FLUID POWER Design Data Sheet-

Womack

Revised Sheet 11 – Womack Design Data File

SELECTION GUIDE FOR ELECTRIC WIRE SIZE

Two Factors to be Considered

When choosing the conductor size for electrical wiring, there are TWO important factors which must be considered, and these are: (1), the safe current-carrying capacity without overheating, and (2), keeping the voltage loss to an acceptable minimum.

On short wiring runs, say up to 20 feet, the voltage loss is usually negligible, and need not be considered. Wire size should be selected solely for its current capacity as shown in Chart 1.

On longer runs, say several hundred feet or more, the voltage loss may be excessive even though the wire has been selected to carry the current without overheating. In this case, a wire of larger diameter should be used which will keep the voltage loss to a selected minimum. Voltage loss per 1000 feet is shown in Chart 2 according to wire size.

Permissible Voltage Loss

There is a voltage loss on any wiring run, and the designer must decide how much can be tolerated without seriously affecting performance. He must select a wire size which will keep the loss within the acceptable limit. Electric motors generally should not be operated at full load on less than 90% of nameplate voltage.

When deciding on acceptable voltage loss in the wiring, the minimum voltage available from the power line at certain periods of the day must be considered. For example, a motor rated at 230 volts should not be run at full load at less than 208 volts (10% less than nameplate rating). If line voltage may sometimes drop as low as 220 volts, the wiring should be designed for no more than 12 volts loss.

A rule-of-thumb is to design the wiring of sufficient size so the voltage drop will not exceed 5% of the input voltage.

Chart 1 – Wire Ampacity for Short Wiring Runs

"Ampacity" is an abbreviation for ampere capacity. This chart is for short wiring runs of less than 20 feet. Values in the chart are taken from the NEC (National Electrical Code) for wire sizes of No. 14 and larger wire. The current capacity depends on the type of insulation and on how the wire is installed – whether confined in a raceway or exposed to the open air. The chart is based on the use of low temperature insulation (140°F). Wire with high temperature insulation will carry higher current without damage to the insulation. For capacity of larger wires, consult the NEC code.

(Figures in the body of this chart are recommended maximum current ratings, in amperes)

Wire Size, B & S	18	16	14	12	10	8	6	4	3	2	1	0	00	000	0000
In Raceway or Cable	6	9	15	20	30	40	55	70	80	95	110	125	145	165	195
In Open Air	8	12	20	25	40	55	80	105	120	140	165	195	225	260	300

Chart 2 – Voltage Loss on Long Wiring Runs

The chart, on the opposite side of this sheet, is for long runs, several hundred feet or longer. Before using the chart, the operating conditions must be determined or decided on, which include the following:

(1). Current draw on the line must be determined.

(2). The amount of voltage loss which can be tolerated must be decided on.

(3). The length of wiring run must be measured or calculated using the sum of outgoing and return wire lengths.

On 3-phase devices such as electric motors, each of the three main wires must carry the current shown on the motor nameplate. However, the length of wiring run is the sum of two (not all three) connecting wires.

Read across the top of the chart to find the column which matches the amperage rating of the load. Figures in this column show voltage losses per 1000 feet of wire length, the sum of outgoing plus return. If, for example, the total wire length is 250 feet, losses would be 1/4th chart values, etc.

(See chart on opposite side of this sheet)

The National Electrical Code (NEC) has been adopted and is published by several agencies. Copies may be purchased by writing to the American National Standards Institute, Inc. (ANSI), 1430 Broadway, New York, N.Y. 10018, or to National Fire Protection Association (NFPA), 60 Batterymarch St., Boston, MA 02110. An amplified version with explanations accompanying the text is published by McGraw-Hill and may be ordered through any book store.

Chart 2 – Figures in body of chart show voltage loss per 1000 feet of wiring run.

Wire Size B & S	Current Flow, Amperes												
	5	10	15	20	25	30	40	50	60	70	80	90	100
18	32.55	65.10	97.65	130.2	162.8	195.3	260.4	325.5	390.6	455.7	520.8	585.9	651.0
16	20.47	40.94	61.41	81.88	102.4	122.8	163.8	204.7	245.6	286.6	327.5	368.5	409.4
14	12.88	25.75	38.63	51.50	64.38	77.25	103.0	128.8	154.5	180.3	206.0	231.8	257.5
12	8.095	16.19	24.28	32.38	40.48	48.57	64.76	80.95	97.14	113.3	129.5	145.7	161.9
10	5.090	10.18	15.27	20.36	25.45	30.54	40.72	50.90	61.08	71.26	81.44	91.62	101.8
8	3.203	6.405	9.608	12.81	16.02	19.22	25.62	32.03	38.43	44.84	51.24	57.65	64.05
6	2.014	4.028	6.042	8.056	10.07	12.08	16.11	20.14	24.18	28.21	32.24	36.27	40.30
4	1.267	2.533	3.800	5.068	6.335	7.602	10.14	12.68	15.22	17.75	20.29	22.82	25.36
3	1.005	2.009	3.014	4.020	5.025	6.030	8.040	10.05	12.07	14.08	16.09	18.10	20.11
2	0.796	1.593	2.390	3.184	3.980	4.776	6.368	7.960	9.552	11.14	12.74	14.33	15.92
1	0.632	1.264	1.896	2.528	3.160	3.792	5.056	6.320	7.584	8.848	10.11	11.38	12.64
0	0.501	1.002	1.503	2.004	2.505	3.006	4.008	5.010	6.012	7.014	8.016	9.018	10.02
00	0.398	0.796	1.193	1.592	1.990	2.388	3.184	3.980	4.776	5.572	6.368	7.164	7.960
000	0.315	0.630	0.945	1.260	1.575	1.890	2.520	3.150	3.780	4.410	5.040	5.670	6.300
0000	0.250	0.500	0.750	1.000	1.250	1.500	2.000	2.500	3.000	3.500	4.000	4.500	5.000

SAFETY UNLOADING OF ACCUMULATORS

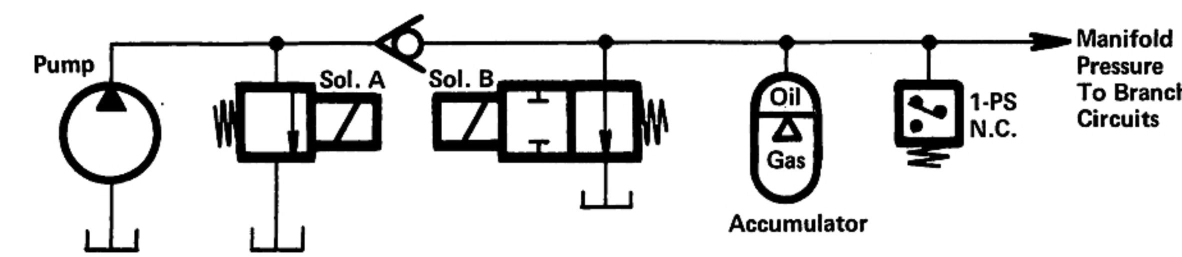

Figure 1. Typical Accumulator Hydraulic Circuit With Automatic Bleed-Down

Figure 1. An accumulator contains a highly compressed gas and can be potentially hazardous in a hydraulic system. It may retain its charge long after the system has been shut down. Service personnel may not be aware of the presence of an accumulator, and could be injured by high pressure oil if a fitting is loosened. A safety circuit should be used which will automatically discharge the accumulator when the system is shut down or the electric motor is stopped.

Solenoid Valve B, which is a 2-way, normally open type, will bleed off the accumulator every time the electric motor is stopped. It can be a miniature size, 1/8 or 1/4", single solenoid type. Solenoid A is part of the system relief valve which is a pilot-operated relief with solenoid dump, which unloads the pump when the accumulator comes up to pressure.

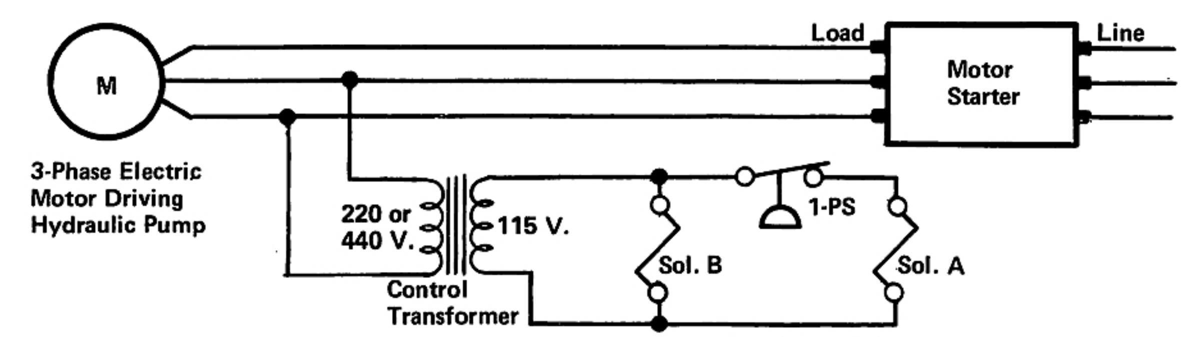

Figure 2. Electrical Circuit for Accumulator Bleed-Down and Pump Unloading

Figure 2. Solenoid Valve B is wired into the electric motor circuit, and opens to bleed off the accumulator when the electric motor is stopped.

Solenoid A is wired through a pressure switch. When the accumulator comes up to full charge, the pressure switch contacts open, breaking the circuit to Solenoid A and allowing the pump to dump through the relief valve.

The solenoids receive electrical power through a control transformer which takes power from one phase and steps the voltage down if necessary.

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