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# Cartridge Database (CS355 Project)

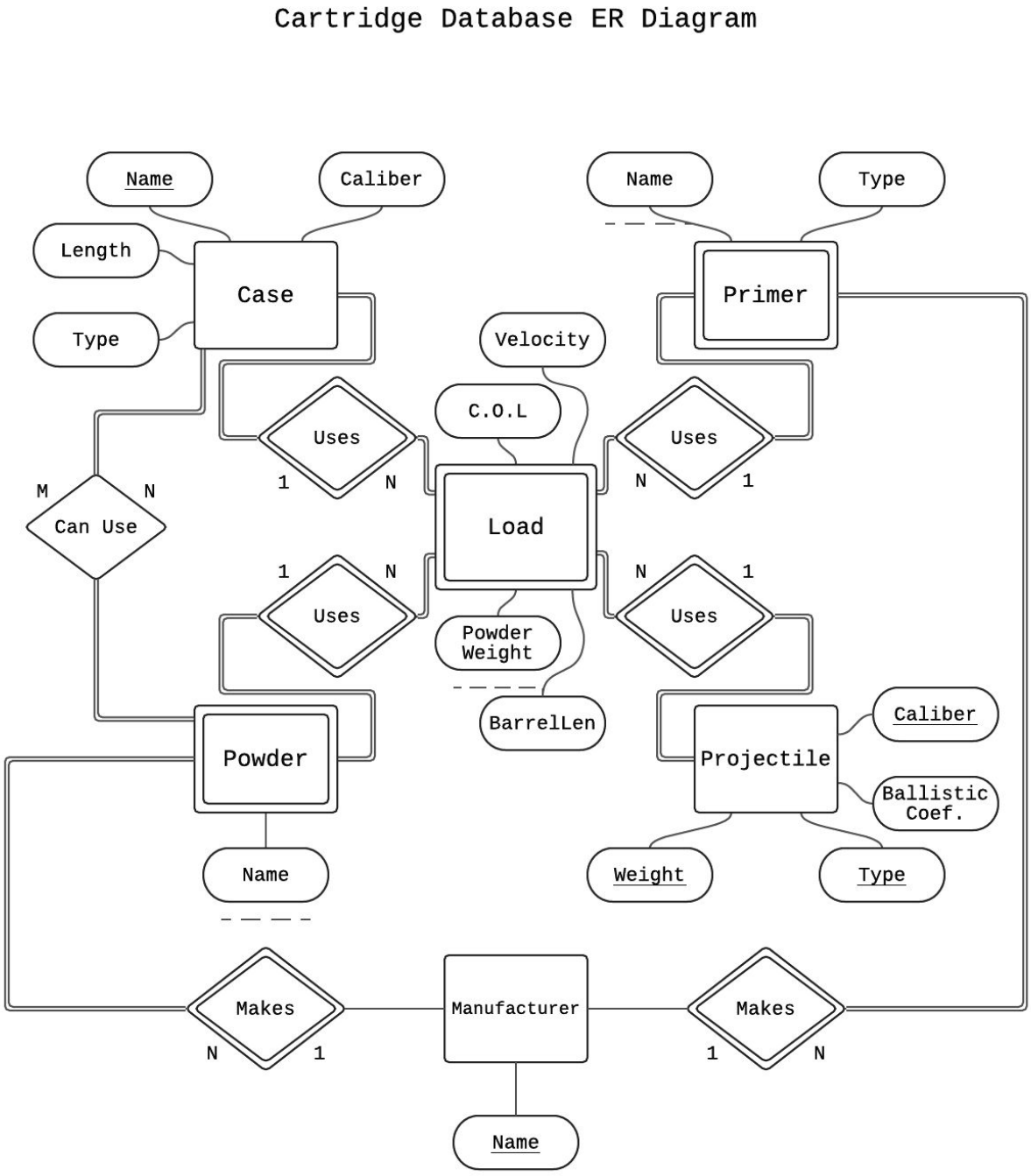
## 1. Overview:

The goal of this database is to easily access component separated load information for handloading metallic cartridges, specifically for pistol calibres. The target user is an individual who has some knowledge of handloading and a setup to handle several different cartridges. Using the database, the user can determine potential other cartridges that use similar equipment, other powders available, and determine other potentially useful metrics.

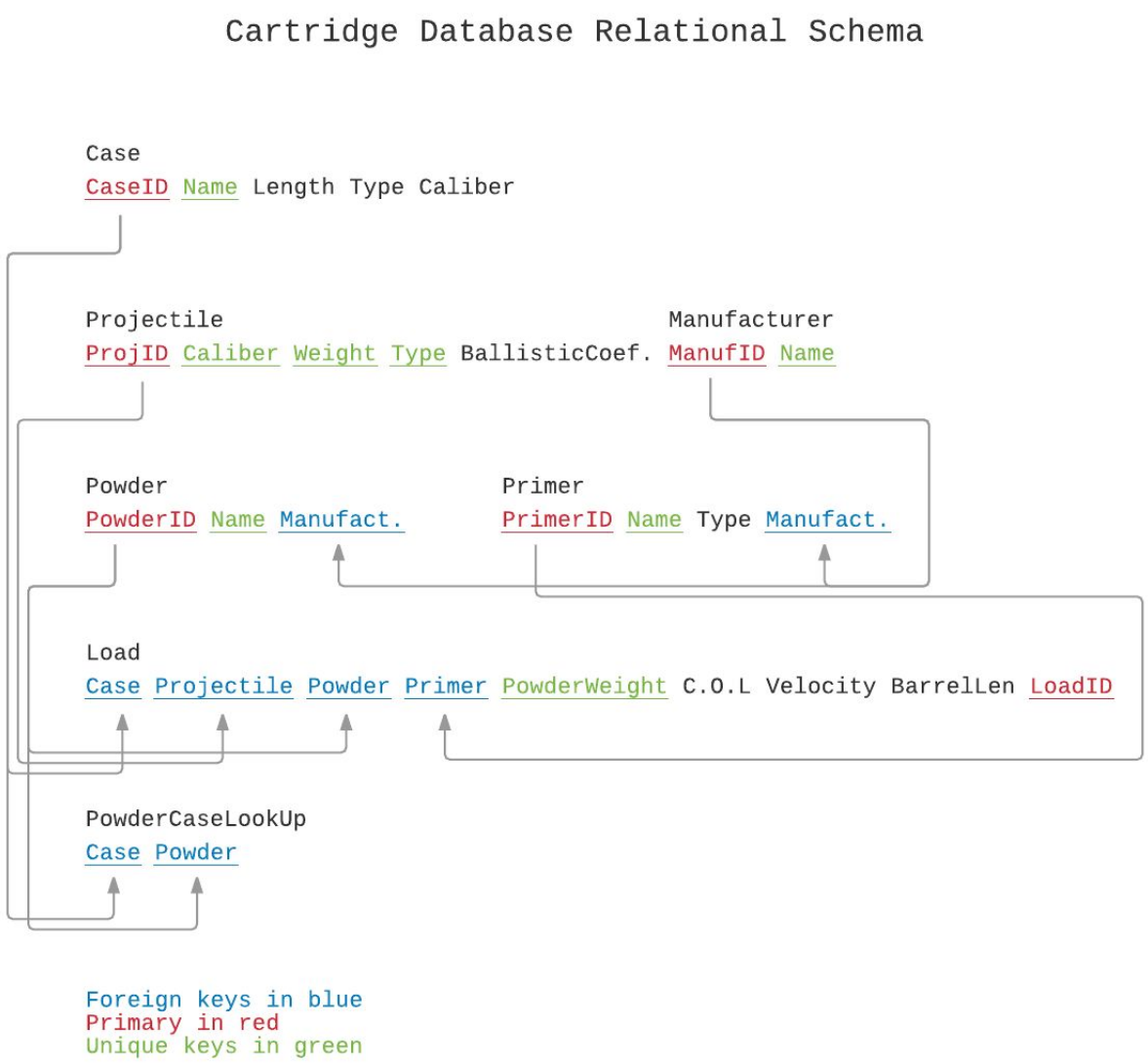
The major components are: brass cases, primers, smokeless powders, and projectiles. Each entity has several variables, such as the case dimensions, primer size, projectile style and weight. For each specific cartridge and then for each of the multiple weights of projectile available, different loads (powder weight in grains) are stored from various sources (text and web). Derived variables such as ballistic energy in foot pounds can also be returned for each load.

Each load must have a case, a projectile, a powder, and a primer. Cases are linked with powders in a look-up table for cross referencing.

2. Entity Relationship Diagram



3. Relational Schema



4. Description of tables

Table Name: cdb_case
Purpose: Describes a brass case for use in a metallic cartridge.
Attributes: The popularly used name for the cartridge, the overall length of an empty case, the type of case (i.e. rimmed, rimless, belted, etc.), The neck diameter in inches (caliber).
Keys: Primary key is auto incrementing ID. Name is unique.
Example Data:

| case_id | name | length | type | caliber |
|---|---|---|---|---|
| 1 | 357 Magnum | 1.29 | Rimmed | 0.357 |
| 2 | 44 Remington Magnum | 1.285 | Rimmed | 0.43 |
| 3 | 45 Automatic | 0.898 | Rimless | 0.451 |
| 4 | 45 Colt (Revolver) | 1.285 | Rimmed | 0.452 |
| 5 | 45 Colt (Ruger & T/C) | 1.285 | Rimmed | 0.452 |
| 6 | 38 Special | 1.155 | Rimmed | 0.357 |
| 7 | 9mm Luger | 0.754 | Rimless | 0.355 |

Table Name: cdb_projectile
Purpose: Describes a lead projectile for use in a metallic cartridge.
Attributes: The diameter in inches (caliber), the weight in grains, the type (i.e. Lead round nose, flat point, hollow point, full metal jacket, etc.), the ballistics coefficient (aerodynamic efficiency).
Keys: Primary key is auto incrementing ID. Caliber, weight, and type are unique when combined.
Example Data:

| proj_id | caliber | weight | type | blstc_coef |
|---|---|---|---|---|
| 1 | 0.358 | 158 | LRN | 0.159 |
| 2 | 0.358 | 158 | SWC HP | 0.139 |
| 3 | 0.358 | 158 | SWC | 0.135 |
| 4 | 0.357 | 158 | FP | 0.199 |
| 5 | 0.357 | 158 | HP | 0.206 |
| 6 | 0.357 | 180 | HP | 0.23 |
| 7 | 0.357 | 125 | FP | 0.148 |
| 8 | 0.357 | 125 | HP | 0.151 |
| 9 | 0.452 | 230 | LRN | 0.207 |
| 10 | 0.451 | 230 | FMJ-FP | 0.168 |
| 11 | 0.451 | 230 | FMJ-RN | 0.184 |
| 12 | 0.451 | 230 | FMJ-HP | 0.188 |
| 13 | 0.452 | 250 | HP | 0.146 |
| 14 | 0.452 | 300 | HP | 0.18 |

Table Name: cdb_manufacturer
Purpose: Describes a company which manufactures smokeless powder or primers.
Attributes: The company name.
Keys: Primary key is auto incrementing ID. Name is unique.
Example Data:

| manuf_id | name |
|---|---|
| 1 | Winchester |
| 2 | Alliant |
| 3 | Hodgdon |
| 4 | IMR |
| 5 | Accurate |
| 6 | CCI |
| 7 | Remington |
| 8 | Federal |

Table Name: cdb_powder
Purpose: Describes a smokeless powder for use in a metallic cartridge.
Attributes: The product name, the manufacturer ID
Keys: Primary key is auto incrementing ID. Manufacturer ID is foreign from cdb_manufacturer. Manufacturer ID and name are unique when combined.
Example Data (shown here with joined manufacturer names):

| powder_id | name | manuf_id | name |
|---|---|---|---|
| 1 | Unique | 2 | Alliant |
| 2 | 2400 | 2 | Alliant |
| 3 | H110 | 3 | Hodgdon |
| 4 | Win 296 | 1 | Winchester |
| 5 | 4227 | 4 | IMR |
| 6 | Power Pro 300-MP | 5 | Accurate |
| 7 | Universal | 3 | Hodgdon |
| 8 | Power Pistol | 2 | Alliant |

Table Name: cdb_primer
Purpose: Describes a boxer type primer for use in a metallic cartridge.
Attributes: The product name, the category (i.e. small/large standard/magnum pistol/rifle) the manufacturer ID.
Keys: Primary key is auto incrementing ID. Manufacturer ID is foreign from cdb_manufacturer. Manufacturer ID and name are unique when combined.
Example Data (shown here with joined manufacturer names):

| primer_id | name | manuf_id | name |
|---|---|---|---|
| 1 | WSPM | 1 | Winchester |
| 2 | WSP | 1 | Winchester |
| 3 | WLP | 1 | Winchester |
| 4 | 205 | 8 | Federal |
| 5 | WLR | 1 | Winchester |

Table Name: cdb_load

Purpose: Describes a completed metallic cartridge load with tested components and powder weight.

Attributes: The IDs of the used case, projectile, powder, and primer. The test weight of smokeless powder in grains. The overall chamber length (in inches). The tested velocity (in feet per second) with the tested barrel length (inches).

Keys: Primary key is auto incrementing ID. Case ID, projectile ID, powder ID, and primer ID are foreign from cdb_case, cdb_projectile, cdb_powder, and cdb_primer respectively. Case ID, projectile ID, powder ID, primer ID, and powder weight are unique when combined

Example Data (shown here with joined case name, projectile info, powder name, and primer name):

| load_id | name | weight | type | name | name | powder_weight | col | velocity | barrel_length |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 357 Magnum | 158 | FP | Win 296 | WSPM | 12.4 | 1.59 | 1000 | 8 |
| 2 | 357 Magnum | 158 | FP | Win 296 | WSPM | 13.1 | 1.59 | 1050 | 8 |
| 3 | 357 Magnum | 158 | FP | Win 296 | WSPM | 13.8 | 1.59 | 1100 | 8 |
| 4 | 357 Magnum | 158 | FP | Win 296 | WSPM | 14.5 | 1.59 | 1150 | 8 |
| 5 | 357 Magnum | 158 | FP | Win 296 | WSPM | 15.2 | 1.59 | 1200 | 8 |
| 6 | 357 Magnum | 158 | FP | Win 296 | WSPM | 16 | 1.59 | 1250 | 8 |
| 7 | 357 Magnum | 158 | FP | 4227 | WSPM | 12.4 | 1.59 | 1000 | 8 |
| 8 | 357 Magnum | 158 | FP | 4227 | WSPM | 13.1 | 1.59 | 1050 | 8 |
| 9 | 357 Magnum | 158 | FP | 4227 | WSPM | 13.8 | 1.59 | 1100 | 8 |
| 10 | 357 Magnum | 158 | FP | 4227 | WSPM | 14.5 | 1.59 | 1150 | 8 |
| 11 | 357 Magnum | 158 | FP | 2400 | WSPM | 10.5 | 1.59 | 1000 | 8 |
| 12 | 357 Magnum | 158 | FP | 2400 | WSPM | 11.4 | 1.59 | 1050 | 8 |
| 13 | 357 Magnum | 158 | FP | 2400 | WSPM | 12.4 | 1.59 | 1100 | 8 |
| 14 | 357 Magnum | 158 | FP | 2400 | WSPM | 13.3 | 1.59 | 1150 | 8 |
| 15 | 357 Magnum | 158 | FP | 2400 | WSPM | 14.3 | 1.59 | 1200 | 8 |
| 16 | 45 Automatic | 230 | FMJ-RN | Universal | WLP | 5.2 | 1.21 | 750 | 5 |
| 17 | 45 Automatic | 230 | FMJ-RN | Universal | WLP | 5.4 | 1.21 | 800 | 5 |
| 18 | 45 Automatic | 230 | FMJ-RN | Universal | WLP | 5.7 | 1.21 | 850 | 5 |
| 19 | 45 Colt (Ruger & T/C) | 250 | HP | 4227 | WLP | 20.2 | 1.595 | 1150 | 10 |
| 20 | 45 Colt (Ruger & T/C) | 250 | HP | 4227 | WLP | 21.5 | 1.595 | 1200 | 10 |
| 21 | 45 Colt (Ruger & T/C) | 250 | HP | 4227 | WLP | 22.9 | 1.595 | 1250 | 10 |
| 22 | 45 Colt (Ruger & T/C) | 250 | HP | 4227 | WLP | 24.2 | 1.595 | 1300 | 10 |
| 23 | 45 Colt (Ruger & T/C) | 300 | HP | Win 296 | WLP | 17.9 | 1.58 | 1050 | 10 |
| 24 | 45 Colt (Ruger & T/C) | 300 | HP | Win 296 | WLP | 18.7 | 1.58 | 1100 | 10 |
| 25 | 45 Colt (Ruger & T/C) | 300 | HP | Win 296 | WLP | 19.4 | 1.58 | 1150 | 10 |
| 26 | 45 Colt (Ruger & T/C) | 300 | HP | Win 296 | WLP | 20.2 | 1.58 | 1200 | 10 |
| 27 | 45 Colt (Ruger & T/C) | 300 | HP | Win 296 | WLP | 21 | 1.58 | 1250 | 10 |
| 28 | 45 Colt (Ruger & T/C) | 300 | HP | Win 296 | WLP | 21.7 | 1.58 | 1300 | 10 |

Table Name: cdb_powder_case
Purpose: A look up table to correlate cases with all powders used across load data.
Attributes: Case ID and powder ID.
Keys: Case ID and powder ID are foreign from cdb_case and cdb_powder, respectively.
Case ID and powder ID are the primary key when combined.
Example Data (shown here with joined case and powder names):

| case_id | name | powder_id | name |
|---|---|---|---|
| 1 | 357 Magnum | 2 | 2400 |
| 1 | 357 Magnum | 3 | H110 |
| 1 | 357 Magnum | 4 | Win 296 |
| 1 | 357 Magnum | 5 | 4227 |
| 1 | 357 Magnum | 6 | Power Pro 300-MP |
| 1 | 357 Magnum | 7 | Universal |
| 3 | 45 Automatic | 7 | Universal |
| 3 | 45 Automatic | 8 | Power Pistol |
| 5 | 45 Colt (Ruger & T/C) | 2 | 2400 |
| 5 | 45 Colt (Ruger & T/C) | 4 | Win 296 |
| 5 | 45 Colt (Ruger & T/C) | 5 | 4227 |

## 5. Queries

Operation: A select statement that returns joined data from 4 other tables.
Purpose: View the load information with added names and data for the given linked IDs which are not user readable on their own.
MySQL:

```
select load_id, c.name, pro.weight, pro.type, pow.name,
pri.name,
                powder_weight, col, velocity, barrel_length from cdb_load
l
                      join cdb_case c on l.case_id = c.case_id
                      join cdb_projectile pro on l.proj_id = pro.proj_id
                      join cdb_powder pow on l.powder_id = pow.powder_id
                      join cdb_primer pri on l.primer_id = pri.primer_id;
```

Result:

| load_id | name | weight | type | name | name | powder_weight | col | velocity | barrel_length |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 357 Magnum | 158 | FP | Win 296 | WSPM | 12.4 | 1.59 | 1000 | 8 |
| 2 | 357 Magnum | 158 | FP | Win 296 | WSPM | 13.1 | 1.59 | 1050 | 8 |
| 3 | 357 Magnum | 158 | FP | Win 296 | WSPM | 13.8 | 1.59 | 1100 | 8 |
| 4 | 357 Magnum | 158 | FP | Win 296 | WSPM | 14.5 | 1.59 | 1150 | 8 |
| 5 | 357 Magnum | 158 | FP | Win 296 | WSPM | 15.2 | 1.59 | 1200 | 8 |
| 6 | 357 Magnum | 158 | FP | Win 296 | WSPM | 16 | 1.59 | 1250 | 8 |

Operation: A select using a subquery that returns the load(s) with the highest velocity and directly relevant information.

Purpose: For users who want to maximize velocity, ideally with an input of which case(s) to search through.

MySQL:
```
select c.name, pro.weight as proj_weight, pro.type as proj_type,
      m.name as manuf, pow.name as powder, powder_weight,
      velocity from cdb_load l
            join cdb_case c on l.case_id = c.case_id
            join cdb_projectile pro on l.proj_id = pro.proj_id
            join cdb_powder pow on l.powder_id = pow.powder_id
            join cdb_manufacturer m on pow.manuf_id = m.manuf_id
            where velocity = (
                  select max(velocity) from cdb_load
            );
```

Result:

| name | proj_weight | proj_type | manuf | powder | powder_weight | velocity |
|---|---|---|---|---|---|---|
| 45 Colt (Ruger & T/C) | 250 | HP | IMR | 4227 | 24.2 | 1300 |
| 45 Colt (Ruger & T/C) | 300 | HP | Winchester | Win 296 | 21.7 | 1300 |

Operation: A select that groups by powder, has a given case name, and an aggregate function for min powder weight.

Purpose: A search that provides the most economical load (least amount of powder per load) for all available powders given a specific case.

MySQL:
```
select c.name, pro.weight as proj_weight, pro.type as proj_type,
      m.name as manuf, pow.name as powder, m.name as manuf,
      min(powder_weight) from cdb_load l
            join cdb_case c on l.case_id = c.case_id
            join cdb_projectile pro on l.proj_id = pro.proj_id
            join cdb_powder pow on l.powder_id = pow.powder_id
            join cdb_manufacturer m on pow.manuf_id = m.manuf_id
            group by powder
            having c.name = '357 Magnum';
```

Result:

| name | proj_weight | proj_type | manuf | powder | manuf | min(powder_weight) |
|---|---|---|---|---|---|---|
| 357 Magnum | 158 | FP | Alliant | 2400 | Alliant | 10.5 |
| 357 Magnum | 158 | FP | IMR | 4227 | IMR | 12.4 |
| 357 Magnum | 158 | FP | Winchester | Win 296 | Winchester | 12.4 |

Operation: A distinct select that returns all cases that have at least one usable powder listed.

Purpose: While the database can contain many different cases, not all might have load information Available. This query returns only the cases that have data corresponding to a powder.

MySQL:
```
select distinct c.name as catridge from cdb_case c
      where exists (select * from cdb_powder_case pc where
            c.case_id = pc.case_id);
```

Result:

| catridge |
| --- |
| 357 Magnum |
| 45 Automatic |
| 45 Colt (Ruger & T/C) |

Operation: A union between selects where each returns a name from a table.

Purpose: If a search by keyword was done across data from the tables, it might want to pull all string identifiers in a union.

MySQL:
```
select name from cdb_case
union
select name from cdb_powder
union
select name from cdb_manufacturer
union
select name from cdb_primer;
```

Result:

| name |
| --- |
| Win 296 |
| Universal |
| Unique |
| Remington |
| Power Pro 300-MP |
| Power Pistol |
| IMR |
| Hodgdon |
| H110 |
| Federal |
| CCI |

Operation: A view that combines data from several tables as well as derives the ballistic energy given a velocity and a bullet weight.

Purpose: This view displays all cases with all powders available to it, as well as the minimum and maximum load data values. It also calculates and lists the ballistic energy of said load in foot pounds.

MySQL:

```
create view cdbView_energyByPowder as
      select c.name as catridge, barrel_length,
      pro.weight as bulletGrn, m.name as manufacturer,
      pow.name as powder,
      min(powder_weight) as grnMin, max(powder_weight) as
grnMax,
      min(velocity) as velMin, max(velocity) as velMax,
      (min(velocity) * min(velocity) * pro.weight / 450435) as
            energyMin,
      (max(velocity) * max(velocity) * pro.weight / 450435) as
            energyMax
      from cdb_load l
      join cdb_case c on l.case_id = c.case_id
      join cdb_projectile pro on l.proj_id = pro.proj_id
      join cdb_powder pow on l.powder_id = pow.powder_id
      join cdb_primer pri on l.primer_id = pri.primer_id
      join cdb_manufacturer m on pow.manuf_id = m.manuf_id
      group by c.name, pow.name;

select * from cdbView_energyByPowder;
```

Result:

| catridge | barrel_length | bulletGrn | manufacturer | powder | grnMin | grnMax | velMin | velMax | energyMin | energyMax |
|---|---|---|---|---|---|---|---|---|---|---|
| 357 Magnum | 8 | 158 | Alliant | 2400 | 10.5 | 14.3 | 1000 | 1200 | 350.7720 | 505.1117 |
| 357 Magnum | 8 | 158 | IMR | 4227 | 12.4 | 14.5 | 1000 | 1150 | 350.7720 | 463.8960 |
| 357 Magnum | 8 | 158 | Winchester | Win 296 | 12.4 | 16 | 1000 | 1250 | 350.7720 | 548.0813 |
| 45 Automatic | 5 | 230 | Hodgdon | Universal | 5.2 | 5.7 | 750 | 850 | 287.2224 | 368.9212 |
| 45 Colt (Ruger & T/C) | 10 | 250 | IMR | 4227 | 20.2 | 24.2 | 1150 | 1300 | 734.0127 | 937.9822 |
| 45 Colt (Ruger & T/C) | 10 | 300 | Winchester | Win 296 | 17.9 | 21.7 | 1050 | 1300 | 734.2902 | 1125.5786 |

Operation: A stored function that calculates ballistic energy on a given load_id.

Purpose: A quick way of returning a specific calculated ballistic energy given a load_id, an important specification that is derived and not stored.

MySQL:

```
delimiter //
      create function cdbFunc_energyFind (_load_id int)
                  returns double
            begin
            declare energy double;
            select (velocity * velocity * p.weight / 450435)
into
                  energy from cdb_load l
            join cdb_projectile p on l.proj_id = p.proj_id
            where _load_id = load_id;
            return energy;
            end //
delimiter ;
```

Example result:

| load_id | name | weight | type | name | name | powder_weight | col | velocity | barrel_length | cdbFunc_energyFind(1) |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 357 Magnum | 158 | FP | Win 296 | WSPM | 12.4 | 1.59 | 1000 | 8 | 350.77203148 |

Operation: A stored procedure that returns load entries given a threshold.

Purpose: Using the energyByPowder view from before, the procedure takes a ballistic energy threshold value and returns all loads above that.

MySQL:

```
delimiter //
      create procedure cdbProc_energyThreshold (threshold
double)
            begin
            select catridge, barrel_length, bulletGrn,
            manufacturer, powder, grnMax, velMax, energyMax from
                  cdbView_energyByPowder
            where energyMax > threshold;
            end //
delimiter ;

call cdbProc_energyThreshold(525.0);
```

Result:

| catridge | barrel_length | bulletGrn | manufacturer | powder | grnMax | velMax | energyMax |
|---|---|---|---|---|---|---|---|
| 357 Magnum | 8 | 158 | Winchester | Win 296 | 16 | 1250 | 548.0813 |
| 45 Colt (Ruger & T/C) | 10 | 250 | IMR | 4227 | 24.2 | 1300 | 937.9822 |
| 45 Colt (Ruger & T/C) | 10 | 300 | Winchester | Win 296 | 21.7 | 1300 | 1125.5786 |