Sizing The DOL Motor Starter Parts (Contactor, Fuse, Circuit Breaker and Thermal Overload Relay)

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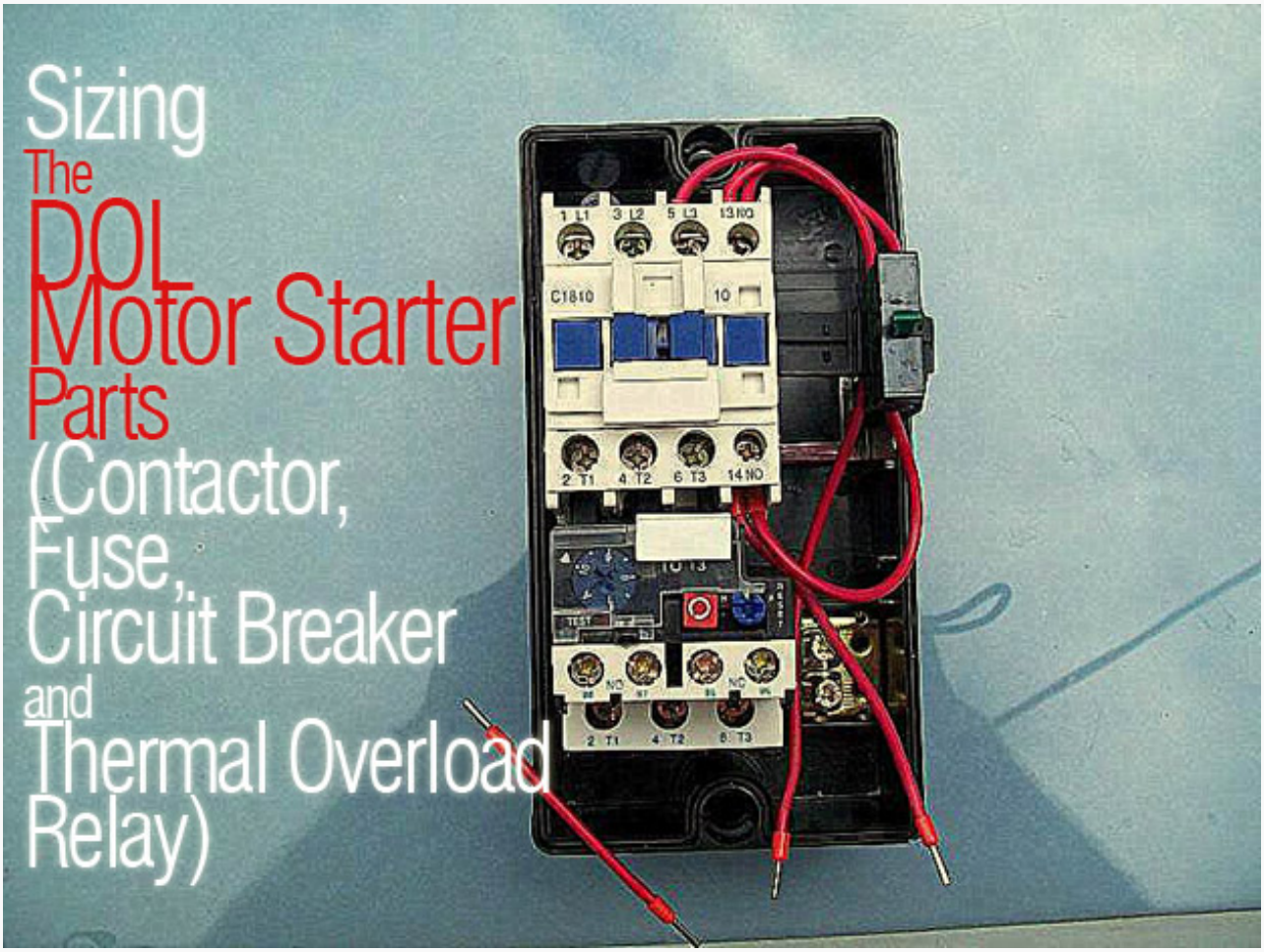

Sizing The DOL Motor Starter Parts (Contactor, Fuse, Circuit Breaker and Thermal Overload Relay)

Calculate size of each part of DOL motor starter for the system voltage 415V, 5HP three phase house hold application induction motor, code A, motor efficiency 80%, motor RPM 750, power factor 0.8 and overload relay of starter is put before motor.

Basic Calculation of Motor Torque and Current

- **Motor Rated Torque (Full Load Torque) = 5252xHPxRPM**
- Motor Rated Torque (Full Load Torque) = 5252x5x750 = 35 lb-ft.
- **Motor Rated Torque (Full Load Torque) = 9500xKWxRPM**
- Motor Rated Torque (Full Load Torque) = 9500x(5×0.746)x750 = 47 Nm
- If Motor Capacity is less than 30 KW than Motor Starting Torque is 3xMotor Full Load Current or 2X Motor Full Load Current.
- **Motor Starting Torque = 3xMotor Full Load Current.**

- Motor Starting Torque = 3×47 = 142Nm.
- **Motor Lock Rotor Current = 1000xHPx figure from below Chart/1.732×415**

Locked Rotor Current

Code	Min.	Max.
A	1	3.14
B	3.15	3.54
C	3.55	3.99
D	4	4.49
E	4.5	4.99
F	5	2.59
G	2.6	6.29
H	6.3	7.09
I	7.1	7.99
K	8	8.99
L	9	9.99
M	10	11.19
N	11.2	12.49
P	12.5	13.99
R	14	15.99
S	16	17.99
T	18	19.99
U	20	22.39
V	22.4	

- As per above chart Minimum Locked Rotor Current = 1000x5x1/1.732×415 = 7 Amp
- Maximum Locked Rotor Current = 1000x5x3.14/1.732×415 = 22 Amp.
- **Motor Full Load Current (Line) = KWx1000/1.732×415**
- Motor Full Load Current (Line) = (5×0.746)x1000/1.732×415 = 6 Amp.
- **Motor Full Load Current (Phase) = Motor Full Load Current (Line)/1.732**
- Motor Full Load Current (Phase) = 6/1.732 =4Amp
- **Motor Starting Current = 6 to 7xFull Load Current.**
- Motor Starting Current (Line) = 7×6 = 45 Amp

1. Size of Fuse

Fuse as per NEC 430-52

Type of Motor	Time Delay Fuse	Non-Time Delay Fuse
Single Phase	300%	175%
3 Phase	300%	175%
Synchronous	300%	175%
Wound Rotor	150%	150%
Direct Current	150%	150%

- **Maximum Size of Time Delay Fuse = 300% x Full Load Line Current.**
- Maximum Size of Time Delay Fuse = 300%x6 = 19 Amp.
- **Maximum Size of Non Time Delay Fuse = 1.75% x Full Load Line Current.**
- Maximum Size of Non Time Delay Fuse = 1.75%6 = 11 Amp.

2. Size of Circuit Breaker

Circuit Breaker as per NEC 430-52

Type of Motor	Instantaneous Trip	Inverse Time
Single Phase	800%	250%
3 Phase	800%	250%
Synchronous	800%	250%
Wound Rotor	800%	150%
Direct Current	200%	150%

- **Maximum Size of Instantaneous Trip Circuit Breaker = 800% x Full Load Line Current.**
- Maximum Size of Instantaneous Trip Circuit Breaker = 800%x6 = 52 Amp.
- **Maximum Size of Inverse Trip Circuit Breaker = 250% x Full Load Line Current.**
- Maximum Size of Inverse Trip Circuit Breaker = 250%x6 = 16 Amp.

3. Thermal Overload Relay

Thermal Overload Relay (Phase):

- **Min. Thermal Overload Relay setting = 70%x Full Load Current(Phase)**
- Min. Thermal Overload Relay setting = 70%x4 = 3 Amp
- **Max. Thermal Overload Relay setting = 120%x Full Load Current(Phase)**
- Max. Thermal Overload Relay setting = 120%x4 = 4 Amp

Thermal Overload Relay (Phase):

- **Thermal Overload Relay setting = 100% x Full Load Current (Line).**
- Thermal Overload Relay setting = 100%x6 = 6 Amp

4. Size and Type of Contactor

Application	Contactor	Making Cap
Non-Inductive or Slightly Inductive ,Resistive Load	AC1	1.5
Slip Ring Motor	AC2	4
Squirrel Cage Motor	AC3	10
Rapid Start / Stop	AC4	12
Switching of Electrical Discharge Lamp	AC5a	3
Switching of Electrical Incandescent Lamp	AC5b	1.5
Switching of Transformer	AC6a	12
Switching of Capacitor Bank	AC6b	12
Slightly Inductive Load in Household or same type load	AC7a	1.5
Motor Load in Household Application	AC7b	8
Hermetic refrigerant Compressor Motor with Manual O/L Reset	AC8a	6
Hermetic refrigerant Compressor Motor with Auto O/L Reset	AC8b	6
Control of Restive & Solid State Load with opto coupler Isolation	AC12	6
Control of Restive Load and Solid State with T/C Isolation	AC13	10
Control of Small Electro Magnetic Load (<72VA)	AC14	6
Control of Small Electro Magnetic Load (>72VA)	AC15	10

As per above chart:

- **Type of Contactor = AC7b**
- **Size of Main Contactor = 100%X Full Load Current (Line).**
- Size of Main Contactor = 100%x6 = 6 Amp.
- **Making/Breaking Capacity of Contactor = Value above Chart x Full Load Current (Line).**
- Making/Breaking Capacity of Contactor = 8×6 = 52 Amp.

Source: http://electrical-engineering-portal.com/sizing-the-dol-motor-starter-parts-contactor-fuse-cb-thermal-overload-relay