THE LANGUAGE OF PYROTECHNIC EFFECT NAMES PART 3:
VDL 1.0 SPECIFICATION

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ABSTRACT

The study of pyrotechnic effect names that began with the 2012 ISF paper “The Language of Pyrotechnic Effect Names” and continued two years later with “Part 2” concludes in this paper with a set of rules that humans or computers can follow to interpret effect descriptions written in English. The set of rules is called VDL, for “Visual Description Language.”

The rules generally produce correct interpretations for effect names as they are, without any modification, but not 100% of the time. This paper is aimed at manufacturers, distributors, and display professionals to show you how to add minor clarifications to the effect names in your catalogs so that VDL based computer programs can produce accurate visual simulations for the effects just by reading them.
INTRODUCTION

Visual Description Language (VDL) is a set of rules for interpreting pyrotechnic effect names. VDL interpretations are often correct for effect names as they are, or nearly correct. For the cases in which the VDL interpretations are wrong, a small adjustment to the name of the effect may be all that is required to fix its VDL interpretation.

Why does this matter?

The VDL rules can be implemented by computer programs. If VDL interprets your effect names correctly, then computer programs that implement VDL can create visual simulations for your effects automatically. Having VDL information associated with fireworks catalog listings makes the products more desirable for display companies who create computerized fireworks display simulations both to design displays and to use as a sales tool.

This paper presents the language specification for VDL. It is addressed to fireworks display professionals who use visual simulations, and to manufacturers and distributors who have display professionals as their customers. With a relatively small amount of effort, you can add value to your fireworks catalogs by making them compatible with computer programs that utilize a commonly accepted set of VDL rules, such as those proposed here.

For outdoor aerial effects, the short “ALL YOU NEED TO KNOW FOR AERIAL” section of this paper shows how the basic aerial effect names are interpreted by VDL rules. You can use these guidelines to make adjustments to the names or descriptions of your fireworks so that the VDL interpretations match the real world effect accurately. You can make the adjustments to the names themselves, or add alternate “VDL description” fields to the catalog listings.

For cakes, the following “ALL YOU NEED TO KNOW FOR CAKES” section shows how to describe single or multi-effect cakes in detail, down to the individual tubes, angles, and timing, such that VDL based computer programs can accurately produce a simulation of the full cake. Since multi-effect cake descriptions are long, they are best suited for an alternate “VDL description” field for your effects, rather than a modification of the effect name itself.

For people with technical backgrounds, the longer section “WHAT VDL EXPERTS NEED TO KNOW” provides the detailed specifications for understanding and adjusting effect descriptions to create the highest quality visual simulations.

ALL YOU NEED TO KNOW FOR AERIAL

The VDL rules are built around a sentence structure, or grammar, that is simple enough to explain in the next few pages. This sentence structure is all you really need to know. You can describe any shell in this manner, and if you do, then computer programs implementing VDL are very likely to understand your description. You don’t have to think very hard.

What you do have to think about is: how does a computer (or for that matter another human being) divide an effect description into groups of words, and understand what the groups are referring to. For example,
Tiger Tail Brocade Silver & Red

could mean a lot of things, depending on how you group the words. If we assume this relatively simple description is an aerial shell, the groups of words may be referring to a rising effect, the primary petal, or the pistil. Here are some different possible interpretations:

<table>
<thead>
<tr>
<th>Rising effect</th>
<th>Primary petal</th>
<th>Pistil</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tiger Tail</td>
<td>Brocade Silver &amp; Red</td>
<td></td>
</tr>
<tr>
<td>Tiger Tail Brocade</td>
<td>Silver &amp; Red</td>
<td></td>
</tr>
<tr>
<td>Tiger Tail To Brocade</td>
<td>Silver &amp; Red</td>
<td></td>
</tr>
<tr>
<td>Tiger Tail</td>
<td>Brocade</td>
<td>Silver &amp; Red</td>
</tr>
<tr>
<td>Tiger Tail Brocade Silver</td>
<td>Red</td>
<td></td>
</tr>
<tr>
<td>Tiger Tail</td>
<td>Brocade Silver</td>
<td>Red</td>
</tr>
<tr>
<td>Tiger Tail Brocade</td>
<td>Silver</td>
<td>Red</td>
</tr>
<tr>
<td>Tiger Tail Brocade Silver</td>
<td>Silver &amp; Red</td>
<td></td>
</tr>
<tr>
<td>Tiger Tail</td>
<td>Brocade Silver &amp; Red</td>
<td>Silver &amp; Red</td>
</tr>
<tr>
<td>Tiger Tail Brocade Silver</td>
<td>Silver &amp; Red</td>
<td>Red</td>
</tr>
</tbody>
</table>

**Table 1 - Multiple interpretations of ambiguous effect description**

Understanding the grouping of words in an effect description and understanding what the groups refer to are important concepts for interpreting effect names. The simple example above has interpretations that are at least somewhat similar. Other effect names described later in this paper could be interpreted ambiguously as completely different kinds of effects. There’s a big difference between an aerial shell and a rising star, but the effect descriptions can look a lot alike.

**Approach**

The approach taken by VDL for word grouping is to use prepositions in the effect name, which indicate the breaks between groups of words. The above example didn’t have any prepositions, but if you wrote it instead as,

**Tiger Tail To Brocade Silver w/ Red Pistil**

then the three groups of words are easy to recognize. Adding prepositions to your effect names to split up the groups of words goes a long way toward making them unambiguous.

The plus sign (+) and ampersand (&) are also important for grouping words. When you see **Red & Blue Peony Cake**, is that a cake of single shells with mixed color stars, or a cake of red shells and blue shells? There is no consistent usage or convention in effect names today, so VDL takes a stand: The plus sign (+) separates sub-effects like shells, whereas the ampersand (&) combines sets of colors that are mixed together. Thus **Red & Blue Peony Cake** has shells with mixed color stars, but **Red + Blue Peony Cake** has red shells and blue shells.

In addition to the plus sign and ampersand, VDL standardizes the syntax for writing “auxiliary” specifications like the caliber of the effect (e.g., write 2.5” instead of 2-1/2) or the number of shots (write 49 Shot, not 49t or 49s or 49 or 7x?).
Together, the few standards for prepositions and the few conventions for specifications make it possible for VDL rules to interpret most effect names. The approach is spelled out in the next sections.

**Auxiliary specifications**

*Auxiliary specifications*, like the height, duration, prefire time, or caliber of the effect can be written the same way across all categories of effects.

2.5" 280′ Peony 2.6s PFT

25mm 49 Shot 18s Red Pearl Cake

If you use the shaded background parts of these examples as templates for writing your auxiliary specifications, VDL rules will read the information correctly. Splitting out the specifications is the first step in grouping the words in the effect description. What’s left after removing the specifications is the *body* of the effect.

**Body**

The body of an effect name describes what it is. The body splits up hierarchically into subgroups based on the propositions and punctuation in the effect name. Each shell in the body, if it has more than one, is a *sub-effect*. Pistils and petals of the sub-effect are represented by *clauses*, as is its attached rising effect if it has one. Within the clauses, the phases of color changes or transitions are the *phrases*.

By way of example, all levels of subgroups -- the body, sub-effect, clauses, and phrases -- are contained in this effect description:

3” 5s Red To Blue Peony w/ Gold Tail + Silver Chrys Chain

The first level of grouping separates the auxiliary specifications from the body.

3” 5s Red To Blue Peony w/ Gold Tail + Silver Chrys Chain

auxiliary body

The body splits into *sub-effects*, separated by plus signs (+):

Red To Blue Peony w/ Gold Tail Silver Chrys

sub-effect sub-effect

To determine what the sub-effects are, the VDL rules first determine if the body is a chain or cake or candle by searching for the terms *Chain*, *Cake*, or *Candle*. If so, then the sub-effects represent the shells in the chain or the shots in the cake or candle. Otherwise the sub-effects are shells or sections of a peanut shell or multi-break cylinder shell. In this example the sub-effects are shells.

Red To Blue Peony w/ Gold Tail Silver Chrys

shell shell
The VDL rules split the sub-effect into its clauses based on the preposition With, and sometimes the preposition To. The preposition With (which we abbreviate w/) is the most straightforward way to add a clause to an effect description. You can easily add a pistil, or a petal, or a tail to an aerial effect with a “with-clause” like w/ Crackling Pistil or w/ Gold Tail. In this example, the clauses are, Red To Blue Peony Gold Tail Silver Chrys clause clause clause

In some circumstances, you can use the preposition To to separate clauses. The effect name at the top of the Approach section above is an example (Tiger Tail To...). The problem with To is that it is also the preposition that separates phrases that represent transitions (e.g., Red To Blue), and the rules that distinguish “to-clauses” from transitions are complex. The rules are described in the expert section, but if you always use “with-clauses” instead of “to-clauses” in your effect names, and only use To for transitions, then you don’t need to worry about the complex rules.

In this example, the To prepositions separate the transition phrases, producing the final level of grouping: Red Blue Peony Gold Tail Silver Chrys phrase phrase phrase phrase

These grouping steps break down the original effect description into individual parts, organized in way that can be interpreted unambiguously. No matter what type of effect you are describing, if your effect name follows this structure, there is a good chance the VDL rules will interpret the different parts of the name correctly.

Types of effects

VDL rules classify effects and sub-effects into six basic categories: shell, mine, rising, fountain, rocket, and other. The rising category encompasses comets and other types of stars or inserts that are shot out of tubes from the ground. The term “rising effect” can mean two things. In the present context, an “independent rising effect” is an effect or sub-effect in the rising category; in other contexts, an “attached rising effect” is an ancillary effect attached to a shell to give it a tail or flowers on the way up. Attached rising effects do not affect the category; a shell with an attached rising effect is still a shell.

Cake and candle are two additional effect categories for effects made up of other basic effects. To give you the general sense of what VDL-based effect names look like, here are examples of VDL effect names in the six basic categories.

<table>
<thead>
<tr>
<th>Effect description</th>
<th>Category</th>
</tr>
</thead>
<tbody>
<tr>
<td>Red To Blue Peony w/ Strobe Tail</td>
<td>Shell</td>
</tr>
<tr>
<td>Red Mine w/ Whirls</td>
<td>Mine</td>
</tr>
<tr>
<td>Color Pearl To Report</td>
<td>Rising</td>
</tr>
<tr>
<td>15’ 20s Crackling Silver Gerb</td>
<td>Fountain</td>
</tr>
<tr>
<td>Silver Rocket w/ Varg Falling Leaves Heading</td>
<td>Rocket</td>
</tr>
</tbody>
</table>
Colors and trails of sparks

You recall that the plus sign (+) separates sub-effects, and the ampersand (&) combines colors that are mixed together. To indicate color transitions, use the word To between the colors. Remember these three rules:

Rule 1: Use the plus sign (+) to separate sub-effects.
Rule 2: Use the ampersand (&) to combine colors of stars that are mixed together.
Rule 3: Use To between colors to represent transitions.

As an example of Rule 1, the following represents three colors of shells:

Red Peony + White Peony + Blue Peony

As an example of Rule 2, the following is a single shell with mixed color stars:

Red & White & Blue Peony

As an example of Rule 3, the following represents a three stage color transition:

Red To White To Blue

Some flower types like Chrys imply that the stars have trails of sparks. Others like Peony imply that they don’t. But these implications are not hard and fast rules. They are defaults that apply in the absence of more specific information. When you describe a shell with additional terms, the color rules can become a little bit complicated.

Some colors and adjectives refer to the flame envelopes/colors of stars (the “tip”), whereas others refer to the trails of sparks that the stars leave behind. In general, chromatic colors like Red, Blue, and Green, refer to flame envelopes. Three special colors -- Gold, Silver, and Gamboge -- refer to trails of sparks. If you want to indicate a gold or silver colored star, you can write Gold Tip or Silver Tip. The color White is used ambiguously in pyrotechnics descriptions. VDL takes the stand that White is a flame envelope color, not a trail of sparks color (generally Silver).

The combination of the flower type and any colors or adjectives in the phrase determines whether the stars have flame envelopes or spark trails, or both. You can use the following table of examples as a guide:

<table>
<thead>
<tr>
<th>Has flame envelope</th>
<th>Has trails of sparks</th>
<th>Has both</th>
</tr>
</thead>
<tbody>
<tr>
<td>Red Peony</td>
<td>Gold Chrys</td>
<td>Red Chrys</td>
</tr>
<tr>
<td>White Peony</td>
<td>Silver Kamuro</td>
<td>Gold Peony</td>
</tr>
<tr>
<td>Gold Tip Peony</td>
<td>Gold No Tip Peony</td>
<td>Crackling Peony</td>
</tr>
<tr>
<td>Red No Trail Chrys</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 3 - Comparison of flame envelope examples to spark trail examples
The terms No Tip and No Trail can be used to cancel out a flame envelope or trail of sparks that would otherwise be implied by the flower type. The bottom left example in the table, Red No Trail Chrys, is a Chrysanthemum shell whose red stars don’t leave the trails of sparks that are characteristic of that type of shell. Without No Trail, the stars would be assumed to have a red flame envelope and a gold trail of sparks (the upper right in the table).

**Petals, pistils, and inclusions**

“With-clauses” like w/ Crackle Pistil or w/ Red Ring or w/ Outer Blue incorporate additional petals into a shell description. The terms in these examples that define the petal shape are required (Pistil, Ring, Outer). If the clause doesn’t specify the petal shape (e.g., w/ Crackle, or w/ Red, or w/ Blue) then the indicated stars or inserts are included in the main petal, mixed in with the others.

You can indicate a specific number of inclusions mixed in by writing out the number longhand as *N-times*, as in this example with five reports.

Crackling Red Peony w/ Five Times Report

As a special case, the “with-clause” w/ Report, by itself without any count indication, simply applies to the stars or inserts preceding it in the description. The following two descriptions have the same meaning:

Red Peony w/ Report
Red Peony To Report

**Trails versus tails (no “r”)**

The words "tail" and "trail" are often conflated because to most people they mean almost the same thing, and they differ by a single letter. VDL rules give a precise meaning to the two terms: a Trail is a path of sparks; A Tail is either (a) a rising effect attached to a shell that may or may not include a trail of sparks (it could be just a flame), or (b) an independent rising effect that necessarily does include a trail of sparks (otherwise it would be called a Pearl). Thus in VDL,

Red Peony w/ Blue Tail

represents a red Peony shell with a rising effect attached to the shell. The attached rising effect produces a blue flame envelope and no trail of sparks because none is indicated or implied by the Tail in the context of an effect attached to a shell.

However, if you write,

Rising Blue Tail

the independent rising effect has both a blue flame envelope, because it is indicated by the tip color Blue, and a trail of sparks implied by the Tail in the context of the independent rising effect.
The word **Pearl** means an independent rising effect with a flame envelope. Since **Pearl** only applies to independent rising effects, it has no ambiguity. It always implies a flame envelope.

**Summary**

If you follow the basic sentence structure presented in this section for your effect names there is a good chance VDL-based programs will understand them correctly. The sentence structure is not a guarantee because obviously your effect names may contain terms that VDL does not even recognize, but if you get the sentence structure right, and the auxiliary specifications right, you will almost always get a serviceable approximation.

So this is a good place to start. If you want to describe cakes, you'll need to read the next section to learn the syntax for specifying the layout of the sub-effects within the cake. If you want to fine tune your effect names to create visual simulations that are highly precise representations of your real world effects, you will may to read the expert section for additional details.

**ALL YOU NEED TO KNOW FOR CAKES**

Cake and candle effect names are based on the sub-effects that they contain, so everything in the previous section also applies to cakes and candles. The additional layer of information that cakes introduce is the arrangement of the sub-effects into rows and tubes, and the firing pattern of those tubes.

**Structure of a cake effect name**

Cakes and candles comprise one or more shots of the other six basic effect types. The syntax of cakes, candles, single shot candles, and candle bundles are all the same. The only difference is the term that defines the device itself: **Cake, Candle, Roman Candle, etc.**

VDL supports multiple levels of detail. For example a simple cake description is,

49 Shot 5s Cake

A more complex description that includes multiple effect types in multiple firing patterns is,

30mm 49 Shot 5s (a) Red Pearl + (b) Blue Pearl Cake 7 Rows, Z-Shape, Row 1,3,5 (a), Row 2,4,6 (b), Row 7 (1.2/abababa/FNT)

The longer example describes a zipper cake with 6 rows of alternating colors, and finally a last row with alternating effects in the tubes in an all-at-once fan, preceded by a 1.2 second delay.

The syntax of a cake description breaks down into auxiliary specifications, body, and row specifications. From the example above, the three parts, in order, are,
(a) Red Pearl + (b) Blue Pearl Cake

7 Rows, Z-Shape, Row 1,3,5 (a), Row 2,4,6 (b), Row 7 (1.2/abababa/FNT)

The body contains one or more effect descriptions of the shots in the cake, separated by plus signs, with single letter labels in parentheses that the row specifications can refer to for the tubes. The row specifications can optionally specify the number of rows, their tube layout, the timing, and the firing patterns of the effects. Within the row specifications, the parts in parentheses are called the firing description; they apply to the rows identified immediately before. In the above example, the firing description (a) applies to rows 1, 3, and 5. The firing description (b) applies to 2, 4, and 6. And the firing description (1.2/abababa/FNT) applies to row 7. Firing descriptions are optional. If not explicitly provided, the default firing descriptions are based on equal timing between firing events, and cycling through the defined effects in each row.

Firing descriptions

Firing descriptions contain information that specifies the construction of a row. The attributes that you can define are,

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Example</th>
<th>Characters</th>
</tr>
</thead>
<tbody>
<tr>
<td>Delay before row</td>
<td>0.2/</td>
<td>Integer or float at the beginning</td>
</tr>
<tr>
<td>Duration of row</td>
<td>/1.2</td>
<td>Integer or float before the asterisk if present, or otherwise at end</td>
</tr>
<tr>
<td>Effects in the tubes, left to right</td>
<td>abababa</td>
<td>Letters referencing labels in the body</td>
</tr>
<tr>
<td>Firing pattern</td>
<td>FNT</td>
<td>Three letter keyword from the firing keyword appendix</td>
</tr>
<tr>
<td>Caliber</td>
<td>3”</td>
<td>Integer or float followed by &quot; mm for millimeters</td>
</tr>
<tr>
<td>Firing in parallel with previous row</td>
<td>*</td>
<td>Asterisk at end of description</td>
</tr>
</tbody>
</table>

Table 4 - Firing description parameters

All the attributes in a firing description other than the asterisk are separated with forward slash, as in these examples:

(0.5/abababa/FNT)
(ababababa/FNR)
(0.2/ababababa/FNR/0.75)
(30mm/a*)
(0.2/30mm/ababababa/FNR/0.75*)
The numbers in the firing descriptions refer to the delay prior to the row if they are at the beginning of the phrase (0.5 and 0.2 in the above examples) or to the duration if they are not at the beginning (0.75 in the example). If there is an asterisk, it must be last.

The three letter firing pattern defines the firing order and angles of the tubes in the row. By default, a cake effect description with no firing pattern specified will have an Up-Sequence firing pattern, abbreviated STR, which means all the tubes are aiming straight up (the “ST” for straight up) and they are fired in left to right order in the row (the “R” for left to right order). A similar firing pattern is Up-Reverse, abbreviated STL, which is the same except fired in the reverse order, right to left. A third example is Up-Together (STT) which is all tubes firing at the same time.

Three other common firing patterns are FNR, FNL, and FNT, for Fan-Right, Fan-Left, and Fan-Together. Additional firing patterns are listed in the table in the later section.

**WHAT VDL EXPERTS NEED TO KNOW**

**Objective**

The earlier sections are aimed at manufacturers, distributors, and display professionals who want to enhance the VDL interpretations of the fireworks in their catalogs to a serviceable level.

This section is aimed at people with a technical background who want to create VDL descriptions that result in the highest quality and most accurate visual simulations possible. If you are manufacturer or distributor interested in investing in your catalog’s VDL descriptions to provide the greatest possible value to your customers, or if you are a display professional wanting to make the highest quality visual simulations for the inventory that you work with, or if you are a programmer or consultant interested in providing VDL tools or services, this section is for you.

**Determining the effect type**

Determining the effect type is arguably the single most important step in interpreting an effect name. For many types of effects, the task is simple: if an effect name includes the term *Rocket*, then it is a rocket; if includes the term *Fountain*, it is a fountain. For other types of effects, particularly effects in cakes, the determination is not simple. *Crossette* in isolation is a shell, but *Crossette* in a cake is an independent rising effect.

Effect names fall into eight categories: *shell, mine, rising, fountain, rocket, other, candle*, and *cake*. The last two categories, candles and cakes, comprise one or more shots of the other six. The category of a VDL effect can be determined according to these rules, in order:

1. If the description contains the term *Cake* or *Candle* or *Chain*, then it is a cake or candle or chain consisting of sub-effects whose categories are determined from the remaining terms. Also, if the description defines the number of shots (e.g., *49 Shot*) then it is a cake unless otherwise indicated.
2. If the description contains plus signs (+), then it represents multiple sub-effects, separated by the plus signs. The category of each sub-effect is determined independently by the remaining rules.

3. If the description contains the terms Rocket, or Fountain, or synonymous term, then the corresponding category applies. Similarly, if a term implies the “other” category (Flame Projector, Strobe Pot, Lance), then that category applies. Otherwise, one of the remaining three categories applies, according to the remaining rules.

4. If the term Mine or a synonym is present before any With, then the mine category applies.

5. If the term Salute or Aerial is present, then the shell category applies (a Ground Salute would be recognized in Step 3 as being in the category “other” by virtue of the term Ground).

6. If a term that definitively implies a petal (Pistol, Ring, Shell, Shell-of-shells, etc.) is present before any With, the shell category applies. Flower types like Willow, Peony, Brocade, etc. are not considered to imply a petal definitively since the terms also can be used to describe star characteristics of a non-shell effect, as in, Brocade Mine.

7. If a term that implies the rising category -- Comet, Pearl, Tail, Rising, but not Tiger Tail -- is present before any With, and no other non-aerially-ambiguous term (as defined in the next rule) that provisionally implies a petal (Willow, Peony, Brocade, etc.) prior to any With exists following a To that follows the term, then the rising category applies.

8. If the description is part of a cake or candle, and does contain a term that is aerially ambiguous (Crossette, Scattering, Shuttle, Whirl, etc.) before any With, and no other non-aerially-ambiguous term that provisionally implies a petal prior to any With exists following a To that follows the term, then the rising category applies.

9. Otherwise the shell category applies.

The foregoing rules provide a reasonable set of answers to some of the most severe ambiguities of effect descriptions written in the English language. Some examples are,

- A Crossette (by itself) is a shell, whereas a Crossette Cake is a cake of individual crossette stars (not shells). An Aerial Crossette Cake is a cake of shells.
- A Comet (by itself) is indeed an independent rising effect, whereas a Comet Ring or Comet Shell or Comet Crossette Shell is an aerial shell (the Comet term being garniture). A Red Peony w/ Comet Tail is an aerial shell with a comet-like attached rising effect.
- A Tail by itself is a rising effect, as are the effects in a Tail Cake or Brocade Tail Cake, but a Brocade by itself is a shell, as is a Tiger Tail by itself or a Brocade w/ Tail or Brocade w/ Tiger Tail or Tiger Tail To Brocade.
- The descriptions Comet To Brocade, and Tiger Tail To Peony and Tail To Salute are all shells, whereas Red Tail To Blue and Silver Tail To Report are rising effects.

The rules are not perfect. For example, in the absence of other information a Comet Crossette would probably be understood by humans to mean a shell, but VDL interprets it as a rising effect. Knowing the rules, however, you can usually add minor clarifications to the effect descriptions to produce the correct interpretation, such as writing Comet Crossette Shell or Aerial Comet Crossette.
The rule set gives reasonable answers to many degenerative effect descriptions that are common in real world inventories. Perhaps the most common is the pithy description:

3" Red → shell

Syntax for shells

Flower names of aerial shells like Peony, Dandelion, and Chrysanthemum describe characteristics of the break and characteristics of the stars themselves. Some flower names like Dandelion imply specific colors, whereas others like Peony or Chrysanthemum imply some characteristics of the stars -- how quickly they expire, and whether they have a flame envelope or leave a trail of sparks -- without any implication of color. In addition to breaks and stars, Dandelion and a few other flower names like it imply a rising effect attached to the shell on the way up.

Almost all effect descriptions based on flower names can be modified with additional adjectives, phrases, and clauses to be different from the prototypical meaning of the flower name, so with respect to the shell’s syntax, the flower name’s characteristics should be considered *provisional*, rather than *definitive*. A *Dahlia* flower type implies a sphere shaped petal (provisionally), but a *Dahlia* *Ring* would have a ring shaped petal (definitively) of otherwise Dahlia-like stars.

The simplest syntax of a shell is just a flower name, which forms the basis of most shell descriptions, e.g.:

**Peony**

Adjective phrases can further specify the star or break characteristics or override the provisional characteristics implied by the flower type, such as,

**Crackling Red Peony**

To-phrases enable the description to incorporate color changing or transitioning stars, as in,

**Crackling Red To Blue Peony**

“With-clauses” enable the description to incorporate pistils, additional petals, or a rising tail.

**Crackling Red To Blue Peony w/ Blue Pistil w/ Gold Tail**

According to the *Structure of an effect name*, above, the “with-clauses” themselves may break down into to-phrases for color changes or transitions. The effect descriptions start to look overwhelming, but the syntax is unambiguous. For example,

**Crackling Red To Blue Peony w/ Blue To Red Pistil w/ Gold Tail**

The syntax of this description has the structure of phrases as described above:
Syntax of attached rising effects (tails)

The with-phrase in the examples above is the most straightforward syntax for rising effects attached to the shell, but in order to support the broadest range of existing effect descriptions, VDL also supports a syntax of writing the tail first, as in these examples,

Tiger Tail To Salute
Red Tail To Brocade
Rising Red To Willow

This syntax is asking for trouble because effect names like these can very reasonably be interpreted to mean independent rising effects or shells with attached rising effects, but since the syntax is in wide use, VDL provides an interpretation.

A careful look at the effect type rules shows why these three examples are all interpreted in VDL as shells with rising effect tails, rather than independent rising effects. The key to the rules is that if the effect description has a term that implies the rising category (Tail, Rising, Comet, etc.) to the left of a To and a term that implies a provisional or definitive petal, or a salute, to the right of the To, then the description splits into a tail description on the left and a shell description on the right.

Differentiating independent rising effects from aerial shells

Based on the last three examples, one might hastily conclude that the effect,

Gold Tail To Red

is a red shell with a gold tail, but according to VDL it is not. Since the term Red doesn’t imply a petal, there is nothing in the description to countermand the interpretation that it is simply a color changing rising star, as might be shot from a cake or candle.

The difference between Tail To Red Peony (an aerial shell with an attached rising effect), and Tail To Red (an independent rising effect that transitions to red) is subtle. To remove any possible ambiguity for describing an aerial shell, you can use the term Aerial for the transition, as in the aerial shell,

Gold Tail To Aerial Red

but in practice this need doesn’t arise very often. To remove any possible ambiguity for describing a rising effect, you can put the Tail term (or Comet or Pearl or Rising, etc.) last, as in the rising effect:

Gold To Red Tail

In cakes and candles, some effect terms like Crossette and Tourbillions typically represent individual rising stars and inserts, yet as individual effects these same terms
typically represent aerial shells. In VDL these terms are called *aerially-ambiguous*, and the effect type rules treat them specially (see rule 8). In cakes and candles (but not as individual effects), aerially-ambiguous terms imply the rising category unless a term like *Aerial* or *Shell* explicitly indicates the aerial shell category. The rule works so well you rarely need to use the *Aerial* or *Shell* term, but if you need to represent a cake that contains crossette shells (as opposed to individual crossette stars), you have a way to do it. Three examples summarize the options:

*Crossette* (aerial shell)
*Crossette Cake* (cake of rising stars)
*Aerial Crossette Cake* (cake of crossette shells)

**Rising flowers**

Rising flowers are themselves shells, so their syntax is the same as the syntax for the shell they are attached to, inside a clause of the form `<description>`: *Rising Flowers*:

- *Green Peony w/ Falling Leaves Rising Flowers*
- *Yellow Peony w/ Red To Blue Rising Flowers*
- *Red Peony w/ Four Times Blue Rising Flowers w/ Green*

The third example indicates the number of rising flower breaks (*Four Times*). VDL supports up to ten rising flowers on an aerial shell, with the number spelled out as in this example. By default the number of rising flowers is three if not otherwise indicated.

The third example also illustrates a limitation on the syntax for rising flowers: They cannot themselves include “with-clauses.” The green pistil at the end of the effect description applies to the aerial peony, not the blue rising flowers. Given the rules of the syntax, it would be clearer to write the description as, *Red Peony w/ Green w/ Four Times Blue Rising Flowers*.

**Tiger tail**

The term *Tiger Tail* is principally a star characteristic, as in *Tiger Tail To Red* (a shell), but if used in a “with-clause” it is interpreted as an attached rising effect unless other terms in the “with-clause” imply a petal or pistil. For example, *Red Chrys w/ Tiger Tail* has an attached Tiger Tail rising effect, whereas *Red Chrys w/ Tiger Tail Pistil* merely has pistil stars with Tiger Tail characteristics.

**Salutes**

The term *Salute* in VDL refers to the explosive effect of an aerial shell that has no stars, in contrast to the term *Report*, which refers to the final explosive charge culminating the life of a star or insert. The subtle difference in words has large difference in meaning, so care must be taken with VDL descriptions including these terms. *Red To Report* is an aerial shell of red stars that end in an explosive charge. *Red To Salute* is a salute shell with a red tail.

**Report**

Since *Report* refers to the final explosive charge culminating the life of a star or insert, the natural VDL syntax is in the form of a transition like *Red To Report*, referring to red stars
that end in report. Outside of VDL, however, there is no bright line distinction between the meaning of these two terms, and it happens that the most common syntax in real world effect names is \textit{w/ Report}, as in \textit{Bottle Rocket w/ Report} or \textit{96 Shot Cake Color Pearl w/ Report}.

To accommodate existing effect names, VDL rules treat clauses like \textit{w/ Report} as if the preposition were \textit{To} instead of \textit{w/}, so the examples in the previous paragraph are interpreted as \textit{Bottle Rocket To Report} and \textit{96 Shot Cake Color Pearl To Report}. This rule applies to “with-clauses” that (a) imply a report and (b) do not contain \textit{To} or \textit{Aerial} or any term that implies a petal (e.g., \textit{Pistil}, \textit{Peony}, \textit{Ring}, etc.) or any term that implies a specific number of stars or inserts (e.g., \textit{Seven Times}). Thus the rule does not apply to \textit{Green Peony w/ Seven Times Report}, because it indicates the number of reports.

The last example illustrates that you can specify an exact number of included reports or other types of inserts or stars by writing out the number longhand as \textit{N-times}. Here are some additional examples:

\textit{Seven Times Report Shell}  
\textit{Peony w/ Seven Times Report}

\textbf{Crackle}

In real world effect names the terms \textit{Crackle} and \textit{Crackling} are both used ambiguously to mean that the stars in an effect have crackling characteristics, or to mean an effect includes crackling stars in addition to the other stars, or to mean an effect has a pistil with small stars that end in a crackling burst. The simple effect name \textit{Red Peony w/ Crackle} could have any of these meanings, depending on who you ask.

VDL takes the position that the terms \textit{Crackle} and \textit{Crackling} are synonyms, and that the differences in meaning come from the grammar. If the terms are used in combination with the flower type, as in \textit{Crackling Red Peony}, then they simply mean that the stars in the flower have crackling characteristics. If the effect description uses a to-phrase, as in \textit{Red Peony To Crackle}, the meaning is that the star assumes crackling characteristics in the second phase of a transition. If the effect description uses a “with-clause” that doesn’t contain \textit{Pistil}, as in \textit{Red Peony w/ Crackle}, the meaning is that the effect includes additional crackling stars. If the effect description uses a “with-clause” including \textit{Pistil}, as in \textit{Red Peony w/ Crackle Pistil}, the meaning is that the pistil contains small stars that end in a crackling burst. The defined term \textit{Popcorn Crackle} by itself means a small petal of small stars that end in a crackling burst, which is the same thing as \textit{w/ Crackle Pistil} except that it may be the primary petal.

\textbf{Glittering, strobing, and other modifiers}

Modifiers like \textit{Glittering} and \textit{Strobing} define star characteristics. A \textit{Strobing Red Peony} has strobing stars. A \textit{Glittering Chrys} leaves trails of glittering sparks. The terms have no semantic complexity except that their inclusion as garniture in an effect description can imply a flame envelope or trail of particles that would not otherwise be entailed. The stars of a \textit{Strobing Chrys}, for example, have to have flame envelopes or there would be nothing to strobe.
Shell-of-shells

A shell-of-shells effect name is just the subshell's effect name, followed by the words Shell-Of-Shells, as in, Red Peony Shell-Of-Shells. If the effect name begins with multiple colors, the colors indicate multiple kinds of subshells. Thus,

Red & Blue Peony Shell-Of-Shells

includes two kinds of subshells: red and blue. It does not include a subshell with mixed red and blue stars because in VDL the interpretation with homogeneous star colors in a shell or shot of a multi-shot effect takes precedence over an interpretation with mixed star colors when both interpretations are possible.

If you want mixed stars, you can write,

Red & Blue Mixed Peony Shell-Of-Shells

adding the term Mixed to indicate that the colors apply to mixed stars within each subshell or shot instead of applying one color per subshell or shot.

You can indicate the number of subshells by writing out the number longhand as N-times:

Seven Times Salute Shell-Of-Shells

Color changes and transitions

If an effect name articulates a transition to the right of the flower type, any trail implied by the flower type does not apply to the transition unless explicitly mentioned. So,

Red Chrys To Blue

begins as stars with a red flame envelope and gold trail, and transition to a blue flame envelope and no trail. If you want the trail in the blue phase, you must explicitly mention it by indicating a trail color, and optionally the term Tip to make the word sequence more readable:

Red Chrys To Blue Tip Gold

Transitions to the left are the same, with one exception: if the flower type is not adorned by any adjectives applying to flame envelopes or trails other than a single flame envelope color, and if all the transition phases to the left of the flower type also consist of only a single flame envelope color, then the transition is a special type of transition called a "simple color change," the significance of which is that flame envelope and trail properties implied by the flower type do apply to transitions on the left for simple color changes. Thus in the effect name,

Red To Blue Chrys

both the red phase and the blue phase of the stars have a gold trail.

Variegated, rainbow, and multi-color
The term Variegated or Varg for short applies to mixed color stars in a shell or mine. It is similar to writing Red & Yellow & Green & Orange & Purple except that the colors are never interpreted to apply to a subshell of a shell-of-shells as a whole or to separate shots of a multi-shot effect; the colors always apply to mixed stars.

The term Multi-Color applies to subshells of a shell-of-shells, or to separate shots of a multi-shot effect; never to mixed stars. Thus Varg and Multi-Color may mean the same set of colors, but they apply to different things. You can imagine the difference between these two shell-of-shells:

Varg Peony Shell-Of-Shells
Multi-Color Peony Shell-Of-Shells

In some effect names, the word Varg or Multi-Color has no meaning because it doesn't apply. These two effect names make no sense:

10 Shot Varg Rising Pearl Cake
Multi-Color Peony

(The rising pearls are each a single star shot, so each one can be at most one color, not a mixture of variegated colors. The multi-color peony is a single shell, so only one color of the multi-color set can apply.)

The term Rainbow is like Multi-Color, applying to subshells or shots but not mixtures of stars. New-Color and Color are just like lists of colors; they can apply subshells, shots, or mixed stars.

Crackle colors

Crackling star trails include energetic sparks that pop. Simply adding the word Crackling to an effect description implies the star has trails and that the trail has crackling sparks. By default, the sparks are the same color as the trail, but VDL defines a special set of colors that apply specifically to the crackling sparks, without applying to the non-crackling sparks of the same star trails. Using these crackle colors, you can represent a second color in the sparks of a trail.

The crackle colors are easy to recognize. They are just usual color names, but ending in -ish, as in, Green-ish or Red-ish. Since these "ish" color names are all distinct, there's never any question as to whether they refer to crackle or trails or tips. They always refer to crackle.

Here are some examples,

Red-ish Gold Comet
Silver Tip Blue-ish Silver Chrys

This second example explicitly specifies the tip color, the crackle color, and the trail color of the chrysanthemum, all three types of colors.

Like trail colors, crackle colors even by themselves in an effect name imply the star has a trail. If unspecified, the color of an implied trail is the default color. So in the example,
Green-ish Peony, the Green-ish color implies the peony stars have trails of a default color (gold), and the trails additionally have mixed in crackle sparks of the specified color, green-ish.

**Cylinder shells**

Unless otherwise indicated, a shell in VDL is assumed to be a ball shell. You can change the construction to cylinder by adding the term *Cylinder* to the description, as in *Red Peony Cylinder Shell*. Multi-break cylinder shells employ the plus sign (+) in the effect name to separate the breaks, as in *Red Peony + White Peony + Blue Peony + Bottom Shot Cylinder Shell*.

**Syntax for mines**

The syntax for mines rests on the basic structure of “with-clauses” and to-phrases described above (*Structure of an effect name*). By the rules of effect types, the term *Mine* or a synonym must be in the first clause, but if the clause breaks down into multiple to-phrases, the *Mine* term can be in any one of the phrases. The following two writing styles mean exactly the same thing:

- Red Mine To Blue
- Red To Blue Mine

If the mine has additional “with-clauses,” they describe additional types of stars that are included in the payload of the mine. You could describe a mine with three colors of stars as either,

- Red & White & Blue Mine
- Red Mine w/ White w/ Blue

The first syntax is simpler if all you need is multiple colors, but the second syntax supports the inclusion of stars with transitions that cannot be expressed in the first syntax, such as,

- Red Mine w/ White To Blue

which represents a mine with two kind of stars: red stars, and color changing stars that change from white to blue.

**Mines that lift shells**

VDL provides two ways to describe a mine that lifts shells, starting with the mine part or starting with the shell part. For example:

- Mine To Willow
- Willow w/ Mine
both describe the same thing, but with a different emphasis. According to the rules governing
the basic effect types, the first example is nominally a mine, and the second is a shell. For
purpose of teasing apart the mine part from the shell part, the rules are:

1. If the description contains the term Mine or a synonym (Bouquet) after With, then the
mine part begins just after the last With before the Mine, and the shell part includes
everything to the left of the With.
2. If the description contains the term Mine or a synonym, and contains To, and contains
a term after the To that provisionally or definitively implies a petal (Crossette, Ring,
Peony, Brocade, etc.) or is Salute or Aerial, then the mine part includes everything
before the last such To, and the shell part includes everything after.
3. If the description contains the term Mine or a synonym, and contains With, and
contains a term after the With that definitively implies a petal (Ring, Horsetail,
etc.), or provisionally implies a petal and is not aerially ambiguous (Peony, Brocade,
etc.), or is Salute or Aerial, then the mine part includes everything before the last
such With, and the shell part includes everything after.

Illustrating these rules, the following examples combine mines and aerial shells:

Red Mine To Willow
Mine To Salute
Blue Mine To Aerial Red
Blue Mine w/ Aerial Crossette
Blue Mine w/ Red Peony

whereas these examples are mines with color changing stars or report, or with other stars or
inserts mixed in, but no aerial shells:

Red Mine To Gold
Mine To Report
Blue Mine To Red
Blue Mine w/ Red
Blue Mine w/ Crossette

To represent a mine with stars that transition from red to Willow-like stars (no aerial shells
involved), you can write,

Red To Willow Mine

which is the same as the first example above except that the Mine is moved to the end. The
syntax <descriptionX> To <descriptionY> Mine is preferable to <descriptionX> Mine
To <descriptionY> if you are describing a mine with transitioning stars because it cannot
be confused with a “mine plus aerial” description.

When effect names combine mines and shells, any With clauses in the name refer to the part
of the effect to their immediate left. The following more complex examples illustrate these
concepts:

Red To Yellow Peony w/ Gold Tail w/ Blue To Green Mine
Blue To Green Mine To Aerial Red To Yellow Peony w/ Gold Tail

Mines that lift bombettes

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Mines that lift bombettes, or small shells, have the exact same syntax requirements as mines that lift individual shells, except an additional term describes the number of shells, as in:

Red Mine To Four Times Blue Peony
Red Mine To Four Times Blue Bombette

which mean the same thing. If the $N$-times term is missing, then the mine is interpreted to be lifting a single shell.

**Layered mines**

As described above, the syntax for mines can incorporate mixtures of multiple star types using the ampersand (&) for colors or “with-clauses” for colors or more complex star descriptions. If a mine includes multiple types of stars in layers, the latter syntax can express the additional layers using the term Above, as in:

Red Mine w/ Blue Above
Red Mine w/ White Above w/ Blue Above

without the Above term, these two descriptions would represent mines with mixtures of red and blue stars, and red, white, and blue stars.

**Syntax for rising effects**

The rising category consists of independent rising effects that are not attached to shells, such as comets, inserts shot from cakes or candles (Tourbillions, Whirls, etc.), stars with no sparks (Pearl, or Red Tail) and stars with trails of sparks (Brocade Tail or just Tail).

Many terms used for rising effects have multiple meanings. The term Comet, by itself, implies a rising star with a bushy trail of sparks or a voluminous flame envelope, but used in conjunction with other terms, as in Comet Shell, the implied spark and flame characteristics apply to the stars in an aerial shell. Similarly, the terms Pearl or Tail, which also imply a rising star, have additional meaning for the stars. Unless otherwise indicated, a Pearl is star with a flame envelope and no trail of sparks, whereas a Tail is a star with a trail of sparks and no flame envelope. When you choose a term to use for a rising effect name, pay attention to the additional meanings of the term. If you want to indicate a rising effect without applying any additional meaning, simply use the term Rising.

Some examples of (independent) rising effects are,

Tail
Brocade Tail
Brocade Tail To Report

Substituting Pearl or Comet or Rising for Tail in these examples will also define a rising effect. The term Report to VDL means an explosive charge inside a star or insert. The term Salute to VDL means an explosive charge in an aerial shell. Thus Brocade Tail To Report is an independent rising effect, whereas Brocade Tail To Salute is an aerial shell with an attached rising effect.
Descriptions that begin with Rising <descriptionX> To <descriptionY> or <descriptionX> Tail To <descriptionY> describe rising effects unless <descriptionY> provisionally or definitively implies a petal or salute (see the section Differentiating independent rising effects from aerial shells, above). Thus,

Red Tail To Blue
Red Tail To Crackling
Red Tail To Report

are all independent rising effects, whereas,

Red Tail To Brocade
Red Tail To Ring
Red Tail To Salute

are all aerial shells with attached rising effects (red tails).

In the context of cakes and candles, the terms Crossette (a splitting star) and Tourbillions (an insert) will refer by default to independent rising effects, though they can also refer to aerial shells by the same name if so indicated. Repeating some examples from the shells section:

Crossette (aerial shell)
Crossette Cake (cake of crossette stars)
Gold Comet Crossette Cake (cake of crossette stars with bushy trails of sparks)
Aerial Crossette Cake (cake of crossette shells)

An alternate way of writing an independent rising effect uses the term Rising instead of the term Tail, e.g.

Rising
Rising Brocade
Rising Brocade To Report

Syntax for fountains

The fountains effect type includes consumer fountains in addition to gerbs and jets and professional effects. The syntax for simple fountains is:

Gold Fountain
Silver Jet
Gerb

The duration and height of the fountain are part of the auxiliary specifications, as in,

25mm 15’ 5s Gold Gerb

Fountains with multiple types of sparks can be described in VDL using “with-clauses”:

Gold Fountain w/ Red Pearls
The syntax is similar to that of mines, except that the clauses and phrases refer to emitted particles instead of stars. Just as a Gold Mine w/ Red has gold stars with some red stars mixed in, a Gold Fountain w/ Red Pearls has gold fountain particles (sparks) with red fountain particles mixed in. The Pearls term at the end isn’t required but can be included to make the description easier to read. You can adjust the number of red pearl particles, and the number of gold fountain particles separately with the adjustment adjectives (see appendix) in the respective “with-clauses.” To decrease the number of red pearls while leaving the number of gold fountain particles the same, you could write Gold Fountain w/ Thin Flow Red Pearls.

Fountains in VDL can include adjective phrases like Crackling or Glittering, which apply to fountain particles similarly to how they apply to spark trails from stars.

Crackling Fountain

The only difference between the syntax of fountain particles and the syntax of stars is that stars leave trails of sparks whereas fountain particles are sparks. If the term Tail or modifiers like Crackling are present in the fountain clause, then the particles in the clause are sparks that leave trails of more sparks; otherwise the particles are just individual sparks of any color including gold, silver, and chromatic colors like red and blue. Like a microscopic shell break, sparks may burst into tinier sparks if described with the adjective phrase Popping, as in Gold Popping Fountain.

The same to-phrases syntax used to describe star transitions in a mine can also be used to describe particle transitions in a fountain. Color changing particles may not be so useful, but if you are paying attention to subtle changes in the appearance sparks over their trajectories, you might write a VDL description with a transition like,

Dim Gold To Very Bright Crackling Gold Fountain

VDL was developed with display fireworks in mind, but the syntax and the ability to describe effect adjustments in English could be applicable to designing consumer fountain fireworks, with the attention of the language directed at characteristics at a fine scale.

Syntax for rockets

Rockets come with headings and without but they always have a tail from the motor, so if you see a description like Silver Rocket, you know that Silver must refer to the tail. If the rocket has a heading, it is described as a shell description, using a “with-clause” or a “to-clause,” as in, Silver Rocket To Red Peony or Silver Rocket w/ Read Peony Heading. The motor size of the rocket can be specified in the auxiliary specifications as the inside diameter (ID). Here is a set of examples:

1" Strobe Rocket
Red To Blue Rocket
Silver To Gold Willow Rocket
200m Gold Rocket To Report
600’ Gold Rocket w/ Diadem Heading
Bottle Rocket w/ Report
800 Shot Saturn Missile Battery
The rule for recognizing a rocket from its effect name is simple -- an effect is a rocket if and only if it contains the term *Rocket* (or a synonym like *Missile*) -- but parsing the rocket description into a tail description and a heading description has the same complexity as differentiating rising effects from aerial shells. Rockets require a special set of rules, followed in order:

1. If the term *Rocket* is followed in order by *To* and *Report* (or *Salute*) before any *With*, and is not followed by more than one *To*, then the description to the left of *To* is the tail of the rocket, and the rocket ends in a report or salute, with no other heading.
2. If the term *Rocket* is followed in order by *With* and *Report* (or *Salute*) before any *To*, and is not followed by more than one *With*, then the description to the left of *With* is the tail of the rocket, and the rocket ends in a report or salute, with no other heading.
3. If the term *To* is present before a term that provisionally or definitively implies a petal (*Crossette*, *Willow*, *Peony*, *Ring*, *Aerial*, *Heading*, etc.), or *Salute*, prior to any *With*, then the description to the left of the last such *To* is the tail of the rocket, and the description to the right is the heading.
4. If the term *With* is present before a term that provisionally or definitively implies a petal or *Salute*, then the description to the left of the first such *With* is the tail of the rocket, and the description to the right is the heading.
5. If the term *To* or *With* is present after *Rocket* and is not followed by *Tail* or *Rising*, then the description to the left of the first such term is the tail of the rocket, and the description to the right is the heading.
6. If a term is present that provisionally or definitively implies a petal or *Salute*, then the full description is the heading.
7. Otherwise the full description is the tail.

The rules for parsing rocket description are different from the rules that differentiate a rising effect from an aerial shell description because to-phrase transitions in rockets are more likely to refer to the tail on the left and the heading on the right, rather than a transition that occurs entirely on the way up. Both are possible, but the term *Tail* is not required for rocket descriptions in circumstances that it is required for aerial effects with tails.

Two of the examples above illustrate the parsing requirements of the syntax rules,

Red To Blue Rocket  (color changing tail; no heading)
Silver To Gold Willow Rocket  (silver tail; gold willow heading)

The syntax of these two examples is very similar, but the first is a transitioning tail description and the second is the combination of a tail and heading description. The difference that separates them is that the second contains a term that implies a petal (*Willow*), whereas the first does not.

A Strobe Rocket is a defined term for a rocket with that type of motor. For purpose of VDL syntax the strobe effect is considered a flame envelope, so “tip” colors like *Red*, *White*, and *Blue* may be used to describe the color. Additionally, you can introduce a trail of sparks to the strobe rocket with a trail color like *Silver*, as in,

Blue Strobe Rocket w/ Salute Heading  (blue flame)
Silver Strobe Rocket w/ Salute Heading (silver sparks and, by default, white flame)
Blue Silver Strobe Rocket w/ Salute Heading (silver sparks and blue flame)

The easiest way to write a rocket description that is never ambiguous is just:

<Tail Description> Rocket w/ <Heading Description> Heading

as in,

Gold Rocket w/ Willow Heading

Syntax for other types of effects

Effects that don’t fall into any of the preceding categories, and that aren’t cakes or candles, are classified as “other” in VDL. “Other” effects have no special syntax. Obviously the term that defines the effect is part of the description. Depending on the type of effect, certain adjectives or modifiers may apply. The auxiliary specifications, particularly for height and duration, are often used. Some examples are:

15’ 5s Red Flame Projector
30s Strobe Pot

Syntax for cakes and candles

Cakes and candles consist of one or more effects of the other effect types. The basic syntax for this category of effects is covered in “ALL YOU NEED TO KNOW FOR CAKES”. This section includes more detailed syntax rules, defined defaults, and tables of applicable terms.

Recall from above that cake descriptions include a set of labeled sub-effect descriptions, followed by sets of designated rows and firing descriptions that apply to those rows.

30mm 49 Shot 5s (a) Red Pearl + (b) Blue Pearl Cake 7 Rows, Z-Shape, Row 1,3,5 (a), Row 2,4,6 (b), Row 7 (1.2/abababa/FNT)

The syntax of the firing description, (a), (b), and (1.2/abababa/FNT) in the above example, begins optionally with a number representing the delay followed by a slash, then optionally continues with a caliber followed by a slash, then includes a sequence of letters identifying the effects (required), then optionally continues with a slash followed by a firing pattern name, then optionally continues with a slash followed by the duration number, then optionally continues with an asterisk.

Using square brackets to indicate the optional terms, the syntax is:

[number ] [caliber ] tubeLabels /[ pattern ] /[ number ] [*]

If the letters identifying the effect labels happen to spell "in" or "mm" (very unusual but technically possible since all individual letters are valid effect labels), then either the delay or
caliber must also be supplied if the duration is supplied. The letters identifying effects are usually patterns like "abcde" or "ababa" or "cccccc" so this exception rarely applies.

In VDL, all parentheses and punctuation (comma and dash) are optional, even in cake descriptions. It is customary to put tube labels and firing descriptions in parentheses, but not required.

**Setting the number of rows, and number of tubes per row**

If the number of rows isn't explicitly specified, then a default of 1 row is implied if the effect has 12 or fewer shots; otherwise a default is calculated based on the square root of the number of shots. The exception to this rule is that the firing patterns \( W\text{-Shape} \) and \( V\text{-Shape} \) imply a default number of tubes per row of 3 and 2, respectively. If you specify a different number of tubes per row for those two firing patterns, the angles are doubled or tripled up.

If the number of rows evenly divides the number of shots, then the default tubes per row is simply the quotient: \( \frac{\text{number of shots}}{\text{number of rows}} \). Otherwise the default number of tubes for all rows except the last is the quotient rounded up, and the final row is the remainder, or a single tube if the remainder is negative or zero. If the default isn't right, you can set the tubes per row explicitly in the firing descriptions based on the number of tube labels, as the following example and corresponding tube diagram illustrate (rows drawn vertically):

10 Shot Peony Cake 3 Rows, Row 1 (aaa), Row 2 (aaaa/STL), Row 3 (aaa)

![Tube Diagram](image)

**(front of cake)**  **(back of cake)**

**Figure 1 - Ignition order of tubes**

If the firing description includes more than one tube label, then the number of tube labels defines the number of tubes in that row, overriding the default (3, 4, 3 in the above example). If the firing description doesn't include a firing pattern for the cake as a whole (\( W\text{-Shape}, Zipper, \) etc.), as the example above does not, then the default firing pattern of \( Up\text{-Sequence} \) (STR) applies. As indicated in the table below the STR firing pattern is ignited on the left end, making the sequence move to the right. In reality, the center row of this example would be ignited on the right so that the fuse would run conveniently zigzag through the rows. The firing keyword STL in the firing description for row 2, above, changes the firing order to right to left. Thus the tubes are ignited in the order of the numbers in the diagram.

**Setting the tubes’ effects**
The effect labels in the firing description specify the effects in the row’s tubes, beginning with the left-most tube. If the firing description has a single label, then the label applies to all tubes in the row. The order of the tube labels in the firing description is unaffected by which end of the row is ignited first. Thus if the left end of the row is ignited first, then the first effect in the specification is the first to go; if the right end of the row is ignited first, then the first effect in the specification is the last to go. The letters in the row description for the middle row of the example above would be applied to the tubes numbered 7, 6, 5, 4, left to right, just as the first row’s letters would be applied 1, 2, 3.

Setting the firing pattern and tube angles

As discussed earlier, the firing pattern indicates the firing order and angles of the tubes in the row. By default, a cake effect description with no firing pattern specified will have an Up-Sequence firing pattern, abbreviated STR, which means all the tubes are aiming up and they are fired in sequence, left to right. The three letter firing pattern keywords are modeled after terms in Vulcan’s modular cake specifications. Vulcan and other vendors can use the same term for Up-Sequence and Up-Reverse because they are the same product except for one is rotated around 180 degrees (Vulcan uses STW). However, to fully specify a cake the orientation of the rows obviously matters, so distinctions like STL versus STR are required in VDL.

The appendices include an exhaustive list of the firing keywords that can be included in the firing description. They are organized in groups of similar tube arrangements. Notice that the first three rows in the table are sequential left-to-right (ignited on the left), sequential right-to-left (ignited on the right) and all together (ignited either side). The last letter in the keyword, R, L, T is an indication of which end is ignited.

The table below shows the list of additional firing terms that specify default firing patterns for all the rows, but that cannot be included within the firing description of any single row. Some of these firing keywords like Zipper or X-Shape apply different defaults to the odd and even rows.

<table>
<thead>
<tr>
<th>X-Shape</th>
<th>Alternating CTO and OTC</th>
<th>Z-Shape</th>
<th>Alternating FNR and FNL</th>
</tr>
</thead>
<tbody>
<tr>
<td>C-Shape</td>
<td>CTO for all rows</td>
<td>W-Shape</td>
<td>TRI for all rows</td>
</tr>
<tr>
<td>V-Shape</td>
<td>VST for all rows</td>
<td>R-Shape</td>
<td>Same as X-Shape</td>
</tr>
<tr>
<td>Zipper</td>
<td>Same as Z-Shape</td>
<td>Peacock</td>
<td>Same as X-Shape</td>
</tr>
<tr>
<td>Bookend</td>
<td>BLT for all rows</td>
<td>Angle</td>
<td>ALR for all rows</td>
</tr>
<tr>
<td>Wipe</td>
<td>FNR for all rows</td>
<td>Fan</td>
<td>FNT for all rows</td>
</tr>
</tbody>
</table>

Table 5 - Firing terms usable in effect body

Adjusting the timing for each row

You can specify the delays or durations of the rows explicitly, or you can use the default times based on the overall effect duration. It is often easier to begin with the defaults and adjust the times of specific rows to suit. The default delays are calculated such that all of the non-zero delays between firing events are the same. Thus if all the tubes were aiming up and had the same effect, you couldn't tell from the visual appearance how many rows the cake
had. If you want to increase the delay between the rows such that the rows fire in recognizable flights, simply specify the delay times in the fronts of the Firing Descriptions.

The asterisk symbol in a row description indicates the row fires in parallel with the previous row, which applies to cakes constructed with multiple rows firing together. A V-shaped cake could be constructed with 4 rows of 10 tubes angled in the same direction, as in,

\[40 \text{ Shot (a) Red Pearl + (b) Blue Pearl Cake 4 Rows, Row 1,3 (a/ARL), Row 2,4 (b/ALL*)}\]

The same visual appearance would be produced by a cake with 20 rows of 2 tubes per row in opposing angles:

\[40 \text{ Shot Red Pearl + Blue Pearl Cake V-Shape}\]

This second description is particularly short because the V-Shape firing pattern description applies to the entire cake and implies by default that rows have two tubes per row. In the absence of firing descriptions, the tubes are assigned effects sequentially in the order in which they are defined. For this V-shaped cake, the two tubes in each row are the red and blue pearls, obviously, so the default effect assignment suffices. In the absence of Firing Descriptions, there is no need for the (a) and (b) labels on the components.

**SUMMARY**

The VDL specification has arisen from a wide study of pyrotechnic effect names used in the industry, and from the needs of display professionals to create visual simulations of the effects they use. The specification is both a practical solution to a real problem, and an opportunity for manufacturers to increase the marketability of their products.

The rules that programmers need to understand to implement VDL interpreters are complicated, but in exchange for that, the rules that manufacturers, distributors, and display professionals need to understand to reap the initial benefits of VDL are relatively simple. Beyond the initial benefits, companies interested in producing the highest quality simulations for the products in their catalogs can fine tune their VDL descriptions with the techniques described in the expert section.

In the coming year, we hope to see more product catalogs from manufacturers and distributors include a “VDL description” field that will enable their customers to generate visual simulations of their effects effortlessly. Several VDL based software tools and websites are already under development, and we hope the data interchange possibilities from VDL lead to a future in which software technologies from multiple vendors provide significant benefits.

**ACKNOWLEDGMENTS**

Thank you to Harry Gilliam of www.skylighter.com and to numerous pyro experts from around the world who have provided thoughtful feedback and editing during the course of development of VDL.
REFERENCES


APPENDIX A: AUXILIARY SPECIFICATIONS

Auxiliary specifications like the prefire time, effect height, and cake duration are sometimes more important than the description of the effect itself, so the VDL standard for writing auxiliary specifications can be valuable on its own. The table below lists the specification types and their syntax.

<table>
<thead>
<tr>
<th>Specification</th>
<th>Example</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Caliber</td>
<td>2.5” or 30mm</td>
<td>For cakes or candles, the inside diameter of the tube unless otherwise indicated on a per-row basis of cakes. For shells, the diameter of the shell. For other items, the tube size or equivalent most representative of the size of the effect, if applicable.</td>
</tr>
<tr>
<td>Number of shots</td>
<td>49 Shots</td>
<td>For cakes and candles, the number of tubes or balls.</td>
</tr>
<tr>
<td>Duration</td>
<td>30s</td>
<td>For cakes, candles and chains, the time delta between the first and last effect ignition. For fountains, flames, or other continuous effects, the visual duration of the effect. For all other effects, including aerial shells, VDL does not ascribe any meaning to the duration term, allowing you to give it your own meaning for these effects, such as the duration of the stars. If you want to adjust the duration of the stars or sparks in an aerial shell based on VDL, use the effect adjustment adjectives like &quot;long&quot; or &quot;long trail&quot;.</td>
</tr>
<tr>
<td>Height</td>
<td>150’ or 30m</td>
<td>The maximum height of the effect, i.e., the break for aerial shells, or the maximum height of the stars or particles for mines or fountains. With respect to cakes, the cake's height applies to all effects within the cake.</td>
</tr>
<tr>
<td>Angle</td>
<td>25 Degree</td>
<td>The full spread, in degrees, between the left-most and right-</td>
</tr>
</tbody>
</table>
most aiming tubes in a cake.

**Prefire time** | **2.2s PFT**
The script time delta between the firing system's ignition of the effect and the designated visual impact of the effect (also called the "display time" or "view time" or "effect time"). Additionally, for cakes and candles the prefire time specifies the time between the ignition of the cake or candle itself and the ignition of its first effect (thereby implying that the "display time" of a cake or candle "is" the ignition of its first effect). For independent aerial shells, the prefire specifies the break time of the shell, but only if the prefire is non-zero. For independent non-aerial effects (comets, mines, fountains, etc.) and for effects inside cakes or candles or chains, the prefire does not specify anything about the break times or durations.

**Chain length** | **Chain of 10**
Indicates a pre-defined chain of N effects, equally spaced over the specified duration if indicated, otherwise firing together as if connected by quickmatch. VDL syntax cannot represent chains that contain cakes, candles, or continuous effects like fountains, though scripting programs may support ad-hoc chains of individual effects connected together by fuse.

**Combined effects** | **Red Peony + Blue Peony Peanut Shell**
Cakes, candles, chains, peanut shells and cylinder shells can all contain multiple effect definitions, separated by the plus sign (+). The plus sign in VDL is not the same thing as ampersand. The plus sign combines multiple effects; the ampersand combines multiple colors in the same effect.

**Table 6 - Auxiliary specifications**

Combining all these elements together, you can write a fully specified effect name like,

50mm 25 Shot 30s 100' Rainbow Mine Cake (0.2s PFT, 25 Degree)

### APPENDIX B: EFFECT ADJUSTMENTS

VDL includes a wide range of effect adjustment adjectives that allow you to specify the visual characteristics of the stars, sparks, breaks, and other aspects of the effects.

An effect description in VDL can include multiple effect adjustments. For example, you could combine two adjustments together to fine tune the break of an effect:

3" Big Sparse Chrys

Or you could combine two other adjustments to fine tune the stars themselves:

3" Short Dim Chrys

On effect descriptions that have a pistil or multiple petals, each adjustment term applies to only one petal, determined by the position of the term in the description. For example, here is a description of an effect with a large primary petal and a small pistil:
Similarly, on effect descriptions with star transitions, the star characteristics apply to a single phase of the transition. Thus you can adjust the brightness of a color changing star before and after its transition independently, e.g.,

6" Bright Red To Dim Blue Crossette

The available effect adjustments are listed in the tables below, organized by the part of the effect to which they apply.

<table>
<thead>
<tr>
<th>Adjustment</th>
<th>Least</th>
<th>Slightly short</th>
<th>Slightly long</th>
<th>Brightness</th>
</tr>
</thead>
<tbody>
<tr>
<td>Size of petal</td>
<td>Very small</td>
<td>Small</td>
<td>Slightly big</td>
<td>Very big**</td>
</tr>
<tr>
<td>Width of mine or fountain</td>
<td>Very narrow</td>
<td>Narrow</td>
<td>Slightly wide</td>
<td>Very wide</td>
</tr>
<tr>
<td>Stars in shell or mine</td>
<td>Very sparse</td>
<td>Sparse</td>
<td>Slightly dense</td>
<td>Very dense</td>
</tr>
<tr>
<td>Flow rate of fountain</td>
<td>Very thin flow</td>
<td>Thin flow</td>
<td>Slightly thick</td>
<td>Thick flow</td>
</tr>
<tr>
<td>Particle speed at apogee*</td>
<td>Very quick</td>
<td>Quick</td>
<td>Very quick</td>
<td></td>
</tr>
</tbody>
</table>

* The apogee is the maximum height of the effect, as specified in the VDL description. The speed at apogee is greater than or equal to zero. The speed at apogee of most aerial effects is zero, representing the apex of the trajectory, but can also be “quick” for an early break. The speed at apogee of gerb particles is sharply non-zero, for expiring on the way up. The speed at apogee of droopy fountains is zero, even if the particles expire on the way down, because the apogee represents the maximum height.

** If you need to make an extreme adjustment beyond the level of the "Very XXX" adjectives, you can list adjectives multiple times for a combined effect, e.g., 3" Very Big Very Big Very Big Chrys

---

<table>
<thead>
<tr>
<th>Adjustment</th>
<th>Least</th>
<th>Slightly light</th>
<th>Slightly heavy</th>
<th>Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>Speed variation</td>
<td>Very even speed</td>
<td>Even speed</td>
<td>Slightly varied speed</td>
<td>Very varied speed</td>
</tr>
<tr>
<td>Duration variation</td>
<td>Very even length</td>
<td>Even length</td>
<td>Slightly varied length</td>
<td>Very varied length</td>
</tr>
<tr>
<td>Weight variation</td>
<td>Very even weight</td>
<td>Even weight</td>
<td>Slightly varied weight</td>
<td>Varied weight</td>
</tr>
<tr>
<td>Size variation</td>
<td>Very even size</td>
<td>Even size</td>
<td>Slightly even size</td>
<td>Slightly varied size</td>
</tr>
<tr>
<td>----------------</td>
<td>---------------</td>
<td>-----------</td>
<td>--------------------</td>
<td>---------------------</td>
</tr>
</tbody>
</table>

**Table 8 - Star and fountain particle adjustments**

<table>
<thead>
<tr>
<th>Adjustment</th>
<th>Thickness</th>
<th>Length</th>
<th>Brightness</th>
<th>Sharpness</th>
<th>Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>Least</td>
<td>Very thin trail</td>
<td>Very short trail</td>
<td>Very dim trail</td>
<td>Very soft trail</td>
<td>Very light trail</td>
</tr>
<tr>
<td>Greatest</td>
<td>Thick trail</td>
<td>Long trail</td>
<td>Bright trail</td>
<td>Sharp trail</td>
<td>Heavy trail</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Adjustment</th>
<th>Emission speed</th>
<th>Inherited speed</th>
<th>Speed variation</th>
<th>Trail diameter</th>
<th>Spark distribution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Least</td>
<td>Very passive trail</td>
<td>Very loose trail</td>
<td>Very even speed trail</td>
<td>Very narrow trail</td>
<td>Uniform</td>
</tr>
<tr>
<td>Greatest</td>
<td>Active trail</td>
<td>Very tight trail</td>
<td>Varied speed trail</td>
<td>Wide trail</td>
<td>Helix</td>
</tr>
</tbody>
</table>

| Adjustment | Trail variation | Weight variation | Size variation | Crackling trail spark adjustments
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Least</td>
<td>Very even length trail</td>
<td>Very even weight trail</td>
<td>Very even size trail</td>
<td>Very thin sparks</td>
</tr>
<tr>
<td>Greatest</td>
<td>Varied length trail</td>
<td>Varied weight trail</td>
<td>Varied size trail</td>
<td>Thick sparks</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Adjustment</th>
<th>Thickness</th>
<th>Length</th>
<th>Brightness</th>
<th>Sharpness</th>
<th>Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>Least</td>
<td>Very thin sparks</td>
<td>Very short sparks</td>
<td>Very dim sparks</td>
<td>Very soft sparks</td>
<td>Very light sparks</td>
</tr>
<tr>
<td>Greatest</td>
<td>Thick sparks</td>
<td>Long sparks</td>
<td>Bright sparks</td>
<td>Sharp sparks</td>
<td>Heavy sparks</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Emission speed</th>
<th>Inherited speed</th>
<th>Speed variation</th>
<th>Trail diameter</th>
<th>Spark distribution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Least</td>
<td>Very passive sparks</td>
<td>Very even speed sparks</td>
<td>Very narrow sparks</td>
<td>Uniform</td>
</tr>
<tr>
<td>Greatest</td>
<td>Active sparks</td>
<td>Varied speed sparks</td>
<td>Wide sparks</td>
<td>Helix</td>
</tr>
</tbody>
</table>

**Table 9 - Trail adjustments**

<table>
<thead>
<tr>
<th>Adjustment</th>
<th>Thickness</th>
<th>Length</th>
<th>Brightness</th>
<th>Sharpness</th>
<th>Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>Least</td>
<td>Very thin sparks</td>
<td>Very short sparks</td>
<td>Very dim sparks</td>
<td>Very soft sparks</td>
<td>Very light sparks</td>
</tr>
<tr>
<td>Greatest</td>
<td>Thick sparks</td>
<td>Long sparks</td>
<td>Bright sparks</td>
<td>Sharp sparks</td>
<td>Heavy sparks</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Emission speed</th>
<th>Inherited speed</th>
<th>Speed variation</th>
<th>Trail diameter</th>
<th>Spark distribution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Least</td>
<td>Very passive sparks</td>
<td>Very even speed sparks</td>
<td>Very narrow sparks</td>
<td>Uniform</td>
</tr>
<tr>
<td>Greatest</td>
<td>Active sparks</td>
<td>Varied speed sparks</td>
<td>Wide sparks</td>
<td>Helix</td>
</tr>
</tbody>
</table>

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### Table 10 - Cracking trail spark adjustments

<table>
<thead>
<tr>
<th>Adjustment</th>
<th>Least</th>
<th>Even length sparks</th>
<th>Slightly even length sparks</th>
<th>Slightly varied length sparks</th>
<th>Varied length sparks</th>
<th>Very varied length sparks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Duration variation</td>
<td>Very even variation</td>
<td>Even length sparks</td>
<td>Slightly even length sparks</td>
<td>Slightly varied length sparks</td>
<td>Varied length sparks</td>
<td>Very varied length sparks</td>
</tr>
<tr>
<td>Weight variation</td>
<td>Very even weight sparks</td>
<td>Even weight sparks</td>
<td>Slightly even weight sparks</td>
<td>Slightly varied weight sparks</td>
<td>Varied weight sparks</td>
<td>Very varied weight sparks</td>
</tr>
<tr>
<td>Size variation</td>
<td>Very even size sparks</td>
<td>Even size sparks</td>
<td>Slightly even size sparks</td>
<td>Slightly varied size sparks</td>
<td>Varied size sparks</td>
<td>Very varied size sparks</td>
</tr>
</tbody>
</table>

### Salute and report and crackle-report adjustments

<table>
<thead>
<tr>
<th>Adjustment</th>
<th>Least</th>
<th>Dim flash</th>
<th>Slightly dim flash</th>
<th>Slightly bright flash</th>
<th>Bright flash</th>
<th>Very bright flash</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flash brightness</td>
<td>Very dim flash</td>
<td>Dim flash</td>
<td>Slightly dim flash</td>
<td>Slightly bright flash</td>
<td>Bright flash</td>
<td>Very bright flash</td>
</tr>
<tr>
<td>Flash sharpness</td>
<td>Very soft flash</td>
<td>Soft flash</td>
<td>Slightly soft flash</td>
<td>Slightly sharp flash</td>
<td>Sharp flash</td>
<td>Very sharp flash</td>
</tr>
<tr>
<td>Flash size variation</td>
<td>Very even size flash</td>
<td>Even size flash</td>
<td>Slightly even size flash</td>
<td>Slightly varied size flash</td>
<td>Varied size flash</td>
<td>Very varied size flash</td>
</tr>
<tr>
<td>Spread of pops (sparks)</td>
<td>Very narrow pops</td>
<td>Narrow pops</td>
<td>Slightly narrow pops</td>
<td>Slightly wide pops</td>
<td>Wide pops</td>
<td>Very wide pops</td>
</tr>
<tr>
<td>Number of pops</td>
<td>Very sparse pops</td>
<td>Sparse pops</td>
<td>Slightly sparse pops</td>
<td>Slightly dense pops</td>
<td>Dense pops</td>
<td>Very dense pops</td>
</tr>
<tr>
<td>Pops duration</td>
<td>Very short pops</td>
<td>Short pops</td>
<td>Slightly short pops</td>
<td>Slightly long pops</td>
<td>Long pops</td>
<td>Very long pops</td>
</tr>
<tr>
<td>Pops brightness</td>
<td>Very dim pops</td>
<td>Dim pops</td>
<td>Slightly dim pops</td>
<td>Slightly bright pops</td>
<td>Bright pops</td>
<td>Very bright pops</td>
</tr>
<tr>
<td>Pops sharpness</td>
<td>Very soft pops</td>
<td>Soft pops</td>
<td>Slightly soft pops</td>
<td>Slightly sharp pops</td>
<td>Sharp pops</td>
<td>Very sharp pops</td>
</tr>
<tr>
<td>Pops weight</td>
<td>Very light pops</td>
<td>Light pops</td>
<td>Slightly light pops</td>
<td>Slightly heavy pops</td>
<td>Heavy pops</td>
<td>Very heavy pops</td>
</tr>
<tr>
<td>Pops speed variation</td>
<td>Very even speed pops</td>
<td>Even speed pops</td>
<td>Slightly even speed pops</td>
<td>Slightly varied speed pops</td>
<td>Varied speed pops</td>
<td>Very varied speed pops</td>
</tr>
<tr>
<td>Pops duration variation</td>
<td>Very even length pops</td>
<td>Even length pops</td>
<td>Slightly even length pops</td>
<td>Slightly varied length pops</td>
<td>Varied length pops</td>
<td>Very varied length pops</td>
</tr>
<tr>
<td>Pops weight variation</td>
<td>Very even weight pops</td>
<td>Even weight pops</td>
<td>Slightly even weight pops</td>
<td>Slightly varied weight pops</td>
<td>Varied weight pops</td>
<td>Very varied weight pops</td>
</tr>
<tr>
<td>Pops size variation</td>
<td>Very even size sparks</td>
<td>Even size sparks</td>
<td>Slightly even size sparks</td>
<td>Slightly varied size sparks</td>
<td>Varied size sparks</td>
<td>Very varied size sparks</td>
</tr>
</tbody>
</table>

### Table 11 - Salute and report and crackle-report adjustments

### Smoke adjustments

<table>
<thead>
<tr>
<th>Adjustment</th>
<th>Least</th>
<th>Clean smoke</th>
<th>Slightly clean smoke</th>
<th>Slightly dirty smoke</th>
<th>Dirty smoke</th>
<th>Very dirty smoke</th>
</tr>
</thead>
<tbody>
<tr>
<td>Density</td>
<td>Very clean smoke *</td>
<td>Clean smoke</td>
<td>Slightly clean smoke</td>
<td>Slightly dirty smoke</td>
<td>Dirty smoke</td>
<td>Very dirty smoke</td>
</tr>
<tr>
<td>Spread</td>
<td>Very small smoke</td>
<td>Small smoke</td>
<td>Slightly small smoke</td>
<td>Slightly big smoke</td>
<td>Big smoke</td>
<td>Very big smoke</td>
</tr>
<tr>
<td>Longevity</td>
<td>Very short smoke</td>
<td>Short smoke</td>
<td>Slightly short smoke</td>
<td>Slightly long smoke</td>
<td>Long smoke</td>
<td>Very long smoke</td>
</tr>
</tbody>
</table>

### Table 12 - Smoke adjustments

* Use the VDL adjective **Smokeless** if you want no smoke at all.

### APPENDIX C: FIRING KEYWORDS

<table>
<thead>
<tr>
<th>Firing keywords</th>
</tr>
</thead>
<tbody>
<tr>
<td>Term</td>
</tr>
<tr>
<td>------</td>
</tr>
<tr>
<td>STR</td>
</tr>
<tr>
<td>STL</td>
</tr>
<tr>
<td>STT</td>
</tr>
<tr>
<td>ALR</td>
</tr>
<tr>
<td>ALL</td>
</tr>
<tr>
<td>ALT</td>
</tr>
<tr>
<td>ARR</td>
</tr>
<tr>
<td>ARL</td>
</tr>
<tr>
<td>ART</td>
</tr>
<tr>
<td>FNR</td>
</tr>
<tr>
<td>FNL</td>
</tr>
<tr>
<td>FNT</td>
</tr>
<tr>
<td>BLR</td>
</tr>
<tr>
<td>BLL</td>
</tr>
<tr>
<td>BLT</td>
</tr>
<tr>
<td>BRR</td>
</tr>
<tr>
<td>BRL</td>
</tr>
<tr>
<td>BRT</td>
</tr>
<tr>
<td>CTO</td>
</tr>
<tr>
<td>OTC</td>
</tr>
<tr>
<td>TRI</td>
</tr>
<tr>
<td>TRX</td>
</tr>
<tr>
<td>VST</td>
</tr>
</tbody>
</table>

Table 13 - Firing keywords

* The description TRI in the body of the effect name will also imply three tubes per row as a default. TRX is the same as TRI except when the number of tubes in a row is not divisible by 3: TRI adds the remainder as straight tubes; TRX adds the remainder as angle tubes. For example, TRI of 11 tube rows has the pattern 3\(\times\)5\(\times\)3, whereas TRX has the pattern 4\(\times\)3\(\times\)4. The description VST will imply two tubes per row as a default.