

# Materials Ordering

Class Projects.....	1
Student Projects (one off) .....	2
Common Material Sizes.....	3
Cut Lists .....	4
Layout and Utilization .....	4
Bill of Materials.....	5
Waste .....	6
Consumables.....	7
Ordering .....	8
Estimating Materials.....	8
Donations .....	14
Safety Data Sheets (SDS).....	14
Storage, Inventory, and Control.....	17
Assessment.....	23
Activities.....	24
Materials Ordering Activity .....	24
Cut List.....	30
Bill of Materials.....	31
Supplemental Files.....	37

Maintaining a supply of materials is an essential task in managing your program. Materials generally make up a large part of the program budget. How much of this cost can be recouped will depend on the district policy with regards to charging a materials fee to the students.

## Class Projects

Projects built for classes (ex. Introduction to Agricultural Mechanics) or classes that require supplies (ex. small engines) are predictable and should be planned and budgeted. The simplest way to budget for these supplies is by class and number of students. For example, if you teach an introductory class where each student will build 10 projects and another course were you will need supplies like gaskets you can build a spreadsheet model of each course and vary the materials needs by the number of sections and the projected enrollment. This method allows

you to create a list of supplies to purchase, a budget, and the cost per student (and project). The model is easily updated each year and ordering becomes a simpler process.

## Student Projects (one off)

Commonly students will build individual projects in fabrication classes or as part of an SAE. Purchasing of materials for these projects usually cannot be planned ahead of time like a course that build set projects. Sometimes a teacher can “stock” commonly used materials, but One should assume that larger projects are funded externally in some way. For example a student wants to build a picnic table for his home or a local farmer wants a trailer. Fairs often have auctions that allow students to recoup the cost (and make a few bucks). For these types of projects materials are ordered for the project and accounting is required to track the cost. It is recommended that a “shop fee” be added to all such projects to recoup the cost of consumables as well as wear and tear on equipment. Commonly this might be 10% of the materials cost. In addition to consumables you may wish to stock common hardware like nuts, bolts, electrical connectors, etc. You will need to manage this inventory and replenish as needed. Student project finances are often run through a booster’s club or a student body account. Some of these funds should be earmarked for supply replacement. Part of the process for the student building the project is to create a bill of materials (see example below). This bill of materials can be used for ordering.

## Common Material Sizes

Understanding the sizes of commonly used materials is required to create a bill of materials. Consider how eggs are sold at the market. ½ dozen, 1 dozen, 18, 2.5 dozen. You can't just buy 3 or 14 eggs. You will need to purchase in the standard sizes. You should become familiar with the sizes of the common materials you need and how to specify them. The table below shows sizes of common materials.

Material	Common Units	Notes
Steel Pipe	21' lengths	Can be ordered in Plain End (PE) or threaded. Black or galvanized. Most commonly purchased will be schedule 40 (the wall thickness).
PVC Pipe	20' lengths	Ordered in "class" sizes or "schedule" sizes. Class sizes are rated in working pressure (ex. class 125 or class 200). Schedule sizes follow steel pipe wall thickness (ex. schedule 40 or schedule 80). For a given diameter like ½" the outside diameter is the same so fittings are interchangeable. Note: Low head irrigation PVC pipe (PIP) is sized differently.
Plumbing Fittings	Each or in quantity (10, or 25 is common)	PVC and Copper need to be specific as to slip or threaded. For example a PVC Tee with a threaded outlet would be commonly referred to as SST. Common abbreviations: IPS=Iron Pipe Size, HT=hose thread. FIP=Female Iron Pipe, MIP=Male Iron Pipe, MHT=Male Hose Thread, FHT=Female Hose Thread
Single Conductor Copper Wire	500' spools	Common type THHN. Specify wire gauge, color, and type. For example White 14 gauge THHN.
Non-metallic Cable	250' roll is common, by available in shorted lengths, and on longer spools.	Sold by AWG size (14 ga, 12, ga.) and number of conductors. Commonly available in 2 and 3 conductors plus the ground in a cable.
Sheet Metal	Often priced by the pound or by the sheet	Common widths 2', 3', 4'. Common lengths 8', 10', 12'. Plain or galvanized. Gauge sizes (thickness) determined by use. 24-28 gauge (thin) is used for many sheet metal projects. Heavier gauges such as 12-16 may be used for large projects.
Steel	Common length is 20'.	Commonly sold by the pound. Acquire a steel table book from a local supplier as a reference for sizes and weights.
Dimensional Lumber	Board feet or Each	Size represents the rough sawn size not the finished size (ex. 2x4 is really 1 ½"x3 ½"). Common lengths 8', 10', 12', 14', 16'). Species and grade are also a factor for some uses.
Lumber	Board feet or each	Size represents the rough sawn size not the finished size (ex. 1x4 is really ¾"x3 ½"). Common lengths 8', 10', 12', 14', 16'). Species and grade are also a factor for some uses.
Hardwood Lumber	Board feet, linear feet or each	Species and grade are a factor for most projects. May come surfaced on 4 sides or only 2 (top/bottom).

Material	Common Units	Notes
Sheet Lumber	4'x8' sheet	Grade is a factor that is determined by use. For example AC, CDX, or BCX. Letters denote the quality of the side (A=highest), X=exterior.
Fasteners	Boxes of 100, 1#, or 5# boxes	Some suppliers still sell nails and screws loose by the pound. The number of nails/pound can be found in most agricultural mechanics books.
Cement	47# or 94# Sacks	Note: 47# sacks are easier to handle.
Sand & Gravel	cubic yard	
Concrete Mix	50, 60, and 80 pound sacks are common	Mix can be used if you are not teaching about mix ratios. Yield (in cubic feet) is shown on the bag.

Note: Local suppliers likely will not stock all common sizes. It is recommended that you determine what is commonly stocked before ordering to avoid delays or substitutions.

## Cut Lists

A cut list is a list of actual dimensions of the materials required to assemble the project. Cut lists are created from plans and project descriptions. The cut list is the first step toward developing a list of materials needed for a project(s). For example a cut list for a wood tool box might look like:

Size	Quantity	Description	Use
3/4"x3.5"x4 1/8"	2	#2 pine	Divider
3/4"x3.5"x15"	2	#2 Pine	Sides
3/4"x3.5"x10"	2	#2 Pine	Ends
3/4"x7"x13 1/2"	1	#2 Pine	Handle
11 1/2"x15"x1/4"	1	AC Plywood	Bottom

Note the use of actual sizes vs. "nominal" sizes. The lumber purchased for this project would 1" nominal thickness.

## Layout and Utilization

Layout is the process of determining how the parts of a project will be cut from materials. It is required to determine what to order. It is important to note that this same skill is something you will be teaching to your students. Some projects may be simple such as an electrical project that will require 6 feet of 12/2 NM cable. If you need to build 40 projects then 6'x40=240'. Common sizes for 12/2 NM wire are 50', 100', and 250' so you might choose to purchase 1 - 250' roll. Wood projects can be more complex as you will need to consider the direction of the grain and the losses due to cutting (kerf) and defects. Some consideration also must be given to the tools used. For example it is more efficient (and safer) to rip longer pieces

on a table saw. In many cases you may allow extra waste for the efficiency and safety of the cutting process. You may wish consider the handling of materials as well. For example it will be easier to handle 3'x8' sheet metal rather than ordering 4'x12' sheets. Your tools may also influence your selection. For example if you have a 3' stationary shear then 4' sheets would have to be cut with a portable shear.

Using the cut list (actual sizes) materials should be purchased to best utilize the materials. The process may be somewhat recursive in nature and may require several tries to get the final layout.

Before starting this process, consideration must be given to type of material and the cutting process. For example with wood the direction of the grain matters. It is not simply fitting the pieces onto a board. Some cutting processes like shearing (used for sheet metal) do not consume any material. Other cutting processes like plasma cutting or cutting with a circular saw consume some material (the "kerf"). To complicate process more the kerf may not matter too much in a welded project as a slightly short piece can be welded, but in a wood project not allowing for the kerf will make the project not fit together properly.

For some materials such as steel tubing the length is generally 20' so the process involves simply fitting the cut list sizes to fit in 20'. For example if the cut list for 1" square tubing calls for:

4 - 96" pieces

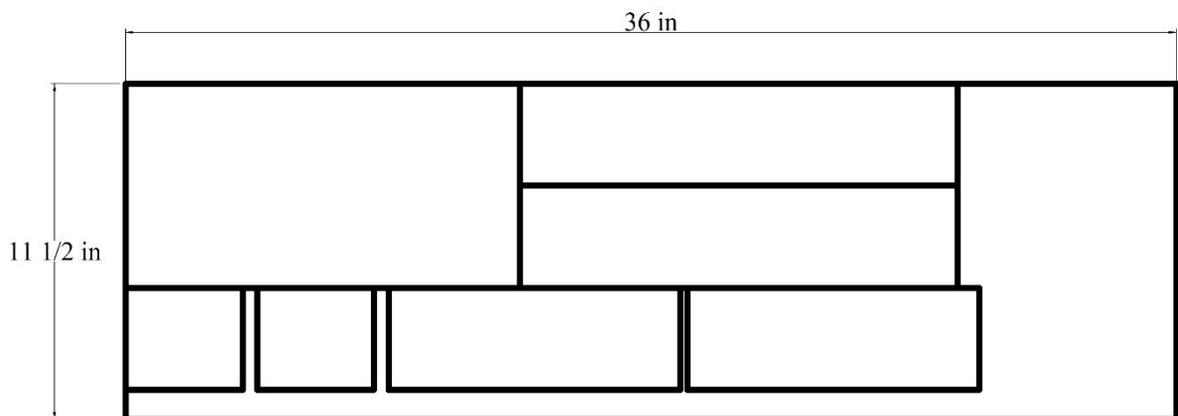
4 - 120" pieces

6 - 46" pieces

2 - 12" pieces

How many 20' long pieces would you order?

The layout for the pine board in the cut list example above on a nominal 1"x12" might look like:



## Bill of Materials

The bill of materials is the "shopping" list and contains the quantity expressed in the common units and a complete description of the material. The bill of materials is commonly developed from the cut list and the layout on the material. Some examples might be:

Quantity	Description	Units	Cost	Amount
5	1/2" PVC SS Elbow	10 pak		
4	1/2"x4'x8' AC plywood	Each		
2	14 gauge THHN, Red wire	500' spool		
1	14"x20 Cap Screw	Box of 100		
6	1/4"x2"x20' Hot Rolled Steel	Pound		
4	24 gauge x 4'x8' galvanized sheet metal	Pound		
3	1/2"x10' "M" copper pipe	Each		

In the bill of materials like materials are consolidated. Cost is the cost per unit and amount is calculated as the quantity x the cost.

Using the tool box cut list and layout examples above and assuming 3' per project and 44 projects the order for #2 pine could be as follows.

Quantity	Description	Units	Cost	Amount
17	1x12x8'	Each	16.00	272.00
	or			
11	1x12x12	Each	24.00	264.00
	or			
9	1x12x16'	Each	32.00	288.00

## Waste

There are three types of waste to consider. First is simply the left over scraps and is often unavoidable even with the best layout. For class projects the plans can often be altered slightly to better utilize common material sizes. For example if the plan calls for 1/2" plywood to be 24" x 24" it cannot be cut evenly from a 4'x8' sheet when you allow for the kerf. If the project could be reduced slightly to 23 3/4" x 23 3/4" then 8 pieces could be cut from a full sheet.

The second type of waste is created from mistakes. These things happen. Depending on the project it will be prudent to build in a percentage to your ordering to accommodate cutting mistakes. Note: Don't automatically start over when a student cuts material too short. Often the project can be completed albeit a bit shorter than the plan called for.

A third type of waste is found in wood due to defects in the lumber. For example if a project calls for 1" pine lumber you could order a high grade lumber with few defects and the waste would be minimal. However using a lower grade lumber will usually cost you less even when you consider discarding the defects. An additional benefit of using lower grade lumber is that students learn how to identify the defects and cut around them. To allow for defects simply

order extra lumber (ex. 10%). Some experience with a local supplier will help establish a good number for the types of projects you intend to build.

A simple way to manage this extra is to order extra pieces. For example if you calculate that you need 10-1"x12"x12' boards then an extra 10% would be one extra board (11).

Waste can generate scraps and many of these can be used for other projects. Consider that scraps from a sheet metal feed scoop project might be used for sharpening templates or that scraps from a wooden sawhorse might be used to build boot jacks.

## Consumables

Consumables are items that are used up in the building process are not commonly found in a bill of materials. These are generally stocked by the shop in sufficient quantity as to not run out during class. Note that the cost of these items should be accounted for in a "shop fee" added to large student projects. Typically a percentage of the materials cost is charged. Some common consumables are:

Arc Welding	Common SMAW rod should be stocked for use in welding classes or for project building. Note that once opened rod should be stored in a heated oven.  Wire electrode (GMAW) must be stocked in the sizes appropriate for your welders.  Tungsten rods for GTAW welding are purchased in packets. For casual GTAW welding a couple of spare rods are plenty.  GMAW welding tips and gun liners.  Plasma cutter tips
Gas	Extra tanks of welding gasses must be stocked. The quantity will depend largely on the mix and number of courses being taught. For example, if Argon is used infrequently for GTAW welding maybe only a single reserve tank is needed. On the other hand, you may wish to stock 3-6 oxygen tanks if you teach several classes that include gas welding and cutting.
Saw blades	Blades for bandsaws, table saws, miter saws, circular saws, jig saws, chop saws should be stocked. Generally having one or two in reserve will be sufficient.
Drill bits / Taps	Cold metal projects commonly include drilling and tapping. Extra drills and taps should be stocked incase these are broken in class. Order the sizes commonly used for projects. The smaller the tap the more likely it will be broken.
Portable Grinders	Wheels for portable grinders wear quickly and cut-off blades even quicker. If you are teaching fabrication you will need to stock a dozen or so (buy in box quantity).
Grinder Stones	Grinder stones (wheels) wear and should be replaced when they reach ½ of the original diameter or if they are cracked. For grinders used daily for fabrication an extra wheel or two should be stocked.

Regular inventory of consumables will not only insure you don't run out of these items and will give you a sense of how much to stock.

## Ordering

Material orders for courses that do set projects can be made before the start of the term. They will be then be on hand for the course. For courses like fabrication materials should be ordered for each project and in stock materials like bolts refreshed as needed.

## Estimating Materials

A spreadsheet can be used to calculate materials needed for a course. The spreadsheet can be used for ordering and budgeting. The spreadsheet requires an estimate of the amount of a material used per student in the common unit of purchase. For example, if you purchase 1"x12"x16' #2 pine lumber and a project requires 4' then the amount per student =  $4' \div 16' = .25$ . Purchased quantity is rounded up to the nearest whole unit. Current inventory (in stock) is subtracted from the order amount. The main advantage of using the spreadsheet is the ease of developing budget and materials orders once it is setup.

Intro to Ag Mechanics

Students: 44 (included are two extra for demonstration)  
 NOTES:

Item	Units	Quantity Per Student	Required	To Order	In stock	Net Order	Cost	Amount	Comments/ Vendor
<b>Rope</b>									
3/8" black poly "truckers" rope	300' spool	0.040	1.76	2	1	1	28.00	28.00	Big spools are best - Home Depot usually carries these.
Black Electrical Tape	roll	0.010	0.44	1	0	1	2.50	2.50	
<b>Tool Sharpening Template</b>									
Scrap 26 ga Galv Sheet metal									Use scraps In stock
<b>Tool Box (Sheet metal)</b>									
3' x 8' x 26 ga Galvanized Sheet Metal	Sheets	0.200	8.80	9	8	1	22.00	22.00	
1" x 48" hardwood dowel	each	0.333	14.67	15	6	9	6.00	54.00	
1" x 12" x 12' #3 common Pine	each	0.125	5.50	6	0	6	22.00	132.00	Also see Pine under woodworkin g
#3 common nails	pound	0.070	3.08	4	50		4.00		
1" x #6 pan head sheet metal screw	box(100)	0.050	2.20	3	1	2	5.25	10.50	

**Concrete**

Agricultural Mechanics Teaching Methods

Materials Ordering

2 x 6 x 8' fir	each	0.250	11.00	11	0	11	9.00	99.00	We will rip to width
6d duplex nail	pound	0.080	3.52	4	1	3	4.00	12.00	
Cement (47 pounds)	sack	0.130	5.72	6	0	6	7.00	42.00	Buy 1/2 sacks (47 lbs) if possible Very low, need to check wth farm to see if they will get more. Very low, need to check wth farm to see if they will get more.
Sand (washed)	Cu Yd	0.009	0.40	1	0	1	5.00	5.00	
Pea Gravel	CU Yd	0.018	0.79	1	0	1	8.00	8.00	
15# roofing felt	roll	0.010	0.44	1	1		94.00		
<b>Cold/Hot Metal</b>									
3/8" x 20' hot rolled Round steel	20' bar	0.150	6.60	7	5	2	8.20	16.40	
4' x 8' x 16ga HR Steel Sheet	each	0.030	1.32	2	1	1	80.00	80.00	Same as welding steel
1/4" x 1 1/2" HR Flat Steel	20' bar	0.100	4.40	5	0	5	28.00	140.00	
1/4" x 1/2" NC Machine Screws (slotted or phillips head)	box 100	0.020	0.88	1	0.5	0.5	9.50	4.75	Fastenal
1/4" NC Nuts	Box 100	0.020	0.88	1	0.5	0.5	8.00	4.00	Fastenal
Gray Primer spray paint	1 can	0.100	4.40	5	1	4	4.50	18.00	
Satin (or gloss) garden green spray paint	1 can	0.100	4.40	5	0	5	4.50	22.50	

Agricultural Mechanics Teaching Methods

Materials Ordering

1/4" HR Steel Round	20' bar	0.100	4.40	5	0	5	3.80	19.00	
Satin High Temp Black Paint	1 can	0.050	2.20	3	0	3	5.50	16.50	
1" hardwood dowel	48"	0.125	5.50	6	0	6	5.50	33.00	
Household cement	tube	0.040	1.76	2	0	2	4.50	9.00	
Minwax Walnut Stain/sealer	8 oz	0.020	0.88	1	0	1	4.00	4.00	
<b>SMAW Arc Welding</b>									
1/4"x1 1/2" x 20' HR Flat Steel	20' bar	0.400	17.60	18	6	12	28.00	336.00	Same as used in Cold/Metal MJB
1/8" E6013 welding rod	50 lb box	0.025	1.10	2	1	1	129.00	129.00	
<b>Gas Welding &amp; Cutting</b>									
1/2"x4" HR Flat Steel	20' bar	0.050	2.20	3	1	2	142.00	284.00	
1/8 x 2 x 20' HR Steel strip	20' bar	0.050	2.20	3	5		18.00		Have sheet sheared in to 2" strips
16 ga.x 2" x 8' strips (sheared)	4 x8 sheet	0.010	0.44	1	1		30.00		
3/16" flux coated brazing rod	Pound	0.200	8.80	9	8	1	10.00	10.00	
<b>GMAW Welding</b>									
1/4"x1 1/2" x 20' HR Flat Steel	20' bar	0.400	17.60	18	0	18	28.00	504.00	
.035 ER70S electrode	Spool	0.001	0.04	1	1		62.00		
<b>Plasma Cutting</b>									
1/4"x4" HR Flat Steel	20' bar	0.050	2.20	3	1	2	72.00	144.00	
<b>Electrical</b>									
14 ga White THHN wire	500' roll	0.010	0.44	1	1		75.00		
14 ga Green THHN wire	500' roll	0.010	0.44	1	1		75.00		

Agricultural Mechanics Teaching Methods

Materials Ordering

14 ga Black THHN wire	500' roll	0.010	0.44	1	1		75.00			
14 ga Red THHN wire	500' roll	0.010	0.44	1	1		75.00			
14/2 with Gnd NM Cable	250' Roll	0.008	0.35	1	0	1	155.0	155.00		
							0			
1/2" EMT	10'	0.200	8.80	9	0	9	6.50	58.50		
<b>Plumbing</b>										
1/2" copper pipe	10'	0.050	2.20	3	1	2	22.00	44.00		
1/2" Galv. Pipe	21'	0.040	1.76	2	2		28.00			
1/2" PVC Schedule 40 Pipe	20'	0.050	2.20	3	0	3	8.00	24.00	(10' pipe OK)	
1/2" ST 90 PVC Ell	each	2.000	88.00	88	0	88	0.40	35.20	Get	
									"contractor"	
1/2" Brass MA	each	1.000	44.00	44	0	44	1.85	81.40	Pack at HD	
									Get	
									"contractor"	
									Pack at HD	
1/2" PEX pipe	100'	0.010	0.44	1	0	1	30.00	30.00	Any color....	
1/2" PEX x 1/2 Copper Adapter	each	1.000	44.00	44	0	44	2.00	88.00		
1/2" PEX Plug (plastic)	each	1.000	44.00	44	0	44	0.75	33.00	Plastic is cheaper	
									bulk packs	
1/2" PEX Copper Crimp Rings	each	2.000	88.00	88	0	88	0.55	48.40		
Solder	1# roll	0.010	0.44	1	1		42.00			
Paste Flux	each	0.025	1.10	2	1	1	3.50	3.50		
Teflon pipe sealing compound	1/2 pt	0.025	1.10	2	1	1	4.50	4.50		
PVC Cement	1/2 Pt	0.060	2.64	3	1	2	2.85	5.70	small brush, gray	
Flux Brushes	each			2	2		0.90			
<b>Flowerbox (woodworking)</b>										
1 x 12 x 12' #3 or btr Pine	each	0.200	8.80	9	0	9	22.00	198.00		

Agricultural Mechanics Teaching Methods

Materials Ordering

4d Galv. EG box nails	lb	0.030	1.32	2	0	2	4.00	8.00	
Exterior Transparent Cedar Stain water based	1 gal	0.020	0.88	1	0	1	40.00	40.00	
3d Galv shingle nails	lb	0.020	0.88	1	20		4.00		
Flux Brushes	each	0.200	8.80	9	0	9	0.90	8.10	
Professional woodworking glue	Gal	0.010	0.44	1	1		26.00		Get a gallon
<b>Rafter</b>									
2"x4"X12" Fir #2 btr	each	0.400	17.60	18	0	18	9.50	171.00	
<b>Painting</b>									
120 grit open coat garnet sandpaper 9x11	4 sheets	0.125	5.50	6	20		7.00		
Builders Paper (brown)	roll	0.025	1.10	2	0	2	15.00	30.00	
2" "cheap" natural bristle brushes	each	0.500	22.00	22	10	12	1.50	18.00	Available in "packs" at Home depot

---

TOTAL

							\$3,273.45
Tax	6%					Tax	\$ 196.41
						Grand Total	\$3,469.86

## Donations

Many materials can be obtained through donations. It never hurts to ask. Often businesses have excess materials that can be useful such as:

- Cabinet shops – hardwood scraps (for cutting boards)
- Fabrication facilities – steel and aluminum scraps used for welding coupons
- Lumber yards – scraps and warped lumber. Can often be used in short pieces.
- Paint suppliers – May have mixed paint that cannot be sold. Note: colors may be odd!
- Farriers – May have used horseshoes for projects.

Cultivating a source of an on-going supply will allow the teacher to plan projects around free materials.

## Safety Data Sheets (SDS)

SDS sheets must be kept for all materials that can pose a hazard. SDS sheets are available for such materials as paints, solvents, fuels, gasses, and welding rod. Fortunately, most can be found online typically on the manufacturer's web site. SDS are a good reference for safety instruction. SDS sheet should be kept together in a binder and be easily accessible should the need arise.

OSHA states<sup>1</sup>

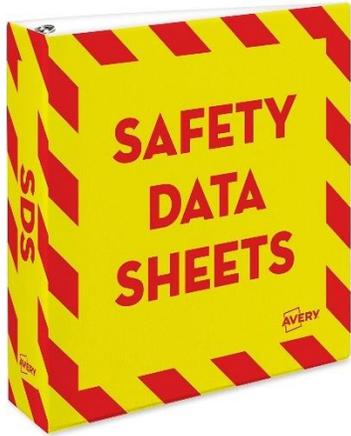
### **“Employer Responsibilities**

Employers must ensure that the SDSs are readily accessible to employees for all hazardous chemicals in their workplace. This may be done in many ways. For example, employers may keep the SDSs in a binder or on computers as long as the employees have immediate access to the information without leaving their work area when needed and a back-up is available for rapid access to the SDS in the case of a power outage or other emergency. Furthermore, employers may want to designate a person(s) responsible for obtaining and maintaining the SDSs. If the employer does not have an SDS, the employer or designated person(s) should contact the manufacturer to obtain one.”

While students are not employees, teachers are employees. Teachers should be in the habit of modeling good industrial practice so posting SDS in the shop and adding instruction to their use will further this goal.

---

<sup>1</sup> <https://www.osha.gov/Publications/OSHA3514.html> OSHA Publication: DSG BR-3514 2/2012 Hazard Communication Standard: Safety Data Sheets



An example of a binder to store SDS.

# SAFETY DATA SHEET

CM531

## Section 1. Identification

**Product name** : DUPLI-COLOR™ Paint Thinner  
**Product code** : CM531  
**Other means of identification** : Not available.  
**Product type** : Liquid.  
**Relevant identified uses of the substance or mixture and uses advised against**  
 Paint or paint related material.

**Manufacturer** : Dupli-Color Products Company  
 Cleveland, OH 44115

**Emergency telephone number of the company** : (216) 566-2917  
**Product Information Telephone Number** : (800) 247-3270  
**Regulatory Information Telephone Number** : (216) 566-2902  
**Transportation Emergency Telephone Number** : (800) 424-9300

## Section 2. Hazards identification

**OSHA/HCS status** : This material is considered hazardous by the OSHA Hazard Communication Standard (29 CFR 1910.1200).

**Classification of the substance or mixture** : FLAMMABLE LIQUIDS - Category 3  
 ACUTE TOXICITY (inhalation) - Category 4  
 SPECIFIC TARGET ORGAN TOXICITY (SINGLE EXPOSURE) (Respiratory tract irritation) - Category 3  
 SPECIFIC TARGET ORGAN TOXICITY (SINGLE EXPOSURE) (Narcotic effects) - Category 3  
 SPECIFIC TARGET ORGAN TOXICITY (REPEATED EXPOSURE) - Category 2  
 Percentage of the mixture consisting of ingredient(s) of unknown acute toxicity: 95% (oral), 95% (dermal), 95% (inhalation)

**GHS label elements**

**Hazard pictograms** :



**Signal word** :

**Hazard statements** :

Warning  
 Flammable liquid and vapor.  
 Harmful if inhaled.  
 May cause respiratory irritation.  
 May cause drowsiness or dizziness.  
 May cause damage to organs through prolonged or repeated exposure.

**Precautionary statements**

<b>Date of issue</b> / <b>Date of revision</b> : 10/1/2021	<b>Date of previous issue</b> : 4/19/2021	<b>Version</b> : 8.01
CM531	DUPLI-COLOR™ Paint Thinner	SHW-85-NA-GHS-US

## Storage, Inventory, and Control

Keeping track of materials is an important task. This process is not much different than the process faced by the local building supply store. Materials should be stored in a way that allows easy access and counting. Storage strategies by necessity will need to be tailored to the shop facility.

Flammable materials (Category 3 liquids) should be stored in a special cabinet. The purpose of the cabinet is to allow time for people to escape a fire before these materials ignite. Flammable materials cabinets doors are self-closing and should remain closed. Typical flammable liquids found in shops are lubricants, solvents and flammable paints. See SDS for specific material hazards. Fuel can be stored in safety cans (5 gallon maximum capacity).



Flammable storage cabinets are required for flammable materials. These come in many different sizes depending on the amount of material to be stored. A maximum of 60 gallons of category 1,2, or 3 liquids can be stored in a single cabinet and no more than 3 cabinets are allowed in a storage area.



Fuel safety can.

Welding Rod once opened should be stored in an oven to prevent moisture absorption. Some shops use a small cabinet or refrigerator with an incandescent bulb to keep moisture away from the open rod. Recommend storage temperature for low hydrogen rod is 250 degrees.



Welding rod (Electrode) oven.



An example of materials for a specific project (electrical) being stored together. The cabinet is only opened when the materials for the project are needed.



Horizontal Lumber Storage



Horizontal Sheet Storage



Vertical storage of lumber. Note bins below for short pieces.



Gas storage – Cylinders should be clearly marked. Oxygen must be separated from fuel.



Stored gas cylinders should be clearly marked with a empty or full status. Commerical tags are availale or these can be easily made in the shop.



Many types of commerical bins are availabe for storing fasteners and small parts. They should be clearly labled. Fasteners (nuts, bolts, and screws) organized by size and type. Note:

Removable trays are useful for projects as they can be taken to the work area during project construction.



Tray storage that is lockable. Trays are easily removed.



Steel is heavy and must be stored on sturdy racks. The “A” frame design is a common one that is easily constructed. Ideally steel storage is located under cover and easily accessible for loading (from a delivery truck) and the construction area.

Control of materials is essential. In some cases this may require locked storage. Instructional materials need to be available for lessons. If they are used for other purposes then they must be replaced in a timely way. Some teachers find that issuing materials for a project prevents students from just getting more when they make a mistake thus reducing material use and allowing the teacher to decide when replacement is necessary.

## Assessment

1. What is the difference between a cut list and bill of materials?
2. When should classroom supplies be ordered?
3. Given a plan for a picnic table what is the first step in determining the amount of material needed?
4. When designing a steel storage are what factors should you consider?
5. How should flammable materials be stored in the shop?

## Activities

### Shopping

Purpose: To become familiar with materials commonly used in agricultural mechanics instruction.

Go to a building supply like Home Depot or Lowes and complete the following assignment.

Find prices for the following:

Size	Material	Price
4'x8'x1/2"	CDX Plywood	
4'x8'x7/16"	OSB	
4'x8'x3/4"	ACX Plywood	
4'x8'x3/4"	Particleboard	

1. Find prices and compute cost per board foot for the following:

Size	Material	Price Each	Price / Bf.
1"x10"x12'	#2 or Btr Pine		
1"x6"x12'	#2 or Btr Pine		
1"x10"x8'	Red Oak	per lf.	
1"x6"x8'	Birch	per lf.	

2. List all the lengths of 2"x4" redwood and the prices. Calculate the cost per board foot.

Size	Material	Price	Price/bf.
2"x4"x _____'	Redwood		

2"x4"x _____'	Redwood		
2"x4"x _____'	Redwood		
2"x4"x _____'	Redwood		

3. List all the different dimensions (height and width) of all 12' Construction grade fir. Record the price and calculate the cost per board foot.

Size	Material	Price Each	Price/bf.
___ x ___ x 12'	Construction Grade Fir		
___ x ___ x 12'	Construction Grade Fir		
___ x ___ x 12'	Construction Grade Fir		
___ x ___ x 12'	Construction Grade Fir		
___ x ___ x 12'	Construction Grade Fir		
___ x ___ x 12'	Construction Grade Fir		
___ x ___ x 12'	Construction Grade Fir		

4. Find the prices for the following (hardware) items

Qty	Size	Material	Price
1 Lb.	4d	Hot dipped galvanized box nails	
50 lb.	16d	vinyl coated sinker nails	
5 lb.	#8 x 3"	Yellow Zinc coated bugle head (deck) screws	
100	#8 x 1 1/2"	Flat head wood screws (in box)	

5. Find prices for the following plumbing supplies.

Qty	Size	Material	Price
25	1/2"	PVC elbow	
1	1/2" x 20'	Schedule 40 PVC Pipe	

6. Find prices for the following electrical supplies.

Qty	Size	Material	Price
1	4" square	Steel box (note depth: _____)	
1	250' roll	14/2 NM cable	
1	500' roll	14 ga THHN conductor (any color)	

7. Find the prices for the following cement products.

Qty	Size	Material	Price
Sack	94 lb.	Portland cement	
Sack	60 lb.	Concrete Mix (not fence post mix)	

8. Find the price of the following tools (brand substitution OK.).

Tool	Price
16 oz. Estwing Straight Claw Hammer	
Dewalt 20 v. Drill	
7 1/4" <u>worm drive</u> circular saw Model: _____	
Stanley Hand Crosscut Saw (or similar)	

## Materials Ordering Activity

Using the attached three project plans develop an order for 42 projects (two classes of 20 + 2 demos). Use the Excel spreadsheet provided. Determine how the spreadsheet works by inspecting each cell. Turn in the spreadsheet online. Note: This is an individual project. Each student will create their own spreadsheet. However the class will work together to get common prices.

Materials notes:

### **Bookend:**

Order 1x12x8' #3 pine (you will rip to 3 ½"). Allow 20% extra for waste. Use #6x1 5/8 Drywall screws for the brace (4) and 4d finish nails for the legs (3). Assume 2 - ½ pints of wood glue.

### **Welding Rod Holder:**

Steel is HR. Assume 20' lengths. Welding rod is in stock.

### **Sprinkler Stand:**

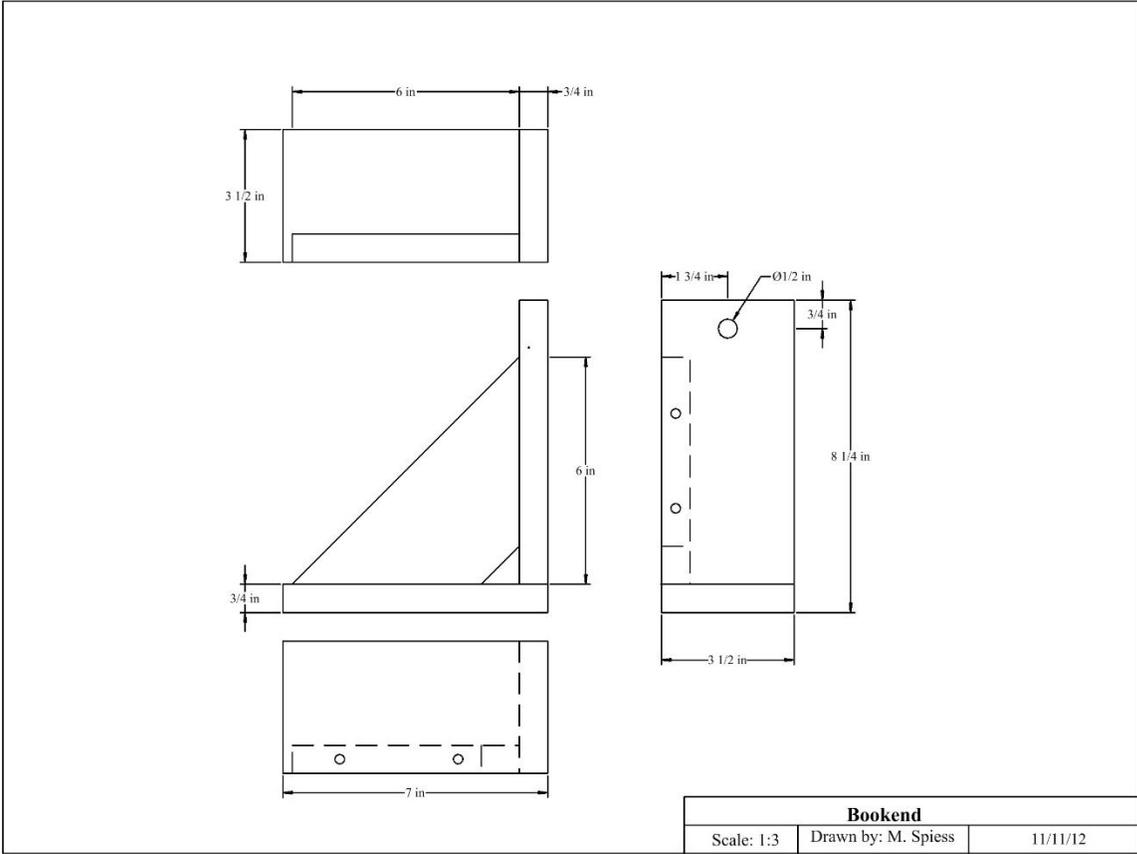
Assume ½" galvanized steel riser, base is all PVC. Order one Slip by Female Hose adapter for each project. Order a full circle shrub head (cheap plastic) for each project. Order a 1/2pt of grey PVC cement for each 15 projects. Order 1 roll of Teflon tape for each 15 projects.

Vendors:

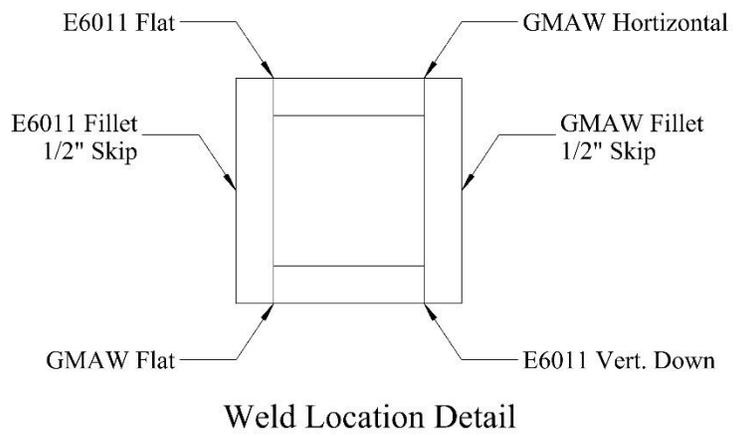
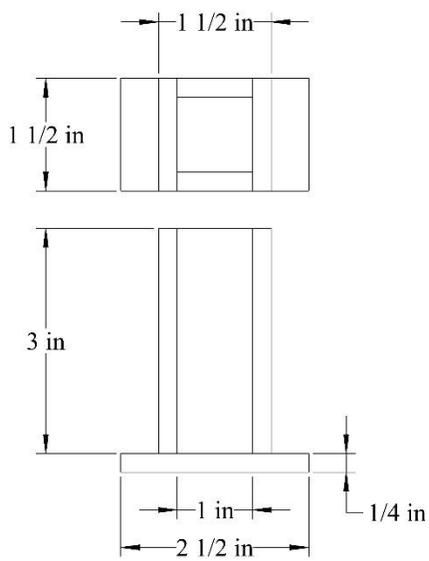
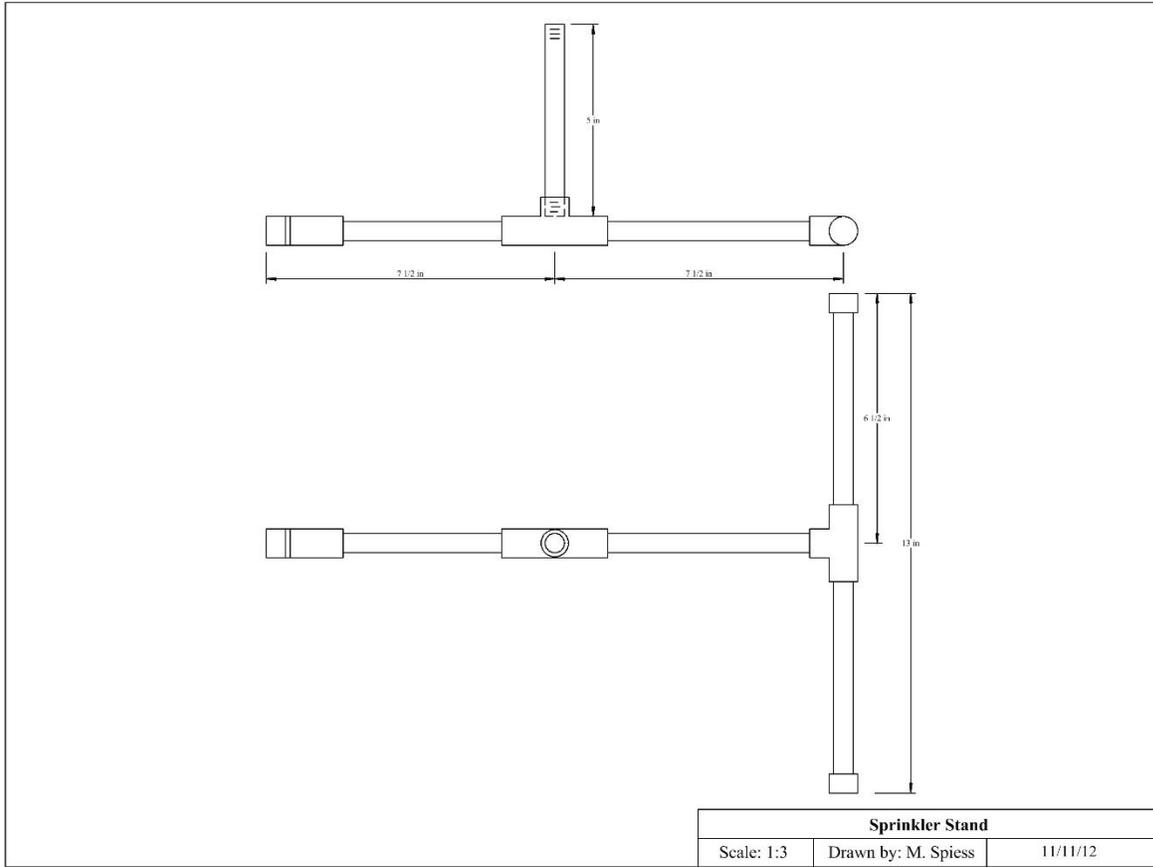
\_\_\_\_\_ - steel and steel pipe

\_\_\_\_\_ - PVC pipe, cement, sprinklers, and fittings

\_\_\_\_\_ - Lumber, screws, glue, nails

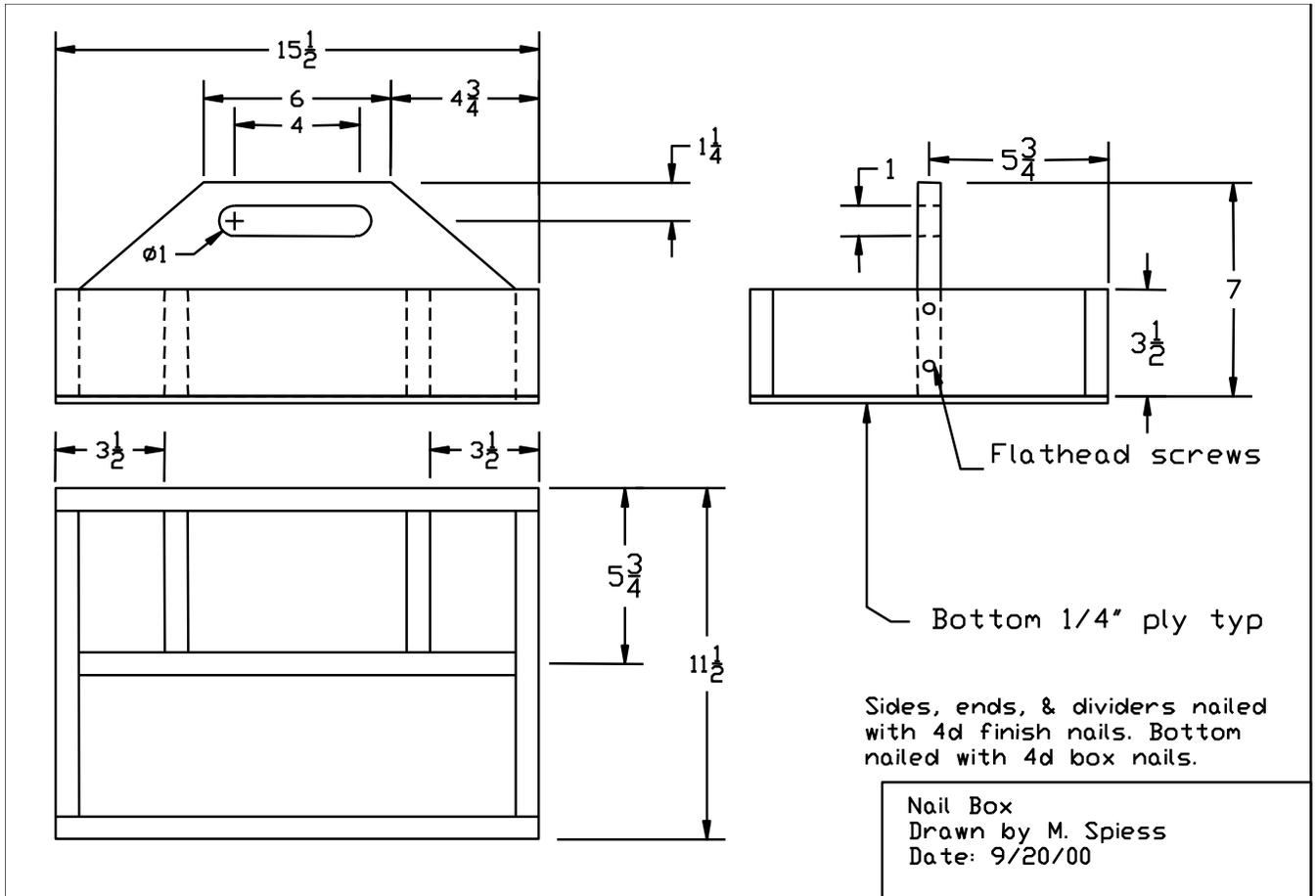


Agricultural Mechanics Teaching Methods



### Cut List

Using the nailbox plan create a cut list for the project. Materials used are #2 pine lumber and 1/4" CDX plywood.



## Agricultural Mechanics Teaching Methods

### Layout

Using the nail box plan above create a layout on 1x12 #2 pine lumber and ¼" plywood. Remember to consider the grain direction for the pine lumber. Draw the layout below.

## Agricultural Mechanics Teaching Methods

### Bill of Materials 1

Using the above nail box plan create a bill of materials for 44 projects. Assume the project will be assembled with 4d box nails and wood glue. Order an extra 10% of the pine to account for defects in the lumber.

Use the following pricing to estimate the cost.

Material	Cost
1x12 #2 pine	\$2.00/bf
1/4" CC Plywood	\$25/sheet
4d Box Nails	\$3.00/lb
1 pint wood glue	\$3.50

Complete the table below.

Material	Units	Qty/Project	Price/Unit
Example: 2x4x8' S4S #2 & BTR Fir	Each	.05	6.00

## Agricultural Mechanics Teaching Methods

### Bill of Materials 2

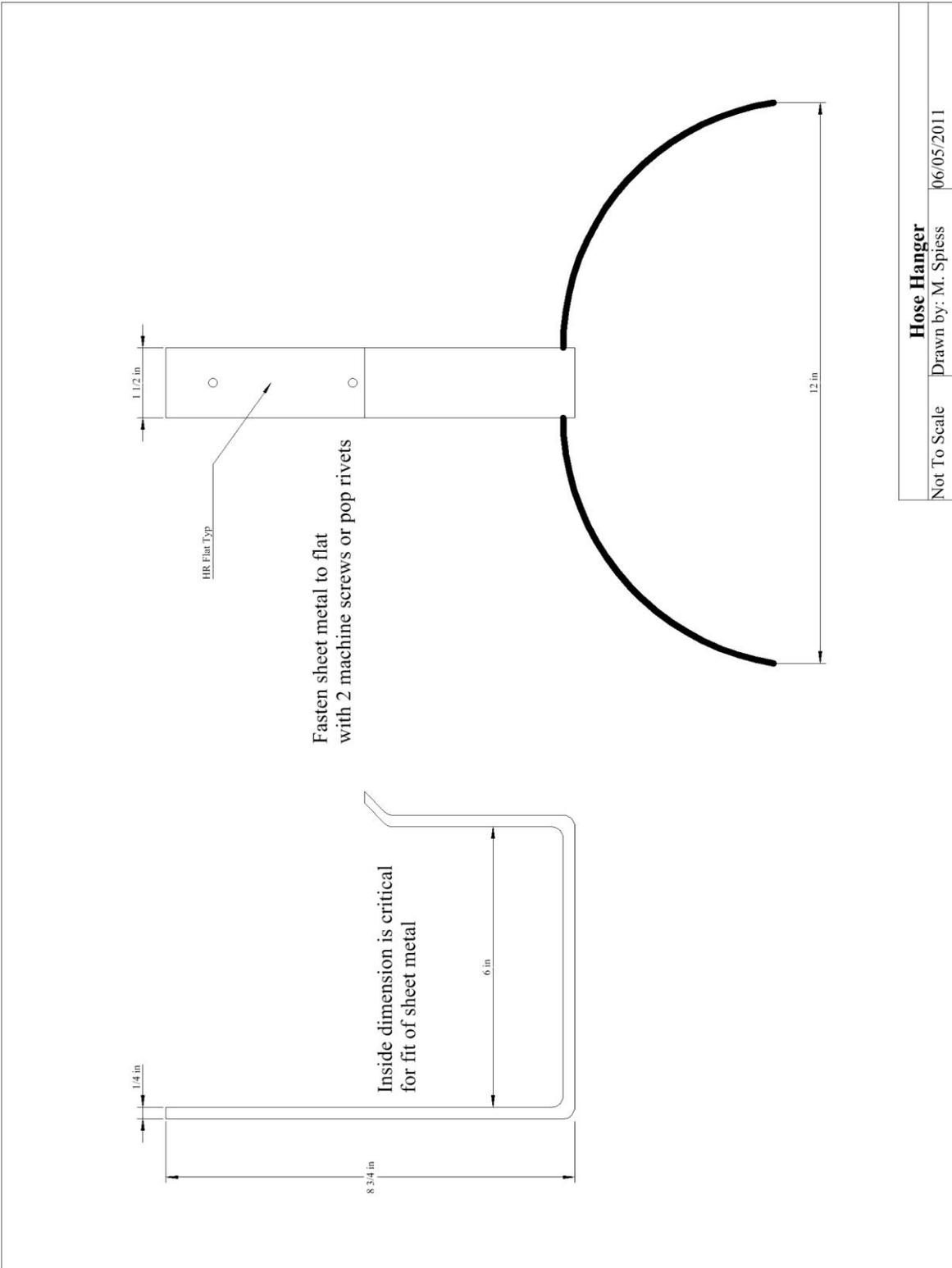
Using the attached plans develop a BOM with cost for three Intro to Ag Mechanics classes with 20 students. Include 4 extra projects for demonstrations (64 total). Use the Shop Materials Cost Estimator spreadsheet to complete the assignment.

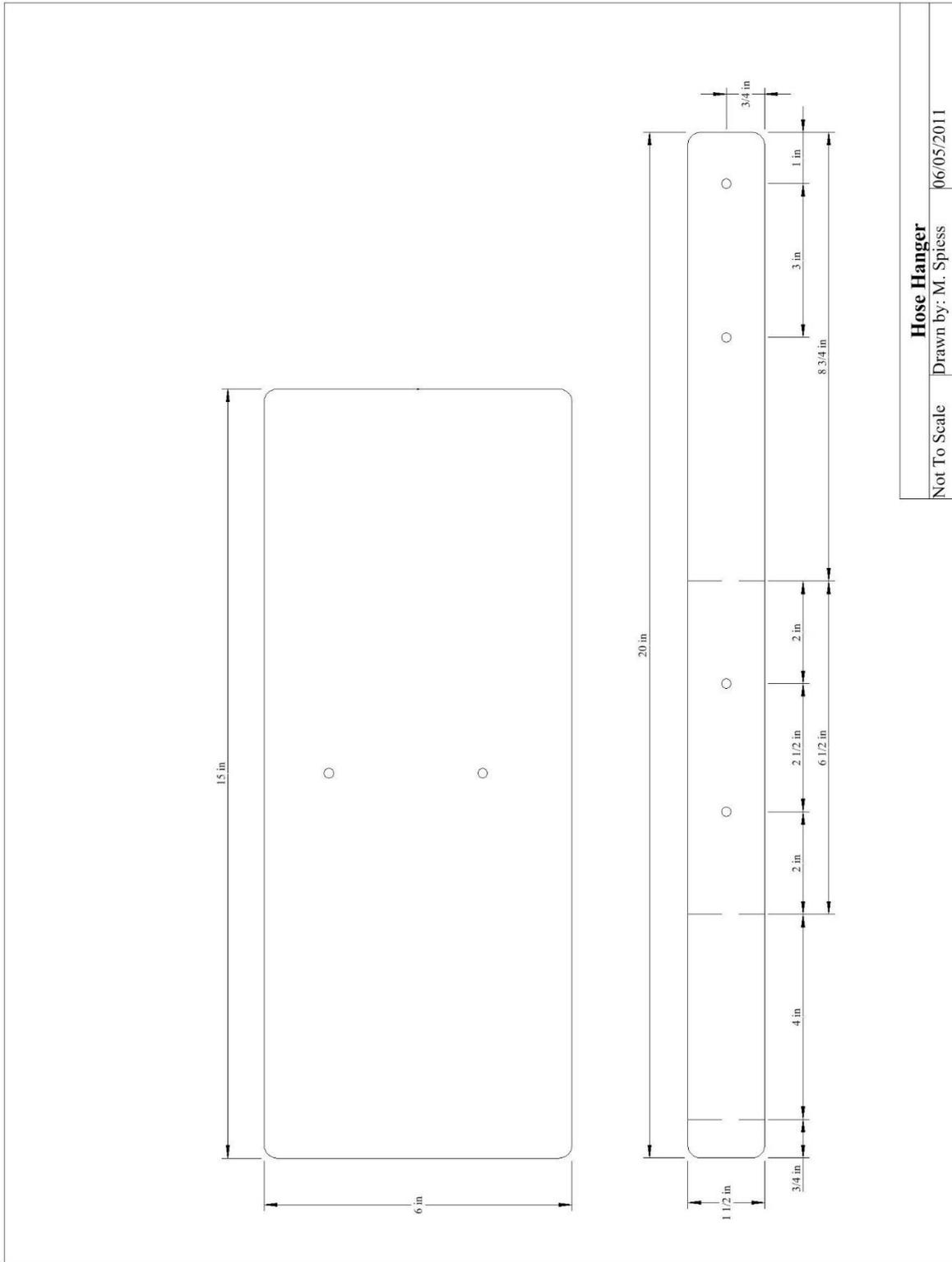
Assume the following prices:

Material	Cost
Fir S4S #2 or Btr	\$.85/bf
½" CC Plywood	\$15/sheet
HR Steel	\$1.00/lb
¼" NC machine screws with nuts	\$3.50/100
#10 x 2 ½" Deck screws	\$30.00/5 lb (about 400 screws)

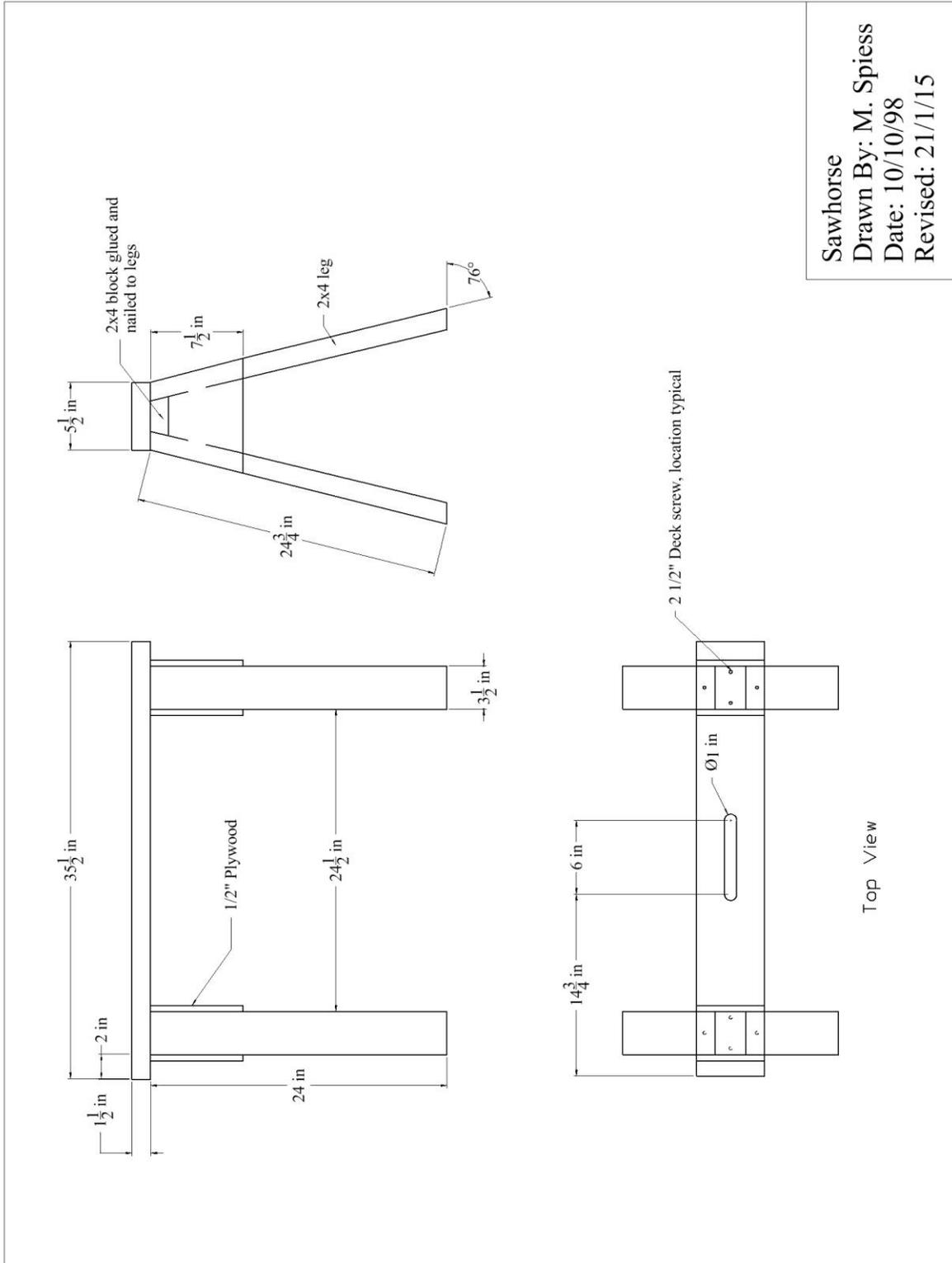
Complete the table below.

Material	Units	Qty/Project	Price/Unit
Example: 2x4x8' S4S #2 & BTR Fir	Each	.05	6.00





**Hose Hanger**  
 Not To Scale Drawn by: M. Spiess 06/05/2011



Sawhorse  
Drawn By: M. Spiess  
Date: 10/10/98  
Revised: 21/1/15

Agricultural Mechanics Teaching Methods

## Supplemental Files

Materials Cost Estimator Spreadsheet