NOTICES

Disclaimers

The findings in this report are not to be construed as an official Department of the Army position unless so designated by other authorized documents.

Citation of manufacturer’s or trade names does not constitute an official endorsement or approval of the use thereof.

Destroy this report when it is no longer needed. Do not return it to the originator.
Blast Parameters From *Explosions in Air* (Coded in C++)

Robert J. Yager
Weapons and Materials Research Directorate, ARL
This report describes a set of arrays, coded in C++, that stores information contained in *Explosions in Air* tables 6-3, 6-4, 6-5, and 6-6. The purpose of the code is to provide model developers with easy access to the tabulated values, which can be used to construct blast pressure histories.
Contents

List of Figures v

List of Tables v

Acknowledgments vi

1. Introduction 1

2. Tabulated Blast Parameters 1

3. C++ Code 2
   3.1 $\bar{R}$ Values: The R Array .................................................................3
   3.2 $\bar{P}_s$ Values: The P_s Array .................................................................3
   3.3 $\bar{u}_s$ Values: The u_s Array .................................................................3
   3.4 $\bar{U}$ Values: The U Array ........................................................................3
   3.5 $\bar{t}_a$ Values: The t_a Array .................................................................3
   3.6 $\bar{\rho}_s$ Values: The rho_s Array ............................................................3
   3.7 $\bar{Q}$ Values: The Q Array ........................................................................4
   3.8 $\bar{T}_s$ Values: The T_s Array ....................................................................4
   3.9 $\bar{P}_r$ Values: The P_r Array ....................................................................4
   3.10 $\bar{\rho}_r$ Values: The rho_r Array ..........................................................4
   3.11 $\bar{T}_r$ Values: The T_r Array ..................................................................4
   3.12 $\bar{I}_s$ Values: The I_s Array .................................................................4
   3.13 $\bar{I}_r$ Values: The I_r Array ..................................................................4
   3.14 $\bar{T}_r$ Values: The t_s Array ..................................................................5
   3.15 $\bar{T}_r$ Values: The t_r Array ..................................................................5
   3.16 $b$ Values: The b Array ........................................................................5
4. Example: Recreating Figure 6-1 From *Explosions in Air*  5
5. Example: Recreating Figure 6-2 From *Explosions in Air*  7
6. Example: Recreating Figure 6-3 From *Explosions in Air*  8
7. Summary  9

Distribution List  11
List of Figures

Figure 1. Recreation of figure 6-1 from Explosions in Air.........................................................6
Figure 2. Recreation of figure 6-2 from Explosions in Air.........................................................7
Figure 3. Recreation of figure 6-3 from Explosions in Air.........................................................9

List of Tables

Table 1. Blast parameters obtained from tables 6-3, 6-4, 6-5, and 6-6 of Explosions in Air...........2
Acknowledgments

The author would like to thank Mr. Richard Pearson of the U.S. Army Research Laboratory’s Weapons and Materials Research Directorate. Mr. Pearson provided technical and editorial recommendations that improved the quality of this report.
1. Introduction

This report describes a set of arrays, coded in C++, that stores information contained in the U.S. Army Materiel Command book *Engineering Design Handbook, Explosions in Air*,\(^1\) tables 6-3, 6-4, 6-5, and 6-6. The purpose of the code is to provide model developers with easy access to the tabulated values, which can be used to construct blast pressure histories.

The symbols used in this report are the same as the symbols used in chapter 6 of *Explosions in Air* and, thus, have the same definitions.

2. Tabulated Blast Parameters

Table 1 presents blast parameters obtained from tables 6-3, 6-4, 6-5, and 6-6 of *Explosions in Air*. Noncolored cells contain values that were taken directly from *Explosions in Air*. Colored cells contain interpolated, extrapolated, or modified values.

Green cells contain interpolated values. Interpolations were performed such that they are linear on a log-log plot.

Orange cells contain values that are not meant to be reliable estimations. The values contained in the orange cells are all set to \(1.0 \times 10^9\). Setting the unknown values to extremely large values was done to assist programmers with the task of testing cell values for validity.

Yellow cells contain extrapolated values that are meant to be reliable estimations. *Explosions in Air* does not list tabulated \(\overline{I}_r\) values for \(0.06 < \overline{R}\). However, *Explosions in Air* figure 6-3 presents graphical data for \(\overline{I}_r\) well below \(\overline{R} = 0.06\). The data point \(\overline{I}_r = 53\) at \(\overline{R} = 0.01423\) was estimated based on figure 6-3. \(\overline{I}_r\) values for \(0.01423 < \overline{R} < 0.06\) were found by interpolating between \(\overline{I}_r\) at \(\overline{R} = 0.01423\) and \(\overline{I}_r\) at \(\overline{R} = 0.06\). Interpolations were performed such that they are linear on a log-log plot.

Blue cells contain modified values.

There appears to be an error in the tabulated values given in table 6-3. For \(\overline{R} = 0.016\), \(\overline{\pi}_s\) is stated to be 31.5. However, 31.5 is inconsistent with neighboring values; 21.5 seems likely to be the correct value.

---

Explosions in Air lists the value for $\bar{R}_a$ at $\bar{R} = 0.01423$ as exactly zero. It is common to work with logarithms of blast parameters, such as when graphing or interpolating. To avoid problems with attempting to find the logarithm of zero, at $\bar{R} = 0.01423$, $\bar{R}_a$ has been set to $1.0 \times 10^{-20}$.

Table 1. Blast parameters obtained from tables 6-3, 6-4, 6-5, and 6-6 of Explosions in Air.

<table>
<thead>
<tr>
<th>$\bar{R}$</th>
<th>$\bar{R}$</th>
<th>$\bar{R}$</th>
<th>$\bar{R}$</th>
<th>$\bar{R}$</th>
<th>$\bar{R}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.0428</td>
<td>0.000328</td>
<td>0.1128</td>
<td>0.0941</td>
<td>0.0448</td>
<td>0.0191</td>
</tr>
<tr>
<td>0.016</td>
<td>0.000076</td>
<td>0.0206</td>
<td>0.0082</td>
<td>0.0041</td>
<td>0.0021</td>
</tr>
<tr>
<td>0.018</td>
<td>0.000166</td>
<td>0.0324</td>
<td>0.0167</td>
<td>0.0084</td>
<td>0.0041</td>
</tr>
<tr>
<td>0.020</td>
<td>0.000258</td>
<td>0.0513</td>
<td>0.0221</td>
<td>0.0124</td>
<td>0.0060</td>
</tr>
<tr>
<td>0.030</td>
<td>0.000805</td>
<td>0.1450</td>
<td>0.0621</td>
<td>0.0313</td>
<td>0.0158</td>
</tr>
<tr>
<td>0.040</td>
<td>0.00148</td>
<td>0.2283</td>
<td>0.1043</td>
<td>0.0515</td>
<td>0.0260</td>
</tr>
<tr>
<td>0.050</td>
<td>0.00227</td>
<td>0.3244</td>
<td>0.1681</td>
<td>0.0722</td>
<td>0.0361</td>
</tr>
<tr>
<td>0.056</td>
<td>0.002759</td>
<td>0.4262</td>
<td>0.2219</td>
<td>0.0934</td>
<td>0.0462</td>
</tr>
<tr>
<td>0.060</td>
<td>0.003125</td>
<td>0.5267</td>
<td>0.2748</td>
<td>0.1147</td>
<td>0.0563</td>
</tr>
<tr>
<td>0.070</td>
<td>0.003486</td>
<td>0.6278</td>
<td>0.3277</td>
<td>0.1359</td>
<td>0.0665</td>
</tr>
<tr>
<td>0.080</td>
<td>0.003845</td>
<td>0.7291</td>
<td>0.3807</td>
<td>0.1571</td>
<td>0.0767</td>
</tr>
<tr>
<td>0.100</td>
<td>0.004204</td>
<td>0.8314</td>
<td>0.4338</td>
<td>0.1783</td>
<td>0.0869</td>
</tr>
<tr>
<td>0.150</td>
<td>0.005868</td>
<td>0.9341</td>
<td>0.5454</td>
<td>0.2096</td>
<td>0.1071</td>
</tr>
<tr>
<td>0.200</td>
<td>0.007536</td>
<td>1.0370</td>
<td>0.6570</td>
<td>0.2409</td>
<td>0.1274</td>
</tr>
<tr>
<td>0.250</td>
<td>0.009205</td>
<td>1.1399</td>
<td>0.7686</td>
<td>0.2822</td>
<td>0.1476</td>
</tr>
<tr>
<td>0.300</td>
<td>0.010875</td>
<td>1.2438</td>
<td>0.8802</td>
<td>0.3236</td>
<td>0.1678</td>
</tr>
<tr>
<td>0.500</td>
<td>0.016493</td>
<td>1.8830</td>
<td>1.4531</td>
<td>0.5570</td>
<td>0.3256</td>
</tr>
<tr>
<td>0.800</td>
<td>0.025837</td>
<td>2.8381</td>
<td>2.2395</td>
<td>0.8903</td>
<td>0.5289</td>
</tr>
<tr>
<td>1.00</td>
<td>0.035180</td>
<td>3.7932</td>
<td>3.1258</td>
<td>1.2237</td>
<td>0.7322</td>
</tr>
<tr>
<td>1.50</td>
<td>0.053267</td>
<td>5.6801</td>
<td>4.9126</td>
<td>1.8354</td>
<td>1.0939</td>
</tr>
<tr>
<td>2.00</td>
<td>0.080115</td>
<td>8.5670</td>
<td>6.7995</td>
<td>2.4471</td>
<td>1.6657</td>
</tr>
<tr>
<td>3.00</td>
<td>0.120172</td>
<td>12.8510</td>
<td>10.0994</td>
<td>3.6715</td>
<td>2.5230</td>
</tr>
<tr>
<td>4.00</td>
<td>0.180254</td>
<td>18.5670</td>
<td>14.7994</td>
<td>5.5123</td>
<td>3.8092</td>
</tr>
<tr>
<td>5.00</td>
<td>0.270384</td>
<td>25.2830</td>
<td>21.4994</td>
<td>7.3531</td>
<td>5.1954</td>
</tr>
<tr>
<td>6.00</td>
<td>0.405512</td>
<td>35.0994</td>
<td>28.1994</td>
<td>9.1939</td>
<td>6.5816</td>
</tr>
<tr>
<td>8.00</td>
<td>0.680800</td>
<td>55.4994</td>
<td>38.5994</td>
<td>12.0347</td>
<td>9.3624</td>
</tr>
<tr>
<td>10.0</td>
<td>1.00000</td>
<td>76.0994</td>
<td>46.9994</td>
<td>15.8754</td>
<td>12.1432</td>
</tr>
<tr>
<td>20.0</td>
<td>5.00000</td>
<td>306.0994</td>
<td>113.9994</td>
<td>31.7508</td>
<td>30.3264</td>
</tr>
<tr>
<td>50.0</td>
<td>25.0000</td>
<td>1530.0994</td>
<td>563.9994</td>
<td>78.6260</td>
<td>75.6528</td>
</tr>
<tr>
<td>100.0</td>
<td>125.000</td>
<td>7650.0994</td>
<td>2813.9994</td>
<td>156.2516</td>
<td>156.2516</td>
</tr>
</tbody>
</table>

3. C++ Code

The following arrays are used to store the values presented in table 1. Each array stores one column.
3.1 $\bar{R}$ Values: The R Array

```cpp
const double R[39]= {//<-----------------------------SCALED RANGES
  0.01423, 0.016, 0.018, 0.02, 0.03, 0.04, 0.05, 0.0538, 0.06, 0.07, 0.08, 0.1, 0.15, 0.2, 0.25, 0.3, 0.4, 0.5,
  0.6, 0.7, 0.8, 1, 1.5, 2, 2.5, 3, 4, 5, 6, 8, 10, 20, 30, 40, 50, 60, 80, 100, 500, 1000
}; //~~~YAGENAUT@GMAIL.COM~~~~~~~~~~~~~~~~~~~~~~~~~LAST~UPDATED~12SEP2013~~~~~~
```

3.2 $\bar{P}_s$ Values: The $P_s$ Array

```cpp
const double P_s[39]= {//<------------------------SCALED PEAK SIDE-ON OVERPRESSURES
  819, 703, 605, 531, 324, 225, 170, 154.29, 133.54, 108.88, 91.24, 67.9, 37.2, 20.4, 11.9, 7.28, 3.46, 2.05, 1.38,
  0.889, 0.616, 0.468, 0.374, 0.261, 0.198, 0.087, 0.0543, 0.0391, 0.0304, 0.0248, 0.0181, 0.0141, 0.00242, 0.00115
}; //~~~YAGENAUT@GMAIL.COM~~~~~~~~~~~~~~~~~~~~~~~~~LAST~UPDATED~12SEP2013~~~~~~
```

3.3 $\bar{u}_s$ Values: The $u_s$ Array

```cpp
const double u_s[39]= {//<------------------------SCALED PEAK PARTICLE SPEEDS
  23.2, 21.5, 19.8, 18.6, 14.4, 12.1, 10.4, 9.8912, 9.1794, 8.2599, 7.5381, 6.47, 4.61, 3.5, 2.69, 1.95, 1.25, 0.888,
  0.672, 0.427, 0.302, 0.165, 0.107, 0.0797, 0.0631, 0.0441, 0.0336, 0.0268, 0.019, 0.0144, 0.00621, 0.0039,
  0.00279, 0.00217, 0.00177, 0.00128, 0.001, 0.000173, 8.2E-5
}; //~~~YAGENAUT@GMAIL.COM~~~~~~~~~~~~~~~~~~~~~~~~~LAST~UPDATED~12SEP2013~~~~~~
```

3.4 $\bar{U}$ Values: The $U$ Array

```cpp
const double U[39]= {//<----------------------------SCALED SHOCK SPEEDS
  25.2, 23.6, 21.9, 20.6, 16.1, 13.5, 11.7, 11.163, 10.408, 9.4284, 8.6543, 7.5, 5.55, 4.27, 3.33, 2.66, 2.167, 1.48,
  1.28, 1.19, 1.11, 1.0733, 1.0481, 1.0374, 1.0257, 1.0198, 1.0159, 1.0111, 1.0085, 1.00372, 1.00232, 1.00167, 1.0013,
  1.00106, 1.000618, 1.000494, 1.0000988, 1.0000494
}; //~~~YAGENAUT@GMAIL.COM~~~~~~~~~~~~~~~~~~~~~~~~~LAST~UPDATED~12SEP2013~~~~~~
```

3.5 $\bar{t}_a$ Values: The $t_a$ Array

```cpp
const double t_a[39]= {//<----------------------------SCALED ARRIVAL TIMES
  1E-20, 7.16E-5, 1.66E-4, 2.58E-4, 8.05E-4, 0.0148, 0.0227, 0.025799, 0.031215,
  0.040863, 0.051599, 0.0762, 0.0154, 0.0255, 0.0382, 0.0541, 0.0990, 0.157, 0.218, 0.34, 0.466,
  0.73, 1.26, 1.71, 2.2, 3.31, 4.21, 5.19, 7.15, 9.1, 18.9, 28.8, 38.9, 48.9, 58.8, 78.5, 98.5, 499, 1000
}; //~~~YAGENAUT@GMAIL.COM~~~~~~~~~~~~~~~~~~~~~~~~~LAST~UPDATED~12SEP2013~~~~~~
```

3.6 $\bar{\rho}_s$ Values: The $\rho_s$ Array

```cpp
const double rho_s[39]= {//<----------------------------SCALED PEAK SIDE-ON DENSITIES
  12.18, 11.9, 11.6, 11.3, 10.1, 9.28, 8.88, 8.6622, 8.3476, 7.9225, 7.5718, 7.02, 5.91, 4.92, 4.2, 3.59, 2.66, 2.09,
  1.81, 1.49, 1.33, 1.17, 1.11, 1.0809, 1.0628, 1.0436, 1.0332, 1.0266, 1.0186, 1.0141, 1.0062, 1.00378, 1.00279,
  1.00217, 1.00177, 1.00103, 1.000824, 1.000073, 1.0000824
}; //~~~YAGENAUT@GMAIL.COM~~~~~~~~~~~~~~~~~~~~~~~~~LAST~UPDATED~12SEP2013~~~~~~
```
3.7 $\bar{Q}$ Values: The Q Array

```cpp
const double Q[39]={{//<----------------------SCALED PEAK DYNAMIC OVERPRESSURES
4570, 3850, 3240, 2760, 1450, 935, 670, 591.18, 490.67, 377.06, 300.14, 205, 87.2, 44.1,
20.8, 9.45, 2.79, 1.08, .57, .212, .094, .0196, .00758, .00423, .00270, .00137, .00082, .000515,
.00025, .000143, 2.76E-5, 1.07E-5, 5.52E-6, 3.31E-6, 2.19E-6, 1.15E-6, 6.95E-7, 2.03E-8, 4.71E-9
};;//~~~YAGENAUT@GMAIL.COM~~~~~~~~~~~~~~~~~~~~~~~~~LAST~UPDATED~12SEP2013~~~~~~
```

3.8 $\bar{\theta}_s$ Values: The T_s Array

```cpp
const double T_s[39]={{//<---------------------SCALED PEAK SIDE-ON TEMPERATURES
4.31, 3.21, 2.48, 1.68, 1.43, 1.3, 1.18, 1.12, 1.07, 1.0436, 1.0306, 1.0247, 1.0172,
1.0134, 1.0107, 1.00745, 1.00565, 1.00248, 1.00112, 1.00087, 1.000709, 1.000413, 1.000033
};;//~~~YAGENAUT@GMAIL.COM~~~~~~~~~~~~~~~~~~~~~~~~~LAST~UPDATED~12SEP2013~~~~~~
```

3.9 $\bar{\rho}_r$ Values: The P_r Array

```cpp
const double P_r[39]={{//<------------------SCALED PEAK REFLECTED OVERPRESSURES
1E9, 1E9, 1E9, 1E9, 1E9, 1E9, 1E9, 1E9, 1E9, 1E9, 1E9, 1E9, 1E9, 1E9, 37.8, 33.2, 24.4,
18.1, 13.5, 10, 6.1, 4.16, 3.14, 2.12, 1.66, 1.32, 1.22, 1.16, 1.12, 1.087, 1.0664, 1.0532,
1.0392, 1.0282, 1.0124, 1.00774, 1.00558, 1.00434, 1.00354, 1.00206, 1.00165, 1.00033, 1.000165
};;//~~~YAGENAUT@GMAIL.COM~~~~~~~~~~~~~~~~~~~~~~~~~LAST~UPDATED~12SEP2013~~~~~~
```

3.10 $\bar{\rho}_r$ Values: The rho_r Array

```cpp
const double rho_r[39]={{//<--------------------SCALED PEAK REFLECTED DENSITIES
1E9, 1E9, 1E9, 1E9, 1E9, 1E9, 1E9, 1E9, 1E9, 1E9, 1E9, 1E9, 1E9, 1E9, 37.8, 33.2, 24.4,
18.1, 13.5, 10, 6.1, 4.16, 3.14, 2.12, 1.66, 1.32, 1.22, 1.16, 1.12, 1.087, 1.0664, 1.0532,
1.0392, 1.0282, 1.0124, 1.00774, 1.00558, 1.00434, 1.00354, 1.00206, 1.00165, 1.00033, 1.000165
};;//~~~YAGENAUT@GMAIL.COM~~~~~~~~~~~~~~~~~~~~~~~~~LAST~UPDATED~12SEP2013~~~~~~
```

3.11 $\bar{\theta}_r$ Values: The T_r Array

```cpp
const double T_r[39]={{//<-------------------SCALED PEAK REFLECTED TEMPERATURES
1E9, 1E9, 1E9, 1E9, 1E9, 1E9, 1E9, 1E9, 1E9, 1E9, 20.7, 16.8, 12.1, 7.46, 5.15, 3.71, 2.42,
1.9, 1.65, 1.39, 1.26, 1.13, 1.088, 1.0612, 1.0594, 1.0344, 1.0268, 1.0214, 1.0149,
1.0113, 1.00496, 1.0031, 1.00224, 1.00174, 1.00142, 1.000825, 1.00066, 1.000132, 1.000066
};;//~~~YAGENAUT@GMAIL.COM~~~~~~~~~~~~~~~~~~~~~~~~~LAST~UPDATED~12SEP2013~~~~~~
```

3.12 $\bar{l}_s$ Values: The I_s Array

```cpp
const double I_s[39]={{//<---------------------SCALED SIDE-ON SPECIFIC IMPULSES
1E9, 1E9, 1E9, 1E9, 1E9, 1E9, 1E9, 1E9, 1E9, 1E9, 1E9, 1E9, 1E9, 1E9, 0.785, 0.788, 0.103,
0.088, 0.0695, 0.057, 0.0482, 0.0371, 0.0302, 0.020674, 0.0158, 0.012752, 0.010704, 0.00812,
0.006268, 0.00546, 0.00410, 0.00325, 0.00158, 0.0010329, 0.000764, 0.0006368, 0.000498,
0.0003694, 0.000293, 5.75E-5, 2.88E-5
};;//~~~YAGENAUT@GMAIL.COM~~~~~~~~~~~~~~~~~~~~~~~~~LAST~UPDATED~12SEP2013~~~~~~
```
3.13 $I_r$ Values: The $I_r$ Array

```c
const double I_r[39] = {
53, 42.0339, 33.3008, 27.0381, 12.1279, 6.86659, 4.41691, 3.82133, 3.08, 2.3506, 1.86, 1.27, .677, .456, .355, .294, .222, .178, .15, .112, .0885, .053722, .029338, .023903, .0173, .013618, .0112, .0084, .00658, .0032, .0020862, .00154, .0012116, .000996, .0007388, .000586, .000115, .0000576
};
```

3.14 $T_s$ Values: The $t_s$ Array

```c
const double t_s[39] = {
1E9, 1E9, 1E9, 1E9, 1E9, 1E9, 1E9, 1E9, 1E9, 1E9, 1E9, 1E9, 1E9, 1E9, 1E9, 1E9, 1E9, 1E9, 1E9, 1E9, 1E9, 1E9, 1E9, 1E9, 1E9, 1E9, 1E9, 1E9, .014, .018, .0206, .0184, .018033, .0175, .0175, .0175, .0191, .0341, .0885, 1E9, 1E9, 1E9, 1E9, 1E9, 1E9, 1E9, 1E9, 1E9, 1E9, 1E9, 1E9, 1E9, 1E9, 1E9, 1E9, 1E9, 1E9, 1E9, 1E9, 1E9, 1E9, 1E9, 1E9, 1E9, 1E9, 1E9, 1E9
};
```

3.15 $T_r$ Values: The $t_r$ Array

```c
const double t_r[39] = {
1E9, 1E9, 1E9, 1E9, 1E9, 1E9, 1E9, 1E9, 1E9, 1E9, 1E9, 1E9, 1E9, 1E9, 1E9, 1E9, 1E9, 1E9, 1E9, 1E9, 1E9, 1E9, 1E9, 1E9, 1E9, 1E9, 1E9, 1E9, 1E9, 1E9, 1E9, 1E9, 1E9, 1E9, 1E9, 1E9, 1E9, 1E9, 1E9, 1E9, 1E9, 1E9, 1E9, 1E9, 1E9, 1E9, 1E9, 1E9, 1E9, 1E9, 1E9
};
```

3.16 $b$ Values: The $b$ Array

```c
const double b[39] = {
1E9, 1E9, 1E9, 1E9, 1E9, 1E9, 1E9, 1E9, 1E9, 1E9, 1E9, 1E9, 1E9, 1E9, 1E9, 1E9, 1E9, 1E9, 1E9, 1E9, 1E9, 1E9, 1E9, 1E9, 1E9, 1E9, 1E9, 1E9, 1E9, 1E9, 1E9, 1E9, 1E9, 1E9, 1E9, 1E9, 1E9, 1E9, 1E9, 1E9, 1E9, 1E9, 1E9, 1E9, 1E9, 1E9, 1E9, 1E9, 1E9, 1E9, 1E9
};
```

4. Example: Recreating Figure 6-1 From Explosions in Air

The following example uses the $R$, $P_s$, $u_s$, $U$, $t_a$, $\rho_s$, $Q$, and $T_s$ arrays to create a text file that contains the information necessary to recreate figure 6-1 from Explosions in Air. Figure 1 presents a graph of the contents of the example’s output file.

Note that there is an error on the original graph: the far-right label for the $\bar{\theta}_s$ line is given as $10\bar{\theta}_s$. 

5
```c
#include <cstdio>
#include "y_blast_eia.h"

int main()
{
    FILE *f=fopen("figure_6_1.csv","w",stdout);
    printf("R_bar,P_bar_s,10^4*P_bar_s,10*u_bar_s,10^5*u_bar_s,10^2*U_bar,
    "10*t_bar_a,10^5*t_bar_a,10*rho_bar_s,Q_bar,10^4*Q_bar,10^8*Q_bar,"
    "10^12*Q_bar,theta_bar_s\n");
    for(int i=0;i<39;++i)
    {
        printf("%e,",yBlastEia::R[i]);
        printf("%e,",yBlastEia::P_s[i]);
        printf("%e,",yBlastEia::P_s[i]*1E4);
        printf("%e,",yBlastEia::u_s[i]*10);
        printf("%e,",yBlastEia::u_s[i]*1E5);
        printf("%e,",yBlastEia::U[i]*1E2);
        printf("%e,",yBlastEia::t_a[i]*10);
        printf("%e,",yBlastEia::t_a[i]*1E5);
        printf("%e,",yBlastEia::rho_s[i]*10);
        printf("%e,",yBlastEia::Q[i]);
        printf("%e,",yBlastEia::Q[i]*1E4);
        printf("%e,",yBlastEia::Q[i]*1E8);
        printf("%e,",yBlastEia::Q[i]*1E12);
        printf("%e\n",yBlastEia::T_s[i]);
    }
    fclose(f);
}
```

Figure 1. Recreation of figure 6-1 from Explosions in Air.
5. Example: Recreating Figure 6-2 From *Explosions in Air*

The following example uses the \( R \), \( P_r \), \( \rho_r \), and \( T_r \) arrays to create a text file that contains the information necessary to recreate figure 6-2 from *Explosions in Air*. Figure 2 presents a graph of the contents of the example’s output file.

```c
#include <cstdio>
#include "y_blast_eia.h"

int main()
{
    FILE *f=fopen("figure_6_2.csv","w",stdout);
    printf("#R_bar,P_bar_r,10^4*P_bar_r,rho_bar_r,10*theta_bar_r\n");
    for(int i=0;i<39;++i)
        printf("%e,%e,%e,%e,%e\n",yBlastEia::R[i],yBlastEia::P_r[i],yBlastEia::P_r[i]*1E4,yBlastEia::rho_r[i],yBlastEia::T_r[i]*10);
    fclose(f);
}
```

Figure 2. Recreation of figure 6-2 from *Explosions in Air*.
6. Example: Recreating Figure 6-3 From Explosions in Air

The following example uses the R, I_s, I_r, t_s, t_r, and b arrays to create a text file that contains the information necessary to recreate figure 6-2 from Explosions in Air. Figure 3 presents a graph of the contents of the example's output file.

Note that there is an error on the original graph: the line that is labeled $b \times 10^3$ should actually be labeled $b \times 10^{-3}$.

```c
#include <cstdio>
#include "y_blast_eia.h"

int main(){
    FILE *f=fopen("figure_6_3.csv","w",stdout);
    printf("#R_bar,I_bar_s,I_bar_s*10^4,I_bar_r*10^-5,I_bar_r*10^-1,I_bar_r*10^3,"
            "T_bar_s*10^-2,T_bar_r*10^-2,b*10^-3\n");
    for(int i=0;i<39;++i){
        printf("%e,",yBlastEia::R[i]);
        printf("%e,",yBlastEia::I_s[i]);
        printf("%e,",yBlastEia::I_s[i]*1E4);
        printf("%e,",yBlastEia::I_r[i]*1E-5);
        printf("%e,",yBlastEia::I_r[i]*1E-1);
        printf("%e,",yBlastEia::I_r[i]*1E3);
        printf("%e,",yBlastEia::t_s[i]*1E-2);
        printf("%e,",yBlastEia::t_r[i]*1E-2);
        printf("%e\n",yBlastEia::b[i]*1E-3);
    }
    fclose(f);
}
```
7. Summary

A summary sheet is provided at the end of this report. It presents the yBlastEia namespace, which contains the 16 arrays that are described in this report.
<table>
<thead>
<tr>
<th>NO. OF COPIES</th>
<th>ORGANIZATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 (PDF)</td>
<td>DEFENSE TECHNICAL INFORMATION CTR DTIC OCA</td>
</tr>
<tr>
<td>1 (PDF)</td>
<td>DIRECTOR US ARMY RESEARCH LAB IMAL HRA</td>
</tr>
<tr>
<td>1 (PDF)</td>
<td>DIRECTOR US ARMY RESEARCH LAB RDRL CIO LL</td>
</tr>
<tr>
<td>1 (PDF)</td>
<td>GOVT PRINTG OFC A MALHOTRA</td>
</tr>
<tr>
<td>1 (PDF)</td>
<td>RDRL WML A R YAGER</td>
</tr>
</tbody>
</table>
INTENTIONALLY LEFT BLANK.