

**BRANCH
FLOWMETRICS**

HARLEY-DAVIDSON XR1000



MODIFICATION AND DYNO TESTS

BRANCH FLOWMETRICS

MAY 15, 1984

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**BRANCH
FLOWMETRICS**

5556 CORPORATE DR. CYPRESS, CA. 90630

H-D XR1000

RECENTLY WE HAD THE PLEASURE TO WORK WITH THE HARLEY-DAVIDSON MOTOR CO. ON THE NEW XR1000, TO INCREASE THE PERFORMANCE IN SUCH A MANNER AS TO KEEP THE GOOD LOW END SMOOTHNESS AND YET MAKE A MORE COMPETITIVE HORSEPOWER OVER THE ENTIRE RANGE. BRANCH FLOWMETRICS HAS BEEN ASSOCIATED WITH HARLEY-DAVIDSON AND THE XR750 FROM THE INTRODUCTION OF THIS RACING MOTOR 13 YEARS AGO AND SINCE THAT TIME HAVE PORTED AND POLISHED ALL OF THE HEADS. THE COMPANY WAS SOLD AND INSTALLED. WHEN THE DECISION CAME TO BUILD THE XR1000, WE WERE CONTRACTED TO MACHINE, PORT AND POLISH, FLOW TEST AND ASSEMBLE 4500 HEADS FOR THIS ENGINE IN 1983. THE HEADS ON THE XR1000 STREET ENGINE ARE THE SAME HEADS THAT ARE USED ON THE XR750 RACING ENGINES EXCEPT THAT THEY HAVE A .040" LARGER INTAKE AND EXHAUST VALVE AND A SLIGHTLY DIFFERENT EXHAUST PIPE MOUNT.

THE FOLLOWING INFORMATION, TEST RESULTS AND PARTS THAT ARE LISTED IN THIS BOOKLET SHOULD GIVE THE DEALER OR CUSTOMER AN IDEA OF WHAT GAINS AND LOSSES CAN BE EXPECTED FROM CHANGES MADE TO THIS ENGINE.

ALL OF THE TEST IN THIS REPORT WERE RUN HERE AT BRANCH FLOWMETRICS ON OUR DYNO, WHICH WE FEEL IS THE FINEST ONE IN THE NATION. ALL TESTS ARE VERY CAREFULLY CONTROLLED, WITH NUMEROUS BACK TO BACK RUNS TO BE SURE THAT THE NUMBERS ARE CORRECT AND REPEATABLE RUN AFTER RUN. IN MOST ALL DYNO'S THERE CAN BE A GREAT DEAL OF OPERATOR ERROR AND THREE DIFFERENT OPERATORS CAN RUN THE SAME ENGINE ON THE SAME DYNO AND GET THREE ENTIRELY DIFFERENT HORSEPOWER READINGS. OUR DYNO IS COMPLETELY COMPUTERIZED AND WE ONLY TELL THE COMPUTER WHERE WE WANT TO START THE TEST AND WHERE WE WANT IT TO STOP. THE TEST, PRESS A BUTTON AND IT COMPLETELY RUNS, RECORDS AND SHUTS ITSELF OFF. IT IS RECORDING 37 FUNCTIONS AT A TIME AND READING EACH ONE OF THEM 100 TIMES A SECOND. AT 5000 RPM FOR EXAMPLE, TORQUE, HORSEPOWER, FUEL, TEMPERATURE, ETC.ETC., ARE ALL RECORDED AT EXACTLY 5000 RPM AND NOT ONE ABOVE OR BELOW.

TO RUN A SERIES OF TESTS OF THIS TYPE WE NEED A GREAT DEAL OF AIR TO BOTH COOL THE ENGINE AND TO FEED IT THE NECESSARY FRESH AIR FOR PROPER COMBUSTION. WE USE A TOTAL OF 40 HP OF FANS TO DO THIS JOB AND THIS ALLOWS US TO KEEP THE ENGINE COOL AND STABLE, ASSURING THAT EACH TEST IS RUN UNDER THE SAME CONDITIONS AND TEMPERATURE. KEEPING THE ENGINE AND OIL TEMP AT A REASONABLE LEVEL IS A MUST IF THE ENGINE IS TO SURVIVE FOR ANY LENGTH OF TIME ON THE DYNO. WE RAN OVER A 160 SERIES OF TESTS, WITH SOME SERIES WE TOOK AS MANY AS 40 DIFFERENT RPM RECORDINGS OF SUCH ITEMS AS MECHANICAL EFFICIENCY, FRICTIONAL HP, FUEL PER HP, MIXTURE PER CYLINDER, ETC.ETC.

THE MOTORCYCLE SUPPLIED WAS A BRAND NEW XR1000, WHICH WAS DRIVEN 275 MILES BEFORE GOING ON THE DYNO. EVERYTHING WAS CHECKED OVER TO BE ASSURED THAT THE TIMING, TAPPET CLEARANCE, COMPRESSION, ETC. WERE WHERE THEY SHOULD BE AS PER FACTORY SPEC'S. THE TABLE AND CHARTS ON THE FOLLOWING PAGE IS AN AVERAGE OF ABOUT 15 RUNS AT EACH RPM.

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STOCK HARLEY-DAVIDSON XR1000 WITH STAND-
ARD CAMS, PIPES, CARBURETOR, JETTING &
TIMING. 275 MILES ON ENGINE SINCE NEW.

	HORSE POWER	TORQUE	MECH. EFF.
	1	2	3
1 2100 RPM	17.9	44.4	83.5
2 2500 RPM	25.4	52.8	84.7
3 3000 RPM	32.1	57.3	84.6
4 3500 RPM	40.3	60.5	83.5
5 4000 RPM	45.2	59.4	81.7
6 4500 RPM	52.8	61.6	80.7
7 5000 RPM	56.9	59.2	78.0
8 5500 RPM	57.2	54.2	74.6
9 6000 RPM	58.2	50.5	71.0
10 6500 RPM	55.6	46.3	68.1
11 6750 RPM	52.7	41.0	65.2

OF TORQUE, WHICH MEANS THAT WE ARE ONLY FILLING THE CYLINDER ABOUT 67% AND IT IS FALLING OFF RAPIDLY. AS WE CONTINUE WITH THE TESTING, ITEMS THAT EFFECT CYLINDER FILL OR TORQUE, SHOW UP READILY.

ONE THING THAT YOU MIGHT CONSIDER AT THIS TIME AND THAT IS THAT GAS AND AIR GENERATE ENERGY AND NOT METAL. WHEN WE BURN GAS & AIR IN A JET WE CALL IT THRUST, IN AN ENGINE WE CALL IT TORQUE, IN A STOVE HEAT, BUT WHATEVER, ITS ENERGY. AT THE TIME THAT AN ENGINE IS MAKING TORQUE OR HORSEPOWER, THE VALVES ARE CLOSED, THE RINGS HAVE THE CYLINDER SEALED AND THE ENGINE ONLY KNOWS HOW MUCH GAS & AIR ARE IN THE COMBUSTION CHAMBER AND HOW MUCH OF IT IS GOING TO BE BURNED IS A FEW THOUSANDS OF A SECOND. AT THIS POINT THE ENGINE KNOWS NOTHING ABOUT 2 VALVE, 4 VALVE, FUEL INJECTION OVERHEAD CAM, ETC., ONLY HOW MUCH OF THE GAS-AIR MIXTURE IS GOING TO BE BURNED AND HOW HARD IS IT GOING TO PUSH THE PISTON DOWN THE CYLINDER.

OVER THE YEARS OF WORKING WITH HUNDREDS OF ENGINES, BOTH ON THE FLOW BENCH AND THE DYNO, WE HAVE BEEN ABLE TO ARRIVE AT FORMULA'S THAT GIVE US A VERY GOOD IDEA OF HOW MUCH POWER AN ENGINE WILL MAKE BY RECORDING THE AMOUNT OF AIR THAT IT IS CAPABLE OF BREATHING AND ABOUT HOW MUCH OF IT WILL BE BURNED. FOR EXAMPLE ON THIS ENGINE WHEN WE LOOK AT THE STOCK FLOW FIGURES AND FROM WHAT WE KNOW OF THE CHAMBER SHAPE, WE FEEL THAT AT 6000 RPM THE ENGINE SHOULD FILL ABOUT 90% AND THAT POSSIBLY WE SHOULD BURN ABOUT 90% OF THE MIXTURE. THIS GIVES US 49.4 FOOT/LBS. TORQUE AND 56.44 HP IN STOCK FORM. IF YOU LOOK BACK AT THE SPEC'S ON PAGE 2, YOU CAN SEE THAT THE ENGINE ACTUALLY PRODUCED 50.5 FOOT/LBS. TORQUE AND 58.2 HP SO FROM A FORMULA AND WHAT WE KNOW OF AN ENGINE WE CAN GET VERY CLOSE TO THE HORSEPOWER BEFORE WE RUN THE ENGINE ON THE DYNO. WITH VARIOUS PIPES, CAMS AND PISTONS, WE ARE ABLE TO ADD OR SUBTRACT A FEW PERCENTAGE POINTS FOR WHAT WE FEEL WILL HAPPEN.

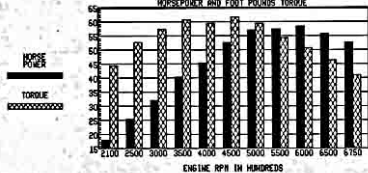
ALSO WE HAVE FORMULA'S FOR PORT VELOCITY'S AND CARBURETOR VELOCITY'S THAT LET US DETERMINE HOW MUCH CYLINDER FILL WE GET HIGH RPM'S AND WHETHER THE CARBURETOR WILL WORK PROPERLY AT CERTAIN SPEEDS. THE HIGHER THE RPM'S THE LESS AMOUNT OF TIME WE HAVE TO FILL THE CYLINDER AND THEREFORE THE HIGHER VELOCITY WE NEED IN THE PORTS WHEN THE VALVES ARE OPEN. STOCK PORT VELOCITY ON THIS ENGINE IS 169 FEET/SEC. AND CARBURETOR VELOCITY IS 163 FT/SEC. MAXIMUM, SO WE DO NOT WISH TO GET BELOW THESE NUMBERS DURING OUR TESTS. WE HAVE FOUND THAT LOWEST CARBURETOR VELOCITY THAT WILL WORK VERY WELL, IS 140 FEET/SEC. THE STOCK CARBURETOR, WHICH IS 36 MM, HAS A VELOCITY OF 163 FT/SEC, BUT IF A LARGER CARBURETOR LIKE A 39.5 MM UNIT IS INSTALLED ON THE STOCK ENGINE, THE VELOCITY IS DOWN TO 136 FT/SEC. AT THIS SPEED THE AIR THROUGH THE VENTURI OF THE CARBURETOR IS SLOW ENOUGH SO THAT IT DOES NOT PULL THE FUEL OUT OF THE FLOAT BOWL PROPERLY, THEREFORE POOR CARBURATION AND FUEL-AIR MIXTURE. LATER AS THE ENGINE WAS MODIFIED AND THE HEADS WERE MADE TO FLOW ALOT MORE AIR, THE CARBURETOR VELOCITY ON THE 39.5 MM CARBURETORS WAS INCREASED TO 164 FT/SEC. WHICH MAKES THEM RESPOND JUST AS WELL AS STOCK.

1. THE FIRST CHANGE WAS TO REMOVE THE AIR CLEANERS TO SEE IF THEY WERE ANY RESTRICTION TO THE BREATHING, BUT THIS SHOWED NO INCREASE IN POWER AT ALL, SO FOR MOST OF THE BALANCE OF THE TEST WE RAN THE AIR CLEANERS IN PLACE.

2. NEXT WE TRIED MOVING THE TIMING AROUND FROM 28 TO A HIGH OF 35 DEGREES, BUT THE ENGINE LIKED STOCK 30 DEGREES THE BEST. ALSO WE TRIED TO JET THE CARBURETOR UP AND DOWN ONE MAIN JET AND THIS DID NOT GAIN POWER EITHER.

HARLEY-DAVIDSON XR1000 STOCK ENGINE

HORSEPOWER AND FOOT POUNDS TORQUE



IT CAN BE SEEN FROM THE ABOVE CHARTS AND GRAPH THAT WE REACH PEAK HORSEPOWER BETWEEN 5800 AND 6000 RPM AND PEAK TORQUE AT ABOUT 4500 RPM. THIS IS ABOUT THE SAME RPM LEVELS THAT THE FACTORY GETS THEIR NUMBERS BUT WE DIFFER CONSIDERABLY IN THE AMOUNT OF HP AND TORQUE. IN THEIR DYNO TESTING, THEY TAKE THEIR POWER READINGS DIRECTLY OFF THE MOTOR SPROCKET SHAFT, WHERE AS WE TAKE OURS AT THE REAR WHEEL SPROCKET. THEY DO NOT TURN THE TRANSMISSION, FRONT CHAIN, CLUTCH, COUNTER SHAFT, REAR CHAIN AND REAR SPROCKET. SPINNING THESE PARTS AND PIECES REALLY EATS UP POWER, AS THE FACTORY STATED HORSEPOWER IS 70 HP AND ON OUR DYNO WE ONLY REACHED 58.2 HP. YOU CAN SEE THAT THAT IS ABOUT A 15 TO 16% LOSE IN THE DRIVE SYSTEM. HERE AT FLOWMETRICS WE ARE ACTUALLY READING REAR WHEEL HORSEPOWER AND WE CONSIDER IT A MUCH MORE REALISTIC NUMBER TO WORK WITH.

OUR HIGHEST HP WAS 58.2 AT 6000 RPM AND AT THIS POINT THE MECHANICAL EFFICIENCY WAS 71%. PEAK TORQUE IS 61.6 FOOT/LBS. AT 4500 RPM AND THE % IS 80.7%. PEAK TORQUE IS THE POINT WHERE THE CYLINDER IS GETTING IT'S HIGHEST CYLINDER FILL AND IN THIS CASE THAT IS ABOUT 100%. AS THE ENGINES TURNS UP TIGHTER, WE HAVE LESS TIME TO FILL THE CYLINDER BECAUSE THE VALVE IS NOT OPEN QUITE AS LONG, WE ARE MOVING SO MUCH MORE AIR THAT THE PORTS, CARBURETORS, MANIFOLDS, ETC., BECOME A RESTRICTION. ALSO WE LESS TIME TO BURN THE MIXTURE IN THE CYLINDER. AT 6750 RPM WE ARE DOWN TO 41 FOOT/LBS.

3. THE NEXT CHANGES WERE TO INSTALL A NUMBER OF AFTER MARKET EXHAUST SYSTEMS, MOST OF WHICH WERE ALL OUT RACING PIPES AS USED ON THE XR750 ENGINES, PLUS THE FACTORY AFTER MARKET EXHAUST SYSTEM THAT THEY HAVE FOR THIS ENGINE. THE FACTORY UNIT IS TWO MAGAPHONES THAT ATTACH TO THE STOCK FRONT HEADER PIPES AND REPLACE THE MUFFLERS ONLY. ANOTHER SYSTEM THAT WAS TESTED WAS TO REMOVE THE STOCK MUFFLERS, CUT THEM OFF AT THE REVERSE CONE AND THEN DRIVE OUT ALL OF THE MUFFLING INSIDE. WE THEN MADE UP SOME ADAPTORS TO ATTACH THE SUPERTRAP DISC UNIT TO THE REAR OF THE MUFFLER. WITH THIS SETUP WE COULD ADD OR SUBTRACT DISCO ALTER THE PIPES PERFORMANCE AND NOISE LEVEL. THIS WAS BY FAR THE QUIETEST PIPE OTHER THAN STOCK. THIS UNIT IS NOW MADE BY SUPERTRAP AND IS CALLED THIER XR SUPER TIPS.

WITH THE RACING TYPE EXHAUST SYSTEM WE HAD A VERY HARD TIME LOADING THE DYNO BELOW 3500 RPM AND WITH SOME OF THE PIPES WE COULD NOT GET BELOW 4000 RPM VERY WELL. THIS IS DUE TO THE PULSES IN THE PIPE WHICH UPSET THE CARBURETION AND COMBUSTION CHAMBER MIXTURE. TO GET THINGS TO REALLY WORK WE NEED A CERTAIN AMOUNT OF BACK PRESSURE AND VOLUMM IN THE PIPE. WITH THE SUPERTRAPS WE WERE ABLE TO LOAD RIGHT DOWN TO 2100 RPM JUST AS WELL AS THE STOCK MUFFLERS.

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STOCK XR1000 WITH SUPERTRAP SUPERTIPS
 INSTALLED ON THE GUTTED STOCK MUFFLERS
 COLUMN 4 IS THE GAIN OR LOSS OVER STOCK

	HORSE- POWER	TORQUE	% MECH. EFF.	INCREASE OR LOSS
	1	2	3	4
1 2500 RPM	25.2	52.9	84.5	-0.2
2 3000 RPM	32.4	56.6	83.9	0.3
3 3500 RPM	38.8	58.1	82.6	-1.5
4 4000 RPM	45.6	59.8	81.6	0.4
5 4500 RPM	46.9	65.6	81.4	4.1
6 5000 RPM	59.4	61.8	78.8	2.5
7 5500 RPM	60.9	57.6	75.8	3.7
8 6000 RPM	59.1	51.3	71.4	0.9
9 6500 RPM	58.5	46.9	67.3	2.9
10 6750 RPM	57.0	44.4	65.5	4.3

IT CAN BE SEEN THAT THE PIPES MADE VERY LITTLE IMPROVEMENT IN THE POWER OF THE ENGINE. SEVERAL OF THE RACING PIPES GAVE IT A HP OR TWO IN THE 5000 TO 6000 RPM RANGE BUT BEGAN TO DROP BACK TO STOCK HP IN THE UPPER RPM RANGES. PEAK TORQUE STAYED AT THE 4500 RPM LEVEL AND WE ARE NOW FILLING THE CYLINDER SLIGHTLY BETTER IN THE HIGHER RPM'S DUE TO A LITTLE LESS BACK PRESSURE IN THE STOCK MUFFLERS.

CARBURETORS

OUR NEXT CHANGES WERE IN THE CARBURATION DEPARTMENT, AS WE FEEL TO REALLY GET THIS ENGINE TO PUT OUT THE HORSEPOWER THAT THE CARBURETORS ARE A RESTRICTION TO THE SYSTEM, ESPECIALLY WHEN WE START MOVING A LOT OF AIR THROUGH THE ENGINE. WE HAD QUITE A FEW CARBS TO PICK FROM, BUT FROM PAST EXPERIENCE ON THE XR750, FELT THAT TWO UNITS THAT WE HAD MADE UP FOR THIS ENGINE WOULD DO THE BEST JOB. BOTH PROVED TO DO A NICE JOB.

THE FIRST WAS A 39.5 MM FLAT SLIDE MIKUNI THAT WE HAD MADE ESPECIALLY FOR THE XR750 ENGINES. THIS IS A 38 MM CARB BORED TO 39.5 MM, TAPERED AND HAND BLENDED IN THE ENTRY AND BORED FOR THE VELOCITY STACK, WHICH IS INSTALLED. WE COMPLETELY MODIFY THIS CARBURETOR FOR THIS ENGINE AND OUR SPECIAL TAPERED INTAKE MANIFOLDS. THESE CARBS USE THE STOCK THROTTLE CABLE WITHOUT ANY CHANGES.

THE SECOND SET OF CARBURETORS TO BE TESTED WERE SOME SPECIAL 41.5 MM LECTRON'S, WHICH ARE USED ON OUR SAME TAPERED MANIFOLDS. LECTRON MAKES THESE UNITS UP FOR US FOR THIS ENGINE AND THEY ARE ALSO BORE TO EXCEPT OUR SPECIAL VELOCITY STACKS. WE DID HAVE A PROBLE WITH THIS CARBURETOR THO AT THE VERY LOW RPM RANGE AND EVEN AFTER CHANGING A NUMBER OF CARBS, POWER JETS, NON-POWER JETS AND ALL KINDS OF NEEDLES, WE COULD NEVER GET THEM TO RUN VERY WELL DOWN LOW. ABOVE 4000 RPM THEY DID A NICE JOB AND THE ENGINE PUT OUT GOOD HORSEPOWER WITH THEM. THEY PUT OUT ABOUT 2 HP BETTER THAN THE 39.5 CARBS WITH THE ENGINE IN STOCK TYPE FORM.

WHEN WE ARE TESTING ON THE DYNO WE METER EACH CARBURETOR TO PEAK POWER, WHICH IN THE CASE OF THE XR1000 IS A SUPPLY OF GAS AT A GIVEN RATE PER HORSEPOWER. THIS IS WHAT WE CALL BRAKE SPECIFIC FUEL CONSUMPTION. ON THE XR750 AND THE XR1000 WE HAVE FOUND THIS TO BE .52 LBS/HP. IN OTHER WORDS A LITTLE OVER 1/2 POUND OF FUEL PER HORSEPOWER PER HOUR. FUEL IS MEASURED ON THE DYNO IN POUNDS RATHER THAN GALLONS AND IT IS APPROXIMATELY 6 POUNDS PER GALLON. IF WE ARE A LITTLE RICH, THE COMPUTER WILL READ .56, .61, .63 ETC. AND IF WE ARE LEAN IT READS DOWN IN THE .43, .47, .49 ETC. THE HARLEY FACTORY USE THIS SAME NUMBER ALSO IN METERING FUEL.

THE CHARTS BELOW ARE FOR THE LECTRON 41.5 MM CARBS AND THE SUPERTRAPS

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STOCK ENGINE WITH SUPERTRAP PIPES AND
 41.5 MM LECTRON CARBURETORS. BRANCH
 TAPERED INTAKE MANIFOLDS.

	HORSE- POWER	TORQUE	% MECH. EFF.	INCREASE OR LOSS
	1	2	3	4
1 2500 RPM	24.8	50.4	83.7	-0.6
2 3000 RPM	31.8	56.0	83.9	-0.3
3 3500 RPM	37.5	56.2	82.4	-2.8
4 4000 RPM	45.5	59.7	81.8	0.3
5 4500 RPM	51.2	59.7	80.1	-1.6
6 5000 RPM	55.1	57.9	77.8	-1.8
7 5500 RPM	64.4	61.5	77.2	7.2
8 6000 RPM	66.1	57.9	74.1	7.9
9 6500 RPM	65.8	53.2	70.3	10.2
10 6750 RPM	63.2	49.3	67.9	10.5

THE LARGE BORE OF THE 41.5 MM CARBS BEGIN TO SHOW UP DOWN AT THE LOWER RPM'S AND SINCE THE VELOCITY IS FAIRLY SLOW DOWN THERE, THE VENTURI DOES NOT GET A GOOD SIGNAL, THEREFORE WE HAVE POOR FUEL METERING AT ALMOST ANYTHING BELOW 5000 RPM. WHEN THE ENGINE REALLY NEEDS A BIG BREATH, AT THE HIGHER RPM'S, THESE CARBS DO SUPPLY THE SYSTEM. IN COLUMN #4 ON PAGE 5, WE SHOW THE INCREASES OR LOSSES OVER STOCK WITH THIS SETUP AND YOU CAN SEE THE MINUS POWER BELOW 5000 RPM. ALL COMBINATIONS OF PIPES AND CARBS WERE TRIED AND THIS WAS THE BEST POWER OVERALL.

WE CAN SEE THAT THE ENGINE IS UNDER CARBURATED WITH THE 36 MM CARBS, EVEN IN STOCK FORM. FOR THE ENGINE TO CONSUME MORE AIR AND THEREFORE MORE HORSEPOWER, IT JUST NEEDS A BIGGER CARBURATOR. AS THE TESTING CONTINUES AND THE POWER AND BREATHING INCREASES, WE GAIN ENOUGH AIR VELOCITY FOR THESE CARBS TO START WORKING WELL DOWN AT THE BOTTOM END.

← CAMS →

WITH MOST OF THE EXTERNAL PARTS AND PIECES CHANGED, WE THEN REMOVED THE CAM COVER AND INSTALLED THE FACTORY "E" CAMS. THIS SET OF CAMS HAS A LIFT OF .450" AND CONSIDERABLY MORE TIMING. AT THIS POINT WE WOULD LIKED TO HAVE SEEN A CAM WITH ABOUT .500" LIFT BUT TO GET INTO THE ENGINE YOU HAVE TO GRIND AWAY PART OF THE MAIN BEARING RACE IN THE RIGHT HAND CASE. AS THE TESTING CONTINUED, WE FOUND THAT WE DID NOT NEED THE ADDITIONAL LIFT, AS OUR CYLINDER FILL GREATLY INCREASED. IN THE CHART BELOW YOU CAN SEE THAT AS YOU WIDEN THE CAM TIMING, THAT IT REALLY HAS AN EFFECT ON THE LOWER RPM LEVELS. THESE TESTS HAVE THE "E" CAMS, 41.5 MM LECTRONS AND THE SUPERTRAP PIPES.

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TEST WITH H-D E CAMS, SUPERTRAP PIPES
WITH 15 DISC, 41.5 LECTRON CARBS ON
BRANCH TAPERED MANIFOLDS.

	HORSE- POWER	TORQUE	% MECH. EFF.	INCREASE OR LOSS	STOCK HP
	1	2	3	4	5
1 2500 RPM	20.9	43.1	81.8	-4.5	25.4
2 3000 RPM	31.2	54.3	83.6	-0.9	32.1
3 3500 RPM	35.6	52.6	81.3	-4.7	40.3
4 4000 RPM	39.6	51.2	79.2	-5.6	45.2
5 4500 RPM	50.9	58.7	79.7	-1.9	52.8
6 5000 RPM	54.5	56.7	77.4	-2.4	56.9
7 5500 RPM	64.1	61.2	77.2	6.9	57.2
8 6000 RPM	65.9	67.3	73.7	7.7	58.2
9 6500 RPM	67.3	53.9	70.4	11.7	55.6
10 6750 RPM	67.1	52.4	68.0	14.4	52.7



AS YOU STUDY THE CHARTS ON PAGE 6, YOU CAN SEE THAT THE CAMS REALLY KILLED THE LOW END POWER AND THIS CAM ISN'T VERY WILD COMPARED TO MOST OF THE AFTER MARKET CAMS FOR THIS ENGINE. MORE CAM TIMING WOULD REALLY HURT DOWN ON THE BOTTOM. WE ARE AT A LOSS UP TO 5500 RPM AND THEN THINGS REALLY BEGIN TO HAPPEN. NOTICE THAT PEAK TORQUE IS NOW UP TO 5500 RPM. DURING THESE TEST WE TRIED A NUMBER OF OTHER PIPES AND CARBURETORS AND THIS SETUP GAVE THE BEST POWER. WITH ALL OF THE RACING PIPES WE COULD NOT LOAD THE DYNO BELOW 4000 RPM AND WITH SOME, WE COULD NOT LOAD BELOW 4500 RPM. WHEN YOU RIDE A MOTORCYCLE WITH THIS TYPE OF PIPE AND CAM COMBINATION, YOU FEEL A BIG KICK WHEN THE ENGINE RPM ENTERS THE CAM RANGE. AS YOU SEE A 10 HP GAIN IN 500 RPM, BETWEEN 5000 AND 5500 RPM. THIS IS A FALSE FEELING THO BECAUSE AT THE LOWER RPM WE HAVE VERY LITTLE HORSEPOWER AND THEN WE GET A BIG RUSH OF IT AT ONE TIME.

AS WE GO OVER THE CHARTS AND GRAPHS THAT THE DYNO IS PRINTING OUT FOR US, WE CAN SEE THAT THE ENGINE IS REALLY STARVING FOR AIR AND FROM OUR FORMULA'S WE KNOW THAT THIS IS A FACT. MOST EVERYTHING EXTERNAL HAS BEEN DONE TO THE ENGINE AND IT IS NOW TIME TO PORT THE HEADS FOR MORE AIR.

THE PHOTO BELOW SHOWS PART OF THE DYNO CONTROL ROOM WITH ONE OF THE TWO TV MONITORS. THERE ARE SEVERAL VERY HEAVY GLASS PLATES BETWEEN THE CONTROL ROOM AND THE DYNO ROOM.



HEAD FLOWING

WE REMOVED THE HEADS FROM THE ENGINE AND PUT THEM ON THE FLOW BENCH TO TEST THEIR FLOW RATE, USING THE STOCK MANIFOLD, STOCK CARBURETOR AND AIR CLEANER. THIS SET OF HEADS FLOWED 110 & 111 CFM AT .500" LIFT, WHICH IS THE NUMBER THAT WE WERE ORIGINALLY DOING SHOOTING FOR ON THE PRODUCTION HEADS. THE VALVE SIZES ARE 45 MM ON THE INTAKE AND 38 MM ON THE EXHAUST SIDE. THIS IS ONE MILLIMETER LARGER THAN THE XR750 USES AND IS ABOUT AS LARGE AS YOU CAN GET INTO THE CHAMBER WITHOUT INTERFERENCE BETWEEN THE TWO AT VALVE OVERLAP. THE VALVES ARE THE BEST RACING VALVES ON THE MARKET AND DO AN EXCELLENT JOB. THE GUIDES ARE FROM THE XR750 AND ARE MADE OF AMPCO 15 & 18. THE SPRINGS ARE THE RACING XR750 SPRINGS THAT WE ORIGINALLY SOLD TO HARLEY-DAVIDSON AND THEY USE THE TITANIUM UPPER SPRING COLLARS AND HEAVY DUTY KEEPERS. THERE IS NO NEED TO CHANGE ANY OF THESE ITEMS, AS THEY ARE THE BEST YOU CAN BUY.

USING OUR FORMULA'S FROM THE FLOW BENCH FOR THIS SIZE CYLINDER, 110 CFM IS GOOD FOR ABOUT 5800 RPM PEAK HORSEPOWER AND THIS IS JUST ABOUT DEAD ON WHERE THE ENGINE WAS PEAKING. TO GET THE PEAK UP TO 6750 RPM, WE NEEDED TO GET THE HEADS TO FLOW 131 CFM THROUGH THE COMPLETE SYSTEM AND IN DOING SO WE HAD TO KEEP THE VELOCITY ABOVE 160 FEET/SEC. THE GUIDES WERE REMOVED AND THE INTAKE PORTS WERE COMPLETELY REMORKED TO OUR LATEST PORT PATTERN FOR MAXIUM FLOW WITH THE 45 MM INTAKE VALVES. THE PORTS WERE ENLARGED AT THE MANIFOLD SURFACE TO MATCH OUR NEW TAPERED MANIFOLDS, SINCE THEY HAVE AN INSIDE DIAMETER OF 1 1/2".

WHEN THE INTAKE PORT WAS FINISHED ON BOTH HEADS, THE FLOW FIGURES WERE 130 CFM ON ONE HEAD AND 131 CFM ON THE OTHER AT .500". SO WE WERE RIGHT ON WHAT WE WERE LOOKING FOR. NORMALLY WE LIKE TO SEE ABOUT 90 PERCENT EXHAUST FLOW TO INTAKE FLOW FOR EVERYDAY TYPE STREET ENGINES AND 95% FOR HIGH PERFORMANCE ENGINES. NOW THAT THE INTAKES WERE FINALIZED WE COULD START ON THE EXHAUST PORT AND BRING THEM UP TO THIS PERCENTAGE. WHEN THE VALVE SEATS WERE GROUND IN THE HEAD, WE SEATED THEM ABOUT .020" DEEPER IN THE HEAD, SO THAT THERE WOULD BE LESS CHANCE OF VALVE TO VALVE INTERFERENCE AT VALVE OVERLAP.

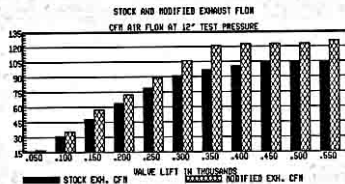
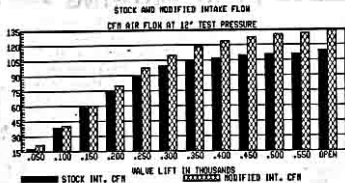
THE CHARTS AND GRAPHS BELOW AND ON THE NEXT PAGE SHOWS THE STOCK INTAKE FLOW AND THE MODIFIED INTAKE FLOW AFTER THE HEADS WERE REWORKED.

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STOCK XR1000 FLOW FIGURES VS. MODIFIED HEADS WITH BRANCH TAPERED MANIFOLDS AND 39.5 MM MIKUNI CARBURETORS & AIRCLEANERS

	STOCK INT. CFM	MODIFIED INT. CFM	STOCK EXH. CFM	MODIFIED EXH. CFM
	1	2	3	4
1 .050 LIFT	17.6	22.0	15.6	17.1
2 .100 LIFT	38.0	40.5	30.6	35.9
3 .150 LIFT	58.5	60.1	47.4	57.0
4 .200 LIFT	74.9	79.8	64.2	72.3
5 .250 LIFT	90.2	97.2	78.6	89.4
6 .300 LIFT	99.3	109.9	90.8	106.0
7 .350 LIFT	104.4	118.0	96.6	120.8
8 .400 LIFT	107.3	123.7	100.6	122.5
9 .450 LIFT	109.5	127.2	104.1	122.5
10 .500 LIFT	110.7	130.1	105.2	122.5
11 .550 LIFT	110.7	131.3	105.2	125.3
12 OPEN PORT	114.1	133.6	0.0	0.0



AS THE FLOW CHARTS SHOW, WE ARE NOW FLOWING ABOUT AS MUCH AIR AT .300" LIFT AS WE WERE AT .550" LIFT IN THE STOCK FORM. ALSO OUR INTAKE PORT VELOCITY IS NOW 178 FEET/SEC. WHICH IS VERY GOOD FOR A PEAK RPM OF 6750. ONE REASON THAT WE HAVE HELD THE RPM LEVEL AT 6750 RPM IS THAT WE ARE APPROACHING WHAT WE CONSIDER PEAK PISTON SPEED IN FEET/SEC. FOR ANY ENGINE LIFE. OUR GOAL WAS TO DEVELOPE AS MUCH POWER AS POSSIBLE WITHOUT BUZZING THE ENGINE SO TIGHT THAT WE START TO LOOSE THE RODS. AT 6750 RPM WE HAVE A PISTON SPEED OF ABOUT 4300 FEET/SEC. WHICH IS ABOUT THE SAME PISTON SPEED AS THE XR750 AT 9000 RPM. WE RUN A GREAT NUMBER OF XR750'S ON THE DYNO AND AT 9000 RPM THEY ARE IN DEEP TROUBLE FROM A STANDPOINT OF STAYING TOGETHER. KEEP THE RPM'S DOWN UNLESS YOU ARE BUILDING AN ALL OUT DRAG JOB AND CAN AFFORD TO TAKE IT APART EVERY WEEK.

Pull Engine

WHILE WE HAD THE HEADS OFF WE DECIDED TO PULL THE ENGINE OUT OF THE FRAME AND CHECK THE LOWER END, AS IT HAD OVER A HUNDRED TESTS RUN ON IT ALREADY AND IT WAS BETTER TO BS SAFE THAN SORRY. THE RIGHT HAND CASE WAS PULLED AND EVERYTHING LOOKED FINE, NO WEAR OR PROBLEMS. WITH THE FLYWHEELS AS CLOSE TO THE WET OIL SUMP IN THE LOWER END OF THE CASES, THERE WAS A STRONG POSSIBLY THAT THE WIND EFFECT OF THE FLYWHEELS WOULD SUCK THE OIL BACK OUT OF THE SUMP AND THROW IT BACK UP INTO THE FLYWHEELS, CREATING A LOT OF EXTRA DRAG. WE MADE UP A SUMP PLATE TO COVER UP MOST OF THE SUMP OPENING AND ATTACHED IT WITH THREE SMALL SCREWS. THE RIGHT CASE WAS REINSTALLED. TO REDUCE THE VOLUME OF OIL TO THE LOWER END, WE MADE UP A SMALL RESTRICTOR PLUG TO INSTALL INTO THE END OF THE GEAR SHAFT. BASICALLY THIS HOLE IS 3/16" OR .187" AND THE RESTRICTOR PLUG WAS REDUCED TO .090". THIS DOES NOT REDUCE PRESSURE BUT ONLY VOLUME AND OVER THE YEARS WE HAVE NEVER SEEN ANY ILL EFFECT FROM IT.

WITH THE CYLINDERS OFF, WE DEGLAZED THEM AND INSTALLED A NEW SET OF FACTORY HIGH COMPRESSION PISTONS WHICH THEY HAD SUPPLIED FOR THIS ENGINE. WE LOOKED THE RINGS OVER AND THEY SHOWED ALMOST NO WEAR AND THE END GAP WAS ABOUT .012". SO WE DECIDED TO STICK WITH THEM. THE FACTORY "E" CAMS WERE INSTALLED AND THE NEW HEADS WERE BOLTED ON THE ENGINE. THE ENGINE WAS INSTALLED BACK IN THE CHASSIS, THE SUPERTRAP PIPES HOOKED UP, THE 41.3 MM LECTRONS BOLTED ON AND WE WERE READY TO RUN THE ENGINE IN FOR ABOUT 30 MINUTES AND CONTINUE THE TEST. PLUGS WERE N&YC CHAMPION AND THE GAP WAS SET AT .022". TAPPET CLEARANCE WAS SET AT .006" COLD. AFTER THE ENGINE WAS WARMED UP, TIMING WAS SET AT 30 DEGREES. BEFORE THE FIRST POWER RUNS WE MADE THE CRANKING COMPRESSION WAS CHECKED AND WE HAD 199# ON EACH CYLINDER.

Dyno Runs

OUR FIRST RUN WAS A VERY SHORT CHECK TO BE SURE THAT EVERYTHING WAS ADJUSTED PROPERLY AND THAT THERE WAS NO VALVE TO PISTON CLEARANCE PROBLEMS AND THAT THE MIXTURE WAS NOT TO LEAN. WE WERE RUNNING EXHAUST TEMPERATURE PROBES SO THAT WE COULD SEE TROUBLE VERY QUICKLY. THE ENGINE WAS CHECKED VERY CLOSELY TO BE SURE THAT WE WERE NOT GETTING INTO DETONATION FROM THE HIGH COMPRESSION BUT THROUGH OUT THE ENTIRE TESTING TO THE FINAL RUNS, WE NEVER EXPERIENCED IT. THE CHARTS BELOW ARE OUR FIRST SHORT RUN.

RPM	HORSEPOWER	TORQUE	% MECH. EFF.
5500	81.9	78.2	80.4
6000	85.9	75.2	79.1
6500	89.2	72.1	75.4

THIS RUN LOOKED VERY GOOD AND WE WERE EXTREMELY HAPPY WITH THE RESULTS FOR NO ADJUSTMENTS. AT 5500 RPM WE WERE UP 24.7 HP, AT 6000 RPM THE GAIN WAS 27.7 HP AND AT 6500 RPM WE WERE UP A WHOPPING 33.6 HP. AT THIS POINT WE COULD START ADJUSTING FUEL MIXTURE, TIMING, INTAKE LENGTH, PLUG GAP AND THE LIKE. AFTER MANY MANY RUNS AND TESTS, WE ARRIVED AT OUR PEAK POWER, WHICH IS IN THE GRAPHS AND CHARTS ON PAGE 12.

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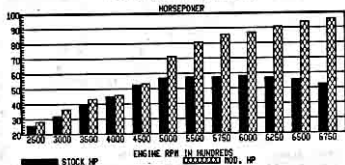
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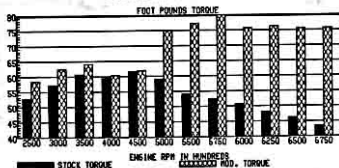
STOCK AND FINAL MODIFIED HORSEPOWER AND TORQUE. MODIFIED IS WITH 41.5 MM ELECTRON SUPERTRAPS, MODIFIED HEADS, E CAMS.

		STOCK HP	MOD. HP	STOCK TORQUE	MOD. TORQUE
		1	2	3	4
1	2500 RPM	25.4	28.1	52.8	58.3
2	3000 RPM	32.1	36.3	57.3	62.5
3	3500 RPM	40.3	43.1	60.5	64.0
4	4000 RPM	45.2	45.9	59.4	60.3
5	4500 RPM	52.8	53.0	61.6	61.9
6	5000 RPM	56.9	71.3	59.2	74.9
7	5500 RPM	57.2	80.7	54.2	77.1
8	5750 RPM	57.7	85.9	52.4	79.9
9	6000 RPM	58.2	87.1	50.5	75.6
10	6250 RPM	56.8	90.8	48.2	76.3
11	6500 RPM	55.6	93.6	46.3	75.6
12	6750 RPM	52.5	95.7	43.4	75.5

STOCK & FINAL MODIFIED HORSEPOWER



STOCK AND FINAL MODIFIED TORQUE



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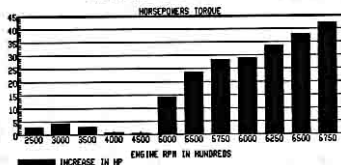
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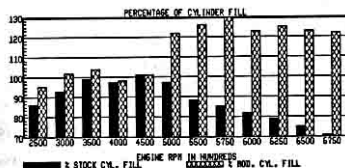
FINAL MODIFIED HP & TORQUE AND THE INCREASE OVER STOCK. ALSO % MECHANICAL EFF NEVER FALLS BELOW 74% AT ANY RPM.

	MOD. HP	TORQUE	MECH. EFF.	STOCK HP	INCREASE IN HP
	1	2	3	4	5
1	2500 RPM	28.1	58.3	25.4	2.7
2	3000 RPM	36.3	62.5	32.1	4.2
3	3500 RPM	43.1	64.0	40.3	2.8
4	4000 RPM	45.9	60.3	45.2	0.7
5	4500 RPM	53.0	61.9	52.8	0.2
6	5000 RPM	71.3	74.9	56.9	14.4
7	5500 RPM	80.7	77.1	57.2	23.5
8	5750 RPM	85.9	78.5	57.8	28.1
9	6000 RPM	87.1	75.6	58.2	28.9
10	6250 RPM	90.8	76.3	57.1	33.7
11	6500 RPM	93.6	75.6	55.6	38.0
12	6750 RPM	95.7	74.5	53.4	42.3

MODIFIED INCREASE HORSEPOWER OVER STOCK



PERCENTAGE OF CYL. FILL STOCK & MODIFIED



LOOKING OVER THE CHARTS AND GRAPHS ON PAGE 12, YOU CAN SEE THAT WE HAVE REALLY MADE A BIG GAIN OVER STOCK IN BOTH THE HP & THE TORQUE AREAS. THE CAM TIMING SHOWS UP VERY WELL WITH THE GREATER TIMING OF THE "E" CAMS AT THE 5000 RPM RANGE AS WE JUMP 14.5 HORSEPOWER IN 500 RPM. THIS WOULD REALLY GIVE YOU A KICK AT THAT SPEED.

NOTICE HOW FLAT THE TORQUE CURVE IS FROM 5000 TO 6750 RPM. THE ENGINE BREATHING IS EXCELLENT AT THIS LEVEL. THIS ENGINE SHOULD PULL VERY STRONGLY FROM 5000 RPM RIGHT ON UP TO PEAK. WE FEEL STRONGLY THAT IF WE HAD TURNED THE ENGINE ON UP TO 7000 OR 7250 THAT WE WOULD HAVE BEEN ABLE TO BREAK THE 100 HP MARK. AT 6750 WE WERE STILL CLIMBING AND THE TORQUE WAS NOT DROPPING OFF AT ALL. IF WE COULD HAVE JUST HELD 75# TORQUE AT 7000 RPM WE WOULD HAVE MADE THE 100 MARK.

LOOK AT THE GRAPH AND THE NUMBER CHART AND YOU CAN SEE THAT IT IS VERY HARD TO IMPROVE THE ENGINE MUCH AT ABOUT 4500 RPM. THIS IS THE SPOT THAT WE WERE GETTING OUR HIGHEST CYLINDER FILL STOCK AND SOMETIMES THIS IS VERY HARD TO IMPROVE UPON.

TO UNDERSTAND HOW GOOD THESE TORQUE FIGURES REALLY ARE, STUDY THE CHART ON THE LATEST 1985 KAWASAKI NINJA 4 VALVE WATER COOLED FOUR. THIS IS ONE OF THE HOTTEST MOTORCYCLES ON THE MARKET THIS YEAR. WE HAD A PEAK TORQUE OF 55.6 LBS. AT 8000 RPM AND THEN FROM THERE TO PEAK RPM'S, WE HAVE A 25% DROP IN CYLINDER FILL OR TORQUE.

8/22/84 PAGE 1
 KAWASAKI 908 cc NINJA FOUR 1984 MODEL
 COMPLETELY STOCK MACHINE WITH ABOUT
 3500 MILES (KAWASAKI FACTORY MOTOR)

	STOCK TORQUE	STOCK HP
	1	2
1 2500 RPM	33.7	16.0
2 3000 RPM	38.3	22.0
3 3500 RPM	36.1	24.1
4 4000 RPM	42.8	32.5
5 4500 RPM	43.7	37.4
6 5000 RPM	41.1	39.5
7 5500 RPM	39.2	41.1
8 6000 RPM	51.3	58.6
9 6500 RPM	50.5	63.0
10 7000 RPM	51.4	68.5
11 7500 RPM	51.3	73.7
12 8000 RPM	55.6	84.7
13 8500 RPM	54.5	89.7
14 9000 RPM	54.1	92.7
15 9500 RPM	49.6	89.2
16 10000 RPM	45.4	87.0
17 10500 RPM	41.7	83.2

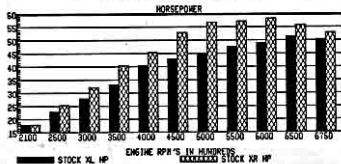
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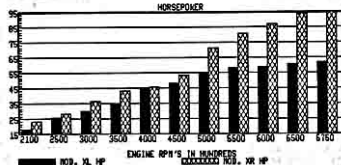
STOCK XL SPORTSTER VS. STOCK XR1000 AND A MODIFIED SPORTSTER VS MODIFIED XR1000 WITH BOTH ENGINES EQUIPPED ABOUT THE SAME

	STOCK XL HP	STOCK XR HP	MOD. XL HP	MOD. XR HP
	1	2	3	4
1 2100 RPM	17.7	17.9	18.2	23.3
2 2500 RPM	23.0	25.4	25.7	28.1
3 3000 RPM	27.9	32.1	30.3	36.3
4 3500 RPM	33.1	40.3	34.9	45.1
5 4000 RPM	40.4	45.2	44.4	45.9
6 4500 RPM	42.8	52.8	48.4	53.0
7 5000 RPM	45.0	56.9	54.1	71.3
8 5500 RPM	47.4	57.2	58.3	80.7
9 6000 RPM	49.1	58.2	58.8	87.1
10 6500 RPM	51.5	55.6	60.8	93.6
11 6750 RPM	50.2	52.7	62.1	95.7

STOCK XR SPORTSTER VS STOCK XR1000



MODIFIED SPORTSTER VS MODIFIED XR1000



THE GRAPHS AND CHARTS ON PAGE 15 ARE FOR THE PURPOSE OF A COMPARISON BETWEEN THE XL 1000 SPORTSTER AND THE XR1000. IN STOCK FORM THEY REALLY ARE NOT TOO FAR APART, BUT WHEN YOU START TO EXTRACT A LOT OF HORSEPOWER OUT OF THE TWO, THE SPORTSTER REALLY FALLS FLAT COMPARED TO THE XR1000. IN THESE TEST THE SPORTSTER HAD THE FULL PORT AND POLISH, BIG VALVES, ANDREWS V9 CAMS, S & S SUPER CARB AND SET OF OPEN DUAL STAGGER PIPES. ON THE FLOW BENCH THE SPORTSTER IS SLIGHTLY BETTER THAN THE XR1000, BUT WHERE THE SPORTSTER GETS INTO TROUBLE IS IN THE COMBUSTION CHAMBER. THE TRUE HEMI-CHAMBER LIKE THE SPORTSTER AND THE EARLY PAN AND SHOVEL HEAD BIG TWINS, IS VERY IN EFFICIENT, AS IT IS A NON TURBULENT CHAMBER AND HAS A BAD FLAME TRAVEL. IT HAS BIG VALVES, FLOWS A LOT OF AIR BUT BURNS VERY LITTLE OF WHAT IS IN THE CHAMBER.

AFTER THE ENGINE HAD REACHED IT'S PEAK POWER WITH THE 41.5 MM LECTRONS, WE REPLACE THEM WITH THE 39.5 MM MIKUNI'S AND RAN ANOTHER SERIES OF TESTS, THE CHARTS BELOW GIVE THESE FIGURES.

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XR1000 MODIFIED WITH 39.5 MM MIKUNI CARB
SUPERTRAP PIPES, E CAMS, MODIFIED HEADS
BRANCH TAPERED INTAKE MANIFOLDS.

	HORSE POWER	TORQUE	FRICTION HP	BRAKE/SPE FUEL	POUNDS FUEL
	1	2	3	4	5
1 2500 RPM	26.10	55.00	4.70	0.70	18.27
2 3000 RPM	34.30	60.40	6.10	0.65	21.95
3 3500 RPM	40.30	60.30	8.10	0.60	23.10
4 4000 RPM	46.30	60.60	10.50	0.57	25.08
5 4500 RPM	56.60	66.00	13.10	0.56	28.22
6 5000 RPM	70.40	74.00	16.10	0.56	38.13
7 5500 RPM	78.20	74.90	19.20	0.55	41.41
8 6000 RPM	81.20	71.10	23.70	0.54	44.06
9 6250 RPM	84.00	71.00	25.50	0.55	46.53
10 6500 RPM	88.40	71.60	28.00	0.54	47.73
11 6750 RPM	90.50	70.40	30.70	0.52	47.06
12 7000 RPM	92.00	69.00	33.60	0.53	48.76

ON THE ABOVE CHART WE HAVE SHOWN SEVERAL OTHER BITS OF INFORMATION THAT WE HAVE DISCUSSED EARLIER BUT HAVE NOT SHOWN IN THE CHARTS AND GRAPHS. ONE IS THE BSFC AND THE OTHER IS LBS.FUEL USED. AS YOU CAN SEE WE ARE A SLIGHT AMOUNT RICH OVER THE .52 BSFC THAT WE ARE LOOKING FOR, BUT ALL IN ALL WE ARE VERY CLOSE. ANOTHER ITEM THAT WE HAVE MENTIONED IN SOME OF THE EARLIER PAGES, IS THE FRICTIONAL HORSEPOWER. THIS IS THE AMOUNT OF HP THAT IT TAKES IN FRICTION TO TURN THE ENGINE AT THE LISTED RPM. THATS RIGHT, IT TAKES 33.6 HP TO SPIN THE ENGINE 7000 RPM. THE ENGINE IS REALLY PUTTING OUT 125.6 HP, BUT WE ONLY HAVE 92 HP LEFT TO WORK WITH. THINK ABOUT THAT AS YOU OVER REV THE ENGINE. IT TAKES ALOT OF HORSEPOWER TO STOP THE ROD AND PISTON AT THE TOP OF THE STROKE AND AT THE BOTTOM EACH TIME THE ENGINE SPINS.

FROM THE CHARTS YOU CAN SEE THAT THE 41.5 MM LECTRONS MAKE THE MOST HP ON THIS ENGINE, BUT THEY RUN POORLY BELOW 4000 RPM AND WE WOULD HIGHLY SUGGEST THAT YOU USE THE 39.5 MM MIKUNI'S. THESE CARBS GIVE JUST AS GOOD THROTTLE RESPONSE AND SMOOTHNESS AS THE STOCK UNITS AND DO AN EXCELLENT JOB OVERALL. STICK WITH SOMETHING THAT WORKS.

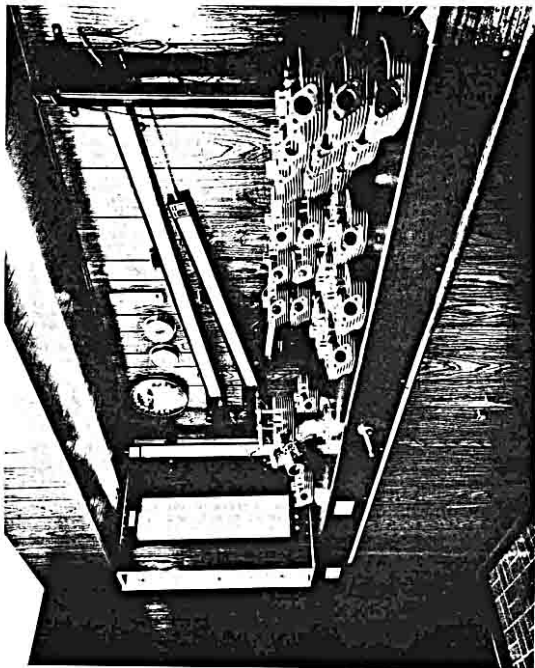
ALSO, ON THE CAMS, STICK WITH THE FACTORY "E" CAM, AS IT IS DOING A FINE JOB FOR A STREET ENGINE. ONE OF THE HIGHER LIFT CAMS WILL WEAR OUT THE VALVES AND GUIDES RAPIDLY AND THE CHANCES OF MAKING MORE HORSEPOWER IS VERY SLIM WHEN WE LOOK AT THE CYLINDER FILL THAT WE ARE ALREADY GETTING. BASICALLY THE CAM TIMING AND LIFT IS MAKING UP FOR POOR BREATHING AND WHEN WE MAKE THE BREATHING AS GOOD AS IT IS ON THIS SET OF HEADS, YOU CAN GET BY WITH A MUCH Milder CAM AND STILL DO THE SAME JOB. MORE CAM TIMING AND LIFT MIGHT HELP IF YOU WERE GOING TO TURN THE ENGINE 7500 TO 7700 RPM AT THE DRAGS, BUT WOULD PROBABLY HURT CONSIDERABLY BELOW 5000 RPM. WITH STOCK BEARING ON AN XR1000, 5000 RPM IS 90 MPH, WHICH MEANS THAT YOU WOULD PROBABLY BE DOWN IN HORSEPOWER FROM STOCK UP TO THIS POINT. WE JUST FINISHED ANOTHER ENGINE AND TESTED 11 CAM SHAFTS IN IT AND ONE OF THE LOWEST LIFTS ONES MADE THE MOST HORSEPOWER EVERYWHERE, STICK WITH STUFF THAT HAS BEEN TESTED AND NOT THE ONES THAT HAVE BEEN BALLYHOOD UP.

FOR PIPES, WE TESTED MANY OF THEM, BUT THE SUPERTRAP SUPERTIPS DID THE BEST JOB, GAVE THE BEST CARBURETION, RAN THE SMOOTHEST AND WERE THE QUIETEST ONES TESTED. WE SEE ALOT OF THE SUPER-WAMMIE-2 INTO 1-TRICKY-DICK STUFF HERE FOR TESTING AND HONESTLY 95% OF IT DOES NOT WORK. TESTS OF THIS TYPE TAKE WEEKS AND COST THOUSANDS FOR DOLLARS AND THEY ARE TO ARRIVE AT THE THINGS THAT REALLY WORK AND MAKE HORSEPOWER. AGAIN STICK WITH SOMETHING THAT HAS BEEN TESTED. IN PRESENTING A PAPER OF THIS TYPE, WE CAN ONLY SHOW A SMALL PERCENTAGE OF THE INFORMATION THAT WE RECEIVE FROM THE COMPUTER AFTER EACH RUN AND FROM THAT INFORMATION WE CONDENSE IT DOWN TO THE BARE BOTTOM LINE FOR YOU.

HOW REPEATABLE IS THIS TYPE OF TEST? WE WONDERED THE SAME THING AND RECENTLY HAD AN INDIVIDUAL DO EXACTLY THE SAME THING THAT WE DID IN THIS TEST TO HIS NEW XR1000. HE THEN RENTED THE DYNO AND WE RAN THE SAME TEST AS WE HAVE HERE, WITH THE 39.5 MM MIKUNI'S AND THE POWER WAS ABOUT THE SAME EVERYWHERE EXCEPT THAT HIS ENGINE MADE 2 1/2 HP MORE AT THE TOP END THAN OUR TEST MOTOR.

WE DID EXPERIENCE CLUTCH TROUBLE ON THE DYNO AND THIS IS EXPECTED, AS THE ENGINE NEVER GETS THIS TYPE OF LOAD ON IT WHEN RIDDEN. ABOUT 75% OF ALL MOTORS TESTED HERE THAT ARE REALLY PUTTING OUT THE TORQUE HAVE SLIPPING PROBLEMS. WE WERE GOING TO CORRECT THIS PROBLEM BEFORE THE MOTORCYCLE WAS TESTED AT THE DRAG STRIP BUT RAN OUT OF TIME. AT THE DRAGS THE MOTOR IN STOCK FORM RAN 13.27 E.T. AND A SPEED OF 101.13 MPH. WHEN IT WAS RETURNED AFTER THE TEST WORK, IT RAN 11.35 E.T. AND 119.50 MPH WITH THE CLUTCH SLIPPING PRETTY GOOD, POSSIBLY A 11.10 TO 11.15 E.T. IS POSSIBLE AND A SPEED OF 122 TO 123 MPH. VERY RESPECTABLE FOR A 2 CYLINDER SMALL DISPLACEMENT ENGINE.

FROM START TO FINISH WE HAVE PICKED THE POWER UP 65% OVER STOCK AND STILL HAVE A VERY SMOOTH, FLEXIBLE ENGINE THAT YOU CAN GO CROSS COUNTRY WITH AND NOT WORRY ABOUT IT BREAKING DOWN. AT LAST A TWIN THAT IS VERY CLOSE TO THE BEST 4 CYLINDER JAPANESE SUPERBIKES.



ONE FINAL SET OF GRAPHS AND CHARTS BELOW WILL GIVE A COMPLETE RUN DOWN ON THE VARIOUS CHANGES AND LIST THEM SIDE BY SIDE SO THAT YOU CAN GLANCE ACROSS THEM AND SEE WHAT WORKS AND WHAT DOES NOT. REMEMBER THESE ARE AVERAGES OF MANY RUNS AND NOT THE PEAK POWER MADE FOR EACH TEST.

COL. #	CARB	PIPES	CAMS	HEADS	PISTONS
1.	STOCK	STOCK	STOCK	STOCK	STOCK
2.	STOCK	SUPERTRAP	STOCK	STOCK	STOCK
3.	41.5mm LECT.	SUPERTRAP	STOCK	STOCK	STOCK
4.	41.5mm LECT.	SUPERTRAP	"E"	STOCK	STOCK
5.	41.5mm LECT.	SUPERTRAP	"E"	BRANCH	HI-COMP

RPM	STOCK	PIPE	PIPE-CARB	PIPE-CARB	PIPE-CARB-CAM
	HP	HP	HP	CAM HP	MOD. HEADS
2500	25.4	25.2	24.8	20.9	28.1
3000	32.1	32.4	31.8	31.8	36.3
3500	40.3	38.8	37.5	35.6	43.1
4000	45.2	45.6	45.5	39.6	45.9
4500	52.8	56.9	51.2	50.9	55.0
5000	56.9	59.4	55.1	54.5	71.3
5500	57.2	60.9	64.4	64.1	80.7
6000	58.2	59.1	66.1	65.9	87.1
6500	55.6	58.5	65.8	67.3	93.6
6750	53.3	57.3	63.5	66.1	95.7

THE NEXT SET OF CHARTS BELOW WILL LIST THE GAINS OR LOSSES ON THE ABOVE TEST: "-" FOR A LOSS AND "+" FOR A GAIN OVER STOCK:

RPM	STOCK	PIPE	PIPE-CARB	PIPE-CARB	PIPE-CARB-CAM
	HP	HP	HP	CAM HP	MOD. HEADS
2500	25.4	- .2	- .6	- 4.5	+ 2.7
3000	32.1	+ .3	- .3	- 3	+ 4.2
3500	40.3	- 1.5	- 2.8	- 4.7	+ 2.8
4000	45.2	+ .4	+ .3	- 5.6	+ .7
4500	52.8	+ 4.1	- 1.6	- 1.9	+ .2
5000	56.9	+ 2.5	- 1.8	- 2.4	+ 14.4
5500	57.2	+ 3.7	+ 7.2	+ 6.9	+ 23.5
6000	58.2	+ .9	+ 7.9	+ 7.7	+ 28.9
6500	55.6	+ 2.8	+ 10.2	+ 11.7	+ 38.0
6750	53.3	+ 4.0	+ 10.2	+ 12.8	+ 42.4

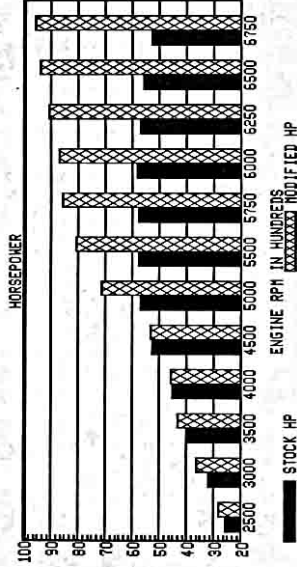
AS YOU LOOK THE NUMBERS OVER AND SEE THE PLUS AND THE MINUS SIGNS, ONE THING THAT REALLY STICKS OUT IS THAT IT IS VERY HARD TO GAIN MUCH AT THE 4000 TO 4500 RPM RANGE. THE INTAKE LENGTH, PORT BREATHING, CAM TIMING, CARBURETION, EXHAUST BACK PRESSURE IN STOCK FORM ISN'T TO BAD AT THIS RPM. WE COULD IMPROVE ON IT, BUT AT THE COST OF A BUNCH IN OTHER RPM LEVELS.

ALSO, WITH THE "E" CAMS AND STOCK PIPES, WE HAD TO USE .012" TAPPET CLEARANCE. IF WE CLOSED IT DOWN TO .006" AS IN THE OTHER PIPES, WE LOST ALMOST 9 HP AT THE BOTTOM END. THIS IS DUE TO THE CAM RAMPS AND TIMING.

THE HORSEPOWER NUMBERS ARE IMPRESSIVE AND THIS IS AN ENGINE THAT IS CAPABLE OF MAKING A BUNCH OF IT. THE HEADS, WHICH CONTROL HP, WERE DESIGNED FROM SCRATCH FOR RACING, THEY FLOW VERY WELL AND ARE RIGID SO THAT UNDER PRESSURE AND HEAT THEY DO NO ALLOW LEAKAGE IN THE VALVE SEAT AREA.

WE HOPE THAT YOU HAVE ENJOYED THIS INFORMATION AND WE ARE GLAD TO SHARE IT WITH THE HARLEY-DAVIDSON XR1000 OWNERS.

STOCK & MODIFIED H-D XR1000



Modified Engine Equipment

1. Branch 130 cfm Heads
2. H-D "E" Cams
3. 41.5mm Lectrons
4. Supertrap Exhaust
5. Branch Manifolds

STOCK & MODIFIED H-D XR1000

