



This publication is intended as a service to building owners, architects and facilities managers by presenting topics of general interest to the industry. For more information please contact Stephen Redding at 713-237-9800. The information originates from established industry publications and other informed sources.

Watts Per Square Foot
Eight is more than enough

Many wonder why modern office tenants continue to request six to eight watts per square foot of low voltage power when studies show actual needs to be nearer one watt per square foot. Will a better understanding of office equipment loads resolve the difference between a tenant's request and what is actually needed?

In an effort to comprehend office electrical loads, a recording power monitor was connected to typical office equipment. The results of that survey are shown in

Equipment	Design Std Watts	Active Watts	Standby Watts	% Active	Avg. Usage Watts
Computer	250	242	161	10	169
Laser Printer	1,000	650	15	20	142
Copier	1,500	950	30	20	214
Fax	1,000	400	15	20	92
Refrigerator	1,000	525	0	33	173
Microwave	1,500	1,493	10	5	84
Coffeepot	1,500	1,469	159	5	224
Totals	7,750	5,729			1,098

Table 1, which clearly shows the disparity between loads derived from full load amps and average operating loads. Which should be used for design? The answer is both.

Electrical systems must be designed to handle the total connected load. Technically, these loads are the actual operating values for the equipment to be installed. Unfortunately, not all computers or printers are alike, and there isn't time to connect a power monitor to each one. Therefore, standards based on worst-case scenarios are used. The standard values also contain a reasonable margin of error to ensure adequate electrical service capacity.

Table 1 might give the mistaken impression that total connected load based on design standard watts will render a product near eight times the power of average usage. This is the case only if each person is lucky enough to have printer, fax, copier, refrigerator and coffeepot at their desk. Using equipment quantities typical for a 10,000-square-foot-office, total connected load and average usage per square foot are calculated in Table 2.

The resulting design value is very near the 3 watts per square foot available when typical lighting power requirements of 1.5 watts per square foot are subtracted from the 4.5 watts per square foot specified for offices by the National Electrical Code (NEC) for lighting and receptacle power.

Table 2 makes it clear that power requirements for a modern office are considerably less than the 8 watts per square foot requested by many tenants. Lease demands for power quantities significantly greater than the NEC minimum should therefore be reserved for special use facilities such as call centers or computer equipment rooms.

Equipment	Quantity	Design Std. Watts	Avg. Usage Watts	Design Std. Connected Watts	Avg. Usage Total Watts
Computer	50	250	169	12,500	8,450
Laser Printer	5	1,000	142	5,000	710
Copier	3	1,500	214	4,500	642
Fax	3	1,000	92	3,000	276
Refrigerator	2	1,000	173	2,000	346
Microwave	2	1,500	84	3,000	168
Coffeepot	2	1,500	224	3,000	449
Totals				33,000	11,041
Watts/sq.ft.				3.30	1.10

As stated previously, both total connected load and average power requirements should be used in design. When does average electrical loading apply? HVAC requirements are best calculated with average electrical equipment loads.

Doesn't air conditioning equipment also have to meet worst-case conditions? The cooling output in BTU hours must match the heat generated per hour by the electrical equipment. If the heat generated exceeds cooling capability for the instant that all printers run at the same time, the HVAC will continue to operate instead of tripping off-line like an overloaded electrical circuit breaker. More efficient HVAC systems result from design based on average electrical equipment load rather than total connected loads.

Using the sample 10,000-square-foot office space, the 9.4 tons of cooling required for total connected loads are reduced to 3.1 tons if the air conditioning system is sized for average electrical power usage. It would require 22.7 tons of air conditioning to compensate for electrical equipment loads if 8 watts per square foot are specified for the example office.

In new building construction, air conditioning cost goes up at a rate near \$2,500 per ton. Oversized air conditioning equipment uses more energy, causes greater temperature swings in controlled areas, and provides less satisfactory humidity control.

Money spent on oversized equipment and added operating expenses can better reside on the corporate bottom line. When specifying power for standard office environments, stick to the recommendations of the NEC. When sizing HVAC equipment, think average rather than connected electrical loads.