To: Star Mazda Competitors
From: Star Race Cars, Tim Lewis
Cc:
Date: April 15, 2009
RE: 2009 Star Mazda Pro Car Oval Baseline Recommendation

Introduction

In February, Star Mazda conducted an oval test at Phoenix International Raceway. While the primary reason for testing was to provide Goodyear with data for their compound selection, we had the opportunity to run through a series of setup changes and were able to establish a baseline oval setup which we are interested in sharing with the competitors.

During this testing, we were able to run lap times faster than the pole for the last race, which was ran on bias-ply tires. We were also able to complete several long distance runs without excessive tire wear, handling degradation or a fall off in lap times.

Similar to the information on road course setup, this is by no means meant to be a 'one-size-fits-all' answer to oval chassis setup. First, we aren't racing at PIR. Second, while we've often found that PIR and Milwaukee correlate in terms of setup, we have no information about setups at the Newton, Iowa oval. Lastly, the conditions at PIR were fairly cool, with a high of about 70 degrees, the track was relatively 'green' and we had to deal with gusting wind. It's likely the conditions at the Milwaukee and Newton race will be significantly different.

Analysis

The first thing that we wanted to give the driver was a level of steering effort that was reasonable and provided a good car feeling. We initially had a 1 degree split which was not enough. The car was 'floaty' on entry and would self-steer early in the corner. Once the chassis was loaded, the steering was too heavy. By adding another degree of caster split, we eliminated the 'floaty' feeling and gave the driver a car with more steering feel on entry. In the center of the corner, the reduction of caster on the right hand side reduced the steering effort, which was also a gain. It should be noted that prior to any oval test or race, the steering rack should be prepared to eliminate any binding, gear lash or excess bearing clearances. Any of these will tend to confuse a driver and cause general setup uncertainty.

We also worked with wing angles and chassis rake to get a good handling balance for the car. Running slightly more than 18mm of rake may seem excessive based on popular road course numbers, but remember that at speed, this number is much smaller. Interestingly, while the rake setting did affect the aerodynamic balance of the car, it was not an over-riding factor. The front flap angle was actually much more effective at controlling aero balance. We will encourage restraint when adding or subtracting front flap angle as it is easy to shift the balance of the car farther than you intend.

We started with a rear wing angle setting more suited to a road course. Our initial speed gains were found by reducing rear gurney size and rear wing angle. These gains in speed were due to a better handling balance as well as a decrease in drag. As the track cooled and lost grip the car started to slide excessively and we went from a car that was 'easy flat' around the track to a car that had a large lift in turn 2. When this started to happen, we increased both front and rear wing angles. This higher downforce setting not only made the car easier to drive and more consistent, but it also made the car faster. Milwaukee is a track which is dominated by corner speed. We can see that similar situations could be at play there.

We spent only a small amount of time on tire alignment. We initially had more negative camber in the right hand side of the car, and ran into tire wear and cupping of the inside of the tires. The wear was primarily an issue during the longer race simulation runs. It might be feasible to run slightly more negative camber for shorter runs or qualifying, but we did not see a handling change when we decreased the negative camber. It could be that large camber angles are detrimental to tire wear and handling.

Conclusion

Lee Bentham and Rocky Moran Jr. were the test drivers for the Star Race Cars / Goodyear oval test. Both are experienced oval drivers and both were given the exact same starting setup. Our drivers felt that they had good, stable cars to do testing with and they both ran a similar lap time when in similar aerodynamic trim. It's difficult to judge absolute speed when doing testing of this sort, but we are confident that the baseline setup will give a reasonable starting point for the competitors.

If we have one last bit of advice for working with rookie drivers on an oval, it is to watch tire temperatures and pressures closely. Feeling the balance of an oval racecar can be difficult, especially as the balance gets more neutral. If the front-to-rear tire temperature split starts to become excessively high or if the right rear tire pressure is consistently high, then these are signs you are venturing towards an oversteering racecar. Do so with care. Very little good has ever been said about a car that oversteers on an oval.

Again, like the road course baseline, this setup is meant to be a starting point, not an ending one. We fully appreciate that track, weather, driver and other influences will change any number of variables through the course of a race weekend. Good Luck!

PRO MAZDA RACECAR CHASSIS BUILD SHEET

		TRACK	Oval Baseline Setup	TRACK LENGTH	1.00 Miles
DATE		CHASSIS	Star Pro Mazda	Sheet Version	1
EVENT		CHASSIS #		SESSION:	End of day
DRIVER		ENGINE#		SETUP FUEL: 10	SESSION FUEL: 10

FRONT AERO

Front Wing Main Angle	std.						Part #
Front Wing Flap Angle	18.0	19.0	Footplate			FWEP Gurney	n/a
Front Wing Flap Gurney	1/2		Forward	0		FWEP Footplate	n/a
Front Wing Middle Gurney	0		Trailing	0		Footplate Skid	n/a

SPRINGS		CAMBERS		AVG.	RIDE HEIGHT		TOE				CASTER		
900	900	+1.4	-3.50	23.8	22.0	25.5	out	2mm	2mm	out	8.0	6.0	
800	800	+2.1	-3.40		42.0		out	1.5mm	2mm	in	8.0	6.0	on arm
		RAKE	18.3	TILT	3.5								

Cold psi		Hot psi	
17.0	21.0	20.0	27.5
17.0	21.0	20.0	27.5

CORNER WEIGHTS		SETUP WEIGHTS LF WEIGHT	% CROSS	Anti-Roll Bars	Bar / Blades		Connected?	Adj.		Tire Codes	
275	295	-20	49.12%	Front	20mm	STD.	CONNECTED	3		620	800
399	444	40.34%	1413	Rear	0.625	0.625	CONNECTED	-0.25"	From Top	620	800
		% FR. WEIGHT	TOTAL								

GEOMETRY

			Left	Right		Left	Right			
Front Rocker Main	STD.	Front Lower Fore	23.630	23.460	Rear Lower Fore	22.978	22.911	Steering pinion	8	teeth
Front ARB Rocker	STIFF	Front Lower Aft	26.622	26.622	Rear Lower Aft	22.442	22.366	Front Roll Center	STD.	
Rear Rocker Main	STD.	Front Upper Fore	18.690	19.009	Rear Upper Fore	16.049	16.049	Rear Roll Center	UPPER	
Rear ARB Rocker	STIFF	Front Upper Aft	24.904	24.879	Rear Upper Aft	n/a	n/a			

DAMPERS

Damper Specifications		Press	Comp. Valve	Reb. Valve	Bump Rubber	Packer	Gap-On Pad	Compression LS	Compression HS	Rebound LS	Rebound HS	Compression LS	Compression HS	Rebound LS	Rebound HS
Fr. ID	Ohlins TTX36-SPEC	75	X	X	0.000	#######	2.000	-10		-12		-10		-17	
Rear ID	Ohlins TTX36-SPEC	75	X	X	0.000	#######	2.000	-7		-10		-12		-10	

Extended Length		Pad Length		Static Droop		Est. Preload		Maximum Travel		Air Gap-Extended	
11.02	11.02	10.820	10.820	0.200	0.200			2.047	2.047		
11.42	11.42	11.120	11.120	0.300	0.300			2.047	2.047		

BRAKES

Brake Bias at 500 psi		Master Cyl.	Rotors	Calipers	Pads	Fluid
55%	Front	0.75	PFC	PFC	05	Motul 600
	Rear	0.812	PFC	PFC	05	

REAR AERO

				Cooling Blanking		
Upper Rear Wing Angle	STD.	Lower Rear Wing Angle	STD.	Left Side	0	inches closed
Upper Rear Wing Flap Angle	35.0	Lower Rear Wing Gurney	1/2	Right Side	0	inches closed

Gear Stack			Max RPM	8600
			Speed	RPM Drop
Final	9	31		
6th	24	26	155.4	171
5th	19	21	152.3	823
4th	18	22	137.7	1203
3rd	19	27	118.4	1675
2nd	17	30	95.4	2320
1st	12	29	69.6	

Differential Settings		
Drive Ramp	n/a	DEG.
Coast Ramp	n/a	DEG.
Clutch Faces Active	0	faces
Preload Spring	none	
Assembled Preload	0	ft*lbs

Amb.	Track

Notes: Oval stack on gears
Be sure to check 1/2 shaft plunge!
Wishbone jigging numbers have been verified and are accurate.
Caster numbers are approximate, but split is accurate
Car setup should be stable, with a small amount of understeer.