

## Essential products for the professional firework display and explosives industry

We have developed products to allow the professional display industry to make sensible and scientifically based estimations of several major issues currently affecting the fireworks display industry and more generally, the explosives industry. The products are designed to assist in planning and legal compliance issues, and to help provide objective decision making criteria, in particular in terms of contingency planning for displays and environmental issues. These tools have been developed alongside our work on some of the major firework displays around the world and are now available to the wider firework community. All are available for purchase on a time limited or perpetual subscription.

Each of these products is based on Microsoft Excel – for simplicity of use and flexibility in developing new additions

- **ShellCalc®** - a trajectory and fallout modelling tool for firework displays
- **EnvCalc®** - for determining the environmental impact of a display
- **SoundCalc®** - for determining sound levels at distances from ground or aerial fireworks
- **PlumeCalc®** – for smoke plume modelling of explosives sites – particularly for CoMAH safety reports
- **LicenceCalc®** – for initial plotting of “Separation distances” for UK Local Authority of HSE licences

CarnDu Ltd also offer bespoke calculations for events or venues – please contact us for further details

### For more information please contact

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w: [www.carndu.com](http://www.carndu.com)

[www.facebook.com/shellcalc](https://www.facebook.com/shellcalc)

[www.facebook.com/envcalc](https://www.facebook.com/envcalc)

[www.facebook.com/plumecalc](https://www.facebook.com/plumecalc)

[www.facebook.com/licencecalc](https://www.facebook.com/licencecalc)

[www.facebook.com/soundcalc](https://www.facebook.com/soundcalc)

**And for more details on the courses we offer**

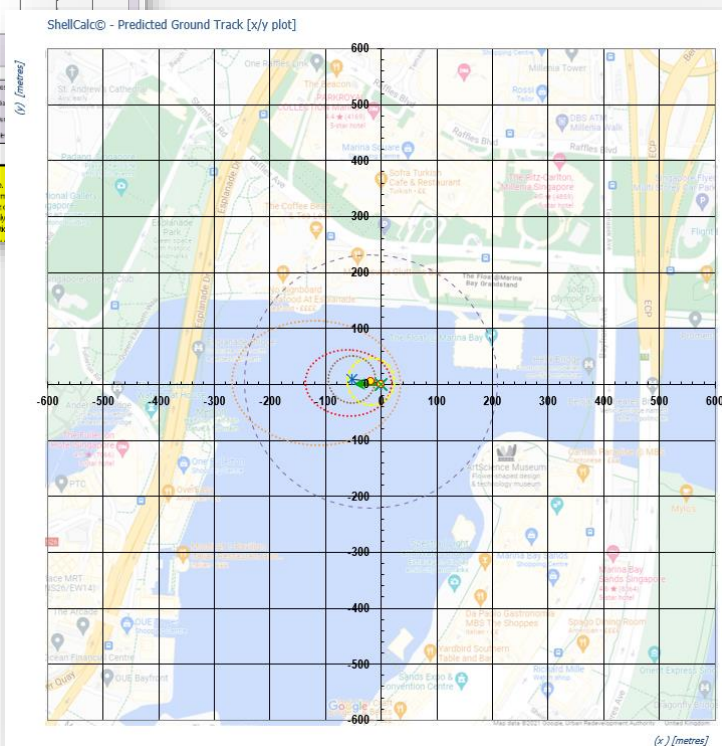
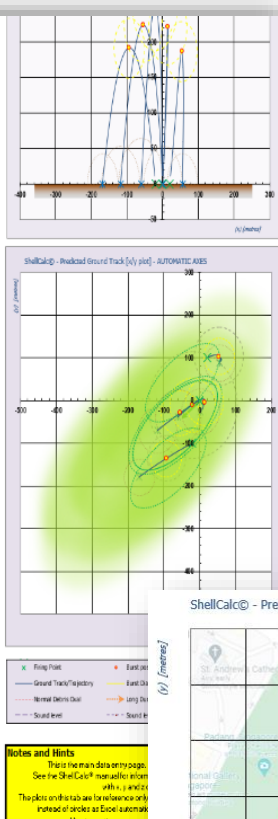
[www.pyroworkshops.com](http://www.pyroworkshops.com)



**ShellCalc® Pro** allows realistic modelling of both the trajectories of a variety of fireworks and their fallout/debris patterns depending on firing angles, wind strength and direction.

- 
- ShellCalc<sup>©</sup>**  
*Trajectory and Fallout  
modelling for  
Firework Displays*

A free version – ShellCalc® Standard – is available but the functionality is limited and we do not recommend it for professional display companies. The Standard version will not be developed further.

[illegible]

## Environmental calculator – EnvCalc© - the Environmental calculator - an environmental impact tool

**EnvCalc©** has been developed to quantify the environmental impact of displays following several very high profile events when the anti-firework lobby has been vocal in condemning firework displays as highly polluting. The calculator considers:

- The chemical by-products of combustion and their environmental impact
- The use of the tool to calculate the amount of combustion by-products released
- Comparison with other event aspects such as travel of the crowd to the display, Importation and transport of fireworks, Display equivalence in terms of power generation, use of drones etc
- Plotting of simple smoke plume



See <https://www.dropbox.com/s/x4fqhmfdbfwu211/EnvCalc.mp4?dl=0>

**EnvCalc© is now available in several languages for the basic Input/Output page – including Spanish, French, Italian, German and Dutch.**

### Environmental Calculator for firework displays v2.0h

Mandatory Inputs (enter values in BLUE cells)

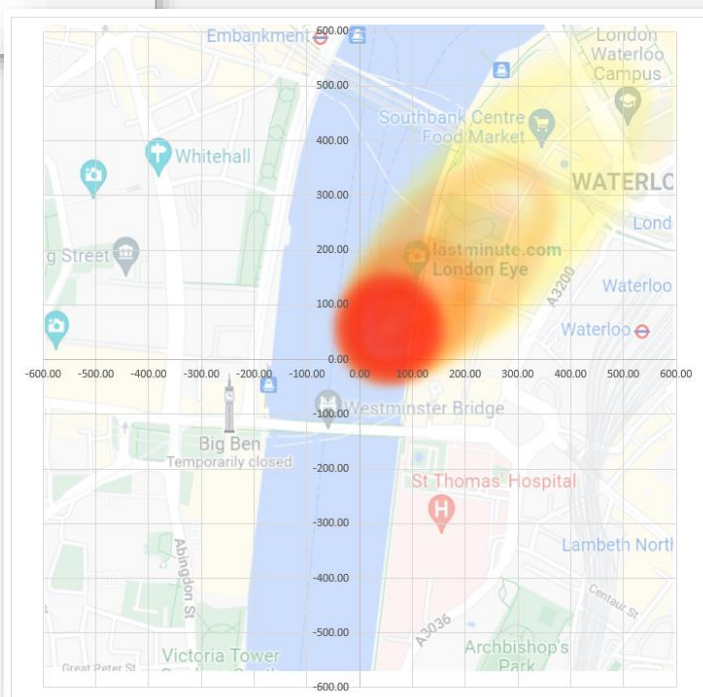
Display Name **ADME Manufacturing**  
 Display Date **12/08/2020**  
 Display NEC **6621g**  
 Distance driven to display **100** km  
 Length of display **5** minutes  
 No of people expected **5000**  
 Average travel distance for spectators **50** km

Optional Inputs (enter values in BLUE cells)

Distance from port to magazine (km) **100**  
 Distance from factory to port (km) **100**  
 Distance by sea to UK (km) **10000**

**Outputs**

	Gases			Solids		
	CO2 + CO	NO2	SO2	total	PM10 (Note 1)	PM2.5 (Note 1)
Total produced from factory to UK import (kg)	456.02	388.80	288.34	273.13	5.3483	2.6903
Total produced for transport to/from display (kg)	46.81	81.73	58.68	285.18	0.2028	0.1009
Total produced in display itself (kg)	350.48	11.57	2.57	348.29	12.4999	9.7246
Total produced by spectators travel (kg)	444.24	36.38	26.54	487.27	16.7369	7.8550
<b>TOTAL FOR EVENT</b>	<b>2987.54</b>	<b>387.89</b>	<b>324.89</b>	<b>856.77</b>	<b>34.3889</b>	<b>12.5628</b>
% import	6.46%	14.86%	25.25%	52.08%	6.95%	12.40%
% transport to display	0.66%	15.47%	15.89%	3.45%	0.15%	0.07%
% display	2.12%	2.89%	0.79%	58.82%	12.88%	81.14%
% spectators	50.78%	6.75%	8.17%	5.68%	57.84%	38.39%
<b>TOTAL FOR EVENT</b>	<b>100.00%</b>	<b>100.00%</b>	<b>100.00%</b>	<b>100.00%</b>	<b>100.00%</b>	<b>100.00%</b>
% display for spectator only	2.20%	26.34%	0.84%	38.15%	16.23%	19.88%
% spectators for spectator only	67.31%	68.43%	91.15%	61.83%	61.77%	21.17%
<b>TOTAL FOR SPECTATOR ONLY</b>	<b>100.00%</b>	<b>100.00%</b>	<b>100.00%</b>	<b>100.00%</b>	<b>100.00%</b>	<b>100.00%</b>
Fraction of display itself compared to spectators	3/42.71	3/72.27	3/10.52	3/10.69	3/3.74	3/3.5
Number of km driven by a car to equate to the display	1185	42887	6526	38812		466399
Concentration in display area (kg/m3)	41023	12348	2572	108232	1841	9722
EU air quality limits (kg/m3)	10000	300	350	30	30	75
(CO only - 2 hours)	(2 hours)	(2 hours)	(2 hours)	(24 hours)	(24 hours)	(24 hours)
Generation rate (kg/s)	111.6	28.13	5.9	195.66	46.57	20.26
Carbon equivalent (minuting) to 80000 generation						
For display only	231.48					
For overall event	10401.40					
No of trees to plant for display itself (carbon offset)	0.5					
No of trees to plant for overall event (carbon offset)	25.4					



## PlumeCalc© - the smoke plume modelling tool for explosives sites

PlumeCalc© is a smoke plume model tailored specifically for explosives sites.

Most smoke plume modelling has been done for chemical sites or similar where the emissions are effectively 24 hours a day, 365 days a year. As a result these models plot the output of smoke for a variety of meteorological conditions and reflect the constant emission of pollutants, both gaseous and solid.

Thankfully, explosives events at manufacturing and storage sites are very rare – and although it is useful to model, perhaps, both the “most likely” and “worst case” scenarios at a particular site (given the prevailing wind and the proximity and location of offsite areas that could be affected by an explosive event) what is more important in many ways is the ability to quickly plot those areas that would be affected immediately affected by any such event in order to react appropriately both in the short term immediately following the event, and in terms of clean up afterwards.

PlumeCalc© has been specifically designed for both planning (eg in a CoMAH safety report) and immediately post event to inform emergency services and other Government authorities (eg the Environment Agency).

We are still working on input parameters but at present these include:

- Storage types – eg Mixed explosives, High explosives (with or without heavy metals), AN based, Mixed fireworks or Manually entered
- Total NEC involved
- Wind speed and direction as well as Precipitation – to calculate deposition of soluble materials



**PlumeCalc©**

*Smoke Plume Calculator  
for  
Explosives Sites*

### Smoke plume calculator for explosives sites v2022c

**Licensed - CarnDu (Test)**

**Mandatory Inputs (enter values in BLUE cells)**

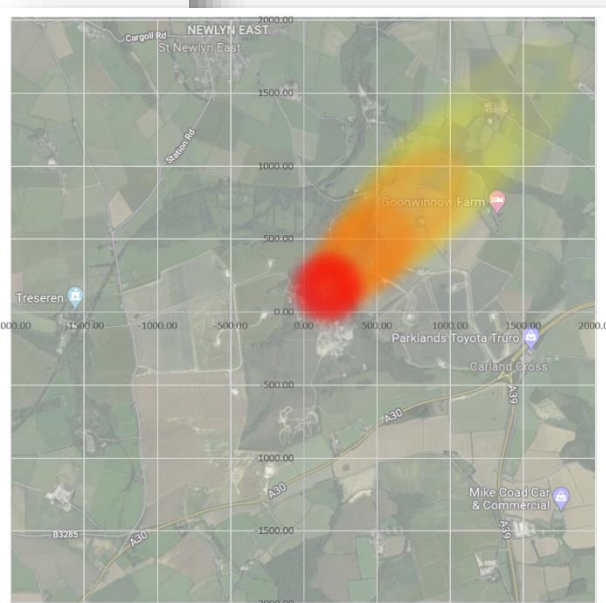
Site Name	Newlyn Downs (Redcliffe)	<small>for reports etc</small>
Model Date	20/02/2022	<small>enter in dd/mm/yyyy format</small>
NEC	25000 kg	
Storage Type	Mixed Storage (typical)	<small>Explosives held</small>

Notes  
This is for a single magazine assuming any communication between magazines does not occur

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**PlumeCalc©**  
*Smoke Plume Calculator  
for  
Explosives Sites*



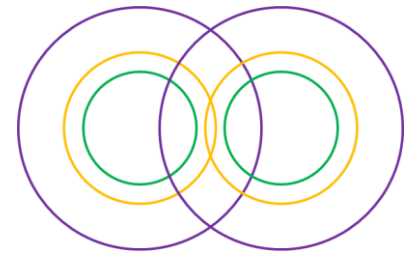
PlumeCalc© will then calculate the approximate breakdown of combustion byproducts and also plot a smoke plume on an imported map or satellite image to display areas that are likely to be affected.

## LicenceCalc© - applying UK Q/D relationships to explosives sites

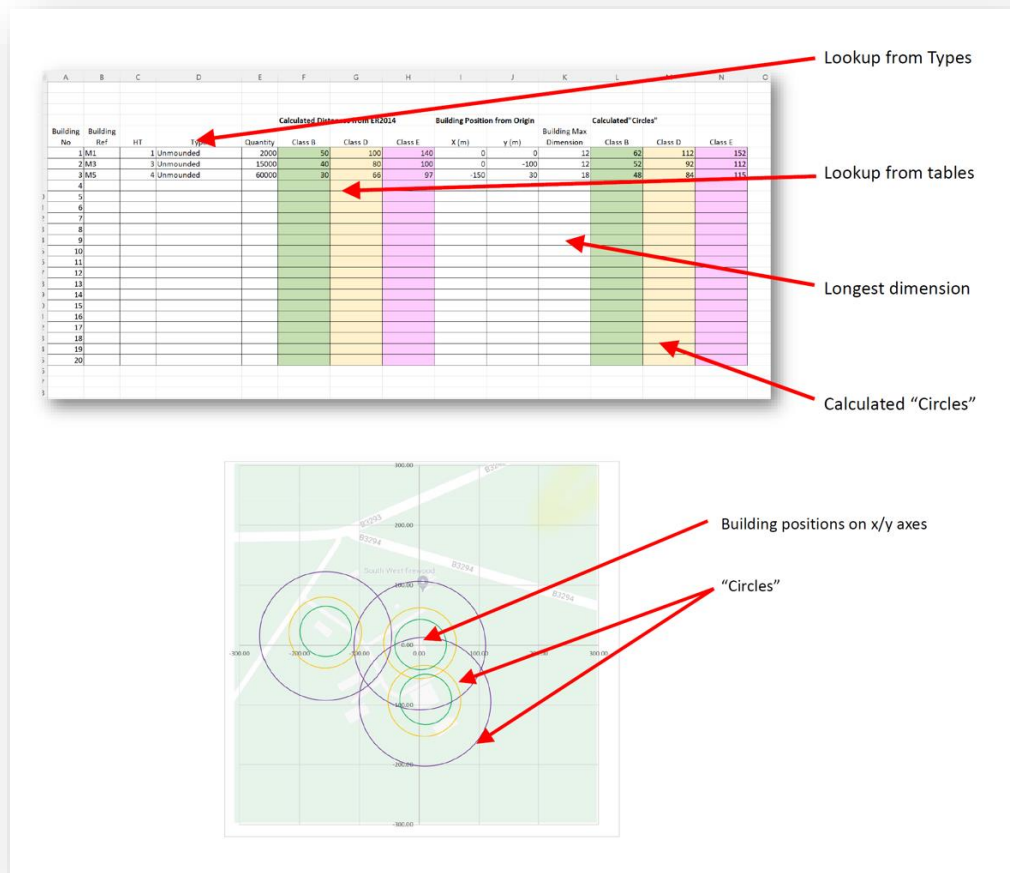
We are looking at creating a tool to assist UK explosive licence holders to obtain Local Authority or HSE licences.

. You add HT, Building Type and Quantity and it looks up the relevant Separation distances from ER2014. You add building positions and dimensions and then the program draws these on a map.

You can then adjust the quantities and see the effect on the "circles" on the map until you can optimise your site prior to submission of an appropriate licence application.



**LicenceCalc©**  
Explosive Licencing Tool





## SoundCalc© Pro – noise planning for ground or aerial fireworks

As noise production is becoming an increasing concern, and the ability to demonstrate that systems are in place (but choice of materials etc) to minimise sound impact and properly calculate what sound level impacts the ground (and audience and wildlife). SoundCalc© Pro also will find application for indoor venues and stage effects.

The program also outputs numerically and allows calculation of distances required to achieve a particular sound level. This new calculator was designed to show sound levels super-imposed onto a map but is equally useful for other noise generators such as:-

- Theatrical devices
- Other indoor sound generation
- War gaming sound levels



### Sound Level Calculator for firework displays v104

Company Name: Trial (limited functions)  
Venue: Helston  
Date: 21/02/2022

**Aerial noise**

Enter the measured (or provided) noise levels and the measured distance along the Horizontal axis (see HELP)  
Then enter the new distance to get the calculated sound level at that distance  
Also calculated is the Horizontal Distance needed to achieve various sound levels from 88dB to 134dB

Given level (db)   
at distance measured at ground level (H<sub>g</sub>) (m)   
at height of burst (H<sub>b</sub>) (m)   
Effective distance from measurement to source (H<sub>es</sub>) (m)   
New distance (m)   
Sound level at that distance

Desired sound level	88	90	92	94	96	98	100	102	104	106	108	110
Distance needed to achieve that level (H <sub>g</sub> ) (m)	11.76	9.34	7.42	5.89	4.68	3.72	2.95	2.35	1.86	1.48	1.18	0.93
Distance along ground to achieve level (H <sub>g</sub> ) (m) (Note 5)	11.72	9.30	7.36	5.82	4.59	3.61	2.81	2.17	1.63	1.18	0.76	0.25

Desired sound level	112	114	116	118	120	122	124	126	128	130	132	134
Distance needed to achieve that level (H <sub>g</sub> ) (m)	74	59	47	37	30	23	19	15	12	9	7	6
Distance along ground to achieve level (H <sub>g</sub> ) (m) (Note 5)	#NUM!	#NUM!	#NUM!	#NUM!	#NUM!	#NUM!	#NUM!	#NUM!	#NUM!	#NUM!	#NUM!	#NUM!

**Notes:**

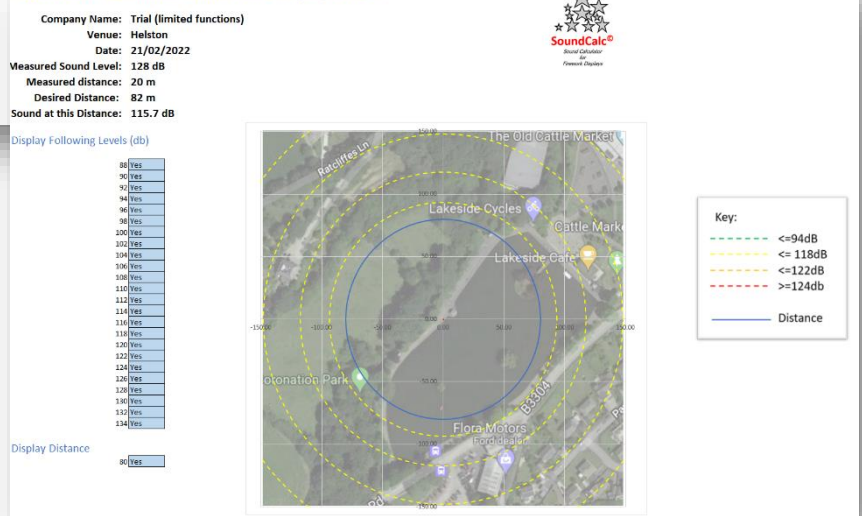
1. The calculations presume no local effects
2. The calculations assume only one firework is producing noise at any one instant
3. The calculations could be used to provide "Safety" areas where the noise level does not exceed, say, 120dB
4. Sound levels and distances can be obtained from measurements and/or the data provided by the manufacturer
5. If #NUM! shows then the height needed is less than the burst height

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SoundCalc© Pro is in final development that allows plotting of simple sound level "circles" on maps in a manner akin to the ShellCalc© sound plotting but applicable to a wide variety of situations.

We also have a FREE sound calculator **SoundCalc© Standard** – to work out approximate sound levels at various distances using test or supplied data but without the ability to plot sound contours onto a map.

### Sound Level Calculator for firework displays v104



## 2022 price list (GBP)

ShellCalc© and EnvCalc© are available as 1 year, 3 year or perpetual licences. As long as the lice is valid software upgrades during the licence period are free. For most companies all you need to pay is the INDIVIDUAL price.

Licence Type	Individual Price (ex VAT) (Note 1)	Individual Price (inc VAT) (Note 1)	Association Deal (ex VAT)	Event/Venue or Enforcer (ex VAT)	Comments
			(Note 2)	(Note 3/4)	
ShellCalc© 1 year	£262.50	£315.00	£210.00	£525.00	
ShellCalc© 3 year	£525.00	£630.00	£420.00	£1,050.00	
ShellCalc© Perpetual	£1,050.00	£1,260.00	£840.00	£2,100.00	
ShellCalc© 1 year Extension	£210.00	£252.00		£420.00	
ShellCalc© 3 year Extension	£420.00	£504.00		£840.00	
ShellCalc© Perpetual extension	£840.00	£1,008.00		£1,680.00	
EnvCalc© 1 year	£131.25	£157.50	£105.00	£262.50	
EnvCalc© 3 year	£262.50	£315.00	£210.00	£525.00	
EnvCalc© Perptual	£525.00	£630.00	£420.00	£1,050.00	
EnvCalc© 1 year Extension	£105.00	£126.00		£210.00	
EnvCalc© 3 year Extension	£210.00	£252.00		£420.00	
EnvCalc© Perpetual Extension	£420.00	£504.00		£840.00	
SoundCalc© Pro 1 year	£131.25	£157.50	£105.00		
SoundCalc© Pro 3 year	£262.50	£315.00	£210.00		
SoundCalc© Pro Perpetual	£525.00	£630.00	£420.00		
SoundCalc© Pro 1 year Extension	£105.00	£126.00			
SoundCalc© Pro 3 year Extension	£210.00	£252.00			
SoundCalc© Pro Perpetual Extension	£420.00	£504.00			
PlumeCalc© 1 year	£262.50	£315.00	£210.00		
PlumeCalc© 3 year	£525.00	£630.00	£420.00		
PlumeCalc© Perpetual	£1,050.00	£1,260.00	£840.00		
PlumeCalc© 1 year Extension	£210.00	£252.00			
PlumeCalc© 3 year Extension	£420.00	£504.00			
PlumeCalc© Perpetual Extension	£840.00	£1,008.00			
PlumeCalc© Emergency Access	£600.00	£720.00			Note 5
LicenceCalc© 1 year	£131.25	£157.50	£105.00		
LicenceCalc© 3 year	£262.50	£315.00	£210.00		
LicenceCalc© Perpetual	£525.00	£630.00	£420.00		
LicenceCalc© 1 year Extension	£105.00	£126.00			
LicenceCalc© 3 year Extension	£210.00	£252.00			
LicenceCalc© Perpetual extension	£420.00	£504.00			
Software Bundle A 1 year	£367.50	£441.00	£315.00	£735.00	Note 6
Software Bundle A 3 year	£735.00	£882.00	£630.00	£1,470.00	
Software Bundle A Perpetual	£1,470.00	£1,764.00	£1,260.00	£2,940.00	
Software Bundle B 1 Year	£472.50	£567.00	£315.00	£945.00	Note 7
Software Bundle B 3 Year	£945.00	£1,134.00	£630.00	£1,890.00	
Software Bundle B Perpetual	£1,890.00	£2,268.00	£1,260.00	£3,780.00	

Prices valid February 2022 and exclude VAT except where shown

**Note 1:** You may make copies for different events or different users WITHIN your company. Distribution of software or licence keys to other companies is strictly prohibited. Extension prices are only valid if extension is taken BEFORE existing licence expiry

**Note 2:** Discounted price only applies if a minimum 10 association members purchase the product at the same time. If there are more than 30 association members purchasing at the same time please consult us for pricing details

**Note 3:** This ONLY applies to enforcing authorities, venues or events. Maximum of 10 events or 3 contractors per annum – additional events or contractors charged at individual prices. You DO NOT need to add event costs to individual prices if you are a company

**Note 4:** We presume enforcers may use the products for a variety of reasons – hence the additional costs. These include: Research, To check against what people submit, To do calculations for a variety of events at a variety of venues, or by a variety of companies at the same venue, Potentially for tendering purposes, Potentially for enforcement purposes

**Note 5:** We will hold a copy of your PlumeCalc© files in case of incident and run the model at your request

**Note 6:** Special discounted price for purchasing ShellCalc© and EnvCalc© OR SoundCalc© at the same time. Note renewals are at standard renewal prices

**Note 6:** Special discounted price for purchasing ShellCalc© AND EnvCalc© AND SoundCalc© at the same time. Note renewals are at standard renewal prices