the Ampeer

January The EFO Officers 2006

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The Next Meeting:
Date: Thursday, January 5 **Time:** 7:30 p.m.
Place: Rick Sawicki's (see map in this issue)

What's In This Issue:

Why Limiting Throttle Will Not Protect Batteries in Systems that are Propped for "Over the Limits" of the Battery From Taking Care of Your Battery Series

By Shawn Palmer
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Welcome to the first of a series of articles exploring some of the "black science" issues of R/C, where we explain in understandable terms some of the most common technical questions, as well as dispel some of the common myths surrounding R/C electronics.

This time we explore one of the most common misconceptions, and least understood important concepts in electric R/C. Quite often we see posted online, or within conversations with customers, the fact that they have their power systems propped for "over the limits" of their batteries, ESC's, and motors, but it's "OK" because they never actually use full throttle. This is 100% incorrect, and the explanation of why, involves a simplified example of how a speed controller works.

We'll break down an ESC's operation into blocks of one second for simplicity. We see when the ESC is at full throttle, it is as close to an "open circuit" as possible between the battery and motor, and "on" for the full one-second block of time, and drawing full throttle current. Each of these blocks of time stream together, and for a hypothetical example – you read 15 amps on your Whattmeter at full throttle. Also for example, you are using a 1050mAh Apogee Li-Po pack (11 amps of output capability), and a Phoenix 10 controller. At 3/4 throttle you read 10 amps, and the misconception is, that if you just stay below 3/4 throttle (or lower the top endpoint on your throttle channel) then everything is OK. What is REALLY happening, is when you are at 3/4 throttle, there is 3/4 of every second that the ESC is "on", and the last 1/4 of every second it is "off". The Whattmeter averages the current readings it's getting, and is showing you an average current.

Furthermore, if we are at 10% throttle, then the ESC is "on" for 1/10th of a second, and "off" for the remaining 9/10ths of a second. Regardless of how long per second it is "off" or "on", when it is "on", it is drawing full throttle current from the batteries, through the controller, and into the motor. So, essentially in an everyday application, you are taxing your batteries, ESC, and motor at full throttle amperage the entire time the system is running, regardless of throttle level. With continued use, the above combination will, at best, most certainly reduce the life span of the Li-Po pack, the ESC, and the motor as well.

What you'll find pleasantly surprising is, if you have a set-up as above, and simply prop down to make your full throttle current 11 amps to bring it "within spec" for all the components, you'll end up with the following: A cooler running (more efficient and longer life) motor, more rpm's to the prop (due to the increased voltage from a happy pack) with no observable loss in power, a lower temperature ESC (more BEC capacity and longer life), and much longer flight times to boot.

So the next time you put together a power system – make sure to prop the system to be within specs on all components of your power system while at full throttle, and enjoy all the longevity and other benefits that come from today's modern equipment. The days of having to "push everything beyond the envelope" just to get acceptable performance are over – off the shelf components used within specs are absolutely capable of giving you more power than you'll ever need.

Shawn Palmer,
Marketing/Support Director,
Castle Creations

The December EFO Meeting

The December meeting was held on Thursday, December 8, a day that southeastern Michigan got dumped on with 6" – 8" of snow that evening! While the attendance was slim, it was a very good meeting.

Keith Shaw discussed the choices for the connectors he uses, and why they are his preferences. He also had a great new plane to share with us, his Bantam SRE. Starting with a basic SR Batteries Bantam Bipe, Keith modified it to resemble a WACO SRE. The results are well worth the little added effort, as the photos show. Keith had not built a model from a kit since the Amptique and was very impressed with the quality of the Bantam Bipe kit.

Camille Goudeseune's review of the Air Hogs' Aero Ace in the December 2005 *Ampeer* inspired EFO VP **Richard Utkan** to purchase one and give it a try. Richard reported that it does live up to exactly what Camille had to say about it. It is a lot of fun for a little price.

Dave Stacer shared his built up Flutter B. He's built a lot of flat foam planes recently, and thought it was time to give a built up plane a go. It is fitted with one of his self-wound CD-Rom motors and has the front end modified a bit for better battery pack carrying.

Rick Sawicki shared his latest electric control line, a Smoothie. It is powered by an AXI 2826-10, 3S1P PolyQuest "Twenty" Li-Po and swings a 12x6 prop. Rick is absolutely thrilled with the new "Twenty" series Polyquest cells and says they deliver much higher voltages under the current draw he uses

than anything else he has used. He says the Smoothie is a great flier and enjoys flying it very much.

Rick with Smoothie (*photo taken at Midwest RC Society meeting KM*)

Richard with Air Hog

Dave with Flutter-B

The members present thank Rick for his great hospitality and we are looking forward to a better-attended January meeting. See you all then and bring in your latest projects and electric flight gizmos.

AXI_Calc

From Louis Fourdan louis4dan@cegetel.net

Thought I'd share this with you. I've downloaded it to the PC and it seems quite interesting. KM

Dear Ken,

I know you by the web and the sites you manage (+ D-Calc group). I suggest to you, if you have time, try my small freeware AXI_Calc program.

It is a calculator (in English) devoted to AXI Outrunners (for the moment) plus one custom ability.

Roughly you enter the battery, the ESC, the motor and gearbox and then you can change for a generic prop

I leave you to look the results and graphs.

You can freely download the program here

http://electrofly.free.fr

The site is in French so you can click

A) "Telechargements" (up) := Download

B) Chapter "Les moteurs" := Motors

click on the link AXI_Calc_V111

It is a .zip file for an exe (VB6). Generally VB6 dll are present on a PC

Best regards
Louis

Some Planes in Progress

I recently heard from Louis Dionne, who is now living in Ottawa. He caught me up on what he's been doing and sent along a couple of photos of a 60" Pfalz DIIIA that he has under construction. He credits his friend Walter with most of the work.

From Walt Thyng of Illinois we have some photos of his Fokker Tripe in progress. Here's what he had to say about this project:

Here are some interim photos of my latest project. The color registration is poor in the photos. (*I tweaked it a bit, so that it looks redder. KM*) The red is Red Baron red not orange. I still have to do the dummy engine, find some Spandaus or figure out how to build them, add the pilot and build custom motor pack. Power will be an Astro 40G on 20 P3000s.

The weight now is 4.5 lbs so a 6.5 lbs flying weight seems doable.

The model is plans built from 1976+/- Bryce Petersen Model Builder plans. The design is sport scale and optimized for aerobatic flying. The wingspan is 48 inches.

More later,
Walt

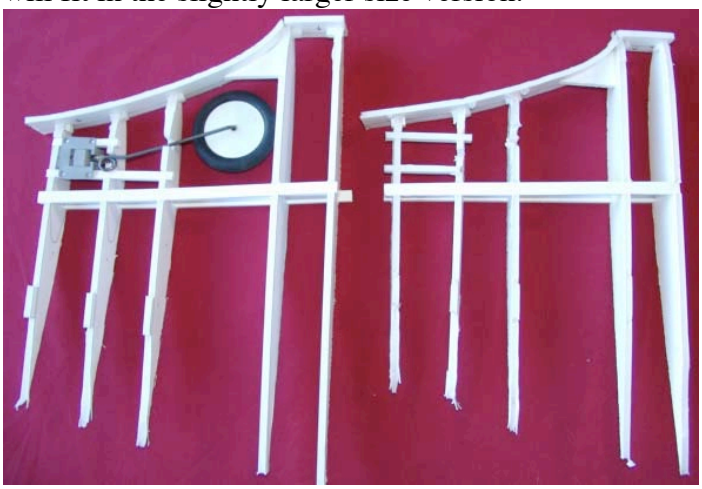
Serendipity, Again!
By Ken Myers

As many of you know, 2005 was an "interesting year" for me. Having moved four times in the last year was an interesting experience! My modeling

life, as well, has been one of constantly finding out new things.

At Toledo, I purchased only one item, a Sombra Labs Shadow 3 receiver. Unfortunately, it was dead out of the box. No complaints though, as it was readily exchanged by Kennedy Composites in a very timely manner! Good folks there. Therefore, it will be a while before I can give a report on it. The replacement is still in the box, somewhere around here.

Just after the beginning of the year, I started designing my first, very own design, sport-scale plane. Things were going quite well, until I built a model of the proposed wing using foam board and found out the wheels, when retracted, weren't going to fit into the wing. I rescaled the design in my CAD program, rebuilt the wing section model, and the gear will fit in the slightly larger size version.



I tried bending the new landing gear using my K&S wire bender, but it just wouldn't do the job. I ordered a new wire bender from Hobby Lobby. They call it "Best Wire Bender". It is part number HLH704 and sells for $25.90. The amazing thing is that it is the best wire bender that I have ever used. I highly recommend it!

With the design well under way, it was time to test my brand-new, year-and-a-half old, AXI 2820/10, as that was the motor I was planning on using in the plane. See the August 2005 *Ampeer* for details on how well that went! Not!

June found me with two broken planes. Both from very freak accidents. Things hadn't happened like this to me in years.

The questionable AXI was put into the Tiger Shark (my own design sport plane) as it was repaired and then flown. The AXI 2820/10 gave up the ghost after four flights. I'll be taking it out of the Tiger Shark soon, and seeing how good Hobby Lobby's exchange policy really is.

The last week of June, and knowing that my AXI was a lemon, I ordered a Hyperion Emeter, Hyperion Z3019-10 outrunner and Hyperion Titan 50A Opti ESC, along with a few other things from ALLERC.com. I chose the Z3019-10 because it showed a lower Kv, 1070 rpm/v, than the AXI 2820/10. The data at aircraft-world.com showed that it swung an APC 11x5.5 E at 29.9 amps when 10.1 volts were applied to the ESC, and the RPM was 8670. Since I wanted a motor that is able to swing an APC 11x7 E at between 8,000 and 9,000 RPM and pull 35 amps or a little less at full throttle, this seemed like a logical choice.

In the meantime, I was looking at data used by the Emeter to calculate efficiency. It just wasn't coming out right. I noted this in the thread about my problems with the AXI motor on RCGroups.com. I also noted that the data at flyingmodels.org for the APC 10x7 E seemed not quite right.

Phil Connolly, the designer of the Hyperion Emeter, Rod Badcock, the designer of the PC software used with the Emeter, and I have been trying to figure out what was not quite correct about the constants being used to reflect efficiency via the RPM readings of the Emeter.

I borrowed an Astro Flight 25 direct drive motor from Keith Shaw, as I had sold mine. Silly me. (It should have been a 40, but that's another story.) I set the timing to neutral, and carefully gathered the motor constants for this particular motor, as it was the prop

information that I was interested in. That is why the data was gathered with a direct battery to motor connection, so that no ESC would enter into the computations. I gathered my first data using my Whattmeter, a pair of Radio Shack multi-meters and a Hobbico Mini-Tach. As usual, the motor runs were captured on videotape and then RPM, Volts and Amps were recorded and logged.

The data I was getting was very different from what Phil got with his dyno using the same type of prop. The ONLY prop being tested was the APC 10x7E, for consistency – yeah, right. We found that at an RPM over 10,000 the prop constant used by the Emeter was changing considerably and quite inconsistently.

With my data so very much out of line, I continued to do research and put a great deal of thought into the "problem", almost two weeks worth. I never came up with a valid reason for the differences in outcomes. There were a lot of false leads and invalid reasoning that kept leading me thinking in circles!

The first week in August, my order arrived from allerc.com. I was anxious to set up and run the new motor and speed control.

It was then that it happened. I had reamed out the prop I had been using so that it would fit the shaft on the AF 25. I opened and balanced a "new" APC 10x7E from my stock. I ran the new Z3019-10 motor, and the RPM and efficiency did not match what was expected from my previous tests with the AF 25. I decided to try and fit the "new" prop onto the AF 25 and see what would happen. I reamed it, slid it on the AF 25 and tried to tighten the prop onto the prop adapter using the nut. I couldn't! The nut ran out of threads before the prop was secured. What?!?

Obviously, the "new" prop had a thinner hub. I double-checked the packaging. Yep, both were APC 10x7E props. I had another "new" prop in the wrapping. It was "thin", just like the one I had just opened.

Next I got out the calipers and measured the hub thicknesses. The "thick" one measured 0.385 in. or 9.779mm, both "thin" ones measured 0.285 in. or 7.2389mm. "Odd," I thought. I weighed them on my digital scale and found that the "thin" hub ones weighed about 15g each and the "thick" hub one weighed about 20g. I checked the APC Web site at apcprop.com. They had posted that a 10x7E had a hub thickness of 0.31 in or 7.874mm. Yikes!

I emailed my findings to the "guys", and it was suggested that I contact APC. I sent an email and received the following reply;

"The original prop (15 grams) met with disfavor due to interference with the larger spinners. The subsequent design has the blades shifted forward to fix this problem. Other thin electric props have been modified as well. All of our stock is up to date. Hobby shop inventories, (two years or so), might still have the old style.

Regards,
Fred Burgdorf"

Therefore, my two "new" props are actually "old" versions of this prop.

How different are these two designs?

The following data was gathered with one test right after the other on a cool summer morning with the same 10-cell pack (after re-topping the charge) hooked directly to the AF 25, NO ESC, using the Hyperion Emeter to collect and save the data at 5 points in each run. I chose two data points that had the same input volts to show the comparison.
Thick 11.11v, RPM-7965, Amps-26
Thin 11.11v, RPM-8100, Amps-23.4

While this doesn't seem like a huge difference, note the RPM for each and note the difference in amps. Now think about what is going to happen as these props each exceed 10,000 RPM.

Two different props in the same packaging and sold as the same prop with no note to the end user.

This might also explain why some folks on RCGroups.com complain about fragile APC E props and others report a couple of years of flights with the same APC E prop.

It could also explain why the data at flyingmodels.org doesn't seem quite right, when compared to the APC 10x7E of today, as the tests were done several years ago.

I mentioned setting up the Hyperion Z3019-10 and running it, but I did not mention how I prepared to run it. Just like the AF 25 I ran a drill press test to determine the Kv. Doing a brushed motor is very easy; so I figured a brushless motor shouldn't be that hard. Yeah, right! I searched and searched the

Internet, trying to find out how to do it. I could not find it anywhere.

When I tried to get a voltage reading off of two leads, which I had remembered reading about, I got nothing. I switched the scale to AC and got a reading, 1.93 volts. Humm. I had measured the rpm at 3120 by taping a white piece of paper on the rotating part of the Z3019-10 with a piece of black electrical tape. This matched the rpm of the drill press that I had gotten for the AF 25 test. I now had the two numbers, but didn't know what to do with them. I had written an email to Tom Cimato of MaxCim motors, with some other questions, so I asked him what to do. He sent me a paper that he had written on brushless motors, along with this response;

"Hi Ken,

Here's how it works.

Ke = volts peak per 1000rpm.

So, 1.93vacrms x 1.414 = 2.729vpk. (it's the peak of the sine wave ac waveform)

1000/3120 = .3205 (1000rpm)

Ke = 2.729 x .3205 = .8746vpk/1000rpm

Kv is the inverse of Ke, so Kv = 1/.8746 = 1.1433 krpm/vpk = 1143 rpm/vpk.

Vpk = the DC bus voltage from the batteries so that the unloaded rpm at any applied voltage can be calculated.

A 10 vdc bus will run this motor at about 11,430rpm at full throttle, or a proportionally lower speed at lesser throttle.

The final loaded rpm is determined from the voltage drop calculated from the load current....gets more complicated but I have a paper that explains that in detail also if you want it.

Does this help?

Regards,
Tom"

All through the month of August I was in almost daily contact with Phil and Rob. We shared some very interesting emails, and they put up with some very stupid statements by me. We did find that the prop constants and prop factors used by the Emeter need some finer "tweaking", and that is in the works.

I spent the month of September trying to reconcile what I had learned, and to get the simple motor formulas that we have been using all these years to work. I can't! They don't work all that well!

All the while I had been gathering data using the Hyperion Z3019-10, Hyperion Titan 50A Opti ESC, and Hyperion Emeter. Here's the average data that I have collected. These are averages of 5 data collections on the same charge using the Emeter.

APC 10x7E 9.78mm hub thickness

#Cells	RPM	Vin	Ain	Win	Eff	Wout
6	7026	6.72	20.0	134.2	85%	114
7	7893	7.76	25.4	196.9	83%	163
8*	8055	7.83	25.7	201.5	86%	173
9	8556	8.50	29.8	253.6	83%	210
10	9432	9.63	36.3	349.8	81%	283
12	10290	10.81	45.6	492.3	76%	374

APC 11x7E 10.54mm hub thickness

#Cells	RPM	Vin	Ain	Win	Eff	Wout
6	6506	6.40	22.7	144.9	84%	122
7	7421	7.51	29.7	222.5	83%	185
8*	7406	7.40	28.6	211.3	86%	182
9	8164	8.47	35.7	302.0	82%	248
10	8670	9.23	40.9	377.8	80%	302

I looked at the data, again, on the aircraft-world.com site for the Z3019-10 and realized that for the 10" and above props, Dave had used fairly flat pitches. This led me to once again choose the wrong motor for the job. Dave used a power supply to get his data. I had mistakenly looked at the data for the APC 11x5.5E and guessed wrong as to what the APC 11x7E would do! For a more realistic "guess," I should have looked at the APC 12x6E, but even then,

my "real world"; data for the Z3019-10 does not come close to matching what Dave at Aircraft World measured. His measurements are way under what I measured. If I had to guess, I'd guess he used the "old" APC "E" props. It just gets harder and harder for me to chose the correct motor for the job.

It now seems that I'll have to order a Z3019-12 for my project. Oh well, live and learn!

As the flying season was closing down, and building season about to start, I got involved with trying to come up with a good way to explain using electric power to glow fliers. I have been working on that article for the last three months! Hopefully, I'll be able to share the "E-conversion" article with the *Ampeer* readers by next month.

As it is the beginning of a new year, I'm going out on a limb and stating what I think will be the "biggest boon" to e-flight this year, balancing chargers and complete "systems" for Lithium Polymer batteries. The FMA BalancePro HD System, being just the tip of the iceberg. It balances each cell as it charges and can charge at a 3C rate. Jim Young has done an excellent review of this system for the Ezone magazine at http://www.rcgroups.com/links/index.php?id=4929

I'd love to hear what *Ampeer* readers think the new "best thing" for electric flight is going to be.

One last thing, in the December 2005 issue of the *Ampeer* I wrote, "The question still remains, if we can't trust the manufacturer's data to help us in selecting the correct motor for our specific application, who can we trust?"

As Tom Cimato very rightly pointed out, because you certainly can trust MaxCim's data, my statement should have been, and now is --- The question still remains, if we can't trust a lot of the manufacturers' data to help us in selecting the correct motor for our specific application, who can we trust?

YAK-54's

From Dick Corby info@altacom.us

Dick had written to me about a YAK-54 that he was converting to electric power. I sent off an email to see if I could get an update on the project. Here's his very sad tale. KM

Not too sure what you have on file, but here's a recap to date. This is over about the past 6 months, and 4 Yaks later.

My 72" Quiqie Somenzini Signature Series Yak went together like a dream. It took only about 10 days to do the conversion, and get it ready to maiden. On a Sunday morning I got it all ready and hit the runway. My son-in-Law took it off and it flew like a Yak should. Stable as a rock, not a click of trim. I thought that it could use a bit more power. I planned on going up to a 20" prop.

After about a minute he handed me the box, and I tried a few basic maneuvers. Rolls, smooth with no altitude loss, inverted same as upright. On a long gentle turn back to the field, suddenly at 4.5 minutes on the timer, and in seconds, it dove for the ground and crashed from about 150 ft. Totaled it out. Li-po's smoking, destroyed the AXI 5320, a real disaster. Someone in the pits turned on, at least that is what we suspect.

The Quique Signature series is a rare plane to find, so I figured to have to wait a long time for another. So in the meantime I got a 52" Ultra RC Fiberglass Yak. It flew great as well, but then I dumb thumbed it and it got totaled.

So I ordered another of the Fiberglass Yak's and it is now waiting to be Maidened. They are a nice little plane, although there is no way that can it be brought in at the weight they say on the box. But it flies very well at 6.8 pounds on the AXI 4120/14 with 4S-2P 6000 MAH pack. The instructions are a bit hard to follow, but enough to get it built. It comes with everything needed to build the model, and for the price is a good buy.

About a month ago I lucked out and got another of the 72" Signature series Yaks, new in the box. This is my project after the New Year. Gradually collecting the parts, motor, batteries, etc. Will put it

up with 9S-2P, and a 20-inch prop this time. I'm kind of stuck at 9S as that is as high as the Astro 109 can go. And having one of the larger chargers requires carrying 2 twelve Volt batteries to the field.

I've taken over the Webmaster duties for the RAMS here is Seattle, and you might check out what I've done.

In the Meet our members' area in my Hangar I have the Pictures of both Yaks. Hopefully after this bout of bad luck I can keep them flying.

http://www.seattlerams.com/

Wishing you and yours a Merry Christmas and a most prosperous and Happy New Year

Dick Corby

More on Future Lithium Polymer Battery Systems

Just as I was finishing up this issue, I received an email from Dave Manley of Lenexa, KS. I'm not quoting all of his email here, except for a few points that I thought were interesting, as well as my response to Dave.

"Okay, I'm a wuss, but I just can't bring myself to give safe harbor to lithium polymer. I'm such a wuss that I prefer to charge my Ni-cads and nickel-metal packs when I'm awake.

I'm beginning to feel like an old fossil. Well, I am an old fossil, but you get the point.

What are your club mates flying? Is anybody still in the Ni-cad mode?"

Hi Dave,

I too have remained in the safe harbor of NiCads and NiMH. We are definitely on the cusp of having much safer Lithium technology. I had purchased, some time last year, an Astro Flight 109 charger and a Kokam 3S1P 2100mAh Li-Po pack. The pack didn't come with taps, so I just got it back from Keith, who added some taps so that I could read each cell and balance them.

Many, if not most, of the EFO members are using Li-Po packs. So far, only one member has reported a less than enjoyable experience from one of his packs - read fire. Rick Sawicki and Dave Stacer, the two guys I fly with the most, are almost exclusively Li-Po now. Keith has a lot of Li-Po powered planes now as well. Dave tends to fly smaller planes like flat foamies and Mountain Models' planes, but Rick flies the larger planes and is the one who has done a lot of large control line conversions to electric power. I hope to have his article in the *Ampeer* soon on his control line conversions.

The BalancePro HD system from FMA direct seems to be just what we need to make Lithium technology user friendly. I'm expecting to see a lot more "complete systems" from the various vendors of lithium batteries. If you've not read Jim Young's review of the FMA charger and system, it is at http://www.rcgroups.com/links/index.php?id=4929

I fly with Jim a lot and respect his opinion!

As I said, I believe that with almost all of the Li-Po vendors now having a version of a "balancer" available and with the new "systems" coming to market, 2006 will be the watershed year for Li-Po batteries.

Actually, I can't wait until spring to try out my "old" Li-Po pack, which has never been flown. The plane I'm designing now will use a brushless motor, Hyperion outrunner, and Li-Po battery from Hyperion.

I do understand your concerns, as they have been mine as well.

The future is Li-Po, but I'm still not sure the future is right now, but it is darn close!

Later,
Ken

Pitts Conversion Suggestion

I have a Hyperion Z3019-10 that needs a home, so I'm thinking of this possible conversion. Thought I'd share it with you.
Herr Pitts Special Kit: 300 sq.in.
Est. Completed Airframe Weight (CAW): 19 oz.
Motor: Hyperion Z3019-10 5 oz.
ESC: Hyperion Titan 30A ESC 1.06 oz.
Battery: MaxAmps 2S1P 2100mAh Li-Po 4.55 oz.
Receiver: FMA M5v2 Sub Micro Rx 0.3 oz.
Servos: 3 Hitec HS-81 servos: 1.76 oz.
Systems total: 12.67 oz. w/fudge factor: 13.3 oz.
Ready to Fly (RTF) weight: 32.3 oz.
Wing loading: 15.5 oz./sq.ft.
Cubic wing loading: 10.7 oz./cu.ft.
Expected performance with an APC 10x7E: 7374 RPM, 23.5 amps, 7.44v, 175 watts in, eff. 80.9%, Pitch Speed 49 MPH

Herr Pitts Special

Upcoming E-vents
2006

February

1 Midwest RC Society monthly meeting, 7:30 p.m., EAA building, Mettetal Airport, Joy & Lilley Rd, Plymouth, MI, **Ken Myers** to give presentation on equivalent conversions of glow airframes to electric power.

Hyperion Z3019-10

Please get event info to Ken Myers ASAP for the 2006 E-vents

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The Next Flying Meeting:
Date: Thursday, Jan. 5 **Time:** 7:30 p.m.
Place: Rick Sawicki's house, 5089 Ledgewood Ct. W., Commerce Twp. MI 48382