAVITY TRANSMITTER, FLOW-THROUGH TYPE

USE OF LETTER C AND D DEFINED ON USER'S LEGEND SHEET

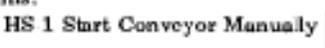
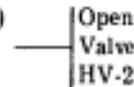
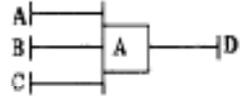
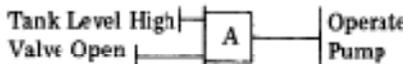
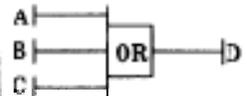
## Diagramas P&I

VOLTAGE	1		2		3	
	1		2		3	
	4		5		6	
FLOW RATE	7		8		9	

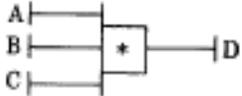
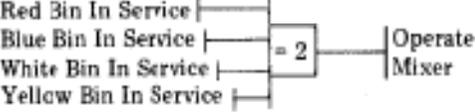
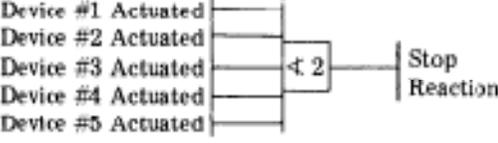
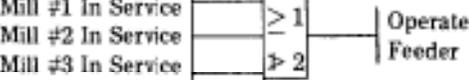
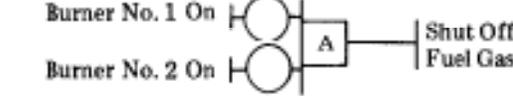
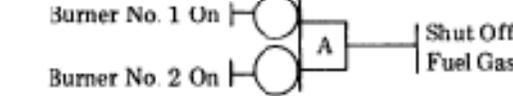
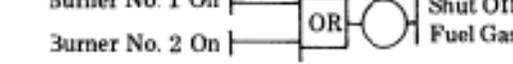
FLOW RATE (cont'd)	10		11		12	
	13		14		15	
	16		17		18	
	19		20		21	

Diagramas lógicos

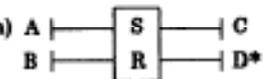
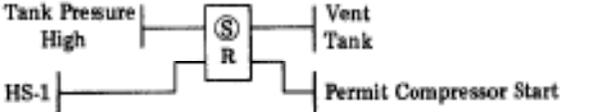
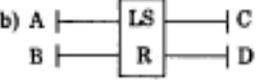
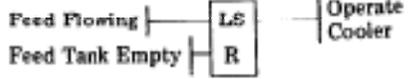
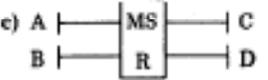
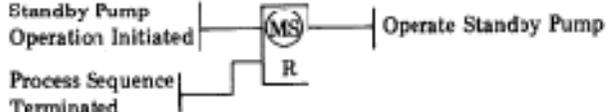
Los diagramas lógicos de control son una forma de representar las acciones implementadas en un sistema de control (P&I) que se desarrollan ante una serie de eventos. Se basan en la lógica.

FUNCTION	SYMBOL	DEFINITION	EXAMPLE
4.1 INPUT	<p>Statement of Input </p> <p>Alternatively:   Statement of Input                       Initiating instrument or device number, if known</p>	An input to the logic sequence	<p>The start position of a hand switch <i>HS-1</i>, is actuated to provide input to start a conveyor.</p> <p>Alternative diagrams:</p> <p>a) </p> <p>b) </p>
4.2 OUTPUT	<p>Statement of Output </p> <p>Alternatively:   Statement of Output                       Operated instrument or device number, if known</p>	An output from the logic sequence.	<p>An output from the logic sequence commands valve <i>HV-2</i> to</p> <p>Alternative diagrams:</p> <p>a) </p> <p>b) </p>
4.3 AND	<p><b>BASIC</b></p> 	Logic output <i>D</i> exists if and only if all logic inputs <i>A</i> , <i>B</i> , and <i>C</i> exist.	<p>Operate pump if suction tank level is high and discharge valve is open.</p> 
4.4 OR	<p><b>BASIC</b></p> 	Logic output <i>D</i> exists if and only if one or more of logic inputs <i>A</i> , <i>B</i> , and <i>C</i> exist.	<p>Stop compressor if cooling water pressure is low or bearing temperature is high.</p> 

Diagramas lógicos

FUNCTION	SYMBOL	DEFINITION	EXAMPLE
<p>4.5 QUALIFIED OR</p>	 <p>*Internal details represent numerical quantities (see "Definition").</p>	<p>Logic output <i>D</i> exists if and only if a specified number of logic inputs <i>A</i>, <i>B</i>, and <i>C</i> exist.</p> <p>Mathematical symbols, including the following, shall be used, as appropriate, in specifying the number:</p> <ul style="list-style-type: none"> <li>a. = equal to</li> <li>b. ≠ not equal to</li> <li>c. &lt; less than</li> <li>d. &gt; greater than</li> <li>e. ≥ not less than</li> <li>f. ≤ not greater than</li> <li>g. ≤ less than or equal to [equivalent to <i>f</i>]</li> <li>h. ≥ greater than or equal to [equivalent to <i>e</i>]</li> </ul>	<p>a) Operate mixer if two, and only two, bins are in service.</p> <p>Red Bin In Service   Blue Bin In Service   White Bin In Service   Yellow Bin In Service  </p>  <p>b) Stop reaction if at least two safety devices call for stop.</p> <p>Device #1 Actuated   Device #2 Actuated   Device #3 Actuated   Device #4 Actuated   Device #5 Actuated  </p>  <p>c) Operate materials feeder if at least one and no more than two mills are in service.</p> <p>Mill #1 In Service   Mill #2 In Service   Mill #3 In Service  </p> 
<p>4.6 NOT</p>	<p>BASIC</p>  <p>The <i>NOT</i> symbol may be drawn tangent to an adjacent logic symbol.</p>	<p>Logic output <i>B</i> exists if and only if logic input <i>A</i> does not exist.</p>	<p>Shut off fuel gas if burners no. 1 and no. 2 are not on.</p> <p>Burner No. 1 On   Burner No. 2 On  </p>  <p>Some Alternatives:</p> <p>Burner No. 1 On   Burner No. 2 On  </p>  <p>Burner No. 1 On   Burner No. 2 On  </p> 

Diagramas lógicos

FUNCTION	SYMBOL	DEFINITION	EXAMPLE
<p>4.7 MEMORY (Flip-Flop)</p> <p style="writing-mode: vertical-rl; transform: rotate(180deg);">BASIC</p>	<p>a) </p> <p>*Output D shall not be shown if it is not used.</p>	<p>S represents set memory and R represents reset memory.</p> <p>Logic output C exists as soon as logic input A exists. C continues to exist, regardless of the subsequent state of A, until the memory is reset, i.e., terminated by logic input B existing. C remains terminated regardless of the subsequent state of B, until A causes the memory to be set.</p> <p>Logic output D, if used, exists when C does not exist, and D does not exist when C exists.</p>	<p>If tank pressure becomes high, vent tank and continue venting, regardless of pressure, until venting is stopped by manual actuation of hand switch, HS-1, provided that the pressure is not high. If the venting is stopped, a compressor may be started.</p> <p></p>
		<p><i>Input-Override Option</i> If inputs A and B exist simultaneously, and if it is desired to have A override B, then S should be encircled, i.e., <math>\textcircled{S}</math>; if B is to override A, then R should be encircled, i.e., <math>\textcircled{R}</math>.</p> <p><i>Loss-Of-Power-Supply Option</i> The unmodified letter S denotes that no consideration has been given to the action of the memory on loss of the logic power supply. See paragraphs 4.7 b, c, and d, below, and 3.8.</p>	
	<p>b) </p> <p>(See Appendix C)</p>	<p>Similar to definition of symbol (a) except that the memory shall be lost in the event of loss of the logic power supply.</p>	<p>If feed begins to flow, the cooler shall operate until the feed tank is empty. In the event of loss of the logic power supply, the cooler shall not operate.</p> <p></p>
	<p>c) </p>	<p>Similar to definition of symbol (a) except that the memory shall be maintained in the event of loss of the logic power supply.</p>	<p>If standby pump operation is initiated, the pump shall operate, even on loss of the logic power supply, until the process sequence is terminated. The pump shall operate if start and stop commands exist simultaneously.</p> <p></p>

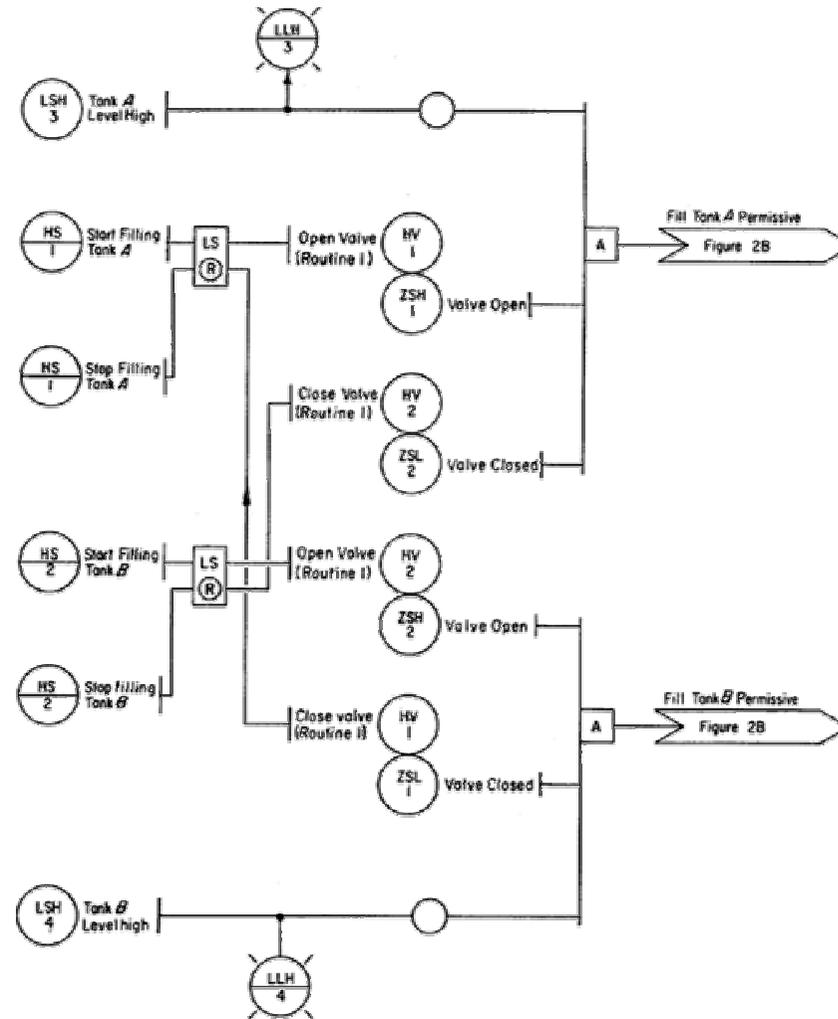
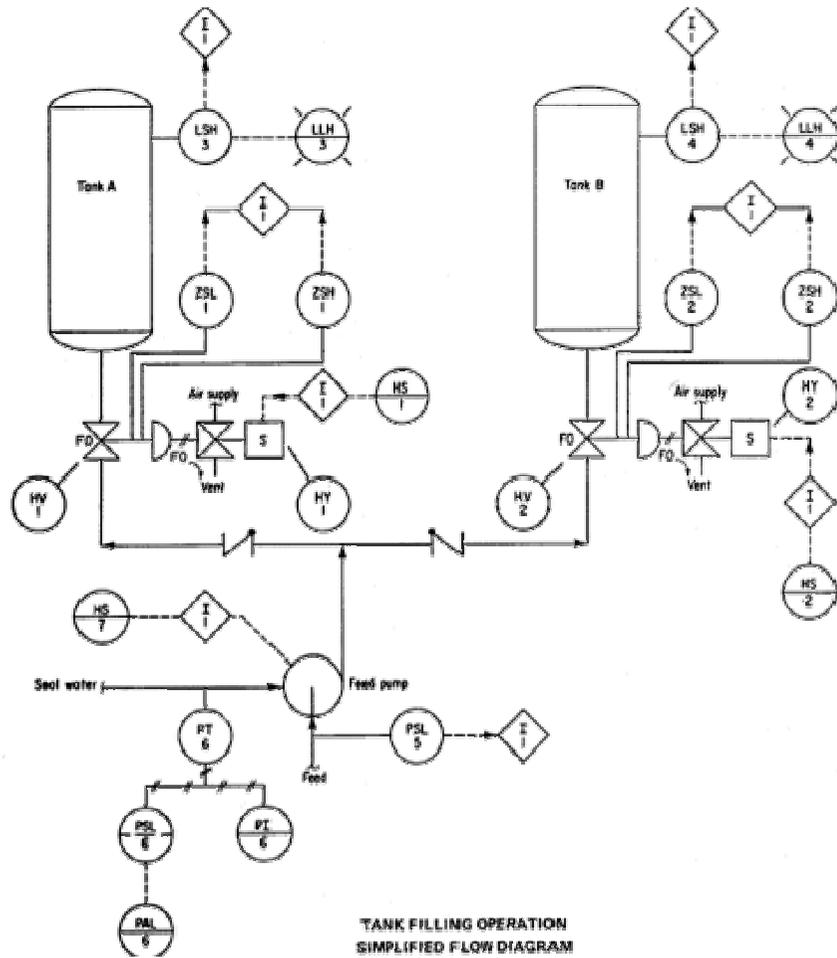
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Diagramas lógicos

Narrativa de control

Diagrama P&I

Diagrama lógico de control



Bibliografía

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