Vloeibaar waterstof

Oplossingen voor meten in vloeibaar waterstof

Endress+Hauser

Introductie: Arjan van Ginkel

- Master ’s Degree & Engineering Management
- 16 jaar in procestechnologie & automatisering
- Rollen in Marketing, Sales, R&D en Business Development
- Focus industrieën O&G, Chemie en Energiemarkt
- Betrokken in waterstof sinds 2009
- Bij Endress+Hauser sinds 2017
- Voorzitter NWBA sinds november 2022

NWBA

Overall product portfolio [1]

Level

Temperature

Flow

Pressure

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Overall product portfolio [2]

Liquid analysis

Optical analysis

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Overall product portfolio [3]

Advanced analytics

IMKO MICROMODULTECHNIK GMBH

BLUE OCEAN NOVA®

analytikjena
An Endress+Hauser Company

System components

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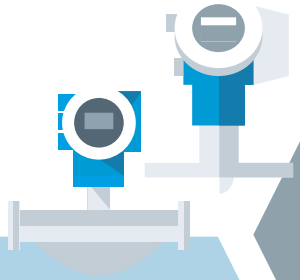
The users' needs are expanding

Reliable
"How do I know if something is wrong, and how do I get the necessary information to correct it?"

Easy to use
"I need my operations to run efficiently, but my staff is quite new. Are there intuitive interfaces allowing actions to be performed quickly and easily on the device while minimizing the risk of mistakes?"



Available
"To be competitive, I need to maximize my uptime. How can I ensure a high degree of availability and that process interruptions are avoided?"

"I need an excellent measurement performance!"

Safe
"How can the device help me to keep operations safe in a reliable and efficient manner?"

Predictive
"How can the device inform me about problems before they occur, so I can optimize my maintenance activities?"

Connected
"How can I profit from the efficiency potential offered by digitalization and IIoT? Are there technologies that help me to realize this potential?"

The Level Measurement – Proservo

Proservo – NMS81

- High mechanically adaptability only requires 3” or larger tank top nozzle
- No gas phase influence for the accuracy loss
- Validation capability with integrated calibration window / chamber
- Hazardous area certification with built-in transmitter
- Available in both proprietary and/or open communication protocol
- **Custody transfer approval to OIMLR85 2008**
- **Measuring distance up 47m, longer on request**
- **Temperature: - 200 to +200 °C**
- **Pressure: 0 to +25 bar**
- **Accuracy: better than +/-0.4mm Level, +/- 2mm Interface +/- 3kg/m³ Density**

SIL 2/3 acc. IEC61508
4..20mA, relay min, max

Weights & Measures
approved by NMi and PTB

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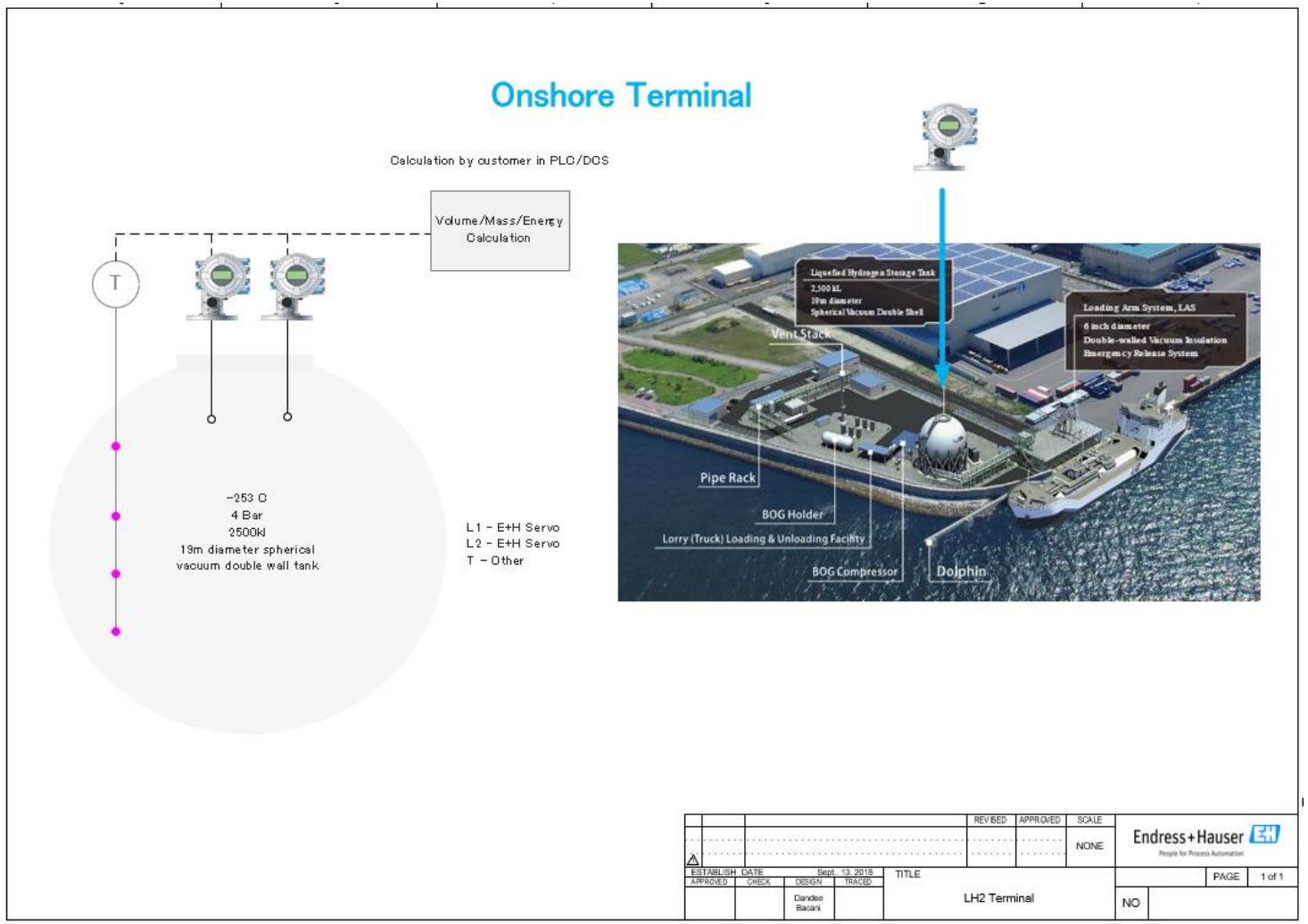
Onshore tank niveau metingen met ProServo



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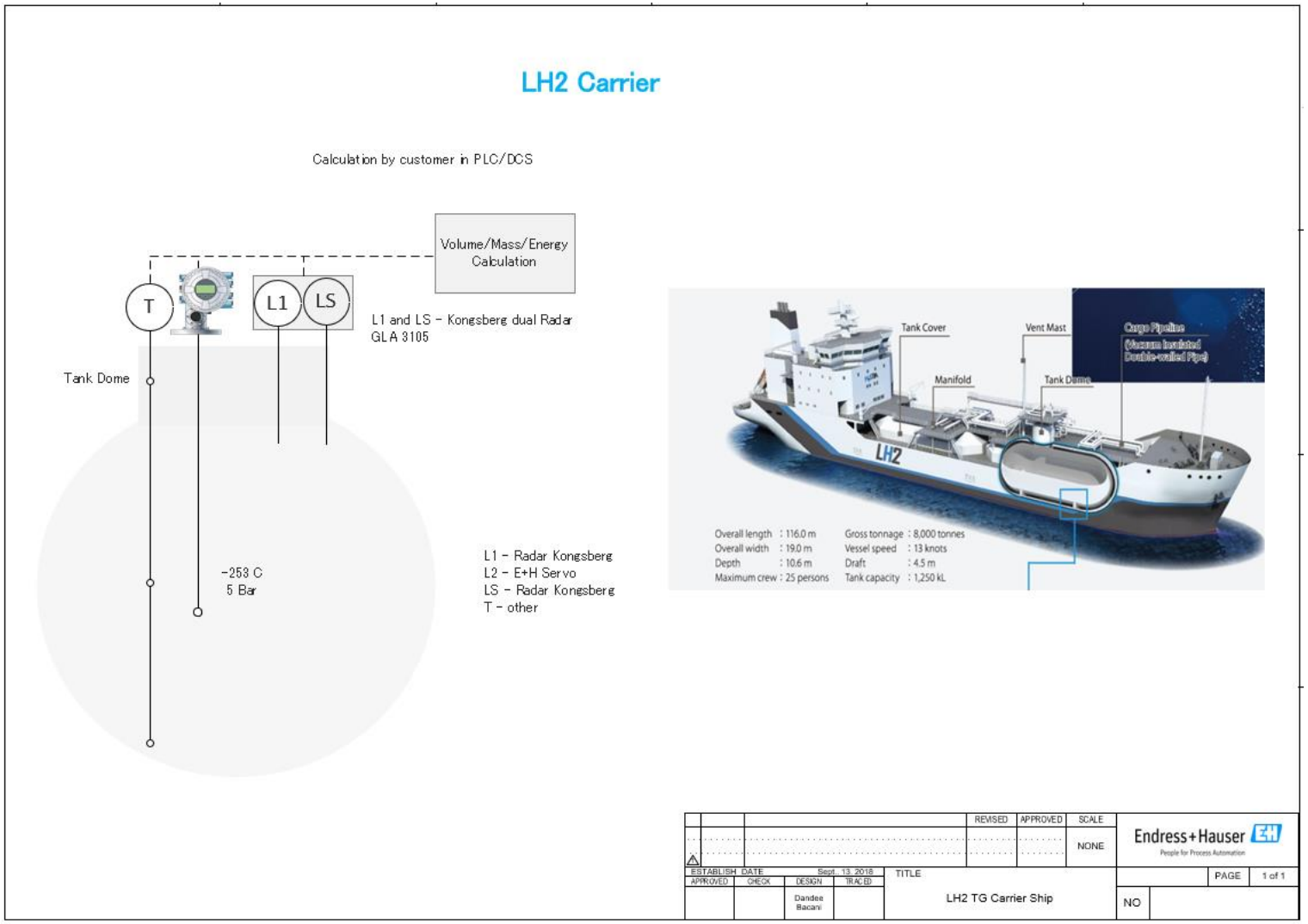
LH2 Carrier tank niveau metingen met ProServo



NK approval

NK approval as general apparatus

NK approval for casting maker

NK certified drum housing*

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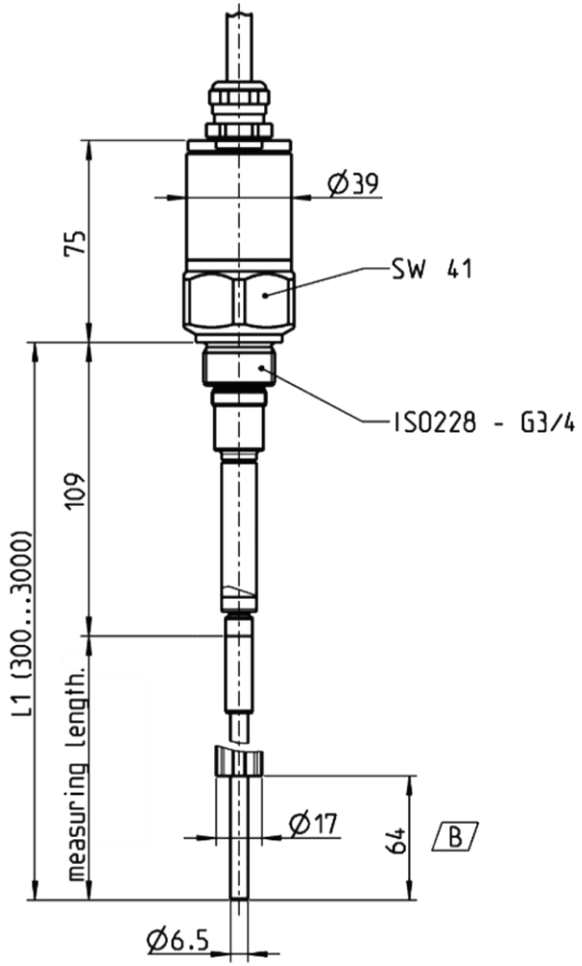
Capacitieve niveaumeting

- Liquicap FMI51 for Liquid Hydrogen (-253 °C / -423.4°F)
  - > 5 years of testing
  - Small storage tank, stationary
  - Ground pipe necessary
  - ATEX, IEC Ex, US &. KR Ex available

In a glance

- Liquicap FMI51 – technical data
  - Separate housing with 2.5 m cable
  - Rod 316Ti blank
  - Up to 2.9 m measuring range in liquid H2 possible
  - Max 6 bar
  - HART electronic



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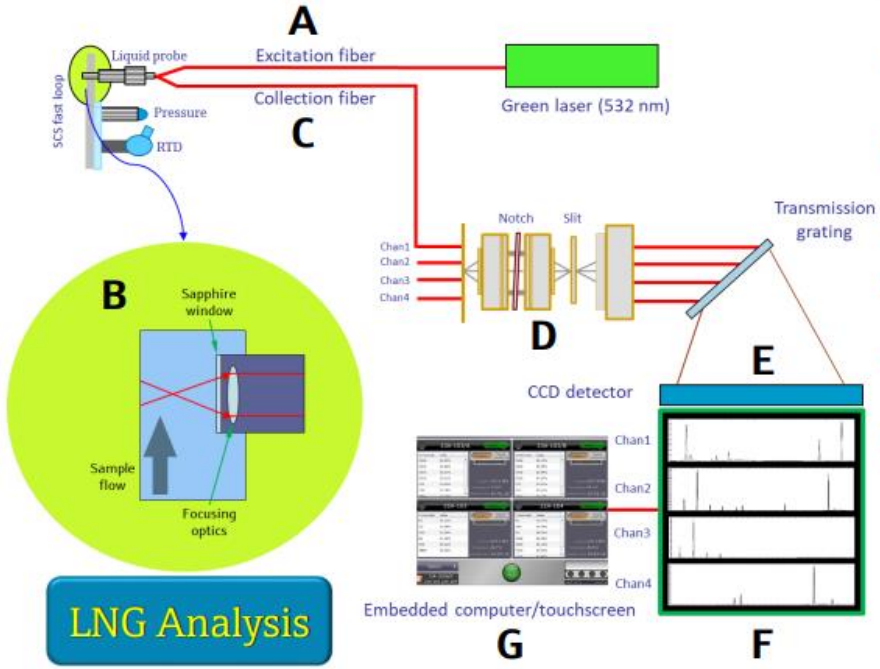
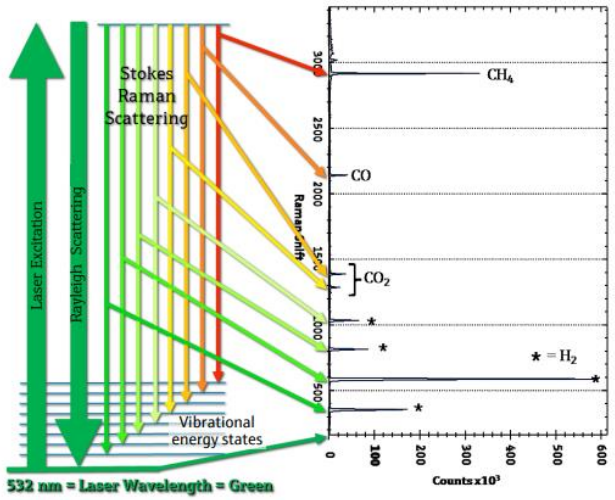
Raman spectroscopie



- **(A)** Green laser light travels along the excitation fiber to the liquid probe (Rxn-41 probe)
- **(B)** Sample flows past the sapphire window of the probe. The laser light is focused into that sample
- **(C)** Scattered light of multiple colors is transmitted along the collection fiber to the spectrograph
- **(D)** The spectrograph separates the colors (like a prism)
- **(E)** The CCD detector collects the light. 4 independent gas probes can be connected to one spectrograph
- **(F)** A plot of the signal versus wavelength is the Raman spectrum
- **(G)** Each peak area in the Raman spectrum corresponds to the concentration of a different gas in the sample. Results are shown on the LCD display

'One color in, multiple colors out'



[Raman Rxn5 process analyzer | Endress+Hauser]

Vloeibaar maken waterstof met Raman spectroscopie

- Gasvorm 75% ortho & 25% para
- Vloeibaar >99% para

- **Probleem:**
  - Ortho moet converteren naar para.
  - Hierbij komt warmte vrij.
  - Conversie gaat erg langzaam.
  - Als het in de vloeibare vorm gebeurt, ontstaat er dus warmte in de tank en krijg je boil off (productverlies).

- **Oplossing**: conversie versnellen bij productie.

- Inzet Raman om voortgang te meten.

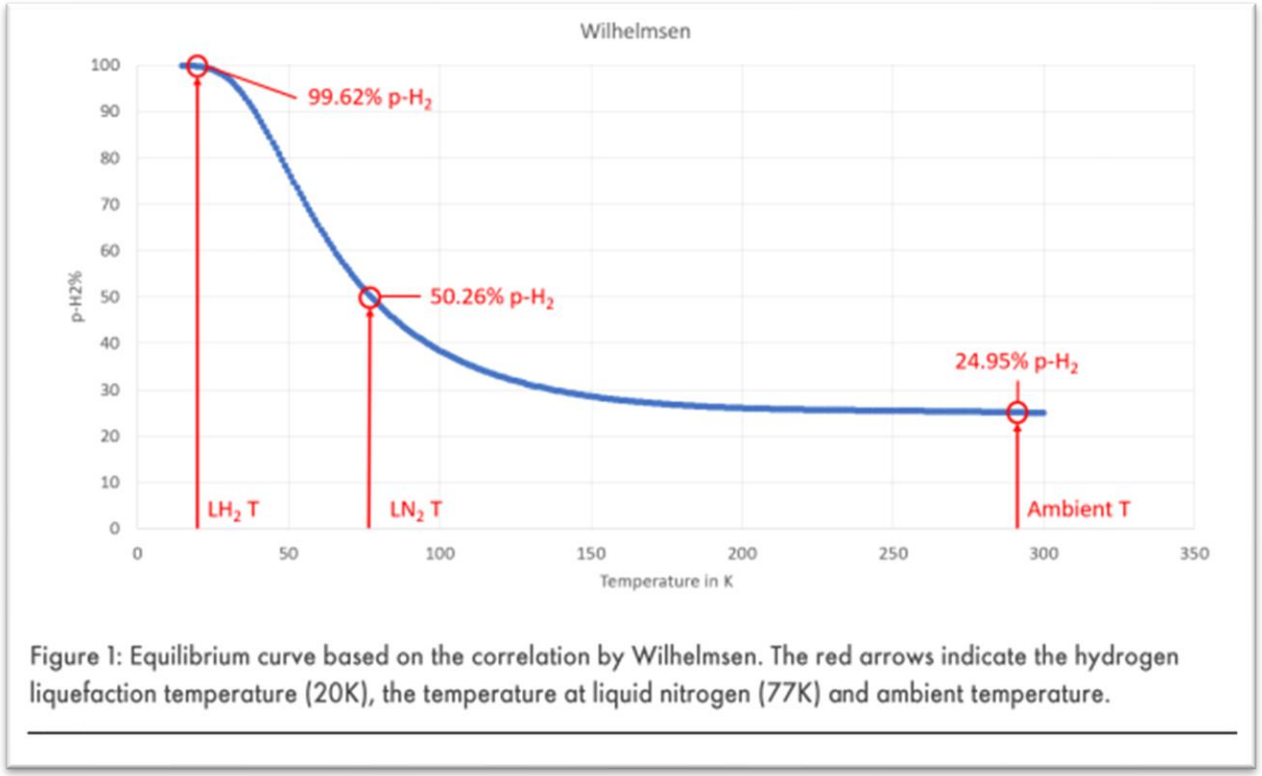


Figure 1: Equilibrium curve based on the correlation by Wilhelmsen. The red arrows indicate the hydrogen liquefaction temperature (20K), the temperature at liquid nitrogen (77K) and ambient temperature.

Thank you very much for having us

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People for Process Automation