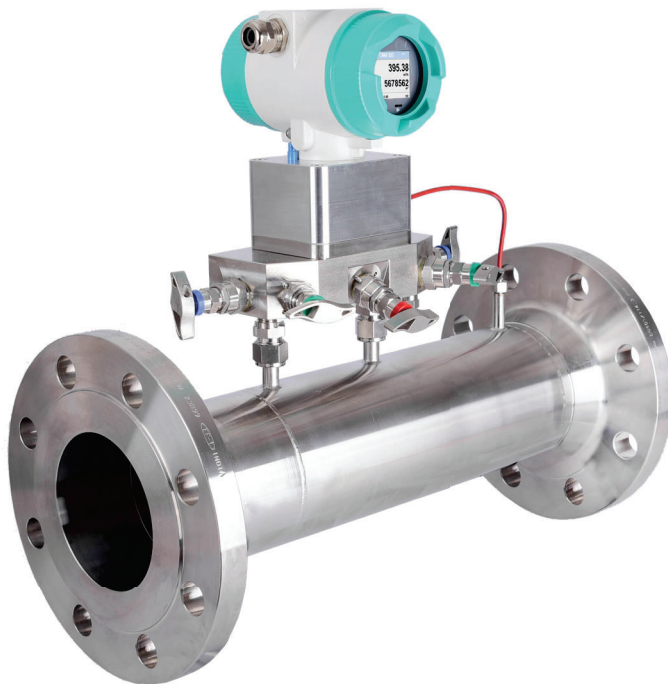




CMM 500 - Compressor Master Meter



Redefining precision

The CMM 500 Compressor Master Meter is a new type of reference flow meter that has been especially developed for high-precision measurement of the volume flow of compressors and for the billing of compressed air.

The CMM 500 can be used both directly behind the compressor for measuring wet compressed air and as a compressed air meter for measuring consumption and billing of dry compressed air.

It is based on a Venturi tube that meets with all the requirements of ISO 5167-3 for dimensional accuracy and surface quality. ISO 5167 is an internationally recognized standard that provides guidelines for accurate flow measurement with differential meters. Venturi pipes are extremely reliable, easy to handle and require low maintenance.

The main advantage of a Venturi tube towards many other measuring systems is the higher differential pressure with a lower pressure loss and the shorter inlet and outlet sections.

At the same time, the low-pressure loss is a major advantage compared to many other measuring methods.

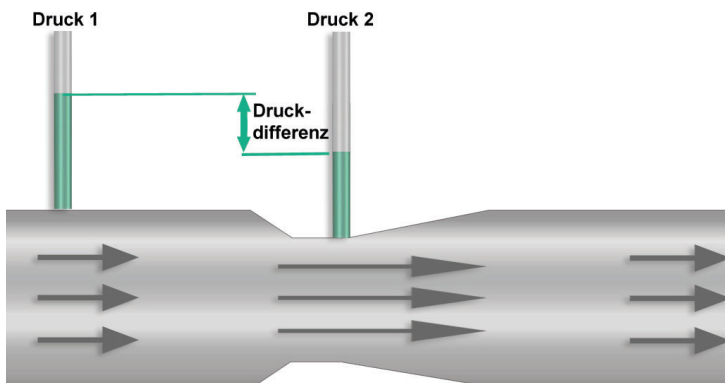
The large measuring range measuring span 1:130 and an accuracy $< 0.5\%$ of the measured value (from $0.2 Q_{max}$ to Q_{max}) are unique.

The small, compact design and the use of long-term stable and highly accurate pressure sensors with stainless steel diaphragms are the basis for precise consumption and flow measurement of operating volume, standard volume, pressure, differential pressure and temperature in one measuring device.

With the help of the valve block, service or maintenance can be carried out on site at any time (zero-point correction, condensate drain, sensor replacement for calibration), even during operation under pressure.

Measurement principle

Flow measurement with the Venturi tube manufactured according to ISO 5167-3



For differential pressure measurement, two separate lines lead to a differential pressure measuring cell. One pressure connection (pressure 1) is located at the inlet of the Venturi tube and a second pressure connection is located at the outlet of the Venturi tube (pressure 2). Without flow, the pressure at the inlet and outlet is identical.

As soon as flow is present, the flow rate in the narrowing increases. At the same time, the static pressure 2 decreases. The pressure at the inlet is higher than at the outlet.

The pressure difference is a rate of the velocity and therefore also of the volume flow. The greater the flow velocity and the associated decrease in pressure in the Venturi tube, the greater the pressure difference. Two additional precision sensors (temperature and absolute pressure) are used to calculate the mass or standard volume flow in accordance with DIN 1343 or ISO 1217 compressed air standard.

The design of the Venturi tube ensures a large measuring span (1:130) with low pressure loss at the same time.



CMM 500 - Compressor Master Meter

Example Ordercode CMM 500:

0690 0500_A1_B1_C1_D1_E1

DESCRIPTION	ORDER NO.
CMM 500 Compressor Master Meter - High-precision reference flow sensor	0690 0500 + Order-code: A...E_

Measuring section

A6	DN 50
A8	DN 80
A9	DN 100
A10	DN 125 - on request
A11	DN 150 - on request
A12	DN 200 - on request

Flange version

B1	Flange DIN EN 1092-1
B2	Flange ANSI 150 lbs (only in combination with E3)
B3	Flange ANSI 300 lbs (only in combination with E4)

Option display

C1	with integrated Display
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Option Signal outputs / bus connection

D1	2 x 4...20 mA analog output (galvanically isolated), pulse output, RS 485 (Modbus-RTU)
D4	1 x 4...20 mA analog output (not galvanically isolated), pulse output, RS 485 (Modbus-RTU)
D5	Ethernet interface (Modbus/TCP), 1 x 4...20 mA analog output (not galvanically isolated), pulse output, RS 485 (Modbus-RTU)
D8	M-Bus, 1 x 4...20 mA analog output (not galvanically isolated), pulse output, RS 485 (Modbus-RTU)
D9	Ethernet interface PoE (Power over Ethernet), (Modbus/TCP), 1 x 4...20 mA analogue output, (not electrically isolated), pulse output RS 485 (Modbus-RTU)

Inlet-/outlet section

E1	without inlet section
E2	Inlet/outlet section with DIN EN 1092-1 flanges for customer-side process connection
E3	Inlet/outlet section with ANSI 150 lbs flanges for customer-side process connection
E4	Inlet/outlet section with ANSI 300 lbs flanges for customer-side process connection

DESCRIPTION	ORDER NO.
Accessories:	
ISO calibration certificate (5 calibration points)	3200 0001
DAkKS-certificate (5 calibration points)	on request
Intelligent chart recorder DS 500 mobile, 4 sensor inputs	0500 5012
CS PM 600 mobile current/effective power meter 100 A	0554 5341
CS PM 600 mobile current/effective power meter 600 A	0554 5342
IAC 500 sensor for measuring ambient conditions (absolute pressure, temperature, rel. humidity), incl. wall bracket	0604 1000

TECHNICAL DATA CMM 500 Compressor Master Meter

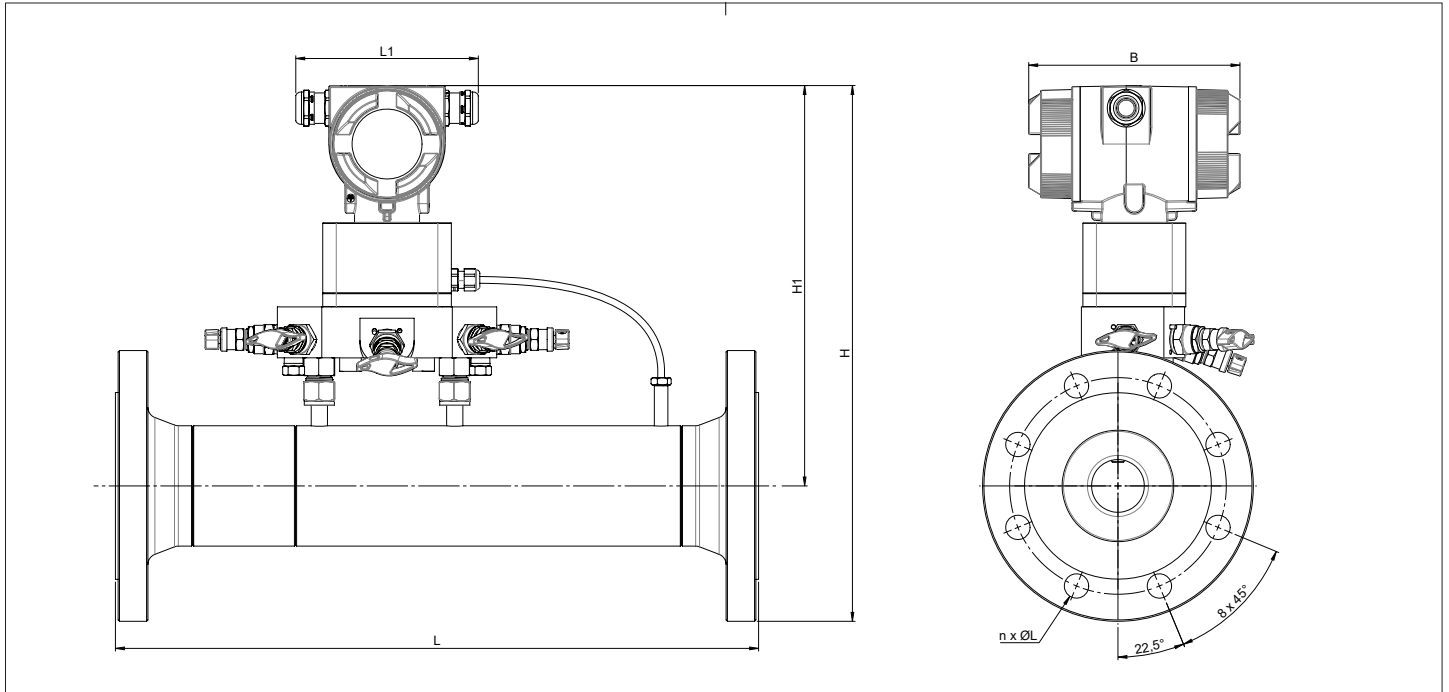
Measuring medium:	Air, gases
Accuracy: (v. M. = from measured value):	± 1% for Qmin up to 0,2 Qmax ± 0,5% for 0,2 Qmax up to Qmax
Typically achievable Accuracy when installing CS inlet and outlet sections:	± 0,75% for Qmin up to 0,2 Qmax ± 0,3% for 0,2 Qmax up to Qmax
Measuring principle:	Differential pressure, Venturi
Measuring range:	1:130
Response time:	t 99: < 1 sec.
Medium temperature:	-20°... +100 °C
Operating pressure:	Max. 16 bar (g), on request 30 bar / 100 bar
Ambient temperature:	-30°... +70 °C
Power supply:	18 ... 36 VDC
Signal output:	Standard: RS 485 (Modbus-RTU), 4...20 mA, pulse Optional: Ethernet Interface, M-Bus
Process connection:	Flange according to DIN EN 1092-1 or ANSI Flange
Installation conditions:	In horizontal lines or in risers

Inlet-/outlet section

- Inlet and outlet sections ensure calm flow conditions and highly accurate measurements
- When installing the CS inlet or outlet sections, it is ensured that there is no turbulence due to different inner diameters, edges of CMM 500 and inlet or outlet section.
- In the case of extreme disturbances and turbulences, e.g. caused by check valves, valves, partially closed ball valves, it is recommended to install a perforated plate straightener in front of the inlet section



Technical drawing

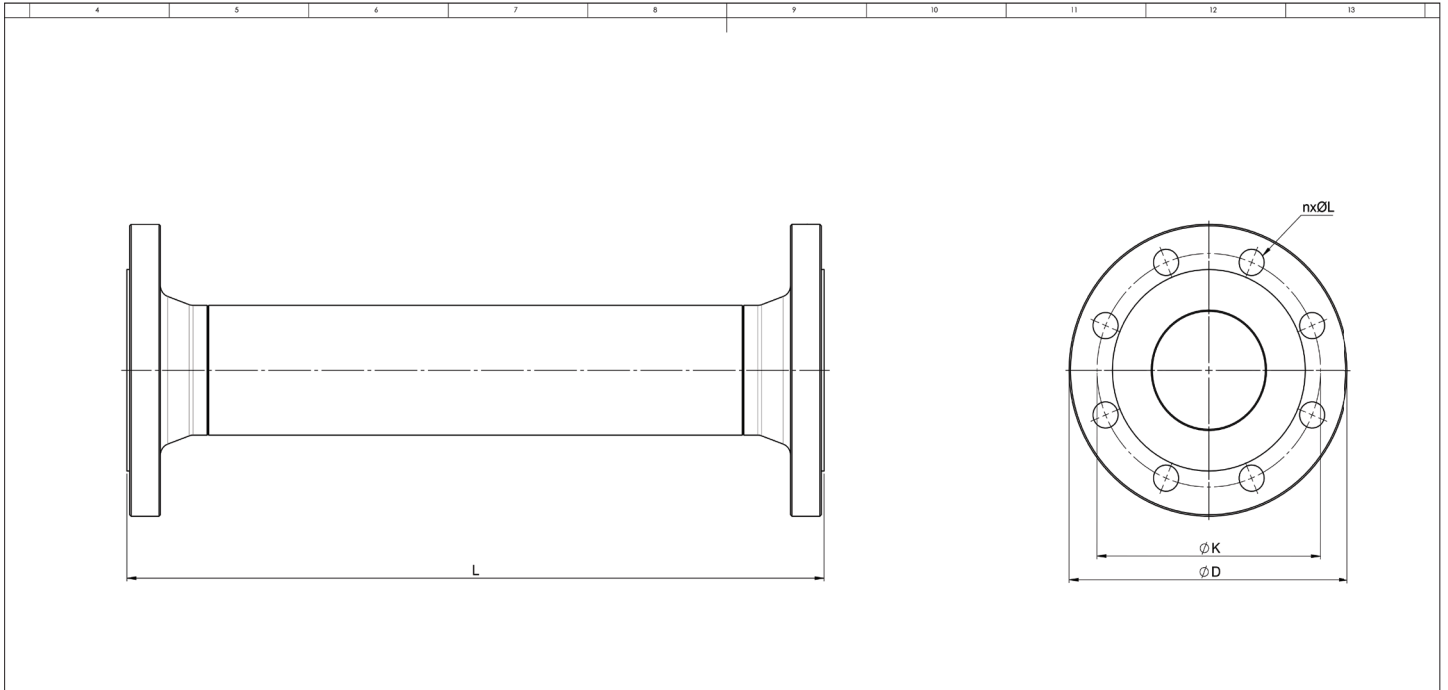


CMM 500						Flange DIN EN 1092-1 Type11 B1 PN40		
Pipe size	L - mm	L1 - mm	H1 - mm	H - mm	B - mm	ØD	ØK	n x ØL
DN 50	475	134,8	242,7	344,2	180	165	125	4 x 18
DN 80	475	134,8	277,3	378,9	180	200	160	8 x 18
DN 100	475	134,8	307,9	409,5	180	235	190	8 x 18
DN 125	on request							
DN 150	on request							
DN 200	on request							

Measuring ranges flow rate CMM 500 for compressed air (ISO 1217:1000 mbar, 20 °C)						
Pipe inner diameter			Operating conditions 7 bar(g), 20 °C		Operating conditions 11 bar(g), 20 °C	
			Measuring range start and end values		Measuring range start and end values	
Inch	mm	DN	m ³ /h	cfm	m ³ /h	cfm
2"	54,5	DN 50	17...1800	11...1050	21...2240	12...1315
3"	82,5	DN 80	33...3475	20...2045	40...4300	23...2530
4"	107,1	DN 100	120...12800	70...7530	147...15900	86...9355
5"	135	DN 125	190...19950	111...11740	228...24750	134...14560
6"	159	DN 150	259...27700	152...16300	315...34350	185...20210
8"	200	DN 200	405...43560	238...25638	500...54050	294...31810



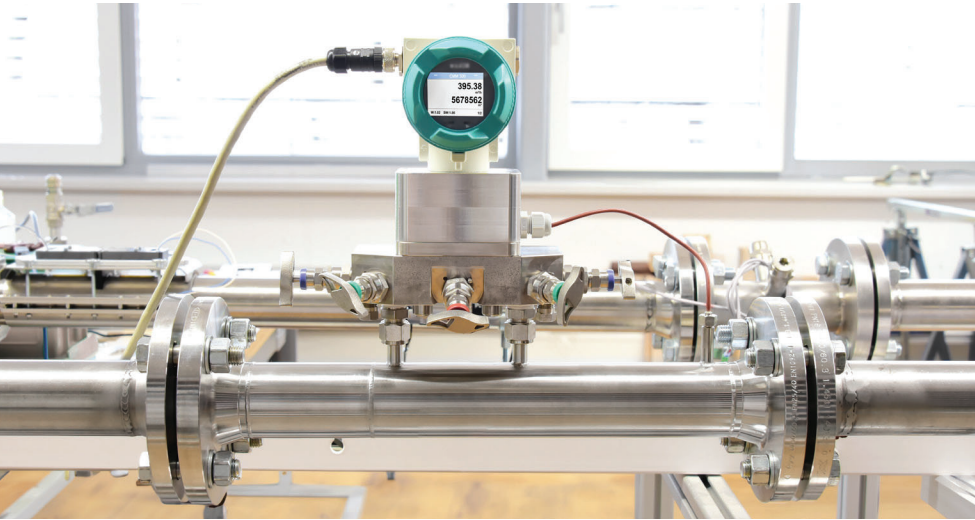
Technical drawing - Inlet and outlet section



Inlet and outlet section			Flange DIN EN 1092-1 Type11 B1 PN40		
Pipe size	Inlet section L - mm	Outlet section L - mm	ØD (mm)	ØK (mm)	n x ØL (mm)
DN 50	500	500	165	125	4 x 18
DN 80	800	500	200	160	8 x 18
DN 100	1000	500	235	190	8 x 22



Fields of application



- ▶ **Reference measuring device** for blower and compressor test benches (effective delivery capacity)
- ▶ **Continuous monitoring** of the volume flow of individual compressors
- ▶ **High-precision measurement** of the volume of compressed air supplied to third parties for billing purposes with DIN EN ISO/IEC 17025 certificate
- ▶ **Measurement on the „wet side“** directly downstream the compressor

▶ The CMM 500 Compressor Master Meter is a reference flow meter that has been especially developed for measuring the delivery volume of wet compressed air directly downstream of compressors.

The large measuring span 1:130 and an accuracy of <0.5 % of the measured value (0.2 Q_{max} to Q_{max}) are unique.

Service or maintenance can be carried out at any time via the mounting plate (zero-point correction, condensate drain, sensor replacement for calibration), even during operation under pressure.

Mechanical advantages

- Accuracy < 0,5%, approved by DIN EN ISO/IEC 17025 certificate
- Huge turn down ratio 1:130
- Fast reaction time, detection of peaks, no adaption time necessary like in case of ultra sound gas counters
- No long straight inlet section required
- Extremely low pressure drop, < 70 mbar at max flow
- Applicable for all gas types (just set up the gas density)
- Pressure range up to 10 bar(g), 30 bar(g), 100 bar(g)
- Direct output of standardized volume flow Nm³, Nm³/h (DIN 1343 resp. ISO 1217)
- Additional outputs: temperature in °C or °F, pressure and differential pressure in bar, psi...
- Available output signals: Modbus-RTU, Modbus TCP, POE, MBus, HART, 4 ... 20 mA
- ATEX Version for flammable and combustible gases coming soon



Mechanical advantages

Robust and long-term stable:

- The Venturi tube manufactured in accordance with ISO 5167-3 is the basis for highly precise measurement results, an internationally recognized standard
- No moving parts as with turbines or gas meters, no ageing of bearings or damage like in case of turbines due to particles or abrasion
- Long-term stable measurement thanks to robust and highly accurate pressure and temperature sensors
- Insensitive to pressure surges and exceeding of the measuring range limit thanks to the use of long-term stable precision pressure sensors with high overload resistance and stainless-steel diaphragms
- Typical gas meters, turbines, rotary pistons etc. can only be used in dry air or gas
- Simple service and maintenance (zero point correction, condensate drain, sensor replacement for calibration) also possible during operation under pressure.

Easy servicing and practicality

During development, attention was paid to practicality and, above all, easy servicing. Thanks to the multifunctional valve block, all necessary maintenance and service work can be carried out safely and without removing the venturi tube under pressure.



Condensate drain

When installed directly behind the compressor, the water separators do not always operate 100%. Condensate can be drained via the drain valve during operation



Zero-point adjustment of the differential pressure sensor

A zero point adjustment of the differential pressure sensor can be carried out at any time via the display during operation under pressure and flow.



Sensor replacement

The sensor can be disconnected from the line pressure during operation via the valve block and can be sent for calibration and service.





Use of the CMM 500 to save costs

Continuous measurement of the volumen flow helps to save costs

Sample calculation

Compressor 250 kW(e) * 6000 operatin hours * 0,17 €/kWh

Annual electricity costs: 255.000 €

Clogged, dirty intake filters or wear can sometimes cause up to 10% loss of performance.

This corresponds to 25.500 € p.a.

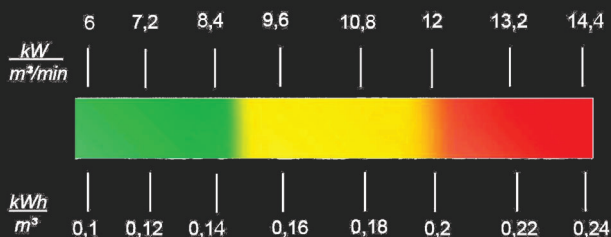
With the **CMM 500 Compressor Master Meter**, you can continuously monitor the volume flow. Problems are detected at an early stage and appropriate countermeasures can be taken

ANALYSIS OF THE SPECIFIC POWER

The specific power of the compressor can be calculated by measuring the power consumption and simultaneously measuring the volume flow. The specific power is calculated using the ratio of the energy consumption required in kWh to the volume of air delivered in m³ over the same period of time

$$\text{Specific power} = \frac{\text{kWh}}{\text{m}^3}$$

The specific power index of the compressor provides information about the nature of the compressor. The color bar below can be used as an evaluation aid



A typical specific power of an oil-injected compressor can be as follows:

Delivery rate: 43,7 Nm³/min (according to ISO 1217 based on 20°C, 1000 mbar)

Total power consumption: 272,7 kW

$$\begin{aligned} \text{Specific power} &= 272,7 \text{ kW} / 43,7 \text{ m}^3/\text{min} \\ &= 6,24 \text{ kW} / \text{m}^3/\text{min} \\ &= 0,104 \text{ kWh} / \text{m}^3 \end{aligned}$$



Efficiency measurement of compressors for energy saving - AIR AUDITS -



The volume flow of compressors depends on the intake air.

The installation location and climatic conditions must already be taken into account when designing compressed air stations.

Large temperature fluctuations, e.g. between day and night, lead to uneven delivery quantities.

The CMM 500 is the heart of a complete measuring system for compressors consisting of:

- **DS 500 mobile**
Intelligent mobile paperless recorder with 12 sensor inputs for data analysis and evaluation with 6 GB memory
- **CMM 500 Compressor Master Meter**
for high-precision measurement of the volume flow in relation to standard ISO 1217 or DIN 1343 in Nm^3/h , Nm^3 , Nm^3/min or l/s
- **IAC 500 Indoor Air Quality Sensor**
for measuring the intake air of the compressor, humidity, absolute pressure and temperature
- **CS PM 600 Mobile Current / Effective Power Meter**
for measuring the total power consumption of the compressor

With the complete measuring system for efficiency measurement (specific power kWh/m^3), the efficiency of the compressor can be calculated for ISO 1217 (20 °C and 1000 mbar) or for intake conditions.

This volume flow therefore does not refer to compressed air, but to expanded air according to ISO 1217 at 20 °C and 1000 mbar or to the respective ambient conditions in the compressor room.



Measurement result

Test conditions:

Pipe inner diameter:	53.1 mm	Pressure:	5 bar(g)
Gas:	Air	Medium moisture:	<30 %rF
Medium temperature:	18...26 °C	Ambient temperature:	18...26 °C
Permissible Tolerance:	+/- 0,5% v.M.	Measurement results related to:	1013,25 hPa, 0 °C

Reference calibration level CS INSTRUMENTS

Measured value	Nominal value	Actual value	Deviation absolute	Permissible deviation absolute	Deviation relative	Permissible deviation relative
[N°]	m³/h	CMM 500 2 Zoll	[m³/h]	m³/h	%	%
1	25,88	26,01	0,12	0,13	0,49	0,5
2	51,87	52,11	0,23	0,26	0,45	0,5
3	64,88	65,18	0,13	0,97	0,20	0,5
4	116,47	116,81	0,34	1,74	0,29	0,5
5	160,81	160,91	0,09	2,41	0,05	0,5
6	194,13	194,02	-0,10	2,91	-0,05	0,5
7	323,98	323,79	-0,18	4,85	0,05	0,5
8	451,55	452,08	0,53	6,77	0,11	0,5
9	711,46	712,93	1,47	10,67	0,20	0,5
10	1.228,36	1.229,59	1,23	18,42	0,10	0,5

result:

