lighting machine shops, warehouses and draughting-rooms.

The following table gives the voltage, current, approximate spherical power, approximate power consumption per candle power, and the life of the various types of lamps. In the case of arc lamps the life applies to the time required to burn one or more electrodes:— not necessary under ordinary conditions, it is advantageous in case of a breakdown on one side, or in case it is desired to operate the system as two-wire. In the latter case the two outside wires are connected in parallel. The amount of copper required for a two-wire system as compared with a three-wire system using three wires of the same size is in the ratio of 1 to 0.35, the percentage loss being the same in each case.

In calculating the size of wire for a. c. circuits the inductance of both the load and the circuit itself must be taken into account. The inductance of the load is expressed by its power factor; i.e., the greater the inductance, the lower the power factor and the greater the current for a given amount of power. The power factor of incandescent lamps is .98 to .99, and for all practical purposes may be assumed to be unity. The power factor of arc lamps varies from .75 to .9, averaging about .85, while the average power factor of induction motors is about .80.

When the two wires forming a circuit are placed in one conduit so that they are not more than one inch apart, the inductance is so small that it may be neglected. The size of wire for such circuits may, therefore, be calculated by means of equation (35), care being exercised in each case to use the proper value for power factor in determining the current. When the wires are placed several inches apart the inductance of the circuit itself must be taken into account. To determine this accurately requires considerable labor, and is beyond the scope of this text.

In dealing with local circuits an allowance for the inductance of the circuit may be made by increasing the constant in equation (35) from 21.6 to 24 if the load consists of incandescent lamps only, to 26 if the load consists of lamps and motors, and to 28 for motors only. If the power factor of the load cannot be determined accurately the values given above will be found sufficiently close to meet the average case. These constants will not apply to long transmission lines. The inductance of the latter must be calculated accurately.

Local circuits in two-phase systems may be calculated in the same way as single-phase circuits by treating each phase as a simple circuit carrying one-half the total power. In the same way a three-phase system may be treated as two circuits with one common wire. The size of wires for either system may, therefore, be determined by changing the constant in equation (35) from 24 to 12 for incandescent lighting load, to 13 for a mixed load, and to 14 for a motor load only.

Example 19.—A number of 440-volt motors, aggregating 75 horse-power, power factor .8, are to be supplied from a distributing point located 500 feet from the switchboard. Allowing a drop of 4 per cent. in the feeder, what size of wire would be required (a) with a single-phase system, and (b) with a two or three-phase system?

(a) The current will be $I = \frac{75 \times 746}{440 \times .8} = 159$ amperes.

Section of wire required is $A = 2{,}800 \frac{159 \times 500}{4 \times 440}$

= 126,000 c.m.

(b) Section of wire is 126,000/2 = 63,000 c.m.

The following table gives the dimensions and resistance of pure copper wire (solid):—

Copper Wire Table.

A. W. G. or B. & S.	DIMENSIONS. Diameter. Inches.	Area. Circular mils.	WEIGHT. Lbs. per Ohm. @ 20 deg. C.	@ 50 deg. C.	LENGTH. Feet per lb.	Feet per Ohm. @ 20 deg. C.	@ 50 deg. C.	RESISTANCE. Ohms. per lb. @ 20 deg. C.	@ 20 deg. C.
0000	.460	211,600	13,090	11,720	1.561	20,440	18,290	.00007639	.00008535
000	.4096	167,800	8,232	7,369	1.969	16,210	14,510	.0001215	.0001357
00	.3648	133,100	5,177	4,634	2.482	12,850	11,500	.0001931	.0002158
0	.3249	105,500	3,256	2,914	3.130	10,190	9,123	.0003071	.0003431
1	.2893	83,690	2,048	1,833	3.947	8,083	7,235	.0004883	.0005456
2	.2576	66,370	1,288	1,153	4.977	6,410	5,738	.0007765	.0008675
3	.2294	52,630	810.0	725.0	6.276	5,084	4,550	.001235	.001379
4	.2043	41,740	509.4	455.9	7.914	4,031	3,608	.001963	.002193
5	.1819	33,100	320.4	286.7	9.980	3,197	2,862	.003122	.003487
6	.1620	26,250	201.5	180.3	12.58	2,535	2,269	.004963	.005545
7	.1443	20,820	126.7	113.4	15.87	2,011	1,800	.007892	.008817
8	.1285	16,510	79.69	71.33	20.01	1,595	1,427	.01255	.01402
9	.1144	13,090	50.12	44.86	25.23	1,265	1,132	.01995	.02229
10	.1019	10,380	31.52	28.21	31.82	1,003	897.6	.03173	.03545
11	.09074	8,234	19.82	17.74	40.12	795.3	711.8	.05045	.05636
12	.08081	6,530	12.47	11.16	50.59	630.7	564.5	.08022	.08962
13	.07196	5,178	7.840	7.017	63.79	500.1	447.7	.1276	.1425
14	.06408	4,107	4.931	4.413	80.44	396.6	355.0	.2028	.2266
15	.05707	3,257	3.101	2.776	101.4	314.5	281.5	.3225	.3603
16	.05082	2,583	1.950	1.746	127.9	249.4	223.3	.5128	.5729
17	.04526	2,048	1.226	1.098	161.3	197.8	177.1	.8153	.9109
18	.04030	1,624	.7713	.6904	203.4	156.9	140.4	1.296	1.448

Determination of Size of Wire.—In Canada and the United States the size of wires is specified either by B. & S. (Brown & Sharpe) gauge or by section in circular mils. Small wires are usually specified by gauge and large cable by section in circular mils. The current which the various wires are allowed to carry according to the National Code is shown in the following tables:—