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Cylinder Test to Utah

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CylindertesttoUtah

ClarkSouers1/24/04

QM-100isanAmmoniumNitrateEmulsion

Explosive Name	Cylinder Shot No.	Primary Comp- onent	Expl. Density (g/cc)	Material	Approx Cylinder Diam inches	Detvel #2 (mm/μs)	Inner Diameter (mm)	Wall hicknes (mm)	Shot Date
QM-100	K260-581	AN	1.261	Cu	2.00	5.987	50.832	5.188	920806

Thefilesyouaregettinghavetime(μs)inthefirstcolumn andoutercopperwallvelocity(mm/μs)inthesecond. Thesenumbersareunscaled,whichmeanstheas-is2-inchdiametercylinder. JWL++with10zones/cmwereused.TheJWLusedwas

ρ _o (g/cc)	1.261	UnreactedMurnahancoefficients(cm-Mbarunits)	
A(Mbar)	4.870215		
B(Mbar)	0.02548871		
R ₁ (dimlss)	5.00		
R ₂ (dimlss)	1.00		
ω(dimless)	0.30	n	7
E _o (Mbar)	0.0367	kappa	102
Γ _{cj} +1(dmls)	4.415547	ReactionRateConstant	
U _s (cm/μs)	0.6500		
C(Mbar)	0.00506568	b1	1
P _{cj} (Mbar)	0.12066	G1	9.1 (μs.Mbar) ⁻¹
v _{cj} (dimlss)	0.774	Detvelof0.65cm/usistheinfinitradiusvalue	

Thecopperhasadensityof8.93g/cc.AUs-upEOSwasusedof

Co	0.394	cm/μs
S1	1.489	dimless
innerradius(cm)	2.5416	
outerradius(cm)	3.0604	
lengthused(cm)	45	
Positionschecked(cm)	30	35 1swerbothplaces
Usedthemassvelocityperpendiculartotheinitialcopperwall,eventhoughthisisnotquiteright. Closeenough		
Runtime	100μs	

code model output -velocity QM-100, unscaled problem, 2 inch size

-4.780330e-01	1.710148e-02
-4.406530e-01	2.213285e-02
-4.033000e-01	2.847146e-02
-3.659613e-01	3.634069e-02
-3.286713e-01	4.627021e-02
-2.913124e-01	5.877342e-02
-2.539163e-01	7.423939e-02
-2.165491e-01	9.261877e-02
-1.792150e-01	1.139332e-01
-1.419844e-01	1.392833e-01
-1.045857e-01	1.681503e-01
-6.719540e-02	2.000137e-01
-2.980753e-02	2.340534e-01
7.528255e-03	2.695267e-01
4.462866e-02	3.061078e-01
8.198791e-02	3.433213e-01
1.193990e-01	3.802647e-01
1.567212e-01	4.156780e-01
1.940354e-01	4.487723e-01
2.314026e-01	4.790038e-01
2.687606e-01	5.059275e-01
3.061186e-01	5.287996e-01
3.434529e-01	5.471745e-01
3.805629e-01	5.609051e-01
4.179304e-01	5.703572e-01
4.553012e-01	5.756604e-01
4.925880e-01	5.776877e-01
5.299037e-01	5.768957e-01
5.672865e-01	5.739023e-01
6.046631e-01	5.695066e-01
6.420511e-01	5.646755e-01
6.793709e-01	5.602983e-01
7.166268e-01	5.567894e-01
7.540079e-01	5.544337e-01
7.914125e-01	5.536113e-01
8.287694e-01	5.539560e-01
8.661019e-01	5.552590e-01
9.032602e-01	5.571817e-01
9.406180e-01	5.594286e-01
9.780269e-01	5.616734e-01
1.015318e+00	5.636593e-01
1.052656e+00	5.652351e-01
1.090009e+00	5.663158e-01
1.127367e+00	5.668832e-01
1.164792e+00	5.669751e-01
1.202124e+00	5.666742e-01
1.239172e+00	5.660945e-01
1.276539e+00	5.653413e-01
1.313910e+00	5.645296e-01
1.351207e+00	5.637584e-01
1.388506e+00	5.631037e-01
1.425864e+00	5.626175e-01
1.463255e+00	5.623248e-01

1.500618e+00	5.622222e-01
1.537966e+00	5.622832e-01
1.575134e+00	5.624656e-01
1.612494e+00	5.627278e-01
1.649922e+00	5.630255e-01
1.687269e+00	5.633181e-01
1.724619e+00	5.635746e-01
1.761890e+00	5.637715e-01
1.799238e+00	5.638999e-01
1.836682e+00	5.639609e-01
1.874011e+00	5.639641e-01
1.911342e+00	5.639213e-01
1.948720e+00	5.638485e-01
1.986093e+00	5.637637e-01
2.023531e+00	5.636837e-01
2.060882e+00	5.636218e-01
2.097997e+00	5.635834e-01
2.135390e+00	5.635777e-01
2.172781e+00	5.636037e-01
2.210076e+00	5.636571e-01
2.247432e+00	5.637307e-01
2.284785e+00	5.638152e-01
2.322202e+00	5.639076e-01
2.359614e+00	5.639995e-01
2.396952e+00	5.640836e-01
2.434108e+00	5.641541e-01
2.471456e+00	5.642080e-01
2.508884e+00	5.642427e-01
2.546239e+00	5.642602e-01
2.583591e+00	5.642726e-01
2.620863e+00	5.642919e-01
2.658228e+00	5.643286e-01
2.695654e+00	5.643915e-01
2.732955e+00	5.644812e-01
2.770301e+00	5.645940e-01
2.807670e+00	5.647321e-01
2.845069e+00	5.650997e-01
2.882417e+00	5.657290e-01
2.919765e+00	5.666108e-01
2.956847e+00	5.679150e-01
2.994251e+00	5.690059e-01
3.031649e+00	5.700099e-01
3.068958e+00	5.710562e-01
3.106307e+00	5.720163e-01
3.143651e+00	5.686491e-01
3.181042e+00	5.672134e-01
3.218436e+00	5.669438e-01
3.255780e+00	5.682625e-01
3.292903e+00	5.702345e-01
3.330246e+00	5.745744e-01
3.367646e+00	5.780976e-01
3.404994e+00	5.810178e-01
3.442333e+00	5.835313e-01
3.479696e+00	5.857806e-01

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3.554442e+00	5.898404e-01
3.591775e+00	5.918316e-01
3.629079e+00	5.938591e-01
3.666448e+00	5.960104e-01
3.703809e+00	5.982913e-01
3.741231e+00	6.007300e-01
3.778562e+00	6.033573e-01
3.815613e+00	6.062150e-01
3.852983e+00	6.092483e-01
3.890358e+00	6.124600e-01
3.927671e+00	6.158581e-01
3.964984e+00	6.193921e-01
4.002324e+00	6.230332e-01
4.039670e+00	6.266866e-01
4.077046e+00	6.302778e-01
4.114373e+00	6.337726e-01
4.151436e+00	6.371407e-01
4.188806e+00	6.403987e-01
4.226146e+00	6.434922e-01
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4.300762e+00	6.492737e-01
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4.450150e+00	6.595206e-01
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4.524756e+00	6.641667e-01
4.562125e+00	6.664125e-01
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1.090658e+01	8.686586e-01
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1.210065e+01	8.896919e-01
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1.239903e+01	8.938377e-01
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1.247379e+01	8.949909e-01
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1.262303e+01	8.974096e-01
1.266036e+01	8.980313e-01
1.269769e+01	8.986567e-01
1.273489e+01	8.992818e-01
1.277222e+01	8.999098e-01
1.280965e+01	9.005382e-01
1.284695e+01	9.011623e-01
1.288426e+01	9.017829e-01
1.292159e+01	9.023993e-01
1.295895e+01	9.030104e-01
1.299636e+01	9.036161e-01
1.303368e+01	9.042133e-01
1.307076e+01	9.047997e-01
1.310812e+01	9.053828e-01
1.314550e+01	9.059585e-01
1.318280e+01	9.065254e-01
1.322012e+01	9.070850e-01
1.325745e+01	9.076373e-01
1.329486e+01	9.081838e-01
1.333226e+01	9.087231e-01
1.336957e+01	9.092550e-01
1.340674e+01	9.097789e-01
1.344407e+01	9.102997e-01
1.348149e+01	9.108167e-01
1.351884e+01	9.113284e-01
1.355617e+01	9.118358e-01

1.359348e+01	9.123395e-01
1.363083e+01	9.128408e-01
1.366823e+01	9.133405e-01
1.370551e+01	9.138366e-01
1.374284e+01	9.143320e-01
1.378020e+01	9.148267e-01
1.381758e+01	9.153211e-01
1.385491e+01	9.158144e-01
1.389223e+01	9.163080e-01
1.392935e+01	9.167989e-01
1.396675e+01	9.172942e-01
1.400412e+01	9.177897e-01
1.404142e+01	9.182852e-01
1.407876e+01	9.187819e-01
1.411610e+01	9.192796e-01
1.415350e+01	9.197786e-01
1.419085e+01	9.202777e-01
1.422817e+01	9.207768e-01
1.426531e+01	9.212739e-01
1.430263e+01	9.217733e-01
1.434001e+01	9.222733e-01
1.437734e+01	9.227722e-01
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1.448936e+01	9.242628e-01
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1.456404e+01	9.252485e-01
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3.416839e+01	1.057679e+00
3.423654e+01	1.057883e+00
3.430463e+01	1.058085e+00
3.437268e+01	1.058288e+00
3.444068e+01	1.058489e+00
3.450864e+01	1.058690e+00
3.457654e+01	1.058890e+00
3.464436e+01	1.059089e+00
3.471204e+01	1.059287e+00
3.477967e+01	1.059484e+00
3.484722e+01	1.059681e+00
3.491586e+01	1.059880e+00
3.498533e+01	1.060081e+00
3.505571e+01	1.060283e+00
3.512640e+01	1.060486e+00

3.519709e+01	1.060688e+00
3.526782e+01	1.060889e+00
3.533855e+01	1.061090e+00
3.540930e+01	1.061290e+00
3.548005e+01	1.061490e+00
3.555081e+01	1.061689e+00
3.562158e+01	1.061888e+00
3.569235e+01	1.062086e+00
3.576313e+01	1.062284e+00
3.583392e+01	1.062482e+00
3.590472e+01	1.062679e+00
3.597553e+01	1.062876e+00
3.604636e+01	1.063072e+00
3.611719e+01	1.063267e+00
3.618804e+01	1.063462e+00
3.625890e+01	1.063657e+00
3.632977e+01	1.063851e+00
3.640064e+01	1.064045e+00
3.647152e+01	1.064238e+00
3.654240e+01	1.064430e+00
3.661328e+01	1.064622e+00
3.668415e+01	1.064814e+00
3.675502e+01	1.065005e+00
3.682589e+01	1.065195e+00
3.689674e+01	1.065385e+00
3.696759e+01	1.065574e+00
3.703842e+01	1.065763e+00
3.710924e+01	1.065951e+00
3.718005e+01	1.066139e+00
3.725084e+01	1.066326e+00
3.732162e+01	1.066513e+00
3.739239e+01	1.066699e+00
3.746314e+01	1.066884e+00
3.753388e+01	1.067070e+00
3.760459e+01	1.067254e+00
3.767530e+01	1.067438e+00
3.774727e+01	1.067625e+00
3.782018e+01	1.067814e+00
3.789391e+01	1.068004e+00
3.796845e+01	1.068196e+00
3.804321e+01	1.068387e+00
3.811812e+01	1.068578e+00
3.819312e+01	1.068769e+00
3.826819e+01	1.068960e+00
3.834332e+01	1.069150e+00
3.841853e+01	1.069339e+00
3.849379e+01	1.069529e+00
3.856913e+01	1.069718e+00
3.864451e+01	1.069907e+00
3.871996e+01	1.070095e+00
3.879545e+01	1.070283e+00
3.887101e+01	1.070471e+00
3.894660e+01	1.070659e+00
3.902227e+01	1.070846e+00

3.909796e+01	1.071033e+00
3.917373e+01	1.071220e+00
3.924952e+01	1.071407e+00
3.932538e+01	1.071593e+00
3.940128e+01	1.071779e+00
3.947724e+01	1.071965e+00
3.955323e+01	1.072151e+00
3.962929e+01	1.072337e+00
3.970538e+01	1.072523e+00
3.978154e+01	1.072709e+00
3.985773e+01	1.072901e+00
3.993399e+01	1.073110e+00
4.001028e+01	1.073329e+00
4.008664e+01	1.073542e+00
4.016303e+01	1.073767e+00
4.023949e+01	1.074010e+00
4.031598e+01	1.074278e+00
4.039254e+01	1.074571e+00
4.046914e+01	1.074877e+00
4.054580e+01	1.075185e+00
4.062250e+01	1.075503e+00
4.069926e+01	1.075865e+00
4.077746e+01	1.076268e+00
4.085587e+01	1.076679e+00
4.093434e+01	1.077075e+00
4.101287e+01	1.077437e+00
4.109149e+01	1.077757e+00
4.117015e+01	1.078037e+00
4.124890e+01	1.078288e+00
4.132769e+01	1.078521e+00
4.140658e+01	1.078744e+00
4.148552e+01	1.078967e+00
4.156456e+01	1.079196e+00
4.164364e+01	1.079433e+00
4.172282e+01	1.079679e+00
4.180206e+01	1.079929e+00
4.188139e+01	1.080178e+00
4.196077e+01	1.080420e+00
4.204024e+01	1.080650e+00

Measured Shot 581 2-inch QM-100, raw data (not scaled)

5.512070e-01	4.895621e-01
6.942060e-01	4.606993e-01
9.741300e-01	4.333340e-01
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1.533978e+00	4.108537e-01
1.714774e+00	4.102415e-01
1.755608e+00	4.102415e-01
1.854736e+00	3.917561e-01
2.005662e+00	4.927777e-01
2.145620e+00	6.787307e-01
2.296550e+00	6.738745e-01
2.436520e+00	6.295751e-01
2.587450e+00	6.103879e-01
2.727410e+00	6.192737e-01

2.878340e+00	6.385183e-01
3.018300e+00	5.499367e-01
3.169230e+00	4.633166e-01
3.309190e+00	5.563175e-01
3.460120e+00	6.429407e-01
3.600080e+00	6.473649e-01
3.751010e+00	6.665726e-01
4.019550e+00	6.901809e-01
4.321410e+00	7.096932e-01
4.612720e+00	7.322696e-01
4.893060e+00	6.890969e-01
5.172980e+00	7.308017e-01
5.345430e+00	7.445060e-01
5.485400e+00	7.135374e-01
5.636330e+00	7.135328e-01
5.776290e+00	7.622112e-01
5.927220e+00	8.055678e-01
6.067180e+00	8.187982e-01
6.218110e+00	7.899526e-01
6.358070e+00	7.323991e-01
6.509000e+00	7.660424e-01
6.648960e+00	8.324686e-01
6.799890e+00	8.084049e-01
6.939860e+00	7.995631e-01
7.090790e+00	8.284057e-01
7.230750e+00	8.328294e-01
7.381680e+00	7.943804e-01
7.521640e+00	7.811075e-01
7.672570e+00	7.377942e-01
7.943730e+00	8.905652e-01
8.243390e+00	8.988973e-01
8.394320e+00	8.804545e-01
8.534280e+00	8.540287e-01
8.812000e+00	7.762575e-01
9.091920e+00	9.200414e-01
9.266990e+00	7.491313e-01
9.406950e+00	7.801431e-01
9.557880e+00	9.051866e-01
9.697850e+00	8.653211e-01
9.848780e+00	9.086957e-01
9.988740e+00	9.175712e-01
1.013967e+01	9.031025e-01
1.027963e+01	9.075052e-01
1.043056e+01	8.738668e-01
1.057052e+01	8.251558e-01
1.072145e+01	9.068927e-01
1.086141e+01	9.998600e-01
1.101234e+01	8.652101e-01
1.115230e+01	8.386527e-01
1.130323e+01	8.915542e-01
1.144320e+01	8.782407e-01
1.159413e+01	9.263818e-01
1.186791e+01	9.446896e-01
1.216494e+01	8.767283e-01

1.245100e+01	8.885253e-01
1.273093e+01	9.660213e-01
1.301086e+01	9.872035e-01
1.318854e+01	8.084305e-01
1.332850e+01	9.057903e-01
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1.361939e+01	8.757313e-01
1.377032e+01	9.190748e-01
1.391028e+01	1.003176e+00
1.406121e+01	9.791024e-01
1.420118e+01	9.171618e-01
1.435211e+01	8.690648e-01
1.449207e+01	9.354292e-01
1.464300e+01	9.690687e-01
1.478296e+01	9.292616e-01
1.493389e+01	9.004250e-01
1.507385e+01	8.738402e-01
1.522478e+01	9.652402e-01
1.536474e+01	1.040534e+00
1.551567e+01	9.779150e-01
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1.740099e+01	9.984993e-01
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2.000809e+01	1.034731e+00
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2.056880e+01	9.789429e-01
2.074080e+01	8.955937e-01
2.088070e+01	9.135774e-01
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2.248620e+01	9.436810e-01
2.262610e+01	1.063539e+00
2.277700e+01	1.120937e+00
2.291700e+01	1.005833e+00
2.306790e+01	9.484294e-01
2.333850e+01	9.905500e-01
2.363870e+01	1.061360e+00
2.392790e+01	9.935668e-01
2.420780e+01	1.025143e+00
2.448770e+01	1.035168e+00
2.466230e+01	1.082997e+00
2.480230e+01	1.052232e+00
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2.524410e+01	1.061770e+00
2.538400e+01	1.041367e+00
2.553560e+01	1.084604e+00
2.567560e+01	1.062674e+00
2.582590e+01	1.033248e+00
2.596590e+01	1.035935e+00
2.611680e+01	1.022371e+00
2.625670e+01	1.044356e+00
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3.017830e+01	1.044050e+00
3.032920e+01	1.015631e+00
3.046910e+01	9.666667e-01
3.062010e+01	9.998247e-01
3.076010e+01	1.031274e+00
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3.264530e+01	1.077822e+00
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3.308720e+01	9.977346e-01
3.322720e+01	1.041816e+00
3.337810e+01	1.152957e+00
3.351800e+01	1.152530e+00