General Considerations, Applications:

He-3 filled proportional counters are standard neutron detectors and are most suitable for the detection of thermal neutrons. Larger types are also used for spectroscopy of epithermal and fast neutrons by pulse height spectroscopy.
This type of detector is very insensitive to photon radiation, and the remaining amount may be well discriminated by electronic means.
There is a wide field of applications for He-3 proportional counters, for the monitoring of natural neutron radiation, for homeland security, for industrial applications in the range of nuclear technologies, in measurement methods for humidity, in oil, gas and mineral exploration, and in material research.

Construction:

The VacuTec He-3 proportional counter tubes consist of welded stainless steel with an alumina ceramic insulator and a pump port made of cupper. By default, the connectors are short solderable leads into axial / radial direction for counter types with small dimensions. Types of larger dimensions are equipped with a coaxial MHV connector. Other types of connectors may be ordered on demand. The counter tube is filled with a defined amount of He-3 gas and a small amount of CO_2 quenching gas for the operation of the proportional counter.

Some Basics:

He-3 is an isotope of the noble gas helium. It is stable, nonradioactive, inert and nontoxic. The natural abundance of He-3 in helium is very low, only 0.00014%.
He-3 is a strong absorber of neutrons. The neutrons are captured by the reaction He-3 (n, p) H-3 building a proton and a triton with a reaction Q-value of 764keV. The energy dependent cross-section of this reaction is one of the well-known standards in neutron measurement. Both the proton and the triton are charged ions and are registered by the proportional counter.

Sensitivity, thermal neutrons:

The cross section of the He-3 (n, p) reaction rises over many decades with decreasing neutron energy E by ($1/\sqrt{E}$), see Figure 1. Therefore He-3 neutron detectors feature a high sensitivity for the detection of low energy neutrons. At thermal energy (25 meV) the neutron detection sensitivity with a detector of diameter D and pressure p and D x p = 8 Inch·bar is about 90% of the saturation value (that is the maximum value or nearly a black detector), with D x p=4.5 Inch·bar it is 70%, and with 2.5 Inch·bar it is 50%. For cold neutrons the detection sensitivity is even higher.
The wall material of VacuTec He-3 neutron detectors is stainless steel of the type ANSI 304 (EN 1.4435), it has quite a low neutron absorption cross section and advantages concerning construction, stability, clean surfaces and low background.
The curve in Figure 2 gives an estimate of the thermal neutron sensitivity of the VacuTec He-3 proportional counter tubes on their dimensions D, L, and the gas pressure p.
The thermal neutron sensitivity data of the VacuTec He-3 Neutron detectors are based on measurements at the PTB Thermal Neutron Calibration Facility. The neutron reference field of this facility is at a 30 cm distance in front of a 50 x 50 cm^2 window as the neutrons are escaping from the graphite moderator surface.

Definitions:
Neutron fields are characterized by the neutron flux density. The unit of neutron flux density is defined by the number of neutrons crossing an area of 1 cm² per 1 second.
The sensitivity of the He-3 Proportional counter is determined by the rate of counted pulses (measured in the unit counts per second, 1/s or cps) per neutron flux density in the unperturbed neutron field. This results in 1/s / (1/cm² 1/s) = cm² or cps / (cm^{-2} s^{-1}). The historical unit cps/nv for the sensitivity is also quite common, it is equivalent to cps / (cm^{-2} s^{-1}).

Sensitivity, neutrons of higher energy:
Neutrons are generated in nature, by radioactive sources or by nuclear fission as fast neutrons in the MeV range or even higher. The detection sensitivity for the direct detection of these fast neutrons drops rapidly, therefore large volume detectors with a high He-3 pressure would be needed for that purpose.
However, to overcome this disadvantage there exists also the approach to moderate the neutrons down in energy to increase their detection sensitivity. Neutrons can be very efficiently moderated e.g. by the hydrogen in plastics, and the gain in detection sensitivity is higher than the neutron loss by absorption in the moderator material.
With special developed moderator designs, the detection sensitivity becomes very flat across a wide range of neutron energies (the Long Counter, from some 10 keV to about 10 MeV), or the pulse rate being nearly proportionally to the neutron dose rate (REM-Counter, a modern version provides the dose rate in µSv/h). With a set of moderators of different sizes it is even possible to select neutrons of different energies providing another method for neutron spectroscopy (Bonner Sphere Spectroscopy), this method works between thermal energies up to 1 GeV.

Pulse height spectrum:
Both the proton and the triton are charged ions and are registered by the proportional counter. For thermal neutrons the total energy of both ions is 764 keV. Assuming a W-value (average energy deposit per ion pair in the gas) of 42 eV, the charge output at full absorption of both ions in the counting gas is Q = 2.9 x M fAs with M being the gas multiplication factor. Recommended operation condition is a gas multiplication factor M about 30, providing good conditions for the He-3 proportional counter and a good signal for a charge sensitive preamplifier.

The measured pulse height spectrum of an He-3 proportional counter is quite complex. A single full energy peak will be only created by neutrons with very low energies compared to the Q-value. Depending on the fill gas and gas pressure, the maximum track lengths of the proton and triton ions may be larger than the geometric dimensions of the counter tube. This results in pulses with reduced signal amplitudes and generates a continuous spectrum with two steps at 191keV and 573keV, respectively. A few examples for counter tubes of different dimensions and filling pressures are shown in the Figure 3. The measurements were performed in the neutron field of a moderated Cf-252 source. The pulse height spectrum of detectors with large volume and / or high pressure features a wide valley between noise and the strong peak at high pulse height. Detectors with low pressure and / or small volume have a rather short valley between the noise and the broad range of pulses from neutron events.

The time period for pulse generation at the anode wire of the counter tube depends on the track length and track directions of the proton and triton, and the drift time of the $^{3}He^{+}$ ions in the counting gas. Consequently, the measured pulse height spectrum will depend on the electronic charge integration time.
Figure 4 shows an example for a 10 cm x 1 inch tube with 4 bar He-3 (Type 063 00 93) measured with integration time constants of 1, 2, 3, 6, 7, and 12 µs. There appears to be no peak of full energy absorption below 3 µs. The optimum time constant for the measurement of the spectrum shape lies in 7 to 12 µs. The resolution also depends on the anode voltage. Figure 5 shows the pulse height spectra of this counter tube measured with 7 µs integration and voltage values between 300V and 900V. The best resolution appears at about 700V. Generally, longer integration times provide a better resolution, however there are also more complications at high event rates (pile-up, precision of the event processing). Therefore, the integration time is a matter of optimization, see also the entry Counting Mode below.

Range of VacuTec He-3 Neutron detectors:
VacuTec manufactures a large variety of He-3 proportional counter tubes, from small types with ½ Inch diameter x 81 mm length to the large volume types with 2 Inch x 253 mm. The standard filling gas pressures are 2 to 10 bars. A list of the standard types with the main technical data is enclosed below. These counter tubes cover the neutron flux density range from $2 \cdot 10^{-3}$ to $2 \cdot 10^{5}$ $(cm^2\ s)^{-1}$.

In some special cases it could also be useful to combine counter tubes, e.g. to build a special detector arrangement or to increase the sensitivity by multiple detectors. In the simplest way this can be done by counter tubes being parallel connected to a common preamplifier and high voltage supply. Figure 6 shows an example of a detector pair Type 060 00 92 (1/2", 50 mm, 4 bar) where the pulse height spectra (red and blue) have been measured with the individual detector examples of the same type, but having a small difference of 3% in gas multiplication. The third (black) spectrum is from the detector pair connected in parallel to the input of a charge sensitive preamplifier. The resulting spectrum is obviously the superposition of the spectra from both individual detectors. The different peak positions from both individual detectors cause a broadened peak in the sum spectrum.

Counting mode:
Although general knowledge is needed, how the pulse height spectrum is generated, what is its shape, and which parameters have an impact on it, for merely counting the neutron events, only a pulse height trigger level or single channel analyzer is necessary to separate the neutron pulses and to discriminate the noise and gamma pulses. There is no need for a complete multichannel electronics for pulse height or even pulse shape analysis for this purpose.
Figure 7 shows the count rate plateaus for such a type of pulse counting system with a VacuTec 63 000 95 He-3 counter tube. The plateaus were determined for five different discriminator levels corresponding to 3, 4, 5, 8, and 11 fAs charge output of the counter tube (from blue to red curves). The plateau is constant within better than 2% over an voltage range of about 200 to 250V.

The lower the discriminator level the longer the plateau becomes. However, neutron fields may be strongly contaminated with gamma rays. Although the sensitivity of He-3 counter tubes for gamma rays is much lower than that for neutrons, and the gamma pulses are small compared to that of neutrons, the small gamma pulses can interfere with each other and pile up. In case the discriminator level is to low, this will lead to a biased neutron count rate. The present measurements have been performed with a Cf-252 source and a polyethylene moderator.

Evaluation kit:
An electronic evaluation kit for the He-3 counter tube will be available from VacuTec. This kit comprises a stable HV supply for anode voltage, a basic multi-channel pulse height analyzer, and a counting channel with a fixed trigger threshold. The kit is powered via a USB port. The USB port connection of the kit provides also a standard connection for the control and data read out by software protocol.

Low level counting:
The pulses above a threshold equivalent to 191keV of absorbed energy are caused by neutrons. The pulses caused by electronic noise and gamma rays lie below and can therefore be discriminated by an appropriate pulse height trigger level.

For qualified low level measurements as in the monitoring of the natural neutron radiation, a generally low detector background rate over the whole amplitude range is required. To test the background of the VacuTec counter tubes, examples were filled with natural Helium instead of He-3, this leads to a zero sensitivity of these detectors to neutrons but not to the other radiation components. With these particular detectors in the natural environment within 15 hours only two (spurious) pulses were registered above a 150 keV trigger level.

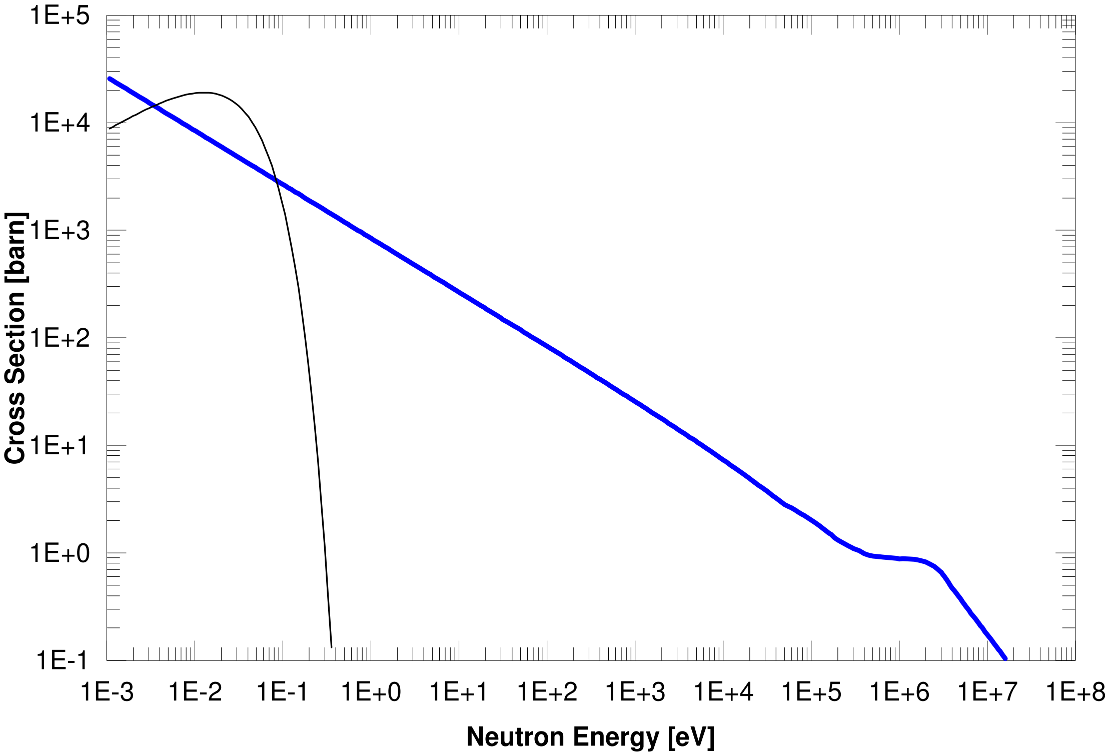


Figure 1: Cross section of the He-3 (n, p) reaction in the neutron energy range 10^{-3} to 10^{8} eV, the thermal energy spectrum is indicated as well.

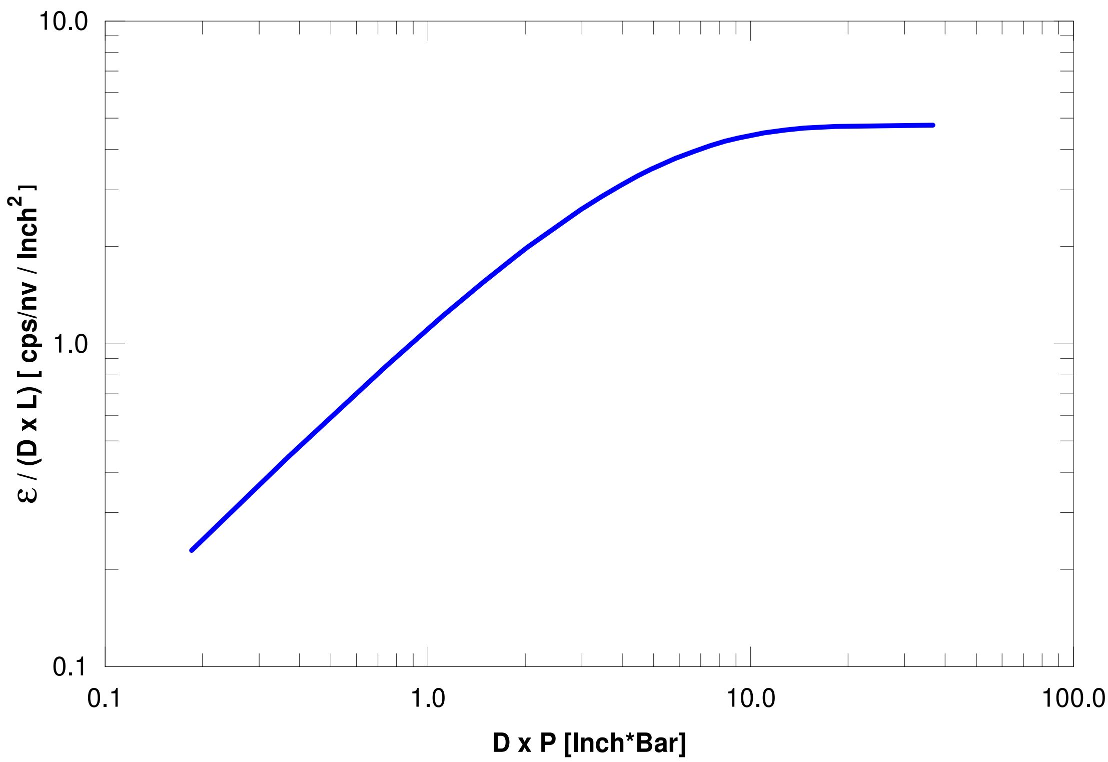


Figure 2: The curve shows the thermal neutron sensitivity ε of the VacuTec He-3 proportional counters on their diameter D, length L, and pressure p.

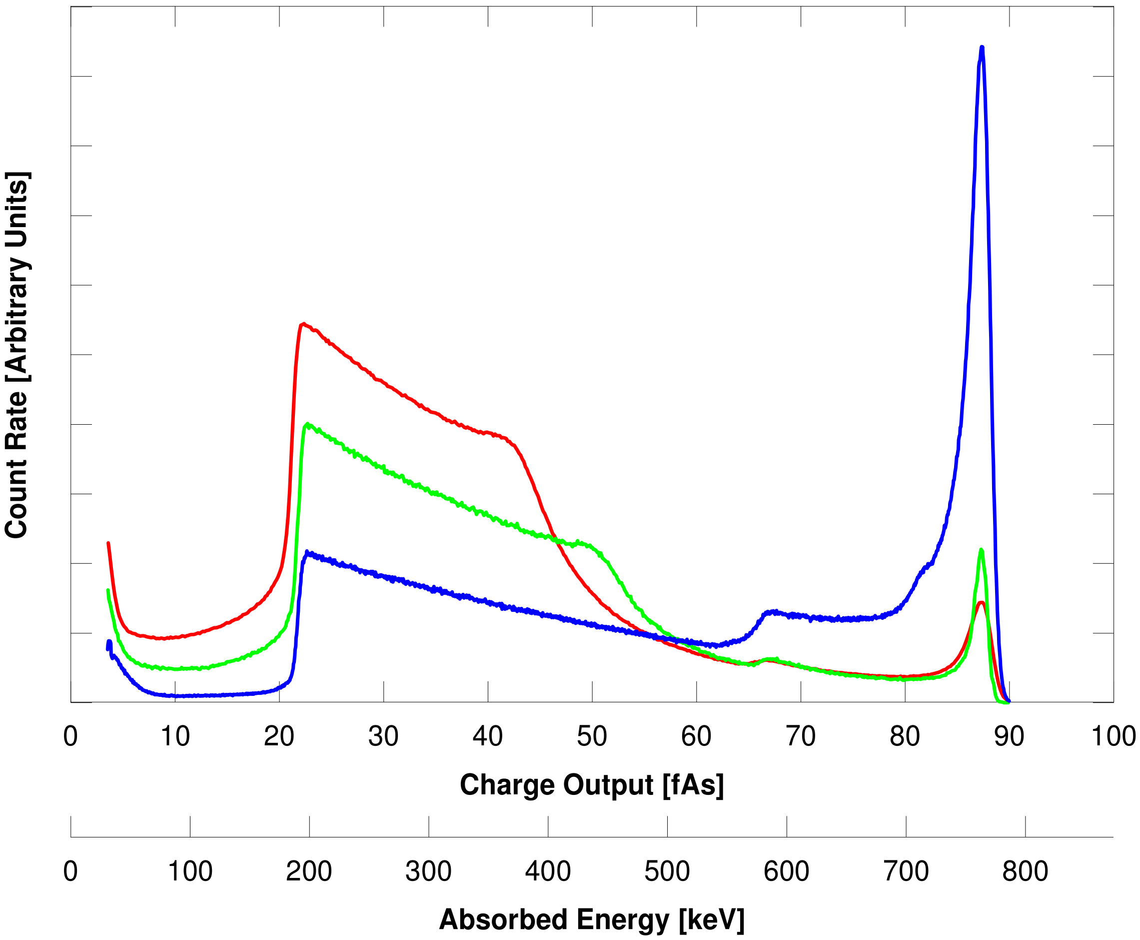


Figure 3: Pulse height spectra of different VacuTec He-3 proportional counters (blue – Type 063 00 95, green – Type 063 00 73, red – Type 060 00 92) measured with a moderated Cf-252 source. One horizontal axis shows the absorbed energy in the counter gas and the other axis the charge output of the counter tube with a multiplication factor of 30.

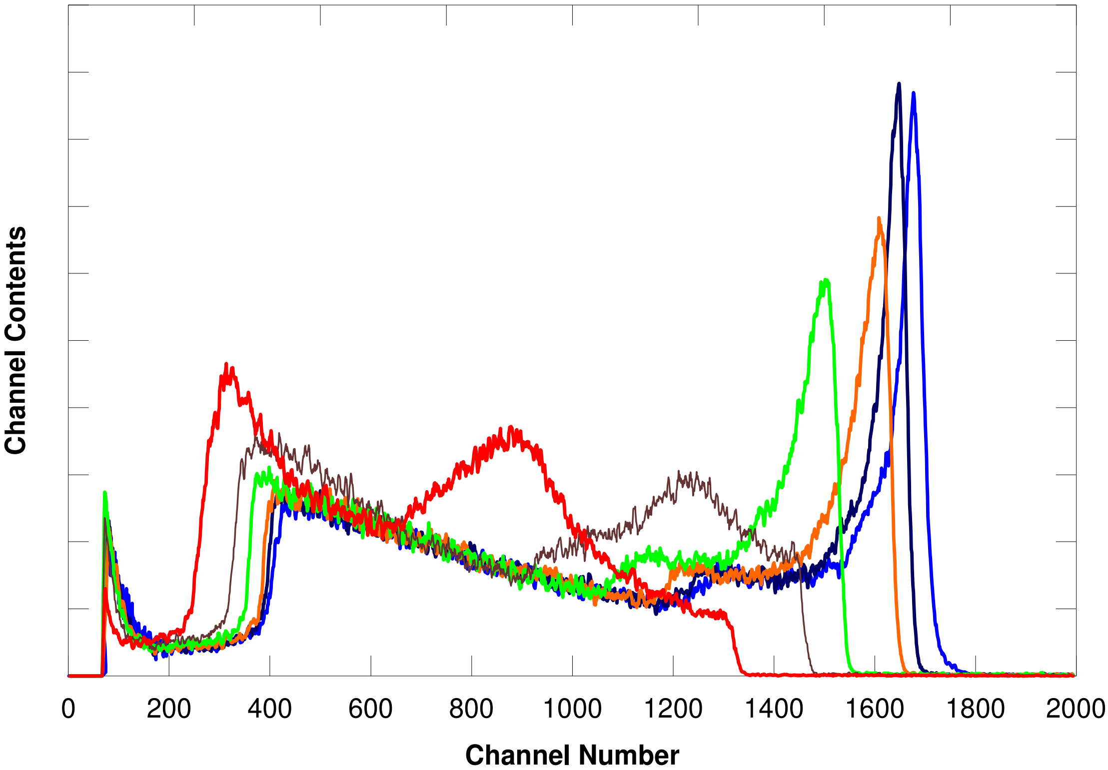


Figure 4: Pulse height spectra of a counter tube Type 063 00 93 measured with different integration times (from red to blue: 1, 2, 3, 6, 7, and 12 µs).

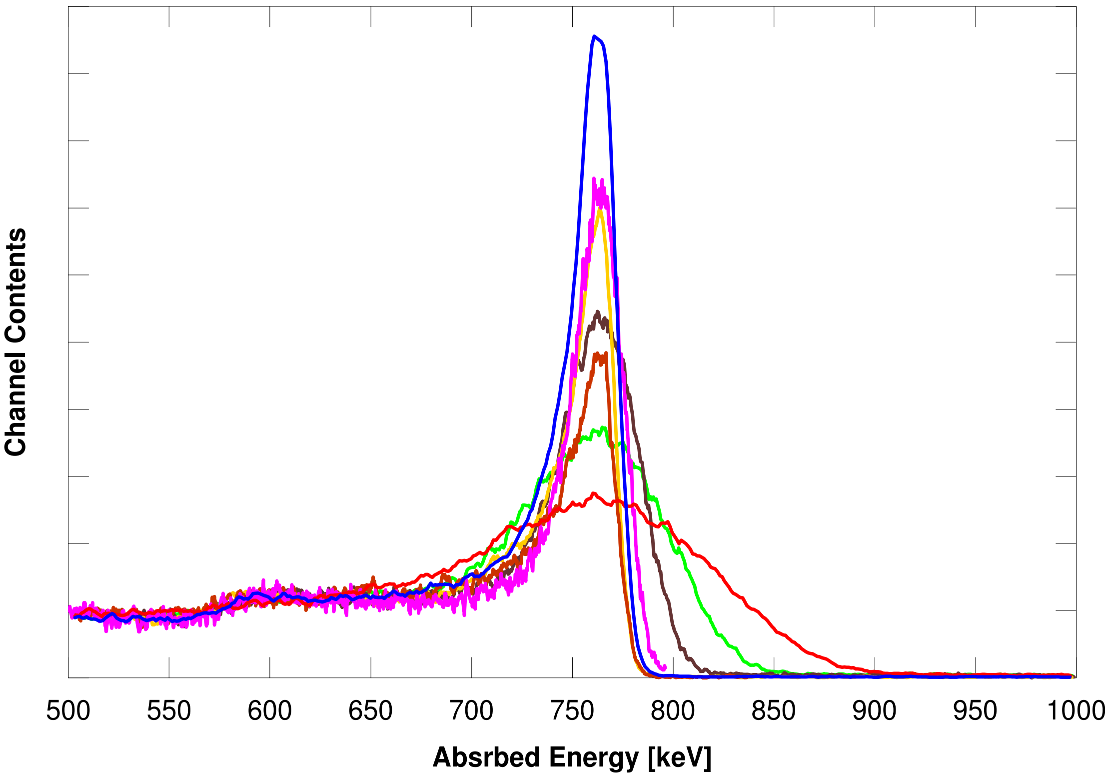


Figure 5: Part of the pulse height spectra of a counter tube Type 063 00 93 measured with 7 µs and anode voltages 300V (red), 400V (green), 500V (dark brown), 600V (violet), blue (700V), 800V (yellow), 900V (brown).

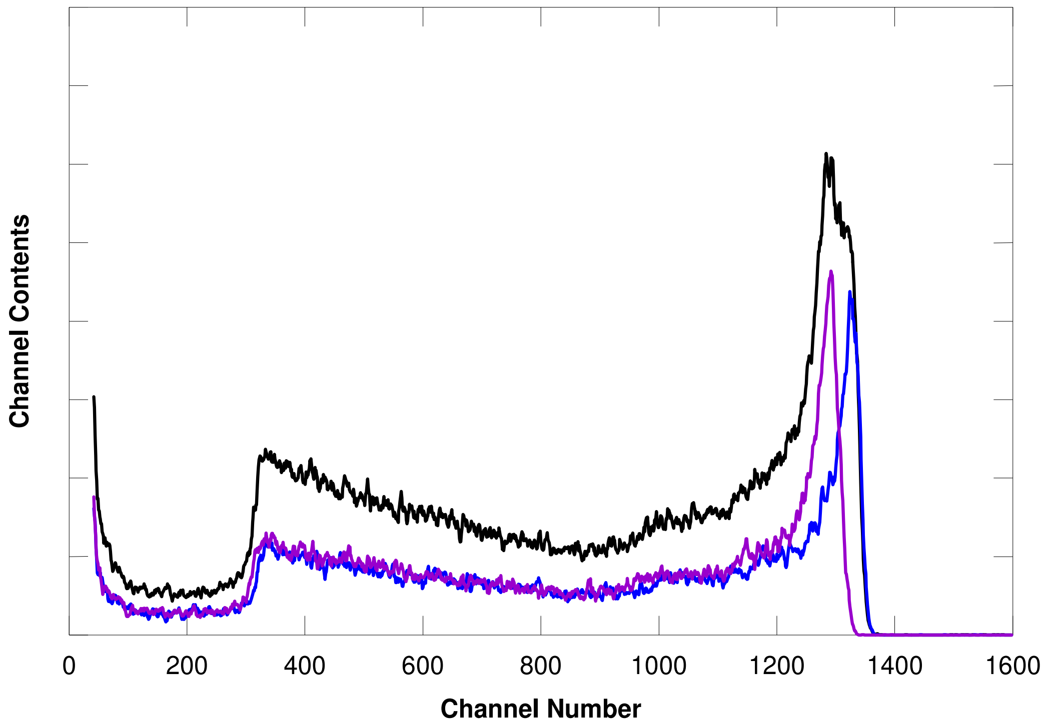


Figure 6: Pulse height spectra (red and blue) measured for the same period of time with two individual detector exemplars of the same type, having a small difference of 3% in gas multiplication and spectrum (black) from the pair of both detectors.

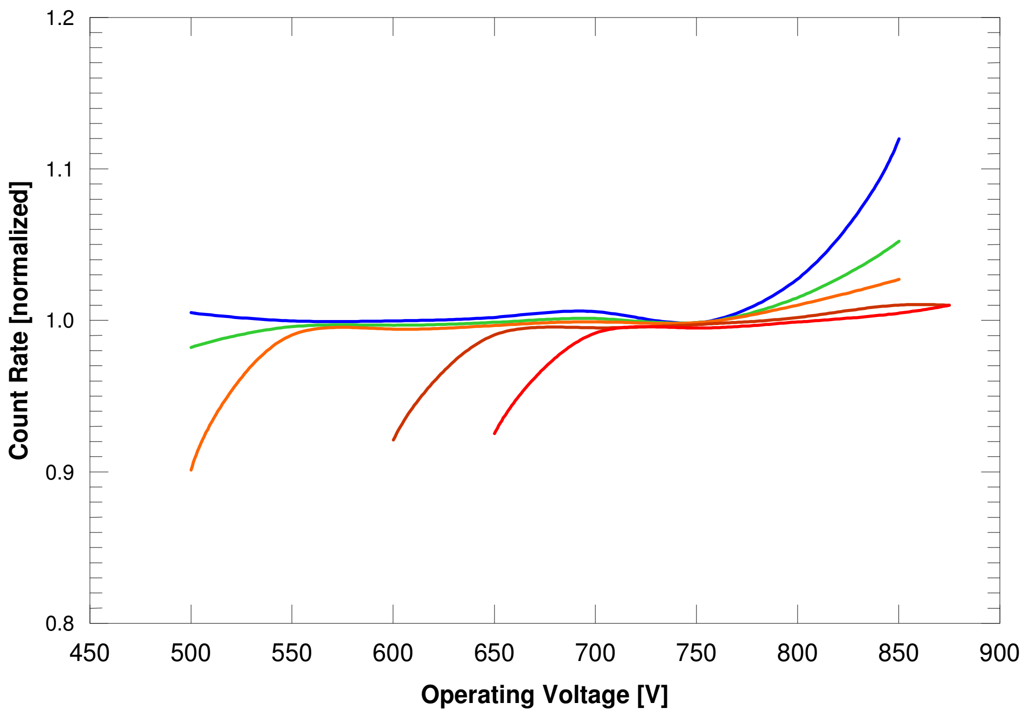
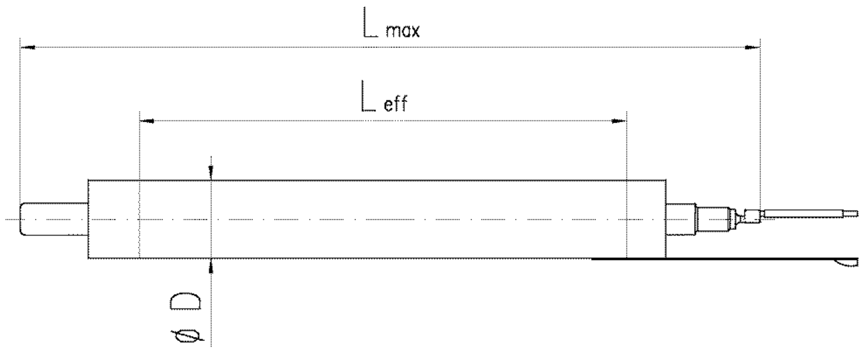
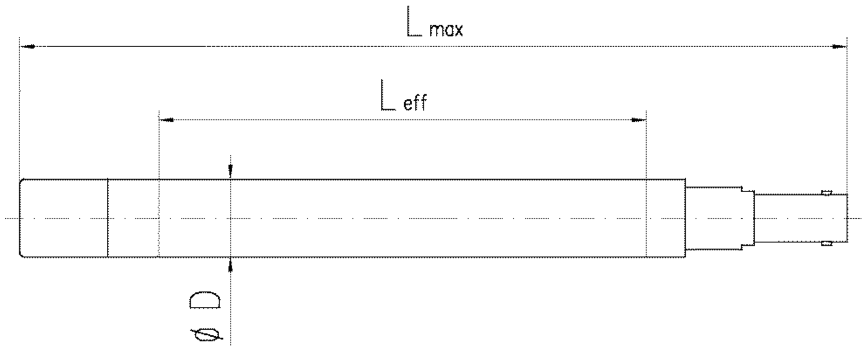


Figure 7: Neutron count rate plateau in dependence on the operating voltage of a 63 000 95 He-3 counter tube with five different discriminator levels (3, 4, 5, 8, and 11 fAs)

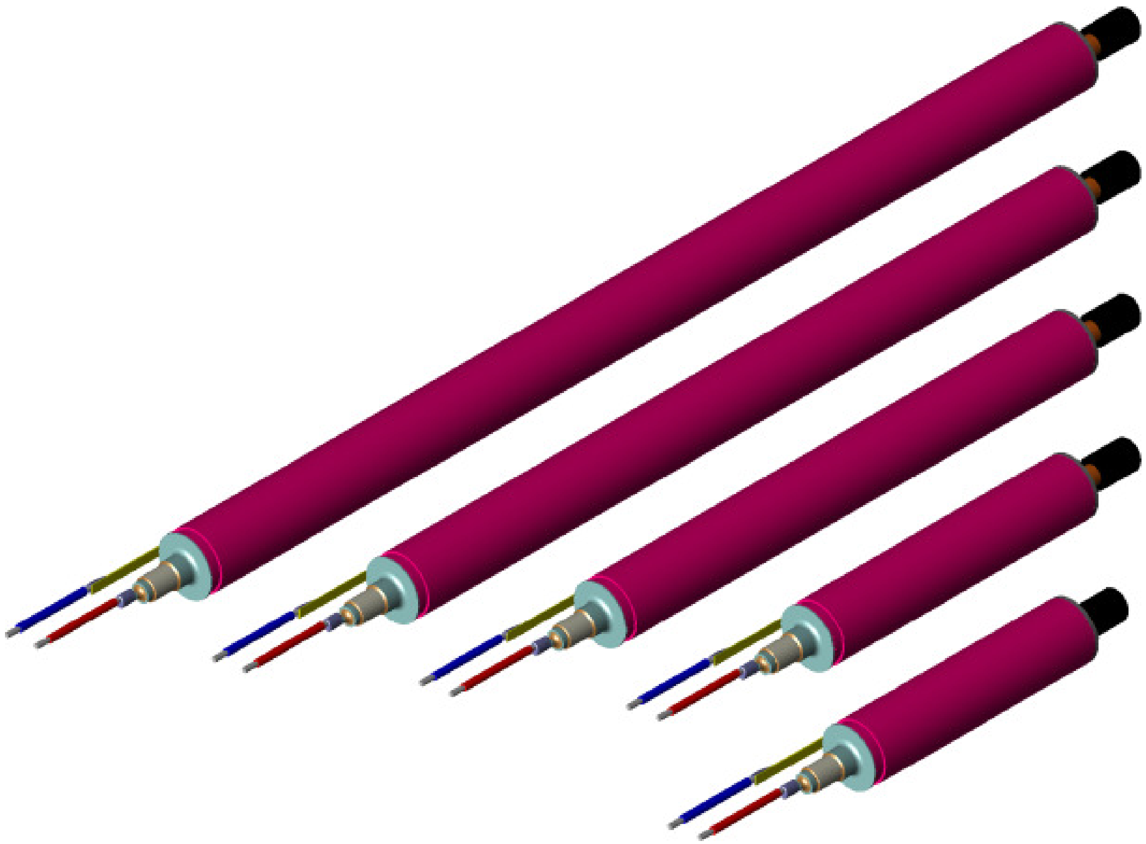




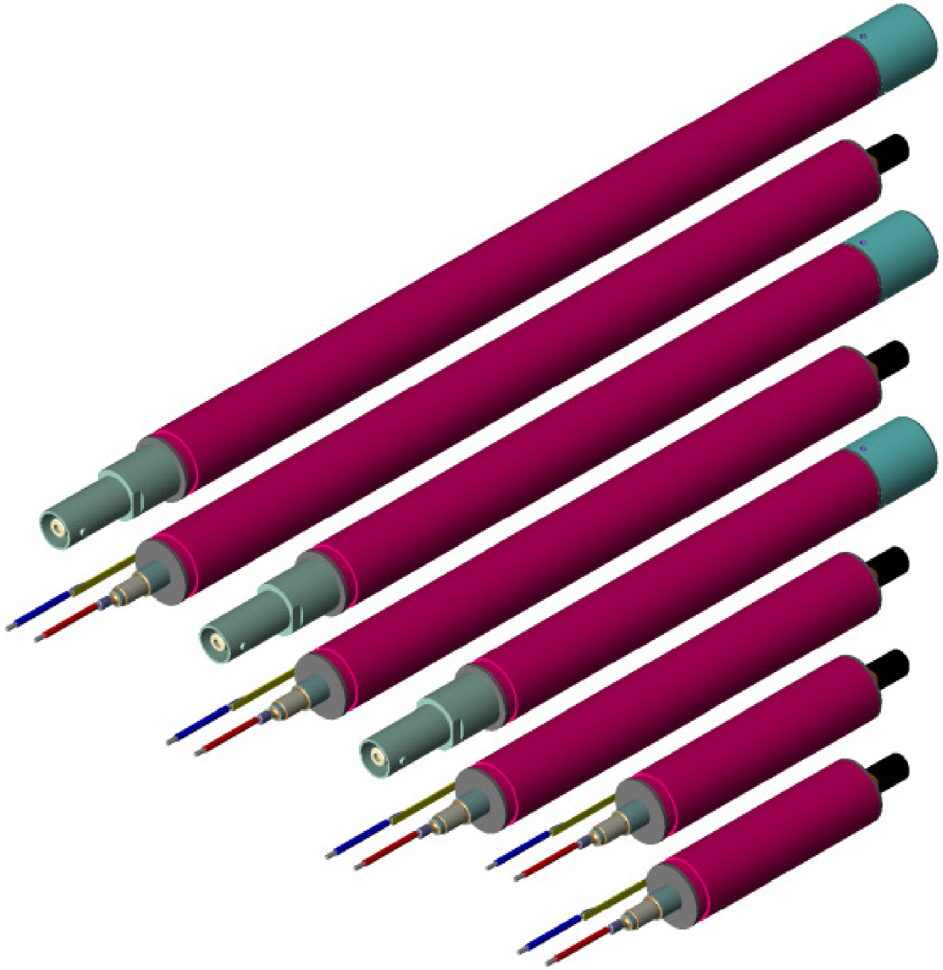
The main dimensions of the VacuTec He-3 counter tubes

Main Specifications of the VacuTec He-3 Neutron Proportional Counters:

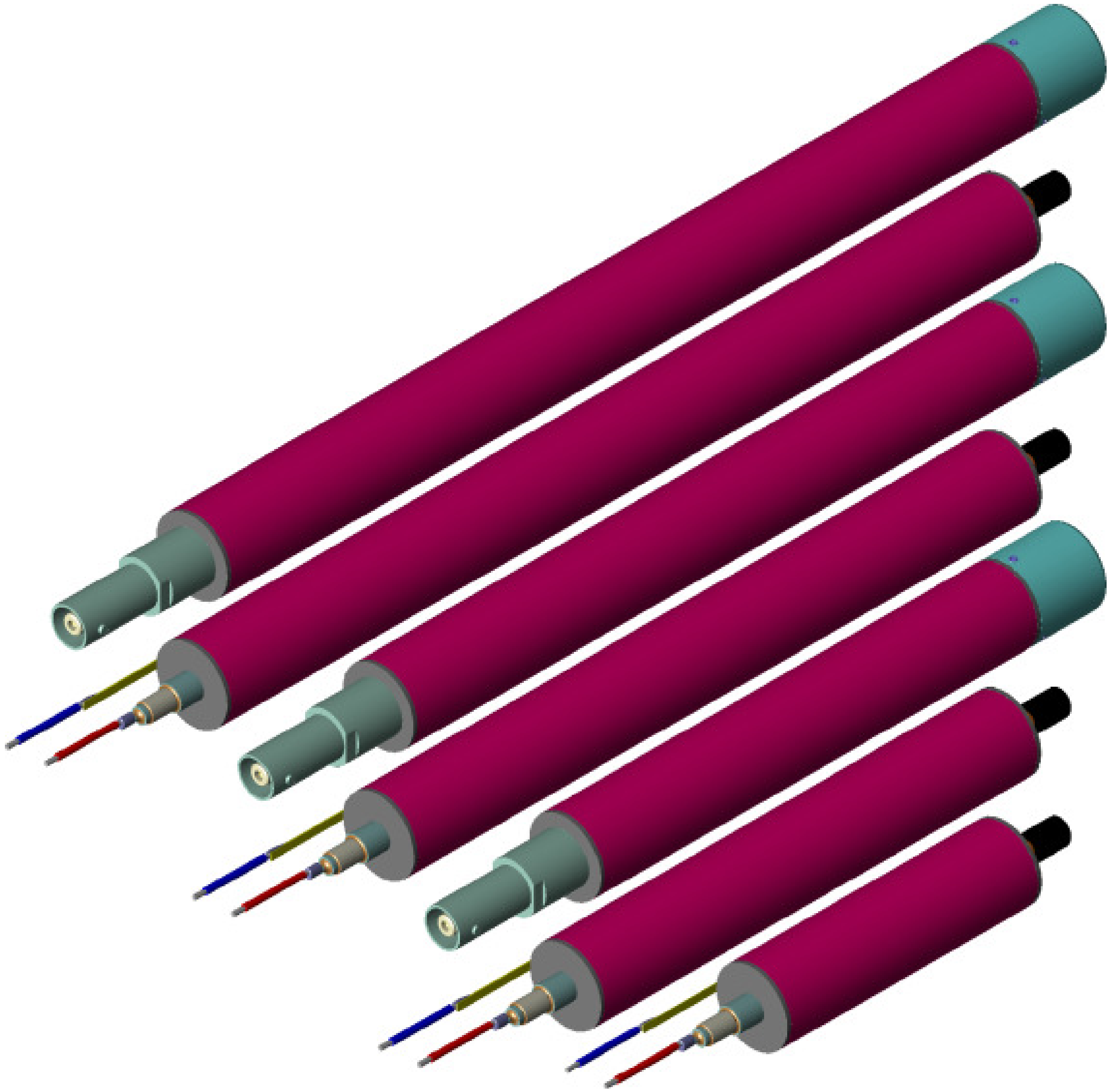
No.	Order Number	Outer Diameter D[Inch]	Max. Length L_{max} [mm]	Connector type	Mass [g]	Effective Length L_{eff} [mm]	Effective Volume [cm^3]	Capaci-tance [pF]	Gas Pressure [bar]	Sensitivity [cps/nv]	Operating Voltage [V]
Type	70 060										
1	060 00 76	0.50	81	Wire	30	40	2.8	3.0	1.95	0.4	490
2	060 00 96	0.50	81	Wire	30	40	2.8	3.0	4.0	0.8	680
3	060 00 66	0.50	81	Wire	30	40	2.8	3.0	6.0	1.0	800
4	060 00 86	0.50	81	Wire	30	40	2.8	3.0	8.0	1.3	910
5	060 00 16	0.50	81	Wire	30	40	2.8	3.0	10.	1.5	1010
6	060 00 72	0.50	94	Wire	35	50	3.5	3.1	1.95	0.5	490
7	060 00 92	0.50	94	Wire	35	50	3.5	3.1	4.0	1.0	680
8	060 00 62	0.50	94	Wire	35	50	3.5	3.1	6.0	1.3	800
9	060 00 82	0.50	94	Wire	35	50	3.5	3.1	8.0	1.6	910
10	060 00 12	0.50	94	Wire	35	50	3.5	3.1	10.0	1.9	1010
11	060 00 73	0.50	144	Wire	60	100	6.9	3.6	1.95	1.2	490
12	060 00 93	0.50	144	Wire	60	100	6.9	3.6	4.0	2.1	680
13	060 00 63	0.50	144	Wire	60	100	6.9	3.6	6.0	2.9	800
14	060 00 83	0.50	144	Wire	60	100	6.9	3.6	8.0	3.5	910
15	060 00 13	0.50	144	Wire	60	100	6.9	3.6	10.0	4.1	1010
16	060 00 74	0.50	194	Wire	80	150	10.4	4.1	1.95	1.8	490
17	060 00 94	0.50	194	Wire	80	150	10.4	4.1	4.0	3.2	680
18	060 00 64	0.50	194	Wire	80	150	10.4	4.1	6.0	4.4	800
19	060 00 84	0.50	194	Wire	80	150	10.4	4.1	8.0	5.4	910
20	060 00 14	0.50	194	Wire	80	150	10.4	4.1	10.0	6.2	1010
21	060 00 75	0.50	244	Wire	105	200	13.9	4.5	1.95	2.4	490
22	060 00 95	0.50	244	Wire	105	200	13.9	4.5	4.0	4.4	680
23	060 00 65	0.50	244	Wire	105	200	13.9	4.5	6.0	6.0	800
24	060 00 85	0.50	244	Wire	105	200	13.9	4.5	8.0	7.3	910
25	060 00 15	0.50	244	Wire	105	200	13.9	4.5	10.0	8.4	1010



No.	Order Number	Outer Diameter D[Inch]	Max. Length L_{max} [mm]	Connector type	Mass [g]	Effective Length L_{eff} [mm]	Effective Volume [cm^3]	Capaci-tance [pF]	Gas Pressure [bar]	Sensitivity [cps/nv]	Operating Voltage [V]
Type	70 061										
26	061 00 76	0.63	88	Wire	45	40	5.0	3.3	1.95	0.7	520
27	061 00 96	0.63	88	Wire	45	40	5.0	3.3	4.0	1.3	720
28	061 00 66	0.63	88	Wire	45	40	5.0	3.3	6.0	1.7	840
29	061 00 86	0.63	88	Wire	45	40	5.0	3.3	8.0	2.0	960
30	061 00 16	0.63	88	Wire	45	40	5.0	3.3	10.0	2.3	1070
31	061 00 72	0.63	101	Wire	50	50	6.2	3.4	1.95	0.9	520
32	061 00 92	0.63	101	Wire	50	50	6.2	3.4	4.0	1.7	720
33	061 00 62	0.63	101	Wire	50	50	6.2	3.4	6.0	2.2	840
34	061 00 82	0.63	101	Wire	50	50	6.2	3.4	8.0	2.6	960
35	061 00 12	0.63	101	Wire	50	50	6.2	3.4	10.0	3.0	1070
36	061 00 73	0.63	151	Wire	80	100	12.4	3.9	1.95	2.0	520
37	061 00 93	0.63	151	Wire	80	100	12.4	3.9	4.0	3.6	720
38	061 00 63	0.63	151	Wire	80	100	12.4	3.9	6.0	4.7	840
39	061 00 83	0.63	151	Wire	80	100	12.4	3.9	8.0	5.7	960
40	061 00 13	0.63	151	Wire	80	100	12.4	3.9	10.0	6.4	1070
41	061 00 74	0.63	201	Wire	110	150	18.6	4.3	1.95	3.1	520
42	061 00 94	0.63	201	Wire	110	150	18.6	4.3	4.0	5.5	720
43	061 00 64	0.63	201	Wire	110	150	18.6	4.3	6.0	7.3	840
44	061 00 84	0.63	201	Wire	110	150	18.6	4.3	8.0	8.7	960
45	061 00 14	0.63	201	Wire	110	150	18.6	4.3	10.0	9.8	1070
46	061 00 75	0.63	251	Wire	140	200	24.8	4.8	1.95	4.2	520
47	061 00 95	0.63	251	Wire	140	200	24.8	4.8	4.0	7.4	720
48	061 00 65	0.63	251	Wire	140	200	24.8	4.8	6.0	9.8	840
49	061 00 85	0.63	251	Wire	140	200	24.8	4.8	8.0	12.	960
50	061 00 15	0.63	251	Wire	140	200	24.8	4.8	10.0	13.	1070
51	061 00 77	0.63	169	MHV	106	100	12.4	5.1	1.95	2.0	520
52	061 00 97	0.63	169	MHV	106	100	12.4	5.1	4.0	3.6	720
53	061 00 67	0.63	169	MHV	106	100	12.4	5.1	6.0	4.7	840
54	061 00 87	0.63	169	MHV	106	100	12.4	5.1	8.0	5.7	960
55	061 00 17	0.63	169	MHV	106	100	12.4	5.1	10.0	6.4	1070
56	061 00 78	0.63	219	MHV	136	150	18.6	5.6	1.95	3.1	520
57	061 00 98	0.63	219	MHV	136	150	18.6	5.6	4.0	5.5	720
58	061 00 68	0.63	219	MHV	136	150	18.6	5.6	6.0	7.3	840
59	061 00 88	0.63	219	MHV	136	150	18.6	5.6	8.0	8.7	960
60	061 00 18	0.63	219	MHV	136	150	18.6	5.6	10.0	9.8	1070
61	061 00 79	0.63	269	MHV	165	200	24.8	6.0	1.95	4.2	520
62	061 00 99	0.63	269	MHV	165	200	24.8	6.0	4.0	7.4	720
63	061 00 69	0.63	269	MHV	165	200	24.8	6.0	6.0	9.8	840
64	061 00 89	0.63	269	MHV	165	200	24.8	6.0	8.0	12.	960
65	061 00 19	0.63	269	MHV	165	200	24.8	6.0	10.0	13.	1070



No.	Order Number	Outer Diameter D[Inch]	Max. Length L_{max}[mm]	Connector type	Mass [g]	Effective Length L_{eff}[mm]	Effective Volume [cm^3]	Capacitance [pF]	Gas Pressure [bar]	Sensitivity [cps/nv]	Operating Voltage [V]
Type	**70 062**										
66	062 00 72	0.75	101	Wire	60	50	9.7	3.3	1.95	1.4	540
67	062 00 92	0.75	101	Wire	60	50	9.7	3.3	4.0	2.4	760
68	062 00 62	0.75	101	Wire	60	50	9.7	3.3	6.0	3.2	870
69	062 00 82	0.75	101	Wire	60	50	9.7	3.3	8.0	3.7	1000
70	062 00 12	0.75	101	Wire	60	50	9.7	3.3	10.0	4.1	1100
71	062 00 73	0.75	151	Wire	100	100	19.5	3.7	1.95	3.1	540
72	062 00 93	0.75	151	Wire	100	100	19.5	3.7	4.0	5.3	760
73	062 00 63	0.75	151	Wire	100	100	19.5	3.7	6.0	6.8	870
74	062 00 83	0.75	151	Wire	100	100	19.5	3.7	8.0	8.0	1000
75	062 00 13	0.75	151	Wire	100	100	19.5	3.7	10.0	8.8	1100
76	062 00 74	0.75	201	Wire	130	150	29.2	4.2	1.95	4.7	540
77	062 00 94	0.75	201	Wire	130	150	29.2	4.2	4.0	8.1	760
78	062 00 64	0.75	201	Wire	130	150	29.2	4.2	6.0	10.	870
79	062 00 84	0.75	201	Wire	130	150	29.2	4.2	8.0	12.	1000
80	062 00 14	0.75	201	Wire	130	150	29.2	4.2	10.0	13.	1100
81	062 00 75	0.75	251	Wire	170	200	39.0	4.6	1.95	6.3	540
82	062 00 95	0.75	251	Wire	170	200	39.0	4.6	4.0	11.	760
83	062 00 65	0.75	251	Wire	170	200	39.0	4.6	6.0	14.	870
84	062 00 85	0.75	251	Wire	170	200	39.0	4.6	8.0	16.	1000
85	062 00 15	0.75	251	Wire	170	200	39.0	4.6	10.0	18.	1100
86	062 00 77	0.75	169	MHV	130	100	19.5	5.1	1.95	3.1	540
87	062 00 97	0.75	169	MHV	130	100	19.5	5.1	4.0	5.3	760
88	062 00 67	0.75	169	MHV	130	100	19.5	5.1	6.0	6.8	870
89	062 00 87	0.75	169	MHV	130	100	19.5	5.1	8.0	8.0	1000
90	062 00 17	0.75	169	MHV	130	100	19.5	5.1	10.0	8.8	1100
91	062 00 78	0.75	219	MHV	165	150	29.2	5.5	1.95	4.7	540
92	062 00 98	0.75	219	MHV	165	150	29.2	5.5	4.0	8.1	760
93	062 00 68	0.75	219	MHV	165	150	29.2	5.5	6.0	10.	870
94	062 00 88	0.75	219	MHV	165	150	29.2	5.5	8.0	12.	1000
95	062 00 18	0.75	219	MHV	165	150	29.2	5.5	10.0	13.	1100
96	062 00 79	0.75	269	MHV	200	200	39.0	5.9	1.95	6.3	540
97	062 00 99	0.75	269	MHV	200	200	39.0	5.9	4.0	11.	760
98	062 00 69	0.75	269	MHV	200	200	39.0	5.9	6.0	14.	870
99	062 00 89	0.75	269	MHV	200	200	39.0	5.9	8.0	16.	1000
100	062 00 19	0.75	269	MHV	200	200	39.0	5.9	10.0	18.	1100



No.	Order Number	Outer Diameter D[Inch]	Max. Length L_{max}[mm]	Connector type	Mass [g]	Effective Length L_{eff}[mm]	Effective Volume [cm^3]	Capaci- tance [pF]	Gas Pressure [bar]	Sensitivity [cps/nv]	Operating Voltage [V]
Type	70 063										
101	063 00 73	1.0	153	MHV	200	100	35.2	4.7	1.95	5.1	590
102	063 00 93	1.0	153	MHV	200	100	35.2	4.7	4.0	8.4	760
103	063 00 63	1.0	153	MHV	200	100	35.2	4.7	6.0	11.	910
104	063 00 83	1.0	153	MHV	200	100	35.2	4.7	8.0	12.	1050
105	063 00 13	1.0	153	MHV	200	100	35.2	4.7	10.0	13.	1160
106	063 00 74	1.0	203	MHV	260	150	52.9	5.1	1.95	7.9	590
107	063 00 94	1.0	203	MHV	260	150	52.9	5.1	4.0	13.	760
108	063 00 64	1.0	203	MHV	260	150	52.9	5.1	6.0	16.	910
109	063 00 84	1.0	203	MHV	260	150	52.9	5.1	8.0	18.	1050
110	063 00 14	1.0	203	MHV	260	150	52.9	5.1	10.0	20.	1160
111	063 00 75	1.0	253	MHV	322	200	70.5	5.5	1.95	11.	590
112	063 00 95	1.0	253	MHV	322	200	70.5	5.5	4.0	18.	760
113	063 00 65	1.0	253	MHV	322	200	70.5	5.5	6.0	22.	910
114	063 00 85	1.0	253	MHV	322	200	70.5	5.5	8.0	25.	1050
115	063 00 15	1.0	253	MHV	322	200	70.5	5.5	10.0	27.	1160
Type	70 064										
116	064 00 74	1.50	203	MHV	420	150	136.2	4.9	1.95	19.	600
117	064 00 94	1.50	203	MHV	420	150	136.2	4.9	4.0	29.	830
118	064 00 64	1.50	203	MHV	420	150	136.2	4.9	6.0	33.	980
119	064 00 84	1.50	203	MHV	420	150	136.2	4.9	8.0	35.	1100
120	064 00 14	1.50	203	MHV	420	150	136.2	4.9	10.0	37.	1240
121	064 00 75	1.50	253	MHV	505	200	181.6	5.3	1.95	26.	600
122	064 00 95	1.50	253	MHV	505	200	181.6	5.3	4.0	38.	830
123	064 00 65	1.50	253	MHV	505	200	181.6	5.3	6.0	44.	980
124	064 00 85	1.50	253	MHV	505	200	181.6	5.3	8.0	47.	1100
125	064 00 15	1.50	253	MHV	505	200	181.6	5.3	10.0	49.	1240
Type	70 065										
126	065 00 74	1.97	203	MHV	590	150	249.3	4.9	1.95	32.	680
127	065 00 94	1.97	203	MHV	590	150	249.3	4.9	4.0	43.	860
128	065 00 64	1.97	203	MHV	590	150	249.3	4.9	6.0	48.	1010
129	065 00 84	1.97	203	MHV	590	150	249.3	4.9	8.0	50.	1160
130	065 00 14	1.97	203	MHV	590	150	249.3	4.9	10.0	50.	1260
131	065 00 75	1.97	253	MHV	710	200	332.4	5.3	1.95	42.	680
132	065 00 95	1.97	253	MHV	710	200	332.4	5.3	4.0	58.	860
133	065 00 65	1.97	253	MHV	710	200	332.4	5.3	6.0	64.	1010
134	065 00 85	1.97	253	MHV	710	200	332.4	5.3	8.0	66.	1160
135	065 00 15	1.97	253	MHV	710	200	332.4	5.3	10.0	67.	1260

Mon Oct 24 10:30:34 2016