



OPENED MAY 16<sup>TH</sup>, 2013

INDUSTRY'S ONLY CYCLING-SPECIFIC WIND TUNNEL

1,600 HOURS OF TESTING SINCE OPENING IN RENTAL TIME THIS WOULD BE NEARLY \$1.6M USD

*60 PROFESSIONAL RIDERS | 200 TOTAL RIDERS TESTED SINCE OPENING* 

WIN TUNNEL IS 1/3 KM FROM SPECIALIZED HQ

HARDWARE AND SOFTWARE DEVELOPED AT SPECIALIZED





3 UNIQUE ASPECTS:

PRECISION RESOLUTION DOWN TO +/-0.0005 m<sup>2</sup> 2X-4X BETTER RESOLUTION VERSUS MANY TUNNELS USED IN CYCLING

#### SIZE

TEST SECTION IS 5m WIDE X 3m TALL X 9m LONG ALLOWS FOR TESTING MULTIPLE RIDERS, DRAFTING

#### SPEED

SPEED RANGE FROM 10 kph TO 115 kph COMPLETE RANGE OF SPEEDS FOR CYCLING





UNDERSTAND REAL-WORLD PERFORMANCE GAINS ON A TYPICAL ROLLING COURSE FOR THE "AERO" SYSTEM VERSUS "TRADITIONAL" CURRENT PROTOUR WINNING CONFIGURATION

> <u>AERO</u> VENGE ViAS CLX 64 WHEELS EVADE SKINSUIT EVADE HELMET

<u>TRADITIONAL</u> TARMAC PRO CL 40 WHEELS JERSEY & BIB SHORTS PREVAIL HELMET

## McLAREN & SPECIALIZED

HAVE COLLABORATED ON CYCLING TECHNOLOGY SINCE 2009

THREE LIMITED EDITION PRODUCTS:

S-WORKS McLAREN VENGE S-WORKS McLAREN TT S-WORKS McLAREN TARMAC

ADDITIONAL TECHNOLOGY COLLABORATIONS HAVE PUSHED INFRASTRUCTURE AND DEVELOPMENT FORWARD

THIS EXPERIENCE AND TESTING PROTOCOL IS ONE OF THOSE SUCH PROJECTS



### McLAREN APPLIED TECHNOLOGIES EXPERTS IN DATA ACQUISITION, SIMULATION, AND ANALYSIS

Mclaren

Mgpil

SHERING &







### WHAT IS MIDAS?

McLAREN INTEGRATED DATA ANALYSIS AND SIMULATION

IN-HOUSE MCLAREN DEVELOPED SOFTWARE SUITE UTILIZED FOR ANALYSIS AND SIMULATION IN FORMULA 1

ALLOWS FOR SIMULATION OF VIRTUAL TEST RUNS OF A GIVEN "TRACK" AND "EQUIPMENT"

McLAREN DEVELOPED A CUSTOM GRAPHICAL USER INTERFACE (GUI) AND MATHEMATICAL SIMULATION FOR BIKE DEVELOPMENT WITHIN SPECIALIZED

THIS TOOL IS UTILIZED FOR ON-ROAD SIMULATION GIVEN RIDER SPECIFIC DATA COLLECTED



## MIDAS & SPECIALIZED

### MATHEMATICAL MODEL & INTERFACE FOR ON-ROAD CYCLING SIMULATION





- 1. MAP AERODYNAMIC PERFORMANCE OF CONFIGURATION IN THE WIN TUNNEL
- 2. COLLECT WIND DATA FROM COURSE
- *3. RIDE COURSE*
- 4. RUN SIMULATION WITH RIDER INPUTS WEIGHT, AERO MAP, ETC.
- 5. USE RIDE POWER PROFILE WITH NEW RIDER INPUTS TO DEMONSTRATE PERFORMANCE DIFFERENCE



COLLECTION OF AERO (C<sub>a</sub>A m<sup>2</sup>) & MASS (kg) RIDER MAPS IN WIN TUNNEL

TWO CONFIGURATIONS: TRADITIONAL & AERO

AERO DATA COLLECTED AT 0 DEG AND 10 DEG YAW ANGLES IN ONE RIDING POSITION





## 2. COLLECT WIND DATA ON COURSE

SPECIALIZED RACING DEVELOPTED CAR-MOUNTED SENSOR & SOFTWARE COLLECTS GPS, ELEVATION PROFILE, COURSE HEADING, WIND SPEED, & WIND DIRECTION ON COURSE

CURRENTLY USED BY SPECIALIZED RACING FOR PROTOUR RACE EQUIPMENT SELECTION AND SIMULATION

## 3. RIDE THE COURSE

### ON-ROAD RIDES AT RIDER'S CHOICE POWER OUTPUT TWO CONFIGURATIONS: TRADITIONAL & AERO RIDER HOLDING CONSISTENT POSITION FROM TUNNEL

COLLECTION OF DATA AT 1 HZ INCLUDING LOCATION (GPS - lat/long), ELEVATION (m), HEADING (deg), WIND SPEED (kph), WIND DIRECTION (deg), AIR DENSITY (kg/m<sup>3</sup>), & RIDER POWER (W)

19.2 KM DAY ROAD LOOP - MORGAN HILL, CALIFORNIA "SPECIALIZED TT TEST LOOP" ON STRAVA







## **4. RUN MIDAS SIMULATION**

EXAMPLE SCREEN: TWO CONFIGURATIONS: "AERO" & "TRADITIONAL"

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### TWO CONFIGURATIONS: "AERO" & "TRADITIONAL"



### INSTANTANEOUS RIDER POWER (WATTS)



### **COURSE PROFILE & ELEVATION**



### TWO CONFIGURATIONS: "AERO" & "TRADITIONAL"



### TWO CONFIGURATIONS: "AERO" & "TRADITIONAL"



**EXPLANATION OF VELOCITY PLOT** 





EXAMPLE : AERO FASTER THAN TRADITIONAL LARGE VELOCITY DIFFERENCE WHERE COURSE IS DOWNHILL HIGHER VELOCITY FROM "AERO" CONFIGURATION EXAMPLE : AERO & TRADITIONAL AT SIMILAR SPEED SMALL DIFFERENCE IN VELOCITY AS RIDER CLIMBS A HILL MASS SAVINGS AND CLIMBING SPEED DECREASE LOCAL AERO BENEFIT SIMILAR VELOCITY BETWEEN TWO CONFIGURATIONS

### ACCUMULATED TIME SAVED OVER COURSE



### ACCUMULATED TIME SAVED OVER COURSE



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## RIDER 4B - AERO



## RIDER 4B - TRADITIONAL





#### AERO

'16 S-WORKS VENGE VIAS ROVAL CLX 64 | S-WORKS TURBO 22 FRONT, 24 REAR S-WORKS EVADE SKINSUIT S-WORKS EVADE HELMET RIB CAGE & LARGE BOTTLE (FULL), GARMIN 1000 RIDERS SELECTION: GLASSES, SOCKS, SHOES

 COMPLETE MASS (kg):
 88.1

 C<sub>d</sub>A (m<sup>2</sup>, 0 deg | 10 deg)
 0.289 | 0.291

#### TRADITIONAL

15 TARMAC PRO RACE ROVAL CL 40 | TURBO PRO 25 FRONT, 25 REAR SHORT SLEEVE JERSEY, BIB SHORT (RIDER'S CHOICE) S-WORKS PREVAIL HELMET RIB CAGE & LARGE BOTTLE (FULL), GARMIN 1000 RIDERS SELECTION: GLASSES, SOCKS, SHOES

 COMPLETE MASS (kg):
 87.6

 C<sub>d</sub>A (m<sup>2</sup>, 0 deg | 10 deg)
 0.322 | 0.332

### RIDER 4B - TRADITIONAL VS. AERO

(PaceRep) 588

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## 5. PERFORMANCE SUMMARY

UNDERSTAND REAL-WORLD PERFORMANCE GAINS ON A TYPICAL ROLLING COURSE FOR THE "AERO" SYSTEM VERSUS "TRADITIONAL" CURRENT PROTOUR WINNING CONFIGURATION

RIDER MAPPING, ON-ROAD TESTING, AND SIMULATION FOR "AERO" AND "TRADITIONAL" CONFIGURATIONS COMPLETED FOR 12 RIDERS

**RESULTS ARE ON NEXT SLIDE** 

RIDER	AVERAGE POWER (W)	TRADITIONAL		AERO			00550
		TIME ON Course (MM:SS)	AVERAGE SPEED (KPH)	TIME ON Course (MM:SS)	AVERAGE SPEED (KPH)	TIME SAVED (sec) OVER 19.2 KM COURSE	SPEED INCREASE (kph)
1A	274.1	34:28.0	35.06	32:34.7	37.13	113	2.07
2A	317.0	32:23.0	37.08	30:45.0	39.04	98	1.96
3A	226.3	38:04.6	31.95	35:42.8	34.06	142	2.11
4A	243.6	37:33.9	32.55	35:51.4	34.10	103	1.55
5A	227.6	39:16.2	30.98	36:53.7	33.01	143	2.03
6A	234.4	35:13.3	34.28	33:04.2	36.47	129	2.19
1B	181.0	40:30.7	30.53	38:33.8	32.08	117	1.55
2B	149.6	38:41.7	31.41	36:39.7	33.15	122	1.74
3B	219.9	32:32.2	37.55	30:25.9	40.12	126	2.57
4B	271.4	31:15.7	38.50	30:07.3	39.96	68	1.46
5B	264.6	32:45.6	37.06	30:55.3	39.23	110	2.17
6B	185.0	37:16.9	33.03	34:29.5	35.67	167	2.64
AVERAGE	232.9	35:50.2	34.17	33:50.3	36.17	120	2.00
MINIMUM	149.6	31:15.7	30.53	30:07.3	32.08	68	1.46
MAXIMUM	317.0	40:30.7	38.50	38:33.8	40.12	167	2.64

	RIDER
1A	AARON GULLEY
2A	ANTONIO DEL PINO
<b>3A</b>	BEN DELANEY
<b>4</b> A	<b>ROBERT ANNIS</b>
5A	WADE WALLACE
6A	FREDERICK BACKELANDT
1B	WARREN ROSSITER
2B	JOE LINDSEY
3B	LUIGI SESTILI
4B	MICHAEL CARMINATI
5B	ROBERT KUEHNEN
6B	SO ISABE

