

# INDOOR

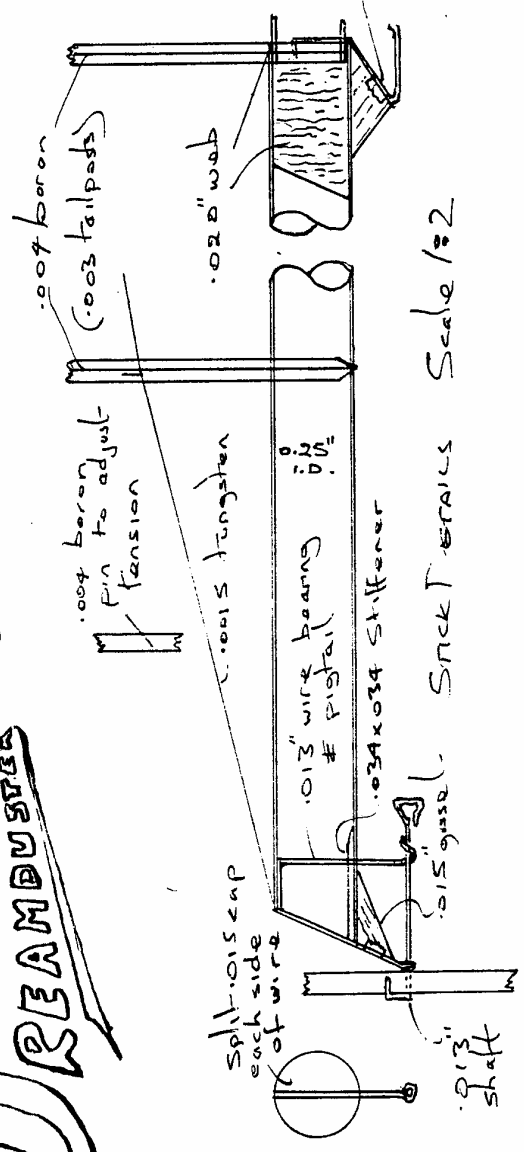
NEWS and VIEWS

ISSUE # 105

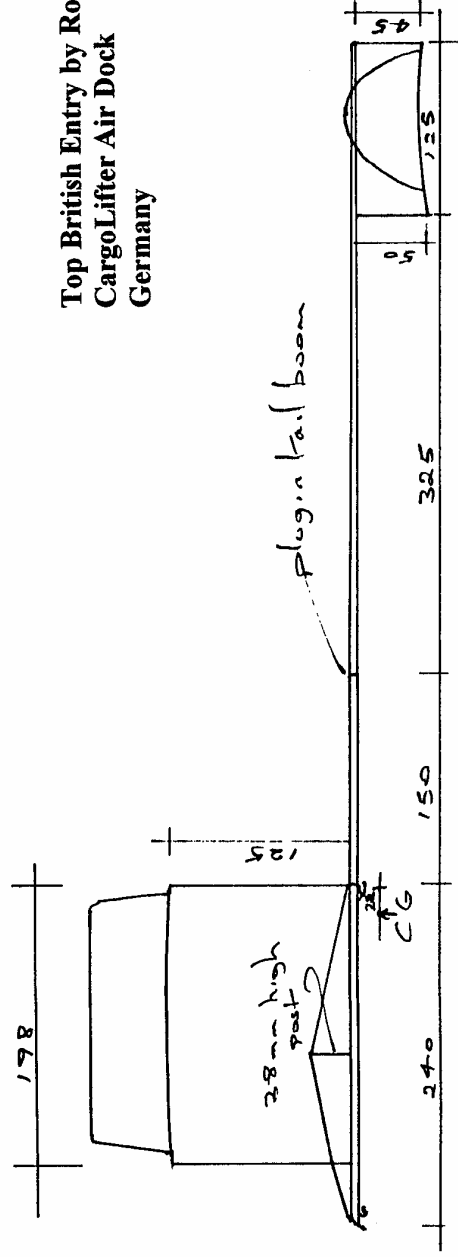
January 2002

**DREAMDUSTS**

F.I.D.



Top British Entry by Ron Green  
CargoLifter Air Dock  
Germany



## From The Editor's Desk

As Garrison Keelor would say, "It's been a quiet week." The hectic, page-cramming and multiple contest reporting of the last few issues seems to be almost past. Thirty-two pages each was a lot, by anyone's standards, and although this, too is a full issue, I think we're tapering off. You, our readers, have outdone yourselves in providing INAV with material.

Only one major indoor 'event' is reported in this issue – the German Nationals at the Cargo Lifter site. But what an event it was, with the best from 8 nations competing in the space-age hangar with its huge, 320 foot ceiling. Laurie Barr, Nick Aikman, and Karol Vins have been great in providing all the results, plans and stories. We present the Cargo Lifter details for your inspection by our contributing editor, Nick, and plans for two of the top entries: Ron Green's Dreamduster F1D and Bob Bailey's 35 cm model. Laurie Barr's Big Bazooka winning F1M model was published in Issue #96.

We have also managed to include some long overdue legal eagle and embryo, thanks to Newt Bollinger of the MIAMA club.

- Carl Bakay

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From The Membership Desk

Hectic time lately. Getting my new venture Tru-Weight Indoor Balsa up and running has consumed more time than expected and now I am having to make like a kid in school and do my assignment the night before it is due.

INAV has started another new program to reach out and attempt to introduce kids to this fabulous hobby. We have partnered with Ray at Indoor Model Specialties and Jake at Specialized Balsa Wood to have a flier that promotes INAV and the Jr subscription included in the orders Jake is shipping the Bambino kit Ray produces. The idea is that Jake primarily serves the science contest market where the sport of indoor flying is not well known and Ray's kit is specifically for Science Olympiad. So far we have gotten some Jr subscriptions from areas that I am not aware of a strong indoor community and I think these fliers may be the medium that got the word out. The flier is a ½ page sheet with a great drawing of an EZB showing the flight and reaction forces that was drawn by Steve Gardner and the wonderful drawing of West Baden done by Carl Bakay that was the cover of the last issue. If you want to see the flier point your browser to <http://www.IndoorDuration.com/INAVorderstuffer.pdf> Feel free to print off a stack of these fliers and distribute them to people that may have an interest in learning more about the sport and to juniors that are looking for a way to learn more about this hobby.

As always we can use your articles, pictures, ideas, plans, and tips to help us fill the next issue of INAV with the great information you expect. Remember, what is old hat to you is probably a revelation to another reader.

Tim

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## A review of Joe Maxwell's new book "The Secrets of Aids for Advanced Aeromodelling"

World renowned balsa wizard Joe Maxwell has done it again with another must have book. Joe is known for the tremendous balsa items he produced such as solid balsa F1B wings and F1B prop blanks, Indoor prop blocks and matched prop molds and various other intricate items made of solid balsa. The general thought was that Joe used computer controlled equipment to produce these amazing items. Now that Joe is out of the business he has written a book that explains the real methods he used.

Joe explains how he used common basic wood working tools to efficiently build complex items through the use of special jigs and fixtures. Nothing that he explains is beyond the realm of the average hobbyist. He tells how he uses a radial arm saw to build perfectly formed indoor prop blocks. This alone is worth the price of the book for the serious indoor flier.

The book has many pictures that illustrate the concepts that are explained very well in each chapter.

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- 7 . Balsa Sheets
- 8 . Trailing Edges

- 9 . Shaping with a Skewed Saw
10. Cambered Building Boards
11. Building Boards - Constant Chord
12. Taper Carrier
13. Building Boards - Tapered
14. Solid Balsa Wings
15. Ribs
16. Mandrels
17. Catalogues

GBP 9.00 in the UK, GBP 10.00 or US\$15.00 elsewhere.  
The easiest way to get a copy is to send bills (not a check).  
Sorry I don't take credit cards. Price includes postage.

Joe Maxwell  
11 Windsor Place  
Stirling  
FK8 2HY  
Scotland  
U.K.

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# ALL AGES "SCIENCE OLYMPIAD WRIGHT STUFF" CONTEST RESULTS

SUNDAY-OCTOBER 7, 2001 @ SCRIPPS RANCH COMMUNITY CENTER, SAN DIEGO

## JUNIORS (UNDER AGE 18)

NAME	RND 1+LND'G	RND 2+LND'G	RND 3+LND'G	BEST TOTAL	PLACE
JORDIE MANN	2:15 + 0	2:50 + 10	2:36 + 0	3:00	1
JUSTIN CHARTRON	2:19 + 10	2:27 + 10	2:23 + 10	2:37	2
ALEX NELSON	2:14 + 0	2:33 + 0	2:20 + 0	2:33	3
SAUMIL SHAH	2:06 + 10	2:08 + 10	2:22 + 10	2:32	4
NICOLE WEBSTER	2:14 + 10	2:04 + 10	1:54 + 0	2:24	5
CODY ALLEN	2:12 + 10	0:23 + 10	2:13 + 10	2:23	6 TIE
ALEX PREISSER	1:04 + 10	2:01 + 10	2:13 + 10	2:23	6 TIE
KIAN SAMII	1:47 + 0	2:13 + 10	0:22 + 0	2:23	6 TIE
AARON GROSS	1:37 + 0	2:09 + 10	1:49 + 10	2:19	9
JOHN WU	1:50 + 10	1:24 + 10	2:08 + 10	2:18	10
KYLE ADLER	1:03 + 0	2:04 + 10	0:26 + 10	2:14	11
PETER DUAN	1:05 + 0	1:22 + 10	1:50 + 10	2:00	12
ANTHONY IVES	1:06 + 0	1:25 + 10	1:34 + 10	1:44	13
KEVIN TIROHN	0:23 + 10	0:38 + 10	1:33 + 10	1:43	14

## SENIORS (OVER AGE 18) NOTE: *SOME WAY, WAY OVER 18!*

CEZAR BANKS	1:22 + 0	3:01 + 10	3:20 + 10	3:30	1
JOHN HUTCHISON	2:25 + 10	1:53 + 0	2:35 + 10	2:45	2
BRIAN FINLEY	1:42 + 10	2:06 + 10	2:20 + 10	2:30	3
JOHN OLDENKAMP	2:05 + 10	1:59 + 10	0:26 + 0	2:15	4
HOWARD HAUPT	1:49 + 10	2:02 + 10	0:40 + 0	2:12	5
GREG HUTCHISON	1:54 + 10	1:02 + 10	1:59 + 10	2:09	6
DICK BAXTER	0:21 + 0	1:11 + 10	1:51 + 10	2:01	7
GUS DEL CASTILLO	0:59 + 0	1:24 + 0	1:34 + 0	1:34	8
LEE TIPPS	0:25 + 0	1:13 + 10	1:31 + 0	1:31	9

**STUFF WORTH NOTING:** TAKING A CUE FROM OTHER MECCAS OF SCIENCE OLYMPIAD WRIGHT STUFF LIKE CLEVELAND, SEATTLE AND ATLANTA, WE TOO (SCALE STAFFEL AND SAN DIEGO ORBITEERS) DECIDED TO HOLD AN UNOFFICIAL CONTEST BASED MOSTLY ON 2001 RULES AND ALLOWING AN "OVER 18" GROUP TO ALSO COMPETE AND ADD TO THE FUN. OUR SITE IS A BIT DOMED, 32.5 FT TO ITS OBSTRUCTED HIGH POINT AND 26.5 FT CLEAR.

MOVER AND SHAKER ROGER WILLIS, A MEMBER OF BOTH CLUBS: a) ARRANGED PUBLICITY, ie SAN DIEGO 5<sup>TH</sup> DISTRICT COUNCIL MEMBER BRIAN MAIENSCHIN TO PRESENT AWARDS, b) DONATED THE JUNIOR TROPHIES AND TEN "HARLAN BAMBINO" KITS AND c) ACTED AS HEAD TIMER AND STARTER. SANDY PECK AND DAUGHTER VERA DID THE CONTEST DIRECTOR CHORES SMOOTHLY AND EFFICIENTLY JUST AS THEY DO AT SAN DIEGO'S OFFICIAL S.O. CONTESTS. VOLUNTEER TIMERS FROM BOTH CLUBS WERE ALWAYS AT THE READY.

AS IT TURNED OUT, MORE THAN HALF THE JUNIORS WERE MIDDLE SCHOOL STUDENTS WITH NO PRIOR MODELING EXPERIENCE. YET ONLY 23 SECONDS SEPARATED 2<sup>ND</sup> FROM 11<sup>TH</sup> PLACE. MIDDLE SCHOOL SCIENCE TEACHER BRIAN FINLEY FINISHED 3<sup>RD</sup> IN SENIORS WITH HIS FIRST TRY, TOO! NO DOUBT THE HANDS ON MENTORING BY DAVID IVES, CEZAR BANKS, JOHN HUTCHISON, GUS DEL CASTILLO, JOHN OLDENKAMP AND FUDO TAKAGI (WHO ALSO MADE THE SENIOR AWARD PLAQUES) PLAYED A BIG PART. BUT LUCK ALSO ENTERED IN. A ZERO FOR LANDING SCORE ALMOST ALWAYS MEANT A CAPRICIOUS CEILING BUMP WHICH PUT THE AIRPLANE INTO A WALL OR HANGUP, THUS STOPPING THE CLOCK.

THE BIGGEST AND MOST MEMORABLE HAPPENING THOUGH, WAS WATCHING THE MIDDLE SCHOOL KIDS' FACES AND BEHAVIOR DURING A GOOD FLIGHT. THEY WERE SO LIT UP THEY JUST GLOWED! SAUCER SIZE EYES, YELPING AND CLAPPING, JUMPING AROUND. WHAT A HIGH! I SHALL BE VERY SURPRISED IF MOST OF THEM DON'T ENTER THE OFFICIAL SCIENCE OLYMPIAD PROGRAM NEXT SPRING 2002.

- CEZAR BANKS

## **THE OPEN INTERNATIONAL MEETING AT THE 'CARGO LIFTER' HANGER: BRIESEN - BRAND: GERMANY: OCTOBER 13<sup>th</sup> AND 14<sup>th</sup>.**

From any point of view this was undoubtedly one of the most successful and enjoyable indoor duration meetings ever. Over 70 competitors including 15 juniors attended, from 9 countries. From Great Britain in the West to Israel in the East, we congregated at what is undoubtedly the best indoor 'cathedral' in the World, 40 miles South of Berlin.

The organisation and hotel accommodation were both excellent, and so was the spirit of friendship and co-operation. Language barriers dissolved as everyone spent 2 days flying in indoor paradise. New World high times were recorded in F1D, F1L and 35cm classes and although the atmosphere was competitive, it was also relaxed and gregarious.

Ten of us made the 'Cargo lifter' pilgrimage from the U.K. John Tipper, Laurie Barr and Geoffrey Lefever took cars and 4 passengers, together with several dozen model boxes, crossing the channel by ferry to mainland Europe and then onwards. Bernie Hunt and Roy Wilson flew, having entrusted their models to be chaperoned by car. As I was AWOL from academic university duties, my schedule was tight and so I also elected to fly, taking my models with me.

This was my first model flying trip abroad and I was nervous about possible damage, especially with increased security after the events of September the 11<sup>th</sup>. A new, small, lightweight foam-core box was built to hold 3 F1D's and two F1L's on trays. A clear window, reinforced corners and several layers of bubble-wrap completed the package. Despite 3 phone calls to British Midland Airways, explanations of the delicate nature of my luggage and agreement that it could be carried as hand baggage, on arrival I was dismayed to find that the box would be consigned to the cargo hold. The neurotic and totally negative check-in clerk would not relent and so, uttering dark threats to sue the airline, I insisted on loading the box personally. This was the only glitch and changing to Lufthansa at Frankfurt, I was treated like royalty, the model box was even given a seat of its own. It is therefore still possible to travel with indoor models but good packing arrangements are even more important than ever.

Although we had seen pictures of the new hanger before, nothing prepared any of us for the reality. The 'Cargo lifter' concept is to build a new generation of huge semi-rigid airships, 800 feet long and capable of carrying loads up to 160 tons. The brand new hanger is situated on a derelict soviet airbase and is claimed to be the largest self supporting structure in the world, 320 feet high, 640 feet wide and 1,100 feet long. In cross section a perfect semi-circle, each end of the building has hemispherical clamshell doors while the straight central section is composed of a minimal steel structure covered by a double layer tensile membrane. This is designed to maintain a constant temperature of around 64 degrees C. all year round.

So, we were flying in a building over twice the height and three times the width of Cardington. Parked at one end was the CL 75, a perfectly spherical developmental balloon/crane capable of lifting 75 tons and only 15 feet smaller in diameter than the hanger height at Akron!

Throughout the weekend, a constant stream of tourists were given the 'Cargo lifter' Experience, with a video presentation, exhibition, coach tour of the facilities and chance to buy the T shirt.

Classes flown were F1D, F1L, F1M and 35cm with plastic covering. As with a World champs, the best 2 times from 6 attempts were counted as the score for each event. This meeting was also used as the German team trial for the Slanic event next year. Flying began at 8.00 am and contest flights 2 hours later. Attempts in any class were possible at any time over the two days with flying ending at 8.00 PM on Saturday and 5.00 PM on Sunday evening. Because of the controlled temperature inside, the air never really became buoyant. It did improve in the early evening on both days, maybe because of the good weather outside. Vast batteries of lights clustered in the ceiling were switched on around 6.00 PM and may have raised the temperature near the roof by a few degrees. Because of the huge floor area and minimal drift, not one model hung up all weekend. Balloon steering was only necessary as models descended over the rows of competitors tables.

With so many models airborne at once, it was sometimes difficult to track and time the right one. Against the cream coloured, central membrane, models literally disappeared, even at low altitude. This problem was made worse by the fact that many planforms in all classes were almost identical.

41 flew in F1D, 28 in F1L, 12 in F1M and 6 in 35cm. I was particularly impressed by the number of junior flyers in F1D and F1L, and also in the standard of construction of many of their models. Several juniors were female and the youngest was only around 8 years old – hope for the future of indoor duration.

The 'Brit Pack' did particularly well, winning all classes except F1D. 'Archbishop' Barr won F1M with his trusty 'Big Bazooka' model and this class was only contested by British and German flyers, suggesting that it has yet to catch on in some other parts of Europe. This is a shame as it is certainly a good way to try out some of the complex constructional techniques that are required for F1D.

F1L was dominated by the British, who took the first 6 places. John Tipper built a model especially for this competition. Constructed using his stiffest wood usually reserved for F1D and beautifully covered with Y2K2, John made two flights over 27 minutes to win the class. One of these flights, observed through binoculars, reached a height of around 300 feet, only a few feet under the girders, right in the middle of the hanger. 27.07 is a new World best in F1L.

British flyers also took the first 3 places in 35cm. Earlier in the year, Geoffrey Lefever had urged Bob Bailey to build one of these diminutive models and even gave him some wood. Bob then went on to make flights of 32 and 33 minutes to win the competition. John Tipper flew his latest tandem to good effect to take 2<sup>nd</sup> and Geoffrey took 3<sup>rd</sup>, probably wishing he hadn't said anything!

As expected, F1D was the most hotly contested class. German flyer Peter Kuttler made 3 flights on Saturday with a best high time of the meeting of 35.32. This has been submitted as a new World record. He then left, having to go to work on Sunday! The next day he was relegated to 2<sup>nd</sup> place by Lutz Schramm who steadily increased his times by 1 minute increments, ending with a higher 2 flight total. I didn't see these models and so cannot describe them. Ron Green took 3<sup>rd</sup> with a new copy of his very successful machine that put him at the top of the UK team trials (see plan). Ron had spent some time earlier in the year building and testing freewheeling, folding and feathering F1D props in anticipation of the height available in the hanger. In the end however, his highest time and new UK record of 35.25 was made with a fairly conventional fixed pitch propeller with boron outlined blades.

There was a fairly even split between braced and unbraced and between microfilm and the Y2K/2 films. Andras Ree had at least 1 unbraced model and as the main proponent of the recent rule changes, he confessed that he never expected the new models to climb so high or fly for so long. The new rules certainly seem to have caught on and the variety of planforms visible shows that there is still plenty of scope for design experimentation. John Tipper took the unofficial altitude record again; his longest flight reached an estimated height of 260/270 feet but still came down in less than 34 minutes.

All of the UK flyers had trouble blowing motors; maybe we were winding them harder than others. Several of us had at least one fully wound motor break on the model. Bernie Hunt did much damage to one motorstick and Derek Richards re-braced a damaged stick, wound again and then had the same thing happen immediately. Ron and I escaped lightly, only doing slight, repairable damage. As we were both winding to around 38gram/centimetres with no back off the luck was running with us. Bob Bailey went to launch his last F1D flight when the rubber exploded just before launch and wrecked the front end of his best aeroplane. The May '99 batch does seem to have a delayed action fuse at times. This wasn't helped by having to take a nerve wracking afternoon stroll out to the centre of the hanger with a fully wound motor.

The most innovative design came from Dieter Siebenmann, making a return to F1D after several years absence. He flew a fairly short-coupled machine with very high wingposts, a drooping tailboom and a motorstick angled to give roughly 10 degrees downthrust relative to the wing. The tailplane had a very wide chord and the propeller was fairly conventional in diameter but with short, paddle shaped blades with a moulded carbon fibre outline, placed on the ends of a long mainspar. Despite these extreme details, the model still did over 33 minutes and had perhaps the most vertical initial climb angle of all.

The event was planned and efficiently organised by Gerhard Woebeking and a small band of helpers. Gerhard was gracious and untiring throughout, as well as being a fine dinner companion. On behalf of all the UK flyers, I thank and congratulate him for all his efforts. Two previous meetings had shown the potential of this site and it is planned to hold 4 meetings a year in future (airships permitting), one of these will be an Open International. A hot buffet was available throughout both competition days and on Saturday evening there was a banquet with robust local food at a nearby Hostelry. The final awards ceremony was an amiable affair, with prizes and certificates to third place for junior and senior winners. A constant update of scores was posted from a laptop.

Afterwards, in a final session of testing, only the UK flyers remained. Having won 35 cm, Bob Bailey took the same aeroplane (see plan) and went for the 'big one'. With a fully wound motor (3000 turns), he was about to launch but the stick showed signs of buckling. A deft smear of cyano' later and the model took off safely and climbed away. It quickly became miniscule to the naked eye and almost impossible to spot, appearing intermittently in the glare from the internal lights. Minutes ticked away and the model still showed commendable reluctance to come down. Packing up stopped as we all peered upwards and when 30 minutes came and went, the plane was still at about 100 feet. Descending slowly, it finally deadsticked at about 40 feet and with the motor hanging conveniently from the rear hook, landed with the watch showing 36.23. An unbelievable time and a fitting finale to the weekend's proceedings. Bob is now wondering if 40 minutes is possible. Over to him for some details:

*This model started life as a scaled down version of my old rules F1D which had on occasions flown extremely well. I preferred the layout to a tandem model, for which, getting the CG in the optimum position poses a very difficult structural problem. Guidance was sought from Geoff Lefever and John Tipper in terms of wood sizes, prop diameter and pitch etc. before starting.*

The prop ribs are split in the middle and attached to the sides of the spar, to ensure the covering is flush with the spars. This technique is also used on my F1D props. There appears to be a distinct climb advantage compared with the usual construction where the ribs are attached to the top of the spar, leaving a gap. I also decided to take on the challenge of building a VP prop in the style of those that Ron Green, Geoff Lefever and I use for F1D. To my knowledge this had not been done before. Initial testing showed that the tailplane was too stiff since it showed no sign of bending; I replaced it with a lighter one covered in microfilm and then a third, covered in Y2K2 film, for more robustness and ease of handling.

Further discussion with Geoff pointed to a larger wing and I chose a chord giving about the same aspect ratio as that for a new rules F1D. This seemed to show a significant improvement. Further testing at home to optimise the prop pitch indicated that a pitch of about 19 inches gave significantly lower power consumption on cruise than higher values. The main trimming took place in a low ceiling site, this also being used to test the VP prop. Conditions at Cardington had not been good enough when time was available. I found out in time that the 35 cm contest (F1P) at the 'Cargo lifter' hanger outlawed microfilm and the prop was accordingly recovered with Y2K2 film.

*Nick Aikman 10.12.01*

# Deutscher Aero Club e.V. - Sportfachgruppe Modellflug

Deutsche Saalflugmeisterschaften 2001 13./14. Oktober - Cargo Lifter Wert

F1L		Nationalität	Jugend	1	2	3	4	5	6	1. Wert	2. Wert	Gesamt	Platz
Tipper, John	GBR			23:00	23:51	27:07	27:02			27:07	27:02	54:09	1
Jones, Geoff	GBR			19:54	22:38	25:33	26:35	25:50		26:35	25:50	52:25	2
Barr, Laurie	GBR			21:20	25:03	24:55	24:41			25:03	24:55	49:58	3
Hunt, Bernhard	GBR			00:00	00:00	00:00	23:38	22:05	23:49	23:49	23:38	47:27	4
Wilson, Roy	GBR			22:05	23:03	22:44	22:40	19:08	23:20	23:20	23:03	46:23	5
Derek, Richards	GBR			22:24	20:36	00:00	21:28			22:24	21:28	43:52	6
Bundesen, Uwe	D			06:59	18:08	22:49	18:45	19:45	21:01	22:49	21:01	43:50	7
Treger, Ivan	SWK			20:38	22:04	15:06	20:52	20:19		22:04	20:52	42:56	8
Schlosser, Benno	D			19:21	20:15	20:53	18:54			20:53	20:15	41:08	9
Feifer, Ladislav	CZE			15:11	17:00	20:07	20:27			20:27	20:07	40:34	10
Lotz, Rainer	D			18:39	18:58	21:27				21:27	18:58	40:25	11
Nimptsch, Werner	D			18:31	17:10	21:43				21:43	18:31	40:14	12
Kaplan, Mikita	CZE			16:32	17:05	18:30	21:23	17:49		21:23	18:30	39:53	13
Markiewicz, Jerzy	PL			15:14	13:50	15:25	18:52	19:30	19:45	19:45	19:30	39:15	14
Kaplanova, Gabriela	CZE	J		08:39	19:03	17:04				19:03	17:04	36:07	15
Kaplanova, Klara	CZE	J		17:26	16:48	00:00	14:50	17:36		17:36	17:26	35:02	16
Rimas, Steponas	LT			13:35	14:18	15:25	15:23	16:53	18:05	18:05	16:53	34:58	17
Ignas, Valikonis	LT	J		05:39	14:05	15:02	15:54	16:01		16:01	15:54	31:55	18
Kaplan, Mikita sen.	CZE			09:10	13:20	14:41	17:09			17:09	14:41	31:50	19
Dambruskas, Ernestus	LT	J		06:56	07:53	00:00	13:45	13:43	17:27	17:27	13:45	31:12	20
Feifer, Lukasz	CZE	J		12:17	00:00	00:00	17:40			17:40	12:17	29:57	21
Vilius, Steponenas	LT	J		10:40	10:59	11:02	13:33	14:58	10:07	14:58	13:33	28:31	22
Wächter, Bruno	D			10:54	14:07	13:55				14:07	13:55	28:02	23
Juozapas, Cybas	LT	J		12:07	12:51	13:00	12:56	13:56	12:45	13:56	13:00	26:56	24
Pukowiec, Michal	PL	J		00:00	00:00	00:00	07:59	16:40	00:16	16:40	07:59	24:39	25
Vaidotas, Veta	LT	J		09:59	11:18	11:21	09:58	08:45	12:35	12:35	11:21	23:56	26
Mejzlik, Petr	CZE	J		07:09	01:52	05:57	12:40	08:12	09:29	12:40	09:29	22:09	27
Rogowski, Mariusz	PL	J		00:00	00:00	00:00	09:00			09:00	00:00	09:00	28
Alkmann, Nick	GBR			00:00	00:00	00:00				00:00	00:00	00:00	29
Bailey, Bob	GBR			00:00	00:00	00:00				00:00	00:00	00:00	29
Green, Ron	GBR			00:00	00:00	00:00				00:00	00:00	00:00	29
Kaidotas, Veta	LT	J		00:00	00:00	00:00				00:00	00:00	00:00	29
Leferer, Geof	GBR			00:00	00:00	00:00				00:00	00:00	00:00	29

# Deutscher Aero Club e. V. - Sportfachgruppe Modellflug

## Deutsche Saerfluggmeisterschaften 2001 13./14. Oktober - Cargo Lifter Wertf.

FIM		Nationalität Jugend											
Name, Vorname	Nationalität	1	2	3	4	5	6	1. Time	2. Time	Total	Platz		
Barr, Laurie	GBR	17:16	17:35	18:51	18:18	19:47	19:47	19:47	18:51	38:38	1		
Lotz, Rainer	D	16:49	18:14	18:38	18:36	19:04	18:36	19:04	18:38	37:42	2		
Schlosser, Benno	D	16:57	17:04	00:00	16:34	16:09	16:52	17:04	16:57	34:01	3		
Bundesen, Uwe	D	16:34	15:59	16:48	17:06	16:05		17:06	16:48	33:54	4		
Tipper, John	GBR	00:00	00:00	00:00	14:49	17:08		17:08	14:49	31:57	5		
Hasselmann, Johannes	D	15:37	15:41	14:23	13:56	13:58		15:41	15:37	31:18	6		
Nimptsch, Werner	D	00:00	00:00	00:00	15:10	15:34		15:34	15:10	30:44	7		
Wächter, Bruno	D	10:22	13:09	15:09	14:05	15:09	13:24	13:30	14:05	29:14	8		
Klinck, Alfred	D	12:47	13:11	00:00	13:30	13:05		13:30	13:24	26:54	9		
Luxemburger, Jürgen	D	11:06	11:35	10:15	15:38			11:35	11:06	22:41	10		
Green, Ron	GBR	00:00	00:00	00:00	15:38			15:38	00:00	15:38	11		
Jones, Geoff	GBR	00:00	00:00	00:00	13:21			13:21	00:00	13:21	12		
<b>FIM 60</b>													
Schlosser, Benno	D	14:01	14:22	15:21	14:27	15:39		15:39	15:21	31:00	1		
Lotz, Philipp	D	12:21	13:44	14:35	14:29	14:21		14:35	14:29	29:04	2		
Hasselmann, Johannes	D	13:34	13:48	14:06	13:54	11:36		14:06	13:54	28:00	3		
Feger, Jens	D	11:42	13:50	14:01	12:50	11:40	12:34	14:01	13:50	27:51	4		
Wächter, Bruno	D	11:14	13:13	12:15	10:52			13:13	12:15	25:28	5		
Luxemburger, Jürgen	D	08:47	09:54	10:20	08:39			10:20	09:54	20:14	6		
Steigenwald, Friedbert	D	08:12	08:35	09:47	08:49	09:17		09:47	09:17	19:04	7		
Viezeus, Ekkehard	D	06:17	06:32	07:58	07:19	08:51	08:01	08:51	08:01	16:52	8		
<b>35 cm (50)</b>													
Bailey, Bob	GBR	32:03	00:00	00:00	33:19			33:19	32:03	65:22	1		
Tipper, John	GBR	28:18	26:09	30:19				30:19	28:18	58:37	2		
Lefever, Jeof	GBR	24:01	20:31	24:51				24:51	24:01	48:52	3		
Nimptsch, Werner	D	19:56	21:30	22:34				22:34	21:30	44:04	4		
Stratner, Werner	D	17:26	17:56	19:26	20:02	20:34	19:59	20:34	20:02	40:36	5		
Viezens, Ekkehard	D	00:00	12:24	07:05	13:10	12:13	12:43	13:10	12:43	25:53	6		
Klinck, Alfred	D	15:34	00:00	00:00				15:34	00:00	15:34	7		

# Deutscher Aero Club e.V. - Sportfachgruppe Modellflug

Deutsche Saalflugmeisterschaften 2001 13./14. Oktober - Cargo Lifter Wert

Name, Vorname	Nationalität	Jugend					Gesamt	Platz		
		1. Wert	2. Wert	3. Wert	4. Wert	5. Wert				
Schramm, Lutz	D	29:27	30:26	31:59	32:06	33:03	34:25	33:03	67:28	1
Kuttler, Peter	D	27:29	31:51	35:32	30:56	35:25	33:30	35:32	31:51	2
Green, Ron	GBR	26:30	31:19	31:20	30:56	35:25	33:30	35:25	31:20	3
Tipper, John	GBR	00:00	00:00	00:00	29:40	31:39	33:30	33:30	31:39	4
Siebenmann, Dieter	SUI	30:38	33:19	31:32	29:56	31:09	32:40	33:19	31:32	5
Treger, Ivan	SWK	23:50	27:30	29:06	21:35	31:09	32:40	32:40	31:09	6
Keller, Peter	SUI	31:31	31:17	29:32	31:39	30:55	31:39	31:39	31:31	7
Hunt, Bernhard	GBR	28:30	30:12	31:25	28:44	29:44	31:42	31:25	30:12	8
Richards, Derek	GBR	25:04	30:45	27:39	28:44	29:44	31:42	30:45	29:44	9
Merkt, Thomas	D	22:47	27:11	27:39	21:01	28:33	31:42	28:33	28:33	10
Lefever, Geof	GBR	29:56	00:00	00:00	26:33	27:50	28:59	28:59	28:59	11
Sukosod, Zoltan	HUN	27:58	27:32	29:59	28:22	26:12	28:35	28:35	28:35	12
Bailey, Bob	GBR	23:24	28:52	29:37	28:47	27:31	28:47	29:37	28:47	13
Nimptsch, Werner	D	28:17	26:13	29:36	28:47	27:31	28:47	29:36	28:47	14
Orsovai, Dezso	HUN	26:14	28:10	29:37	27:03	28:42	29:02	29:37	28:10	15
Lotz, Rainer	D	24:22	25:43	26:46	27:16	28:42	29:02	29:02	28:42	16
Krause, Marian	D	22:48	23:08	26:12	27:16	27:54	28:13	29:13	27:54	17
Miron, Ran	ISR	24:45	24:27	22:09	26:43	29:10	27:21	29:10	27:21	18
Schönfelder, Karl	D	20:40	18:33	23:01	24:28	29:39	26:46	29:39	26:46	19
Aikman, Nick	GBR	22:57	27:29	00:00	28:28	26:54	26:46	28:28	27:29	20
Kaplan, Mikita	CZE	22:24	22:55	26:09	23:46	29:40	26:09	29:40	26:09	21
Dihm, Jan	PL	24:48	22:11	25:52	24:42	24:26	26:48	26:48	25:52	22
Shenkar, Ruben	ISR	20:36	22:16	20:49	23:41	25:54	26:11	26:11	25:54	23
Ree, Andras	HUN	23:07	23:52	00:00	25:00	26:01	26:01	26:01	25:00	24
Sukosod, Tamas	HUN	19:21	18:43	16:30	20:30	26:28	24:00	26:28	24:00	25
Rimas, Steponenas	LT	20:16	24:33	24:51	23:54	23:03	24:55	24:55	24:51	26
Vitaljus, Salogubovas	LT	18:15	23:38	23:34	24:16	24:08	25:19	25:19	24:16	27
Ciapala, Edward	PL	22:39	19:50	25:08	24:16	01:57	23:07	25:08	24:16	28
Fleik, Jakub	PL	23:58	24:01	24:41	22:01	23:28	23:20	24:41	24:01	29
Klinck, Alfred	D	23:03	22:52	23:11	19:08	22:37	23:02	23:11	23:03	30
Markiewicz, Jerzy	PL	20:36	21:17	21:51	18:27	23:02	22:47	23:02	22:47	31
Kaplanova, Klara	CZE	18:26	25:09	00:00	18:18	21:06	21:26	25:09	18:26	32
Markunas, Martynas	LT	10:22	16:58	18:26	19:28	21:06	21:26	18:26	18:26	33
Rogowski, Mariusz	PL	18:40	19:58	19:51	16:59	21:13	17:58	21:13	19:58	34
Pukowiec, Grzegorz	PL	17:20	18:01	20:46	17:18	18:38	16:02	20:46	18:38	35
Gytis, Tyla	LT	19:09	18:34	00:00	11:08	16:48	16:02	19:09	18:34	36
Pukowiec, Michal	PL	10:05	18:49	18:01	11:37	16:48	16:02	18:49	18:01	37
Ignas, Valikonis	LT	19:08	17:13	17:12	17:37	14:13	16:02	19:08	17:37	38
Feifer, Ladislav	CZE	13:14	16:10	00:00	20:06	12:50	13:51	16:10	16:10	39
Dambruskas, Ernestus	LT	10:16	12:46	18:23	09:53	12:50	13:51	18:23	12:46	40
Stanczak, Marek	PL	00:00	00:00	00:00	09:53	12:50	13:51	00:00	12:50	41
Barr, Laurie	GBR	00:00	00:00	00:00	09:53	12:50	13:51	00:00	12:50	42

Posted by Vern Hacker on the indoor mailing list:

The Balsa tree grows in the Rain forest[Jungle;Tropics] It grows all the time and does not have annular rings. There are some differences that are ring like that reflect differences in Rain fall not temperature changes as we see in our maples etc. This was confirmed to me by the head of the Holden Arboretum

I have confirmed what I posted. The rings in a balsa log are not annular, but represent differing growth rates mainly related to the amount of rain in the rain forest. Hack

## In Search of the Perfect Sheet of Balsa

By Tim Goldstein

[tim@IndoorDuration.com](mailto:tim@IndoorDuration.com)

For the past 2 years or so in my normal compulsive and excessive manner I have been talking with fliers, researching methods, looking for sources, experimenting with techniques, and buying equipment to get myself a supply of top quality indoor balsa. This search has had many twists and turns and the pursuit has often times taken over my time that should have been spent building planes. Initially my quest was focused around finding the supplier that would ship me the exact wood I needed and eventually turned into developing a method to be that supplier for myself. Along the way I have spent much time, effort, and money. This article is an attempt to document what I have tried, what I have learned, what is working for me, and what has been a dead end.

In the beginning God created perfect balsa. Then we had the deal with the apple and now we have to scrap and fuss to find a decent piece of wood. My search started as a result of my coming back to the hobby of indoor flying and I had the good fortune to get a copy of INAV 90 with Larry Coslick's article on the Hobby Shopper EZB. In that article he describes a process of building a relatively competitive EZB using only hobby shop wood. Much of the process revolves around selecting the best parts of the wood and then carefully sanding them to thickness. Having had a tiny bit of experience with indoor about 10 years ago I knew that real indoor wood was very expensive and this idea of using regular sheets seemed quite appealing. So, I dug into my stack of light balsa I collected over the years when I had the occasion to visit the LA area and stop in a Superior Balsa (<http://www.superiorbalsa.com>). From that I was able to pull out a couple of sheets that looked more promising than the normal hobby shop stock and I proceeded to start building a Hobby Shopper. The results were encouraging, but I realized I needed a larger stock of light wood to select from. Some browsing through magazines, searching the Internet, and calling around lead me to Lone Star (<http://www.lonestar-models.com>). They had a pretty reasonable price on contest grade balsa and a good reputation of delivering wood that was what you ordered. Out came the credit card and I soon had about \$100 worth of contest wood on the way. I waited expectantly. When the wood arrived I was pleased with what I got. Densities ranged from mid 4# to just over 6# and the grain was decent. I proceeded to build some Hobby Shoppers and they came in at the target weight and flew well. I was happy.



With a little success under my belt I now wanted to get the weight of my Hobby Shopper models down a little to get the times up. I decided that my 250 mg props would be a good place to start. I dug through my growing pile of light wood which I had carefully graded for density and picked the lightest I had. I proceeded to sand it down until I could read the newspaper through it and then washed it in water as instructed and let it dry. On a lark I decided to weigh this piece of Ecuador gold and was shocked that my mid 4# piece was now 5-1/4# wood. How disappointing. I had used a brand new piece of paper and gone very slowly with as little down pressure as I could. Oh well, It was my best piece of wood and while heavier than it started it was still lighter than what I had used previously. The prop came out about 25 mg lighter than past attempts. I continued

to build using pieces I laboriously sanded down and started paying more attention to the before and after weight. I started to reach the conclusion that while I could easily sand down 5# wood with very little density gain, that was not true of low 4# wood. Time to do some more thinking about the whole wood thing.

I reached the conclusion that maybe I should try some of the expensive indoor wood and see if there was really something to it. Out came an order sheet and the checkbook and soon they were on the way to the supplier. Expectant waiting followed and was rewarded with a box on my door step. I eagerly open it up and the thought jumps in my mind, this is not much wood for all the money I spent. I take it off to the workbench to touch, study, caress, weight, and measure the sheets. I go through my 15 or so sheets and find that they are not exactly what I ordered. There were a few sheets that were the density I expected and there were a few sheets that were the thickness I expected, but unfortunately they were not the same sheets. Oh well live and learn, but for the most part this wood was lighter than anything I was able to sand down myself. Off to build a new prop with this costly lumber. Well, the new prop finally allows me to break the 200 mg barrier and is actually about 185 mg. Definitely an improvement over the sanded down stuff and my times continue to improve.

I start thinking some more about this indoor wood thing. It seems like there really is something to having the wood sawn to the proper thickness and not sanded. I started asking around about sawing indoor balsa and it seemed to be a black art. There were a few select wizards that were cutting successfully, but no one wanted to talk in detail about how they did it and what worked. The few references I could find all indicated that indoor balsa sawing was done with a circular type saw and not a band saw. This gave me a place to start. It was time to experiment.

It seemed that a lot of the mystery around wood cutting was the actual blade. I figured that choosing the blade I wanted to use would be a good place to start. From the little bit I could find the saw blade needed to have no offset on the teeth and be hollow ground to give some clearance. I started looking at wood blades and could not find anything that seemed to meet this description. Another one of my hobbies is metal machining. Through this I was familiar with a circular type blade that seemed to meet all the requirements. It is referred to as a jewelers saw or slitting saw and I knew they were available in a variety of diameters from 1" on up 5" diameter and range of thicknesses from .010" up to .125". This sounded like just the ticket and I just happened to have a few .020" x 2" blades on hand. So I mounted one up on an arbor and put it in the chuck of my metal lathe and tried cutting some sticks off of an 1/8" sheet and it worked great. Now I just needed a bigger diameter blade and some balsa blocks to experiment with. I jumped on the Internet and ordered some .030" x 4" blades from a tool supplier and stopped in to a local hobby shop to find the lightest block they had.

A week or so later I was ready to test out what I thought would be a great way to slice indoor wood. The machine I was using is a Shoptask 3 in 1 metal machine and the cross feed has 12" of travel. I have converted the machine to be a computer controlled CNC unit. I again set up the blade in the lathe and now attach a 6" long x 1-1/4" thick balsa block to the cross slide and instruct the computer to feed it through at 5 inches per minute. The blade starts cutting into the wood and the cut is looking good until I have the blade complete into the wood. Then things go drastically wrong! The blade is suddenly wobbling all over the place and the smell of scorched balsa hits me. Of course the computer could care less and it is still trying to feed the wood into the blade that now is looking like a rotating potato chip. I am desperately diving for the stop switches to stop the feed and the spindle motor before something breaks. I get everything stopped and it is just a mess. Gouged, singed balsa, warped blade, and what a stink. I stand there assessing the damage for a few minutes and while I am watching the blade miraculously start straightening out and goes back to the proper shape. Curious. Post mortem analysis revealed that the blade has so little clearance with the slight hollow grinding that it was rubbing against the balsa block. Once enough of the blade got into the balsa wood the heating effect of the drag was greater than the cooling of the blade on the part that was not in the cut. The ensuing expansion caused the blade to warp. Once the blade was allowed to cool it contracted and regained its shape. Great lesson, only about \$30 wasted and now I was at a loss regarding how to cut balsa.

Good fortune came my way. I heard of a book offered by Joe Maxwell of Scotland titled "Balsa for Indoor Models" (now out of print, but Joe is allowing INAV to publish excerpts from it). Quickly my money was in the mail for a copy. What a great book! It covered so many aspects of balsa that were a mystery including a complete chapter on how Joe went about cutting indoor wood. I was now convinced I could master the art as there was nothing Joe was doing that was beyond a mere mortal. The major difference in approach between Joe and I was in the blade. Joe was getting his results with a Dewalt Thin-Kerf carbide blade. (Kerf is the width of the cut made by the blade – Ed.) Even with that name the blade has a .095" or so kerf, but Joe thought that the wood wastage was more than offset by the smooth finish and zero density gain he was getting. So armed with new knowledge and after some e-mail exchange with Joe I was in search of some carbide blades to try. While looking I saw some carbide saw blades that were designed for use on battery powered circular saws that were 5 – 6" in diameter and only had a .065" or so kerf. These appealed to me as the size was more appropriate for my equipment and the thinner kerf was attractive. So, \$50 later and I had a few different brands of these cordless saw blades to try. Back into the workshop I headed. This time I was ready for the worst as I instructed the computer to feed the wood into the blade with the kill button in my hand. The saw entered the wood and just kept on cutting to the end. No problems at all!

Now I had a blade that seemed to be cutting just fine, but I was limited to a 6" block. Time for some more head scratching and scheming. I was convinced that the consistent feed that the computer controlled equipment delivered was something that would be very beneficial to top quality results. This meant that I needed to cut the wood on a machine that had a maximum 12" of travel. A little more looking it over and the thought occurred to me that I could get enough travel to cut a 12" long block if I were to move the table on a diagonal. Normally this would be out of the question on a manual machine, but with the computer control it would be easy. To take advantage of this I would have to put the blade in the mill spindle sitting horizontally and pass the wood through it diagonally and then lower the quill for the next cut. I didn't see any reason this would not work so I set it up and tried cutting the hobby shop test block I had. Wonder of wonders, I was getting nice consistent sheets of mid 5# balsa! They were a little more coarse on the surface finish than the commercial Indoor balsa I had purchased, but it was very usable and I cut it myself. I proceeded to build some parts with it and they worked great.

With some successful results under my belt I decided to start looking for some light balsa logs to cut and began thinking about what a machine optimized for indoor balsa cutting would look like. I found a vendor that claimed to have some under 5# balsa block so I order \$100 worth. It was very costly on a board foot basis, but they delivered what they promised. I was happy and bought another couple hundred dollars worth while they had some light material to sell. On the machine side I analyzed what is was that allowed me to get the results I did.

Some of the attributes that I felt important was an automatic feed to get consistent cuts, moving the balsa on a fixed track so that the blade stayed centered in the kerf, a cross feed to set the sheet thickness that had a sub-thousandth of an inch resolution, a very stiff spindle to reduce vibration, and a smaller than normal blade diameter (All the balsa cutters I could get to tell me anything admitted to using a 10" saw) to help eliminate vibration in the blade. I then created a design for the carriage portion of a

dedicated balsa cutter and set out to build it. It has a 24" lengthwise feed with a 6" cross feed. The carriage is moved with ball screws that are driven by stepper motors. The contraption was completed and tested and it did indeed move as expected and looked like it would do the job of moving the balsa block past the saw blade perfectly. Now I needed to come up with a spindle and drive system for my balsa cutter. My two requirements for the spindle was that it allowed speeds in the 6000 – 8000 rpm range and that it was very stiff. I started thinking about how I could build a unit that would accomplish these goals and every design I could come up with require more complexity than I was willing to create. I then started looking if there was a commercial spindle I could use. About this same time I ran into a deal on a 5500 lbs computer controlled Bridgeport series II milling machine. I jumped at the opportunity and was soon the proud owner of some serious iron. Unfortunately, I had no place to put it. This quickly led to a decision to buy a 10' x 20' storage shed and to remodel the house. The goal was to end up with half the car garage as a metal working shop and a wife that was happy to have it that way. This endeavor put all hobby projects on hold.

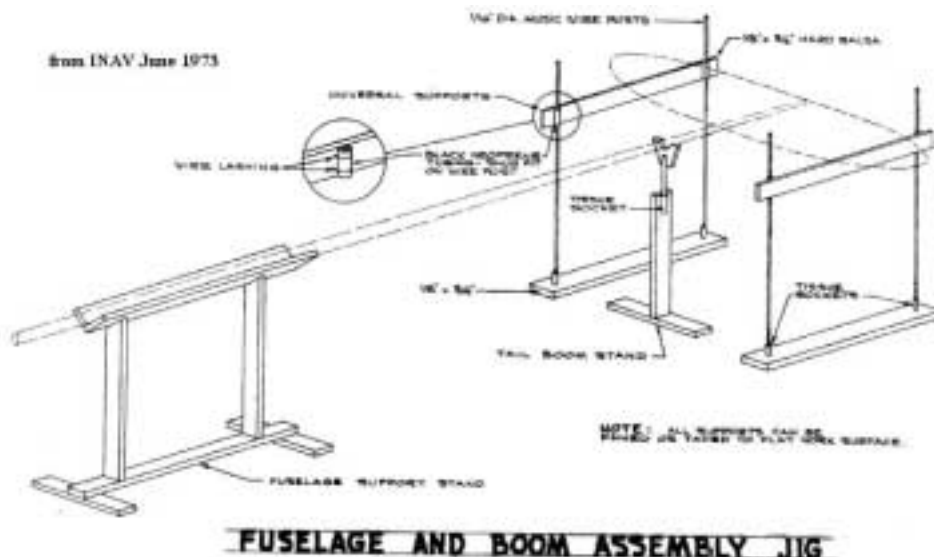
Once the house was about done and Bridgett (the Bridgeport) had been moved into place I set to work getting her running. I quickly realized that the 30" of travel she offered would let me cut 18" strips of balsa quite easily. Out came the credit card and an order was placed for an arbor to fit the saw blade to the machine. Once the blade arrived I was ready to give cutting another try. I took my test piece of balsa and attached it solidly to the table. The motor was spun up and the computer was commanded to go. The blade parted the balsa and the cut was better than I had previously achieved. I proceeded to cut off a number of sheets of B grain stock in thickness from .008" on up. Success seemed at hand. I took my balsa in the house and compared it to the commercial indoor wood I had. Close but no cigar. While the wood had no visible saw marks the carbide blade was just not sharp enough to cut cleanly with the RPM of the machine. So close I could taste it, but a little more scheming still required.

E-mail exchanges with Laurie Barr and an brief explanation of cutting techniques from Stan Chilton got me thinking that I needed a steel blade to get a clean cut. Stan uses a wood working blade that he has reworked to his specification. Laurie pointed me toward 6" x .0625" metal working slotting saw blade. I had never seen ones quite that large a diameter, but armed with the knowledge that they existed I was on a quest. I found a German made cobalt steel blade that seemed to fit the bill. Was a little pricey at \$85, but thought I would give it a try. Of course it took a different sized arbor than the previous blade so that was added to the order for about \$35. At the same time I decided the results were encouraging enough that I would buy the industrial type dust collector with the optional 5 micron filter bags that Stan Chilton told me would cure the gagging on balsa dust problem. The dust collector and the blades arrived and I was ready to try again.

Out with the balsa block and power up all the equipment. Punch the button on the computer and the block heads to the blade. Wow this is great, the dust is streaming off the blade and into the dust collector hose just like smoke. No gagging, Stan was right. Even more important, the balsa sheet now looks spectacular. It is as smooth on the surface as the best I have from the commercial indoor source. I finally feel I have this balsa cutting thing figured out.

What did not work for me:  
 Cutting on a table saw  
 Carbide blades  
 Hand feeding  
 Small diameter thin blades

What is working:  
 HSS blades  
 Computer controlled feed  
 5 micron filtered dust collector  
 Tramming the blade a few thousandth



## UPCOMING CONTESTS FOR 2002

### **2001/2002 INTERNATIONAL POSTAL CONTEST** from 1st Oct 2001 to 31<sup>st</sup> March 2002

F1L , F1M , FAC Peanut Scale, No Cal (profile) Scale  
(see complete details on this postal contest elsewhere in this issue)

### **ILLINOIS - CHAMPAIGN**

April 13 - 14 2002 Midwestern States Indoor Championship. Category III flown at Univ. of IL ROTC Armory. Hosted by the Chicago Aeronuts. Most events from HLG to F1D including Science Olympiad & FAC. AMA license required. \$20 advance registration, \$25 on site, \$1 Jr & Sr. CD: Robert Warmann, 245 N Oaklawn Ave, Elmhurst, IL 60126 Phone (630) 834-9075 Make check payable to Chicago Aeronuts Entry form is available as a link in the Contest section of <http://www.IndoorDuration.com>

### **IDAHO – MOSCOW**

July 27 – 30 Kibbie Dome Indoor. A 4-day contest with the Wally Miller EZB contest (1.2 gm) flown in the middle of the main event. All AMA and FAI events flown. This is a world class 145' ceiling site. Normally an FAC contest is held at the same time. Fun fly style format allows lots of time for low stress flying. CD Andy Tagliafico at 503-452-0546

### **MASSACHUSETTS – CAMBRIDGE**

Evening Indoor at MIT –Flying from 6 pm to 10 pm at MIT's Dupont Gym, the corner of Vassar and Massachusetts Ave. in Cambridge, Mass. Call Ray Harlan at 508-358-4013. Nov. 3, Dec 8, Jan 5, Feb 2, March 2, April 6, May 4

### **MICHIGAN – FLINT**

May 5, 2002 Eighth Annual Spring Fling with 20 events, including Science Olympiad with mass launch. AMA and FAC events. Everything from catapult glider to F1D. Site: Inside Swing Golf Dome, Burton, Michigan. CD George Lewis, 3602 St. Clair Hwy, China Twp., MI 48054. 810-329-6833.

### **NEW YORK – ROCHESTER**

Rochester Indoor Flyers have indoor flying sessions on alternate Sundays from 12 til 5 pm at the New Covenant Fellowship, 2070 Five Mile Line Road, Penfield, NY. Contact Bob Clemens, WNYFFS President at [robert.clemens@worldnet.att.net](mailto:robert.clemens@worldnet.att.net) for details.

### **NEW JERSEY – LAKEHURST\***

Indoor Flying at Lakehurst – The East Coast Indoor Modelers (ECIM) have the use of Hangar #1 every week from sunup to sundown. The hangar is 800 ft. long by 250 ft., and 180 ft. high. To join ECIM. Contact Rob Romash at 856-985-6849. E-mail [cgrain1@yahoo.com](mailto:cgrain1@yahoo.com) . Dues are \$15 a year with a current AMA card.

### **TENNESSEE – JOHNSON CITY**

May 30 – June 3 AMA/NFFS Indoor Nationals, Johnson City, TN. Flying is in the MiniDome fieldhouse of East Tennessee State University. No Contest Director as yet. Stay posted.

### **WASHINGTON - SEATTLE**

The Boeing Employees Free Flight Model Flying Club (Hawks) have published their Northwest Indoor Flying Schedule. Events alternate between the Everett and Oxbow Recreation centers at the Boeing plant. Contact Keith Varnau in Seattle, WA at 425-717-5669 or 425-885-2335 evenings.

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#### **\*Lakehurst note:**

Due to the change in security caused by the events of September 11, 2001 you now must have an ECIM membership card in addition to an AMA card to access the Lakehurst site. Contact Rob Romash as listed above for details.

## UNITED STATES INDOOR CHAMPIONSHIPS 2002 SCHEDULE

7:30	IHLG	P-24 LAUNCH AT 2:30*	3:00	6:00	6:30	10:00
	STD CATAPULT			RETRIVAL PERIOD IF NECESSARY		
WEDNESDAY 29 MAY 2002	UNLIM CATAPULT		INTERMEDIATE STICK 35 CM*		INTERMEDIATE STICK 35 CM*	
	UNLIM RUBBER SPEED*					
	RTP SPEED*					
	STRAIGHT LINE SPEED*					
	RACE TO THE ROOF*					
	7:30		1:00	4:00	4:30	10:00
	FAC PEANUT*			RETRIVAL PERIOD IF NECESSARY		
	BOSTONIAN					
THURSDAY 30 MAY 2002	HIGH WING MONOPLANE*		F1D		F1D	
	PIONEER*		HAND LAUNCH STICK CABIN ROG		HAND LAUNCH STICK CABIN ROG	
	MORDERN CIVIL PRODUCTION*					
	WW I MASS LAUNCH, 11:30*					
	BOSTONIAN MASS LAUNCH, 12:30*					
	7:30		12:00	3:00	3:30	6:00
	SCIENCE OLYMPIAD*			RETRIVAL PERIOD IF NECESSARY		10:00
	MINISTICK					
FRIDAY 31 MAY 2002	AMA SCALE		EZ-B		EZ-B	F1L
	MINISTICK MASS LAUNCH, 11:30					
	DIME SCALE*					
	PISTACHIO*					
	KIT PLAN SCALE					
	7:30		1:00	3:00	3:30	7:00
	FAC SCALE*			RETRIVAL PERIOD IF NECESSARY		10:00
	GOLDEN AGE*					
	COCONUT SCALE*		PENNYPLANE MANHATTAN		PENNYPLANE MANHATTAN	AUUTO GIRO HELICOPTER ORNITHOPTER A-6 A ROG
SATURDAY 1 JUNE 2002	NO CAL SCALE*					
	AMA PEANUT SCALE					
	WW II MASS LAUNCH 10:30					
	COCONUT SCALE MASS LAUNCH, 11:30					
	SCIENCE OLYMPIAD					
	7:30		11:30	12:00	3:00	
				RETRIVAL PERIOD IF NECESSARY		
SUNDAY 2 JUNE 2002	LIMITED PENNYPLANE F1M*		LIMITED PENNYPLANE F1M*		PREPARATION TO DEPART.	
					BUILDING MUST BE CLEARED BY 6:00 PM	*= NON AMA EVENTS
					HAVE A GOOD YEAR"	

**2002 AMA INDOOR NATIONALS AND THE  
EIGHTEENTH UNITED STATES INDOOR  
CHAMPIONSHIPS  
"MINI-DOME" - EAST TENNESSEE STATE UNIVERSITY  
JOHNSON CITY, TENNESSEE  
MAY 29-JUNE 2, 2002**

**NON-AMA EVENTS REGISTRATION**

**Send Entry Payable To:**

**USIC 2002, 112 TILLERSON DR NEWPORT NEWS, VA 23602**

Name: \_\_\_\_\_ AMA # \_\_\_\_\_  
 Street: \_\_\_\_\_ JR [ ] SR [ ] OPEN [ ]  
 City: \_\_\_\_\_ State \_\_\_\_\_ ZIP \_\_\_\_\_ Phone: [ ]

I hereby certify that I understand all of the rules under which I will compete and will diligently follow the Official AMA Safety Code as well as any rules that may be established on site and will apply the use of accepted common sense in all my flying and affairs at the contest site.

Signature: \_\_\_\_\_

**FEES**

Entry fee (includes one event)	\$12.00	_____
Jr & Sr entry (includes one event)	\$1.00	_____
Additional events, OPEN	\$5.00 x _____	_____
Additional events, Jr & Sr	\$1.00 x _____	_____
P-24 Mass Launch	\$3.00	_____
8" Table & 2 Chairs	\$16.50 x _____	_____
Dormitory cost. (\$35/night/room) (Single or double occupancy) *	\$35.00 x _____	_____
Total Fees	\$ _____	

**ENTRIES MUST BE POSTMARKED BY MAY 13, 2002  
LATE ENTRY FEE OF \$10.00 PAYABLE ON SITE**

DORMITORY HOUSING WILL BE IN THE LUNTSFORD APTS,  
No linens will be provided, so bring your own sheets, pillows, towels  
etc: A \$25.00 fee will be charged for lost or unreturned keys, NO  
EXCEPTIONS. You must recruit your own room mate

Please indicate Dormitory reservations for nights of :							
	May	May	May	May	June	June	
	28	29	30	31	1	2	
Single							
Double							

**NON-AMA EVENTS**

- Events entered
- A6
- 35 CM
- DIME SCALE
- NO CAL
- GOLDEN AGE SCALE
- HIGH WING MONO
- UNLIM. RUBBER SPEED
- COCONUT SCALE
- WWI & WWII MASS LAUNCH
- FAC SCALE
- FAC PEANUT
- PIONEER
- MOD. CIVIL PRODUCTION
- PISTACHIO SCALE (MIAMI)
- P24 MASS LAUNCH

Entry fee for 3 events below is \$5 for all three.

- ROUND THE POLE
- STRAIGHT LINE SPEED
- RACE TO ROOF
- F1L
- F1M(F1DB)

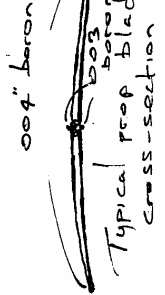
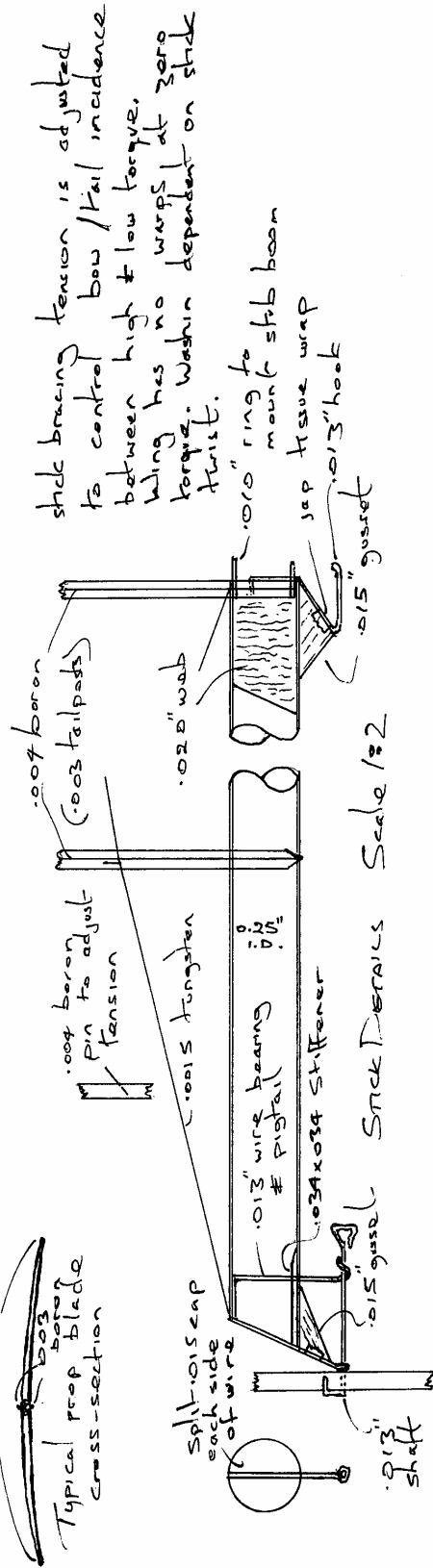
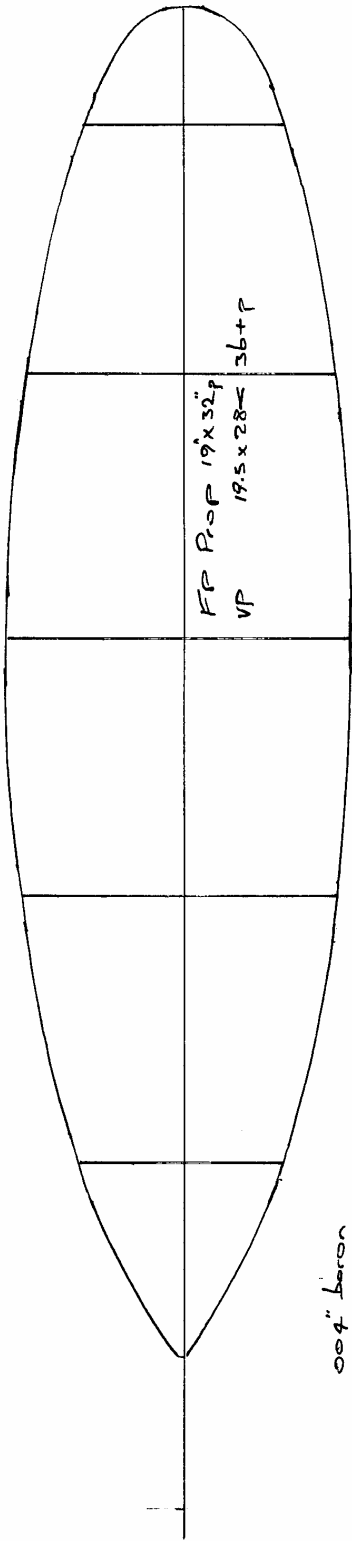
In case of emergency, please contact:

Name: \_\_\_\_\_

Street \_\_\_\_\_

City \_\_\_\_\_ State \_\_\_\_\_ Zip \_\_\_\_\_

Phone: \_\_\_\_\_



Typical Weights.

Stick & stub boom	0.39 gr.
Boom	0.15
Wing	0.30
Stab	0.13
FP prop	0.22
VP prop	0.23

Typical Wood Sizes.

Stick	0.013"
Stub boom	0.010
Boom	0.009

Wing.

spars	.090" > .055 x .034
tips	.055 > .035 x .030
ribs	.060 > .045 Andrews x .025

Stab.

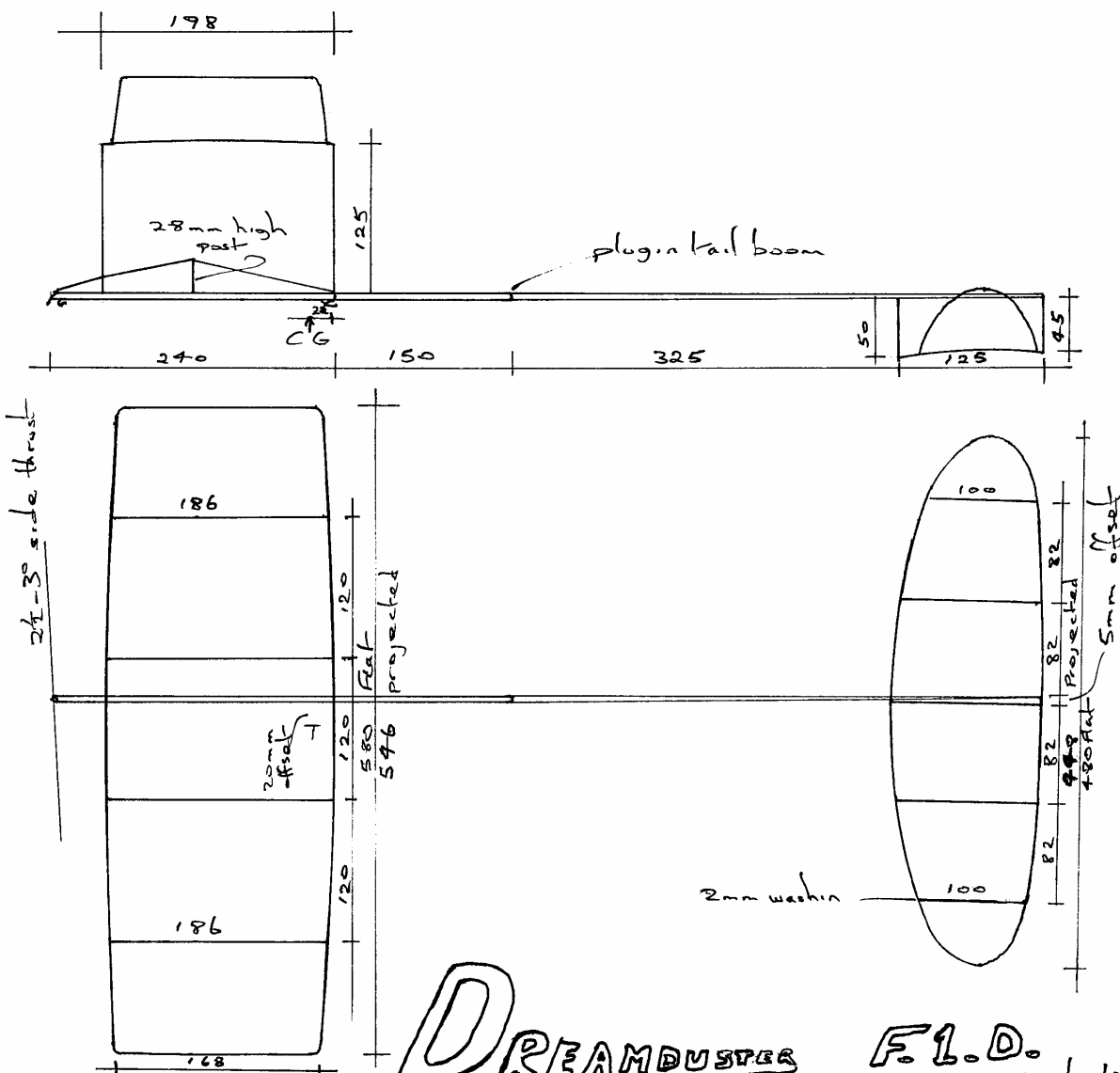
spars	.050 > .035 x .029
tips	.029 x .029
ribs	.030 x .024

Note: Wood density & sizes very dependent on stiffness

Prop

Outline	.004 boron
ribs	.024 x 2.024
spar	0.070" dia > .032 + 2 .003 boron

VP hub similar to Steve Brown but wire top stop & zap tissue tubes to allow adjustment or replacement of blades

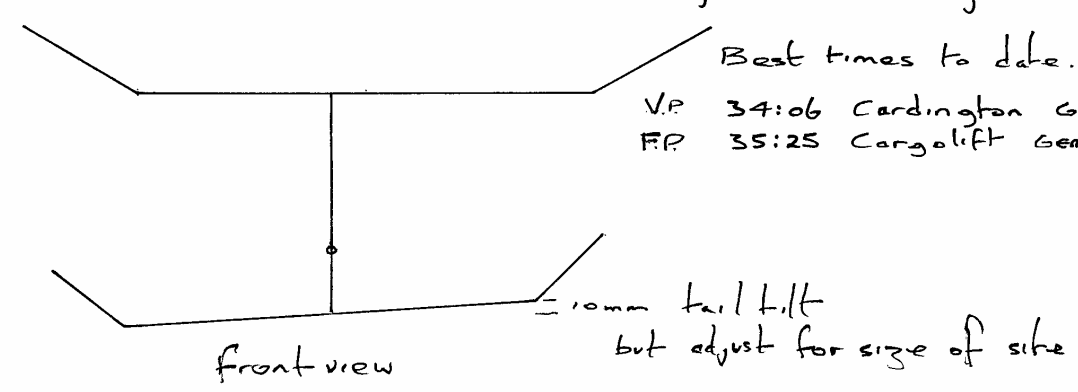


# DREAMDUSTER F1.0

Scale 1:5  
 designed & drawn by Ron Green

Best times to date.

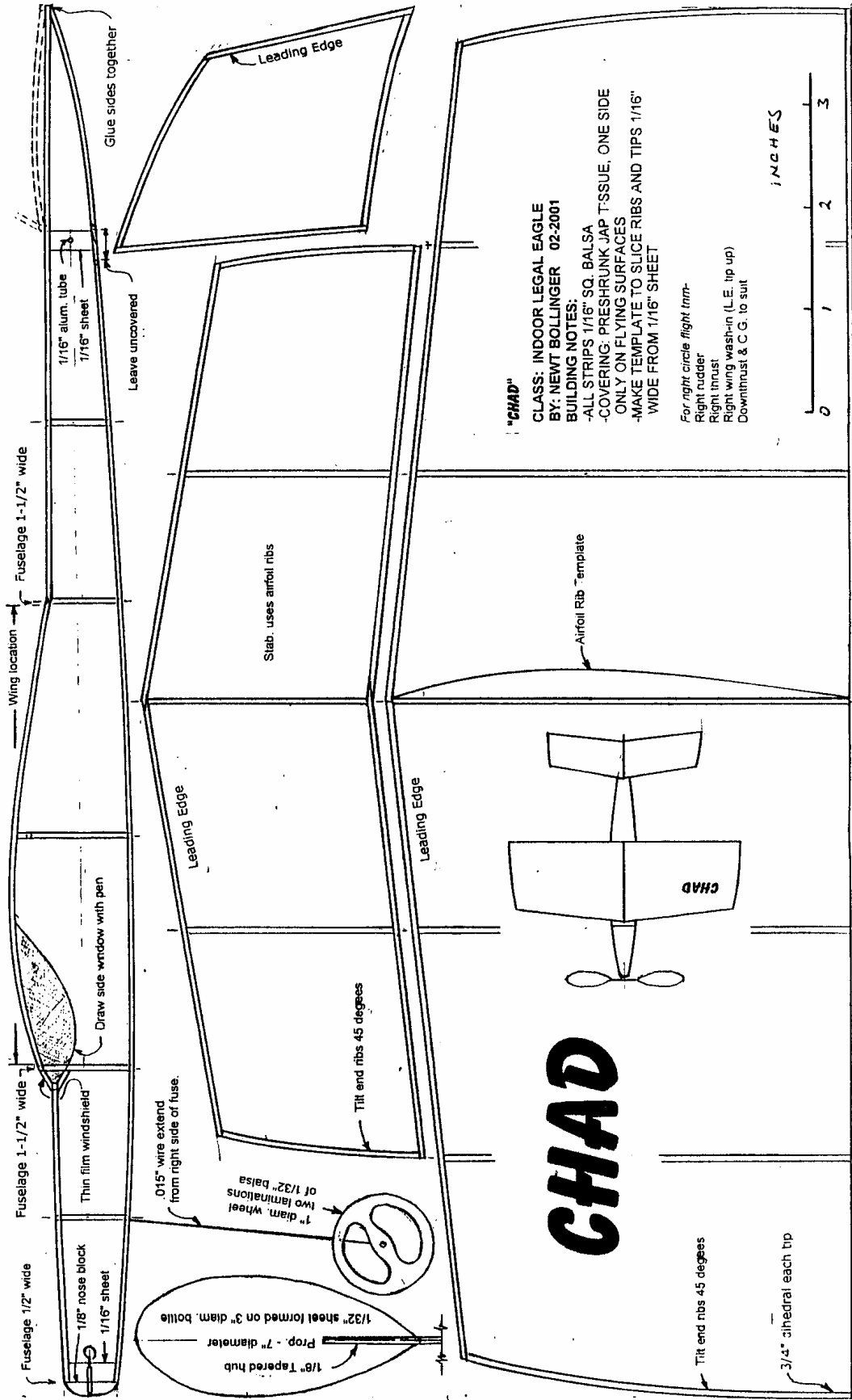
- V.P 34:06 Cardington GB
- F.P 35:25 Cargolift Germany



10mm tail tilt  
 but adjust for size of site

14

# Enlarge 164% to Legal Size



## THE INDOOR LEGAL EAGLE EVENT

### DRAWING REQUIREMENTS

1. Drawing must fit on one side of one sheet of legal size (8-1/2" x 14") paper.
2. No component parts drawing may be superimposed or overlap another and must clear one another and the edge of the paper by at least 1/8 inch.
3. Wing(s) and stabilizer must be drawn full span, tip to tip and fuselage drawn in its full length from nose through tail in one piece.
4. Fin(s) may be drawn where space allows and not necessarily attached to the side view.
5. Landing gear must be drawn in its place on the side view showing its full length.
6. No top or front view is required.
7. Drawing must be presented to C.D. on demand.

### DESIGN REQUIREMENTS

1. Smallest wood size to be 1/16 inch square except for propeller.
2. Fuselage measured to its outside surface must contain a space 1" x 1.5" x 3".
3. Fuselage must have a cabin or open cockpit with a raised windshield of at least 30 degrees of clear or translucent material. Cockpit must be actually open, with a headrest or canopy.
4. Flight surfaces; Leading and trailing edges cannot parallel each other.
5. Tip outlines must have no straight lines except for stabilizer where a twin fin is used.
6. If twin fins, or two wings are used in the design, parts may be built in duplicate over the same drawing.
7. Jap tissue required on all non-sheeted, open framework surfaces except for fuselage surfaces covered by a flying surface directly attached to the fuselage and areas involved in an open cockpit or minimum access area to the motor. No ultra light film covering to be used, unless used for windshield or windows. Flight surfaces may be single or double covered.
8. Landing gear must use at least one 1 inch diameter wood wheel.
9. Use of motor stick(s) or tube(s) O.K. and if used, must be shown on the side view in one continuous length in the proper position.

### FLYING

1. Models must R.O.G. from floor or any solid place designated by C.D. on contest day.
2. Total of best 3 flights out of 5 wins and delay timing of 20 seconds with two delays in succession as one official, per AMA rules.

Updated: June 28, 2000

Photos of Chad and DNA, supplied by Newt Bollinger of the MIAMA group. Contact him at [Newtsworld@aol.com](mailto:Newtsworld@aol.com) For more details on building and flying



## ANNOUNCEMENTS !!! ANNOUNCEMENTS !!!

### Electric Indoor Free Flight event, official as of Jan. 1, 2002.

Submitted by: Bob Wilder AMA 14951

**Model Specifications.** The models shall be powered by no more than two (2) Nickel-Cadmium 50 mA cells and may weigh no more than one ounce. There shall be no other restrictions on model size or configuration.

**Scoring.** Scoring shall be based on the duration of the best single flight of three attempts. An attempt shall consist of any flight longer than 20 seconds.

Time shall be recorded in minutes and seconds with fractions of a second dropped. Timing shall begin when the model is hand-launched and ends when the model touches the floor or contacts any part of the building and ceases transitional movement for longer than 10 seconds.

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### Call for Papers for the 2002 NFFS Symposium



see us at: [www.freeflight.org/](http://www.freeflight.org/)

The Symposium is presented annually by the National Free Flight Society. The primary purpose of the Symposium is to promote and encourage the investigation, discussion, and documentation of the technical and theoretic side of free flight. Papers addressing historical, administrative, documentary, and philosophical aspects of the sport are also welcome. Outstanding models and modelers are honored.

Bucky Servaites, editor  
7660 Duffield Circle, Centerville, OH 45459  
(937) 433-0975 [servaites@aol.com](mailto:servaites@aol.com)

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### 2001/2002 INTERNATIONAL POSTAL CONTEST from 1st Oct 2001 to 31<sup>st</sup> March 2002

The events for the 2001/2002 season are;

F1L (International Easy-B)

F1M (F1D Beginner/ International Pennyplane)

FAC Peanut Scale

NoCal (profile) Scale with a minimum weight of 6.2 grams without rubber motor and built to FAC rules.

I have assumed that most flyers have regular access to spaces with Category I ceilings (less than 8 metres) and all times will be factored to that height, even though they may have been flown in higher ceilings. Most of the above classes have rules regarding dimensions, minimum weights and maximum rubber weight. I propose to run the contest on a trust basis and will assume that all flyers will abide by the rules so that I do not create the problem of requiring the flyer to provide me with a certification by a third party that his models comply with the rules.

The contest will start on 1<sup>st</sup> October 2001 and finish on 31<sup>st</sup> March 2002. Any flight times from 31<sup>st</sup> March should be sent to me as soon as possible after that date.

Entries should include the ceiling height, the flight time and, in the case of the scale events the name of the full-size aircraft that the model is scaled down from.

The entries can be sent to me by e-mail or fax or snail mail as follows:

e-mail [henderson98@yahoo.com](mailto:henderson98@yahoo.com)

Fax (416) 481 0016

Regular mail W.Henderson  
15 Joicey Blvd.  
Toronto, ON  
Canada M5M 2S8

ANNOUNCEMENTS, continued

**Tan II status**

Dear FAI Customer,

We are currently out of good 1/8", 3/16", and 1/4" contest rubber. We do have some 3/32" and 1/16" that are good. Due to the collapse of the rubber thread business for golf balls, we currently have two factories downsizing into one factory at a new location. The net result is that the next production lot will not be available until approximately November 30th. This order will be for 1/8" only, and if it meets specs, the other sizes will be available at the end of the year, or early in January 2002.

Good News: Our same Tan II Q/C and sales management team will be in place at the new location.

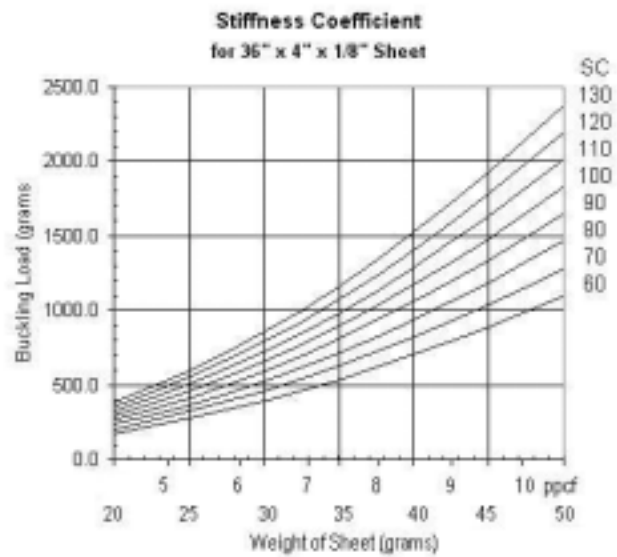
Bad News: Due to the lower demand for a critical synthetic additive ( golf ball related ), we can expect a noticeable increase in cost of Tan II. Our factory or we do not know the amount of this increase at this time.

John Clapp

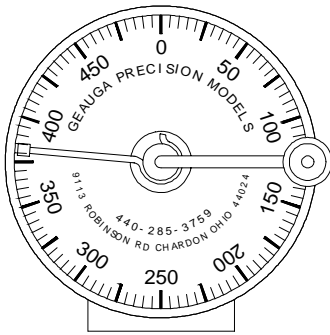
**STIFFNESS COEFFICIENT CHARTS**

You may remember the chart at right. It was from a series of articles in INAV #103, reprinted from the Norwind News. Many readers have pointed out that the 4-inch wide by 1/8" balsa sheet was not the best example. So we created two more charts to cover the more common 1/32" and 1/16" indoor sizes, in 3-inch widths.

We also increased the stiffness coefficient range to 130, and included a pounds per cubic foot density scale along the bottom. To get your own copy of the EXE file to experiment further, check out [www.indoorduration.com](http://www.indoorduration.com) and click on Utilities.



## Geauga Precision Fills Void for Indoor Flyers



Bob Wilder's retirement from the indoor winder business a couple years ago left a big void in the supply of quality winders for indoor flyers. A year ago it wasn't uncommon to hear stories of used Wilder winders selling for substantial premiums over their original new cost. Fortunately that situation changed for the better in March 2001. That's when Geauga Precision Models of Chardon, Ohio announced plans to produce winders similar to the excellent winders formerly produced by Bob. Since then, the better part of 100 flyers have had their winder needs met by Geauga Precision.

Actually Geauga Precision manufactures four different winders. In 20:1 and 10:1 they produce winders almost identical to the Wilder design. They have the same basic configuration with aluminum housing and integral turns counter. They do differ in appearance by incorporating a couple of "O" ring trims that

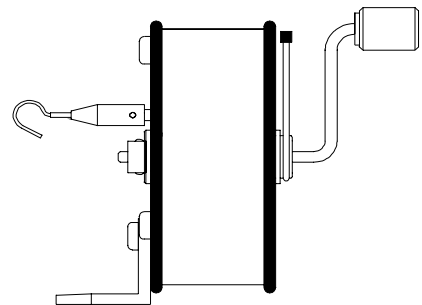
happen to provide a better grip on the housing and provide some protection against dents and dings that winders suffer when they hit the floor.

In addition to the basic winders, Geauga Precision offers enhanced version winders in both 20:1 and 10:1 ratios. These two versions incorporate a unique sliding gear lock that allows the user to securely lock both the input and output shafts of the winder with the push of a button. When used with a stooze this feature provides the user with a simplified technique for transferring a wound motor to the airplane.

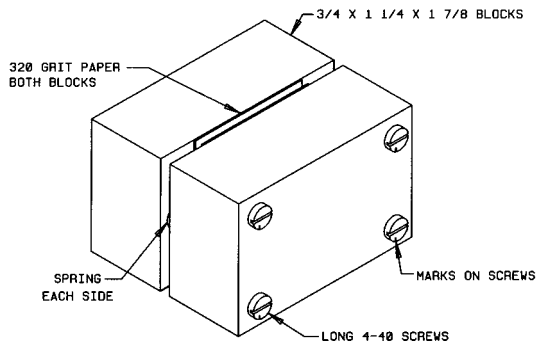
Standard on all winders are two 8-32 tapped holes for attaching the winder to your favorite mounting or stooze. Optional, is a ready made foot and socket combination that make attachment to your stooze as simple as installing two #10 X 3/4 wood screws (provided). Included in the cost of any configuration winder is the choice of either .031 or .047 inch wire used to make the output hook. With this choice you can pretty well tailor your winder to the type of motors you're winding. A second output hook is optional. The cost of the basic 20:1 non locking winder is \$95.00, and the 20:1 locking winder is \$110.00. There is a \$20.00 premium for 10:1 versions, and the optional mounting system and optional second output hook are each \$15.00. Shipping to U.S. addresses is \$7.00.

Also, in 2002 look for GPM to offer a premium quality prop bearing for models 3 grams and up. This bearing will offer top performance with unparalleled durability and ease of use.

For more information or ordering, contact Wayne Johnson at:  
Geauga Precision Models  
9113 Robinson Road  
Chardon, Ohio 44024  
Phone : 440-285-3759  
E-mail : johnsonwd@earthlink.net  
Additional information under links at <http://www.IndoorDuration.com>



## A WING POST SANDER by Ray Harlan



Recently I devised a wing post sander that works so well I had to pass it along. After 40-odd years of indoor building I got tired of sanding posts to get good fits in tissue tubes. I always liked round posts and have not gone with the rectangular-post crowd. The sanding rig I came up with not only gets posts round (to .0002" or better!), but can let you ease into a very nice tight fit on the tube.

Start with two wood blocks about 3/4 x 1 1/4 x 1 7/8. Tape them together and drill .089 holes near each corner. Mark the blocks so they can be matched in the same positions later. Separate them and open the holes in one block to .120. Tap the other block 4-40. Even though the blocks are wood, if the screws are long (1 1/2") the threads will hold just fine. Mark the inside faces of the blocks between the upper and lower screws so counterbores can be drilled

to hold the springs. Choose two light springs to hold the blocks apart against the screw heads. Drill counterbores so the springs have good clearance and the springs hold the blocks apart about .2" with no load. Glue two one-inch wide strips of 320 paper to the inside faces of the blocks. Assemble them with the springs in place and run the screws down until the faces of the blocks touch. Now put a mark on each screw head in the same spot relative to the block (e.g. down). If the screws are backed off the same amounts, the blocks will stay parallel.

To use the sander, first shape extra-length posts to a rough octagon shape by planing or sanding off the corners of square stock. Start with a piece that is at least .010" over the required final size, so the sander can round it without having any low flat spots. Put the post in a drill press or electric drill by lightly holding it in the chuck. Run the drill at low speed (about 600 RPM). Open the sander blocks so the post fits in loosely and slowly run the sander up the post and back again. All of the screw-head marks should be in the same position. Close the screws 1/8 turn and repeat the sanding. Be careful not to twist the block so as to put a bending load on the post. Repeat this process until the post is a tight fit in the tissue tube. Remember, each 1/8 turn reduces the post diameter about .003". The final passes will have less than 1/8 turn changes on the screw. When finished, twirling the post in a dial thickness gage will show no movement of the needle, and the posts will be the same diameter their full length. Even Middle School Science Olympiad students have used it successfully.

Ray Harlan

The following was posted by Bernard Hunt on the Yahoogroups Indoor mailing list:

There is a lot of folklore about what grain (more accurately described as medullary ray orientation) is best for particular duty (wing spar, wing rib, solid motor stick etc).

There is pretty full decription of the mechanical properties of balsa (density, strength, stiffness etc)in the scientific literature. Balsa is highly anisotropic in that its properties vary strongly with direction. Here are some data from a standard textbook on timber for 12lb density (200 kg/m<sup>3</sup>) balsa:

E Lengthways	6300	G LT	203
E Radial	300	G LR	312
E Tangential	106	G TR	33

Where E= Youngs modulus and G= shear modulus.

Lengthways= along the trunk and parallel to the TRUE grain.

Radial= from the centre to the outside( the direction in which the medullary rays run).

Tangential= parallel to outer circumference (or bark) of the tree.

The plane Lengthways-Radial (LR) is one we call "C grain".

The plane Lengthways-Tangential (LT) is the one we call "A grain".

The anisotropy is even more extreme for lower density balsa.

Strength properties follow a similar pattern to these stiffness properties with the added complication that tensile and compressive properties differ.

These data tell us:

Balsa is 20-60 times stiffer along the true grain than across it.

A "C Grain" balsa sheet is 3 times stiffer across the sheet than an "A grain" sheet.

The stiffness of a spar or sheet along the true grain is exactly the same whether it is "C" or "A" grain. You should not be able to tell them apart on an Euler buckling test.

Balsa has great stiffness along the true grain for its weight but it is poor in shear. This means that resistance of a spar or stick to twisting is not naturally good - you need to make them thick.

# GOLD NUGGETS

## THE PLEASURES OF FLYING INDOOR MODELS

By: Laurie Barr, [laurie.barr@lineone.net](mailto:laurie.barr@lineone.net)

I started building model aircraft that flew (sometimes!) around 1945. Being war time, all materials were scarce but you could still get small cabin duration model kits, and so after the first one actually flew, I was hooked. From that moment on, my first love was always rubber-driven models, mostly small lightweights, and later on, much larger high performance unlimited duration types, all of my own design.

During this period of my life, marriage and children came along, as well as starting my own business. This was a magic time, which was completely fulfilling, and the whole family went everywhere, including caravanning to a World Champs in Gothenburg, Sweden in 1971 when I was a Wakefield team member. Eventually I became less addicted, especially after a hard day's flying, when it usually meant haven to compete in an unlimited flyoff, which also meant long hours searching for the model, quite often without a result. Often too, you did not always win, even though you knew you should have; remember, this was in the days before binoculars and tracker bugs! It was like testing flashbulbs!

At about this time I became attracted to indoor duration, which had all the things I loved about model flying; moreover you did it all in the same airspace, the right model won, and you did not have to become an athlete to compete on equal terms. All the structures were low tech; the only difficulty was being able to lift sheets of microfilm but, oh how rewarding to get perfect rainbow colored frames of film, lifted and stored.

Coming up to date, at 73 years old, I can still compete indoors on equal terms, the materials are still mostly low tech, and the only "techy" material is boron, which is simple to use. The flying of these models to World Champ standard does require a lot of control over prop pitch and diameter, rubber/launch torque, etc., but it is all manageable with out having a degree in maths.

As the rules for the previously exacting F1D have been changed, to make construction and transportation easier (the models are now smaller, with a higher minimum weight), and with the advent of the plastic film known as YK2-2, virtually any class of indoor duration model is within the ability of reasonably competent model builders.

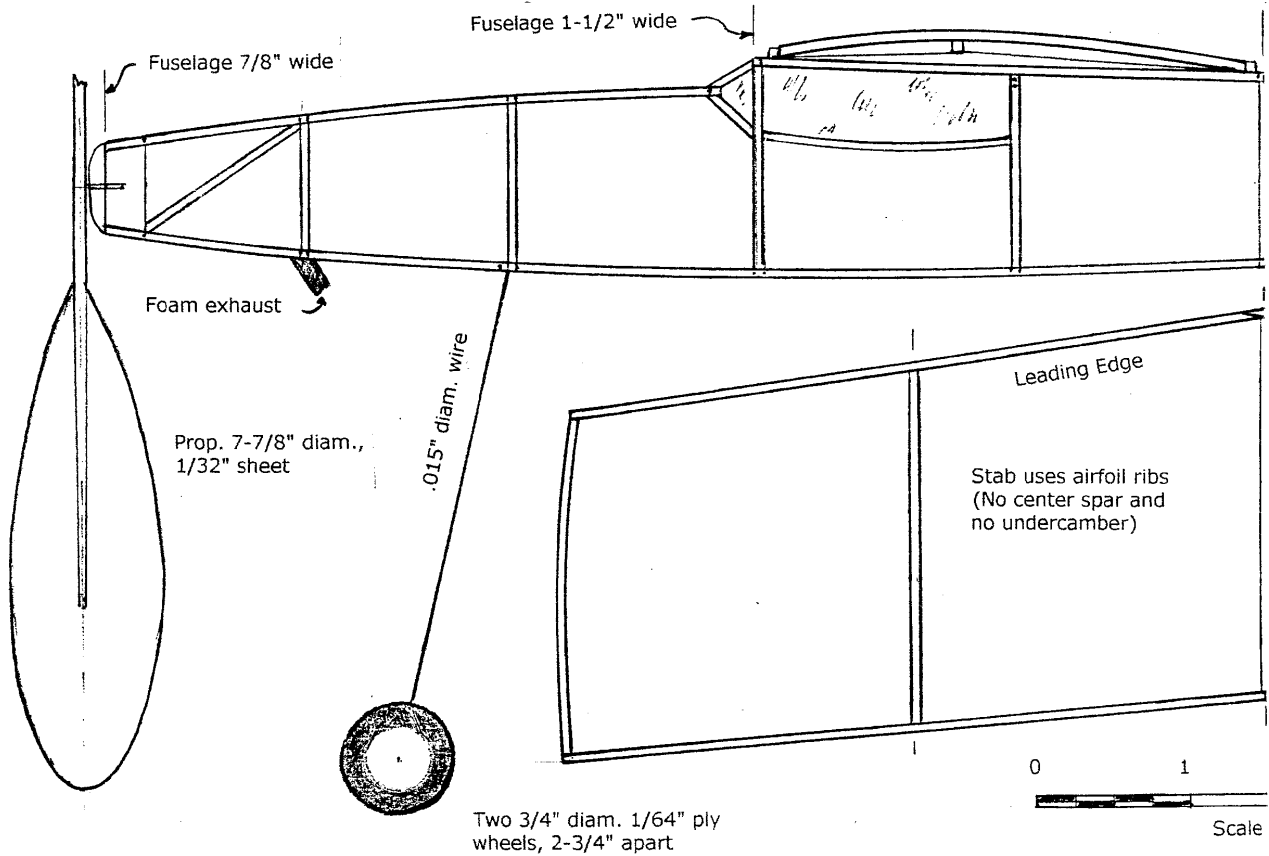
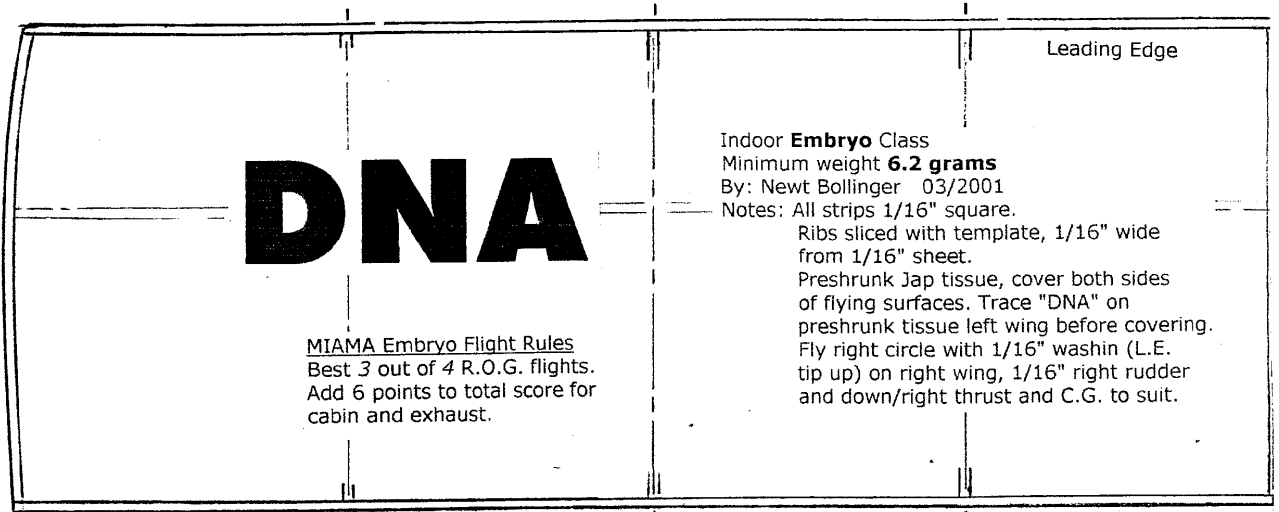
Regarding other materials, these are available, both in the U.K., U.S.A., and elsewhere, and you can further enhance your stock of spar wood by hunting down sheets of 4 lb to 6 ½ lb balsa at your local model shop, which apart from thin quarter-grained motor stick and tailboom stock, can be used to make the rest, such as super stiff spars, ribs for all types of models, and for fuselages on EZB and Pennyplane, etc.

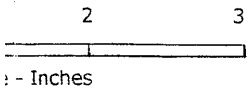
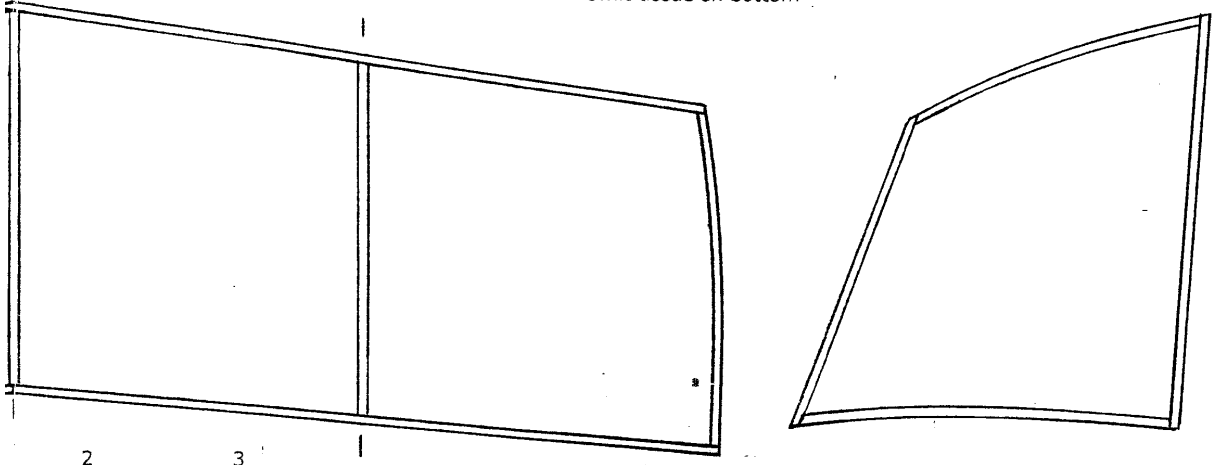
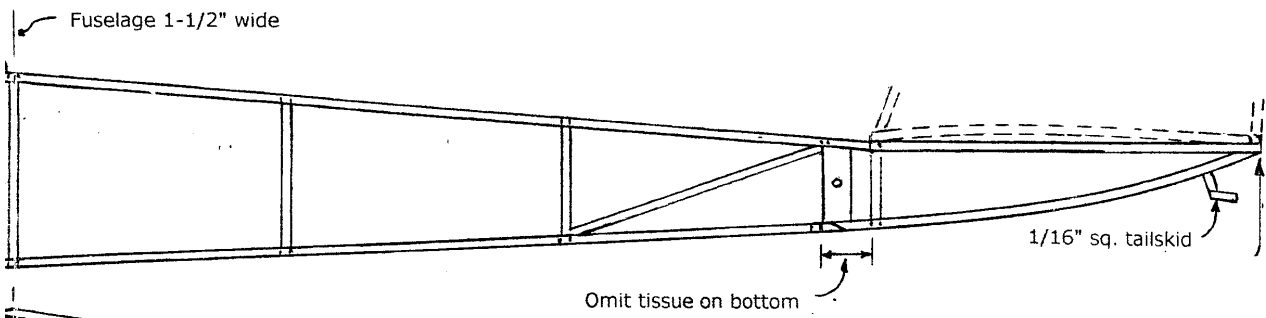
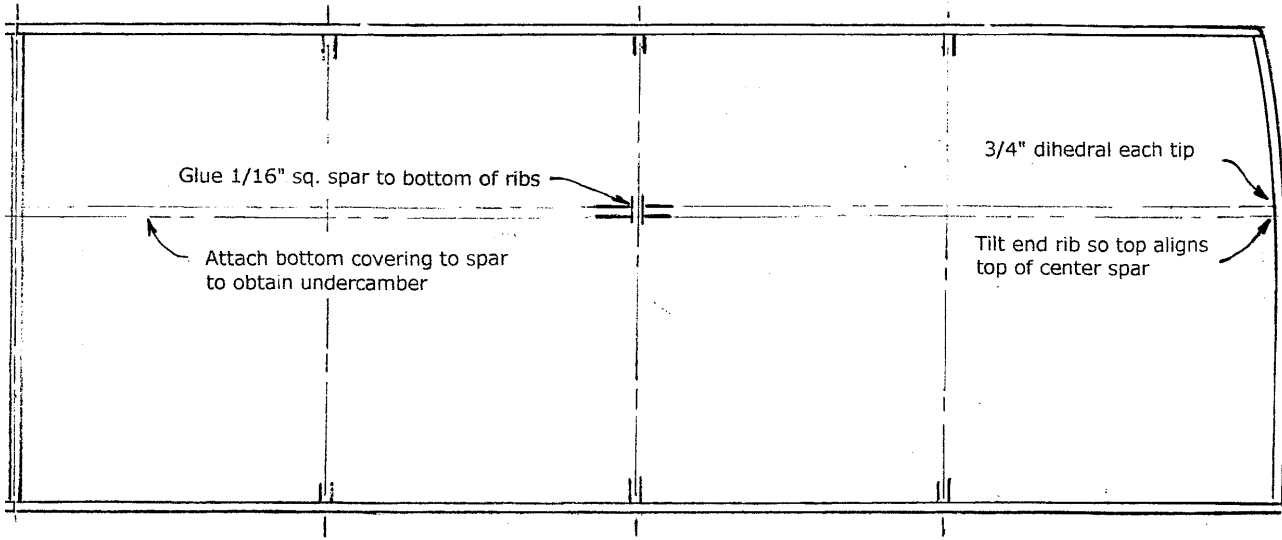
Many of the really keen indoor types have their own special sheet of super wood which they found in a local model shop. Typically this will be straight grained, very white, but crucially has the strength of normal wood in the 8 to 10 lb range!, but is much lighter.

I am to be found in local model shops, with a small, battery powered postal scale to weigh promising looking white sheets of 1/8th, 3/16th and ¼" balsa wood, and using the formula of weight in ounces x 108, the sum of which is divided by the total sum of the thickness x width x length, which will give the sheet weight in pounds per square inch. You then take the selected sheet(s) home to test their tensile strength. (see Norwind News articles on stress testing in Issue 103, ed.)

The building and flying of indoor duration models is quick and easy once you have the "feel" for it, and it takes only a couple of models to become competent. Indoor flyers are friendly, and will help you with all kinds of advice. They are avid users of the Internet, and will give up their latest performance-enhancing ideas freely. There are many indoor events at sports halls etc. being organized throughout the U.K., the best of which (as far as duration flying in high ceilings) are at Cardington in Bedfordshire, and the Velodrome, at Manchester.

I can thoroughly recommend that you come inside and enjoy the true delights of indoor flying, which was pioneered by some of the all-time greats of our hobby, such as Carl Goldberg, Frank Zaik, Max Hacklinger, Karl- Heinz Rieke, Bob Copland, Reg Parham and others. In the U.K. I recommend you get in touch with John Tipper, who has all the materials you will need, and also sells starter kits. His address is John Tipper, 23, Green Lane, Chichester, West Sussex, PO19 4NS, Tel: 01243773346.





# ORIGINS AND PROPERTIES OF INDOOR BALSAM WOOD

BY

JAKE ZIMMER, Owner [www.SpecializedBalsamwood.com](http://www.SpecializedBalsamwood.com)

If you have ever wondered where balsam wood comes from and how many different properties it may have, this is the article for you. Ninety percent of balsam comes from Ecuador, and the other 10% originates from Costa Rica, Colombia, Peru and a few places in Asia. Balsam trees are quite large and fast growing. Many people consider them weeds because of how fast they grow. Balsam trees can reach heights of over 90 feet in years instead of decades. Normally at least 6 years of growth must occur before a balsam tree is harvested. The trees can become several feet in diameter, but only the outer portion of the tree can be used. For this reason, you don't see very many large blocks of balsam. Some of the larger and older balsam trees are off limits to balsam tree harvesters so there is little chance of getting blocks over 6 inches thick from a plantation. Everything that I receive for manufacturing comes from plantations instead of rain forests. I would assume that the other manufacturers do the same thing, but it is always a good thing to check. When plantation trees are harvested, I sort of think of it as someone mowing their lawn and selling the clippings for mulch since the trees grow back shortly after being planted. A process such as this seems to be quite environmentally friendly and supportive of native animal species. After the trees have been cut down to the right lengths, they are stripped of bark and rough cut to the proper dimensions. Next, the blocks are kiln dried for around 2 weeks and stacked on pallets for ease of mobility and shipping. The pallets are loaded into a semi container between 20 and 40 feet long and brought to a ship for transport to their final destination. Each shipment must be fumigated and checked by port authorities before being allowed into the US. Checking for illegal substances may damage portions of the shipment and leave several select blocks with holes bored through them. Two common scenarios exist for why balsam may have holes in it; either a bug could have eaten its way through the balsam, or a block of balsam may have been drilled and checked by port authorities. After arriving, the container is usually unloaded onto another truck and shipped to its final storage area. I end up sorting the balsam by size, density, and quality before it is stored for later use. The process of importing balsam is quite time consuming and costly after shipping is calculated into the cost of the raw balsam materials.

The density range for balsam is quite substantial. The lightest balsam I have ever found was 0.3375-grams/ cubic inch and the heaviest balsam was 9.6-grams/ cubic inch. Light contest grade and heavy RR Industrial Grade balsam are very hard to find. I have sorted several thousands of balsam sticks from different sources and have only found a small percentage of the extreme densities. When determining the appropriate density category for balsam, I use the following standards to separate balsam into 5 basic categories. Contest grade is balsam under 6 pounds per cubic foot, light is 6.5-10lb/ft<sup>3</sup>, medium is 10-13lb/ft<sup>3</sup>, heavy is 13-16lb/ft<sup>3</sup>, and RR Industrial Grade is any balsam over 16 pounds per cubic foot. Grain patterns on light balsam are spread farther apart than those on heavier balsam. Depending on how the balsam is cut, the grains may either be straight or slanted. Most of the time, trees just grow that way, but every once in a while a block may be mistakenly cut at an angle. Structures, for example would demand straight grains to optimize weight-bearing efficiency. If someone is using the slanted grains for decoration however, they don't usually care what the grains look like as long as the material is considered balsam. There are different colors of balsam. The color usually depends on the density and the origin of the balsam plantation in general. Light balsam is light colored, and heavier balsam is more grayish in color. Contest grade balsam usually has discoloration spots when located around the bark of the tree. If the bark is not removed quickly enough, the balsam may become even more discolored than it usually would. So that's the basics for selecting densities of balsam, and a quick answer to the question "where balsam comes from?" Many more things are involved in the processing balsam in the cutting field and manufacturing, but this should give the average balsam model enthusiast a good intermediate understanding of the materials they are dealing with.

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About Y2K films

By Gene Joshu

The first film we received was a gift of sorts. Sort of like a kick in the butt. What to do with it? Try to get someone to help or advise how to unroll this stuff. It wasn't easy to learn how to handle this stuff. How are we going to sell this stuff, what to call it, how much should we charge, is there any more of this stuff in the universe, who knows? One problem at a time and now we have Y2K Film. What to do with the money? We decided to support indoor flying with the profits, especially juniors and science Olympiad and where there is need.

Now we're selling Y2K Film, where do we get more? Where did the first come from? We decide to limit the film to two rolls a year to each buyer. In general, it worked out fine.

We got a lead on the second roll. It's lighter than the first roll; Y2K2. Now we sort of have an indirect route to the film so without saying anything we relax the two roll limit. Some of the European countries have a hard time buying the film because of the expense, so we sent them batches of six to eight rolls to keep the cost down and also send some free rolls for the junior teams. Almost one half of all our sales are foreign.

Now in 2002 the supply seems fairly certain. The quality is the big question. It's a little like the rubber supply. We can't get exactly what we need and so we are always looking for a lighter or equal film to what we already have. We don't limit to two rolls per year anymore either. We don't want to sell one person 10 or 12 rolls just for himself because no one needs that much and there is too much effort into rolling off the film just to let it set on a shelf. We think we are reasonable, try us.

As of now we have Y2K, Y2K2, and PPP film which is heavier than the others, but lighter than some of the other films available.

PPP Film (Penny Plane Plastic)  
1025 Cedar St  
Catawissa MO 63015

.7 micron film that is economical  
and easy to apply.

12" x 50' rolls

\$25.00 per roll

Price includes shipping

Y2K Films

4514 Meadow Ln

Red Bud IL 62278

Y2K (.5 micron) or Y2K2 (.3 micron)

12" x 25' rolls

\$33.00 per roll Domestic

\$35.00 per roll Foreign

Price includes shipping

## A New Method of Joining Prop Spars

Steve Fujikawa

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I have never been satisfied with the customary method of joining 2 prop spars with a scarf joint. Spars joined in this manner have their thickest dimension parallel to the shaft and the blades glued on along the spanwise edge. There are a couple of things wrong with this. First, a rectangular cross section spar is in theory intended to take loads parallel to the deepest dimension and we're applying them at an average 45°, an inefficient use of the beam's section. Second, if the spars are double tapered, the blade longitudinal axes are not exactly radial, a negligible aerodynamic inefficiency to be sure, but more importantly it complicates blade set up by not being able to sight along the length of both spars to determine straightness.

The new method eliminates both shortcomings by orienting the spars at 45° to the shaft while providing a full span reference line for alignment, and in addition presents a more stable mounting surface for the blade by allowing gluing to the flat top of the spar rather than the edge. It is compatible with both sheet wood and built up props. And the wood joint is simple and requires no compound mitering.

Referring to the illustrations, notches are first cut in the top of the spars at the hub. Experimentation will show that the notches can be interlocked in a right or left hand manner. We only want the right hand as shown, so get this right before you glue it! The spars are glued using a straightedge and a flat benchtop for alignment. A filler piece is added to the bottom side at the hub to provide a flat surface for the thrust bearing. The location of the exact geometric center of the spar is at the center of the joint. Initially I thought that drilling square through the joint might be complicated by the harder glue deflecting the drill, but this is actually not a problem.

The hub itself thus created is extremely stiff and some weight could be saved by shaving off a little wood from the overlapping section, if desired. In theory, a lighter weight spar could also be used as its section is now being employed more efficiently.

When the spars are joined using a straightedge, a perfectly straight full span reference line is created for gluing the blades. I like to check blade alignment by sighting spanwise along the prop spar. Straight lines drawn down the longitudinal axis of the blades should appear perfectly co-linear, any blade misalignment is immediately apparent.

When gluing the blade to the spar, lay the spar top flat on the blade axis and put a single drop of glue at the 45° point. When then placed on the pitch gauge the angular distribution should be very nearly perfect, and completing the gluing is easy.

I suggest that this joint also be used with the EZB blades described in INAV #96 pp. 16-18. The author had the right idea with gluing the blades flat but the described wedge doesn't facilitate pitching or alignment. Although a straightedge/benchtop can't be used as a gluing jig with the blades already attached, blade alignment and pitching will still be simplified.

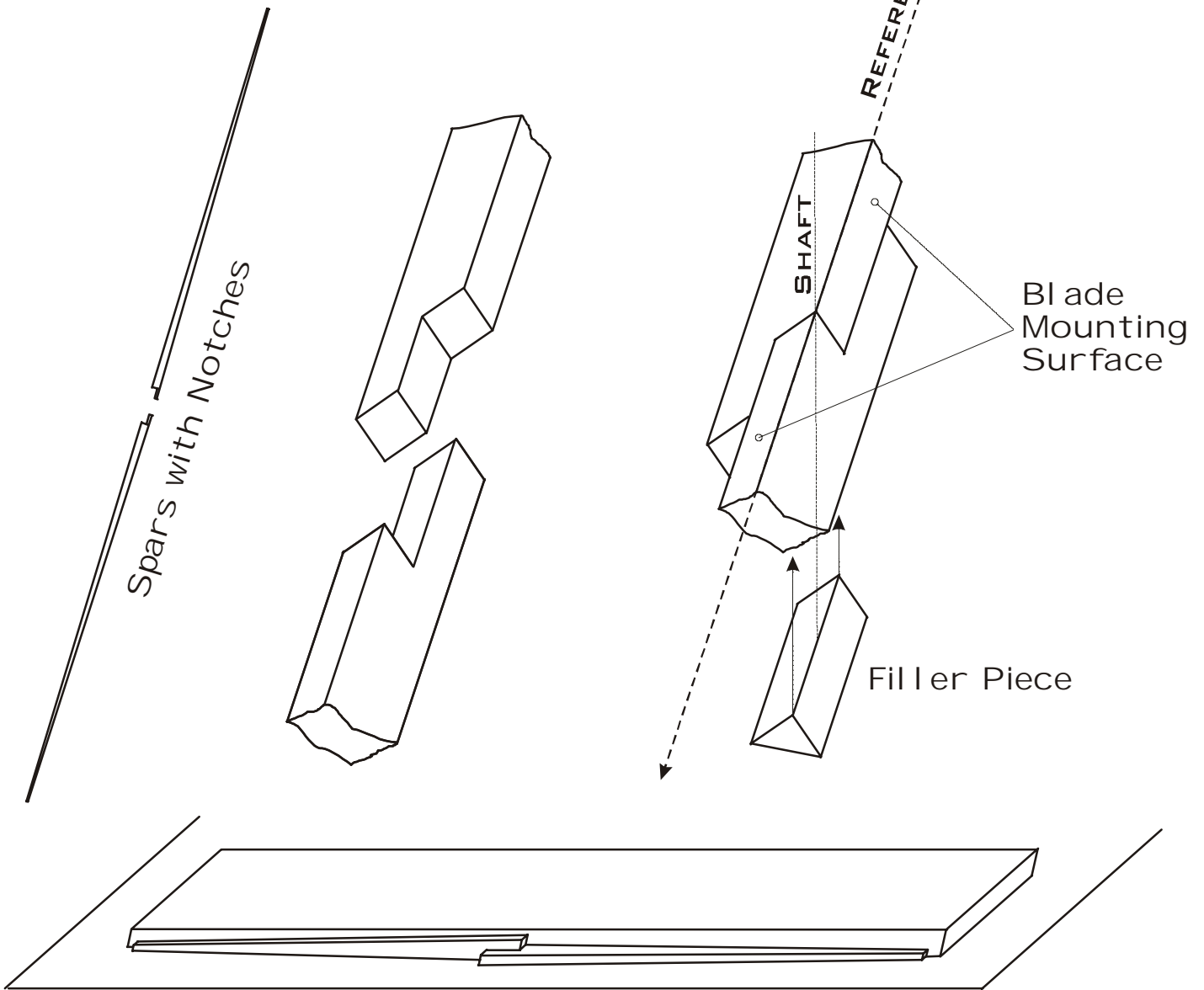
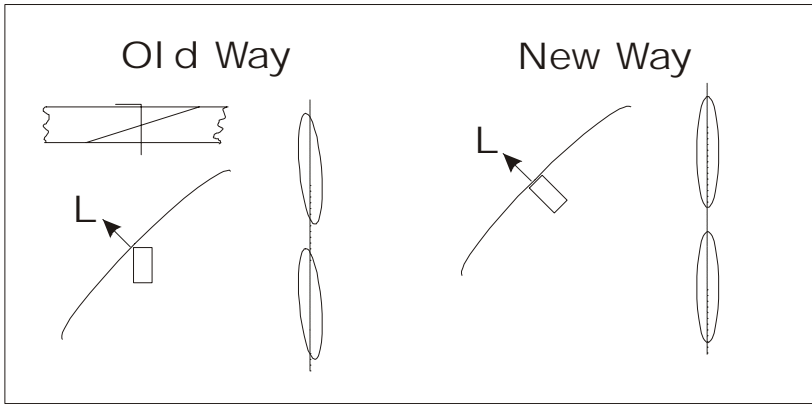
### INAV fund drive to support the Jr F1D team

So far we only have 12 donors to support this worthy cause. This is your chance to put your money where your mouth is in supporting our first ever full junior team to the World Championship. Donations are tax deductible. Make checks out to NFFS and mark that it is for the INAV Jr Team Fund.

Mail to:  
Vern Hacker  
25599 Breckenridge DR  
Euclid OH 44117

Contributors will be recognized in a future issue of INAV. Take a collection up next time you fly and get the money in!

# A New Method of Joining Prop Spars



Gluing the Spars with a Straightedge

# **BALSA: A Beginner's Journey Into Hell**

By: H. Bruce McCrory, 12/28/01

A while back a friend emailed me. He had cut into a new block of balsa from Lone Star Hobbies. It had an S.C. of 130. The best I had at the time was SC 108 – average. Shortly after, another email, SC 141.

SC is short for Stiffness Coefficient, a method of selecting and categorizing balsa based on one of its most desirable characteristics, stiffness. The stiffest wood goes into wing spars and booms. For its weight, stiff balsa will keep these structural members rigid where weaker or heavier, bulkier wood can flop and twist. The rest of balsa is identified by degrees of “punky”, “mushy” and “takes-a-set”. Finding the “best” has been the most frustrating, challenging experience I’ve had, other than trying to become a millionaire. I’m only a year into this search for the “Holy Grail” as I’ve come to call it.

I have a love/hate relationship with balsa that goes back to my first balsa purchase for my first plane about two years ago. Since then, I have sliced, diced, and quartered 3 and 4-foot sheets; spent hours and wasted .07-inch sanding a bandsawn sheet for a .010” prop blade that ended up a pound denser than the raw block. I’ve razor-cut perfect .010” c-grain sheets with no waste but damaged strength. My garage has boxes of wood that some day may be useful in some specific application, but are useless for EZB. Test strips from each sheet were cut and shattered, looking for motor sticks. I even have some failures from another Grail seeker. My search sent me to some of the most interesting of places and characters. Throughout this journey I’ve learned a lot and realize I know less as I learn more. Each discovery brings new questions and problems to be solved. For me the search, resolution, and discovery is ninety percent of the enjoyment of this sport/hobby.

The real nightmare started when “Doc” Dona gave me a copy of Larry Coslick’s “Hobby Shop EZB”, INAV #90. Larry describes going down to his local retailer, picking through balsa, finding some clear, clean sections of wood in the ideal 3/32<sup>nd</sup> –inch sheet and cutting some EZB motor sticks. Generously he picked an average weight blank from the sheet and describes how to test it for “stiffness” using coins, sticks and thread. Easy.

Wrong! A year later, after hundreds of motor stick blanks, I’m still searching for that elusive bugger that meets Larry’s motor stick specifications. It has been a costly venture. The grapevine news says Mr. Coslick works pretty hard to find his motor sticks, too.

This I do know. When you pick up, or cut, a sheet of the best – or, rather the stiffest - balsa, you won’t recognize it unless you know what to look for. If you know, it will be instantly recognizable. I have accumulated a lot of wood in a short time. It takes practice and a lot of failures to begin to identify useful balsa through self-training. If you buy mail order, the only difference is the experience and care taken by the handler collecting your order. I always stop by my favorite stores periodically, but finding a stiff piece of balsa will be more accidental than picking through the stock for what is best. Ninety percent will be bad or mediocre and the rest will be “average” based on the Hunt/Taylor Stiffness Coefficient test. (See Issue #104 – ed.)

Discouraging? Not really. I’m learning to work around the problem – if it is one – and discovering the unique qualities of even the poorest of my poor balsa. INAV #104 is testimony. I picked my poorest 4-pound (4.06) sheet of “Contest” grade balsa hovering at SC 50, built three A6 planes for the published plan and will attempt the world duration record next summer at Kibbie with one of them. You don’t need the “best” wood to be competitive. There are many other factors that influence model performance, and balsa is the least important. [That last sentence is the most important in this article.]

Yes. I finally found a stiff sheet – a block actually. It isn’t the Holy Grail, but at SC 120 and better it will suffice. There is a lot of information block number 5.7A - as it is labeled - can reveal about the structural properties of balsa. No. 5.7A filled the missing link next to poor, mediocre, and good stiffness rating. It was so good to me that I stopped hacking away the surface on my bandsaw and sent it to Tim Goldstein to custom cut. I’m still not sure that he will do this sort of thing commercially, but beautifully finished sheets of 5.7A returned with my first orders from Tru-Weight Indoor Balsa, Tim’s new venture. And, the scraps! Insist on return of scraps if the cuts are to be A, C. Half the block disappears in dust and odd sized wedges. Tim puts a lot of work

into each sheet he cuts for sale, also. They are individually numbered, weighed, and rated for stiffness. Exactly what I did with half of the 40 odd sheets from 5.7A. Like reading geological history, this is what my good block tells me, so far:

1. Except for a half-inch band of hard wood that bisects the block tangentially, like a growth ring, the 2-inch depth is consistently stiff. This tells me that SC is not an isolated strip in otherwise mediocre wood. If the sheet or block is mediocre, no band of gold will likely be hidden in it.
2. I think the Stiffness Coefficient test as presently designed is useful in only a limited range of density. The hardwood band, which Tim grouched about, could be an entire book or graduate thesis in my mind. The a-grain cuts went right through the band losing only .051-inch of wood in each cut. The Stiffness Coefficient story, with its flaws, speaks loudly from the 11 sheets. Outside the band, average density is 4.5 pounds, and SC- 126. Through the hard band, density climbs to 10.4 pounds with a geometric decrease in stiffness to SC 80. I have no reason to think stiffness would change relative to density. But this premise is tainted by an earlier discovery dealing with Mini-sticks. My first mini used an 11-pound, SC 70 motor stick that weighed less than any lower density sticks I've built since. It holds higher torque than lesser motors that have snapped the other sticks. There is more, but enough of block 5.7A.

The architects of the SC test admit it is most accurate in 1/8-inch by 1/4-inch strips. This size does not fit my methods of stripping structural members. It is also difficult to convince a dealer to permit stripping wood for a test to determine if he or she has any decent balsa. Since the density range for most indoor construction is 4 – 6 pounds, the Stiffness Coefficient test probably is the most accurate way to select balsa stock for structural members. It offers nothing to understanding the requirements of individual parts for a plane, however.

The important lesson from my journey so far is that only by building and testing, with very detailed records, will my competitive passion improve. Most critical is to know as accurately as possible the strength and physical properties of each individual part. The records can be reviewed for any future modifications. The only way to do this is to test each part by deflection under load. Coslick's previously mentioned article describes deflection and is a very good example of record keeping. I've added twist to my construction records. Twist, or torsion resistance, in a wood strip is primarily a carryover from an architectural background and is very important to sizing motor sticks. This is also Larry's sequel to the "sticks and coins" test for selecting motor sticks. Twist is calculated by very similar methods used in a torque meter. The strip replaces the tension wire and weight is added to a moment arm with pointer at one end of the strip.

What about the super stuff, the "best" balsa? Are you at the store? Yes? It's in front of you. Bob Randolph didn't have great wood. He knew how to fly planes. Steve Brown doesn't SC test his wood. He inspects it visually, feels the bending tension in spar wood stock, and watches the bend from dead load on motor tube sheets. Steve also tests spars by deflection. Other fliers I watch closely are no different.

Wood options are numerous. What is needed to achieve the desired end? Answer: optimum structure, which can be either stiff or weak wood. The search for the Holy Grail is still very much a part of my time, but far more is spent learning how to fly, studying rubber energy characteristics, plane design, and other, more important aspects of construction.

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*Editor's note:* To answer if Tim Goldstein has earned the right to our respect in the balsa-cutting field, one has only to read about his own search for the Holy Grail in this issue. Check out his Tru-Weight Balsa site for yourself at [www.fld.biz](http://www.fld.biz). As a novice stiffness tester, I can vouch for Bruce in the fact that there is a whole lot of S.C. 60-90 wood out there. Once found, anything over 110 should be treasured. But don't throw away your less-than-contest-best wood. Give it to one of the many S.O. or T.S.A. mentors who may be helping youngsters in your area. I'm certain they will find a use for it.

## On EZB Motor Sticks

Bill Dodson

“Does anyone here fly EZB’s?”

“Yes, the fellow at the end of the line. Just follow the sound of the cussing...”

Few things are more challenging in indoor modeling than finding a light EZB motor stick. I built my first model from the IMS kit, then ordered a bunch of indoor balsa from Mr. Gitlow. I had been sent a copy of INAV #90 by a generous modeler, and started slicing and testing wood bits with the intention of building a .6-.7 gram Hobby Shopper EZB. I sliced a motor stick sized stick off the bottom of a piece of IMS fuselage stock, trimmed it to size, and it met the deflection tests. It only weighed .145 grams, and my model came out to .515 grams finished. It climbed right up and out of sight in the rafters at Tustin never to be seen again. I then proceeded to try and duplicate this feat (the model, not the rafters), but could not even come close to that motor stick’s weight or stiffness, even from the rest of the motor stick stock sheet. My lightest effort came out to .185 grams, and was not adequately stiff.

I spent many afternoons and evenings going through contest balsa in hobby shops, and brought home a bunch of promising pieces, and I thought a lot about the subject. What I wanted was a way to test 9” lengths of 1/4” by 3/32” balsa right off to tell if I had a winner or not, without having to go to the trouble of turning them into motor stick blanks first. I have tons of blanks – my best pieces to date came from a 1/4” thick piece, so I could not just slice them out directly, as one can from 3/32” sheet. It stands to reason that if you test a fuselage blank for stiffness in bending, a strip of wood in “pre-blank” condition could also be tested, I just needed to know what deflection to look for. I tried some sanity check calculations to see if the problem can be brought from the realm of the abstract into engineering terms. From the Hobby Shopper article, the dimensions of a finished motor stick are roughly:

.094” thick, 8.5 “ long  
.150” high at the nose increasing to .225” about 2.8” back  
.120” tall at the tail end

To calculate its volume:

$$V = .094 \times [ (.150 + .225) / 2 \times 2.8 + (8.5 - 2.8) \times (.225 + .120) / 2 ] = .142 \text{ cubic inches}$$

Assuming 5.5 lb density balsa, this motor stick should weigh:

$$W = 5.5 \text{ lb / cu. Ft} / (1728 \text{ cu in/cu ft}) \times .142 \text{ cu in} \times 453.6 \text{ grams/lb} = .205 \text{ grams}$$

( Eavg = 220,000 psi )  
5.0 lb balsa -- .186 grams ( Eavg = 180,000 psi )  
4.5 lb balsa -- .168 grams ( Eavg = 140,000 psi )  
4.0 lb balsa – .149 grams ( Eavg = 100,000 psi )

Since I have sheets of 3.8 lb wood, a .145 gram motor stick is possible, but can one reasonably expect to find a piece stiff enough? J. H. Maxwell gives us the following formula for average balsa stiffness ( Eavg ) as a function of its density, which I added to the above listing :

$$E_{avg} = 0.08 \times (\text{Density} - 2.75) \times 1,000,000 \text{ psi} \quad (\text{eq. 1})$$

Larry Coslick, in the Hobby Shopper article, writes that a good fuselage stick should deflect no more than ( .120 - .051 ) = .069 inches when a 31.9 gram weight is applied to the top of the stick, or when a 10.7 gram weight is applied on it’s side. I will assume that the 8.5 “ motor stick is supported 1/10” in from each end, for an unsupported length of 8.3”.

To estimate the value of E required for the fuselage stick, I turned to NASTRAN, a finite element analysis software package used to calculate structural deflection and stresses, and for aircraft flutter analysis. It is akin to hunting mice with a Bazooka, but it has been far too long since I have used my brain to derive a closed form solution. I modeled a 5.5 lb/cu. Ft. balsa beam ( Eavg = 220,000 psi ) to the requisite dimensions, broke it into some 400 solid elements, and applied the proper loads (Figures 1 & 2). Running the model, I obtained:

Volume = .142 cu. In.  
Weight = .205 grams  
Vertical Deflection = 0.072” for a 31.9 gram load  
Lateral Deflection = .096” for a 10.7 gram load

Which checks out well for volume and weight, but requires a sanity check for the deflection values. To this end, I also modeled a .094 x .25 x 8.5 and a .125 x .25 x 8.5 strip of 5.5 lb balsa (Eavg = 220,000 psi) in NASTRAN, to compare the results to the beam deflection equation for a rectangular strip:

$$\text{Deflection} = (\text{Load} \times \text{Length}^3) / (4 \times \text{Thickness} \times \text{Depth}^3 \times E) \quad (\text{eq. 2})$$

Distance between pivots = 8.3” (“Length”) – this assumes the sticks bridge the pivots by .1” on each side. Since the deflection is proportional to the length cubed, this dimension is important to the final result.

I found a passable closed form solution for the deflection of a tapered beam and attempted to express it in spreadsheet form. I input the same constant width and depth sticks for a sanity check:

	HAND CALC	NASTRAN	SPREADSHEET
<b>.094 x .25 x 8.5 beam:</b>			
Vert Def -- 32.9 gram load	0.031	0.031	0.031
Lateral Defl – 10.7 gram load	0.074	0.074	0.074
<b>.125 x .25 x 8.5 beam:</b>			
Vert Def -- 39.5 gram load	0.023	0.023	0.023
Lateral Defl – 10.7 gram load	0.031	0.031	0.031

From the above table, we can at least conclude that the NASTRAN and spreadsheet results for the straight beam are reliable. For a Hobby Shopper motor stick made from average stiffness 5.5 lb wood we calculate:

	NASTRAN	SPREADSHEET	
<b>.094 x .150/.225/.120 x 8.5 fuselage:</b>			Difference
Vert Def -- 32.9 gram load	0.072	0.082	14%
Lateral Defl – 10.7 gram load	0.096	0.095	---
<b>.125 x .150/.225/.120 x 8.5 fuselage:</b>			
Vert Def -- 39.5 gram load	0.054	0.062	14%
Lateral Defl – 10.7 gram load	0.041	0.041	---

From this table we see the hazards of collecting enough information that the various answers conflict. Had I used either method by itself I could have believed my answers were perfect. This is the danger of trying to predict reality from mathematical approximations – they are just approximations. There is great value in these approximations, however, for predicting general trends, as we will see shortly. I tend to go with the NASTRAN results (NASTRAN costs \$120,000 and is specifically for structural analysis, EXCEL costs \$200 and is very general purpose, and, of course, I - the weakest link - generated the inputs for both) for deflection, as I am not sure how well the closed form deflection equation handles a lot of taper. NASTRAN handles any shape pretty much the same way and gives good results provided the input is correct. The spreadsheet, however, can be posted for general public use, and one can always reduce the output by 14% or so.

Using the constant section beam bending equation above we derive the following relationship for scaling bending deflections (eq. 3):

$$\text{Def1} / \text{Def2} = \text{Load1} / \text{Load2} \times \text{Length1}^3 / \text{Length2}^3 \times \text{Thick2} / \text{Thick1} \times \text{Depth2}^3 / \text{Depth1}^3 \times E2 / E1$$

We can now determine the wood stiffness required to meet the Hobby Shopper deflections Larry wrote up in his construction article. Using the NASTRAN results, to get .069" deflection in both directions for a Hobby Shopper fuselage of the same dimensions, the balsa stiffness required is:

$$E_{2v} = E_1 \times \text{Def}_{1v} / \text{Def}_{2v} = 220,000 \times .072 / .069 = 229,565 \text{ psi}$$

$$E_{2s} = E_1 \times \text{Def}_{1s} / \text{Def}_{2s} = 220,000 \times .096 / .069 = 306,087 \text{ psi}$$

This answer mirrors what I have seen in motor stick testing, that is; "It is relatively easy to find a motor stick stiff enough vertically, by very hard to find one that meets the side bending requirements".

Assume for the moment that balsa stiffness is the same in either direction. To size a motor stick that meets the Hobby Shopper requirements with the same E in both directions, we use equation 3 above (or the spreadsheet) to solve for the ratio of depths required, which turns out to be an ~ 15% reduction in overall height, but requires E = 352,000 psi to meet bending requirements. If we keep the same vertical dimension, we can get a motor stick that meets the bending requirements by going to a width of .111" from .094", and now we only need a stiffness value of 184,000 psi to meet deflection criteria. The following table details the motor stick weight and stiffness ratio required for various densities of balsa for these two cases:

**Volume =** 0.124cu.in.  
**Stiffness Required =** 352,000Psi

<b>Wood Density =</b>	<b>6.0</b>	<b>5.5</b>	<b>5.0</b>	<b>4.5</b>
<b>Motor stick Weight =</b>	0.195	0.179	0.163	0.146
<b>Average Stiffness (Eavg) =</b>	260,000	220,000	180,000	140,000
<b>Stiffness Ratio Required =</b>	1.35	1.60	1.96	---

Going this route, I doubt we could come up with a viable motor stick. If we leave the height the same, and increase the width to .111", we get:

**Volume =** 0.168cu.in.  
**Stiffness Required =** 184,000Psi

<b>Wood Density =</b>	<b>6.0</b>	<b>5.5</b>	<b>5.0</b>	<b>4.5</b>
<b>Motor stick Weight =</b>	0.264	0.242	0.220	0.198
<b>Average Stiffness (Eavg) =</b>	260,000	220,000	180,000	140,000
<b>Stiffness Ratio Required =</b>	.71	.84	1.02	1.3

One can measure the directional stiffness of an un-tapered blank, and input these in the spreadsheet to get some direction on what size the final blank should be to meet stiffness criteria, and how much it should weigh. Although the spreadsheet can handle it, I have not experimented with tapering the stick in width as well as in height. It would be interesting to see if there is any advantage to doing this.

Tweaking motor stick dimensions for 140% stiffness wood in my spreadsheet (dividing vertical deflection numbers by 1.14 to match the NASTRAN results) gives a weight of .190 grams for a straight-sided motor stick blank in balsa densities from 6.5 to 5.0 lb. Weight increases slightly for 4.5 – 4.0 lb wood to .195 and .200 grams. From these numbers it appears that a .185 gram motor stick from a good piece of wood is possible, and that anything much lighter (if we hold to the same stiffness requirements) is exceptional. This agrees well with my experience testing dozens of motor stick candidate strips, and finding that many of those that meet stiffness weigh over .225 grams (those go in to my giveaway box). I'd like to know how this matches other people's experience.

This study assumes uniform density across the motor stick. If you follow Larry's advice and cut a motor stick out of the "light" area of a good balsa sheet, but with a touch of darker and stiffer wood around both edges, you could beat the weight numbers. The .145 gram motor stick I had was from a dark/light striped band on the edge of a sheet of IMS fuselage stock.

Other non-wood factors contribute to the success of an EZB motor stick:

Installing the propeller shaft and rear hook at exactly the right distance below the motor stick is critical. If this distance is increased at all by sloppy building you will have too much down thrust with full winds, and the model will either dive into the floor, or speed up enough for a wing tip to tuck under. If either one is much off center the motor stick will want to bow sideways under a fully wound motor. You can turn this to your favor by bending the rear hook a little to one side or the other to help fight a bowing tendency in the motor stick.

When walking out to launch on a fully wound motor, wait until just the moment before launch to hook up the motor to the rear hook. This will prevent the stick from taking a set in the minutes before launch. You can also bow the stick away from a problem direction immediately before launch.

The lighter you build a model, the less rubber/torque it will require, and the less stiff the motor stick will have to be. For a very light model, say under .45 grams, you might be able to relax the motor stick stiffness a tad. A lot of weight can be saved in other areas if pursued with some thought and diligence. Look closely at models that are turning in higher times in contests and you will see a lot of tiny details that shave off weight.

I would also recommend a tail boom that flexes no more than 3/4" under the recommended test load. The high value of over an inch mentioned in the Hobby Shopper article was inadequate for my models, while the 3/4" test booms have been fine.

Editor's Note: Bill's spreadsheet associated with this article can be found at [www.indoorduration.com](http://www.indoorduration.com) under "Utilities". The Hobby Shopper article by Larry Coslick can be found in the same site under "Articles", or from the INAV archive CD in Issue #90.

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## Balsa Facts

Botanical Name: *Ochroma pyramidale*

**VITAL STATISTICS:** Tropical Height 80 feet to 90 feet tall with a trunk diameter of 12 to 14 inches. A medium-tall, thin tree, balsa grows extremely fast. It is ready to harvest in 5 to 6 years from planting. The best balsa wood comes from younger rather than older trees. Balsa trees are widely distributed throughout Central and South America, from southern Mexico to southern Bolivia and Brazil. Ecuador, however, has been the principal area of growth since the wood gained commercial importance. It is often grown there in 5,000 acre balsa tree plantations with on-site milling and production facilities.

A very surprising feature of balsa is that it can withstand some corrosive chemicals better than stainless steel! Balsa's value is chronically underestimated because of its association with model building and novelties - most familiarly that most wonderful toy from our youth, the model airplane glider. In fact, only 10% of balsa production goes into models and novelties. Balsa has a long list of very interesting uses. Due to its buoyancy it is primarily used in floatation devices, life preservers, rafts, boat hulls and speed boats. Due to its light weight it is used in aircraft flooring, recreational vehicles, off road vehicles and subway cars. Also, in artificial limbs, bathtub and shower stall bottoms and theatrical props. Due to its porosity it is used in insulation, cushioning, sound proofing, vibration modifying and other musical and theatrical needs

**WHY IS Balsa WOOD SO LIGHT?** The secret to balsa wood's lightness can only be seen with a microscope. The cells are big and very thinned walled, so that the ratio of solid matter to open space is as small as possible. Most woods have gobs of heavy, plastic-like cement, called lignin, holding the cells together. In balsa, lignin is at a minimum. Only about 40% of the volume of a piece of balsa is solid substance. To give a balsa tree the strength it needs to stand in the jungle, nature pumps each balsa cell full of water until they become rigid - like a car tire full of air. Green balsa wood typically contains five times as much water by weight as it has actual wood substance, compared to most hardwoods which contain very little water in relation to wood substance. Green balsa wood must therefore be carefully kiln dried to remove most of the water before it can be sold. Kiln drying is a tedious two week process that carefully removes the excess water until the moisture content is only 6%. Kiln drying also kills any bacteria, fungi, and insects that may have been in the raw balsa wood.

**IS Balsa THE LIGHTEST WOOD IN THE WORLD?** No! Most people are surprised to hear that botanically, balsa wood is only about the third or fourth lightest wood in the world. However, all the woods which are lighter than balsa are terribly weak and unsuitable for any practical use. The very lightest varieties don't really resemble wood at all, as we commonly think of it, but are more like a tree-like vegetable that grows in rings, similar in texture to an onion. It is not until balsa is reached that there is any sign of real strength combined with lightness. In fact, balsa wood is often considered the strongest wood for its weight in the world. Pound for pound it is stronger in some respects than pine, hickory, or even oak

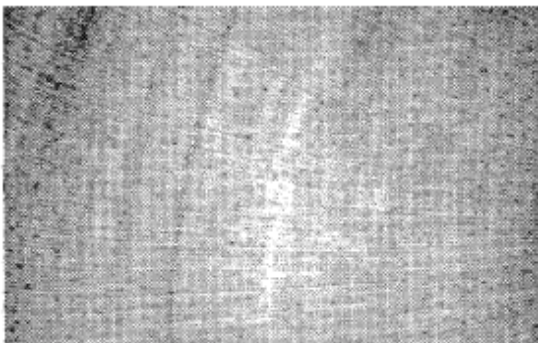
From his book  
Balsa for Indoor Models

### 3 . Grain

What we call grain is, to be more precise, the position and orientation of the cells which make up a piece of wood. These cells fall into two main categories, Longitudinal and Radial. Longitudinal are those cells which were vertical when the tree was growing, and consequently run lengthwise in a sheet or a strip. Radial, as the name implies, are cells radiating from the centre of the tree, and so they lie at right angles to the longitudinal cells.

The cells in the longitudinal direction are further divided into two varieties, namely Fibres and Vessels. Of these, the fibres are the more important since they give the wood its strength, and the thickness of their walls determines its density. In balsa, the fibres are thin-walled and enclose a high proportion of air, making the wood very light. Vessels are the long tubular ducts through which the sap flowed up the tree. Botanically, balsa is a diffuse-porous hardwood, which means that the vessels are evenly distributed rather than being concentrated in annular rings, as they are in softwoods.

All this description of cells is more readily understood if you look at a transverse section through a block, similar to the one shown here.



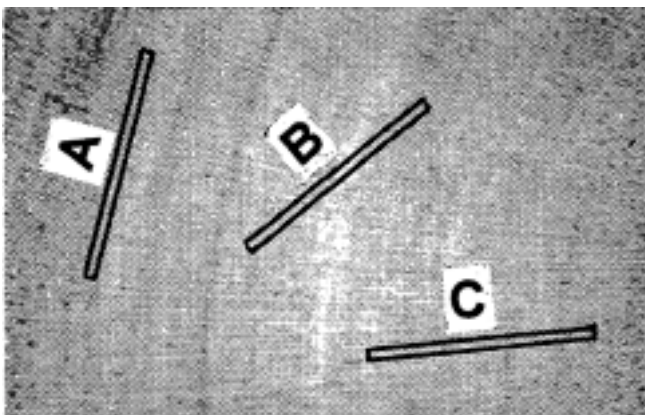
The photograph is actually of a thin slice from the end of a plank, lit by a back light to show up the grain.

Visible in this photograph of the end of a plank are the growth rings, the rays, and the pin-holes formed by the vessels. Note how the rays are bent.

A section like this cuts through the vessels and fibres, and, although the fibres are too small to be distinguished by the naked eye, the vessels show up as pin-holes scattered about randomly. Also clearly visible are the rays which appear as fine lines fanning out across the block.

Another feature of this section is the pattern of rings, seen as light and dark shaded arcs. These are not annular rings which, in low density balsa, are about  $1/2^\circ$  apart. Rather they are the result of seasonal changes as the tree was growing, and I prefer to call them growth rings. Mostly, the rays pass through the rings at  $90^\circ$ , although this angle can vary slightly.

Sometimes it is difficult to see the grain on the end of a block, because it has not been cut with a fine saw. The solution is to clean up a small area with a sharp knife or a razor blade, then dab it with a damp tissue. This will make the grain stand out. To illustrate the practical application of this knowledge of grain, the ends of three different sheets have been drawn on the end-grain photograph to show how they would lie within a plank. Sheet A is tangential to the rings, sheet C is in line with the rays, and sheet B is somewhere in between.



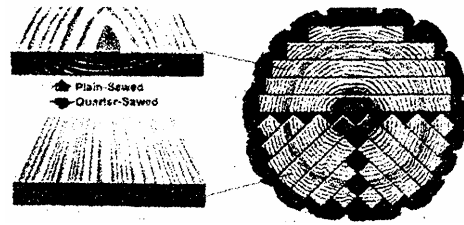
**The position of each sheet within a plank determines its grain. A is tangential to the rings, and C is line with the rays.**

Using the letters A, B and C to identify the grain of sheets is a long established practice, and its origin is another interesting piece of Indoor history.

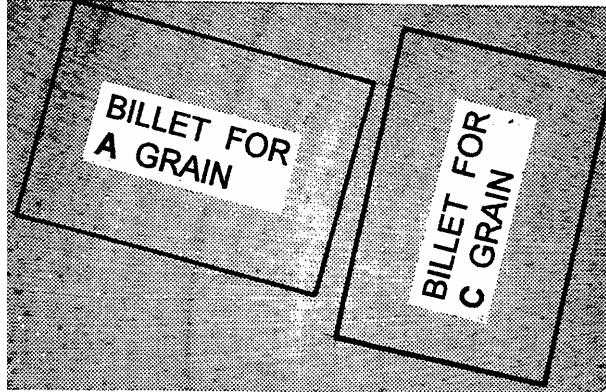
In 1933, when JASCO started to produce balsa specifically for Indoor models, they found that some of the sheets could easily be rolled into tubes for motor sticks, while others were stiff and tended to crack when rolled. Examination of the two types of sheets revealed that there was a variance of  $90^\circ$  in their grain. To differentiate the grain cuts they introduced a code in which A indicated the easy-to-roll

stock, C was the stiff cut, and B was for general use. Later, they discovered, from a Belsaw catalogue, that their grain coding agreed with the way logs are sawn in the timber industry.

**Plain and quarter sawed. These timber trade terms correspond to A and C in Indoor balsa.**



The Belsaw diagram shows that A grain corresponds to plain sawn and C to quarter sawn (now generally called quarter grain). Note, however, that, of the quarter grain boards, only the middle one is actually in line with the rays. This is a point I shall return to later.

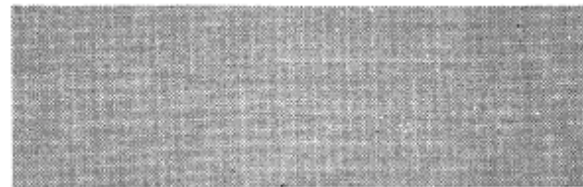


**Billets must be cut from a plank at the correct angles to yield the different grains of sheet. This involves some awkward sawing and a lot of waste.**

The planks, as they are received by the Indoor balsa specialists from the importers, may have been cut from any part of the log, and, as a result, every plank has a different pattern of rays and rings on its ends. From these the sawyer has to extract the billets from which he will saw the final sheets.

To yield sheets with the required grain, the billets must be correctly orientated in the plank, and this often necessitates sawing at some very awkward angles, as well as generating a lot of unavoidable waste.

The illustration shows how two billets, one for A grain sheets and the other for C grain, might obtained from a plank. Given a suitable billet, A grain sheets are relatively easy to produce. A series of parallel cuts will result in sheets all of which will be A grain, and will look like the one shown here. You can see that it is fairly featureless except for the vessels, which appear as darker lines.



**A grain sheets are featureless, except for the vessel lines. The longer these lines are the better.**

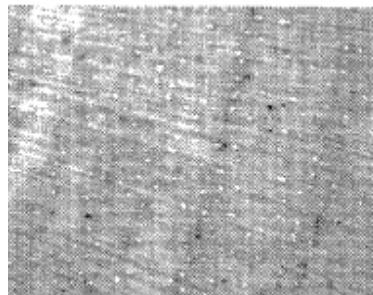
Long vessel lines are desirable because they indicate that the sheet was cut in line with the longitudinal grain. If the vessel lines are short, the grain is running through the sheet at an angle, and strips,

such as spars or motor sticks, cut from it will be weak.

For a sheet to be true A grain, the rays should run through it at 90° to the surface at, or near, the centre line. The only way to check this is to examine the end of the sheet with the aid of a magnifying glass.

A grain has two main attributes - its uniformity and its flexibility across the sheet. Uniformity results from the fact that the whole sheet was growing at, more or less, the same time. When a number of strips are sliced from an A grain sheet, there is a good chance that they will all have the the same density and stiffness. The flexibility allows the sheet to be bent to very small radii without cracking. This is particularly helpful in rolling tubular tail booms.

**In this enlargement of a small area of the end-grain the vessel holes show up clearly, and can be measured.**



**photograph,**

occurs when  
Then the  
thickness will

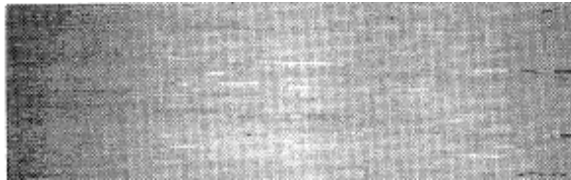
area of the  
and can

In very thin sheets, you will often find slits going right through. This is the thickness of the sheet is less than the diameter of the vessels. opposite walls of those vessels which happen to come midway in the have been cut away, leaving gaps through the sheet.

To put this into perspective, I have enlarged, by a factor of 2 a small transverse section photograph. In this, the vessel holes show clearly readily be measured. The average actual size is 0.02" diameter, so any sheet with a thickness less than that is liable to show



slits.



**Greatly enlarged section of a very thin sheet shows that where the opposite walls of a vessel are cut away, the result is a slit right through. Slits can be clearly seen in the photograph below of a 0005" sheet.**

This phenomenon can appear in sheets of any grain, but it is more prevalent in A grain. This is because, although the vessels are tightly packed between the rays, they are less constrained radially. Thus the holes tend to be oval, rather than round, with the longer axis in the radial direction, that is through the thickness of an A grain sheet.

C is a more complex grain. Strictly speaking, a C grain sheet should be sawn in line with the rays, but we can reasonably relax this a little and say that any sheet that is within 5° of the rays is true C grain. Sheets complying with this definition look like the one shown here, where the rays appear as narrow stripes running right across. As the angle between sheet and rays increases above 5°, the stripes get shorter, then become mere speckles, and, eventually, disappear altogether.

**In C grain the rays are parallel to the surface of the sheet, and appear as stripes running right across.**



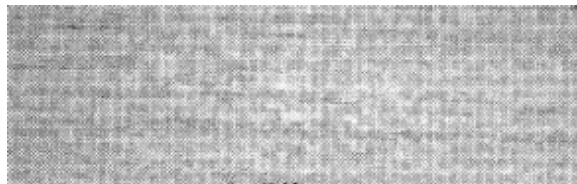
[If you would like to see perfect C grain, find a block with a split in it, and open up the block along the split. The split will almost certainly be radial, and perfect C grain will be revealed]

When a billet for C grain is sawn in parallel cuts, only two, or at the most three, sheets (depending on the thickness) will be true C grain, with an extensive pattern of stripes. All the other sheets will

be speckled, to a greater or lesser extent.

In order to produce more C grain sheets from a billet, the angle of the saw has to be adjusted every few cuts. This process is time-consuming, as well as being wasteful, so - understandably - the main producers of Indoor balsa avoid it. It is significant that, in their literature, Micro-X, I.M.S. and SIG all describe C grain as "mottled" or "speckled". This is a misconception, fostered by the supplies people, to justify the sale of sheets with even a hint of speckling, as C grain. To be realistic, speckled sheets should be termed CB grain, and any sheet sold as C grain ought to display a good proportion of distinct stripes.

**When the rays run through the sheet at an angle, they appear as speckles. Such sheets should be grain.**



**angle, they called CB**

Another common misconception is that C grain grain are one and the same thing. Reference back diagram on page 16 shows that not all quarter grain

and quarter to the sheets (or, in

this case, boards) are in line with the rays. Thus speckled sheets may correctly be regarded as quarter grain, although they are not true C grain. Paradoxically, all C grain sheets are quarter grain, but not all quarter grain sheets are C grain.

A further problem in producing C grain sheets is that the rays, as seen on the end of a billet, are often not straight, but bent. Also the pattern of rays may be twisted, from one end of the billet to the other. All of which explains why a complete sheet of C grain is a rarity.

Stiffness across the sheet, which is the main attribute of C grain, is simply due to the rays acting as stiffeners. Note, however, that although the rays give stiffness across the sheet, they do nothing to improve the stiffness lengthways. Bending tests I conducted on A and C grain motor sticks, cut close together in the same piece of balsa, showed that they were exactly equal in stiffness.

The combination of longitudinal fibres and lateral rays makes C sheets a kind of natural plywood. In fact, a good way of deciding where to use C grain is to imagine that you are designing a very large Indoor-type model with no weight constraints, and then think "Would I use plywood for that component?"

Two obvious applications are propeller blades and tubular motor sticks, where another quality of C grain comes into play.

That is its ability to maintain a curve after it has been formed. If the rays are bent by some moisture/heat process, they will retain that shape after drying and cooling. This means that propeller blades will keep their camber, and motor sticks will stay circular and resist crushing.

For some motor sticks C grain may be too stiff and the rays too prominent to permit forming to the radii required. In these cases it is advisable to use CB grain.

# Grinding Indoor Wood

## Ray Harlan

Although I have only a little experience grinding indoor wood, I was asked to write a short article on the subject. I am fortunate to have an old, mechanical Brown and Sharpe (ca 1956) that I bought cheaply some years ago. When Stan Chilton told me he was grinding wood, I asked about the particulars and he even supplied a 2" wide wheel of 60 grit aluminum oxide. I built a vacuum chuck for it, but wasn't inspired to grind wood until talking with Tim Goldstein last year. I had been hung up on balsa dust getting everywhere, which I didn't want on my other good machines. He assured me that the dust was minimal, which is true. However, if a lot of balsa is to be ground, some sort of dust vacuum is useful.

The vacuum chuck is just a piece of 3/4" x 2" x 18" aluminum with .040 holes every 1/4". It is relieved on the bottom and a tapped hole in the end of the plate holds a hose barb. The bottom reliefs let air get to this exit port but provide stiffening webs so the top surface remains flat under vacuum. The aluminum plate is epoxied to a 1/2" plate of steel that is held to the magnetic chuck. After building the chuck, it must be ground on the machine to get the top surface flat and parallel to the travel. Don't use the balsa-grinding wheel.

My first attempts at grinding seemed quite successful, until I discovered that the finished .006 balsa (for EZB props) appeared to have hinges running along the sheet. Close examination under a microscope showed that several rogue grains were sticking out of the wheel and nearly slicing through the balsa. They couldn't be felt on the wheel. If metal was being ground, they would have popped off immediately, but the balsa didn't offer enough resistance. A couple of touches to the running wheel with 320 paper managed to dislodge them and the wheel has been fine since. I am not sure of the best wheel to use, but generally a hard wheel (silicon carbide) would be chosen. It might not have rogue grains. A coarser wheel would not load as easily, but the present wheel isn't bad. I blow off the imbedded dust every few sheets.

To grind wood, I place it on the vacuum chuck and add strips of paper if the sheet is narrower than the chuck, so no holes are open in the chuck. The hose from the chuck goes to a shop vac, which provides plenty of downward force to hold the balsa. The wheel is started, brought down to just touch the surface of the wood and the table is hand traversed at a speed of about 4"/sec. For each new pass, the wheel is lowered .001-.002" until a surface sheen can be seen over the whole sheet. Grinding leaves a very smooth, almost polished, finish. When the whole sheet has this, there are no low spots. The sheet is turned over and the other side is ground. Usually only .002" needs to be removed from this side to remove saw marks (the chuck pulls the wood down and forces the bottom to be flat, so grinding the first side gets a uniform thickness). The final thickness will be uniform to .0002" or better!

I have not tested the density or stiffness coefficient of a sheet before grinding it, so I don't know how grinding affects these. To get density of the unground sheet, the thickness must be accurately known and it often varies several thousandths. Furthermore, the surface roughness will influence the measurement. The stiffness coefficient also depends on the density. There would be a large uncertainty in these parameters before grinding.

Some might think that the polished surface must be, in part, due to crushing cells when grinding. In looking at the surface under a 30-power microscope, I don't see any evidence of this; it may take higher power to assess it. One test could be performed with a sheet of, say .025 A-grain balsa. It could be ground flat on both sides and the density measured. Then it could be ground again, taking off .005 total and the density again measured. This could be repeated several times until the sheet was about .005 thick and all of the density measurements could be compared. If the surface were compacted by grinding, it would increase the density near the surface. One would expect that this crush layer would be a fixed thickness, not proportional to the sheet thickness. Therefore, as the sheet got thinner, the density should increase, because the crush layers would be an increasingly higher proportion of the total sheet thickness. If the test shows a constant density, there is no crush layer. I haven't made this test, but the thin wood ground (.006) had a density of 4#/cuft, so the effect, if present, can't be very significant.

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