TOWARDS IMPROVING OIL/KERNEL EXTRACTION RATE IN FELDA

The above Seminar is being organised by FELDA on 31 March 1987. The speakers will be Tuan Hj. Jamaludin Lamin of FELDA and Dr. Abdul Azis Ariffin of PORIM. Topics that are expected to be highlighted will include FFB ripeness standards, harvesting practices, FFB transport, FFB grading and process control in palm oil mills and effective mill/scheme coordinataion.

• BOILER OPERATIONS

WHY SUPERHEATERS FAIL

We have received a request from one of our readers to include under boiler operations articles on boiler failures and their causes. To start-off this request, we are giving below an article by Vickers Hoskins on why superheaters fail.

The superheater elements are positioned in a high temperature zone of the boiler from which they have no protection against overheating until steam is actually passing through them.

For this reason, whenever the boiler is being started up or the steam flow is stopped for any reason whatsover the vent/drain is always opened so that any steam generated is blown to the atmosphere through the superheater thereby keeping it cool and enabling the fire to continue without danger of the superheater becoming over-heated, leading to early failure.

During start-up it might appear that blowing steam to the atmosphere is wasteful. However the rate of energy loss through the superheater vent/drain soon becomes very marginal compared to the rate of energy input through the firing rate, and it will be found that the pressure increases at a satisfactory rate.

Nominally the rate of heat input should be such as to result in a boiler water temperature increase of about 100°F per hour. This is most critical in a stone-cold setting when no steam is available for maintaining the superheater but may be increased in a boiler that has been banked over-night and has steam available.

Suggested rate of temperature/steam raising is shown in the attached diagram (Figure 1).

It is stressed that the superheater vent/drain is never closed until the boiler has been put on range and a flow through the steam main is established.

Likewise, when taking the boiler out of service, before the main stop valve on the boiler/steam header is operated to stop the steam flow, the superheater vent/drain is always opened so that as the steam flow to the main ceases it is replaced by flow to waste and the superheater remains protected while heat remains in the boiler setting.

If more than one boiler is feeding into a common steam range precautions must be taken to ensure that if, for any reason, one of the boilers should lose pressure the superheater vent/drain is immediately opened and kept open until pressure has been regained and the boiler takes over its share of the load once more.

A constant awareness of the superheater condition is essential if it is to achieve satisfactory long life in operation, and any condition which may lead to it becoming over-heated circumvented by appropriate venting. It is far better to over-use the vent facility and waste a very marginal amount of energy than neglect to vent for 5 to 10 minutes and take years off the useful life of the superheater by overheating it.

Once more, it is emphasised that there must be a constant awareness of the safety of the superheater heating surfaces under all circumstances of operation.

(Vickers Hoskins)

• MAINTENANCE

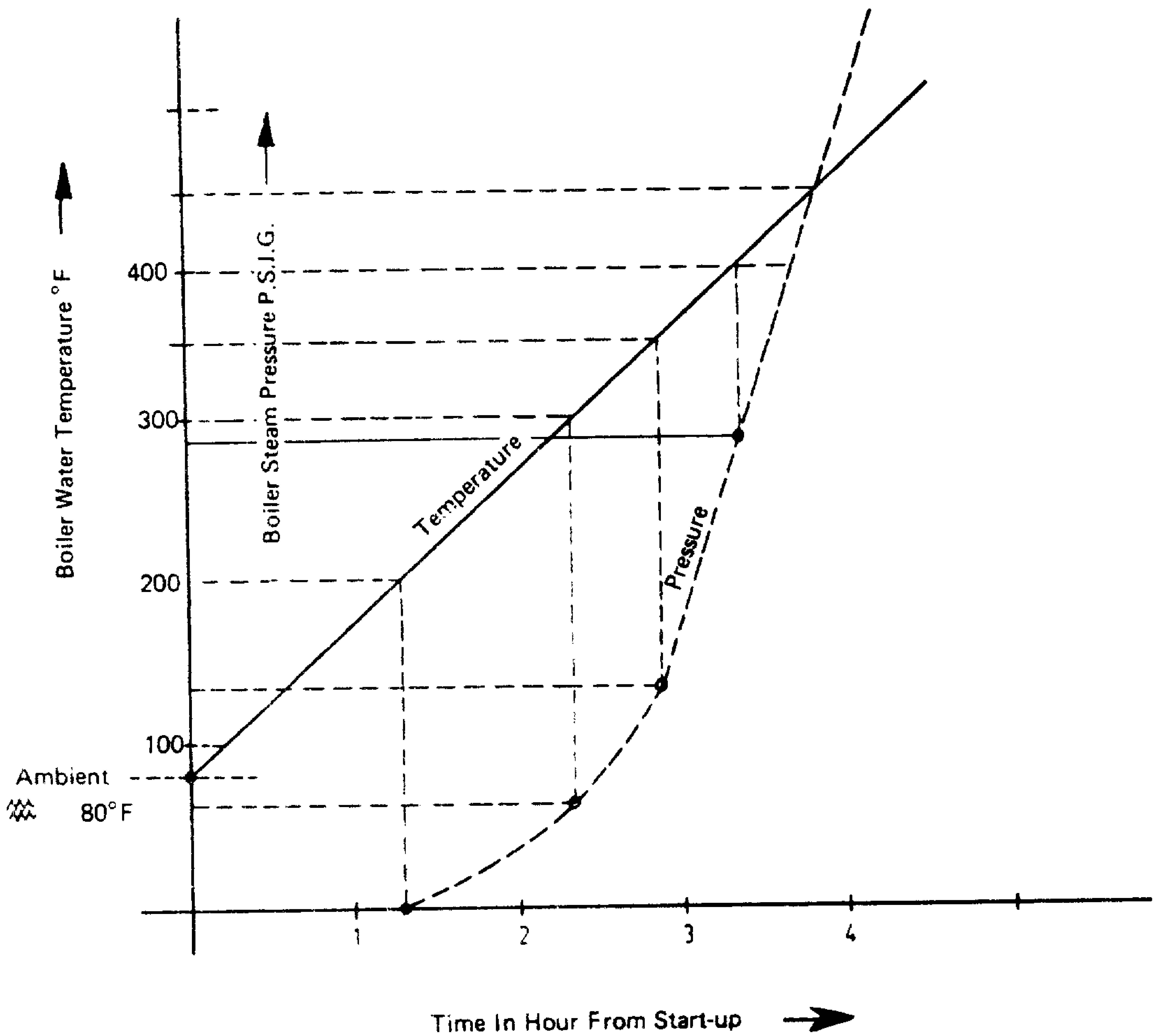
PREDICTIVE MAINTENANCE IN THE PALM OIL INDUSTRY : PART ONE

The current approach in automation of palm oil mills has one inherent weakness : the emphasis is more on process control than overall plant reliability. No matter how sophisticated the process control system adopted, mechanical failures of critical machines bring the plant to a standstill. Predictive maintenance can virtually eliminate unexpected breakdowns, i.e. increases reliability and therefore productivity. Unexpected breakdowns are especially critical during peak months and downtime can result in substantial financial losses. In this series, the authors will discuss their experiences in the introduction of predictive maintenance in palm oil mills based on the Bruel and Kjaer range of equipment. Practical examples will be provided to illustrate various possible applications of predictive maintenance on palm oil mill machinery.

WHAT IS PREDICTIVE MAINTENANCE

Nowadays the concept of preventive maintenance is widely recognized as an economically sounder maintenance approach than

Fig. 1 : **Temperature & Pressure Raising Rates From Cold**



run-to-breakdown maintenance. Run-to-breakdown method is particularly unsuitable in palm oil mills with integrated production processes and limited stand-by equipment.

Historically, time-based (periodic) maintenance was the first preventive type of maintenance to arise. It is based on the concept that the failure rate increases after a given number of running hours and that the period with low failure rate is constant for a type of equipment. However, it is obvious that the operational period for machines before maintenance is required varies greatly with load conditions, assembling conditions, etc. For good reliability, the operational period must be shorter than the shortest time between failure; hence unnecessary overhauls which are expensive in terms of labour, spare-parts and downtime losses will be carried out on machines which could be kept operating for much longer period. Even more detrimental is the fact that increasing the overhaul frequency also increases the number of human errors during dismantling and reassembling.

Obviously the ideal method would be to carry out preventive maintenance at irregular intervals, depending on the actual condition of the machine. An individual approach is required and this is the axiom of predictive maintenance. The most cost-effective approach in cutting down unplanned downtime and unnecessary wear and tear of machinery is to transfer part of the maintenance effort from run-to-breakdown and time-based maintenance to predictive maintenance.

Experience indicates that most rotating equipment faults, e.g. rotor unbalance, misalignment, gearbox problems and deteriorating bearing show up as changes in the vibration signatures of the machine long before ultimate breakdown. Vibration is thus a primary indicator of machine health. Secondary indicators are bearing temperatures and lubricant, but none of these can detect such a wide range of potential faults, and at such an early stage, as vibration measurement.

Instrumentation for Predictive Maintenance

The instrumentation can be classified into 3 levels of sophistication (Fig. 1):

Elementary Level

This simplest system uses a straight forward pocket-sized vibration meter which measures the vibration level over a specific wide frequency range. Measurements are compared with general established reference values for each machine. Machine condition is thus evaluated in the field on a minimum of data.

Equipment required:
Portable vibration meter

Intermediate Level

Fault detection at an earlier stage together with diagnosis and breakdown prediction become possible when using a system which can perform frequency analysis. Full frequency analysis and spectrum plot-out is performed on the spot for each monitoring point. Current spectra are compared manually with recorded reference spectra to reveal tell-tale increases in the level of individual frequency components.

Equipment required:
Portable vibration analyzer
Portable level recorder

Advanced Level

As the number of points increases, a computer-aided spectrum comparison system will be the most economical solution. Vibration samples from each machine are collected on an instrumentation tape recorder and automatically compared with reference spectra back at the office. Advanced programmes aid fault diagnosis and trend monitoring.

Equipment required:
Real-time fast-fourier transform (FFT) vibration analyser
Portable tape recorder
Computer system with appropriate software
X-Y recorder

ELEMENTARY LEVEL PREDICTIVE MAINTENANCE USING WIDE-BAND MEASUREMENTS

Getting Started with Elementary Level Predictive Maintenance

For the cautious, one can make a start in predictive maintenance by acquiring a high-quality hand-held vibration meter. This type of meter gives RMS and peak level readings of vibration acceleration, velocity or displacement over frequency ranges 10Hz to 1000Hz or 10Hz to 10kHz. RMS velocity readings can be compared directly with standarized vibration severity criteria tables (Tables 1 & 2).

Vibration measurements on the surface of machine elements reflect the cyclic forces being transmitted at that point. The actual vibration velocity measured is proportional not only to the forces involved but also to the mobility of the structure at that point. Mobility is a measure of the structure's willingness to set into motion and is the inverse of mechanical impedance. Fig 2 illustrates the relationship with respect to frequency. Note that in Fig. 2, the high force component "A" at frequency "n" is countered by a low mobility at frequency "n" so that no special peak is noted in the vibration spectrum. Therefore, low levels peaks in a vibration spectrum may be just as important as high level peaks.

Figure 1:

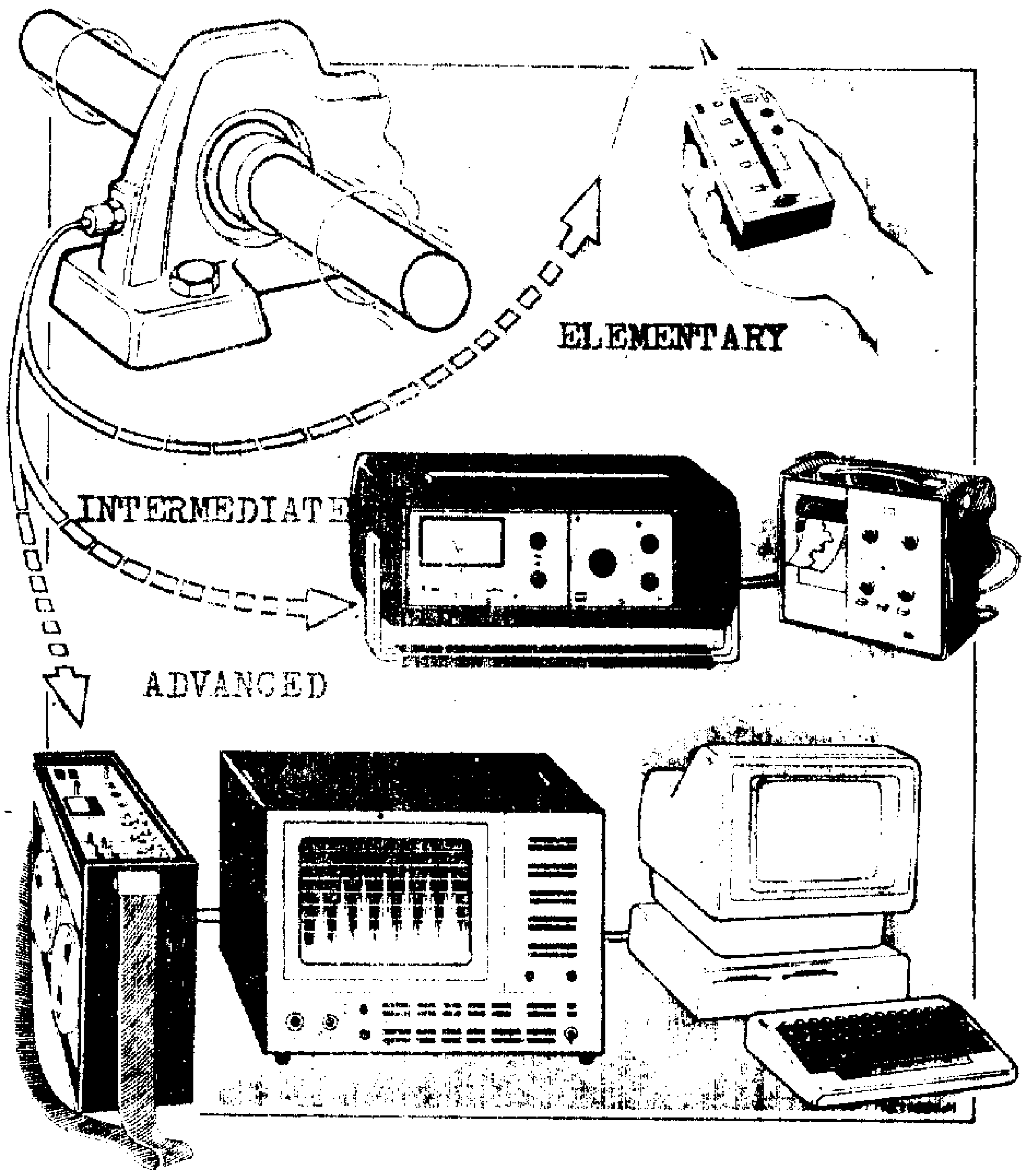


Table 1: **Vibration Severity Criteria (10 Hz – 1 kHz)**

(VDI 2056, ISO 2372, BS 4675)

RMS Velocity (mm/s)	RMS Velocity V dB (ref. 10^{-6} mm/s)	Group K: < 15 kW	Group M: 15 – 75 kW (300 kW)	Group G: > 75 kW
45 – 28	153 – 149	Not Permissible	Not Permissible	Not Permissible
28 – 18	149 – 145	Not Permissible	Not Permissible	Not Permissible
18 – 11,2	145 – 141	Not Permissible	Not Permissible	Not Permissible
11,2 – 7,1	141 – 137	Not Permissible	Not Permissible (20 dB (× 10))	Just Tolerable
7,1 – 4,5	137 – 133	Not Permissible	Just Tolerable	Just Tolerable
4,5 – 2,8	133 – 129	Just Tolerable (8 dB (× 2.5))	Just Tolerable	Allowable
2,8 – 1,8	129 – 125	Just Tolerable	Allowable	Allowable
1,8 – 1,12	125 – 121	Allowable	Allowable	Good
1,12 – 0,71	121 – 117	Allowable	Good	Good
0,71 – 0,45	117 – [illegible]	Good	Good	Good
0,45 – 0,28	[illegible] – 109	Good	Good	Good
0,28 – 0,18	109 – 105	Good	Good	Good
		Small machines, up to 15 kW	*Medium machines, 15–75 kW or up to 300 kW on special foundations*	*Large machines with rigid and heavy foundations whose natural frequency exceeds machine speed*
		Group K	Group M	Group G

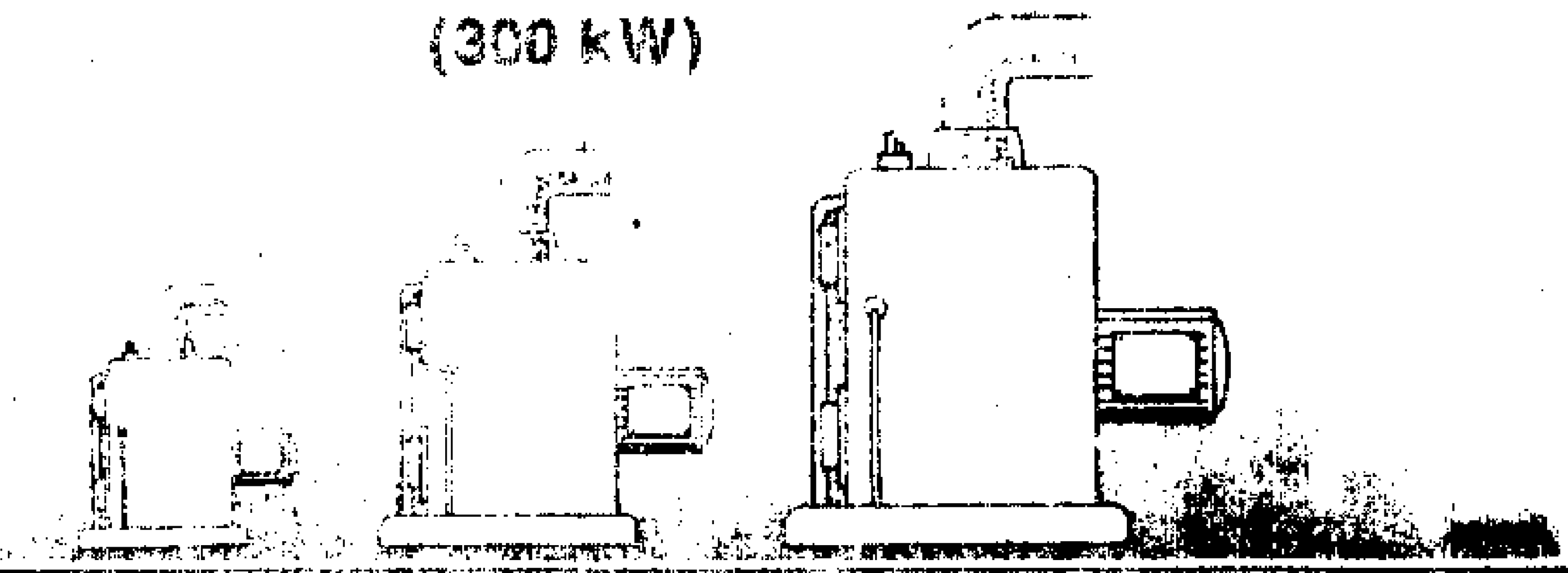


Table 2 :

Table of Criteria for Bearing Vibration Measurements (10-10 000 Hz)

Extracted from Canadian Government Specification CDA/MS/NVSH 107: "Vibration Limits For Maintenance".

Measure overall velocity RMS and allow for the following machine types:	FOR NEW MACHINES				FOR WORN MACHINES (full speed & power)			
	Long life[1]		Short life[2]		Check (recondition) level[3]		Recondition to new (Oct. analysis)[4]	
	VdB*	mm/s	VdB*	mm/s	VdB*	mm/s	VdB*	mm/s
Gas Turbines								
(over 20,000 HP)	138	7,9	145	18	145	18	150	32
(6 to 20,000 HP)	128	2,5	135	5,6	140	10	145	18
(up to 5,000 HP)	118	0,79	130	3,2	135	5,6	140	10
Steam Turbines								
(over 20,000 HP)	125	1,8	145	18	145	18	150	32
(6 to 20,000 HP)	120	1,0	135	5,6	145	18	150	32
(up to 5,000 HP)	115	0,56	130	3,2	140	10	145	18
Compressors								
(free piston)	140	10	150	32	150	32	155	56
(HP air, air cond.)	133	4,5	140	10	140	10	145	18
(LP air)	123	1,4	135	5,6	140	10	145	18
(refridge)	115	0,56	135	5,6	140	10	145	18
Diesel Generators	123	1,4	140	10	145	18	150	32
Centrifuges, Oil Separators	123	1,4	140	10	145	18	150	32
Gear Boxes								
(over 10,000 HP)	120	1,0	140	10	145	18	150	32
(10 to 10,000 HP)	115	0,56	135	5,6	145	18	150	32
(up to 10 HP)	110	0,32	130	3,2	140	10	145	18

Measure overall velocity RMS and allow for the following machine types:	FOR NEW MACHINES				FOR WORN MACHINES (full speed & power)			
	Long life[1]		Short life[2]		Check (recondition) level[3]		Recondition to new (Oct. analysis)[4]	
	VdB*	mm/s	VdB*	mm/s	VdB*	mm/s	VdB*	mm/s
Boilers (Aux.)	120	1,0	130	3,2	135	5,6	140	10
Motor Generator Sets	120	1,0	130	3,2	135	5,6	140	10
Pumps								
(over 5 HP)	123	1,4	135	5,6	140	10	145	18
(up to 5 HP)	118	0,79	130	3,2	135	5,6	140	10
Fans								
(below 1800 rpm)	120	1,0	130	3,2	135	5,6	140	10
(above 1800 rpm)	115	0,56	130	3,2	135	5,6	140	10
Electric Motors								
(over 5 HP or below 1200 rpm)	108	0,25	125	1,8	130	3,2	135	5,6
(upto 5 HP or above 1200 rpm)	103	0,14	125	1,8	130	3,2	135	5,6
Transformers								
(over 1 kVA)	103	0,14	–	–	115	0,56	120	1,0
(1 kVA or below)	100	0,10	–	–	110	0,32	115	0,56

* Ref. 10^{-6} mm/s. Originally an older specification for VdB gave values 20 dB smaller than those found here. (Due to a different dB reference level used.)

1) Long life is approximately 1000 to 10000 hours.

2) Short life is approximately 100 to 1000 hours.

3) When this level is reached, service is called for. Alternatively perform frequent octave analysis and refer to next column.

4) When this level is exceeded in any octave band repair immediately.