

Consideraciones de instalación de Bombas Centrífugas

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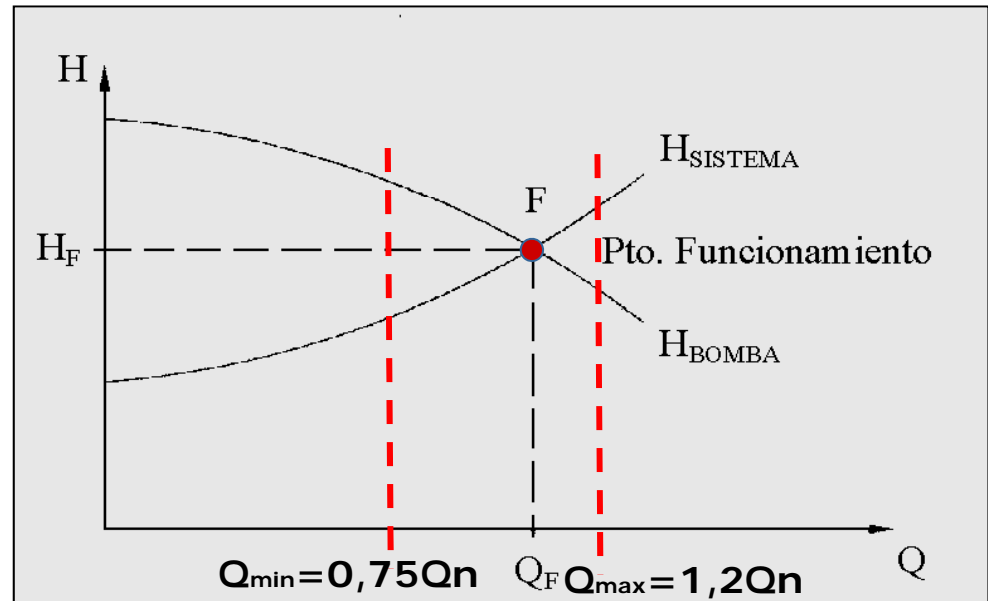
Febrero 2009

El Desempeño de la BC



Para grandes capacidades corrientemente se requiere instalar más de una bomba. i.e
Hablamos de ...

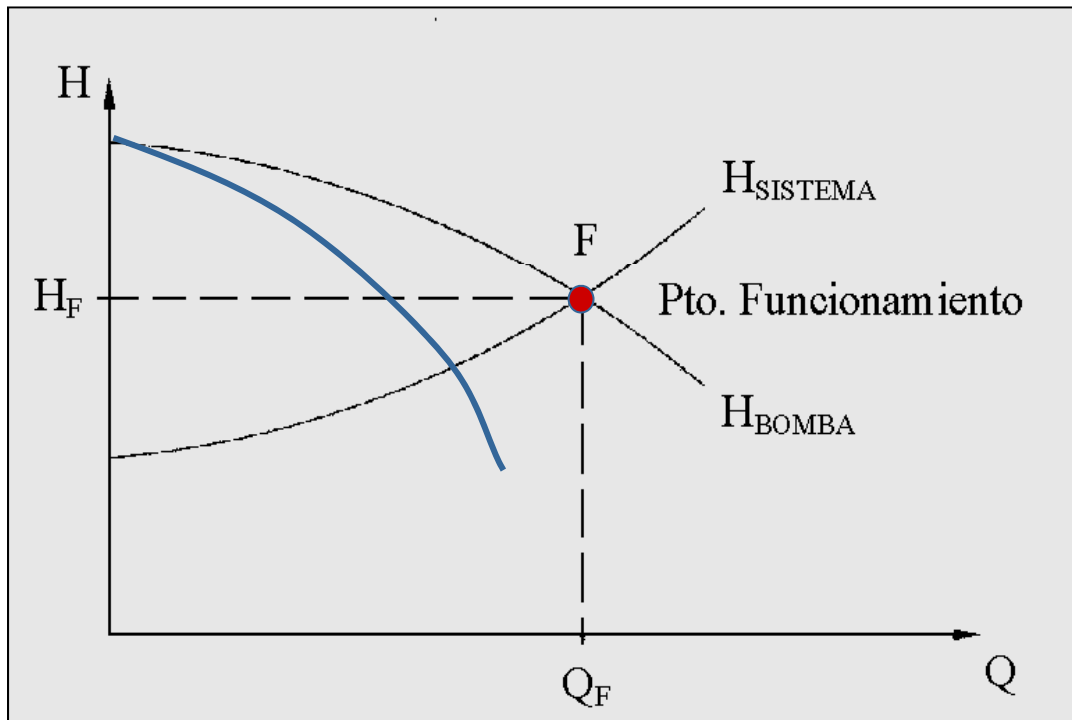
Estaciones de Bombeo



Cada bomba tendrá su Pto de Funcionamiento

El Desempeño de la BC

Existen diversos factores que pueden alterar el funcionamiento de una bomba



Viscosidad
Cavitación
Condiciones de
Instalación

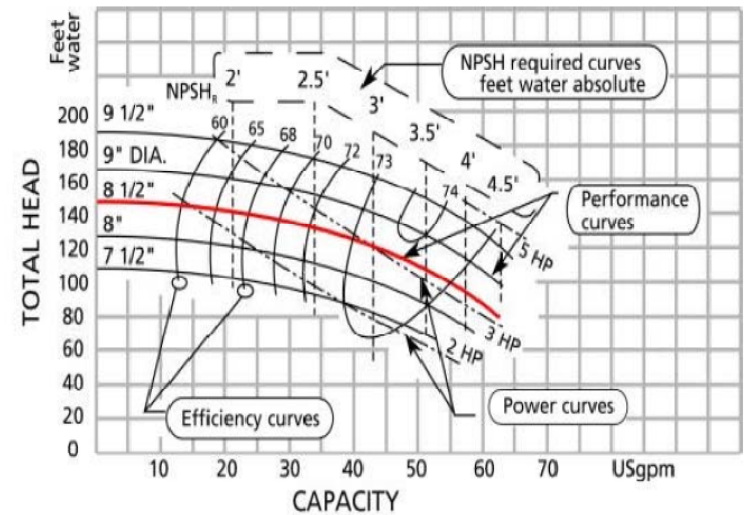
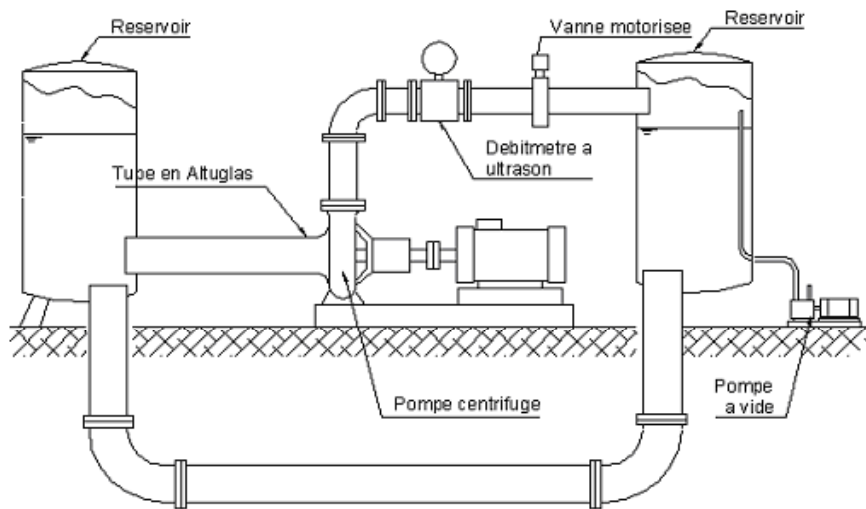
$Q \downarrow$

$H \downarrow$

$\eta \downarrow$

El Desempeño de la BC

Las curvas características son obtenidas en bancos de ensayo ...



Para una sola bomba en condiciones controladas de laboratorio bajo NORMAS ESPECÍFICAS

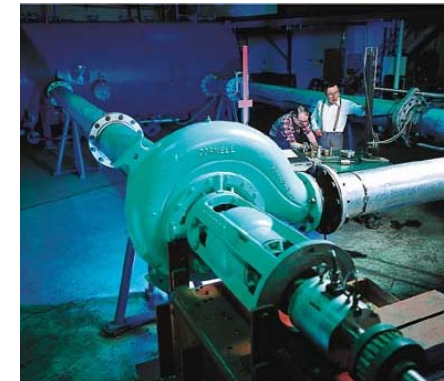
Las Instalación en Campo

Más de una bomba?



*Múltiples de succión y
descarga*

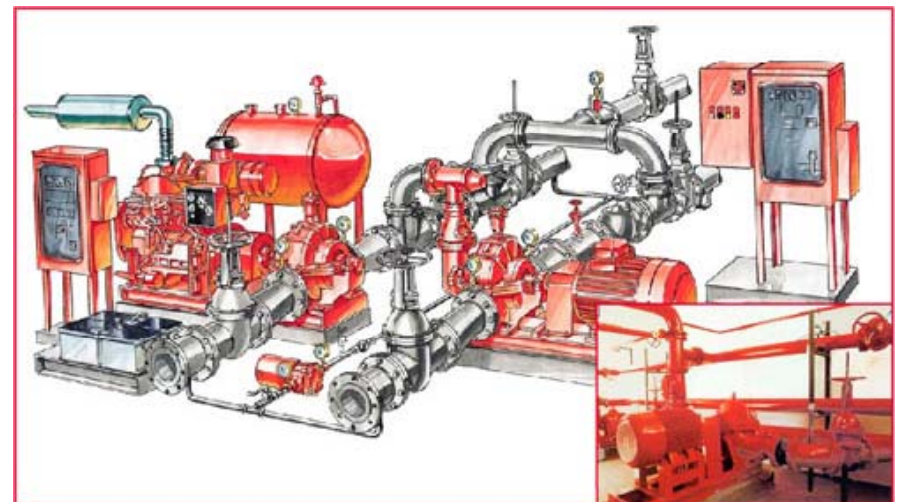
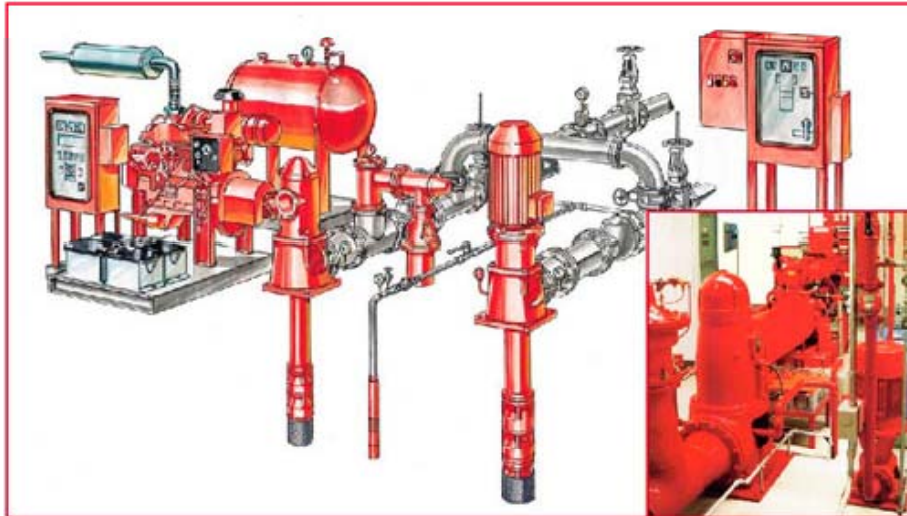
Limitaciones de espacio



Las Instalación en Campo

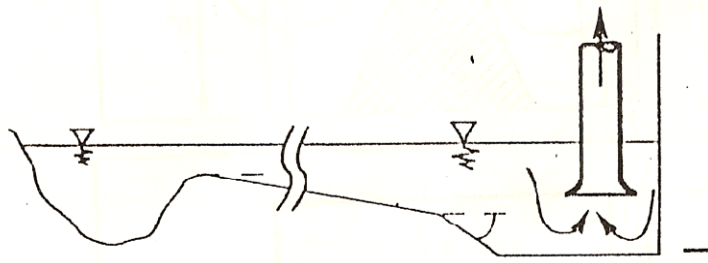
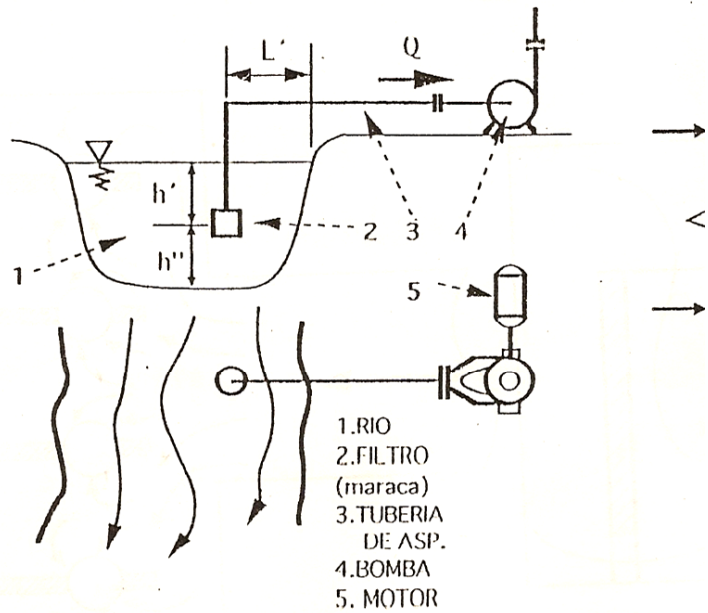


Sistemas contra Incendio



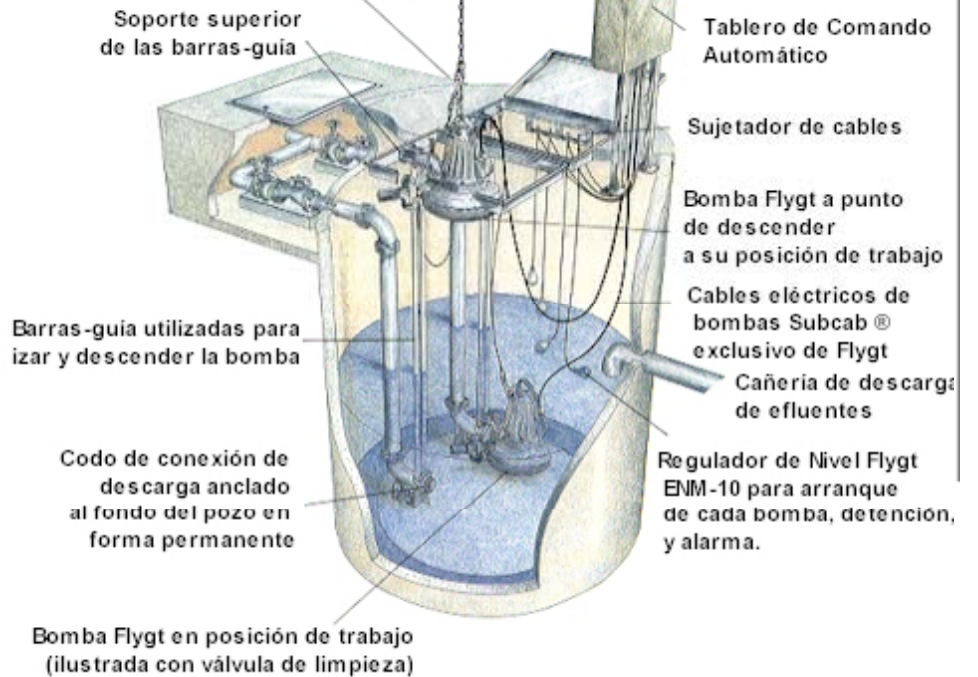
Esquemas frecuentes de instalación

De un río, Lago o efluente natural



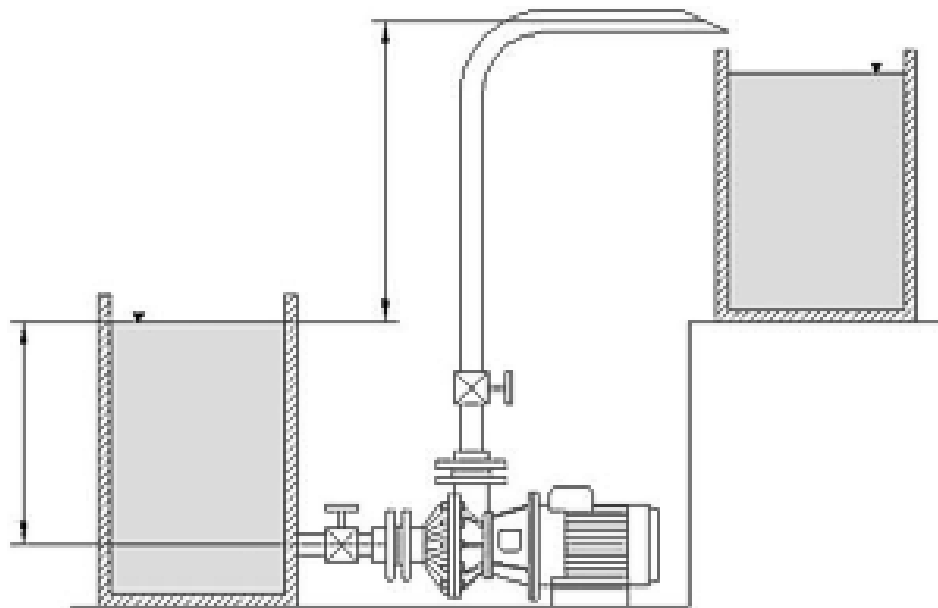
A partir de un tanque

Izaje de bombas para service

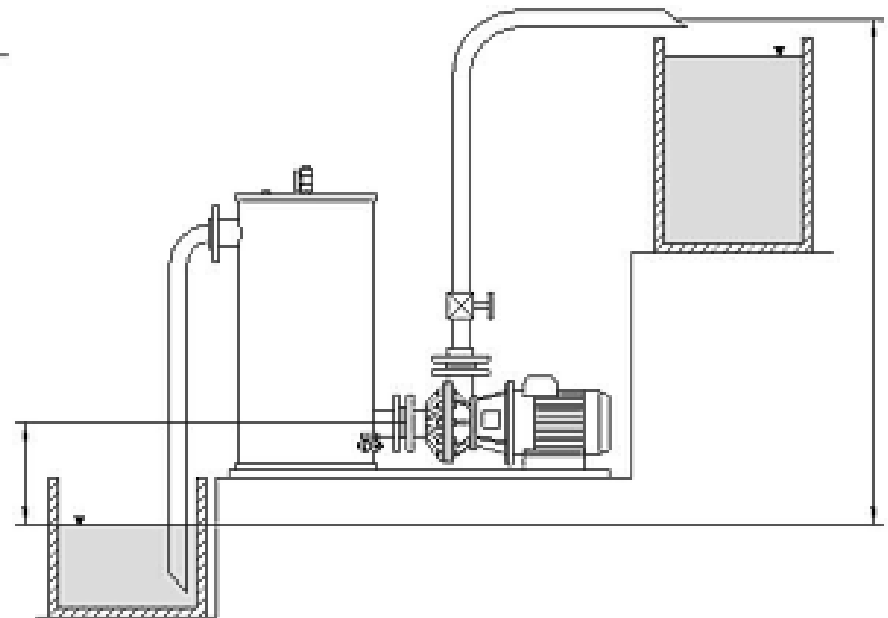


Esquemas frecuentes de instalación

Bombas Horizontales con Tanque de Alimentación



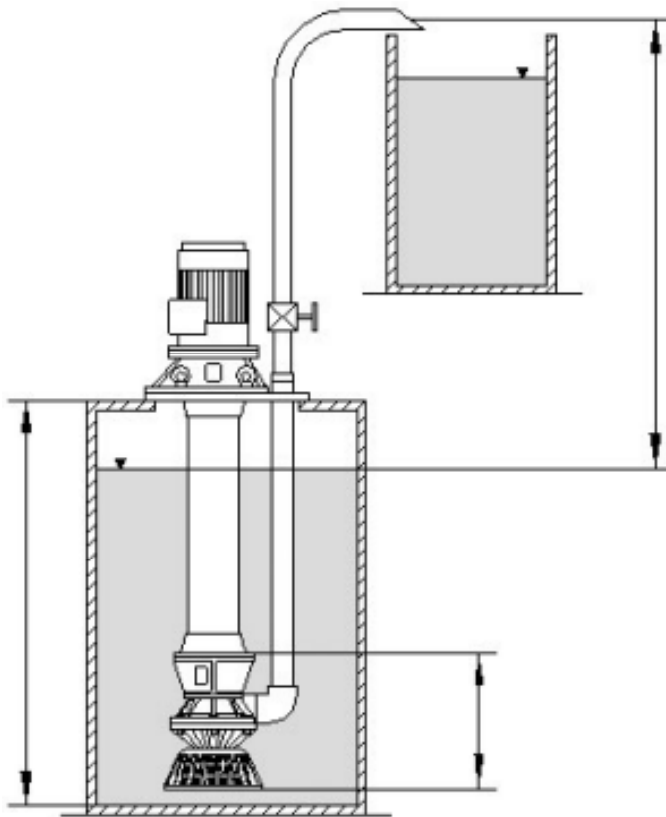
Sin Tanque de Presurización



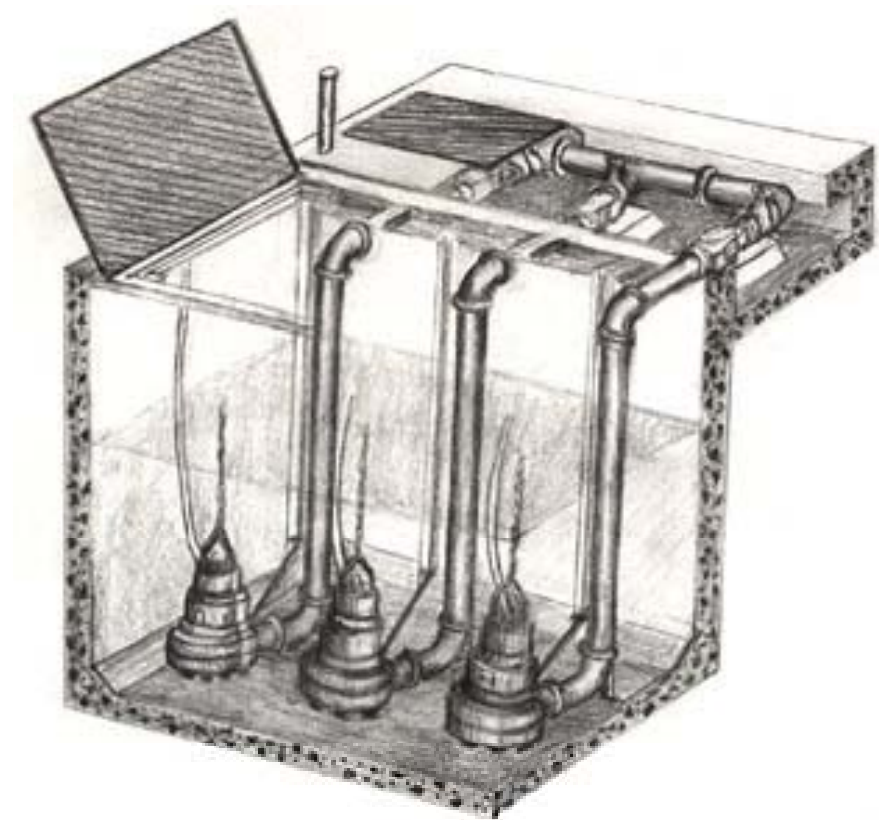
Con Tanque de Presurización

Esquemas frecuentes de instalación

Bombas Verticales

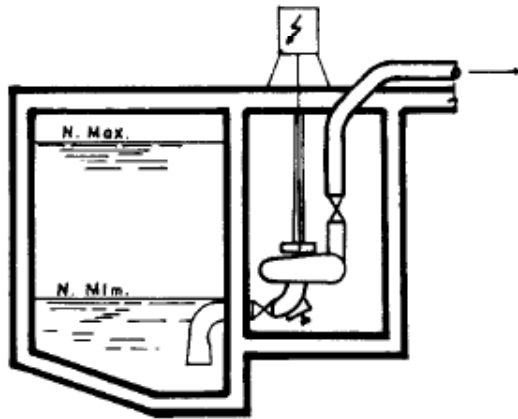


De pozo húmedo

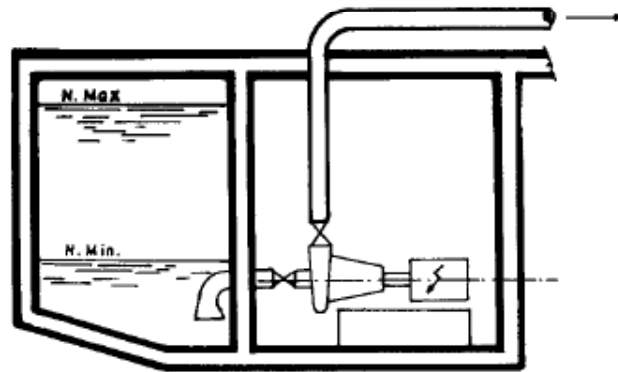


Sumergibles

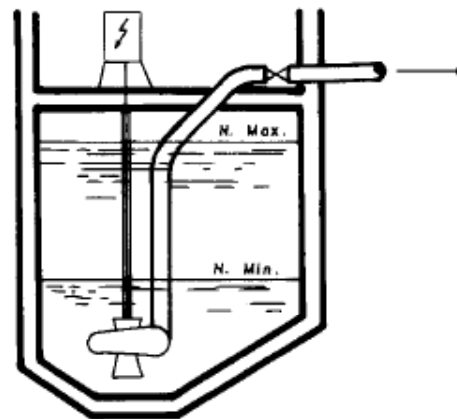
Una instalación de aguas residuales



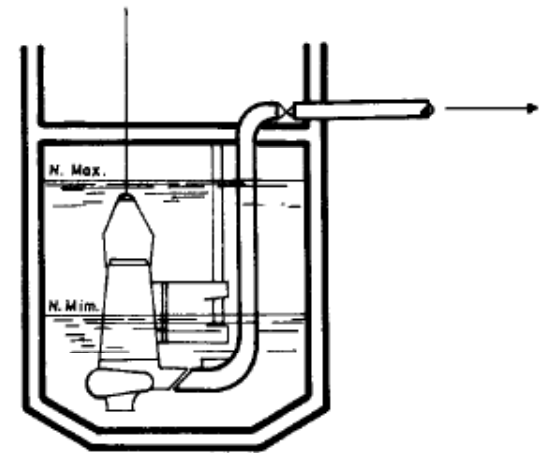
**BOMBA CENTRIFUGA DE EJE VERTICAL
INSTALADA EN POZO SECO**



**BOMBA CENTRIFUGA DE EJE VERTICAL INSTALADO
EN POZO SECO**

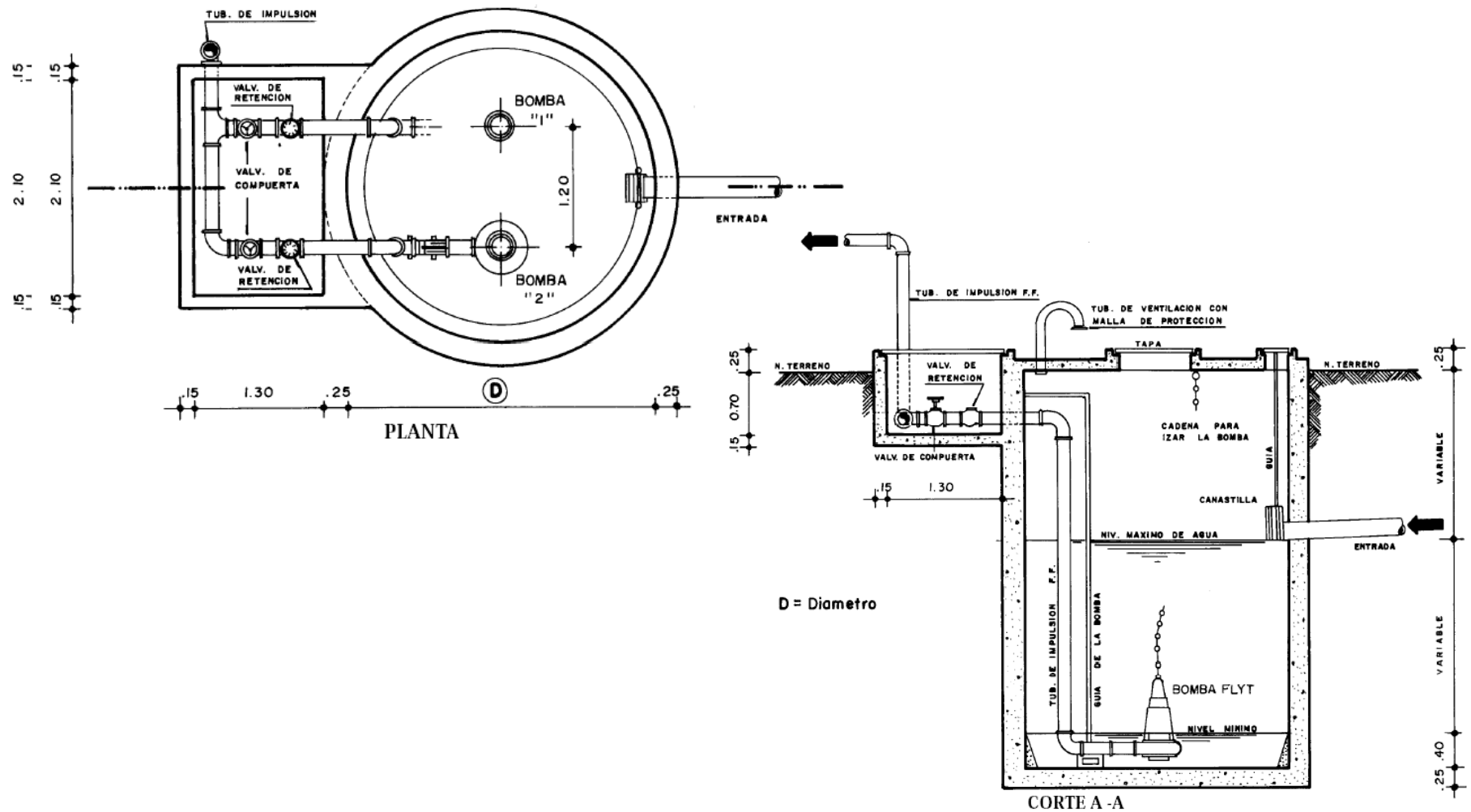


**BOMBA CENTRIFUGA DE EJE VERTICAL
INSTALADA EN POZO HUMEDO**



BOMBA CENTRIFUGA SUMERGIDA

Una instalación de aguas residuales



Bombas Verticales

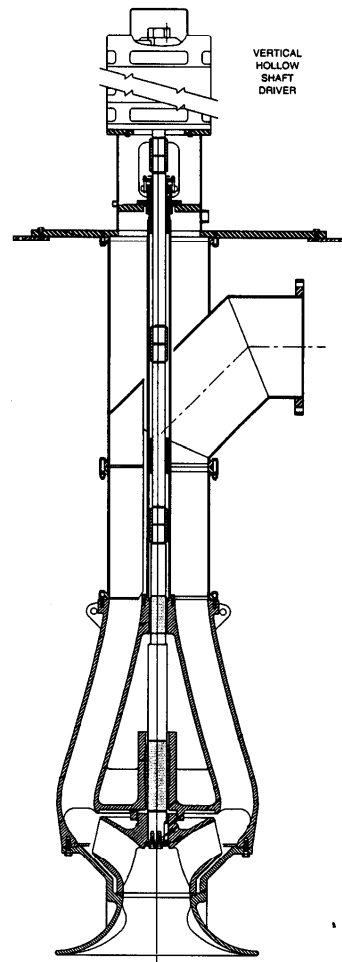


FIGURE 5.53 Vertical, mixed flow pump with enclosed line shafting for solids handling service. (Courtesy Fairbanks Morse Co.)

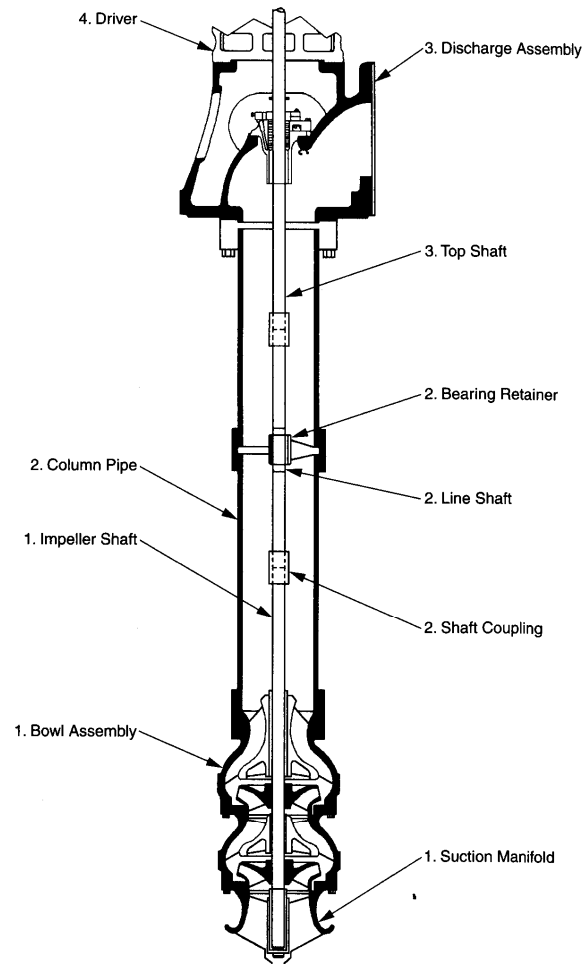
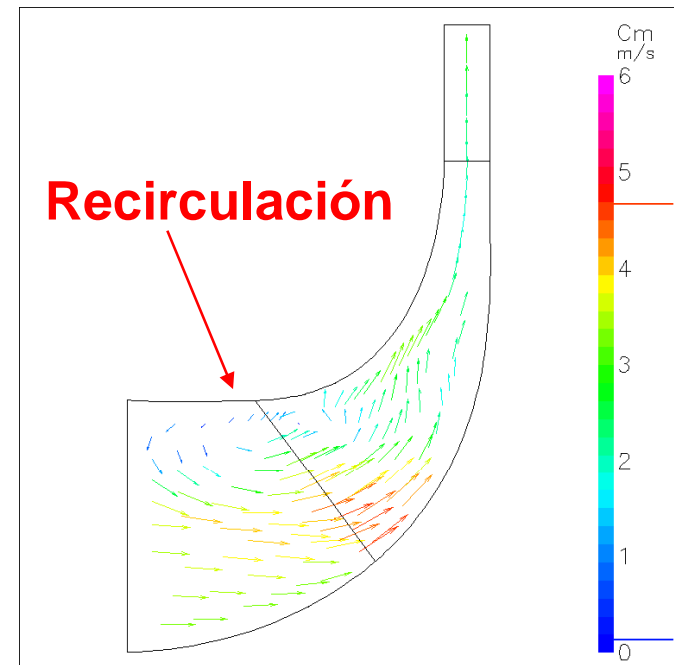


FIGURE 5.35 Four subassemblies for an axial flow pump. (Courtesy Peerless Pumps.)

Fenómenos Hidráulicos en la succión de la bomba

Distribución de Velocidades no Uniforme

Variaciones de la V_m no mayores a un 20% con respecto a la V_m en el caudal nominal



$$NPSH_{disponible} > FSNPSH_{requerido}$$



Fenómenos Hidráulicos en la succión de la bomba

Formación de Vórtices o Torbellinos



Fig. 4.1
Hollow vortex.

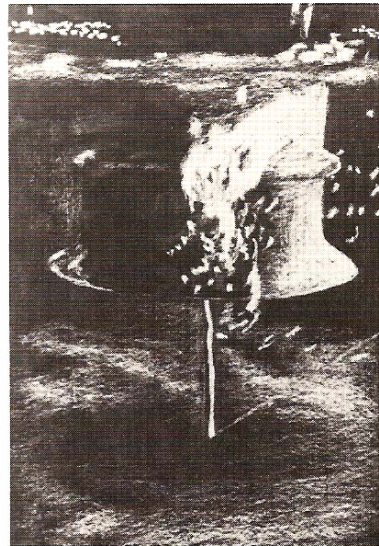
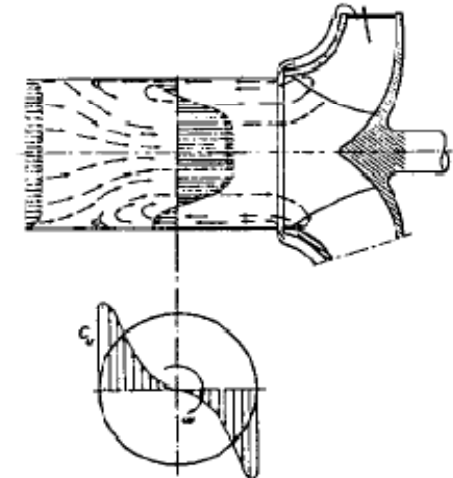
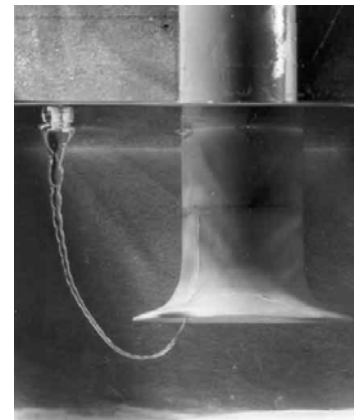


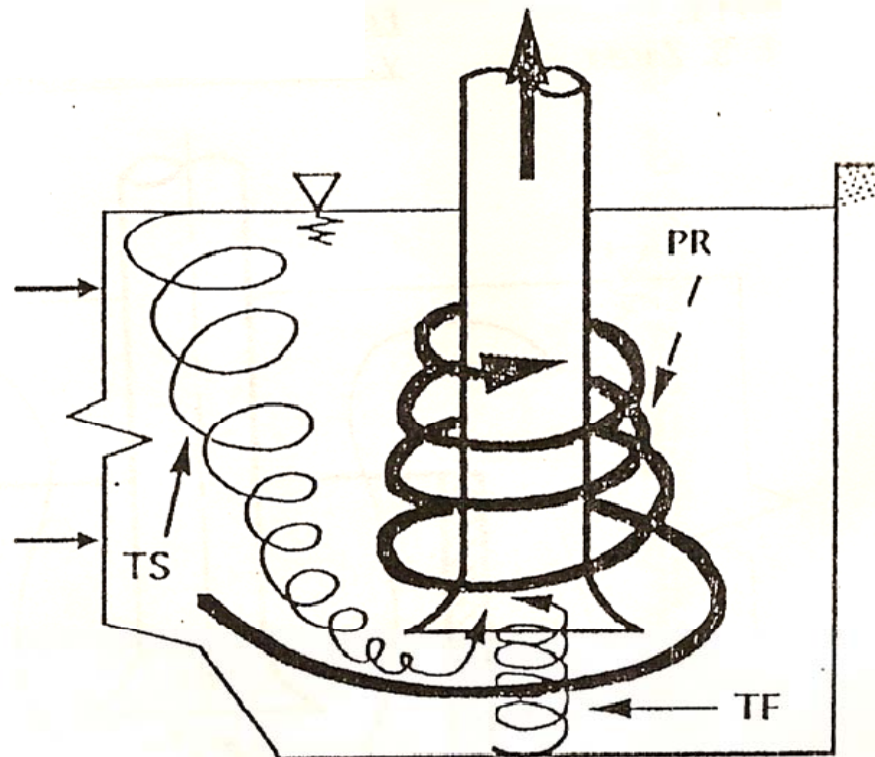
Fig. 4.2
Bottom vortex. (Photographs by Société
Hydrotechnique de France)

Prerotación

Todos los rotores inducen prerotación, especialmente a cargas parciales. Este fenómeno debe ser evitado para evitar desprendimiento



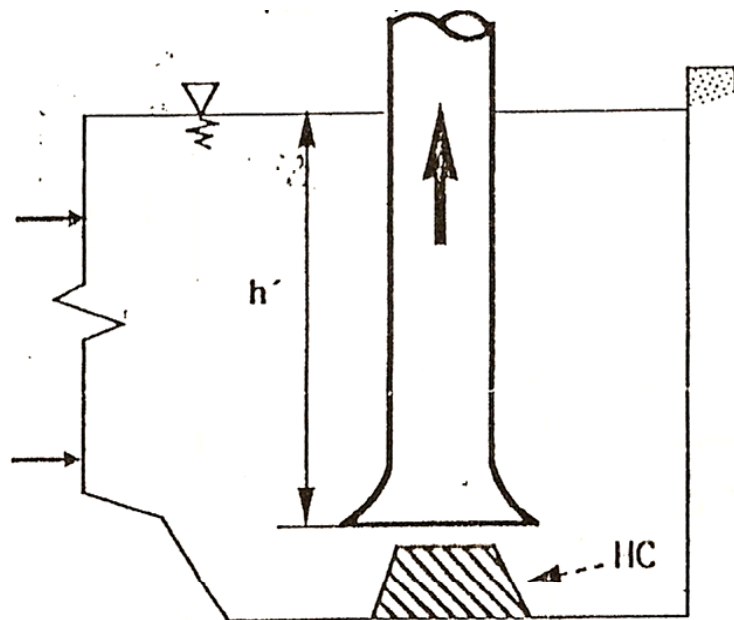
Fenómenos Hidráulicos en la succión de la bomba



TF - Torbellino de fondo.
TS - Torbellino de superficie.
PR - Prerotación.

Fig. 4 Fenómenos Hidráulicos en un tanque de aspiración.

Dispositivos de control de los fenómenos de hidráulicos en la succión



h' - Profundidad de sumersión.
HC - Hidrocono.

Fig. 5 Hidrocono para suprimir el torbellino de fondo.

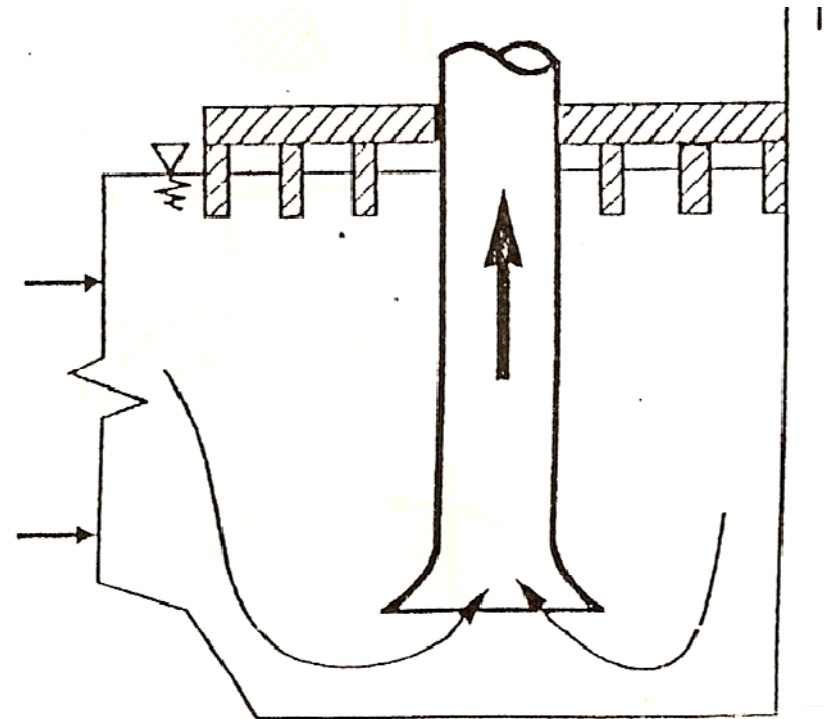


Fig. 6 Rejilla flotante para controlar los

Dispositivos de control de los fenómenos de hidráulicos en la succión

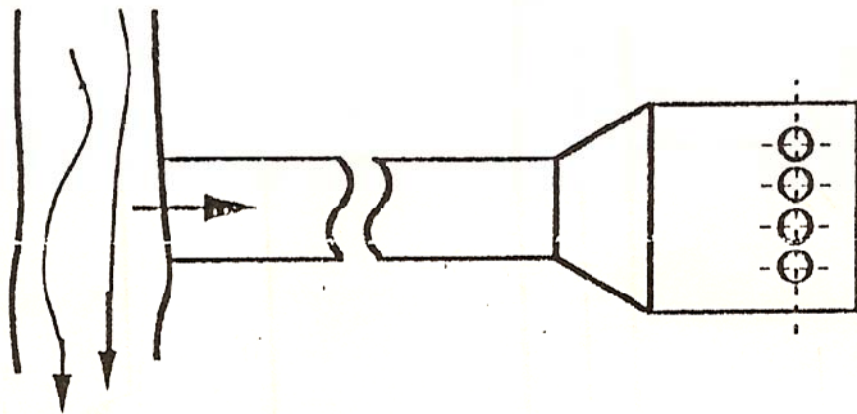


Fig. 2 Tanque de aspiración para varias bombas sin dispositivos de control de vórtices.

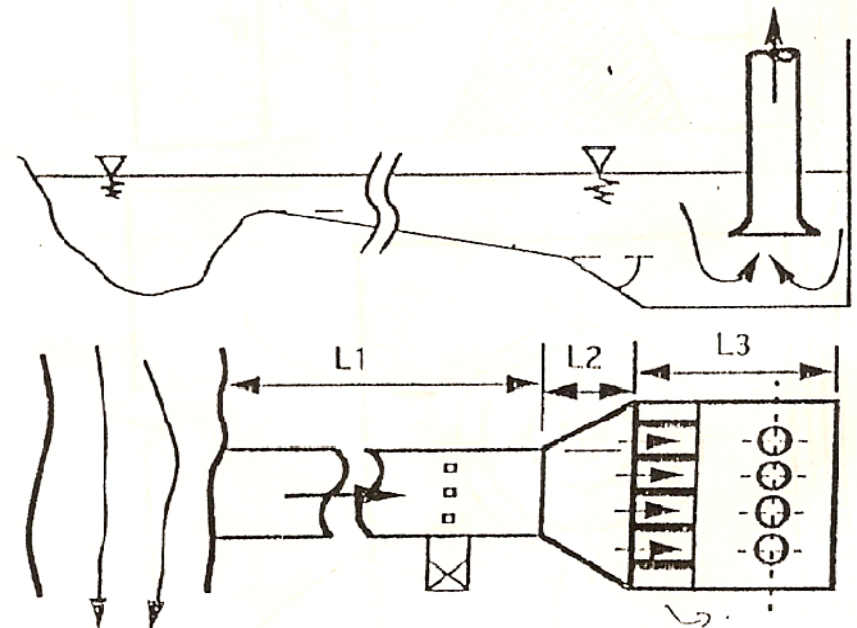


Fig. 3 Tanque de aspiración para varias bombas con paredes guía para uniformizar la distribución de la velocidad.

Dispositivos de control de los fenómenos de hidrauclcos en la succi3n

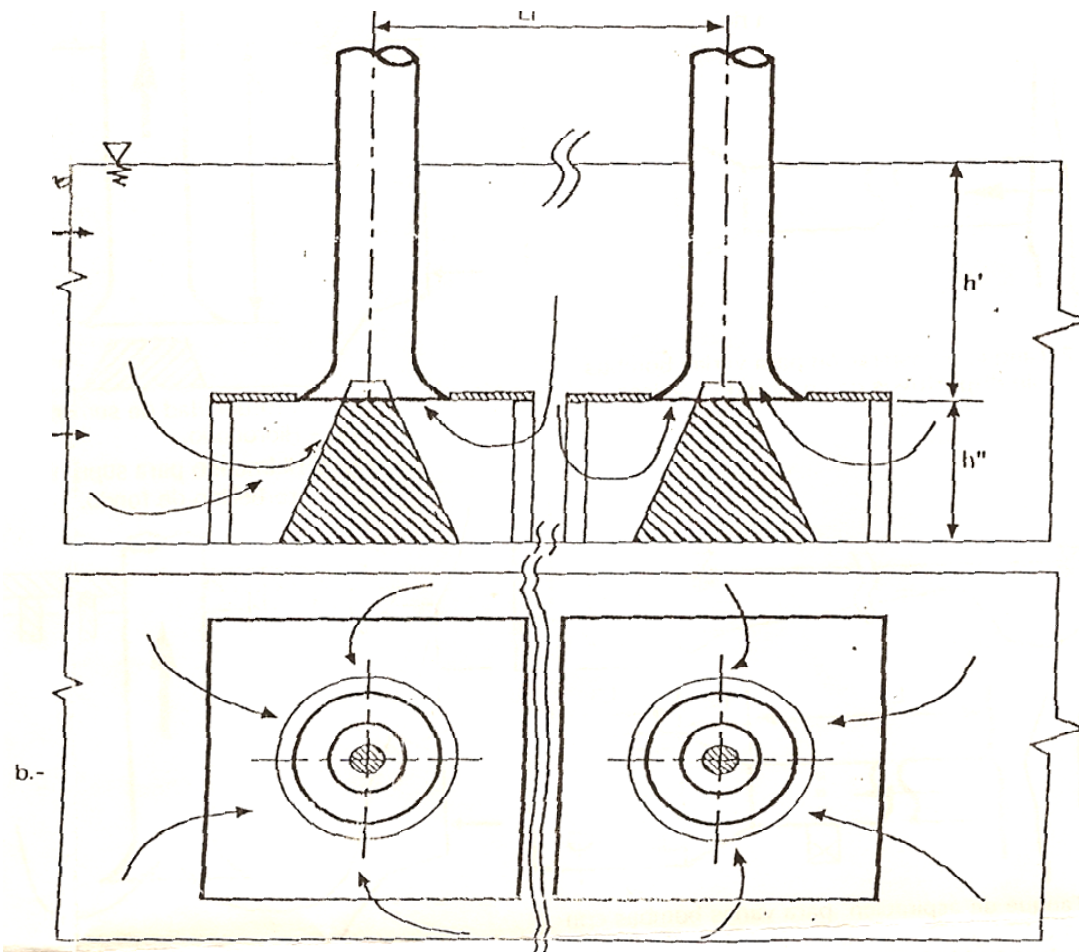


Fig. 9 Lamina metalica horizontal para controlar los torbellinos de superficie. El hidrocono elimina el torbellino de fondo. a) Elevaci3n. b) Vista de planta.

Dispositivos de control de los fenómenos de hidráulicos en la succión

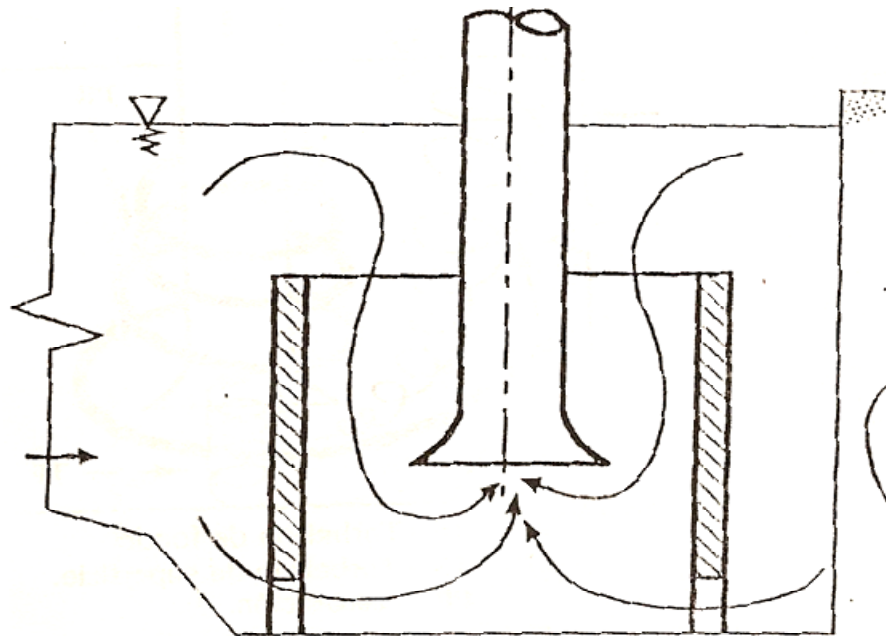


Fig. 8 .Cilindros para controlar los torbellinos.

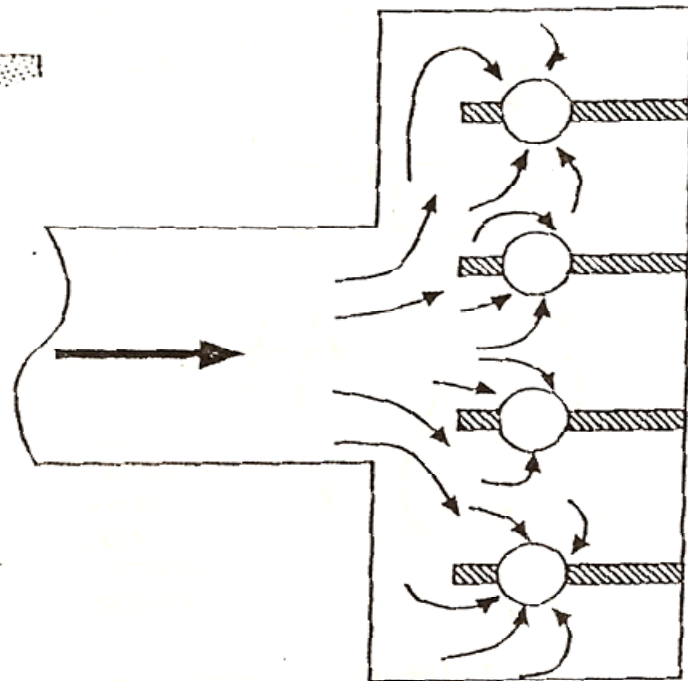


Fig. 7 Paredes para impedir la prerotación.

Diseño de la Succión

Generalmente es un compromiso entre los costos, obras civiles y limitaciones hidráulicas

Dos tipos de instalación

Secas (Dry)

Húmedas o mojadas (Wet)

Zonas o partes

Entrada, Alimentación

Tanque

Tubería o codo de aspiración o entrada

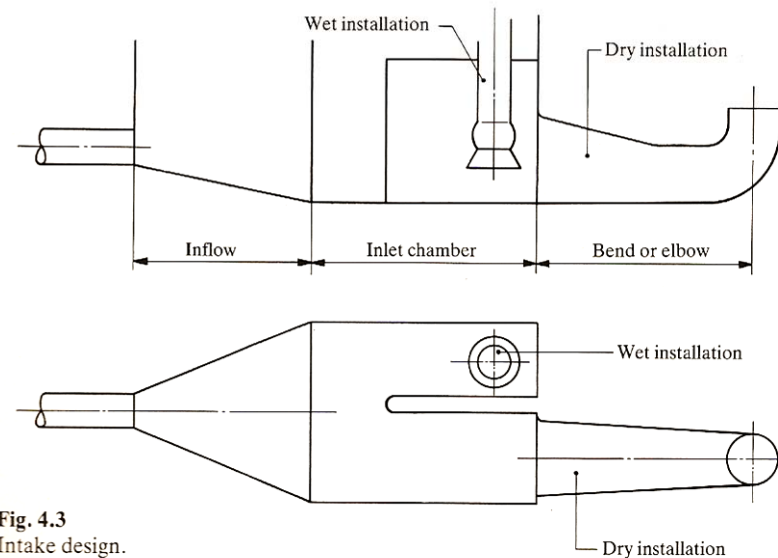


Fig. 4.3
Intake design.

Diseño de la Succión.

Tanque abiertas con succión de campana

Instalación individual

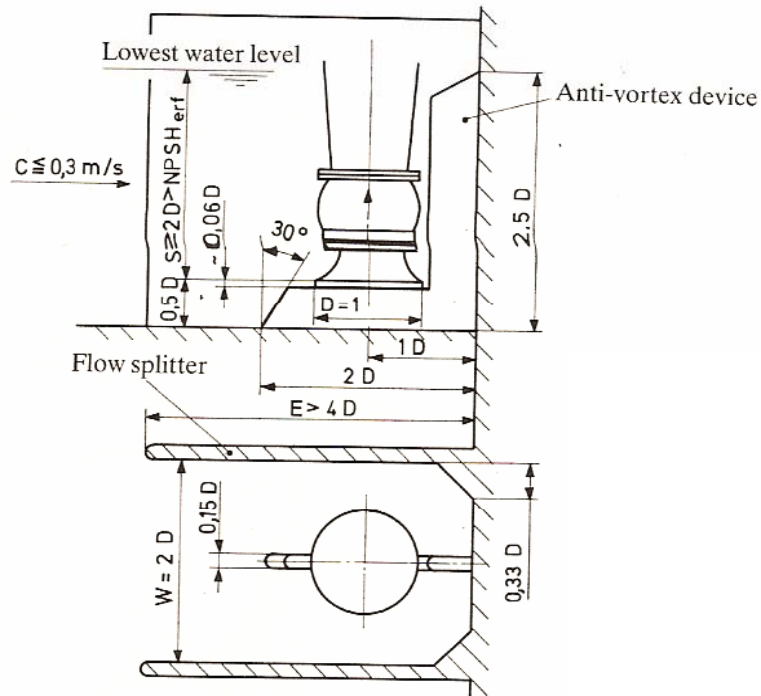


Fig. 4.4
Open inlet chamber, normal installation for flow rates $\leq 20 \text{ m}^3/\text{s}$. Minimum overlap $S \geq 2D \geq NPSH_{\text{req}}$.

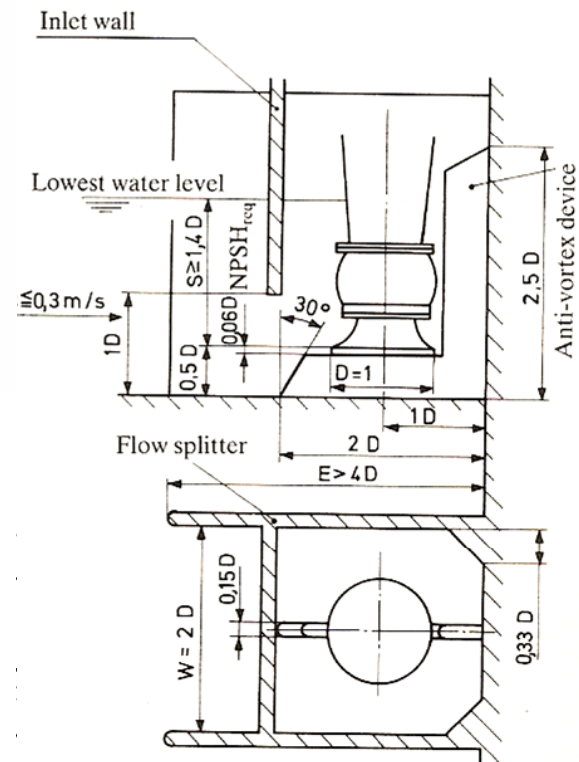


Fig. 4.5
Open inlet chamber with inlet wall for flow rates $\leq 20 \text{ m}^3/\text{s}$. Minimum overlap $S \geq 1.4D \geq NPSH_{\text{req}}$.

Diseño de la Succión. Tanque abiertas con succión de campana

Bajos niveles de Agua

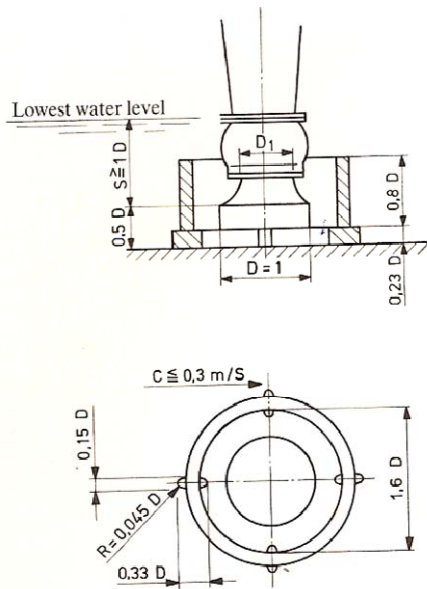


Fig. 4.6
Installation with baffle cylinder for flow rates $\leq 20 \text{ m}^3/\text{s}$. Minimum overlap $S \geq 1D \geq \text{NPSH}_{\text{req}}$.

Instalación de bombas en paralelo

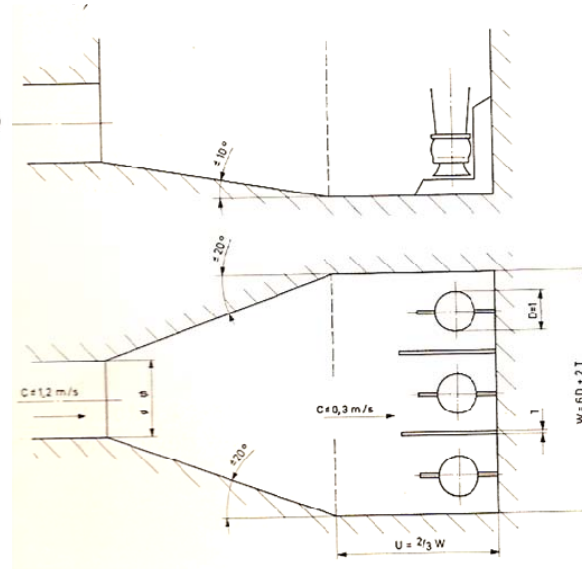
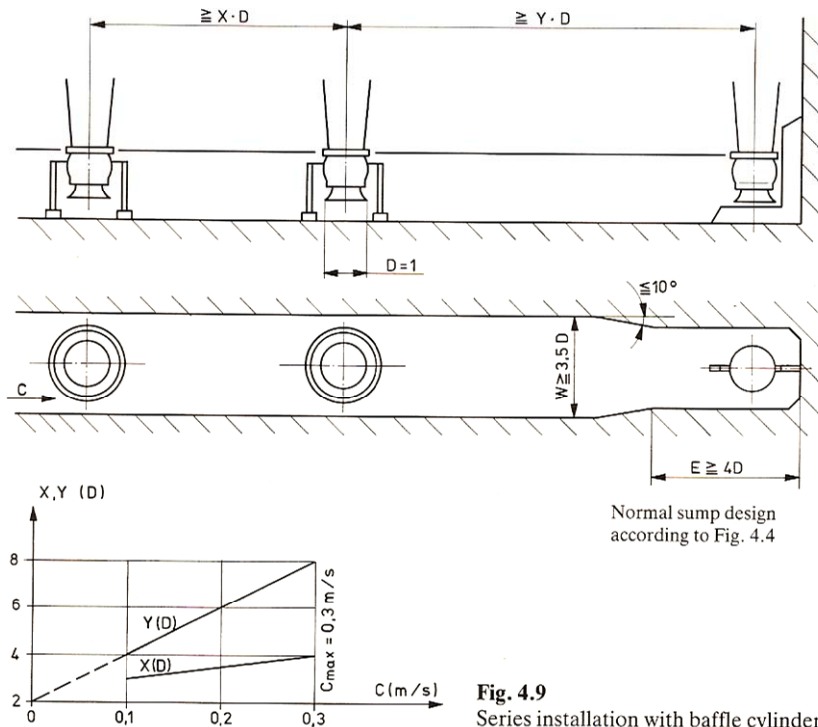


Fig. 4.7
The dimensions of the inlet chamber and the arrangement of the pump correspond to Figs. 4.4 and 4.5. The additional data concern the inflow and chamber structure. If the maximum admissible diffuser angle ($\leq 20^\circ$) is exceeded, grids must be provided at a distance "U".

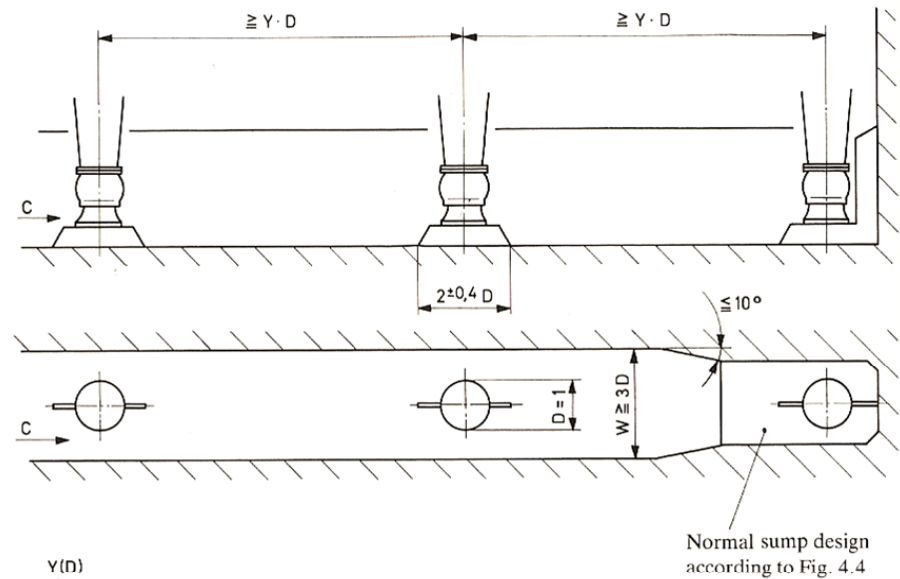
Diseño de la Succión.

Tanque abiertas con succión de campana

Instalación de bombas en línea



c) Series installation



Buenas Prácticas



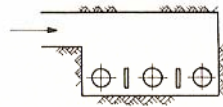



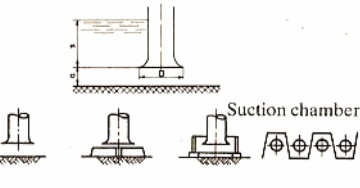

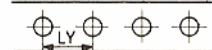
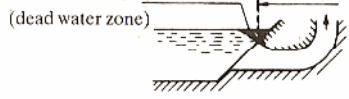
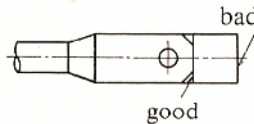
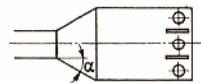
<p>1. Danger of air entrainment.</p>  <p>Avoid edge</p>	<p>6. Waterjet in the intake reservoir is very bad, because air bubbles are entrained.</p> 	<p>10. Poor arrangement, not advisable!</p> 
<p>2. Check $NPSH_{req}$ and minimum overlap "S" with Fig. 4.13.</p>	<p>7. Poor inflow. Side off-take from main channel.</p> 	<p>11. Keep inlet flow angle small ($\leq 10^\circ$).</p> 
<p>3. Inflow velocity at entry into pump chamber $c \leq 0.3$ m/s with wet installation.</p>	<p>Recommended installation</p> 	<p>12. Precautions against vortex formation:</p> <ul style="list-style-type: none"> - overlap "S" - bottom clearance $a = 0.5 D$ - anti-rotation device or cross or - baffle cylinder as in Fig. 4.6 
<p>4. Unfavourable pump chamber geometry. With high velocity in the inlet channel a high Y value results. Improve by making Y conform to Figs. 4.8 and 4.9 or by fitting a screen.</p> 	<p>8. Poor installation, feasible only if the conditions of Figs. 4.8 or 4.9 are met.</p> 	<p>13. Poor design of bend inlet.</p> <p>Better: Vertical wall rounded at bend inlet, or increased overlap.</p> <p>Risk of vortex formation (dead water zone)</p> 
<p>5. Always provide a wall with in-fillings behind the pump.</p> 	<p>9. Risk of flow separation owing to wide diffuser angle. Install as in Fig. 4.7.</p> 	

Fig. 4.14

Hints for designing pump chambers.

Buenas Prácticas






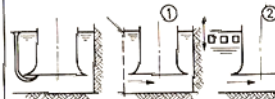
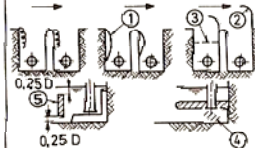

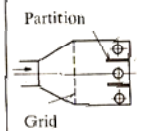

1. Good flow conditions but insufficient overlap: modify before bellmouth			
<p>Vortex</p>  <p>Improvement: - metal disk close to water surface, otherwise ineffective - float on surface</p>	<p>Too much bottom clearance</p>  <p>Improvement: Use cone and anti-rotation fin</p>	<p>Vortex</p>  <p>Improvement: Anti-rotation cross in bellmouth.</p>	
<p>Big inflow chamber or lake Vortex</p>  <p>Improvement: Install cylinder as in Fig. 4.6</p>	<p>Vortex</p>  <p>Improvement: Fit partition as in Fig. 4.5</p>	<p>Vortex Grid</p>  <p>Improvement: - fit grid close to bellmouth - surface float</p>	
2. Adverse flow conditions due to poor inflow geometry to inlet chamber			
 <p>Improvement: ① Fittings to prevent flow separation. ② Deflecting vanes. ③ Possible additional grid or straightener. ④ Deflecting vanes with covered chamber ⑤ Partition.</p>	<p>Vortex entrained air Grid</p>  <p>Cause: Insufficient overlap or sloping wall.</p> <p>Important: Grid on water level reduces vortex formation. Grid may be fitted rigid or floating.</p>	<p>Partition</p>  <p>Grid</p> <p>Additional partition if running with reduced number of pumps is possible. Grid must be fitted if diffuser angle does not conform to Fig. 4.7.</p>	 <p>Provide deflecting vanes for lateral inflow.</p>

Fig. 4.15
Hints for improving the flow in existing installations.