DYNOTECH
THE SNOWMOBILE PERFORMANCE PUBLICATION

1989 MACH I

PERFORMANCE IMPROVEMENTS BY GARY POTYOK

Using our stock Mach I tested previously as a baseline (issue #2), we used Ski-Doo's 1989 "Service School Performance Tips" combined with our own ideas to plan our hunt for more power.

PHASE 1

All engine components were matched using a die grinder, and the exhaust port was polished. The head was cut to yield 13.7/1 uncorrected compression, and the squish bands were machined to give .055" clearance. We chose this compression ratio as a compromise between the high/low factory specs. Planning to run 100/130 av gas, this ratio will provide us a pump gas "safety cushion" for maintained trail riding. We used NGK BIO ES plugs and set the ignition timing at 18 degrees/.085" BTDC.

We modified the exhaust canister by removing the steel wool inside and shortening the baffling 1/2". The carbs were set with 230/260 jets to correct for our CAT with a gutted airbox. The result was a 4.7 CBHP increase over stock.

PHASE 1 DATA

DATA FOR 29.92 IN. Hg. 60 f DRY AIR
TEST: 100 RPM/Sec Acceleration
FUEL SPEC. GRAV.: .690
VAPOR PRESSURE: .35
BAROMETRIC PRES.: 29.83

RPM	CBT	CBHP	FUEL	AIR	A/F	BSFC	CAT
6000	44.9	51.3	49.1	132.9	12.4	.97	55
6250	48.1	57.2	57.3	147.4	11.8	1.01	55
6500	51.7	64.0	57.4	152.8	12.2	.91	55
6750	54.8	70.4	57.0	156.3	12.6	.82	55
7000	66.9	89.2	56.4	168.3	13.7	.64	57
7250	67.4	93.0	58.7	172.9	13.5	.64	57
7500	67.1	95.8	58.7	177.1	13.9	.62	56
7750	65.3	96.4	54.7	177.5	14.9	.58	58
8000	60.1	92.3	53.0	178.6	15.5	.58	56

PHASE 2

During our stock baseline testing we had tried 40mm carbs but realized only a small increase in power. Because of this we opted to install a set of 44mm Mikunis jetted 320/360 with BBO needle jets. The results were impressive. We achieved a 4+ CBHP peak increase and a nice gain throughout the powerband (note the torque increase and CAT). With the proper needles and needle jets, our part throttle BSFC (not shown in our data) was as good as, or lower than, the stock carbs. This will result in excellent fuel mileage while trail riding.

PHASE 2 DATA 44mm Carbs

DATA FOR 29.92 IN. Hg. 60 f DRY AIR
TEST: 100 RPM/Sec Acceleration
FUEL SPEC. GRAV.: .690
VAPOR PRESSURE: .35
BAROMETRIC PRES.: 29.85

RPM	CBT	CBHP	FUEL	AIR	A/F	BSFC	CAT
6000	51.1	58.4	52.1	129.3	11.4	.90	50
6250	51.6	61.4	57.2	153.5	12.3	.93	50
6500	62.7	77.6	58.2	165.6	13.1	.75	49
6750	68.3	87.8	62.3	171.2	12.6	.71	48
7000	69.8	93.0	61.7	175.9	13.1	.66	48
7250	71.5	98.7	64.1	181.8	13.0	.65	47
7500	70.7	101.0	62.3	187.6	13.8	.62	48
7750	66.8	98.6	66.4	189.1	13.1	.68	48
8000	57.1	87.0	66.2	188.6	13.1	.76	47

PHASE 3

We now tried different mod exhaust canisters, RAVE adjustments, and K&N filters--all of which produced no conclusive results. Something was holding us back. On a hunch (and with nothing to lose) we decided to install an 86 Formula Plus tuned pipe with a 30mm I.D. stinger and stock exhaust canister. This provided us with some interesting, and probably controversial, results. We obtained a 3.2 CBHP peak gain with the powerband moving up to 8000 RPM, and some loss of

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midrange torque.

PHASE 3 DATA
Data for 29.92 inches Hg. 60 F dry air.
TEST: 100 RPM/Sec Accel.
FUEL SPECIFIC GRAVITY: .690
VAPOR PRESSURE: .35
BAROMETRIC PRESSURE: 29.86

RPM	CBT	CBHP	FUEL	AIR	A/F	BSFC	CAT
6000	40.5	46.3	39.2	106.6	12.5	.85	51
6250	43.2	51.4	46.6	121.3	12.0	.91	52
6500	54.5	67.5	53.3	146.3	12.6	.79	50
6750	59.1	76.0	56.1	150.7	12.3	.74	51
7000	65.1	86.8	58.1	162.8	12.9	.67	52
7250	67.9	93.7	62.9	170.2	12.4	.68	52
7500	68.6	98.0	60.1	177.0	13.5	.62	48
7750	68.9	101.7	61.7	179.2	13.3	.61	50
8000	68.4	104.2	65.5	182.4	12.8	.63	50

PHASE 4

While monitoring our data we decided to change the jetting to reduce the stagger. This resulted in a P.T.O. jet increase to 360. At this time we installed our original mod exhaust canister with the Plus tuned pipe. This resulted in a 1.5 CBHP peak increase and a general gain throughout the powerband. **Note the low BSFC in this data.**

PHASE 4 DATA
DATA FOR 29.92 IN. Hg. 60 f DRY AIR
TEST: 100 RPM/Sec Acceleration
FUEL SPEC. GRAV.: .690
VAPOR PRESSURE: .30
BAROMETRIC PRES.: 29.88

RPM	CBT	CBHP	FUEL	AIR	A/F	BSFC	CAT
6000	49.4	56.4	44.8	138.9	14.2	.79	46
6250	52.6	62.6	44.5	142.1	14.7	.71	48
6500	56.8	70.3	46.3	147.5	14.6	.66	48
6750	60.6	77.9	47.3	154.0	14.9	.61	48
7000	66.5	88.6	48.1	165.6	15.8	.54	49
7250	68.4	94.4	49.0	172.2	16.1	.52	49
7500	69.2	98.8	55.0	177.7	14.8	.56	48
7750	70.1	103.4	58.2	181.4	14.3	.56	48
8000	69.3	105.6	59.4	185.6	14.3	.56	47
8250	66.1	103.8	58.1	187.5	14.8	.56	48

PHASE 5

Next we decided to install the factory mod rotary valve. This is a 207 rotor with an increase in duration of 10 degrees and timed at 140 degrees/71 degrees. We had tried this rotor during baseline testing without much success, but with the modified motor we obtained 2.5 CBHP and a nice increase throughout the powerband. Noting the BSFC from the previous test we opted to jet up to 380/400.

PHASE 5 DATA
DATA FOR 29.92 IN. Hg. 60 f DRY AIR
TEST: 100 RPM/Sec Acceleration
FUEL SPEC. GRAV.: .690
VAPOR PRESSURE: .35
BAROMETRIC PRES.: 29.88

RPM	CBT	CBHP	FUEL	AIR	A/F	BSFC	CAT
6000	48.3	55.2	53.5	133.4	11.4	.97	46
6250	57.1	68.0	56.7	145.0	11.7	.83	46
6500	61.3	75.9	57.8	151.5	12.0	.76	45
6750	64.0	82.3	58.2	157.0	12.4	.71	45
7000	67.5	90.0	62.0	167.5	12.4	.69	44
7250	70.6	97.5	65.3	176.6	12.4	.67	46
7500	70.9	101.2	68.5	182.0	12.2	.67	45
7750	71.7	105.8	69.8	185.8	12.2	.66	45
8000	71.0	108.1	70.2	190.3	12.4	.65	43

We just had to wonder about the stock Mach tuned pipe, so at this point we reinstalled it--*and lost 6+ CBHP*. This also resulted in a narrower power peak at a lower RPM, but the CB torque did increase by 3.9.

Our work on the Mach I produced 17 CBHP with the only major costs being the 44 carbs and the time to fine tune❑

FIELD TEST

Having completed our trail tune up, we decided that some follow up field testing was in order. We equipped the sled with exhaust temperature gauges to continuously monitor the jetting. Our initial test runs revealed that the jetting stagger had to be increased from two to four sizes on the mag side to compensate for the gutted air box.

We soon discovered that regardless of jet size the engine was running too lean at WOT. Upon close examination of the fuel system it was determined that the fuel tank pickup and small fuel lines were causing the sled to lean out at WOT--the pickup and fuel lines were actually limiting our top end fuel flow.

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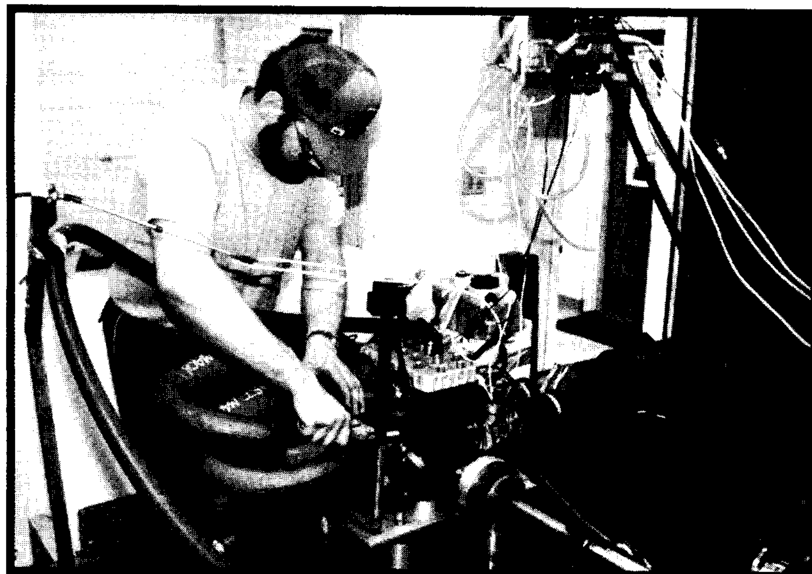
We drilled out the pickup, moved the check valve, and installed large fuel lines on the entire fuel system. We installed 550/590 mains, BB0 needle jets, 7DH2-3 needles, and 40 pilots with our gutted airbox. This combination worked well at WOT. Our exhaust temperature gauges registered 1250-1300 degrees.

With this jetting and 100/130 Av Gas we were able to run at WOT for over two miles with no problems.

Gary Potyok (GLF Racing) is a free-lance Bombardier chassis and engine performance mechanic, specializing in the Formula Plus and Mach 1. Affectionately known as "Dr." by his customers, Gary lives in Grimbsy, Ontario, Canada (416-945-1365)❑



PIPE SHOOTOUT #6

MODIFIED SKI DOO MACH I

We used our modified Mach 1 engine (as tested above) for our sixth Pipe Shootout. The engine was changed slightly from the time we tested it for our "Performance Improvements" article. Gary Potyok cut the heads to yield a 15-1 compression ratio and .055" squish, widened the exhaust port to 58 mm, and installed 46 mm carbs. RV timing remained at 140/71.

On the dyno, we found that the gutted airbox, while marginally adequate for 44mm carbs, cost us about 1.5 CBHP when using the 46mm carbs. Consequently, all testing was performed with the airbox removed--airflow readings were therefore unavailable.

RAVE springs were stock. Jetting was around 410-440, CC0, for maximum power with our mid seventies CAT. ***Note that the mid .50's BSFC requires 100+ octane gasoline!***

To demonstrate the dramatic effect that the RAVE can have on the power curve with these pipes, we have also shown each pipe (set) with the RAVE locked closed.

The pipes were tested with the engine out of the chassis to facilitate pipe changing. Testing the Decker pipes "in chassis" would have required cutting an additional opening in the belly pan (their design uses an individual silencer on each pipe).

Both the Precision Products and the FAST twin pipes have their own canister type silencers that exit out the stock belly pan opening. However, Precision Products suggested that some metal would have to be removed from the frame for pipe clearance. We should note that the Precision Products pipes were designed for high RPM, and would be better suited to a more radically modified Formula III spec engine.

The Aaen single pipe uses the factory canister

PIPE SHOOTOUT

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and Y pipe, and is easily installed with no clearance problems. The Aaen pipe is similar in appearance to the stock Formula Plus pipe. The "stinger" end of the pipe has a 33mm ID. As has been the case with all the new Aaen pipes, those heavy duty punched steel spring retainers are used at both ends of the pipe. The paint on the Aaen Mach 1 pipe, however, couldn't take the heat of our repetitive tests; it literally peeled off the front of the pipe after three dyno runs.

The Formula Plus pipe is a 1986 version, with a 30mm ID "stinger".

Stock Pipe & Mod Can 96 dB...
Data for 29.92 inches Hg. 60 F dry air.
TEST: 100 RPM/Sec Accel.
FUEL SPECIFIC GRAVITY: .710
VAPOR PRESSURE: .55
BAROMETRIC PRESSURE: 30.10

RPM	CBT	CBHP	FUEL	BSFC	CAT
6750	74.7	96.0	56.1	.60	76
7000	76.6	102.1	57.9	.57	75
7250	76.1	105.1	58.6	.58	77
7500	71.6	102.2	61.2	.62	76
7750	45.4	67.0	57.4	.89	78
8000	42.1	64.1	55.3	.89	78

Formula Plus Pipe & Mod Can 96 dB
Data for 29.92 inches Hg. 60 F dry air.
TEST: 100 RPM/Sec Accel.
FUEL SPECIFIC GRAVITY: .710
VAPOR PRESSURE: .55
BAROMETRIC PRESSURE: 30.12

RPM	CBT	CBHP	FUEL	BSFC	CAT
6000	51.9	59.3	42.8	.74	74
6250	56.5	67.2	47.9	.73	70
6500	65.9	81.6	54.2	.68	75
6750	69.1	88.8	55.2	.64	75
7000	72.2	96.2	56.2	.60	74
7250	73.3	101.2	59.5	.61	75
7500	74.8	106.8	59.1	.57	75
7750	75.3	111.1	60.9	.56	76
8000	73.4	111.8	59.0	.54	75
8250	60.6	95.2	57.9	.63	75

Formula Plus Pipe & Mod Can
(RAVE locked closed)
Data for 29.92 inches Hg. 60 F dry air.
TEST: 100 RPM/Sec Accel.
FUEL SPECIFIC GRAVITY: .710
VAPOR PRESSURE: .55
BAROMETRIC PRESSURE: 30.12

RPM	CBT	CBHP	FUEL	BSFC	CAT
6000	60.6	69.2	42.6	.63	75
6250	67.8	80.7	51.7	.66	74
6500	69.2	85.6	55.1	.66	74
6750	71.2	91.5	54.0	.61	75
7000	71.2	94.9	57.7	.63	75
7250	70.0	96.6	57.1	.61	75
7500	68.0	97.1	58.1	.62	75
7750	63.5	93.7	57.4	.63	75
8000	55.0	83.8	51.7	.64	75

Aaen Single Pipe & Mod Can 100 dB
Data for 29.92 inches Hg. 60 F dry air.
TEST: 100 RPM/Sec Accel.
FUEL SPECIFIC GRAVITY: .710
VAPOR PRESSURE: .55
BAROMETRIC PRESSURE: 30.10

RPM	CBT	CBHP	FUEL	BSFC	CAT
6000	49.4	56.4	39.2	.71	72
6250	51.4	61.2	44.3	.74	72
6500	61.8	76.5	53.3	.72	72
6750	69.4	89.2	57.6	.67	74
7000	72.0	96.0	57.9	.62	74
7250	72.8	100.5	58.4	.60	74
7500	74.6	106.5	58.8	.57	74
7750	73.1	107.9	61.2	.58	73
8000	70.5	107.4	58.9	.56	73
8250	56.0	88.0	55.6	.65	73

Aaen Single Pipe & Mod Can
(RAVE locked closed)
Data for 29.92 inches Hg. 60 F dry air.
TEST: 100 RPM/Sec Accel.
FUEL SPECIFIC GRAVITY: .710
VAPOR PRESSURE: .55
BAROMETRIC PRESSURE: 30.10

RPM	CBT	CBHP	FUEL	BSFC	CAT
6000	66.2	75.6	48.4	.66	73
6250	69.3	82.5	50.1	.62	73
6500	71.5	88.5	55.2	.64	73
6750	72.1	92.7	57.6	.64	72
7000	72.9	97.2	58.6	.62	72
7250	72.8	100.5	57.5	.59	71
7500	72.3	103.2	59.0	.59	71
7750	69.0	101.8	59.5	.60	71
8000	62.8	95.7	58.4	.63	72
8250	47.8	75.1	58.9	.81	73

PIPE SHOOTOUT

Continued from page 4

Decker Twin Pipes 98 dB

Data for 29.92 inches Hg. 60 F dry air.
TEST: 100 RPM/Sec Accel.
FUEL SPECIFIC GRAVITY: .710
VAPOR PRESSURE: .55
BAROMETRIC PRESSURE: 30.13

RPM	CBT	CBHP	FUEL	BSFC	CAT
6000	66.4	75.9	51.8	.70	70
6250	70.6	84.0	54.6	.66	69
6500	72.0	89.1	57.3	.66	69
6750	71.1	91.4	58.1	.65	69
7000	70.8	94.4	58.1	.63	68
7250	72.6	100.2	58.7	.60	68
7500	74.6	106.5	61.8	.59	68
7750	75.0	110.7	63.5	.59	69
8000	61.7	94.0	65.9	.72	69
8250	47.8	75.1	64.4	.88	69
8500	45.7	74.0	64.0	.89	69

Decker Twin Pipes (RAVE locked closed)

Data for 29.92 inches Hg. 60 F dry air.
TEST: 100 RPM/Sec Accel.
FUEL SPECIFIC GRAVITY: .710
VAPOR PRESSURE: .55
BAROMETRIC PRESSURE: 30.14

RPM	CBT	CBHP	FUEL	BSFC	CAT
6000	71.1	81.2	53.7	.67	63
6250	73.3	87.2	57.0	.66	64
6500	72.4	89.6	58.5	.66	62
6750	70.6	90.7	61.7	.69	65
7000	66.9	89.2	61.6	.70	65
7250	64.1	88.5	62.9	.72	64
7500	59.2	84.5	63.9	.77	66
7750	50.1	73.9	64.9	.89	64
8000	46.8	71.3	63.4	.90	64
8250	44.9	70.5	64.1	.92	62

Precision Products Twin Pipes 100 dB

Data for 29.92 inches Hg. 60 F dry air.
TEST: 100 RPM/Sec Accel.
FUEL SPECIFIC GRAVITY: .710
VAPOR PRESSURE: .52
BAROMETRIC PRESSURE: 30.03

RPM	CBT	CBHP	FUEL	BSFC	CAT
6000	45.0	51.4	32.1	.63	59
6250	50.8	60.5	40.1	.67	59
6500	54.9	67.9	46.3	.69	59
6750	66.6	85.6	59.1	.70	59
7000	67.5	90.0	61.9	.70	59
7250	66.3	91.5	62.1	.69	60
7500	68.0	97.1	61.4	.64	59
7750	68.2	100.6	60.9	.61	59
8000	68.3	104.0	63.4	.62	60
8250	68.5	107.6	65.0	.61	60
8500	69.6	112.6	64.0	.58	60
8750	69.6	116.0	64.2	.56	60
9000	68.6	117.6	67.1	.58	60

Precision Products Twin Pipes (RAVE locked closed)

Data for 29.92 inches Hg. 60 F dry air.
TEST: 100 RPM/Sec Accel.
FUEL SPECIFIC GRAVITY: .710
VAPOR PRESSURE: .55
BAROMETRIC PRESSURE: 30.15

RPM	CBT	CBHP	FUEL	BSFC	CAT
6000	51.3	58.6	41.6	.72	63
6250	54.8	65.2	44.6	.70	63
6500	58.3	72.2	49.5	.70	63
6750	70.2	90.2	57.0	.64	62
7000	71.4	95.2	58.6	.63	64
7250	71.5	98.7	58.0	.60	63
7500	71.3	101.8	59.1	.59	63
7750	69.2	102.1	58.7	.59	65
8000	67.0	102.1	57.7	.57	64
8250	64.4	101.2	57.9	.58	64

FAST Twin Pipes 96 dB

Data for 29.92 inches Hg. 60 F dry air.
TEST: 100 RPM/Sec Accel.
FUEL SPECIFIC GRAVITY: .710
VAPOR PRESSURE: .55
BAROMETRIC PRESSURE: 30.11

RPM	CBT	CBHP	FUEL	BSFC	CAT
6000	60.6	69.2	47.5	.70	69
6250	62.7	74.6	50.5	.69	71
6500	65.7	81.3	51.3	.65	70
6750	68.7	88.3	50.9	.59	70
7000	71.1	94.8	55.2	.60	70
7250	73.6	101.6	57.1	.58	70
7500	74.8	106.8	58.5	.56	70
7750	76.4	112.7	59.1	.54	69
8000	78.0	118.8	60.8	.52	70
8250	77.3	121.4	65.9	.56	71
8500	52.3	84.6	63.6	.77	71

FAST Twin Pipes (RAVE locked closed)

Data for 29.92 inches Hg. 60 F dry air.
TEST: 100 RPM/Sec Accel.
FUEL SPECIFIC GRAVITY: .710
VAPOR PRESSURE: .55
BAROMETRIC PRESSURE: 30.13

RPM	CBT	CBHP	FUEL	BSFC	CAT
6000	69.8	79.7	51.5	.66	68
6250	72.2	85.9	55.9	.66	68
6500	71.1	88.0	55.4	.64	68
6750	71.4	91.8	58.4	.65	68
7000	70.6	94.1	57.8	.63	68
7250	69.2	95.5	57.8	.62	68
7500	67.2	96.0	58.0	.62	68
7750	65.6	96.8	58.6	.62	68
8000	58.3	88.8	61.7	.71	69

PIPE SHOOTOUT

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LARGER MAIN JETS & STIFFER RAVE SPRINGS

These final three tests reveal how the horsepower and BSFC are affected by larger (safer) main jets. While this data was generated with the FAST twin pipes, all of the other single and twin pipes showed a similar reduction in CBHP and increase in BSFC. The main jets used in the 46mm carbs were 470-500 instead of the 410-440 used in the previous tests. Note the lower CAT.

Also, note the unusually dramatic shift in the power peak from 8250 to 8000 resulting from the richer jetting. We ran a total of eight dyno runs with the richer jets, and in each test the power peak occurred at 8000 RPM.

In the final test, we installed SKI-DOO's optional stiffer RAVE springs (part #420 2399 44). These springs exert 73% more pressure against the RAVE diaphragm in the closed position, causing a later valve opening. We performed several very rapid ramped acceleration tests with the stiffer springs (1.1 seconds from 6000 to 7500 and 1.2 seconds from 7500 to 8250), and the RAVE opening was correct with this set of pipes.

The varied tuned lengths and backpressure levels of the different pipes warrant experimenting with each one to obtain the most benefit from the RAVE--a few hours in the field with a stopwatch and a couple of dollars worth of springs would be time and money well spent❑

FAST Twin Pipes 96 dB
Data for 29.92 inches Hg. 60 F dry air.
TEST: 100 RPM/Sec Accel.
FUEL SPECIFIC GRAVITY: .710
VAPOR PRESSURE: .55
BAROMETRIC PRESSURE: 30.11

RPM	CBT	CBHP	FUEL	BSFC	CAT
6000	60.6	69.2	47.5	.70	69
6250	62.7	74.6	50.5	.69	71
6500	65.7	81.3	51.3	.65	70
6750	68.7	88.3	50.9	.59	70
7000	71.1	94.8	55.2	.60	70
7250	73.6	101.6	57.1	.58	70
7500	74.8	106.8	58.5	.56	70
7750	76.4	112.7	59.1	.54	69
8000	78.0	118.8	60.8	.52	70
8250	77.3	121.4	65.9	.56	71
8500	52.3	84.6	63.6	.77	71

FAST Twin Pipes
Richer Jets, Standard RAVE Springs
Data for 29.92 inches Hg. 60 F dry air.
TEST: 100 RPM/Sec Accel.
FUEL SPECIFIC GRAVITY: .710
VAPOR PRESSURE: .52
BAROMETRIC PRESSURE: 30.02

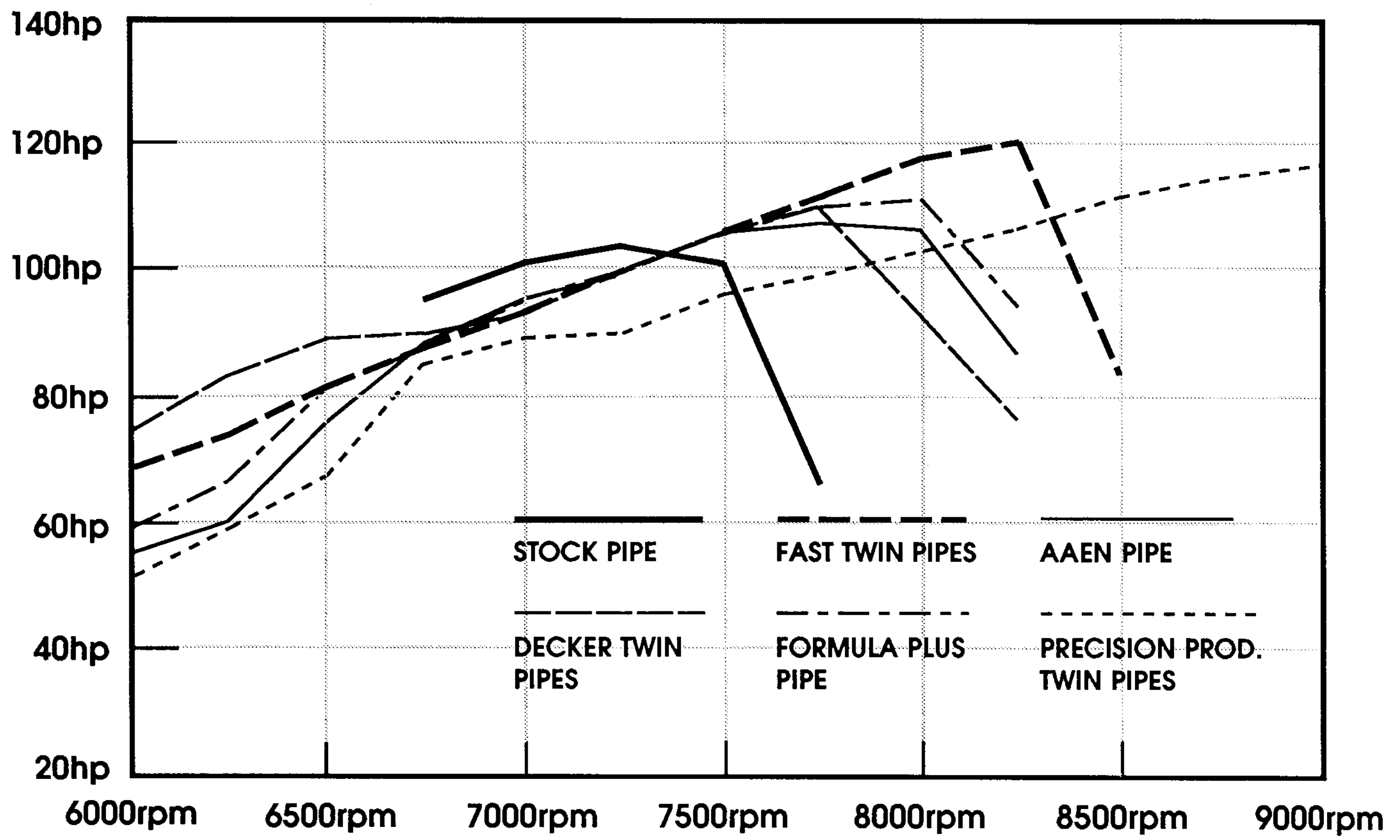
RPM	CBT	CBHP	FUEL	BSFC	CAT
6000	59.8	68.3	50.5	.75	60
6250	63.5	75.6	56.5	.76	61
6500	66.0	81.7	59.6	.74	61
6750	68.6	88.2	61.3	.71	61
7000	70.6	94.1	66.1	.71	61
7250	72.7	100.4	65.5	.67	63
7500	73.8	105.4	66.2	.64	61
7750	75.9	112.0	68.0	.62	61
8000	77.0	117.3	69.2	.60	61
8250	67.0	105.2	70.0	.68	60
8500	47.8	77.4	69.4	.91	61

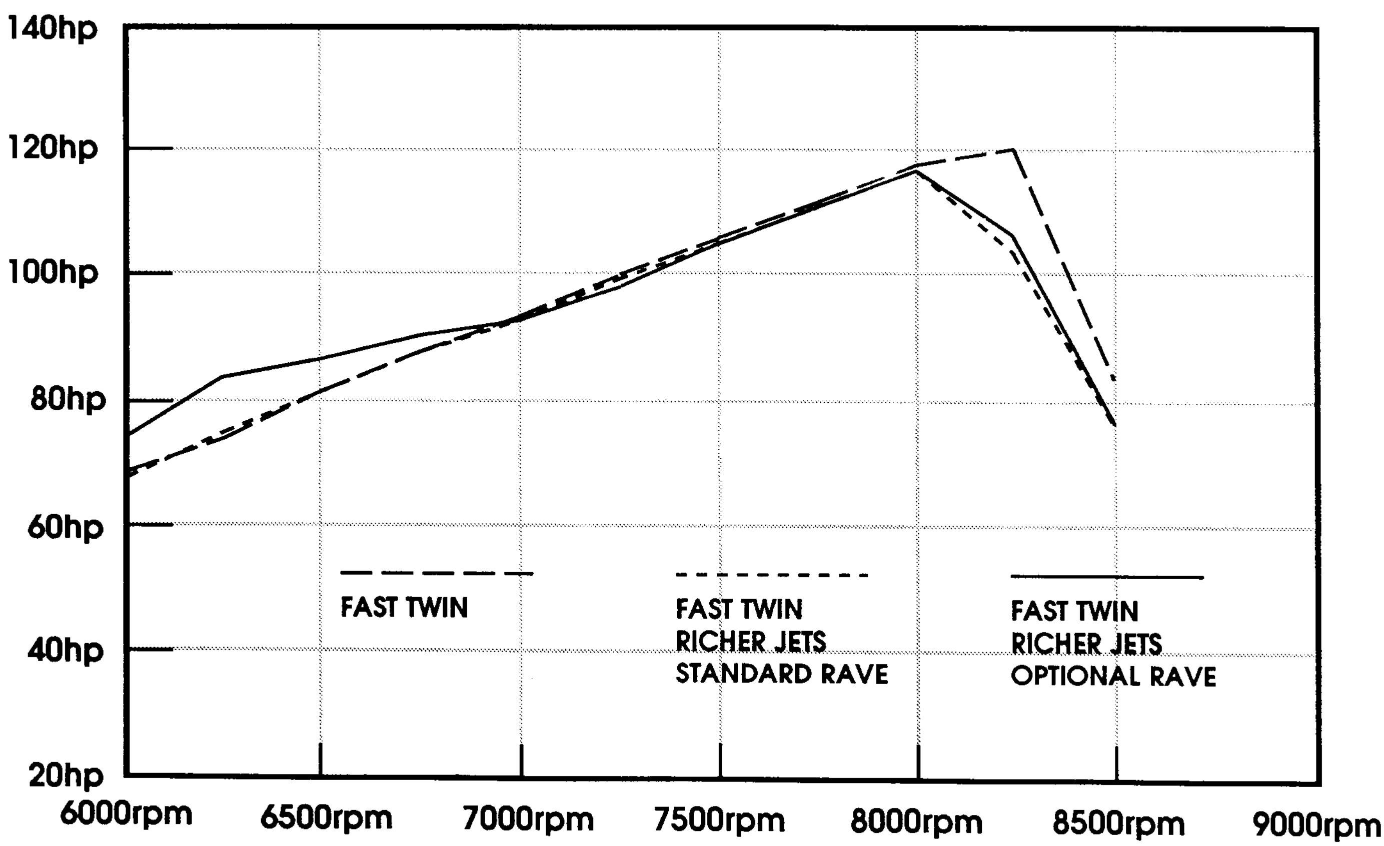
FAST Twin Pipes
Richer Jets, Optional RAVE Springs
Data for 29.92 inches Hg. 60 F dry air.
TEST: 100 RPM/Sec Accel.
FUEL SPECIFIC GRAVITY: .710
VAPOR PRESSURE: .52
BAROMETRIC PRESSURE: 30.02

RPM	CBT	CBHP	FUEL	BSFC	CAT
6000	65.2	74.5	52.9	.72	61
6250	70.9	84.4	62.0	.75	61
6500	70.4	87.1	65.0	.76	61
6750	70.9	91.1	65.5	.73	61
7000	70.2	93.6	65.8	.72	61
7250	71.4	98.6	65.8	.68	62
7500	74.1	105.8	68.2	.66	60
7750	75.9	112.0	68.8	.62	61
8000	77.0	117.3	67.9	.59	60
8250	68.4	107.4	68.8	.65	63
8500	48.4	78.3	69.7	.91	62

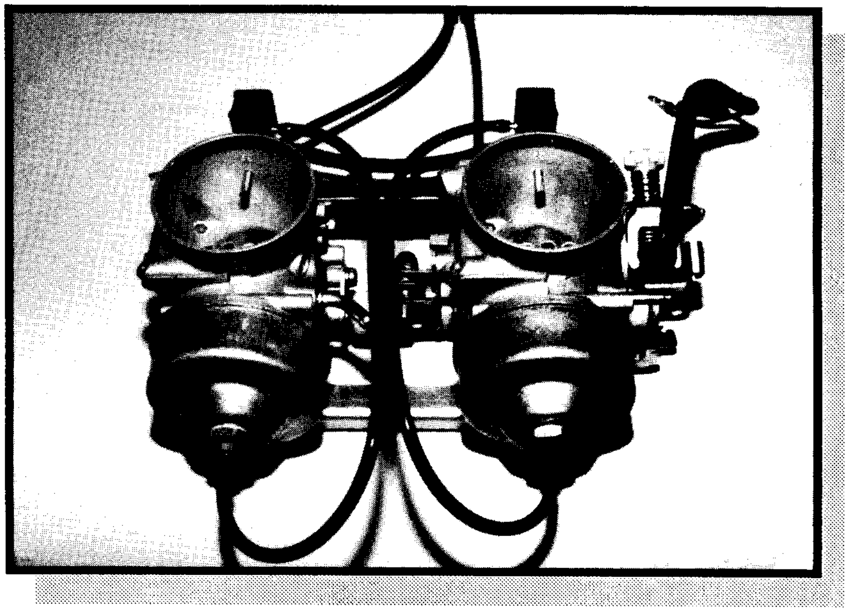
PIPE SHOOTOUT

Continued from page 6





DIAL-A-JET PRODUCT EVALUATION



Dial-A-Jet is a supplemental fuel metering device that is adjusted manually through an external five-position rotary switch. It is designed to deliver fuel in response to the level of acoustic signals resonating through the intake tract of an engine. According to its designer, Dennis Dean, the Dial-A-Jet will additionally alter its fuel delivery automatically in response to changes in Relative Air Density. Dennis informed us that during the onset of detonation these acoustic signals are amplified causing the fuel flow to increase. While this design concept sounds ideal, we were unable to document or verify on the dyno any changes in fuel flow caused by either detonation or barometric pressure. We had hoped to make our dyno evaluations while a changing weather front moved into our area--at times we have seen as much as a 1 in. mg. change in barometric pressure (equal to 1,000 ft. change in elevation), over a 24 hour period. Unfortunately, the barometer remained too stable during our allotted dyno time for us to reach any positive conclusions regarding the fuel flow/barometric pressure relationship.

To test the fuel flow/CAT relationship (part of our RAD), we temporarily removed the cold air induction and air flowmeter. With 40 degree air blowing over the sled, we were able to record as high as 107 degree F CAT during repetitive tests. While horsepower was reduced dramatically, the Dial-A-Jets delivered the same amount of fuel as when the CAT was much lower.

We installed Dial-A-Jets in two of our engines. The first, a 1986 stock Phazer with 3,000 miles on the odometer, was equipped with an aftermarket pipe and cold air intake. Normally when a cold air intake is installed, the main jets should be increased two or three sizes to compensate for the additional oxygen molecules packed into the cold winter air. We left the main jets stock and added the Dial-A-Jets. Installation was easy; we simply drilled the cast-in dead end orifice in the top of each carb bell, then drilled and tapped the floatbowl fittings to install the fuel supply glands. On 92 octane gas this engine registered severe audible detonation with the Dial-A-Jets in the leanest position at 20 degrees F. at sea level. Clicking the Dial-A-Jets to the full rich position totally eliminated detonation in the mid-range with a very slight amount of pinging remaining at the very top end. Jetting up one size eliminated all pinging with Dial-A-Jets in the middle position and left us with easily adjustable fuel flow as conditions required.

To show the Dial-A-Jet's fuel flow characteristics on 38mm slide carbs, we installed them on our second engine, a Modified Phazer with ported cylinders, half inch shorter Y pipe, Aaen single pipe with repackable silencer, Swain Tech TBC coated SX pistons and combustion chambers, Mikuni 38 mm flat slides with gutted airbox and cold air intake. The Dial-A-Jets fit perfectly into the pre-cast opening provided for the standard Mikuni power jet. The standard power jet float bowl fitting works fine--just remember to remove the brass stand-off tube inside the float bowl to allow fuel to reach the Dial-A-Jet.

➡

DIAL-A-JET

Continued from page 8

PHAZER 260 Main Jet Only
Data for 29.92 inches Hg. 60 F dry air.
TEST: 100 RPM/Sec Accel.
FUEL SPEC. GRAV.: .711
VAPOR PRESSURE: .21
BAROMETRIC PRES.: 30.04

RPM	CBT	CBHP	FUEL	BSFC	CAT
6750	56.5	72.6	40.7	.56	35
7000	57.0	76.0	42.0	.54	34
7250	58.4	80.4	44.9	.54	34
7500	58.6	83.7	45.2	.53	35
7750	59.0	87.1	46.8	.53	36
8000	56.9	86.7	47.8	.54	35
8250	48.2	75.7	48.2	.62	35

PHAZER 260 Main Jet--Dial-A-Jet In Lean Position
Data for 29.92 inches Hg. 60 F dry air.
TEST: 100 RPM/ Sec Accel.
FUEL SPEC. GRAV.: .711
VAPOR PRESSURE: .21
BAROMETRIC PRES.: 30.04

RPM	CBT	CBHP	FUEL	BSFC	CAT
6750	54.0	69.4	40.8	.58	36
7000	56.5	75.3	41.8	.54	36
7250	58.7	81.0	43.3	.52	37
7500	59.0	84.3	46.0	.53	38
7750	58.3	86.0	46.9	.53	38
8000	56.1	85.5	47.9	.54	36
8250	48.3	75.9	47.5	.61	36

PHAZER 260 Main Jet--Dial-A-Jet In Middle Position
Data for 29.92 inches Hg. 60 F dry air.
TEST: 100 RPM/ Sec Accel.
FUEL SPEC. GRAV.: .711
VAPOR PRESSURE: .21
BAROMETRIC PRES.: 30.04

RPM	CBT	CBHP	FUEL	BSFC	CAT
6750	54.2	69.7	40.7	.57	36
7000	57.1	76.1	43.4	.56	36
7250	59.4	82.0	45.4	.54	36
7500	59.4	84.8	47.7	.55	36
7750	58.4	86.2	48.4	.55	36
8000	55.7	84.8	48.1	.55	36
8250	37.3	58.6	47.6	.79	37

PHAZER 260 Main Jet--Dial-A-Jet in Richest Position
Data for 29.92 inches Hg. 60 F dry air.
TEST: 100 RPM/Sec Acceleration
FUEL SPEC. GRAV.: .711
VAPOR PRESSURE: 21
BAROMETRIC PRES.: 30.04

RPM	CBT	CBHP	FUEL	BSFC	CAT
6750	54.5	70.0	43.8	.61	38
7000	56.7	75.6	46.4	.60	38
7250	58.8	81.2	46.8	.57	39
7500	58.5	83.5	49.1	.58	39
7750	57.5	84.8	51.2	.59	38
8000	54.6	83.2	51.0	.60	38
8250	36.5	57.3	49.9	.85	38

During our field test the modified Phazer's flat slides were fitted with Q-6 needle jets and 260 main jets, and the Dial-A-Jets were disconnected. The altitude for our field test was 2,000 ft. (Old Forge, NY, on several inches of packed snow) and the temperature at the test strip was 10 degrees F. The Phazer was run against three other performance sleds for comparison. 92 octane pump gas was used.

With the Dial-A-Jets disconnected we were able to run just 3/4 mile at W.O.T. before audible detonation set in. After connecting the Dial-A-Jets we adjusted them to the leanest position. Then, repeating our field test, there was still some slight pinging at the end of the mile. Adjusting the Dial-A-Jets to the middle position completely eliminated the detonation even on repetitive runs.

Interestingly the Phazer was now consistently several sled lengths quicker from 1/8 mile on, even though we had not previously heard any pinging until well beyond that point. Back at 500 ft. altitude where we normally ride, the full rich position on the Dial-A-Jet allows detonation-free riding down to 20 degrees. At temperatures below that we must go to larger main jets, then shift the Dial-A-Jets back to lean.

We have elected to show the Dial-A-Jet data from only the modified Phazer engine with 260 main jets installed. The net fuel flow change on the dyno with the Dial-A-Jets in the full rich position was about six percent, or about one and a half jet sizes.

The Dial-A-Jets had a more dramatic effect on fuel flow with the stock engine. Because of the greater pressure differential between the float bowls and the very restrictive stock airbox, the Dial-A-Jets in the rich position added 14 percent more fuel in the mid-range and top end position.

The Dial-A-Jets have proven to be a great advantage in helping our air-cooled engines remain at peak performance. We can hear the engine ping when we're lean, and the ease with which we can "Dial" the fuel flow is a welcome respite from the misery that normally accompanies winter field tuning--any automatic compensation that may be occurring during changing air density or detonation is an added benefit.

Dial-A-Jet Manufactured by Thunder Products
Sales 614-927-5300 Tech 614-836-2834❑

BIG BORE

INDY 400

Occasionally, we run across an exceptional engine/pipe/carb combination that merits publication in DYNOTECH. In this case, Starting Line Products built a big bore Polaris Indy 400 (440 actual cc) for Webb Polaris of Long Island, N.Y. After receiving the engine from SLP, Pete Webb journeyed directly to the C&H Dyno to break-in and dial in the engine. After our Dyno evaluation and tuning, this engine in a stock Indy chassis has run 95 mph on radar at 2000 ft altitude. The following two sets of dyno data compare a stock Indy 400 with that of the SLP 440 big bore. Both engines are shown with stock carbs, jetting, and pipes (the 440's carbs were bored to 35.2mm). While not shown in our data, the stock 400 made 66.8 observed HP at 21 degree F CAT, and the SLP 440 made 81.3 observed HP at 32 degree F CAT□

STOCK INDY 400
Data for 29.92 inches Hg. 60 F dry air.
TEST: 100 RPM/Sec Accel.
FUEL SPECIFIC GRAVITY: .695
VAPOR PRESSURE: .17
BAROMETRIC PRESSURE: 30.45

RPM	CBT	CBHP	FUEL	AIR	A/F	BSFC	CAT
6000	32.7	37.4	32.9	86.8	12.1	.83	20
6250	35.0	41.7	34.4	91.7	12.2	.78	19
6500	36.7	45.4	34.9	94.3	12.4	.72	20
6750	38.5	49.5	36.1	95.6	12.2	.69	21
7000	41.4	55.2	40.1	99.6	11.4	.69	20
7250	43.0	59.4	40.4	102.5	11.7	.64	20
7500	43.4	62.0	41.0	104.9	11.7	.62	20
7750	42.7	63.0	41.9	106.3	11.6	.63	21
8000	39.9	60.8	43.4	107.2	11.3	.67	20

SLP 400/440
Data for 29.92 inches Hg. 60 F dry air.
TEST: 100 RPM/Sec Accel.
FUEL SPECIFIC GRAVITY: .734
VAPOR PRESSURE: .10
BAROMETRIC PRESSURE: 30.31

RPM	CBT	CBHP	FUEL	AIR	A/F	BSFC	CAT
6000	38.7	44.2	37.6	96.1	11.7	.81	31
6250	40.7	48.4	39.8	102.8	11.9	.79	32
6500	46.4	57.4	45.9	113.9	11.4	.77	32
6750	49.6	63.7	48.7	120.5	11.4	.73	31
7000	52.4	69.8	49.8	126.8	11.7	.68	54
7250	53.0	73.2	51.0	130.5	11.8	.67	54
7500	53.4	76.3	49.3	134.1	12.5	.62	55
7750	52.8	77.9	50.6	135.5	12.3	.62	55
8000	49.9	76.0	51.1	136.8	12.3	.64	54

FEEDBACK

JIM CZEKALA

FIRST CLASS
Most of you will be happy to hear that **DYNO*TECH*** will be shipped via first class mail next season (beginning with the 7th issue). Though third class bulk mailings offer substantial savings, they have been painfully slow and inconsistent.

INTO THE '90's
In response to your requests we have already scheduled stock evaluations for the 1990 Mach 1 and Polaris 650. Also, we are looking forward to testing the new Prowler, and spending more time on the popular Indy 500 and 488 Trail Indy.

ORDER BLANKS
In issue #4, we included a page of perforated **DYNO*TECH*** order blanks. Anyone who sponsors five NEW subscribers will receive the next season of **DYNO*TECH*** *FREE OF CHARGE* (be sure to fill in your name as sponsor).

Next season, we'll be using "CopyGuard" ink to thwart photocopiers--it is hoped that this policy will increase our subscriber base and allow us to keep subscription rates as low as possible. Please give an order blank to any of your friends who wish to "be informed"--their *official* subscriptions will benefit us all.

Also, anyone who is interested in five or more issues sent to a single address (clubs, companies, etc.) please call for group rates.

LANGUAGE BARRIER
Recently, a Canadian subscriber wrote to inform me--in English that was better than my French--that our jet spec was "too lean in our Indy 650" pipe test. Based on our test data, he had purchased Decker pipes for his Indy then ran into trouble using 230 main jets (our leaned-to-the bone spec at 50 degrees F) for Quebec trail riding.

Our numerical data, (e.g., RPM, torque and horsepower) is easily understood. Unfortunately, a large number of our foreign subscribers do not read or speak English very well. Consequently the text and other data accompanying our evaluations is often misinterpreted. We are therefore investigating the possibility of translating our articles into French. If any of our bi-lingual subscribers are interested in helping us develop this project, please let

Continued on page 12

SLICK 50
TWO STROKE TREATMENT

PRODUCT EVALUATION

Every internal combustion engine requires a certain amount of horsepower just to run itself. Friction caused by the rotating and reciprocating parts, both inside and outside the engine, absorb a portion of its potential output. Bearings, seals, pistons and rings, oil and water pumps, and even the internal windage and air pumping action of the engine contribute to what is known as **Friction Horsepower**.

The magnitude of Friction Horsepower varies with engine size and design. Four-stroke engines typically have higher Friction Horsepower losses than two-stroke engines of similar displacement; camshafts, rocker arms, intake and exhaust valves and springs require additional horsepower to operate.

Friction Horsepower is dramatically effected by engine speed; it ***increases with the square of the engine RPM.*** An engine's 5000 RPM Friction Horsepower doubles at 7000 RPM, then quadruples at 10000 RPM!

Slick 50 Two Stroke Treatment consists of friction reducing TFE (teflon) dissolved in an oily base liquid. The directions instruct us to slowly inject the Slick 50 Two Stroke Treatment directly into the intakes of a running, cold engine. The base liquid vaporizes and blows through the crankcase and cylinders, leaving behind some of the TFE in the form of a semi-permanent coating on the inside of the engine. The treatment is supposed to be repeated once a year.

For our Dyno analysis, we used a stock 650 Polaris triple engine with Decker triple pipes. Stock 38mm carbs were used with 240 main jets. 100 LL Av Gas was premixed with petroleum oil at 32-1.

It is estimated that the Friction Horsepower of our stock Polaris 650 is 10 HP at 7000 RPM, increasing to around 18 HP at 9500 RPM. Hopefully, the Slick 50 would reduce this friction, and result in an increased net CBHP output.

After warming the engine, we ran six tests to establish our baseline. The engine was then allowed to cool for one hour before we treated it with the Slick 50 Two Stroke Treatment.

Following the instructions, we slowly injected the contents of two squeeze bottles into the three cylinders of the running engine. This operation was accompanied by huge plumes of dense white vapor billowing from each of the triple pipes as the individual cylinders were treated.

After several minutes of brisk running to totally clear the engine of residual Slick 50, six more tests were run. The following test data is most typical of the tests we completed.

WITHOUT SLICK 50
Data for 29.92 inches Hg. 60 F dry air.
TEST: 100 RPM/Sec Accel.
FUEL SPECIFIC GRAVITY: .700
VAPOR PRESSURE: .42
BAROMETRIC PRESSURE: 30.12

RPM	CBT	CBHP	FUEL	AIR	A/F	BSFC	CAT
7000	65.6	87.4	55.0	177.8	15.7	.63	56
7250	65.3	90.1	57.0	179.3	14.5	.63	55
7500	66.0	94.2	59.0	179.2	14.0	.63	57
7750	67.6	99.8	60.5	180.3	13.7	.61	57
8000	67.9	103.4	60.6	181.5	13.7	.59	57
8250	68.2	107.1	59.3	181.7	14.0	.56	57
8500	68.4	110.7	59.1	184.0	14.3	.54	55
8750	67.8	113.0	60.4	185.2	14.2	.54	55
9000	67.7	116.0	61.8	187.8	14.1	.53	55
9250	66.7	117.5	61.5	189.5	14.2	.53	56
9500	62.0	112.1	63.7	190.7	13.6	.57	57

WITH SLICK 50
Data for 29.92 inches Hg. 60 F dry air.
TEST: 100 RPM/Sec Accel.
FUEL SPECIFIC GRAVITY: .700
VAPOR PRESSURE: .42
BAROMETRIC PRESSURE: 30.13

RPM	CBT	CBHP	FUEL	AIR	A/F	BSFC	CAT
7000	63.8	85.0	53.9	176.3	14.7	.63	55
7250	65.0	89.7	59.6	178.8	13.8	.67	55
7500	65.4	93.4	61.1	178.9	13.5	.65	54
7750	66.3	97.8	62.4	179.7	13.2	.64	55
8000	66.5	101.3	63.5	181.1	13.1	.63	54
8250	67.1	105.4	62.0	182.1	13.6	.59	54
8500	67.8	109.7	63.1	183.7	13.4	.58	54
8750	67.2	112.0	64.8	185.4	13.2	.58	54
9000	67.1	115.0	66.6	187.2	13.1	.58	52
9250	66.7	117.5	63.3	189.8	13.9	.54	54
9500	63.1	114.1	62.8	191.2	13.9	.55	54

Our treated test engine made identical peak CBHP at 9250 RPM, and two more horsepower at 9500 RPM.--***But lost horsepower at every RPM below 9250.*** There was also a telltale pattern of reduced airflow in the lower RPM ranges. ➡

SLICK 50

TWO STROKE TREATMENT

Continued from page 11

All of the evidence we gathered points to a lowered Friction Horsepower, accompanied by some loss of ring seal in the Polaris 650. Increased blowby (compression sneaking past the rings) on a two-stroke not only reduces cranking pressure, but also displaces some of the intake charge, which reduces net airflow through the engine.

Evidently, the reduced Friction Horsepower more than offset the reduced ring seal from 9250 on up. There is some merit to the temporary friction reduction afforded us by the Slick 50 on ultra high RPM engines, keeping in mind the potential slight loss of low speed and midrange horsepower.

ENERGY RELEASE?

We encountered a similar situation last year when testing a fuel or oil additive called "Energy Release". The product was provided by a local distributor who brought along a testimonial videotape touting mileage and power increases; included was a two-stroke powered Jet-Ski that experienced a phenomenal increase in top speed when using Energy Release in the gasoline. How could we pass this up?

During a test session on my Polaris 650 powered Exciter, I proceeded to mix four gallons ($21.60 worth) of VP C14 gasoline with the recommended amount of Energy Release, ***and immediately lost two horsepower.*** Not only in the midrange, but at peak RPM as well. While I hadn't monitored airflow during this evaluation, I can only surmise that the ring seal was compromised by the slippery additive.

"No problem", I thought, switching back to straight C14 premix--but the horsepower ***was still missing!*** To reclaim the missing horsepower I was forced to "berryhone" the cylinders to get rid of the residue.

I sold, at a tremendous discount, the rest of the Energy Release laced C14 to my unsuspecting pals who I race against on the local haylots and lakes on weekends. They think I'm a great guy❑

FEEDBACK

Continued from page 10

us know. A good understanding of the subject matter, and access to a FAX machine are important.

CYCLE MAGAZINE

Utilizing the C&H Dyno to obtain the necessary data, Kevin Cameron recently completed an interesting feature article on camshaft timing for an upcoming issue of ***CYCLE*** magazine. His article shows how, and explains why subtle changes in intake and exhaust timing affect the performance of the four-stroke Suzuki GSXR1100 motorcycle. The article should appear in the August or September issue of ***CYCLE***. While you're at it, check out Kevin's monthly "TDC" column.

NEW DYNO TESTING FACILITY IN THE CHICAGO AREA

Last winter Rich Vetter and three of his friends traveled all the way from Chicago, Ill. to dyno tune several Kawasaki Interceptors, including a three cylinder version that they had built themselves. One of the Interceptors was bone stock, and we had hoped to make a "Nostalgia Corner" article based on the gathered data. Unfortunately, the stocker turned out to be somewhat off the mark and so we were unable to publish the test results in **DYNO*TECH***. But these guys had such a good time and learned so much during their one day session, that they've decided to build a test facility of their own.

Don Crush, who has just returned from his training session at SuperFlow in Colorado, will be director of operations. After taking delivery of their $50000 computerized SF901C dyno in August, Rich expects to invest another $200,000 in their facility construction (including their own chassis holding fixture, shaft system, and outside air blower to accommodate either bare engines or complete sleds).

Midwest Dyno Service plans to be operational by October. Don can be reached at 815-726-DYNO (3966).

PROJECT SLED UPDATES

Big Bore Formula Plus+++ with .050 squish & gutted airbox

Aaron Swable put 1000 miles on the 580 big bore last winter, all of them on pump gas of varied quality. After severely detonating the engine at extended WOT on "mystery" gas, he jetted up to a conservative 440-480 and was able to run almost trouble free for the rest of the season.

Continued on page 16

KLOTZ

NITRO POWER ADDITIVE

The label on the can promises "up to 10% more horsepower...rejetting might be necessary".

The first engine we put to the Klotz test was a 440 Kawasaki Invader. As revealed in the BSFC and A/F ratios, the Invader's carburetion was conservative. After repeating several consistent baseline tests, we added the dosage of Nitro Power Additive prescribed for competition use. The result was a horsepower increase throughout the power band that ranged from zero to 5.4% at each RPM measured, averaging 2.6% overall. The following data documents the gains we measured before and after the additive was used.

STRAIGHT GASOLINE
Data for 29.92 inches Hg. 60 F dry air.
TEST: 100 RPM/Sec Accel.
FUEL SPECIFIC GRAVITY: .695
VAPOR PRESSURE: .39
BAROMETRIC PRESSURE: 29.79

RPM	CBT	CBHP	FUEL	AIR	A/F	BSFC	CAT
6500	38.4	47.5	46.4	101.7	10.1	.99	54
6750	40.1	51.5	41.1	99.2	11.1	.81	54
7000	40.9	54.5	40.5	95.0	10.8	.75	55
7250	42.7	58.9	40.3	94.4	10.8	.69	55
7500	45.4	64.8	40.6	96.8	10.9	.64	56
7750	46.8	69.1	41.0	100.2	11.2	.60	55
8000	45.7	69.6	41.5	104.5	11.6	.60	54

WITH KLOTZ ADDITIVE
Data for 29.92 inches Hg. 60 F dry air.
TEST: 100 RPM/Sec Accel.
FUEL SPECIFIC GRAVITY: .695
VAPOR PRESSURE: .39
BAROMETRIC PRESSURE: 29.78

RPM	CBT	CBHP	FUEL	AIR	A/F	BSFC	CAT
6500	39.8	49.3	35.6	101.7	13.1	.73	55
6750	40.4	51.9	39.0	99.5	11.7	.76	55
7000	41.9	55.8	39.8	95.9	11.1	.72	54
7250	45.0	62.1	40.4	95.6	10.9	.66	54
7500	46.9	67.0	41.9	98.3	10.8	.63	55
7750	47.9	70.7	42.3	101.1	11.0	.61	55
8000	45.7	69.6	41.4	105.6	11.7	.60	54

The second engine we used to analyze the Klotz Nitro Power Additive was Aaron Swable's Formula Plus 580 (also tested in issue 2). Checking the BSFC and A/F ratio, this engine was jetted quite lean for close to maximum horsepower at that temperature. Using Nitro Power Additive laced gasoline in the Plus, resulted in close to identical horsepower numbers at every RPM, with perhaps a 1/2% advantage.

580 PLUS STRAIGHT GASOLINE
Data for 29.92 inches Hg. 60 F dry air.
TEST: 100 RPM/Sec Accel.
FUEL SPECIFIC GRAVITY: .695
VAPOR PRESSURE: .69
BAROMETRIC PRESSURE: 29.99

RPM	CBT	CBHP	FUEL	AIR	A/F	BSFC	CAT
6500	64.9	80.3	43.3	139.1	14.8	.56	79
6750	67.4	86.6	46.0	145.6	14.5	.55	78
7000	70.1	93.4	49.5	151.6	14.1	.55	78
7250	71.2	98.3	53.9	157.2	13.4	.57	78
7500	72.5	103.5	53.2	164.8	14.2	.54	79
7750	71.2	105.1	54.1	171.9	14.6	.54	79
8000	62.6	95.4	53.1	174.4	15.1	.58	76
8250	50.6	79.5	53.2	168.0	14.5	.70	78

580 PLUS WITH KLOTZ ADDITIVE
Data for 29.92 inches Hg. 60 F dry air.
TEST: 100 RPM/Sec Accel.
FUEL SPECIFIC GRAVITY: .695
VAPOR PRESSURE: .69
BAROMETRIC PRESSURE: 30.00

RPM	CBT	CBHP	FUEL	AIR	A/F	BSFC	CAT
6500	65.1	80.6	42.4	138.2	15.0	.55	81
6750	67.1	86.2	44.7	144.9	14.9	.54	79
7000	70.0	93.3	49.5	151.6	14.1	.55	79
7250	71.8	99.1	52.5	158.2	13.8	.55	78
7500	72.3	103.2	55.5	164.3	13.6	.56	78
7750	71.6	105.7	55.2	172.3	14.3	.55	79
8000	64.1	97.6	54.6	173.3	14.6	.59	79
8250	50.3	79.0	55.2	166.9	13.9	.73	79

Finally, we added the competition dosage of Klotz Nitro Power Additive to the Av Gas pre-mix on our Decker piped stock Polaris 650 (this test was run after our Slick 50 evaluation in this issue). Once again, we documented a 1/2% CBHP improvement at peak power RPM.

AV GAS PRE-MIX POLARIS 650
Data for 29.92 inches Hg. 60 F dry air.
TEST: 100 RPM/Sec Accel.
FUEL SPECIFIC GRAVITY: .710
VAPOR PRESSURE: .42
BAROMETRIC PRESSURE: 30.16

RPM	CBT	CBHP	FUEL	AIR	A/F	BSFC	CAT
6750	58.1	74.7	44.3	160.4	16.6	.59	50
7000	63.3	84.4	52.8	179.5	15.6	.62	50
7250	65.5	90.4	54.3	182.0	15.4	.60	51
7500	65.8	94.0	57.1	181.4	14.6	.61	51
7750	67.1	99.0	58.4	182.3	14.3	.59	51
8000	67.5	102.8	57.3	182.9	14.7	.56	52
8250	68.0	106.8	57.7	183.7	14.6	.54	51
8500	68.1	110.2	60.8	185.8	14.0	.55	52
8750	67.7	112.8	60.5	186.3	14.1	.53	51
9000	67.6	115.8	61.5	187.8	14.0	.53	51
9250	67.2	118.4	62.2	190.9	14.1	.52	51
9500	63.6	115.0	61.6	192.3	14.3	.53	51

The directions suggest that jetting up might be necessary, so after this test we jetted up one size, only to see the CBHP fall off❑

READING PISTONS

THE CELLAR DWELLER KEVIN CAMERON

Your engine has just seized. Is that all you want to know about it? The piston is an encyclopedia about why it happened.

Where are the marks on the piston? A seizure from insufficient clearance or from applying power before full warm-up is usually on the skirt, below the wristpin. The shape of a new piston is not a simple taper from top to bottom. Typically, the ringbelt is .006-.010" smaller than the skirt region, and has a slow taper of its own. Just before the wristpin level is reached, the diameter flares out and a second taper begins, extending to the bottom of the skirt. This "skirt plateau", or region of close clearance, exists to stabilize the piston in the bore, preventing it from rocking, and thereby losing ring seal. Both regions (ringbelt and skirt) are tapered because the heat source--combustion--is at the top of the piston. Therefore the upper parts of the piston must be smaller than the lower parts. At running temperature, the taper disappears from thermal expansion.

Clearance seizures are uncommon in well-designed stock engines, but can occur from improper choice of clearance after rebore, or by assuming that a new piston is the size it's marked to be. Always measure! Trust no one! Only a bore gauge and micrometer will do a proper, accurate job of measurement. Feeler gauges will measure clearance in truck-sized bores, but will never give correct clearance in small-bore engines.

Cold seizures are much more common, especially in liquid cooled race engines without thermostats (their pistons get hot faster than their cylinders can). Such engines should be warmed up to operating temperature before full power is used. The obvious exceptions are the need to run with a nearly-cold engine (to get maximum power through greater density of cold air) in drag racing or at the starts of short track races. Here, you have to discover by experiment what clearance and warm-up procedure gives you the best running combination--without cold-seizure.

Certain pistons--almost always forgings--have masses of unnecessary material above and around the wristpin bosses. The more material there is, the more the piston will bulge at those points when it gets hot, so if you have odd seizures at wristpin level, but not above or below, piston design may be the cause. Relieve the piston surface in the area where you've learned to expect the problem.

The commonest seizures occur simply because too much heat is entering the piston from the combustion gases. The usual reason is light detonation. In this case, seizure will be almost entirely above the wristpin level, with extensive damage to the friction surface on the exhaust face. Aluminum from the piston may be smeared over the ring(s), trapping them in the groove(s). Sometimes the problem is simply not enough clearance--especially if this is a production engine that has now been tuned for racing. Production clearances are set for a moderate heat load, and at higher horsepower, the extra heat may simply expand the piston a bit more. A slight clearance increase may fix everything.

A common cause of seizure is an air leak, which leans out the mixture, thereby pushing the engine into detonation. When there is an air leak, the engine's idle speed will usually be elevated. The leak is often in a torn or deteriorated rubber carb mount--wiggle these around with the engine running to be sure. Have the cases been apart for a crank

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READING PISTONS

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change? People have been known to forget to install a seal now and then, or they might leave out the case sealer, etc. Base gaskets can be crushed in long service, and can migrate out from under the cylinders from vibration, leaving a deadly gap. Never use sealer on base gaskets; it can act as a high pressure lubricant, actually encouraging the gaskets to squeeze out under pressure. Modern gaskets bond themselves to the metal when installed bare; that's what you want.

When you seize, always check the appearance of the piston and cylinder head on the cylinder that didn't seize. It will give a check on the likely running conditions at the moment of sticking (unless there is a problem on just the one cylinder).

When you get a heat seizure in a designed-for-racing engine, simply increasing clearance may be the wrong thing to do, for the bigger the clearance, the harder it is for the piston to transfer its heat to the cooler cylinder walls, and the harder it is for the rings to seal. In many cases, race-engine seizures are caused by insufficient break-in of piston and cylinder. In the press of racing action, people change pistons and cylinders, then rush to the starting line with little or no running time on the new parts. Inevitably, extra heat is generated in the initial process of rubbing off the rough edges, and a seizure results that would never have happened if the engine had been broken-in more slowly. Many racers therefore break in new cylinders and pistons before putting them in their spares kits.

Be sure that a seizure is not simply a result of slight leanness "on the needle"--meaning when running at part-throttle. Mixture is normally richer on full throttle than at 7/8 throttle, so if you are having your heat seizures just at the instant of knocking the throttle, try a richer needle setting or one size larger needle jet.

When you seize, always check the appearance of the piston and cylinder head on the cylinder that didn't seize. It will give a check on the likely running conditions at the moment of sticking (unless there is a problem on just the one cylinder). If the plug looks lean, ask yourself if anything is slowing the delivery of fuel. This could mean too-small a main jet, a failing fuel pump, a blocked fuel filter or tank breather, or frothing in the floatbowls caused by unusual vibration. If this is a production engine that has been hot-rodded, consider the possibility that the fuel pump, carb float valves, or other standard parts of the fuel system may not be up to delivering the extra fuel you need. Extra vibration from raised RPM can effect carburetion, and snowmobile carb mounts are often too stiff to begin with. If there is a carb vibration problem, adding weight to the carbs may cure it.

When the seizure is accompanied by an actual hole in the piston, or by a crater of detonation-erosion in the center of the piston crown, look for too-early ignition or too-hot a spark plug heat range. Look at the center wire of the plug(s) in the unseized cylinder(s). Is the tip of the wire still sharp edged from the manufacturing process, or has the wire begun to soften? If it has, this surelyindicates early ignition or too hot a plug heat range. Early timing gives more torque at lower RPM, but works against the engine up higher in in the rev band. Don't imagine that you have to push to the ragged edge with timing. Remember that electronic ignition modules can fail in ways that aren't spelled out in the manual.

Even when your engine is running well, have

FEEDBACK

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After sucking in a base gasket one weekend, Aaron replaced them with homemade gaskets that were .010" thinner than stock. This brought him some grief in the form of minor detonation at WOT--reverting back to the stock thickness base gaskets alleviated the problem.

While we never had the opportunity to clock the 580 Plus on radar, Aaron was able to run respectably with stock 650's.

Modified Polaris 650
After we used his engine in our modified Indy pipe shootout, Ed Sedlmeier purchased Decker triple pipes. With his carbs bored to 39.2mm and a gutted airbox, Ed runs 380-370-370 main jets and Q4 needle jets to be safe trail riding at 20 degrees F, sea level.

With Bender Racing's Bruce Schrader driving, the DynoTech Indy 650 took first place in both the AA and Open Improved Stock classes at the 1989 Erie County Winterfest dragraces. During a test session on the lake, Ed ran 111 MPH on lightly dusted ice, no track lubricators at 25 degrees F.

On the same day, Ed's wife's 1986 Formula Plus with 207 RV, gutted airbox and 360-380 main jets, drilled exhaust canister, and stock head went 99 MPH.

Update Ported Yamaha Exciter
By winter's end, Richard Hiley had been unable to do much with his PSI twin pipes (because of the problems discussed in issue #4). However, with his shortened stock pipe he was able to trail ride the Exciter over 1800 miles, and turn 101 MPH at a Canadian radar run.

Wildcat-FIII Spec
Too late in the season to get the clutching and suspension dialed in, Carl McQuillen installed his 650 twin in a '76 Merc Sno-Twister chassis. Surprisingly, the engine, PSI twin pipes, and stock exhaust canister fit under the hood without any pipe modifications.

When properly done, the Arctic FIII port spec has worked out very well for trail riding subscribers and dyno customers; CBHP numbers in the mid 120's are common with moderate compression increases and safe jetting❑

READING PISTONS

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a careful look at the pistons whenever the top end is off. Run a finger over the domes or compare with new pistons, to be sure the metal isn't softening and sagging a bit from running too hot. If the engine has a large piston-controlled intake port, carefully examine the intake-side skirt for cracking. Turn the piston upside down and look all around the wristpin bosses for little cracks. Make sure the piston ring (s) are free in their groves--not tending to gum and stick. Look at the burn pattern on the crowns. You may see the flow paths of the several transfer streams, and they should be reasonably symmetrical. If they are not, you may have manufacturing imperfections in one or more of the transfers. The edges of the crown should be smooth--not roughened and pitted or with a light sand blasted appearance that indicates detonation. In a well tuned engine that is used hard (racing, lakes, etc.) the center of the piston will always be dry, but the edges may show a bit of black and wetness. When everything is just right, the entire piston crown will be dry and free of all deposits except for a dusty matte surface. This is seen only if the engine is chopped immediately after a hard run❑

DYNOTECH is an independent newsletter published by **DYNOTECH** Corp., P.O. Box 801 Batavia N.Y. 14021, in affiliation with C&H Dyno Service, 8 Apollo Drive, Batavia, N.Y. 14020. Subscription rate is $30.00 per year (six issues). Phone: 716-344-1313. No part of this publication may be printed or otherwise reproduced without express permission from the publisher. Send address changes to **DYNOTECH**, P.O. Box 801, Batavia, N.Y. 14021. **DYNOTECH** makes every effort to assure the accuracy of articles and technical information listed in this newsletter. **DYNOTECH** assumes no responsibility for damages due to errors, omissions, or applications of any information.

Jim Czekala
PUBLISHER
CONTRIBUTING EDITOR

Derek Molloy
EDITOR
GRAPHIC DESIGN

Kevin Cameron
CONTRIBUTING EDITOR

Debbie Molloy
CIRCULATION
COORDINATOR