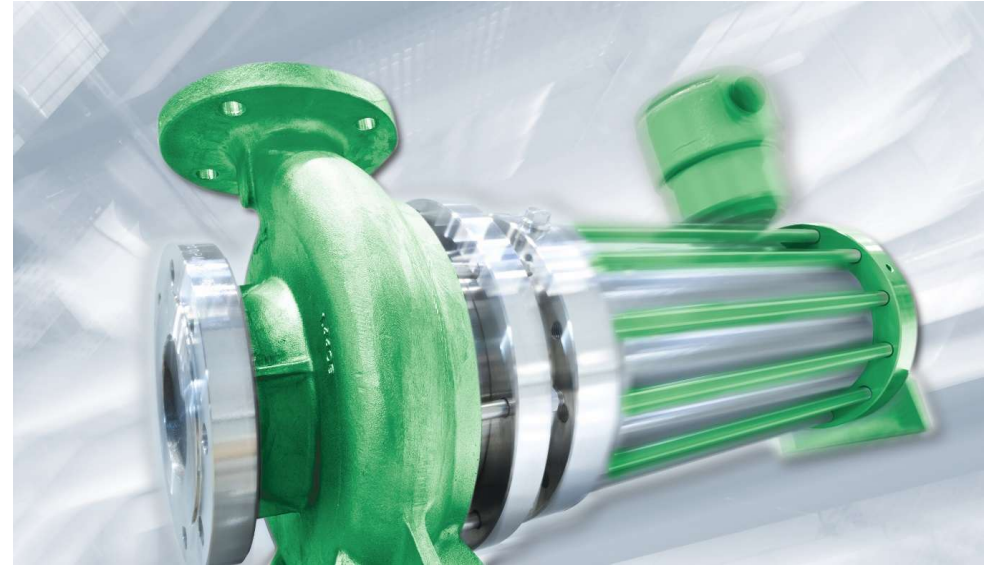
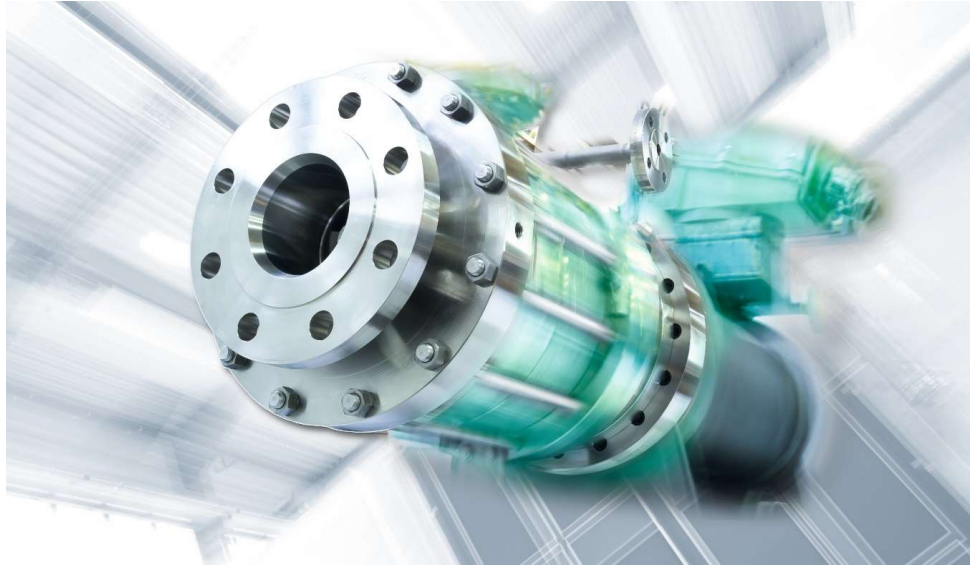




Challenges of pumping ammonia and existing solutions

Iván Pérez Pindado. GM Hermetic Pumpen Ibérica
Perez.ivan@hermetic-pumpen.com

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HISTORIA DE HERMETIC-PUMPEN . DESARROLLOS

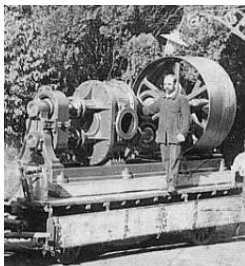
2

Desarrollo

hand driven wine pump



rotary lobe pump



First canned motor pump



Desulphurization



Fluido supercrítico

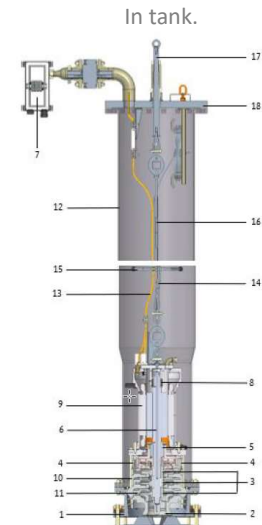


Fig. 4: Principle structure

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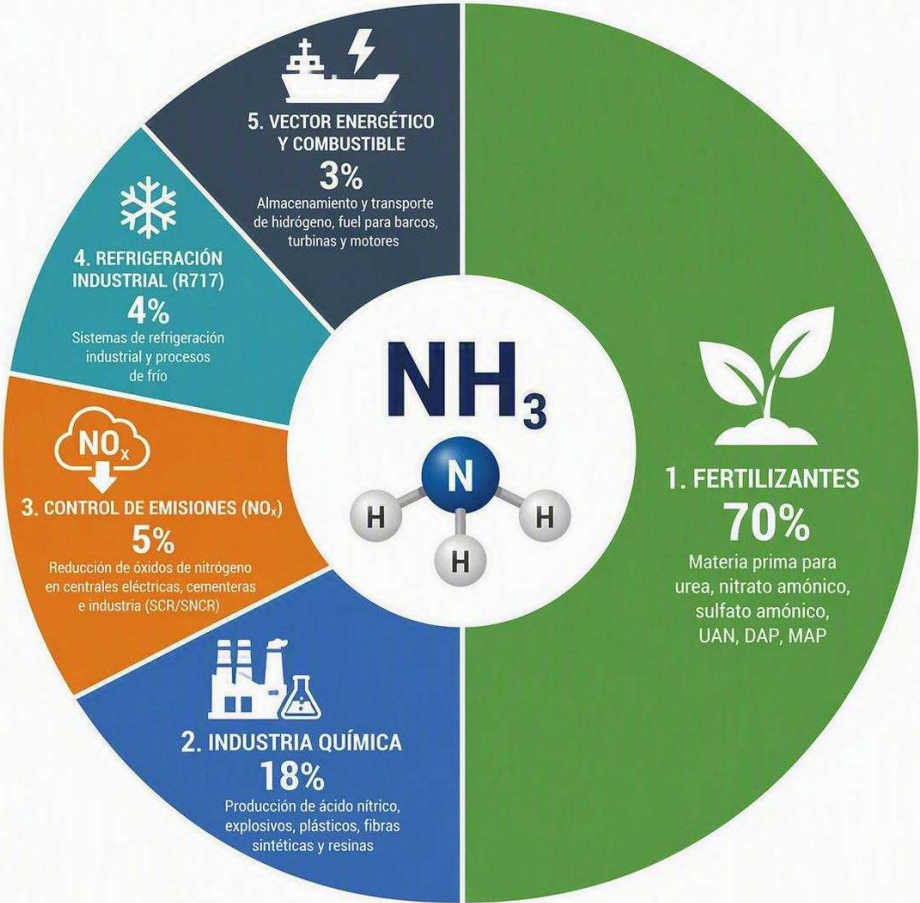


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AMONIACO

PRINCIPALES USOS DEL AMONIACO (NH₃)

Participación aproximada de la demanda global actual



Fuente: IEA – Ammonia Technology Roadmap (2021)
Alrededor del 70% del amoníaco mundial se utiliza en fertilizantes.
El resto se destina a aplicaciones industriales y energéticas.





Segundo producto químico más producido

Tóxico

Gas licuado (alta presión de vapor)

Bombeo a baja temperatura (aprox -35°C)

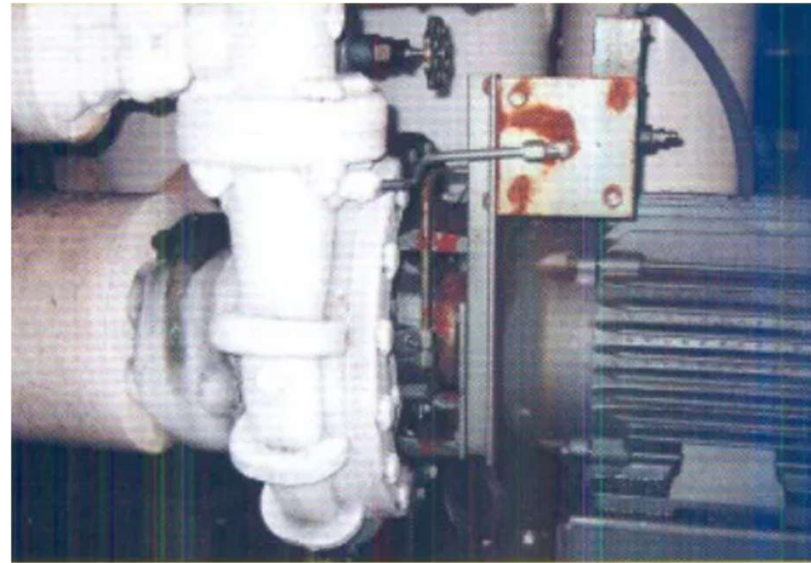
Corrosivo (NH₃ + agua)

Explosivo bajo ciertas condiciones (determinada concentración de aire, fuente ignición)

¿PROBLEMAS TÉCNICOS/DESAFÍOS AL BOMBLEAR AMONIACO?



Sello bomba amoníaco

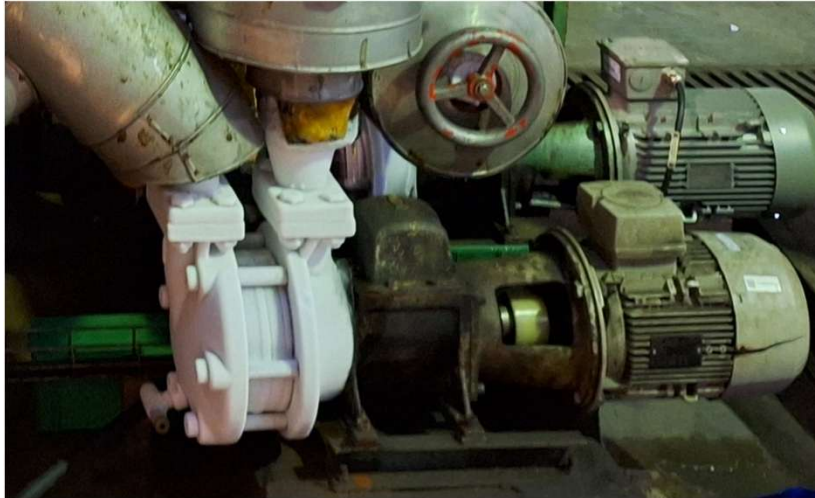


Fuga por deterioro de sello en bomba amoníaco

Corrosión por amoníaco → deterioro de sello y **fugas**

BOMBEO A MUY BAJA TEMPERATURA , HASTA -50° C

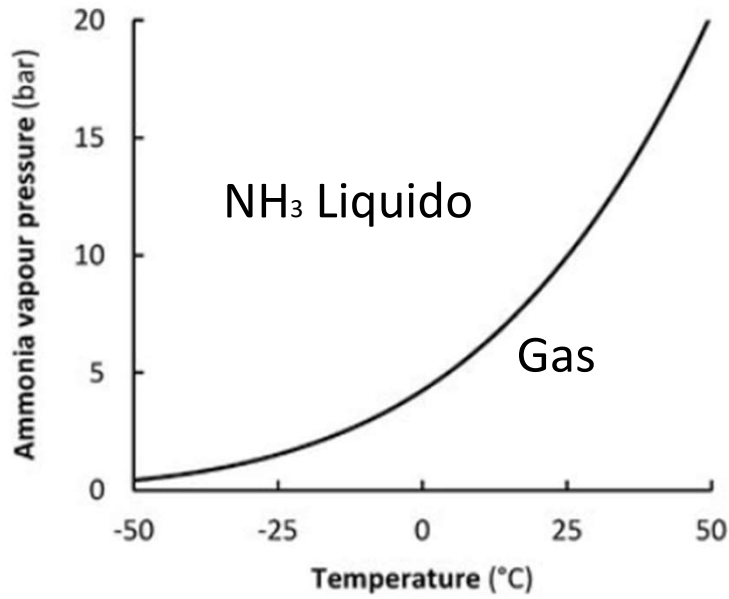
8



Bomba con sello → posible problema por baja temperatura, alto contraste entre ambas caras del sello

Bomba mag drive → eje bloqueado por hielo durante parada de la bomba

Baja temperatura → deterioro de sello y acoplamiento. Fugas



Alta presión de vapor → deterioro de sello. **Fugas**
Mag drive → riesgo de evaporación interna de fluido.

Desafío	Problema	Riesgo
 Corrosión química	Deterioro de sellos	 Fugas
 Baja temperatura	Sellos y acoplamiento	 Fugas
 Alta presión de vapor	Deterioro de sellos Evaporación en mag. drive	 Fugas



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SOLUCIONES DISPONIBLES

Directiva / Norma	Consideraciones	Bomba
EU PED 2014/68/EU (Pressure equipment directive)	NH3 fluido peligroso (Group 1)	No especifica
EN 378 (instalaciones refrigeración)	Minimizar riesgo de fuga	No especifica
ATEX	Puede o no aplicar para NH3	No especifica
PGS 12 (Guia diseño terminales amoniaco Paises Bajos)	“Best available technique for pump configuration: internal pump where all penetrations go through the roof”.	In-tank
API 610 + API 682	API 610 con doble sello, plan 53 o superior	
API 685	Mag drive y canned motor pumps	

¿CUÁLES SON LOS TRES PRINCIPALES FALLOS
MECÁNICOS EN BOMBAS CENTRÍFUGAS?



Cuales son los 3 elementos mecanicos que mas fallan en una bomba centrifuga?

Si hablamos de **elementos mecánicos de la bomba centrífuga** que más fallan en servicio industrial, el consenso en mantenimiento y fiabilidad suele ser:

 1. Sello mecánico

Es el componente con mayor tasa de sustitución.

Por qué falla

- Desgaste normal de las caras.
- Vibraciones.
- Marcha en seco.
- Mala refrigeración o lubricación.
- Desalineación.

Consecuencia



Fugas de mediana

 2. Rodamientos

El segundo elemento más propenso al fallo.

Por qué falla

- Lubricación incorrecta.
- Contaminación por agua o partículas.
- Desalineación.
- Vibraciones excesivas.

Consecuencia

- Aumento de vibración y ruido.
- Sobrecalentamiento.
- Daños en eje y sello.

 3. Acoplamiento (y sus elementos elásticos)

Frecuentemente el tercer elemento que requiere intervención.

API 610 pump + plan API 53B

Fluido barrera externo+ monitoring + cooling

Suministro N2 para presurización de fluido barrera+ monitoring

No garantiza total ausencia de fugas

Base plate a medida

Plan de mantenimiento

Causas de fallo + riesgos bombeo amoniaco

Sello

Acoplamiento

Rodamiento de bolas

Alta presión en el sello → alta diferencia presión en ambas caras

Bombeo a baja temperatura → riesgo congelación sello/ acoplamiento

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API 685 acoplamiento magnético / mag drive pump

Sin sello

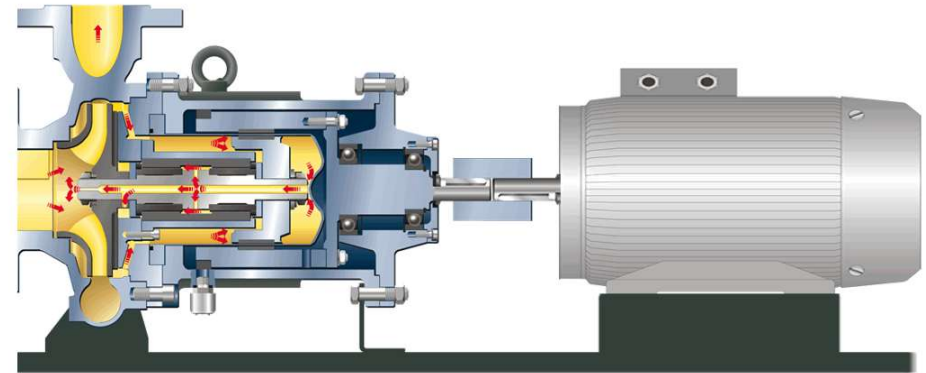
No se puede garantizar las condiciones del fluido en el interior (riesgo gasificación)

Mantenimiento sencillo (motor y acoplamiento standard)

Plan de mantenimiento

En caso de rotura de la carcasa, puede existir riesgo de fuga

Limitación en PN (normalmente a PN25)



Causas de fallo + riesgos bombeo amoniaco

Sello

Acoplamiento

Rodamiento de bolas

~~Alta presión en el sello → alta diferencia presión en ambas caras~~

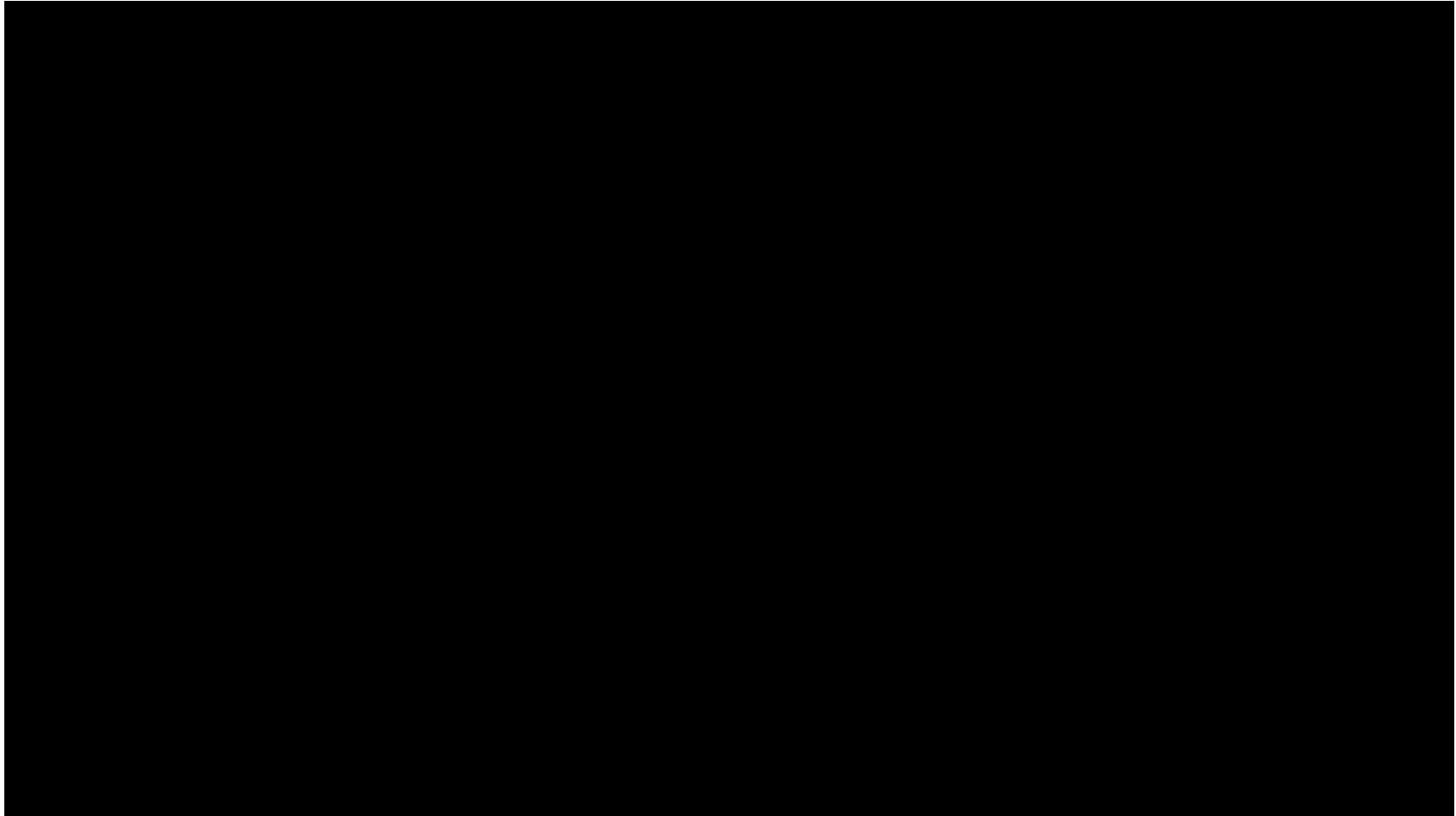
Bombeo a baja temperatura → riesgo congelación sello/ acoplamiento

En caso de rotura no hay doble barrera

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BOMBA DE MOTOR ENCAPSULADO / CANNED MOTOR PUMP

17



API 685 acoplamiento magnético / canned motor pump

Sin sello

Control de las condiciones del fluido en el interior

Sin mantenimiento (condition monitoring)

En caso de rotura, secondary containment que asegura 100% libre de fugas

Sin limite en PN

Causas de fallo + riesgos bombeo amoniaco

~~Sello~~

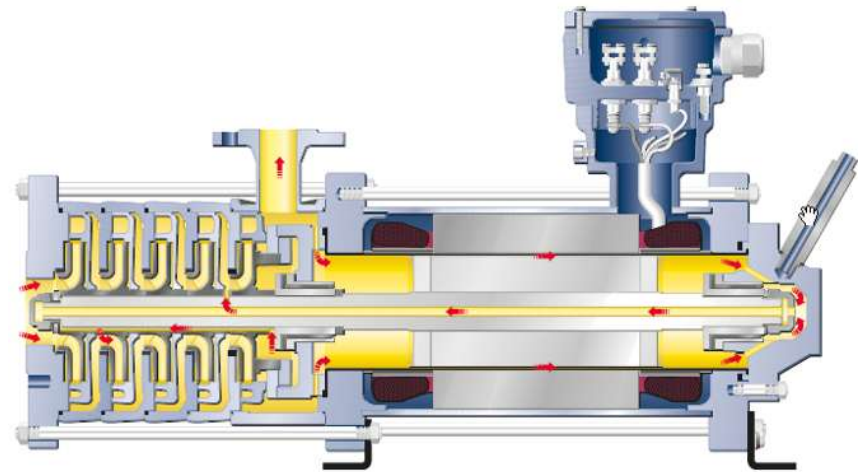
~~Acoplamiento~~

~~Rodamiento de bolas~~

~~Alta presión en el sello → alta diferencia presión en ambas caras~~

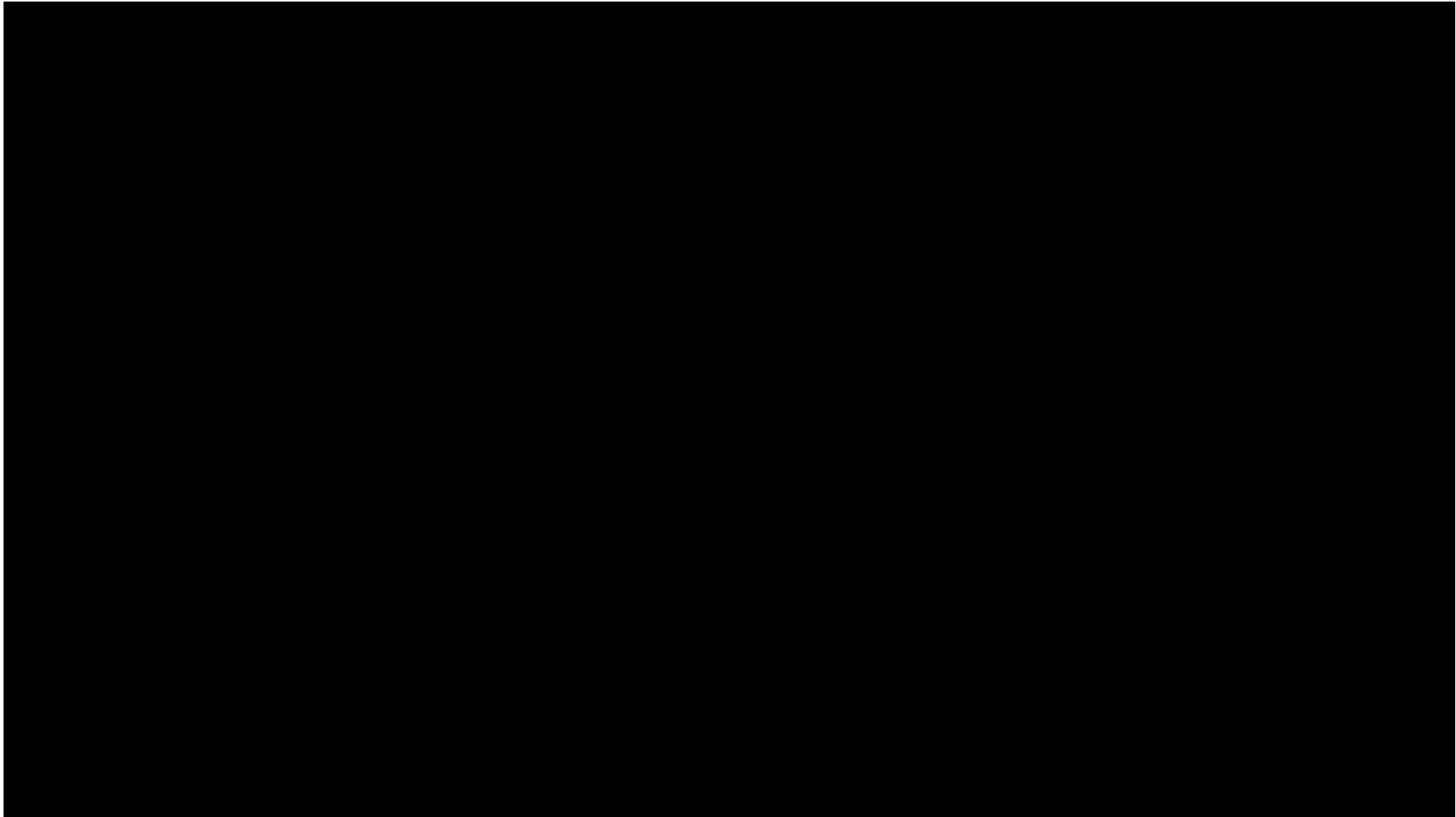
~~Bombeo a baja temperatura → riesgo congelación sello/ acoplamiento~~

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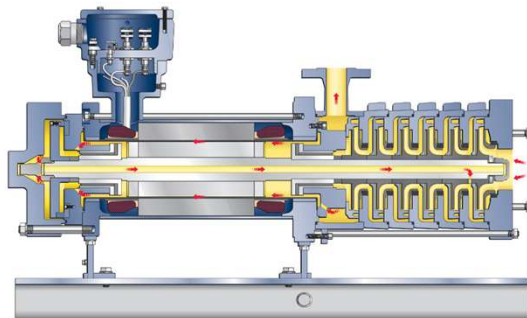
BOMBA DE MOTOR ENCAPSULADO / CANNED MOTOR PUMP

19



QUE BOMBA ES CANNED MOTOR PUMP. Y CUAL NO ESTA FUNCIONANDO

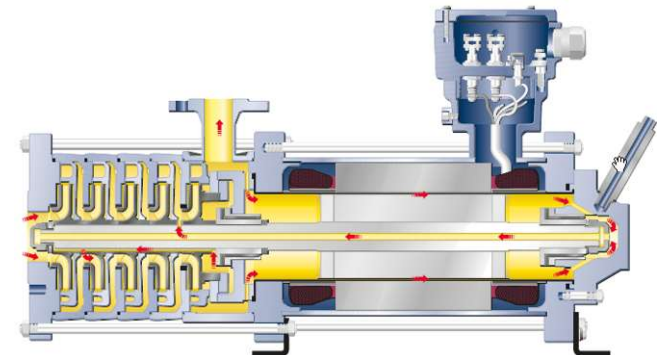
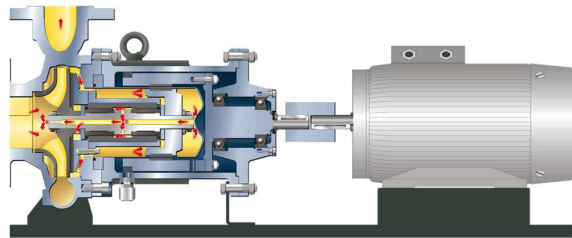
20





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CONCLUSIONES





Canned Motor Pumps for liquid ammonia

Environmental Safety and Reliability of Sealless Technology for Liquified Gas Application / Ammonia

HERMETIC Seminar - September 2026

Sealless Technology **Unlimited**





01 Technology of Canned Motor Pumps

⌚ 10'

02 Ammonia & Liquified Gas Design

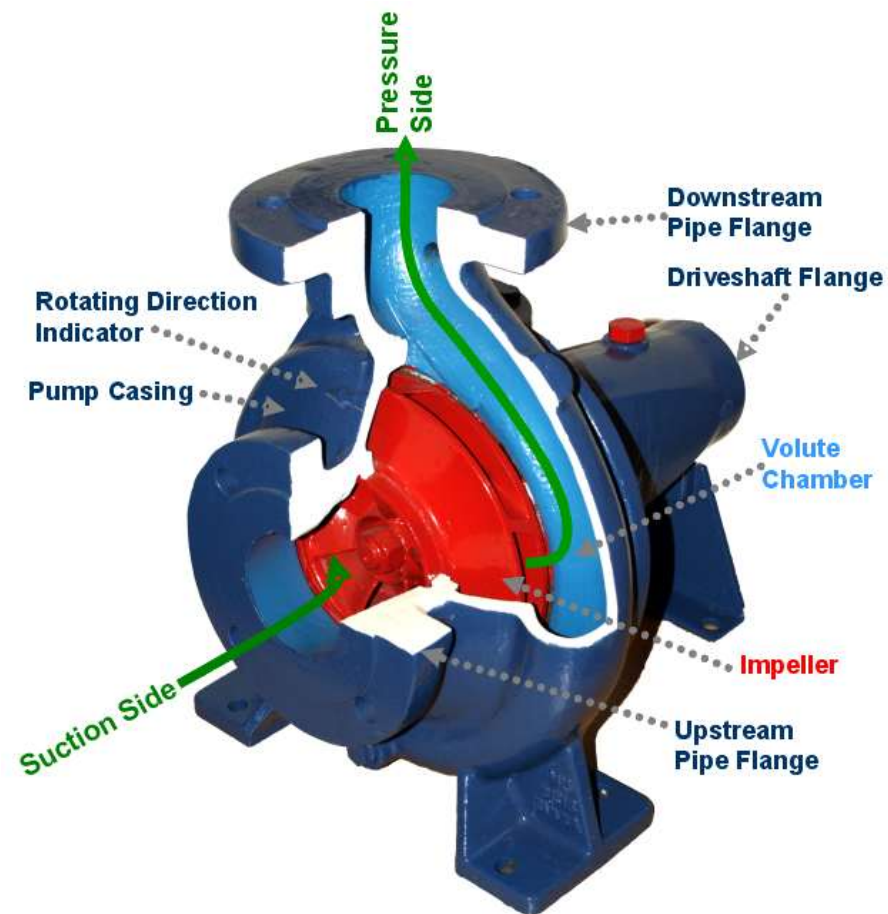
⌚ 10'

03 Operational Safety & Reliability

⌚ 15'

CONVENTIONAL CENTRIFUGAL PUMP

25



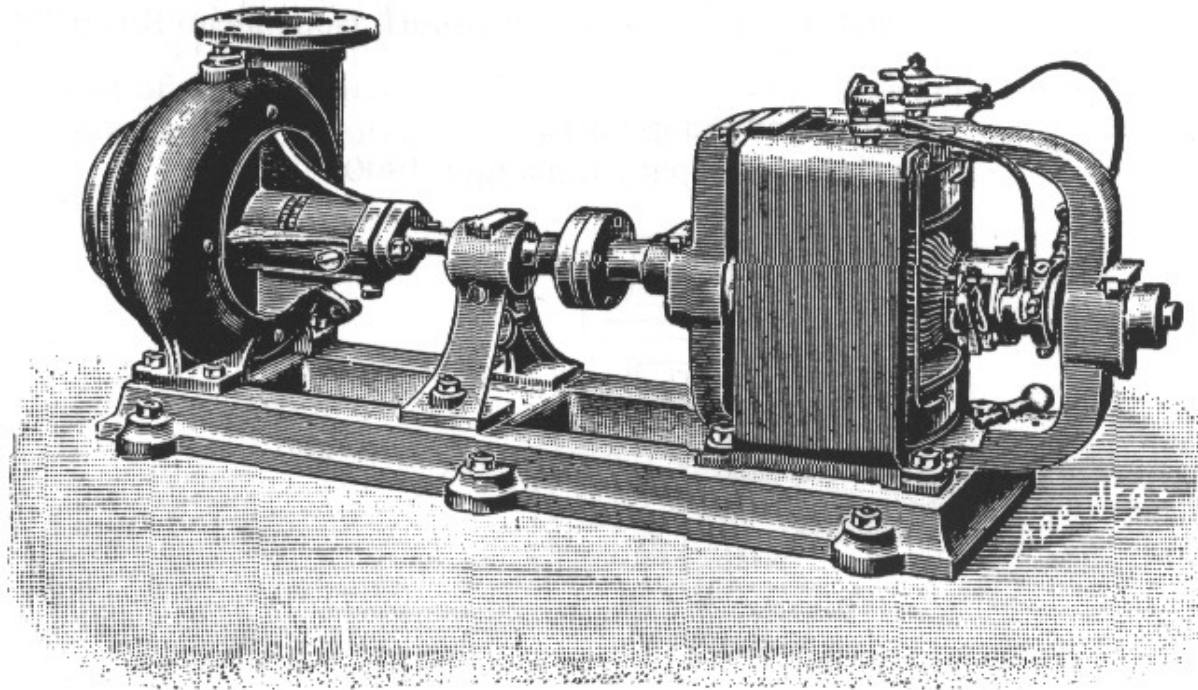
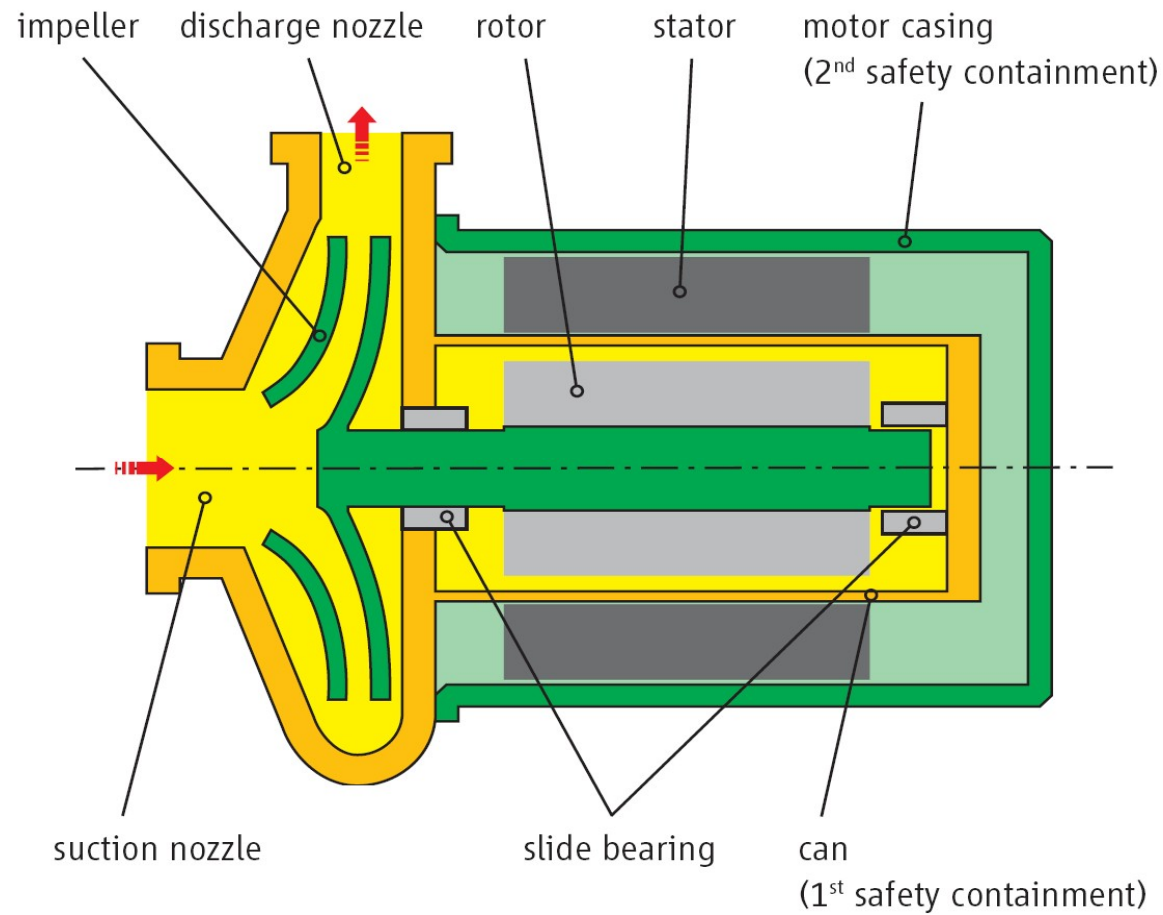


Fig 1.6 First standard production centrifugal pump from the W. Lederle Engine and Pump Factory from 1898.

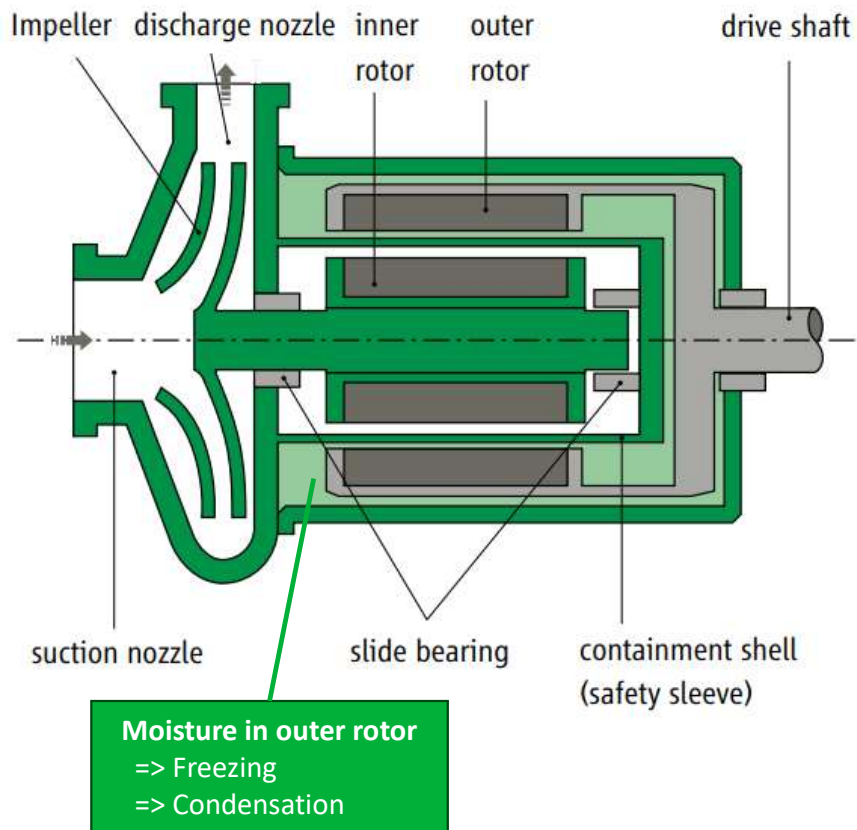
TECHNICAL PRINCIPLE OF CANNED MOTOR PUMP

27

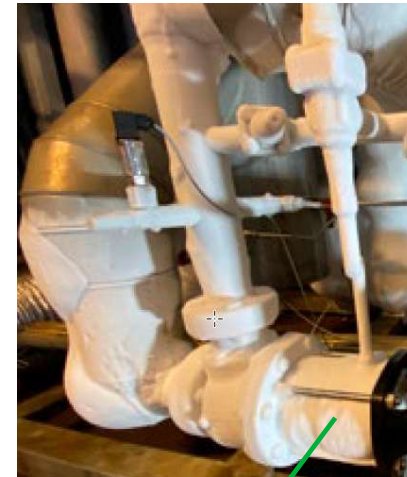


SEALLESS DESIGN – MDP AT LOW TEMP. AMMONIA

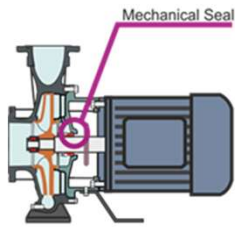
28



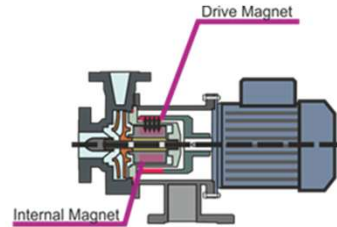
Picture: MDP in Ammonia System



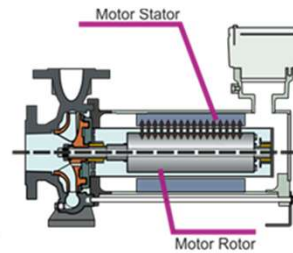
- **moisture in outer rotor**
- outer rotor must be:
heated or
flushed with nitrogen



Mechanical Sealed



Magnetically Driven



Canned

Technology	Leakage	LOPC 1)
Mechanical Seal	Small leakage	P0
Mag. Drive	No leakage	P1
Canned Motor	No Leakage	P2

1) Result of LOPC, LOSS OFF PRIMARY CONTAINMENT

Risked bases shaft sealing

- Mech. Seal / P0 once a year
- MDP / P1 = once every 10 year
- CMP / P2 = nearly damage once in 100 year



source for LOPC research:

Expert team pumps in chemical industries

2000 Members

New guideline for risk based shaft sealing selection



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01 Technology of Canned Motor Pumps

 10'

02 Ammonia & Liquified Gas Design

 10'

03 Operational Safety & Reliability

 15'

INTERNAL FLOW FOR AMMONIA AT BOILING POINT

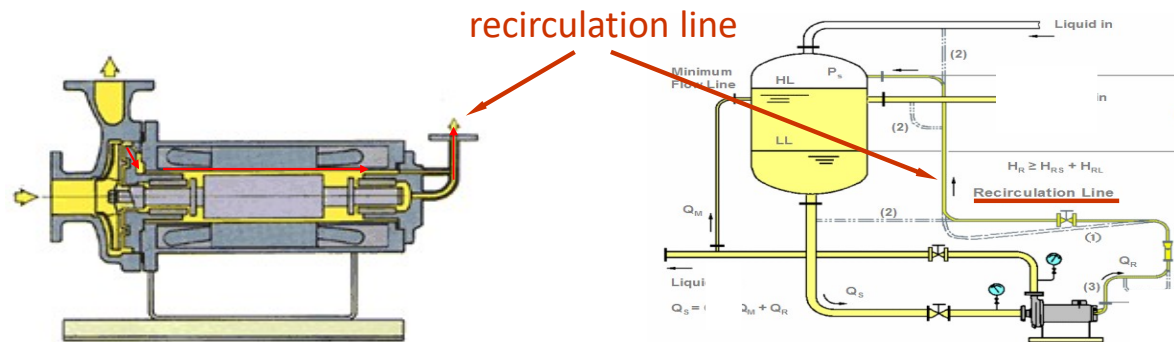
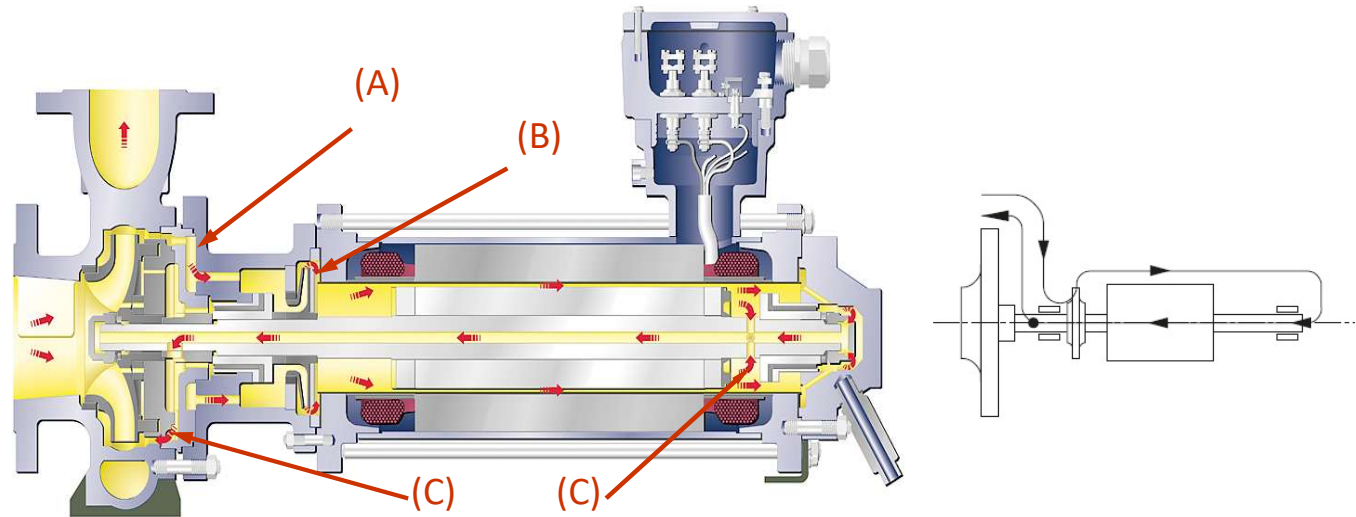
31

DESCRIPTION of Ammonia Design:

- (A) Partial NH₃ flow is deviated with at higher pressure into the motor.
- (B) Pressurised with an auxiliary impeller.
- (C) Carried back to the DISCHARGE side of the pump (C).

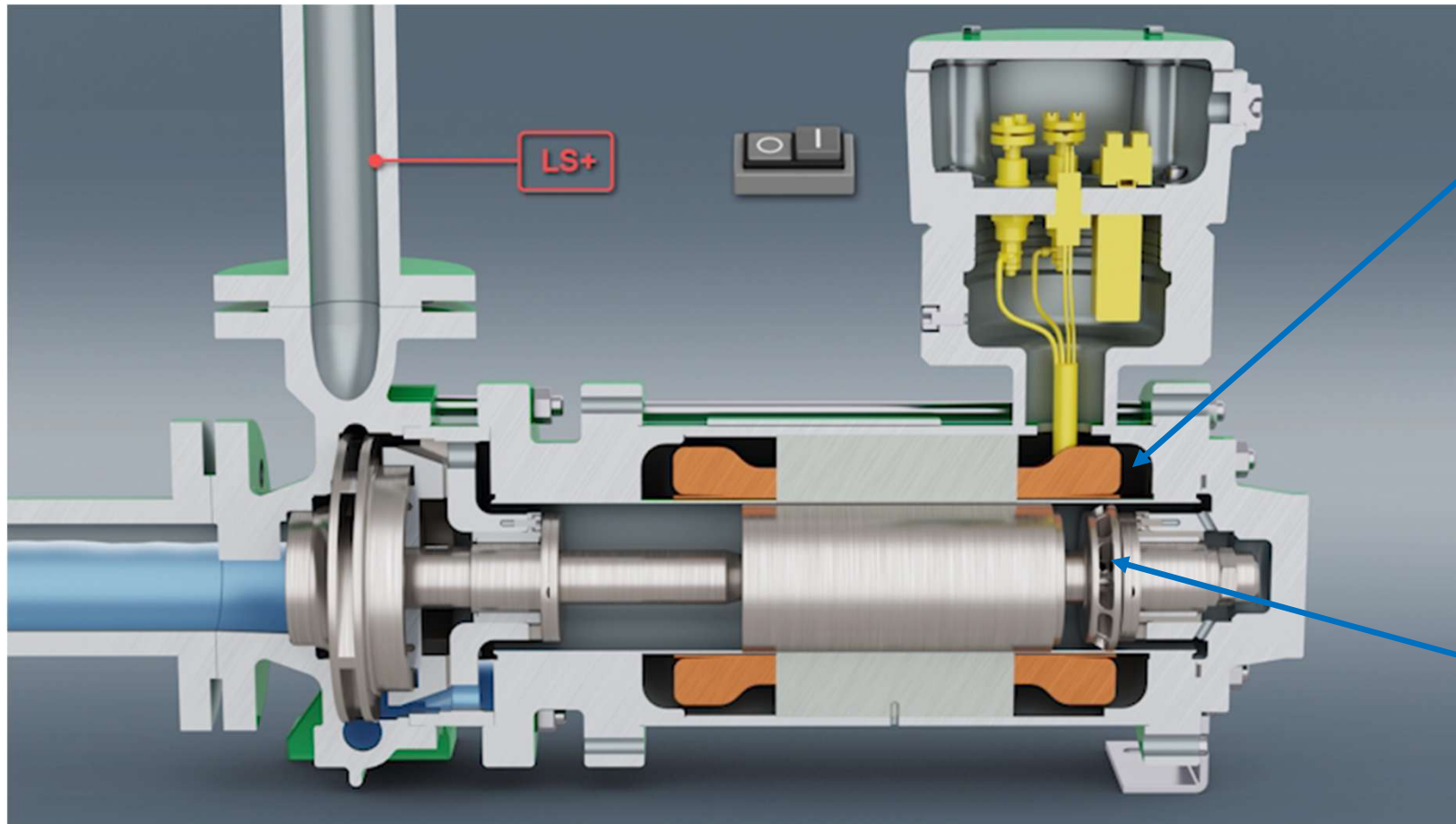
=> Internal integrated partial flow

=> Competitors uses often EXTERNAL PIPING (recirculation line), back to suction vessel for partial flow.



TECHNICAL PRINCIPLE CANNED MOTOR PUMP – AMMONIA DESIGN

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CMP Winding Chamber

- Fully sealed monoblock design
- dried by Vacuum
- Nitrogene filled
- No freezing in motor chamber

Auxiliary impeller

- overpressure of motor
- avoid vaporisation

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01 Technology of Canned Motor Pumps

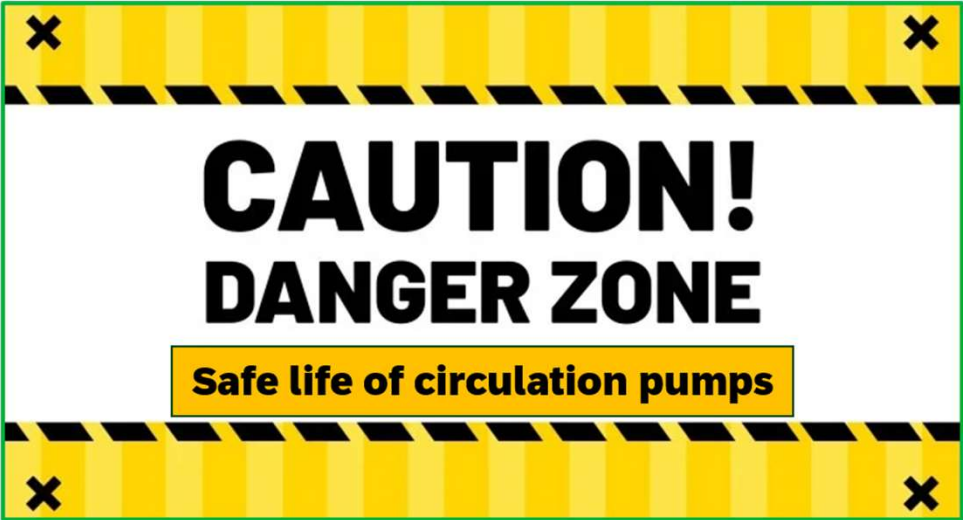
⌚ 10'

02 Ammonia & Liquified Gas Design

⌚ 10'

03 Operational Safety & Reliability

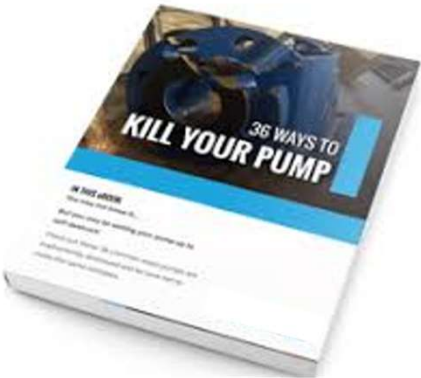
⌚ 15'





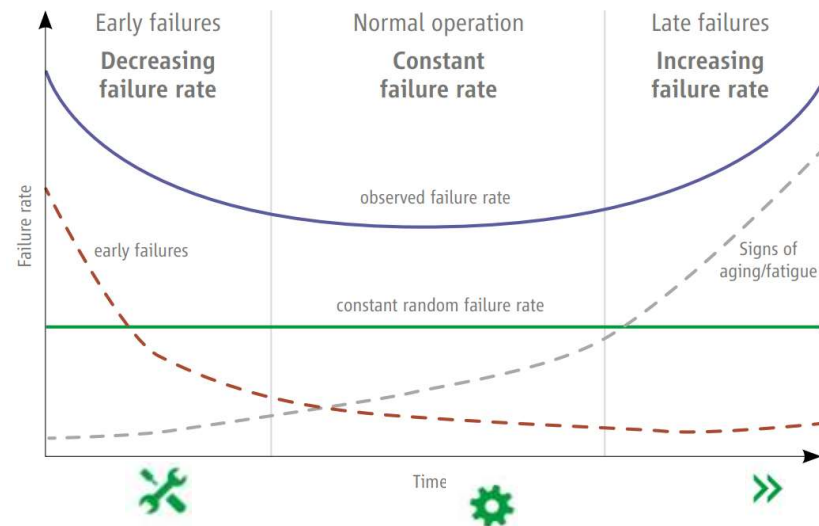
#HowToKillYourPump –
Santa’s Centrifugal Pumps Special

19	24	2	16	13	7
1	14	23	5	15	3
10	21	6	17	4	18
22	9	12	11	8	20



TIME PHASES OF FAILURE

35



Phase 1: Early Failures

Possible errors in design, manufacture, or commissioning
Leads relative quickly to a pump failure



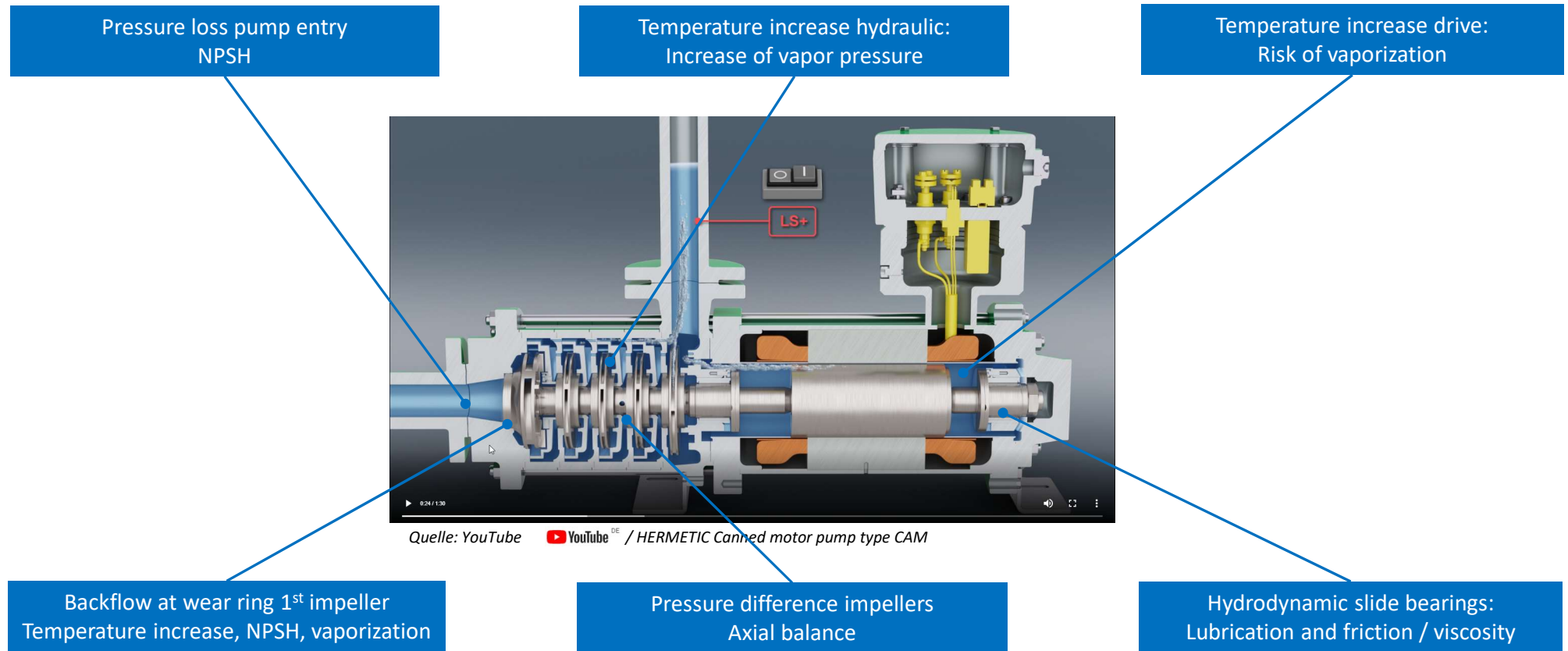
Phase 2: Normal operation

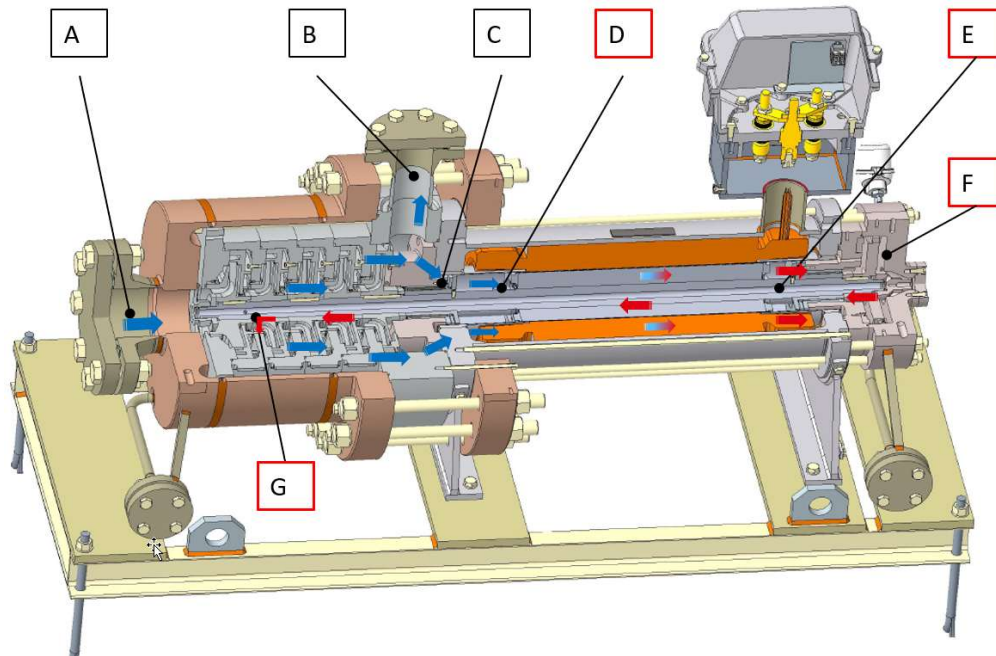
Few errors occur in this stage



Phase 3: Late failures

change of pump parameters over time
or age-related wear of moving parts



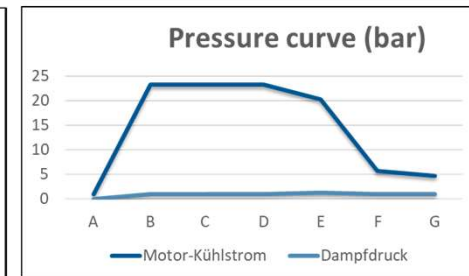
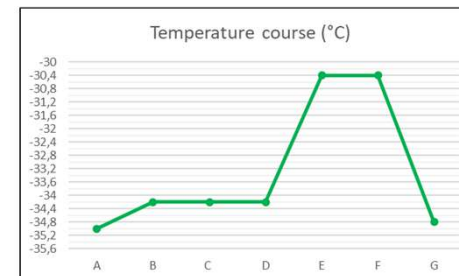


Result:

- Single thermic calculation in every operation point
- Guaranteed operational safety & reliability

Heat balance calculation for ammonia pumps

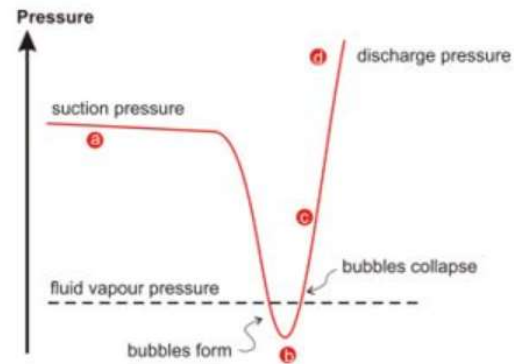
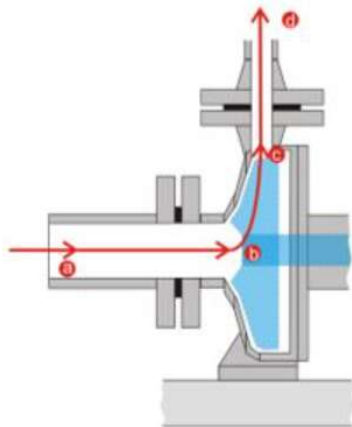
							Delta Temp. Delta vap. Pr.		Over pressure by hydraulic		safety Hmin-DHT			
Results:							DT	DHT	Hmin	S	DTges	DTS	NPSH*	
Q	H	P	N1	N2	QT		[K]	[m]	[m]	[m]	[K]	[K]	[m]	
[m3/h]	[m]	[kW]	[kW]	[kW]	[m3/h]									
20.0	435.0	64.5	48.3	19.1	9.2		6.5	5.0	87.0	82.0	4.0	0.2	2.6	
30.0	430.1	68.8	44.8	19.4	9.2		5.1	3.8	86.0	82.2	2.5	0.1	2.6	
40.0	422.7	73.2	41.7	19.6	9.1		4.4	3.3	84.5	81.3	1.8	0.0	2.6	
50.0	412.6	77.6	39.2	19.9	9.0		4.0	3.0	82.5	79.5	1.4	0.0	2.7	
60.0	400.0	82.1	37.3	20.2	8.8		3.9	2.8	80.0	77.2	1.1	0.0	2.8	
70.0	384.8	86.6	36.4	20.5	8.7		3.8	2.8	77.0	74.2	1.0	0.0	3.0	
80.0	367.0	91.1	36.4	20.8	8.5		3.8	2.8	73.4	70.6	0.8	0.0	3.2	
90.0	346.6	95.6	37.5	21.2	8.2		3.8	2.8	69.3	66.5	0.8	0.0	3.4	
100.0	323.7	100.2	39.9	21.6	7.9		3.9	2.9	64.7	61.8	0.7	0.0	3.7	



CAVITATION

38

What is cavitation?



Effect:

- Ammonia enters the pump
- Pressure drops below vapour pressure at inlet
- Bubble occurs
- NH₃ pressure rises at discharge section
- Bubble collapses

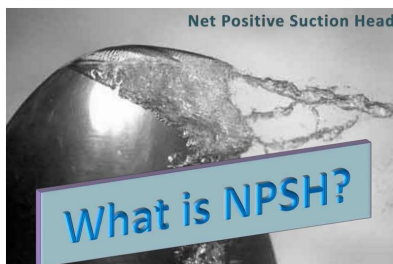
NPSH = Net Positive Suction Head

- static pressure in the suction nozzle falls below the vapor pressure of the Ammonia
- **CAVITATION** with damage of pump parts occurs



NPSH = Net Positive Suction Head

- NPSHa = value from the system
- NPSHr = value from the pump



5 main causes that can lead to cavitation

- The existing NPSHa value drops below the NPSHr value of the pump.
Safety margin 0,5m
- **NPSH test of critical equipment / pumps**
- The pipe diameter was designed too small.
- The conveying speed in the suction line is too high.
- The filter in the suction line has not been removed or is not monitored.
- The piping on the separator was installed incorrectly

Effect:

- Noise
- Vibration
- Performance drops
- Pump damage





- reliability & life-cycle costs



BALANCING - MAXIMUM OF RELIABILITY

42

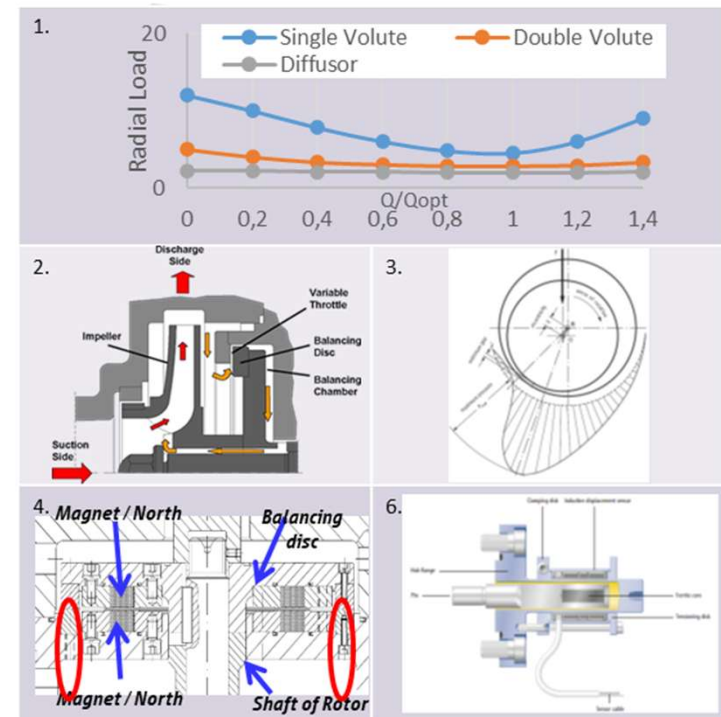
ZART® *simply best balance*



Zero Axial & Radial Thrust –
wear free operation
in HERMETIC ammonia canned motor pumps

Reliability – Examples

1. Reduction of radial forces, e. g. double volute, diffusor casing, pump arrangement
2. Hydrodynamic axial and radial thrust compensation e. g. balancing disc / holes etc.
3. Hydrodynamic lubricated bearings
4. Magnetic support bearings
5. Rotor position measurement (forces) performance test for each pump
6. Online rotor position measurement available

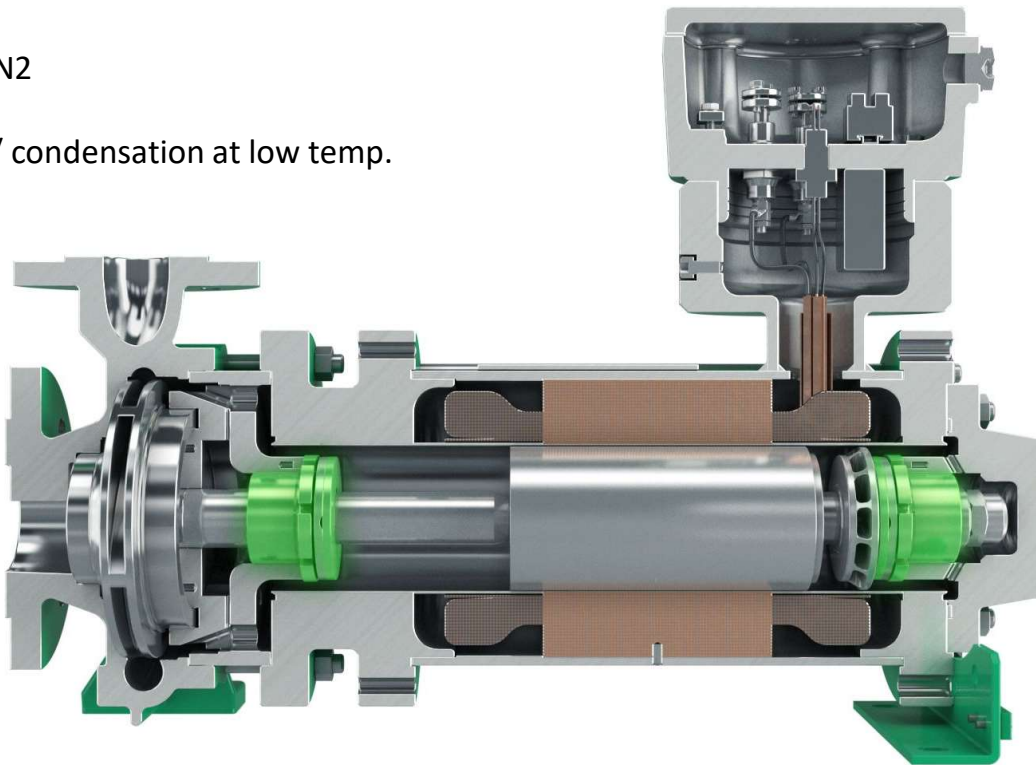


TWO DESIGN FEATURES FOR EXTENDED SERVICE LIFE

1) Integrated motor

Advantages of an integrated canned motor

- ✓ winding vacuum dried
- ✓ inerted with N₂
- ✓ no moisture / condensation at low temp.



2) Only two hydrodynamic slide bearings.

Advantages of hydrodynamic slide bearings:

- ✓ Operate directly in the pumped fluid — no external lubrication needed
- ✓ No contact between stationary and rotating parts
- ✓ Due to high level bearing material no wear during operation

SLIDE BEARING - TECHNOLOGY

44

Slide bearing consists of bearing bush + axial ring + bearing sleeve

Parts of bearing:

- Bearing bush: SIC 30, abrasions resistant, shock proof 1
- Axial ring
- Sleeve: Tungsten carbide coating wear less, no thermal tension 2

Bearing bush consists of:

- Body in stainless steel 3
- SIC 30-bush

Advantages

- Hard material, nearly abrasion resistant
- Temperature insensitive



Low wear resistant carbon bearings / competitor

TENSION FREE ASSEMBLING OF SIC30 BEARING BUSH

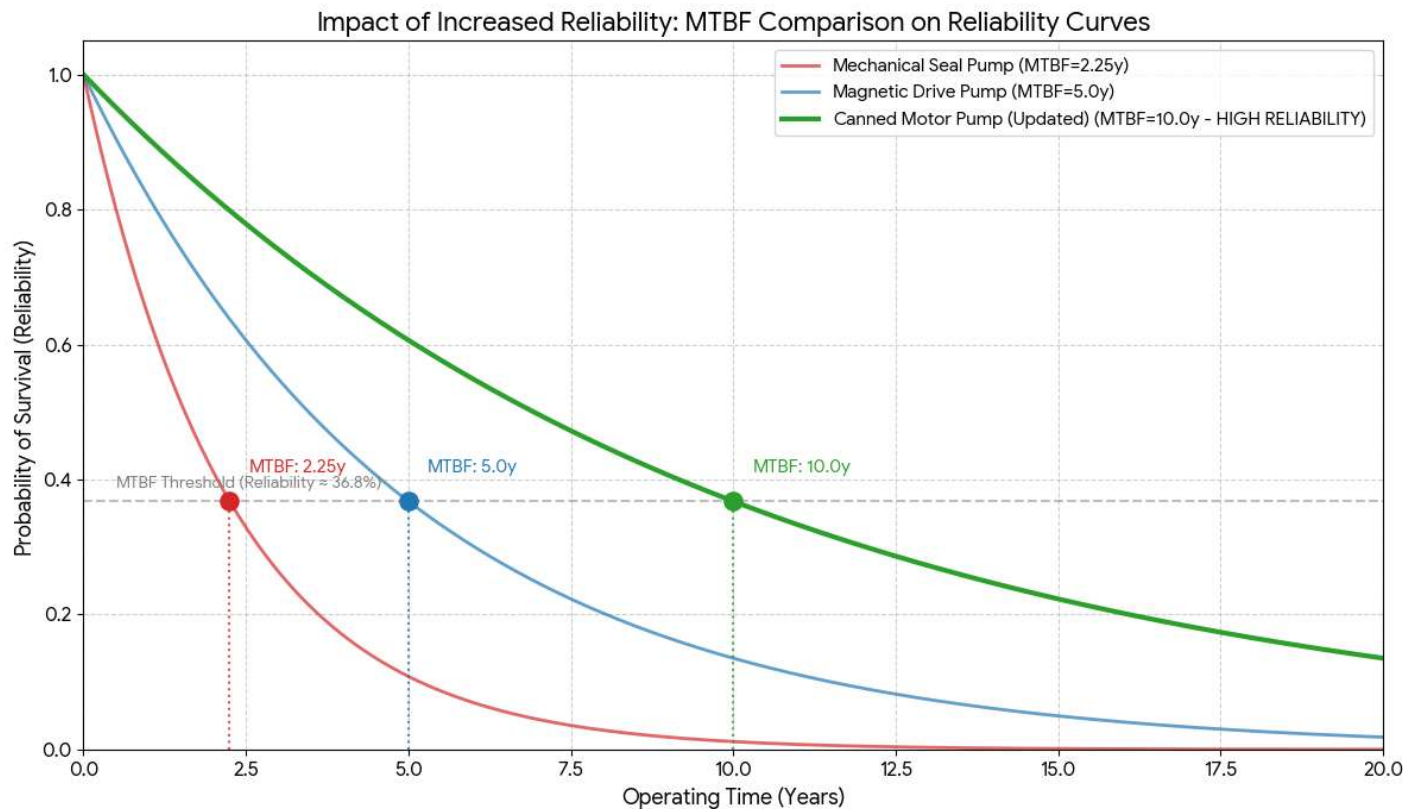
45



Simply the best pump technology

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CMP after 5 years operation:

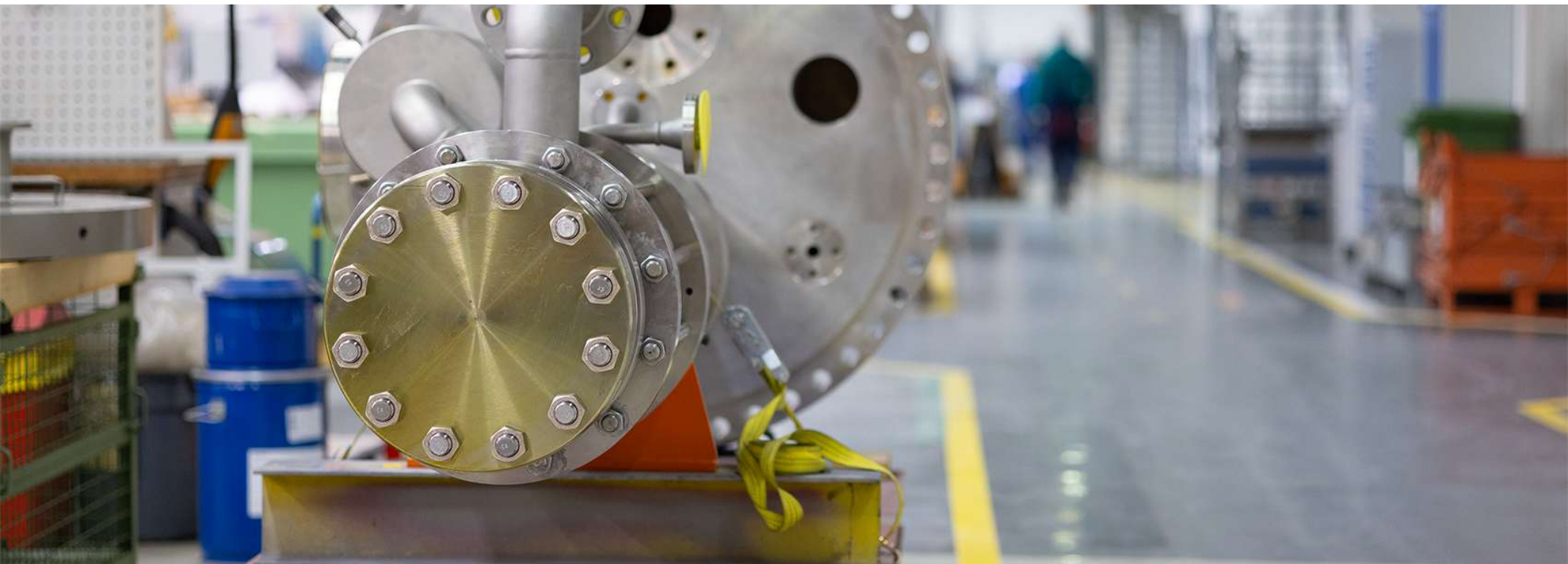
=> Probability of Survival 50% higher than MDP and 6 times higher than mechanical sealed pump

Canned Motor Pumps

CMP offer the highest MTBF because they eliminate both the seal and the external motor bearings

CMP curve is much flatter. The probability of failure remains very low compared to the other two options.

CMP: **10+ years** without intervention in clean services.



Thank you!

www.hermetic-pumpen.com

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 **LEDERLE**
Hermetic
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