



THE 6X[®]

Radar level measurement

Radar level measurement

Radar technology

Guided Wave Radar

2 GHz



6 GHz



1993

26 GHz



1997

80 GHz



2014

80 GHz-
Gen2



2022



Radar sensors

Basic version



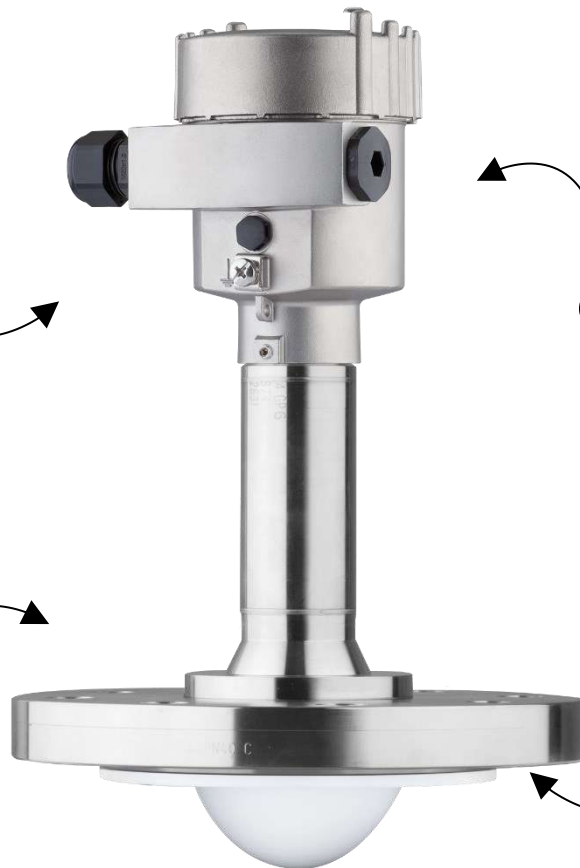
Radar sensors

Pro version

Several housing
en electronics
options

Extensive certificate
options

High pressure &
temperature options
(+450dgrC & 160Barg)



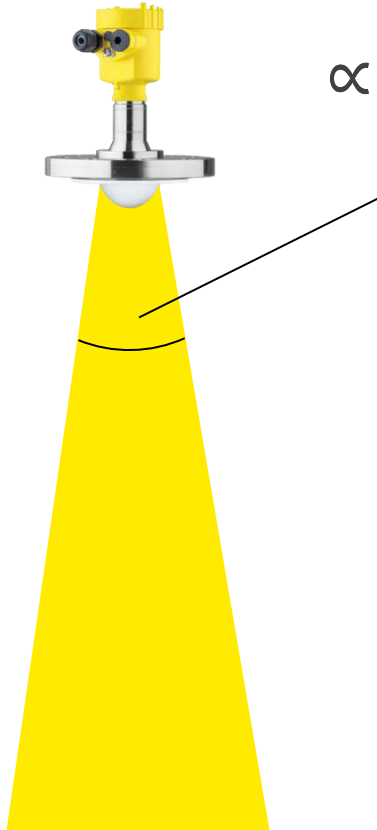
For liquids and bulk
solids

Focussing

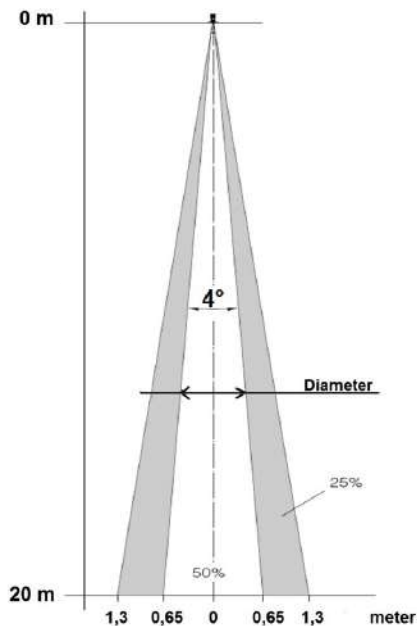
Focussing

Beam angle of horn antenna:

$$\alpha = 70^\circ \times \frac{\text{Light speed} / \text{Frequency}}{\text{Effective antenna surface}}$$



Beam angle radar

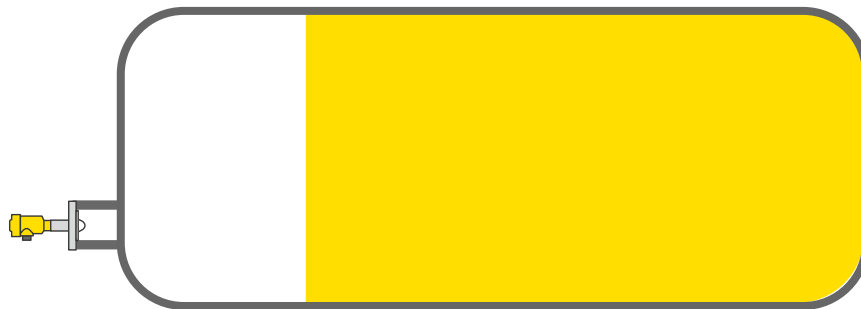
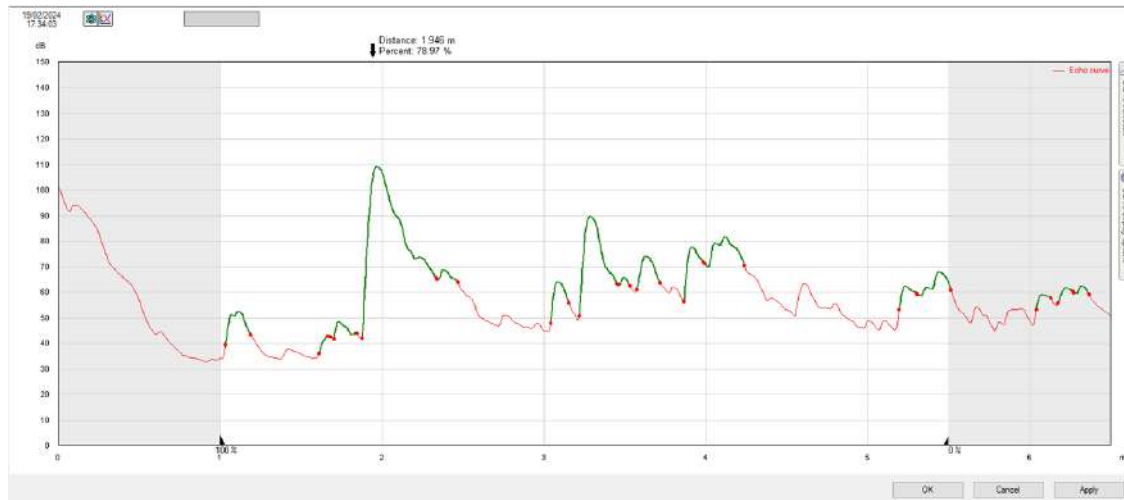


Process connection	26 GHz	80 GHz
G ¾"	Not available	14°
G 1-1/2"	21°	8°
DN50 / 2"	18°	7°
DN80 / 3"	10°	3,3°
DN100 / 4"	10°	3,3°

Note: beam angle is -3dB point.

Echo curve

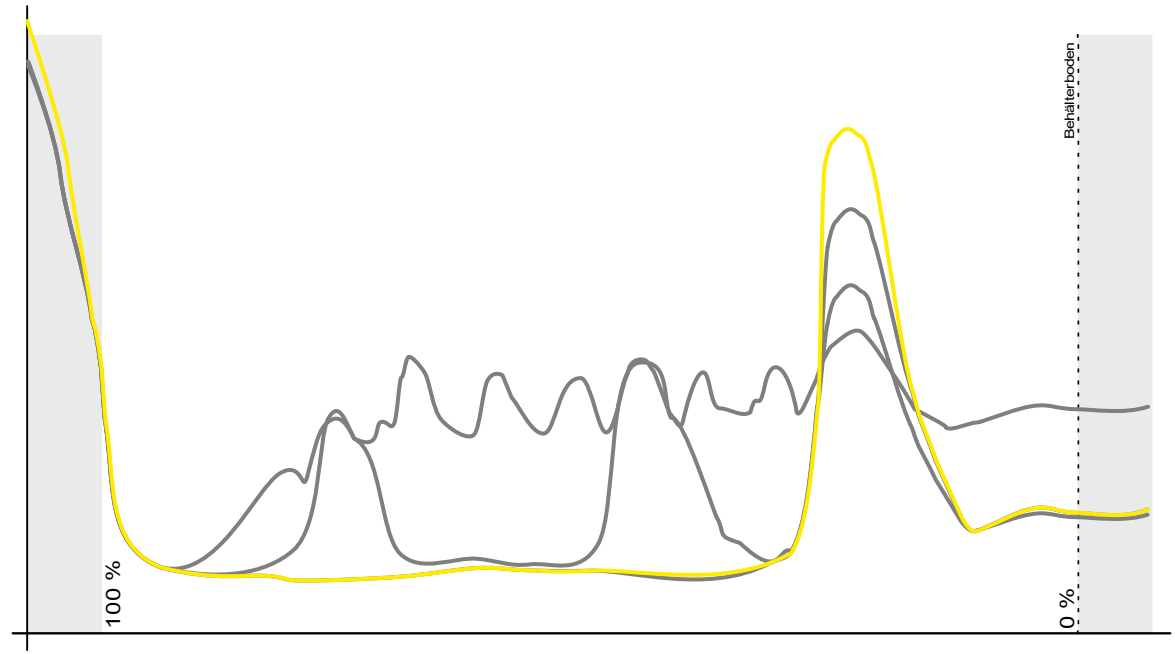
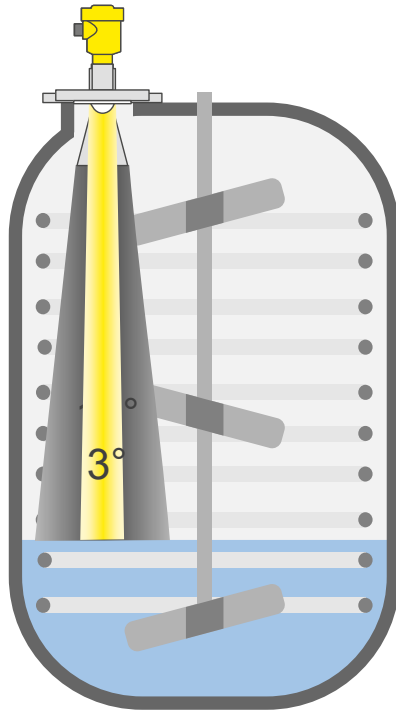
Signal strength



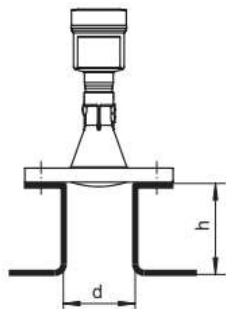
Distance

26 GHz

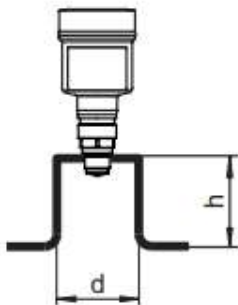
80 GHz



Mounting recommendations



Diámetro de tubuladura d		Longitud de tubuladura h	
80 mm	3"	≤ 400 mm	≤ 15.8 in
100 mm	4"	≤ 500 mm	≤ 19.7 in
150 mm	6"	≤ 800 mm	≤ 31.5 in



Diámetro de tubuladura d		Longitud de tubuladura h	
40 mm	1½"	≤ 150 mm	≤ 5.9 in
50 mm	2"	≤ 200 mm	≤ 7.9 in
80 mm	3"	≤ 300 mm	≤ 11.8 in
100 mm	4"	≤ 400 mm	≤ 15.8 in
150 mm	6"	≤ 600 mm	≤ 23.6 in

Dynamic range

Dynamic range

Limited
dynamic range



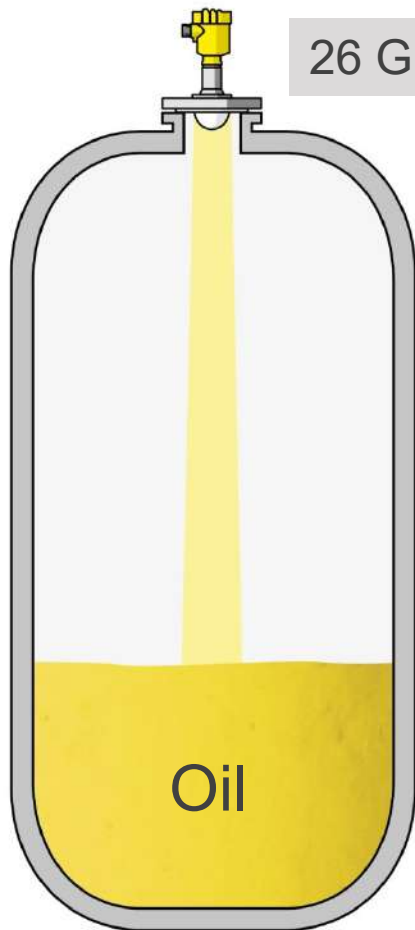
Large
dynamic range

Dynamic range



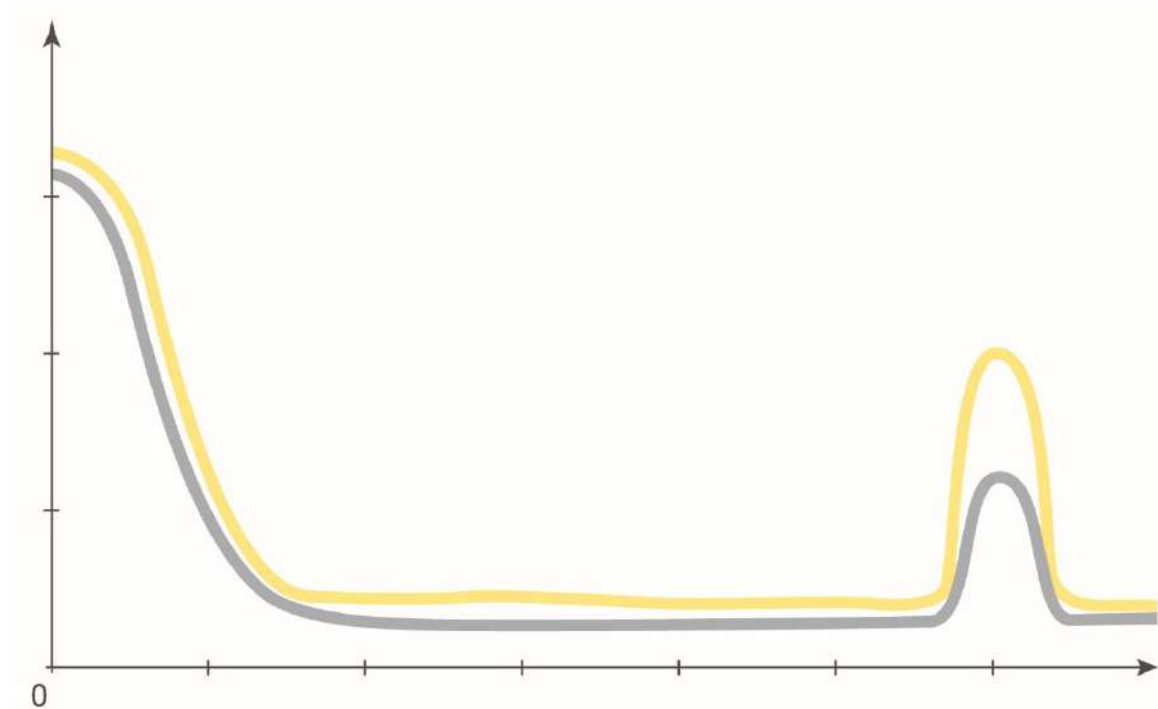
ϵ_r





26 GHz

80 GHz





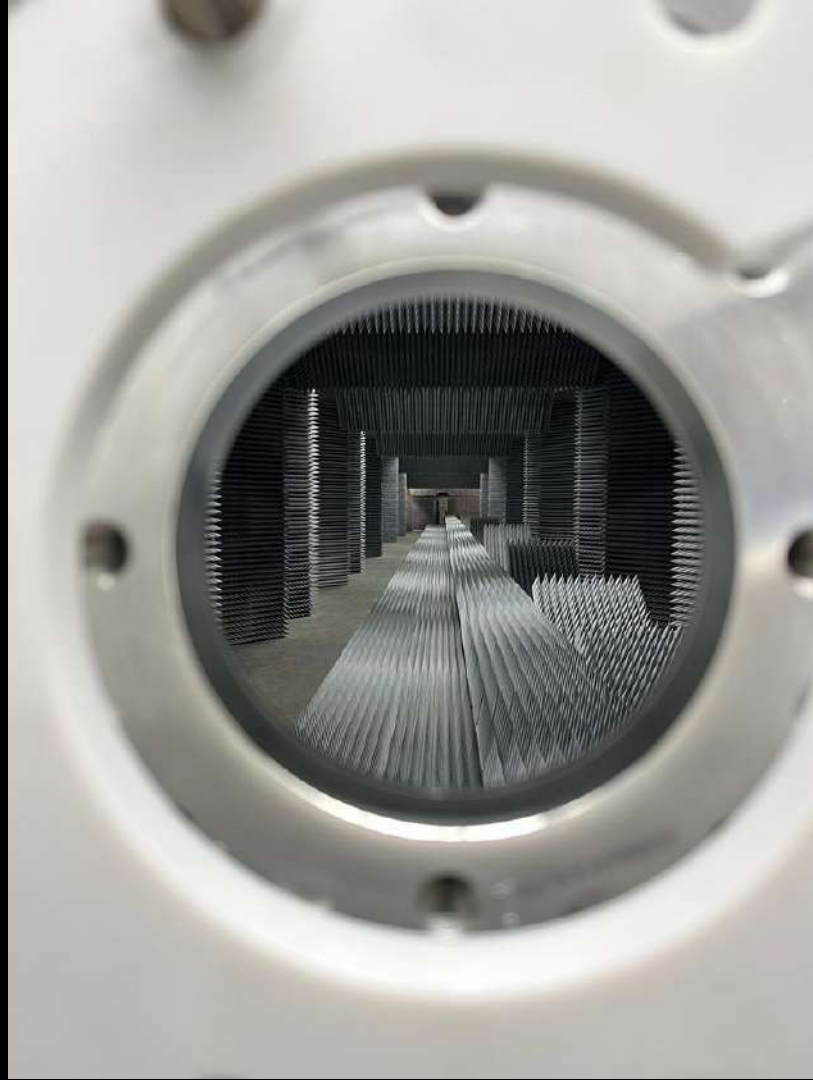
VEGA

Values on the market

> 30 m

3.5 m - 17 m





VEGAPULS 6X

What's new?

80 GHz – Gen 1

VEGAPULS 64 & 69



Temp: -196...200°C

Pressure: -1...20 Barg

80 GHz – Gen 2

VEGAPULS 6X



Temp: -196...**450**°C

Pressure: -1...**160** Barg

What's new?

80 GHz – Gen 2

VEGAPULS 6X



New VEGA radar chip



IEC 61508



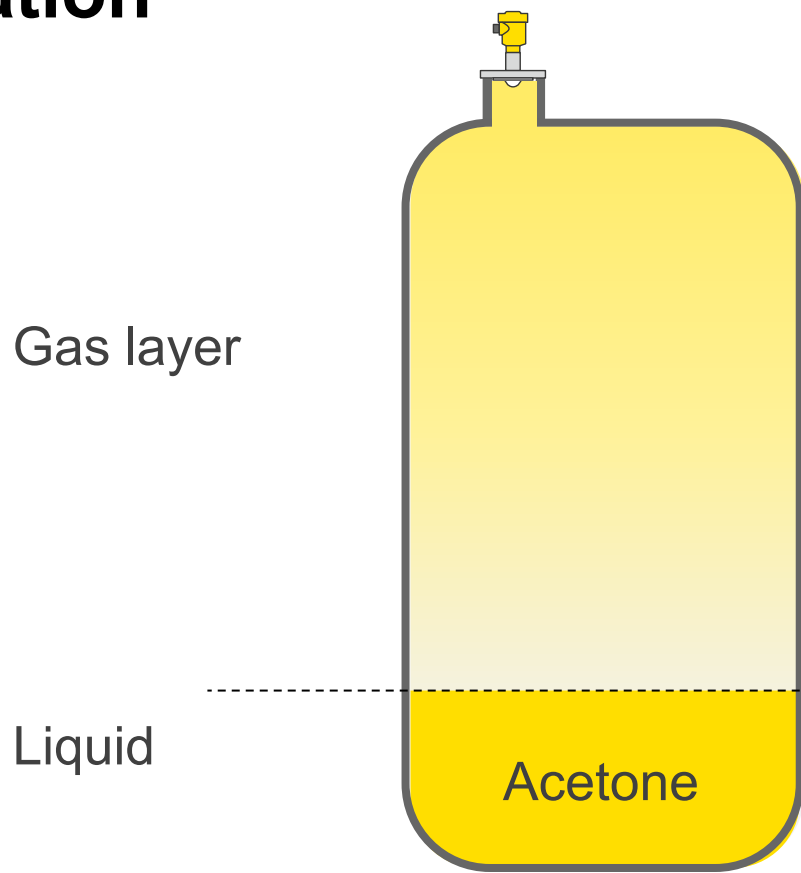
IEC 62443 (cyber security)

1 sensor for both solids & liquids



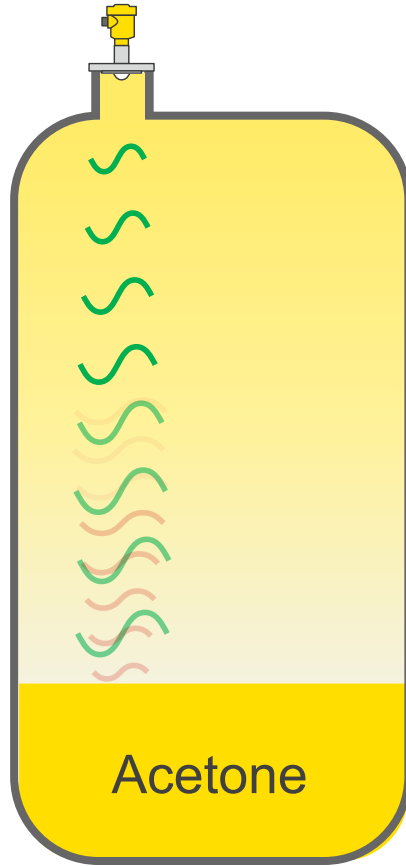
Absorption of microwaves by gas overlay

Application



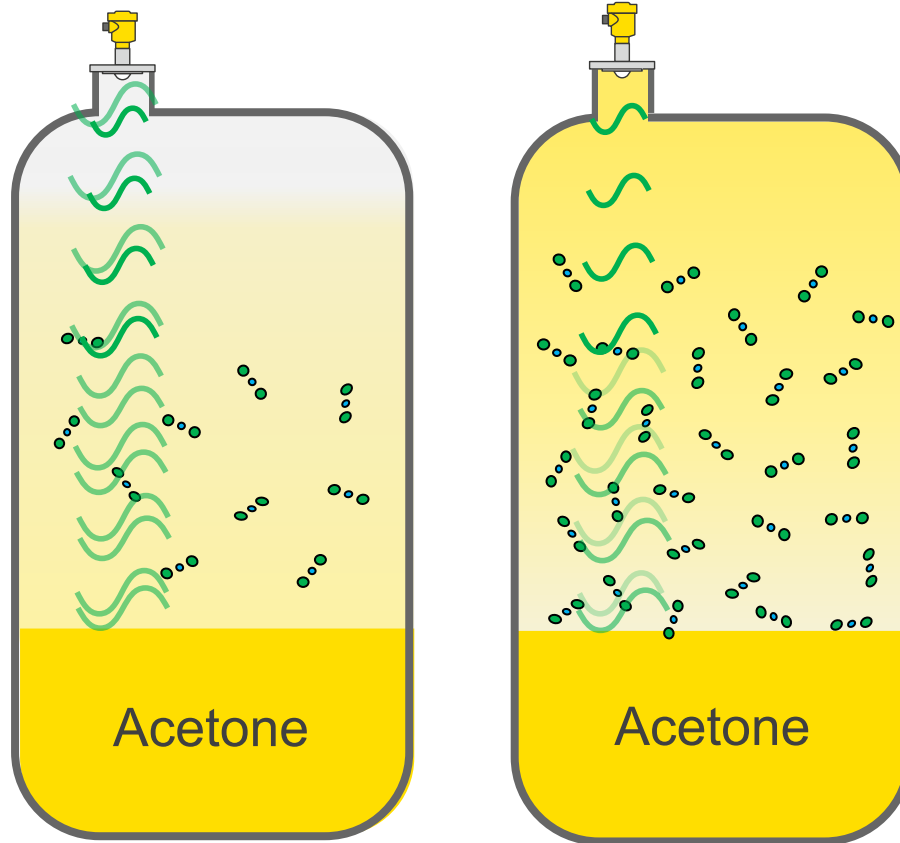
Problem

Absorption

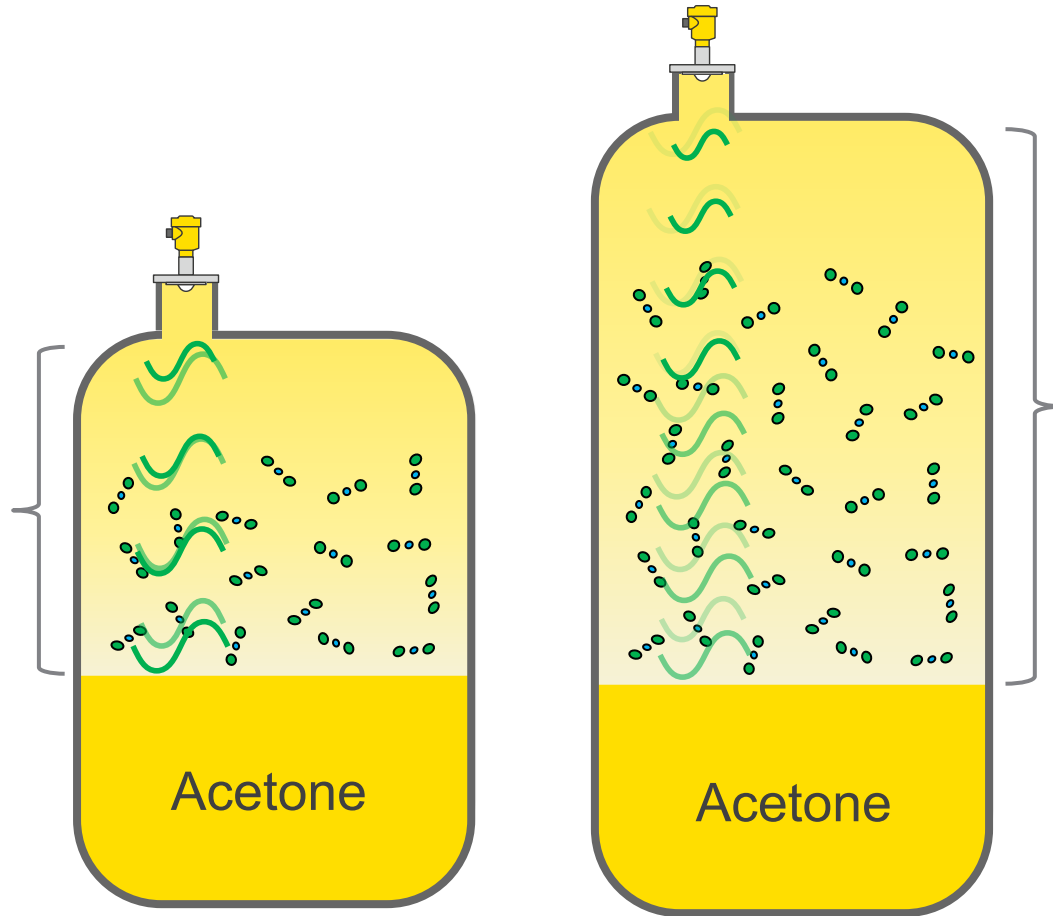


Influencing factors

Concentration

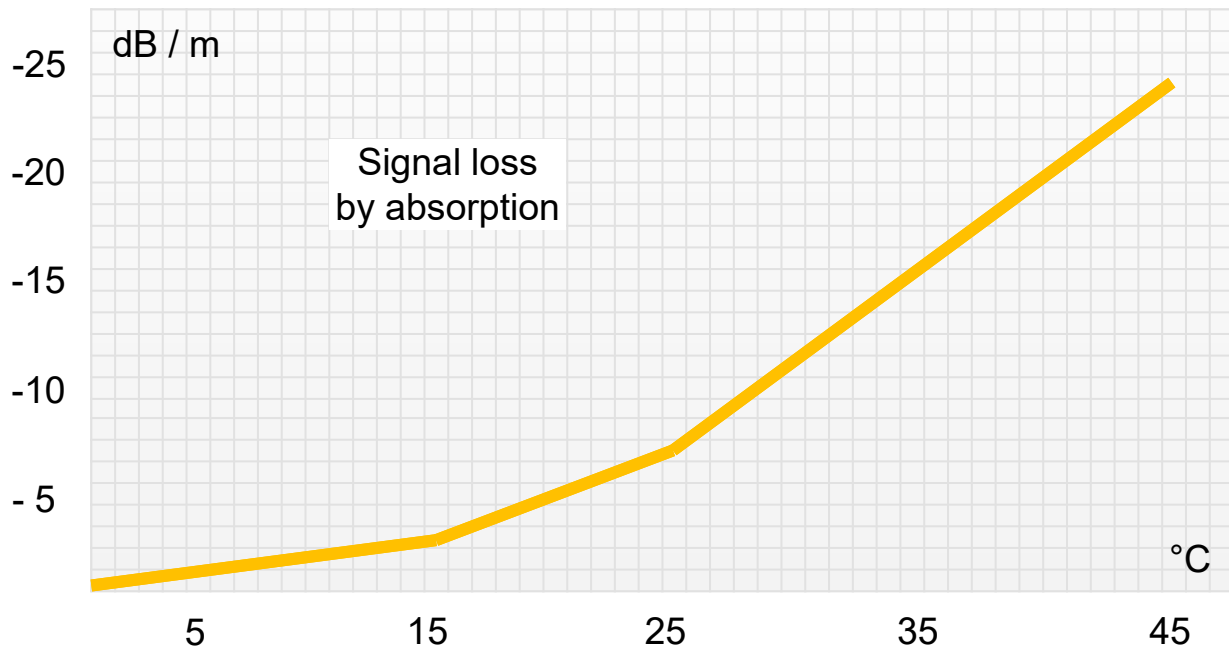


Distance

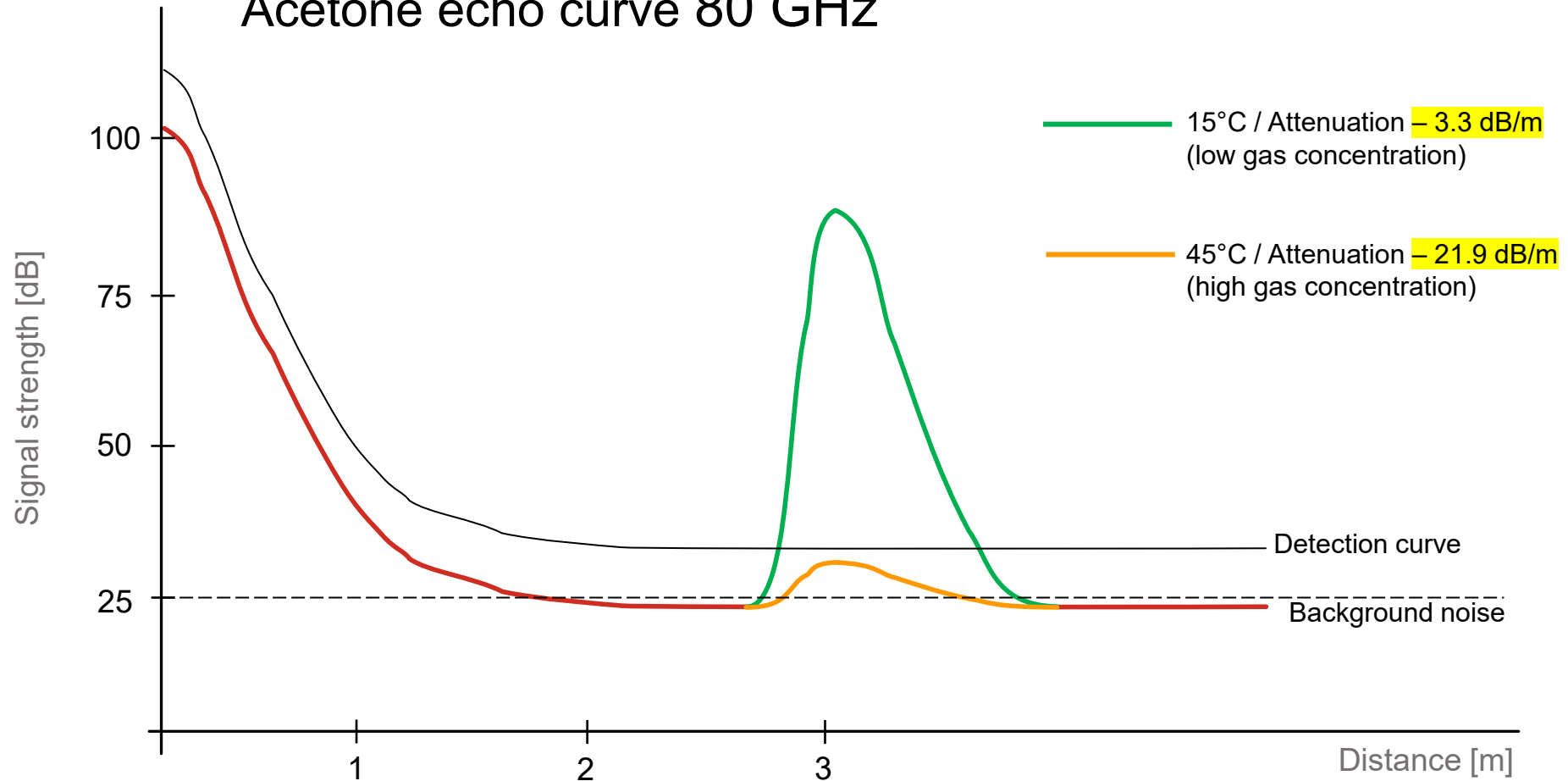


Attenuation of microwaves

Acetone at 80GHz



Acetone echo curve 80 GHz



Process media

Media

with detailed information for signal attenuation

Medium				Signal attenuation			
Atmosphere	Common name	Sum. formula	Remark	TDR - VEGA FLEX 2 GHz dB / m	C-Band 6 GHz dB / m	K-Band 26 GHz dB / m	W-Band 80 GHz dB / m
Acetone 15°C	Propanone, propane-2, 2-propanone, dimethyl ketone, acetonum, spiritus pyroaceticus	C ₃ H ₆ O	Temperature 15°C	0	-1.1	-1.4	-3.3
Acetone 25°C	Propanone, propane-2, 2-propanone, dimethyl ketone, acetonum, spiritus pyroaceticus	C ₃ H ₆ O	Temperature 25°C	0	-2.1	-2.8	-6.8
Acetone 45°C	Propanone, propane-2, 2-propanone, dimethyl ketone, acetonum, spiritus pyroaceticus	C ₃ H ₆ O	Temperature 45°C	0	-7	-8.8	-21.9
Ammonia	Azane, alkali volatile, alkaline air, ammonia, volatile caustic salt, animal caustic salt, R717	NH ₃	Gas concentration 5 %	0	0	-0.9	0
Ammonia	Azane, alkali volatile, alkaline air, ammonia, volatile caustic salt, animal caustic salt, R717	NH ₃	Gas concentration 10 %	0	0	-1.8	0
Refrigerant R404	Organic refrigerant mixture of R-125 (pentafluoroethane), R-134a (tetrafluoroethane), R143a (trifluoroethane)	C ₂ HF ₅	Process pressure 10 bar	0	-13	-53	
Propylenoxid	2-Methyloxirane (IUPAC), 1,2-epoxypropane, methyloxirane, propylene oxide	C ₃ H ₆ O				-3.8	-12.8
Nitrogen	Nitrogenium, azot, azotum, nitrogen gas, zoogenium	N ₂		0	0	0	0

Media

with general information for signal attenuation

Medium				Signal attenuation			
Atmosphere	Common name	Sum. formula	Remark	TDR - VEGAFLEX	C-Band	K-Band	W W-Band
				2 GHz	6 GHz	26 GHz	80 GHz
				dB / m	dB / m	dB / m	dB / m
Dichloromethane	DCM, methylene chloride, methylene dichloride, or refrigerant R30	CH ₂ Cl ₂					Problems possible
Difluoroethane	Refrigerant R152a, HCF-152a	C ₂ H ₄ F ₂		No influence			no echo
Difluoroethane, R152a HFC	Refrigerant, R152a, Freon 152a, HFC-152a, Ethylidene fluoride, Ethylidene difluoride, HYDROFLUOROCARBON 152A (INCI)[1],	C2H4F2		ok		Probably problematic, atmosphere attenuates	Probably problematic, atmosphere attenuates
Dimethylether	Methoxymethane (IUPAC), wood ether, methyl ether, methyl oxide, DME	C ₂ H ₆ O	Process pressure 3.7 bar			no echo	no echo
Dimethylether DME	Methoxymethane (IUPAC), wood ether, methyl ether, dimethyl ether, methyl oxide, DME, DIMETHYL ETHER	C2H6O		ok		Probably problematic, atmosphere attenuates	Probably problematic, atmosphere attenuates
Isobutylene	Isobutenes or 2-methyl-butenes					Seems to work, echo in dstance 14 m: 68 dB	Problematic
Methane	Refrigerant R-50	CH ₄					
Methylacetat 70%, Methanol 30%			Temperature 70°C				no echo
Methylchloride	Methyl chloride, methyl chloride, chloromethane, monochloromethane, R-41	CH ₃ Cl					Probably problematic
Dichlormethan	DCM, Methylenchlorid, Methylendichlorid, oder Refrigerant R31	CH ₂ Cl ₂					Probably problematic

Media

with general information for signal attenuation

Medium				Signal attenuation			
Atmosphere	Common name	Sum. formula	Remark	TDR - VEGAFLEX	C-Band	K-Band	W-Band
				2 GHz	6 GHz	26 GHz	80 GHz
				dB / m	dB / m	dB / m	dB / m
Propylene	Propene, Refrigerant R-1269	C ₃ H ₆	Process pressure 11 bar	No or very low attenuation of echo signal, probably small change in runtime of approx. 0.4%, SN 60404895			Very small echo in distance 12 m, attenuation about -5 dB / m
Propylene	Propene, Refrigerant R-1270	C ₃ H ₆	Process pressure 9 bar				no echo
Propylene	Propene, Refrigerant R-1270	C ₃ H ₆	Process pressure 9 bar				no echo in distance of more than 7 m
Propylene gas liquid	Propylene, Propene, R-1270	C ₃ H ₆	Approx. 1 m nozzle with ball valve, electronics with increased sensitivity required, process pressure 4.5 bar			-0.7	
Sulfur dioxide	Sulphur dioxide, sulphur(IV) oxide, sulphuric anhydride	SO ₂			Works without problems (Messrs. Brüggemann in Heilbronn)		no echo (no confirmed findings)
Silane	Chemical compound consisting of silicon (Si) and hydrogen (H)	SiH ₄	Unpressurized, approx 70 - 80°C; comes out of the column at 110°C			Echo in distance 15 m, measurement reliability. approx. 15 dB, there have been failures because no echo could be detected, reason unknown (M.Christ, mail 11.09.2023)	no echo in distance 15 m
Vinylchloride	Vinyl chloride, chloroethene, chloroethylene, monochloroethene, monochloroethylene, R-1140, Frigen 1140	C ₂ H ₃ Cl					Probably problematic

What about extreme conditions?

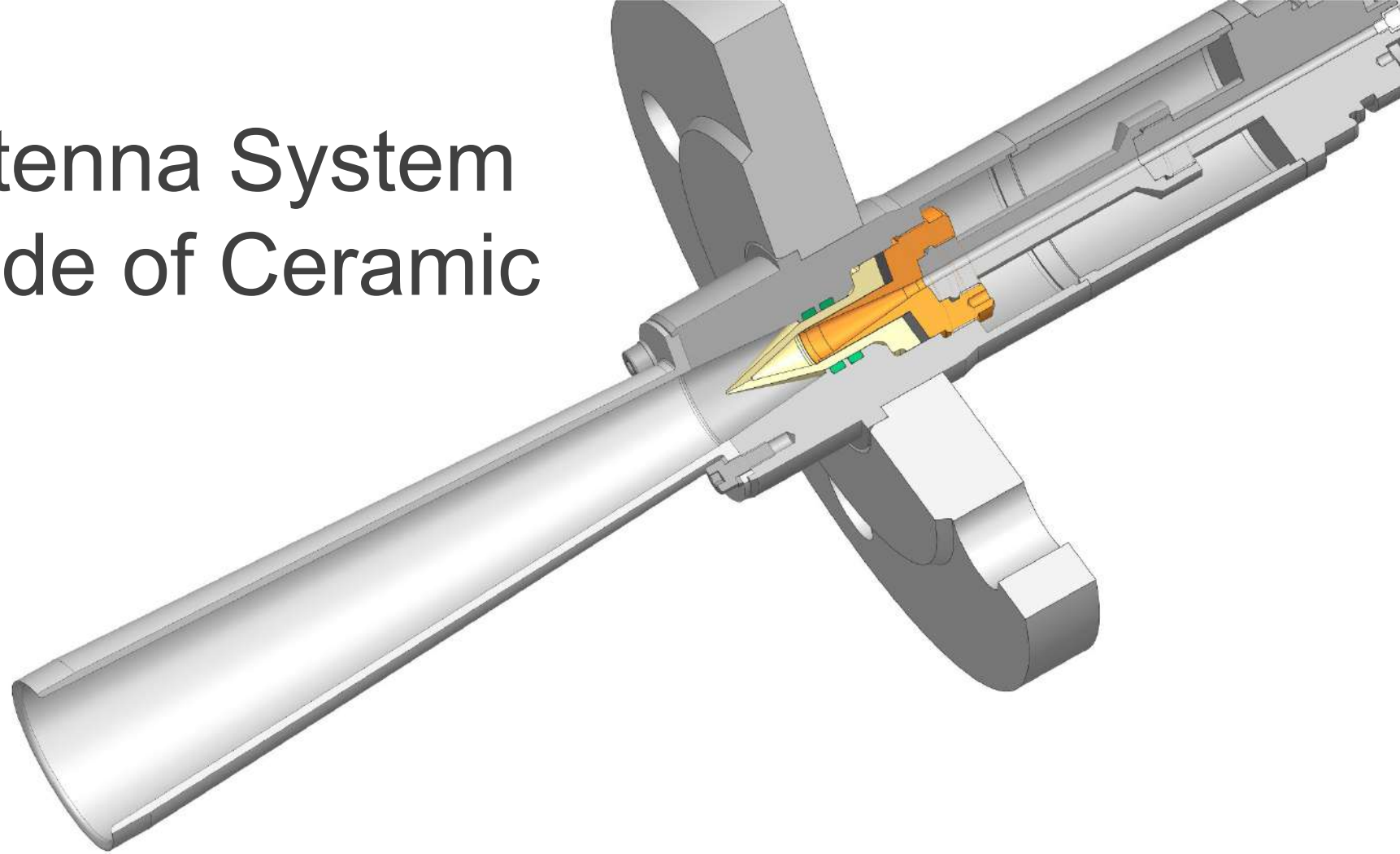
New horn antenna

80 GHz

- High pressure resistance
- High temperature resistance
- Ceramic process separation



Antenna System made of Ceramic



-196

PROCESS TEMPERATURE

+450 °C

-1

PROCESS PRESSURE

+160 BAR



Applications with 80Ghz

High nozzle



Bitumen

dK : 2,8

Temp : ~150-200°C

Height : 13 mtr

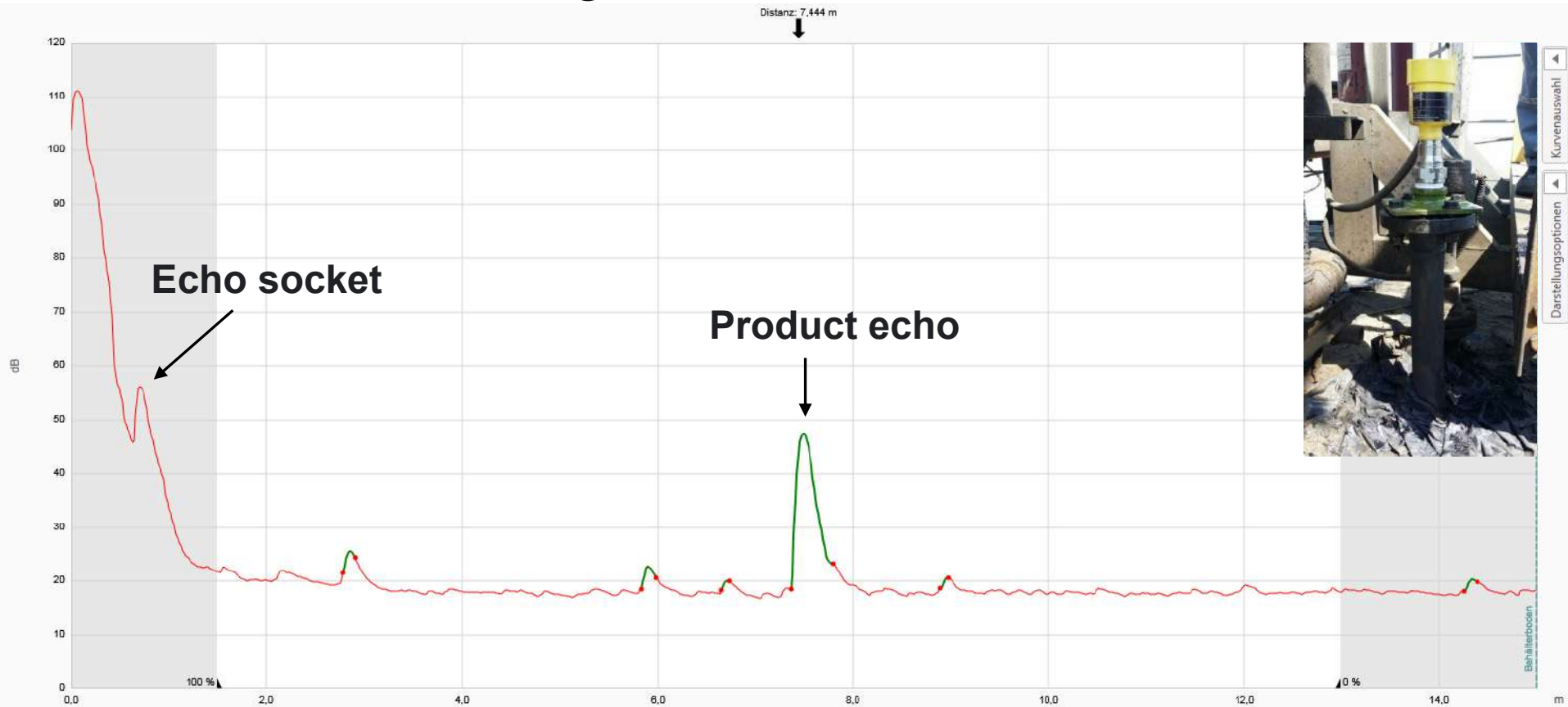
Nozzle : 2"

Radar : G1½"

$\alpha = 7^\circ$

VEGAPULS 80GHz

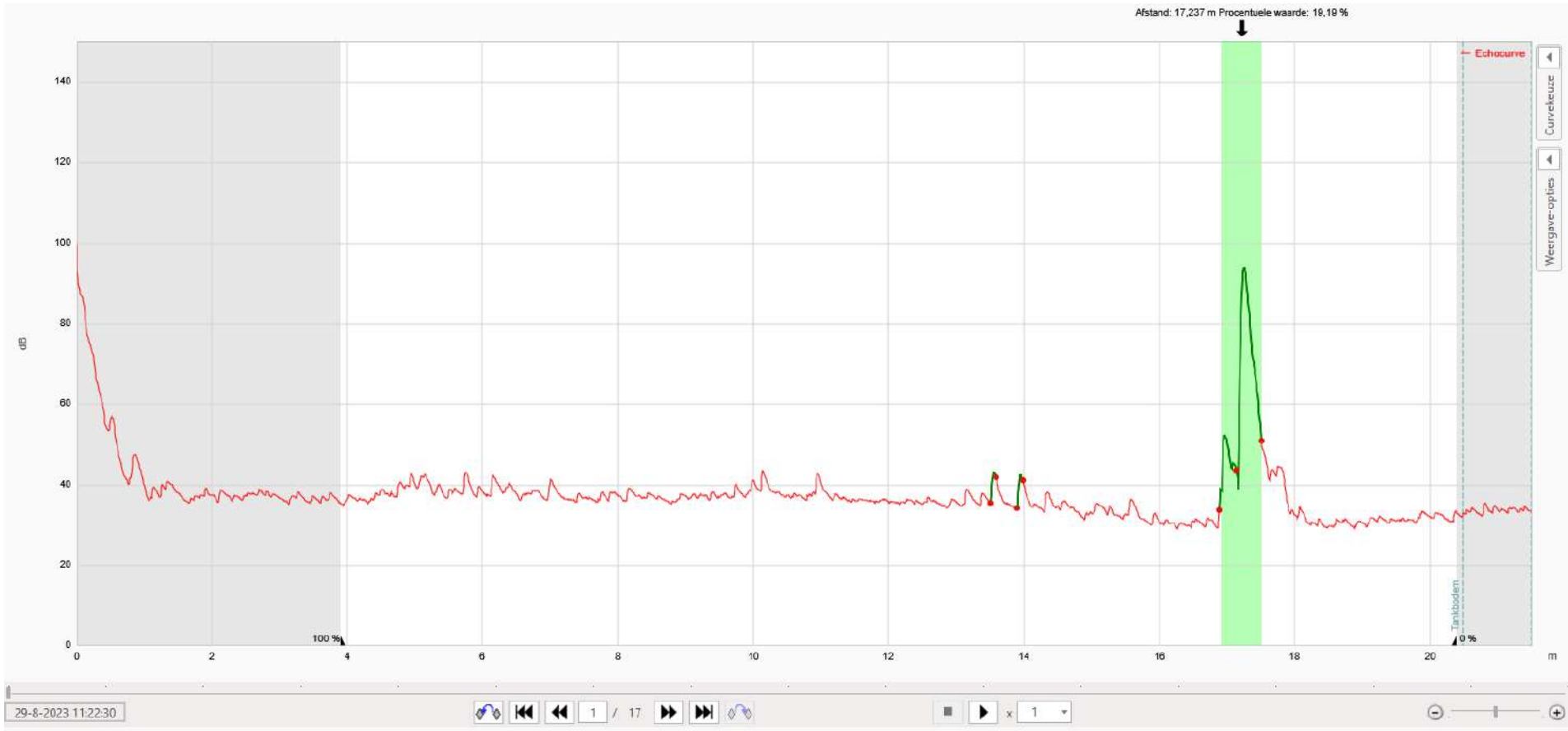
700 mm socket length



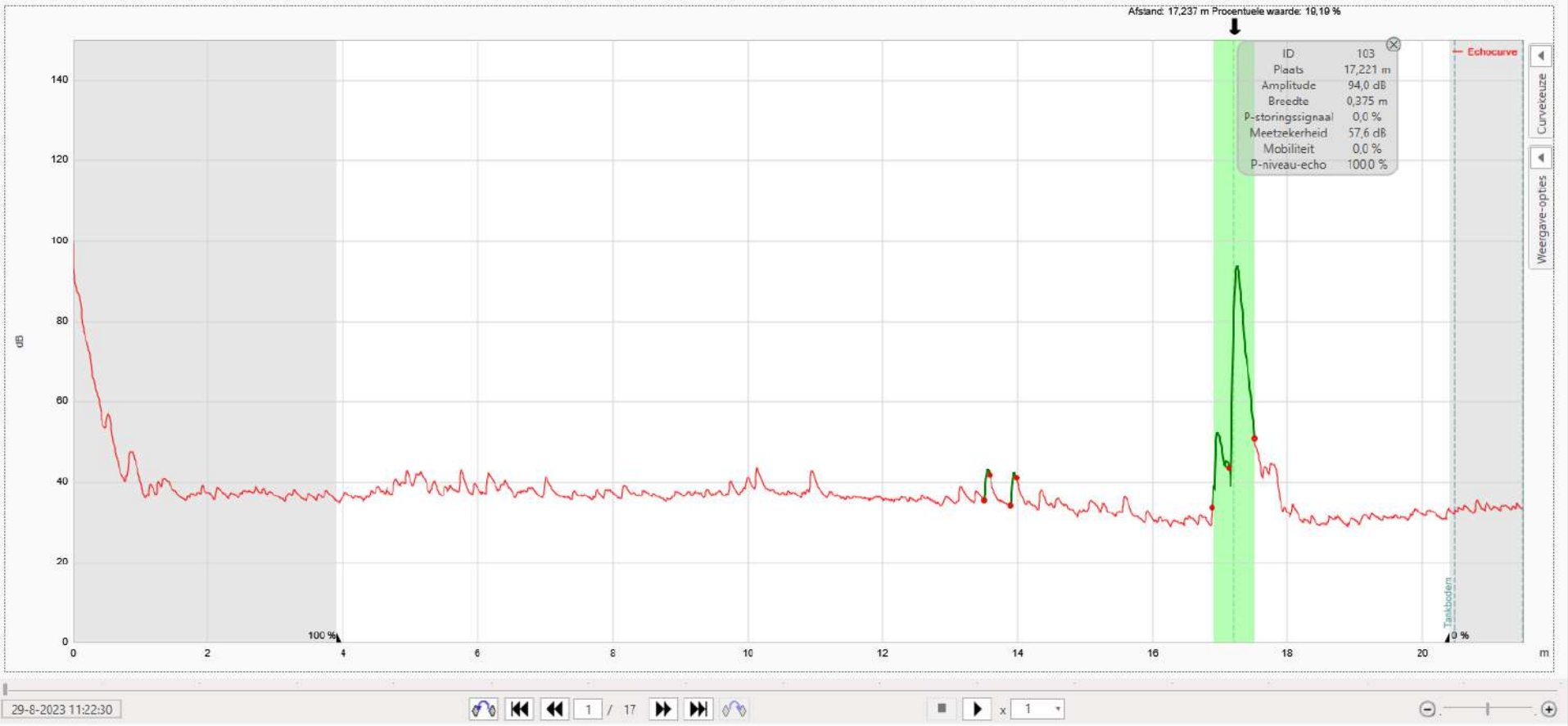
6X on stilling well



6X on stilling well



6X on stilling well



6X on stilling well
160 mm



6X on nozzle



6X on pressure relieve valve



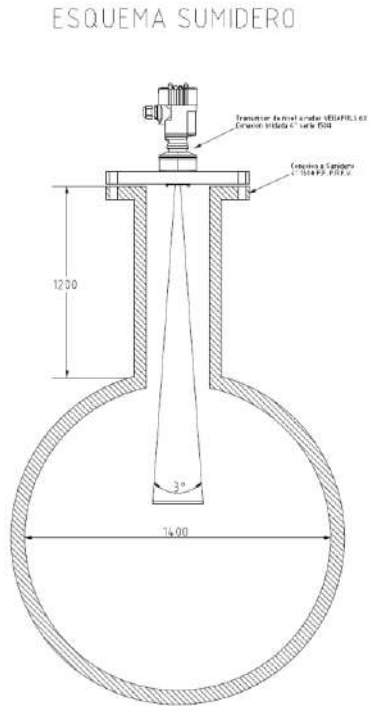
6X on floating roof



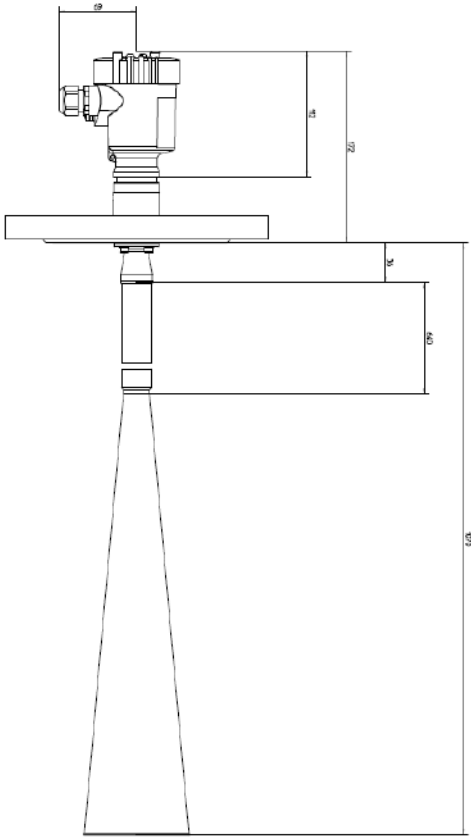
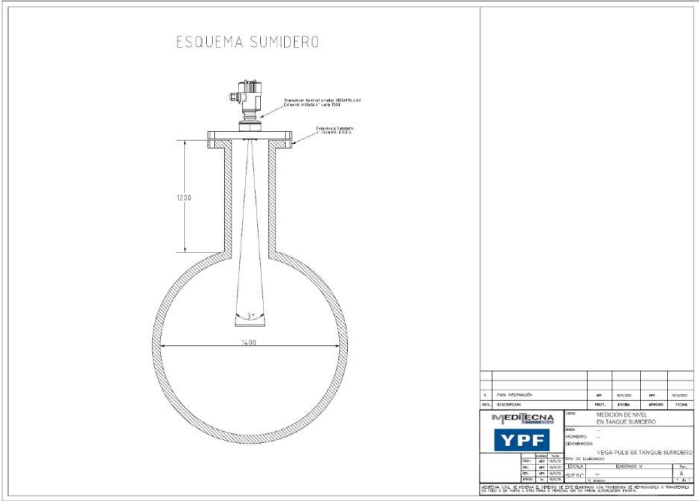
6X on floating roof



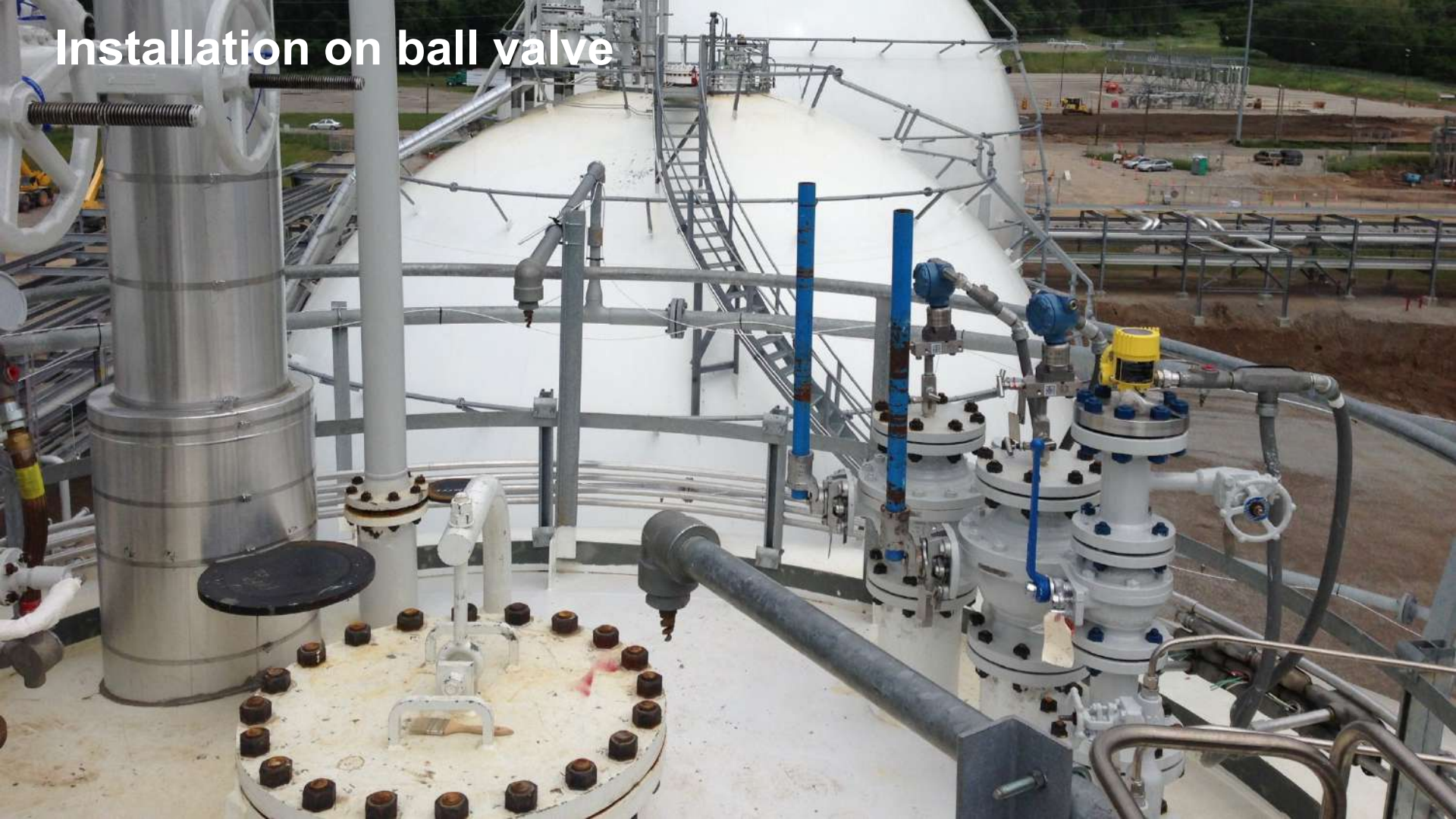
6X in underground storage tank

[illegible]

6X in underground storage tank

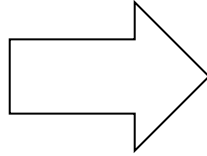


Installation on ball valve



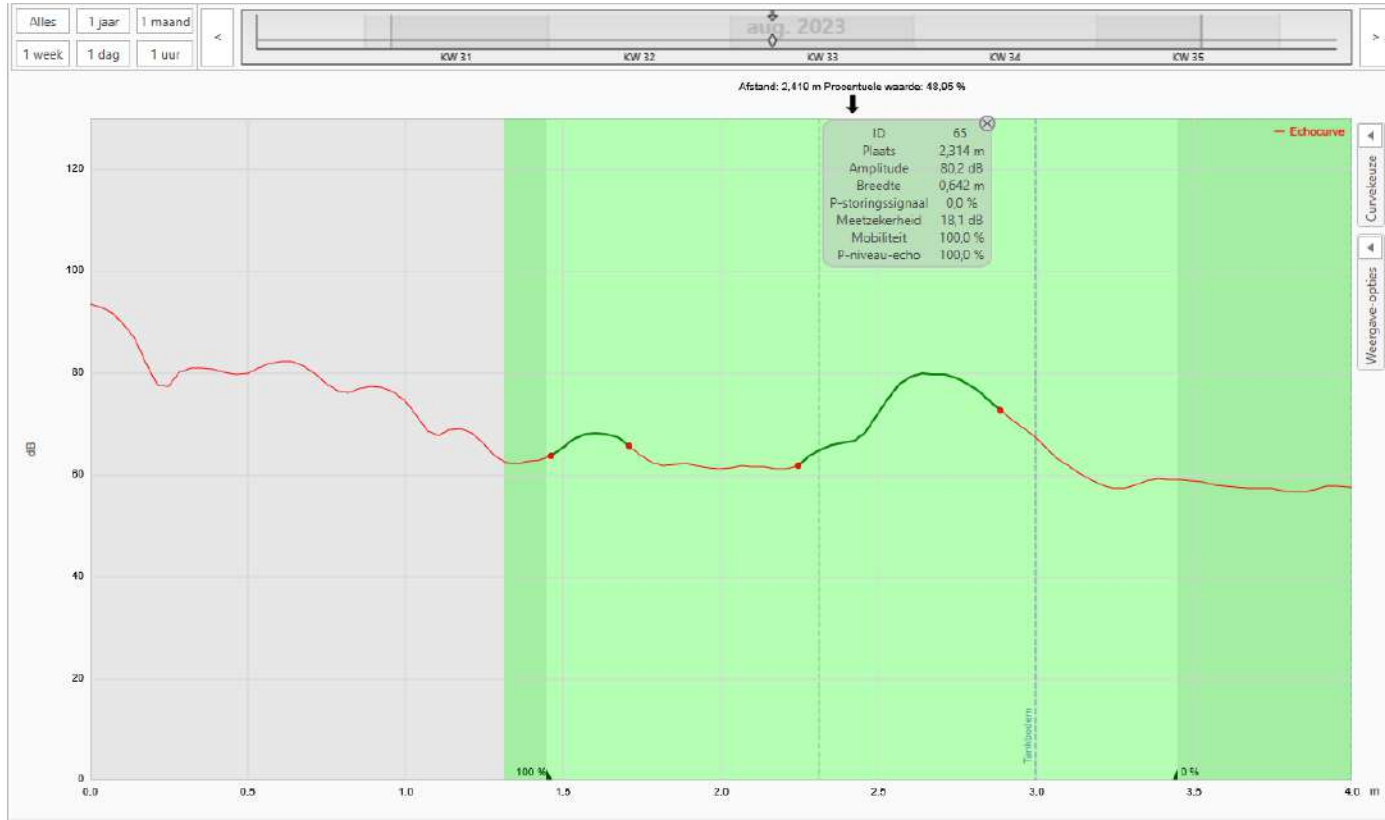
VEGAPULS 6X

Digester



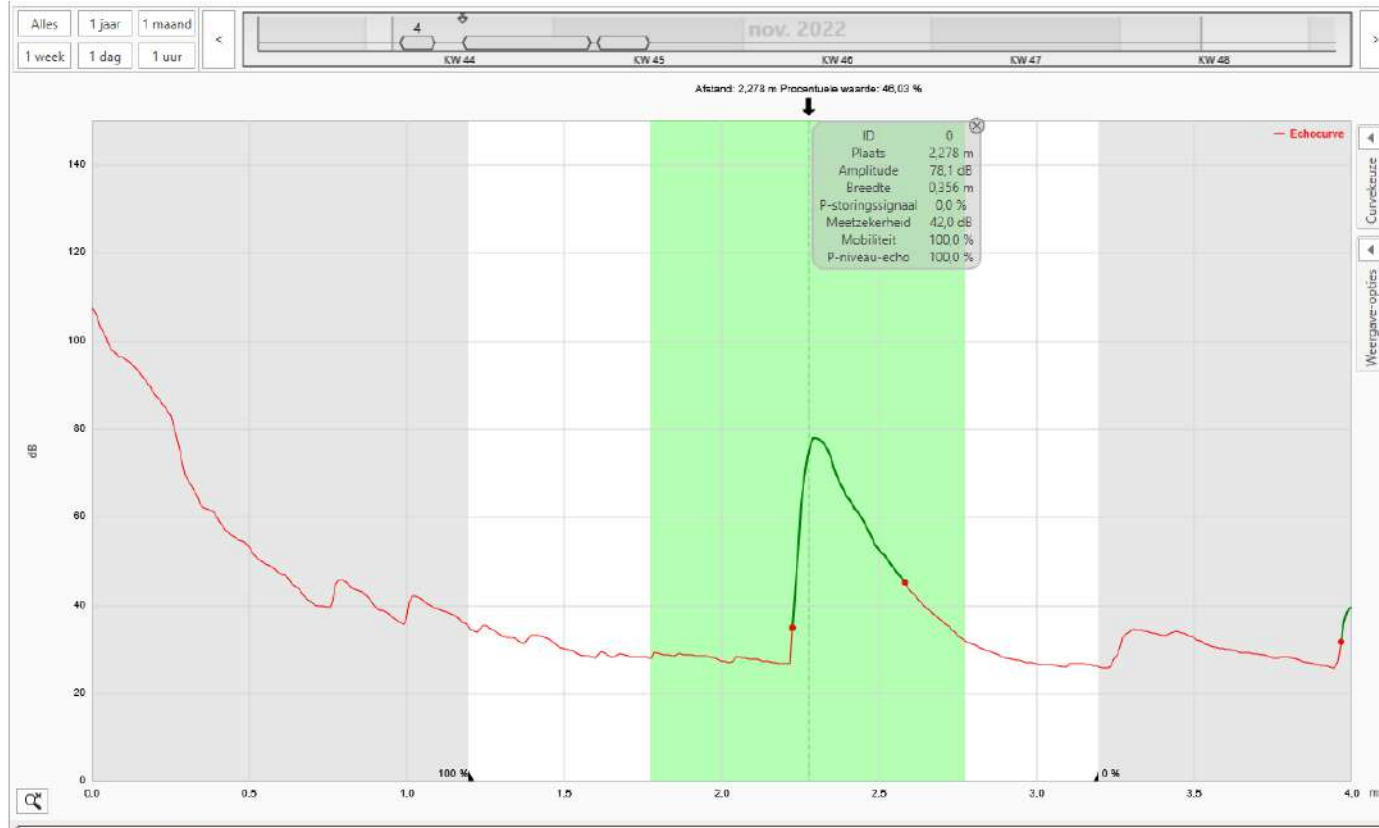
VEGAPULS 66

6 GHz radar sensor



VEGAPULS 6X

80 GHz radar sensor



VEGAPULS 6X on ball valve



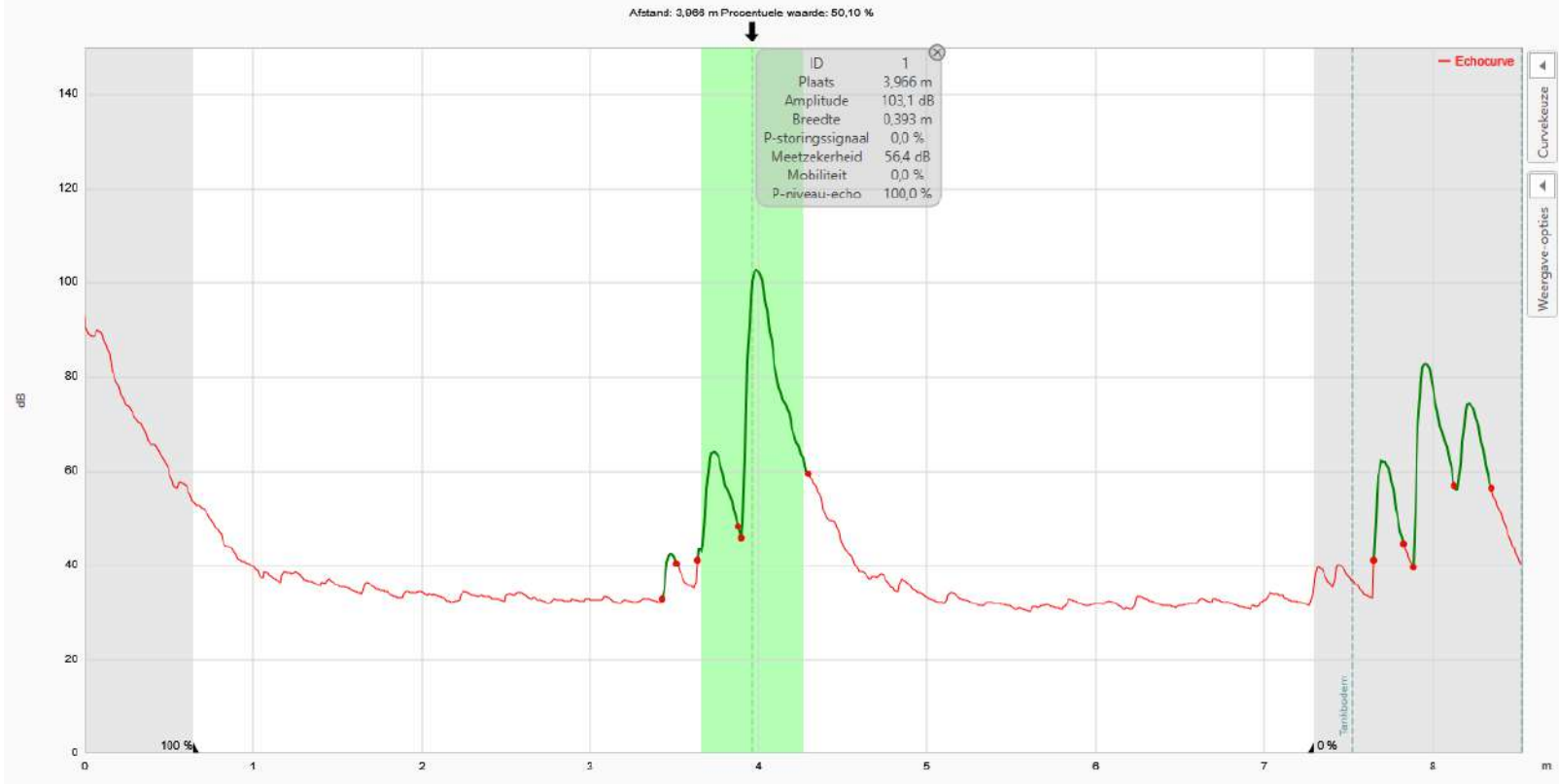
VEGAPULS 6X – T303

Oleum – Fuming Sulfuric acid



VEGAPULS 6X – T303

Oleum



Questions

