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Building Indoor Peanut Scale Airplanes

by Lester W. Garber PhD - December 11, 1986

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1. SELECTING A DESIGN.

Selecting a superior design is usually a compromise between scale points and flying characteristics. The best compromise is to select a good flying design, build the model as light as possible, and add as scale detail as desired. Study the rules carefully!

A good flying Peanut design should have a broad wing chord (2.5 inches or more), overall length about equal to span, a large stab, and a long nose moment.

The Lacey and Fike are classic examples of designs with these features. It is possible to build the Lacey to four (4) grams and have flights of three (3) minutes.

However, the Lacey and Fike typically do not do well with respect to scale points. Several monoplane designs from pre-1935 are good flying designs and will score higher scale points.

2. WHAT IS A LIGHT PEANUT'?

It is not unusual for Peanuts to weigh 8 to 15 grams. I consider a Peanut to be light if it is a good flying design, has good scale detail, and weighs less than 5 grams.

A design with a narrow wing chord, small fuselage, and weighing four (4) grams is NOT a light Peanut; it is a SMALL Peanut. High aspect ratios (narrow wing chords) are undesirable because of the 13-inch span limitation. In other words, narrow wing chords result in small wing areas and higher wing loadings. This reduces flight times.

3. **WHY BUILD LIGHT PEANUTS'?**

I have three answers to this question:

1. Light Peanuts fly longer.
2. Light Peanuts are easier to adjust.
3. Light Peanuts do not break when they hit the wall.

With respect to the first point: A simple energy analysis shows that flight time is inversely proportional to weight to the 3/2 power. This means, for example, which decreasing the weight by 50% should increase the flight time by 84%. Decreasing the weight by 25% should increase the flight time by 40%. Weight is ever so critical!

With respect to the second point: Light Peanuts require less power and fly at a lower speed. In other words, he forces (torque and aerodynamic forces) acting on the od l are smaller. Since the model flies at a lower speed, the effects of small warps, drag, and other imperfections will be. 1 ss. Light Peanuts will also recover from stalls and other disturbances more quickly because of momentum considerations. The model will be less sensitive to thrust and other trim adjustments.

With respect to the third point: Aerodynamic considerations that lift ·s proportional to velocity squared. To generate the lift, the model must fly 1.41 times the original velocity in level flight, lift equals weigh, therefore doubling the weight means the model must fly 1.41 times as! fast!!

When a Peanut impacts the wall, whether its breaks depends on its structural strength and the amount of kinetic energy it has when it hits the wall. The structure must absorb the KE without bending and/or breaking.

Kinetic energy is proportional to velocity squared. If the model is flying 1.41 as fast, it possesses twice as much kinetic energy! The bottom line is this; a model having ½ the weight, will fly at 71% the velocity, and will possess 25% he kinetic energy when it hits the wall. Therefore, light Peanuts are much less likely to break.

4. HOW TO BUILD LIGHT PEANUTS.

In the following comments, I will use as an example a 1918 Hergt monoplane design from Walt Mooney. This is a good flying design; 13” span, 2.85’ chord, 11” fuselage length, 1.7” nose moment. The Hergt has spoked wheels, little rigging, and a nine-cylinder radial engine for scale detail. My finished model weighs .75 grams and makes flights more than two minutes.

To build light Peanuts with sufficient strength requires Burt Rutan's construction criterion: "Check every piece for lightness by throwing it up in the air. If it comes down, it is too heavy!"

Apply lightness and strength considerations to EVERY piece. Making one small piece half as heavy will not reduce the weight by much but making every piece half as heavy will result in a light Peanut.

Construction methods should be based on lightness and strength considerations, not on building time. In other words, if it takes you twice as long to build a component that is half as heavy, do it. My Hergt required 52 hours of construction time.

The diminutive Hergt Monoplane. Ailerons were fitted instead of wing warping. Surprisingly given its configuration and power, it appeared in August 1918.

I find the following tools to be particularly useful:

1. Scale for accurate weighi.ng to .001 grams.
2. Wood stripper for making all strip stock.
3. Notebook for recording weights and other construction data (a valuable learning tool).
4. Carbon steel razor blades for clean cuts.
5. Tweezers made of bamboo to hold small parts without crushing the wood.

For cement I use Duco cement thinned with three parts acetone. Use a syringe with a .010 ID needle to apply cement. The balsa I use is indoor wood. The cost of materials for peanuts is minor relative to the amount of building time. Therefore, always use the best available materials.

For the Hergt, I recorded the following weight data on the basic components.

	Ready to cover (gm)	Covered (gm)
Fuselage frame	0.528	0.875
9 Cyl engine and cowl	0.710	0.710
Prop & nose plug	0.970	0.970
Wheels	0.272	0.272
Undercarriage	0.177	0.177
Wing (left and right)	0.423	0.913
Stab	0.065	0.242
Total	3.169	4.266
Misc Detail		0.484

FINISHED WEIGHT (Ready to fly) 4.750

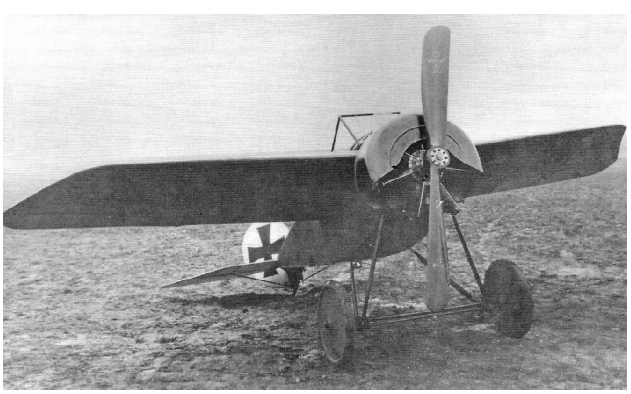
Total paper weight: 1.019 gm

Weight of dope applied to frames to adhere paper: 0.131 gm.

These measurements are typical for a light peanut. Fuselage longerons and cross pieces were cut from 7 lb/ft^3 balsa. Apart from stab and in frames and other non-load bearing pieces, using 4 or 5 lb/ft^3 wood for strip stock is false economy because of low- strengths. The longerons and front cross pieces were .040 square. Remaining cross pieces were .040 by .030. The turtledeck was constructed with 5 lb/ft^3 strips (.025 sq. Additional diagonals were added near the front. I added approximately 30 small gussets (5lb/ft^3 .020 sheet) at all stress points.

Considerable weight can be saved during the construction of scale details. Plastic is quite dense relative to balsa and Styrofoam. Do not use plastic wheels and engine cylinders, they are too heavy for indoor Peanuts. The spoked wheels on the Hergt were constructed from foam and balsa with small brass hubs (.025 OD, 0.15 ID, 0,075 long).

The engine cylinders are tubes rolled from .012-inch balsa. Paint (dope, etc.,) is heavy, felt tip pens can be used to color most details. Sliced ribs (5 lb/ft^3, .022 X .030) were used n the wings. The LE and TE were 7 lb/ft^3 .040 sq and .040 X .030, respectively.



The Hergt Monoplane was powered by an 80 hp Gnome rotary. The small Hergt monoplane was designed and built at FEA 1 at Altenburg. F.D. Hergt was the designer and the prototype was flown by Mario Scherff. Unlike most monoplanes, the cantilever wings and fuselage were covered with plywood.

The aircraft was unarmed and powered by an 80 hp Gnome rotary. The lack of armament and small size indicates the aircraft was intended for training use; installation of a low-power engine indicated the design was not intended for production as a fighter.

A single wing spar (5 lb/ft^3, .020 X .093) was located between the sliced rjbs. Diagonals (5 lb/ft^3, .025 sq) were located between the LE and spar for additional LE strength. Wing tips were formed from .025 X .030 bamboo.

Stab and in frames do not need excessive strength and can be constructed from 5 lb/ft^3 .040 X .025 strips. Keeping the tail light cannot be over-emphasized. Adding weight to the nose is a poor solution for an overweight ail. If the tail is too heavy, make a new tail and, if necessary, rebuild the fuselage. If the tail is 0.10 g heavy, you will typically have to add 0.40 g to the nose -- now you have added an additional 0.50 g to the model!!

5. COVERING LIGHT PEANUTS

The typical procedure used to cover a Peanut is this:

1. Cover the model attaching tissue with some type of adhesive.
2. Spray the model with water or alcohol and hope that it does not warp too badly!
3. Apply one or two coats of thin dope again hoping that the model does not warp too badly!

It is very exasperating to spend 40 hours building and then have the model turn into a pretzel after covering!

Gerry Wagner *of* Southington, CT gave me the following method for covering light Peanuts. It is vastly superior to the above method. Prepare the tissue by the following procedure:

1. Make an 18 X 24-inch rectangular frame from pine strips 3/8 X 3/4 inch or larger. The frame must be strong to prevent twisting as the tissue shrinks.
2. Paint the frame with two coats of hick dope.
3. On a HUMID day, tape an 18 X 24-inch sheet of tissue to the frame. Try to minimize wrinkles. Use small pieces of masking tape.
4. Using a brush and acetone, brush the tissue around the frame to dissolve dope and adhere the issue to the frame. Try to minimize wrinkles. The tissue must be rigidly attached to the frame at every point.
5. Using a spray bottle (Windex, etc.,) and water, spray the tissue and let it dry. The tissue will shrink, removing all wrinkles. and become tight as a drum on the rigid frame.
6. Repeat step 5 at least 10 times over one or two weeks.
7. Leave tissue on frame until you are ready to cover.

The type of tissue is particularly important. From a weight point of view, the difference between light and heavy Japanese tissue can be as much as 50%. Such weight differences can only be detected by weighing sheets of tissue with a good scale, they cannot be 'sensed or felt'. On the Hergt, the total tissue weight on all surfaces was 1.019 grams.

To cover the model, use the following procedure:

1. On all frames, make sure there are no bumps or other protrusions that will prevent the tissue from laying flat against the frame. Sand if necessary.
2. Using dope thinned 5O% and a small brush, brush one coat of dope on the frames. Apply dope only where tissue will touch and use as little dope as possible. This will add between .1 and .2 gm to the model.
3. On the day you cover the model, be sure that the humidity is VERY LOW. This is important, if you cover the model on a high humidity day, later when the humidity is low, the model will warp.
4. Cut pieces of tissue from the frame to match the model frames. The tissue pieces should overlap the model frames by no more than 1/8 inch. A sharp carbon steel razor blade works best to cut tissue. Be careful that you do not wrinkle the pieces of tissue during the cutting and fitting.
5. Remember that tissue must wrinkle if it curves in two directions (compound curves). No single piece of tissue should have to follow a large compound curve. If necessary, cover a particular frame with two or more smaller pieces. For example, on the Hergt the upper surface of each wing was covered with three pieces of tissue to accommodate compound curves at the wing tips.
6. Lay pieces of tissue on model frames. They should lay flat against the frame at all points with no wrinkles. There should be no more. than 1/8-inch overlap at any point, if necessary, trim tissue. If the tissue does not lay perfectly flat against the frame at all points, do not try to force it -- that never works. Ty to understand why it does not conform to the frame. It should be covered with two or more smaller pieces instead of one larger piece. Remember, you cannot force the tissue to fit a frame. When laid on the frame, it should fall into place.
7. When the tissue matches the frame, dip a small brush into acetone and carefully touch the tissue at several points on the frame. The acetone will soak through the tissue, dissolve the dope on the frame, adhere the tissue to the frame. Continue to do this to attach the tissue at all points. Let dry and trim with a sharp carbon steel razor. Continue this procedure to cover all frames.
8. At this point, all frames should be nicely covered. The tissue is wrinkle free but not tight and that is the way it should be. Do not do anything else. Do not spray the covered frames with water or alcohol, which will only cause wrinkles. Do not dope the tissue, it is not necessary, adds excessive amounts of weight (as much as 1 gm with two coats) and may cause warps.
9. Cut aileron outlines and other trim from colored tissue that is pre-doped. Position trim on covered frames and attach with acetone. if you try to directly dope trim to the frame tissue, it ·will cause wrinkles. Models covered by this method will not warp. On a very humid day they may develop wrinkles but that is never a genuine problem. Because this method results in warp-free structures, the model will perform consistently. I have a Lacey built and covered by these methods three years ago. The model weighs 4.5 gm and has flown for 2 minutes and 55 seconds. Flying trim has not changed significantly since the model the first trim.

6. FLYING LIGHT PEANUTS

Trimming peanuts is a whole other subject. If the model is light, warp free, and not tail heavy (properly balanced) it should be easy to trim. In general, try to make fly against torque (to the right) because the circle will tighten as power decreases. This prevents diving under the initial power burst and stalling during the latter part of the flight. I build right and down thrust into my models with a bit (1/16 inch) of washout in the right wing. I use decalage and CG location so that the model is not pitch sensitive.

As with all indoor models, trim peanuts to fly close to the stall speed. When the model stalls, the wing on the inside of the turn should stall first. This causes the model to fall into the turn which quickens recovery and prevents wandering. Experiment with propeller shapes, diameters, and pitches. Do not use plastic propellers, they are too heavy. I use balsa (5-6 lb/ft^3) blades that formed on a carved pitch block. The warped blades glue to bamboo pegs and plugged into a hub made of plastic tubing (Bic ball point pen ink tube). The blades can be twisted at the bub to vary pitch. I use props that are 6 to 7 inches diameter and have blades that are about an inch wide. Prop blades wider than one (1) inch do not work present too much frontal drag.

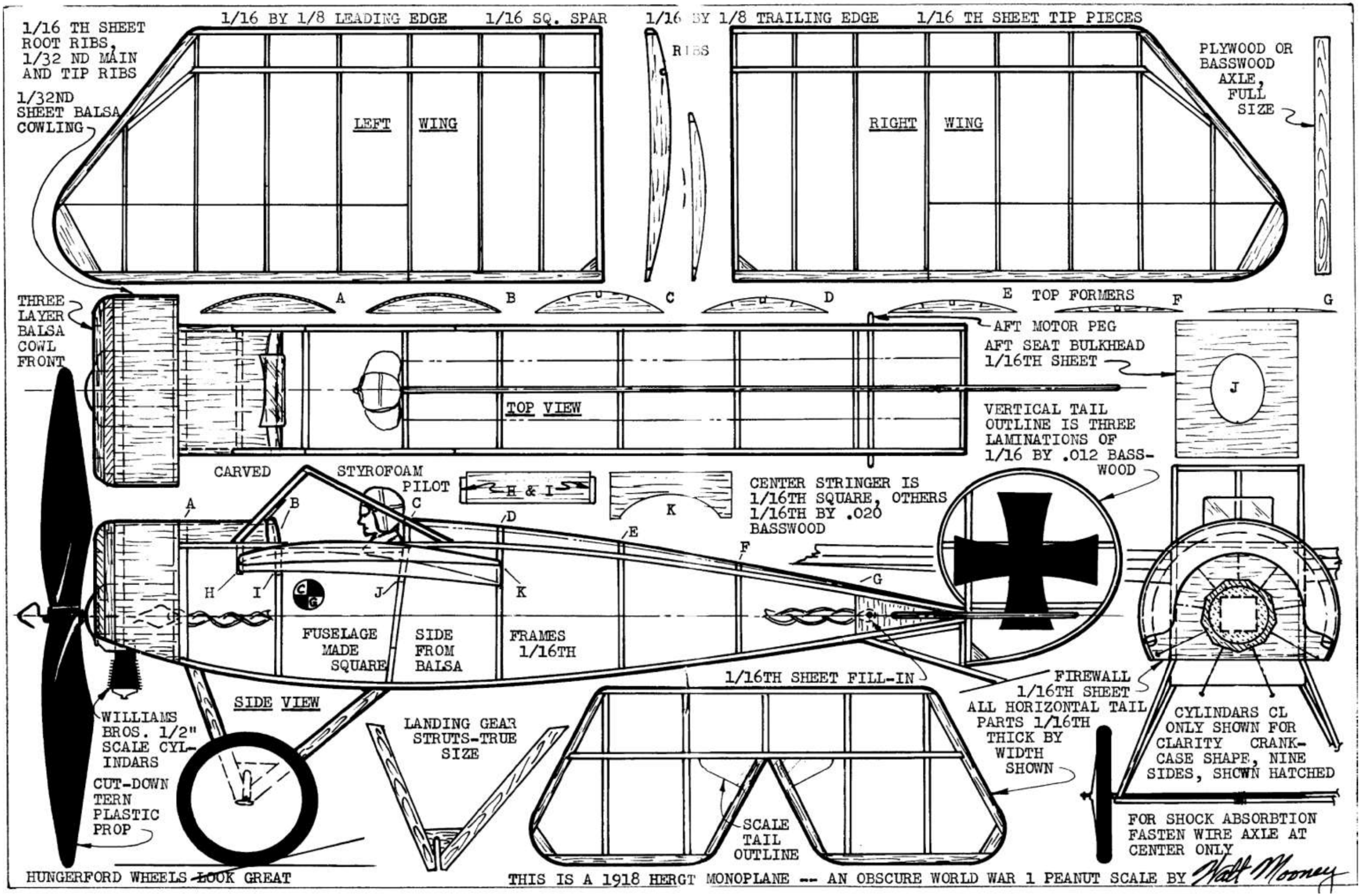
After spending 50 hours building a masterpiece, nothing is more depressing than to have a motor explode and destroy your creation. Design a GOOD winding tube for your model and use it EVERY time. Take good notes while flying. Measure the weight and lengths of motors. After each flying session, study these notes.

7. CLOSING COMMENTS

Professionally I am an engineer and building and flying model airplanes is a microcosm of engineering. The best genera1 advice I can give is to measure things (weights, time, strengths, etc.,), take good notes while building and flying, make rational experiments, study what you and others have done so that you can
improve in the future.

One may disagree with my statements. I build Peanuts that are light and fly well. Others prefer to emphasize scale considerations and are less concerned about weight. (I have seen excessively heavy masterpieces explode as they hit the wall at terrific rate of speed!)

A fool learns from his own mistakes, while a wise man learns from the mistakes of others. This fool has learned much from others and makes no claims of originality for. all the techniques described herein. Nor does he claim that these are the only correct techniques. In the end there are no great secrets, and most modelers are enthusiastic about sharing their knowledge and experiences. That is the way it should be and that is why we are a close group.


1/16 TH SHEET ROOT RIBS, 1/32 ND MAIN AND TIP RIBS
1/32ND SHEET BALSA COWLING
1/16 BY 1/8 LEADING EDGE
1/16 SQ. SPAR
1/16 BY 1/8 TRAILING EDGE
1/16 TH SHEET TIP PIECES
LEFT WING
RIGHT WING
RIBS
PLYWOOD OR BASSWOOD AXLE, FULL SIZE
THREE LAYER BALSA COWL FRONT
A
B
C
D
E
TOP FORMERS
F
G
AFT MOTOR PEG
AFT SEAT BULKHEAD 1/16TH SHEET
J
TOP VIEW
VERTICAL TAIL OUTLINE IS THREE LAMINATIONS OF 1/16 BY .012 BASSWOOD
CARVED
STYROFOAM PILOT
H & I
K
CENTER STRINGER IS 1/16TH SQUARE, OTHERS 1/16TH BY .020 BASSWOOD
H
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FUSELAGE MADE SQUARE
SIDE FROM BALSA
FRAMES 1/16TH
SIDE VIEW
1/16TH SHEET FILL-IN
FIREWALL 1/16TH SHEET
ALL HORIZONTAL TAIL PARTS 1/16TH THICK BY WIDTH SHOWN
CYLINDARS CL ONLY SHOWN FOR CLARITY CRANK-CASE SHAPE, NINE SIDES, SHOWN HATCHED
WILLIAMS BROS. 1/2" SCALE CYLINDARS
LANDING GEAR STRUTS-TRUE SIZE
CUT-DOWN TERN PLASTIC PROP
SCALE TAIL OUTLINE
FOR SHOCK ABSORBTION FASTEN WIRE AXLE AT CENTER ONLY
HUNGERFORD WHEELS LOOK GREAT
THIS IS A 1918 HERGT MONOPLANE -- AN OBSCURE WORLD WAR 1 PEANUT SCALE BY Walt Mooney

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The next SAM 56 Dinner Meeting will be at:

Mediterranean Grill

335 S Towne East Mall Dr., Wichita, KS 67207
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Saturday, November 12, 2022
Social Hour @ 6:00 PM, Dinner @ 6:30 PM...

Upcoming events:

Tulsa Glue Dobbers Fall Ralley, Wellington Airport, Nov 4 – 5th.

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