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CHAINSAW TESTING AND SELECTION

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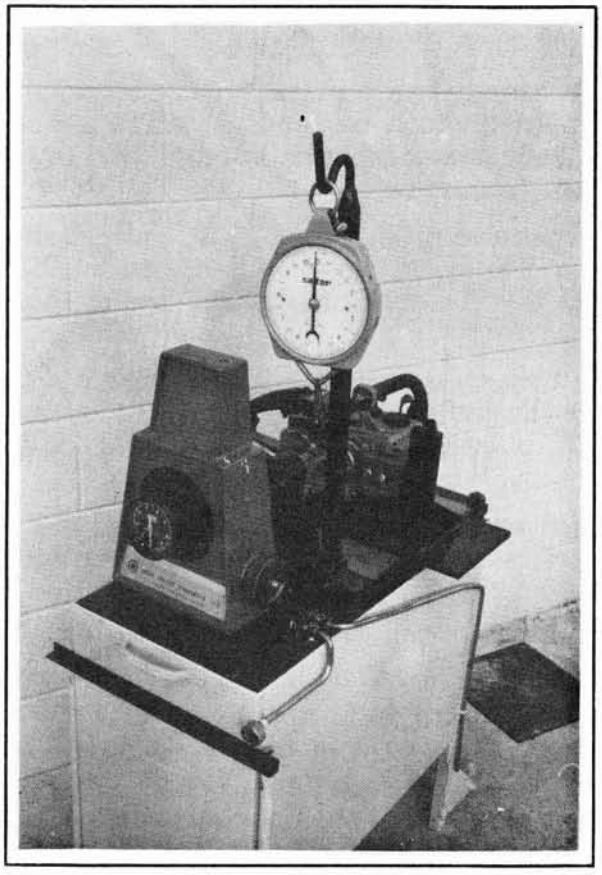

Fig. 1 - N.Z.F.S. chainsaw dynamometer for torque/speed measurement

INTRODUCTION

Since 1972 the Engineering Division of the New Zealand Forest Service has been testing chainsaw performance to determine power, noise, vibration, and fuel consumption.

LIRA Technical Release, Vol. 2 No. 3 1980, showed tables of values recorded for saws tested in 1979 and described test procedures.

This Technical Release is an update recording recent tests.

TESTING PROCEDURE

RUNNING IN

Before testing, each new chainsaw is run in with bar and chain fitted. The saw throttle is adjusted so that the saw runs at 3000 to 3500 RPM, just sufficient speed to engage the clutch and drive the chain. The saw is allowed to run for one tank full of fuel.

OUTPUT POWER

This test is performed on a hydraulic dynamometer (a modified GO - Power Model DY-60). The engine loading is controlled by varying the flow of water through a small impeller wheel; increasing the water flow increases the applied load. Measured torque is determined by a spring balance acting on the impeller casing at at known radius.

The chainsaw is secured by means of its guide bar fixing screws, and a special adaptor connects the clutch centre with the dynamometer impeller shaft. The chainsaw mounting is resiliently isolated from the dynomometer.

With the chainsaw engine at full throttle, the load is adjusted until the maximum smooth running speed is achieved. From maximum speed the load is increased to reduce speed in increments of 500 RPM down to the minimum smooth running speed. At each speed increment, the torque is recorded. This procedure is performed twice to obtain an average set of readings.

From the readings and calculations, graphs of torque and power against speed are plotted, from which peak torque and peak power are derived. Peak power figures corrected for temperature and pressure are shown in the tables on Pages 4, 5 and 6. In theory, the peak cutting rate should be achieved at this peak power speed.

Maximum torque generally occurs in the 5500 to 6500 RPM region. At this point, the chain should have maximum cutting pull.

As with most power drives, the chainsaw is rarely used at its maximum peak power, except when using maximum size bars in large timber. The saw is used mainly at higher speeds. For this reason, power and fuel values are listed for engine speeds of 8500 and 9500 RPM which should cover most chainsaw usage and shows the variation in power to fuel ratio.

FUEL CONSUMPTION

During the power tests on the dynamometer, the fuel measuring system is connected to the carburetter feed pipe bypassing the chainsaw fuel tank. This enables fuel consumption to be measured over a 30 second period for all or part of the speed range. The measurements are taken for both power test runs from which an average is derived for each speed increment to give fuel consumption in litres per hour.

NOISE LEVEL

Chainsaw noise level is measured with a microphone extension attached to the right ear protector of a person operating the chainsaw. The microphone is connected to a meter measuring noise level in dBA. The dBA scale indicates noise level in proportion to human ear sensitivity to noise at high, low and medium frequencies.

Noise levels are recorded with the affect of any noise reflecting objects, background noises, and wind, minimised. Noise level and engine speed are measured with the chainsaw idling and at wide open throttle (W.O.T). The chainsaw is held free at thigh height for these two tests.

While the operator saws at wide open throttle through a pine log of about 30 cm diameter, an average noise level is assessed from a generally roving scale pointer as the chainsaw goes through the widest portion of the log. The operator, as far as possible, keeps the saw cutting at peak power running.

An average of three readings are taken for each type of test. Before the tests the noise level meter is checked and adjusted if necessary, to agree with a standard noise level calibrator placed over the microphone. This procedure is repeated after completing the tests.

VIBRATION

The test procedure for vibration is similar to the noise test, using the same instrument, tachometer, operations and conditions. Instead of the extension microphone, miniature accelerometers are placed between the operator's hands and the chainsaw handles. Vibration is measured in three perpendicular planes on each handle. The accelerometers, via the sound level meter, sense vibration in decibels, in the same way that a microphone senses air vibration for sound.

The vibration measuring instrumentation electronically weighs the decibel values in accordance with the International Standards Organisation draft standard ISO/DIS5349. Decibel vibration values are obtained for each of three planes on both handles for each chainsaw.

CHAINSAW SELECTION

The first factors that are considered when selecting chainsaws for a Government contract are operator safety, namely noise and vibration. After this, other factors must be considered - overall performance in comparison to cost, ease of servicing, availability of spare parts and after sales service provided by the agent. Operator opinion cannot be ignored, although this is not always available, especially where new models are concerned.

NOISE

The New Zealand standard limit of noise exposure, set by the Health Department, is basically equivalent to a continuous noise level of 85 dBA for an eight hour day. Chainsaws operating in various types of forestry operation, are continually varying between idle, wide open throttle, and off. The actual acceptable level of chainsaw noise at WOT can, therefore, be higher than the standard continuous level of 85 dBA.

In 1970, the New Zealand Forest Service established acceptable WOT chainsaw noise levels which would allow a chainsaw to be operated within normal working hours and still be within the New Zealand standard acceptable noise exposure limit. Since the chainsaw noise pattern is different for different types of operation, acceptable noise levels for the main types of operation were established. The limits, which apply to the present New Zealand standard, are :

Thinning	102 dBA	Class I saws (40-54 cc)
Clearfelling	105 dBA	Class II and III saws (55-100 cc)

With few exceptions, chainsaw noise levels are in excess of those given above. It therefore follows that ear protectors (ear muffs or ear plugs) must generally be worn by operators employed full time on chainsaw operations.

VIBRATION

The method of measuring and analysing chainsaw handle vibration is in accordance with the ISO draft standard ISO/DIS5349.

For the 1984 contract selection tests, it was found that all vibration levels were within the acceptable limit recommended by the above standard and therefore did not influence selection. For this reason, the results are not included in this publication.

AVAILABILITY OF TESTING FACILITIES

The New Zealand Forest Service chainsaw tests are primarily used to select chainsaws for a two-yearly Government contract. They may be performed at a fee for private firms and others. Requests should be sent to the Engineering Division, New Zealand Forest Service, Private Bag, Wellington, from whom full details of the testing procedure are available. Requests for special tests or experimentation will also be considered.

TABLE GUIDE

BAR CLEAR LENGTH - the dimension between bar tip and bucking spikes or chainsaw body.

PEAK POWER AT REVS PER MINUTE - maximum power on the power/speed curve and speed at which it occurs.

CHAIN PITCH AND SPROCKET - details used to calculate chain speed at peak power to indicate peak cutting rate.

TANK RUN TIME - continuous running at peak power speed.

WOT - wide open throttle, i.e. trigger fully depressed

EXHAUST DIRECTION - "horizontal degrees" clockwise from guide bar looking down on the saw.
"vertical degrees" from the guide bar looking at the side of the saw.

TABLE 1 CHAINSAW TEST RESULTS 1984
CLASS 1A, LIGHT DUTY, 40-54CC, 5-6KG, BARE WEIGHT, 40CM GUIDE BAR

		OLEO-MAC			HUSQVARNA			PIONEER	JONSEREDS	STIHL				ECHO
		950A	945A	355A	50	154	44	P28	520SP	023 AVE	032 AVE	011 AVE	440 EVL	400 EVL
Cylinder Displacement	cc	50.	46.	53.	50.	54.	44.	51.	49.	47.	51.	41.	44.3	40.2
Weight, All up, Fueled	kg	6.91	6.90	8.26	6.86	7.05	6.40	7.29	6.37	7.40	8.05	5.40	6.61	6.50
Bare, No Bar	kg	5.14	51.2	6.30	5.09	5.41	4.79	5.78	4.54	5.55	6.14	4.20	5.28	5.15
Bar Clear Length	cm	39.	40.	38.	38.	33 & 45	38	39	31.	37.	37.	37.	35.	35.
Sprocket No. of Teeth		7	7	7	7	7	7	8	7	7	7	6	7	7
Fuel Capacity	Litres	0.69	0.69	0.69	0.64	0.64	0.57	0.44	0.60	0.51	0.56	0.25	0.45	0.49
Peak Power														
Power	kW	1.53	1.29	1.75	1.81	2.12	1.78	1.37	1.84	1.67	1.90	1.24	1.53	1.35
At RPM		8000	8000	7500	8000	9000	9000	8000	8000	8500	9000	7500	8000	8000
Fuel per hour	Litres	1.67	1.25	1.81	1.42	1.62	1.54	1.47	1.79	1.56	1.54	0.96	1.43	1.28
Tank run time	Mins	24.73	30.67	22.87	27.04	23.70	22.21	17.96	20.11	19.62	21.82	15.94	18.88	22.97
At 8500 RPM														
Power	kW	1.51	1.24	1.70	1.70	1.59	1.78	1.30	1.75	1.67	1.86	1.12	1.49	1.30
Fuel per hour	Litres	1.79	1.38	1.97	1.52	1.53	1.54	1.45	1.83	1.56	1.45	1.09	1.51	1.31
Tank run time	Mins	23.08	30.00	20.97	25.30	24.15	22.27	18.18	19.67	19.62	23.14	14.09	17.86	22.48
At 9500 RPM														
Power	kW	1.34	1.13	1.28	1.57	1.94	1.68	0.88	1.58	1.52	1.85	0.92	1.27	1.10
Fuel per hour	Litres	1.81	1.35	2.09	1.48	1.73	1.52	1.70	1.89	1.65	1.67	1.24	1.58	1.35
Tank run time	Mins	22.85	30.67	19.83	25.91	22.15	22.44	15.49	19.05	18.55	20.07	12.32	17.05	21.78
Noise Level														
At WOT Cutting	dBA	107.	107.3	107.7	99.2	103.3	106.8	103.5	105.7	103.7	101.7	102.	102.8	105.
At Idle	dBA	81	81	83	80	76	80	87	81.5	80.5	80	86	81	84
Muffler Exhaust														
Volume	cc	302	302	-	312	297	203	144	180	276	220	-	220	205
Position		Front	Front	Front	Front	Front	Front	Side Rear	Front	Front	Front	-	U/side	U/side Rt Rear
Exhaust Direction														
Horizontal (Bar at 0°)		45 RT	45 RT	45 RT	45 RT	45 RT	45 RT	0	45 RT	45 RT	0	-	45 RT	45 RT
Vertical (Bar at 0°)		0	0	0	0	0	0	45	0	0	45	-	0	0

TABLE 2 CHAINSAW TEST RESULTS 1984
CLASS 1B, LIGHT DUTY, 55-69CC, 6-7KG, BARE WEIGHT, 40CM GUIDE BAR

		OLEO-MAC 264	HUSQVARNA 266	JONSEREDS 630	STIHL 038 AVE	ECHO 610 EVL	ECHO 660 EVL	McCULLOCH PRO MAC 655	PIONEER P42
Cylinder Displacement	cc	59.	66.	62.	67	61	64.2	60.	65.
Weight, All up, Fueled	kg	8.65	8.05	7.95	8.88	8.85	8.83	9.05	9.95
Bare, No Bar	kg	6.48	6.06	6.04	6.65	6.98	6.92	7.14	7.59
Bar Clear Length	cm	46.	38.	38.	43.	36.	36.	38.	46.
Sprocket No. of Teeth		7.	7.	7.	7.	7.	7.	7.	8.
Fuel Capacity	Litres	0.69	0.74	0.78	0.69	0.65	0.65	0.45	0.81
Peak Power									
Power	kW	2.47	2.90	2.73	2.74	2.39	2.31	2.07	3.32
At RPM		8000	8500	8000	9000	8000	7500	7000	8500
Fuel per hour	Litres	1.92	1.87	1.76	2.26	1.93	1.93	2.55	2.49
Tank run time	Mins	21.56	23.74	26.59	18.32	20.21	20.21	10.59	19.52
At 8500 RPM									
Power	kW	2.38	2.88	2.70	2.67	2.39	2.17	1.73	3.32
Fuel per hour	Litres	2.00	1.87	2.15	2.32	2.12	1.93	2.89	2.49
Tank run time	Mins	20.66	23.72	21.73	17.88	18.36	20.19	9.36	19.52
At 9500 RPM									
Power	kW	2.17	2.75	2.34	2.56	2.00	2.00	1.31	2.91
Fuel per hour	Litres	2.14	2.07	2.35	2.34	2.43	2.00	2.86	2.92
Tank run time	Mins	19.33	21.42	19.90	17.71	16.05	19.52	9.43	16.67
Noise Level									
At WOT Cutting	dBA	108.3	106.7	103.7	105.6	105.3	110.3	113.7	106.3
At Idle	dBA	82	84	80.3	80	91	83	95	87
Muffler Exhaust									
Volume	cc	396	350	408	432	195	254	-	405
Position		Front	Front	Front	Front	U/side	U/side	-	Side rear
Exhaust Direction									
Horizontal (Bar at 0°)		0	45RT	45RT	90RT	90RT	130rt	-	45RT
Vertical (Hor at 0°)		45	0	0	0	45	0	-	0

TABLE 3 CHAINSAW TEST RESULTS 1984
CLASS 2, LIGHT MEDIUM DUTY, 70-89CC, 6.7-7.7KG, BARE WEIGHT, 50-60CM GUIDE BAR

		HUSQVARNA 181 SE	STIHL 048 AVE	STIHL 056 AVE SUPER	JONSEREDS 820	JONSEREDS 920
Cylinder Displacement	cc	81.	76.	87.	81.	87
Weight, All up, Fueled	kg	9.56	10.44	10.80	10.48	10.15
Bare, No Bar	kg	6.98	7.80	7.90	7.77	7.40
Bar Clear Length	cm	49.	43.	49.	48.	48.
Sprocket No. of Teeth		7.	7.	7.	8.	7.
Fuel Capacity	Litres	0.90	0.82	0.84	0.98	0.97
Peak Power						
Power	kW	3.34	2.86	3.77	2.83	3.56
At RPM		9000	8000	8000	7500	8500
Fuel per hour	Litres	2.35	2.76	2.37	1.91	2.80
Tank run time	Mins	22.98	17.83	21.27	30.79	20.79
At 8500 RPM						
Power	kW	3.22	2.64	3.69	1.94	3.56
Fuel per hour	Litres	2.30	2.83	2.44	1.99	2.80
Tank run time	Mins	23.44	17.37	20.64	29.61	20.77
At 9500 RPM						
Power	kW	3.30	2.08	3.03	2.22	3.29
Fuel per hour	Litres	2.32	3.10	2.51	1.93	2.83
Tank run time	Mins	23.32	15.89	20.10	30.43	20.55
Noise Level						
At WOT Cutting	dBA	109.3	106.0	107.5	107.8	108.7
At Idle	dBA	82	81	85	82.5	84
Muffler Exhaust						
Volume	cc	468	408	528	338	380
Position		Front	Front	Front	Front	Front
Exhaust Direction						
Horizontal (Bar at 0°)		0	0	0	0	45RT
Vertical (Hor at 0°)		0	0	0	45	0

TABLE 4 CHAINSAW TEST RESULTS 1984
CLASS 3, MEDIUM DUTY, 90-100CC, 8.5-9.5KG, BARE WEIGHT, 60-70CM GUIDE BAR

		HUSQVARNA 2100 CD	PIONEER P 62	JONSEREDS 1020	STIHL 051 AVE	ECHO 900 EVL
Cylinder Displacement	cc	100	98	100	89	91
Weight, All up, Fueled	kg	12.70	11.70	12.30	13.09	13.20
Bare, No Bar	kg	8.55	8.62	8.46	9.39	9.40
Bar Clear Length	cm	61	56	60	61	62
Sprocket No. of Teeth		8	7	7	7	7
Fuel Capacity	Litres	1.00	0.98	0.99	1.09	0.95
Peak Power						
Power	kW	4.01	4.14	3.61	3.99	3.66
At RPM		8500	8000	8000	7500	7500
Fuel per hour	Litres	2.50	2.90	3.64	2.75	2.62
Tank run time	Mins	24.00	20.28	16.32	23.78	21.76
At 8500 RPM						
Power	kW	4.01	4.04	3.56	3.02	3.18
Fuel per hour	Litres	2.50	2.99	2.08	3.40	2.68
Tank run time	Mins	24.04	19.64	28.53	19.26	21.25
At 9500 RPM						
Power	kW	2.97	1.78	3.29	0.61	2.02
Fuel per hour	Litres	3.37	4.06	2.83	UNDEF	2.89
Tank run time	Mins	17.83	14.48	20.97	UNDEF	19.75
Noise Level						
At WOT Cutting	dBA	108.5	109.8	110.3	109.5	109.8
At Idle	dBA	81.5	89	84	90	91.5
Muffler Exhaust						
Volume	cc	360	371	450	464	373
Position		Front	Side at Rear	Front	Side at Rear	Front
Exhaust Direction						
Horizontal (Bar at 0°)		0	0	0	Vented 45RT	Vented 45L
Vertical (Hor at 0°)		30-60	0	30-60	0	0

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