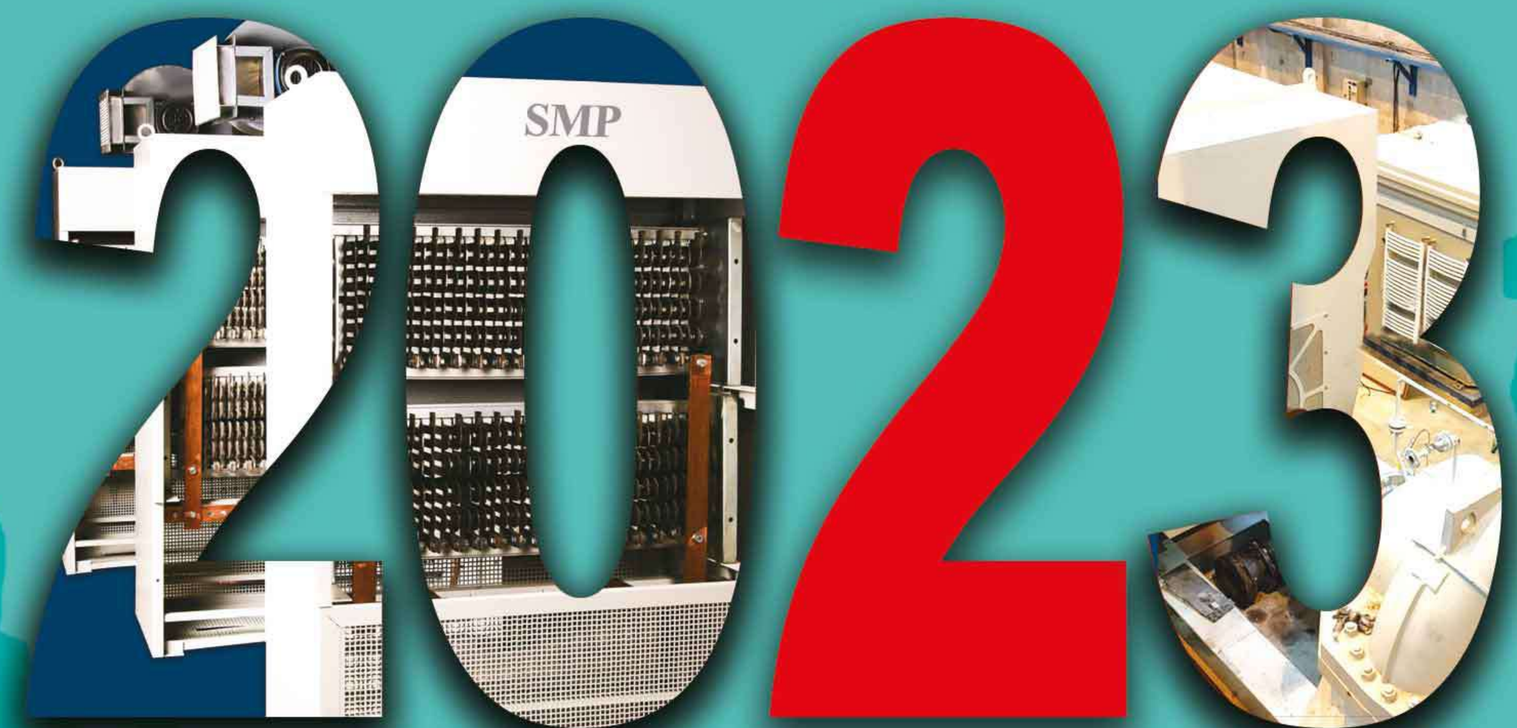


STARTERS & INDUSTRIAL RESISTORS

SMP GROUP

Liquid Rheostat (Resistor)
Double Liquid Starter
Oil Cooled Starter
Reducer Speed Resistor

Damping Resistor
Slip Resistor
Resistance Box
Crane Brake Resistor

Water Pump Station
Ball Mill & Hummer Mill
Grinding Mill & Roller Mill
Crusher
ID Fan & EP Fan
Conveyor Belt

Design And Production
Of Technical Equipment

Starters Of Electrical Motors

SMP

GROUP

www.smpir.com

DESIGNED BY:
M.Khodadad 09133252340

TABLE OF CONTENTS

No . Page

Oil Cooled Starter

64

Resistor for drive engineering

90

Brake Resistor

94

TABLE OF CONTENTS

No .
Page

SMP is one of the chief leaders in producting variuse technical equipment and providing consulting service,We work hard to earn our customers trust by delivering exeptional consistent quality and top notch service.With more than three-decades of experience our company is proud of making you feel confident that you are getting the best quality and service available.

Seyed Mohsen Poursaeed

SMP
GROUP

SMP GROUP

Design & Production Of Technical Equipment

SOME OF OUR COSTUMERS:

SMP GROUP

Design and Production of Technical Equipment

Due to our know-how, we can design and customize products to fit our customer's requirements precisely.
SMP products, bearing the highest technical quality, are meant to meet the requirements to the standards with the most competitive prices in the market.

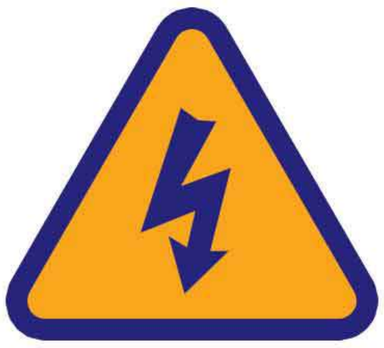
SMP company with 30 years of experience and a strong technical and scientific team, and using the latest equipment, operates in the field of designing and manufacturing all kinds of resistors and precision instrument sensors for industrial use.


SIEMENS
SIRIUS

THE UNIT THE FOLLOWING STANDARDS:

- EN IEC 61439-1:2020: Low voltage switchgear and control gear assemblies part 1
- EN 60204-1:2003: Electrical equipment of industrial machines, part 1.
- EN 60470:2001, IEC 60470:2000 High-voltage alternating current contactors and contactor-based motor starters
- DIN / VDE 0101/ 0111
- IEC 61131-2 Equipment Requirements and Tests
- IEC 60071-1 Insulation co-ordination
- IEC 60255-1:2009 Measuring relays and protection equipment
- IEC 60947 Low-voltage switchgear and control gear

Protection: IP54 acc. to DIN EN 60529:2014-09
Indoor outdoor (optional)



SAFETY INSTRUCTIONS:

- Use the personal protective equipment: safety glasses, safety shoes, …
- Do not remove the cover while power is applied or the unit is in operation.
- Do not open the cover except for periodic inspections or wiring, even if the input power is not applied.
- Operate the resistors with dry hands.
- Make sure that the cover is closed after repair or inspection.
- Do not clean the equipment with acidic material.
  protect power cables, plugs, sockets and any other connectors for wear or damage.
- Ensure that the insulation on all cables and on the appliance is safe before connecting it to the power supply.
- Ensure that cables are always protected against short circuit and overload.
- Don't pull or carry the appliance by the power cable.
- Don't use worn or damaged cables, plugs or connectors. Immediately have any faulty item repaired or replaced by a qualified electrician.
- After wiring, check that there are no bare wires, that all wires have been correctly connected, that the cable outer insulation extends beyond the cable restraint and that the restraint is tight.
- Ensure that the work area is well ventilated as the gases produced are flammable.
- Remove personal metallic items such as rings, bracelets, necklaces and watches.
- The unit is adjusted during commissioning and should only be serviced by qualified personnel.

SMP ADVANCES FEATURES

The Liquid resistance starters design & manufacture by SMP has many advantage:

1. All the parts used in the starter are produced in SMP, so it can be designed and manufactured based on the technical specifications of the applicant and in order to adapt to the technical needs of the customer
2. The starters and the individual components used within them are adaptable to Extremely Weather Conditions. Whether in the snow fields, or the desert regions of the outback,
3. The starters are operating almost maintenance free. The range of liquid resistance starters are designed for controlling of kW to MW slip ring motors and extended, up to 10000 kW, or any higher rating required.
4. SMP's unique design, with movement of the moving contact system prevents from regular mechanical problem.
5. SMP's direct involvement in all elements of production from conception through to design and manufacturing ensures a superior level of quality control, consistency of product that promise.
6. By means of its logistics services SMP guarantee the availability of a high-quality spare parts service.
7. Moreover, via the unique moving electrode system greatly extend the mechanical life of the motor and driven machine.
8. Robust and non-flammable construction
9. Simple in operation
10. Low maintenance costs
11. The insulation cover is unbreakable
12. Electrode insuldtion cover permeability is %0
13. The accordion cover on the electrode axis poerents the penetration of dust and pollution.
14. Separate cabinets for control and feed.

KEY BENEFITS

- Simple, easy to understand technology
- Optimum control over starting current, motor torque and load acceleration.

- Ability to create maximum torque at start time
- Ability to production current at least during start time
- Minimal structural resistance changes in successive starts
- Soft and continuous flow reduction by increasing the rotor speed to achieve normal operating conditions
- Soft and continuous reduction of external rotor resistance during Start period
- Minimum stress in the internal mechanism
- Minimum mechanical stresses on the load connected to the motor
- High reliability
- No need for specialist electrical personnel or equiment
- Low maintenance
- Long service life
- Ideal for down time critical plant

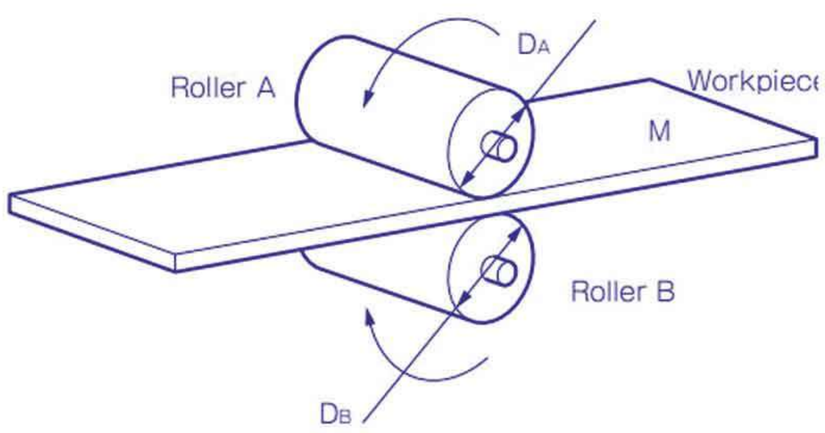
MOMENT OF INERTIA

The involved moment of inertia or flywheel mass is the size of the flywheel, connected to the motor axis. An application with a small moment of inertia is usually called a normal start while an application with a big moment of inertia is called a heavy duty start.

Normal start
Small moment of inertia, short starting time
Examples of applications are pumps, compressors, bow thrusters and short conveyor belts.

Heavy duty start
Big moment of inertia, long starting time
Examples of applications are fans, crushers, mills and long conveyor belts.

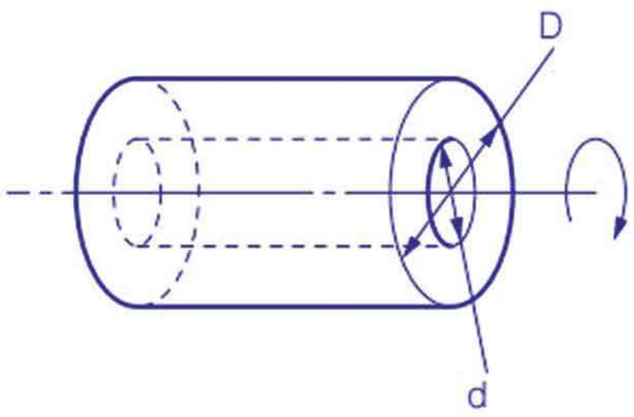
Moment Of Inertia when a Workpiece Is Held by the Rollers



J_A: Moment of inertia of the roller (kg.m²)
J_B : Moment of inertia of the roller (kg.m²)
D_A: Diameter of the roller A (m)
D_B: Diameter of the roller B (m)
M:Equivalent mass of the workpiece (kg)

$$J = J_A + \left(\frac{D_A}{D_B}\right)^2 J_B + \frac{1}{4} M.D_A^2 \ (kg.m^2)$$

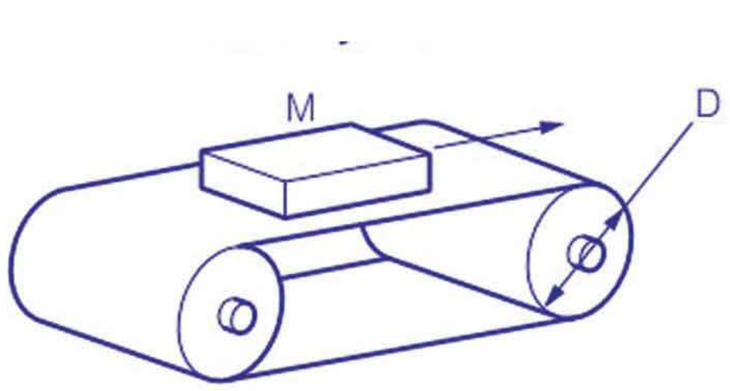
Moment Of Inertia Of a Hollow Cylinder



D: Outer diameter of the cylinder (m)
d: Inner diameter of the cylinder (m)
M: Mass of the cylinder (kg)

$$J = \frac{1}{8} M (D^2+d^2) \ (kg.m^2)$$

Moment Of Inertia Of the Belt Conveyor



J_A: Moment of inertia for a roller (kg.m^2)

M: Mass of the load (kg)

D: Diameter of the roller (m)

$$J = J_A + (\frac{1}{4})\ M.D^2\ (kg.m^2)$$

Motor Shaft Conversion Moment Of Inertia

Z_1: Teeth number of the motor -side gear

Z_2: Teeth number of the Load-side gear

R: Gear ratio Z_1/Z_2

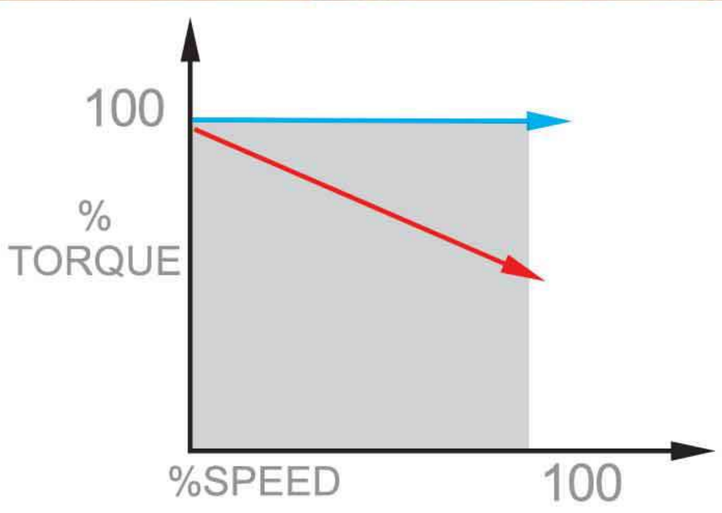
J_A: Moment of inertia of load (kg.m^2)

J_1: Moment of inertia of motor-side gear (kg.m^2)

J_2: Moment of inertia of load-side gear (kg.m^2)

$$J = J_1 + (J_A + J_2)\ R^2\ (kg.m^2)$$

BALL MILL



There are different types of industrial mills. A ball mill consists of a hollow cylindrical shell rotating about its axis. The axis of the shell may be either horizontal or at a small angle to the horizontal. It is partially filled with balls. The grinding media are the balls, which may be made of steel (chrome steel), stainless steel, ceramic, or rubber. Roller mills are mills that use cylindrical rollers, either in opposing pairs or against flat plates, to crush or grind various materials, such as grain, ore, gravel, plastic, and others. This program requires high torque and the ratio of load torque to rated torque is 1.4.

These loads are components of constant power loads. Constant horsepower loads require high torque at low speeds and low torque at high speeds, which means constant horsepower at any speed.

Constant horsepower loads include grinders, winding machines and lathes. For constant horsepower loads, the torque loading is a function of speed up to 100% operating speed. As the speed of the operation is decreased, the torque increases so that the horsepower required remains essentially constant. (heavy duty start)

CRASHER & CONVEYOR

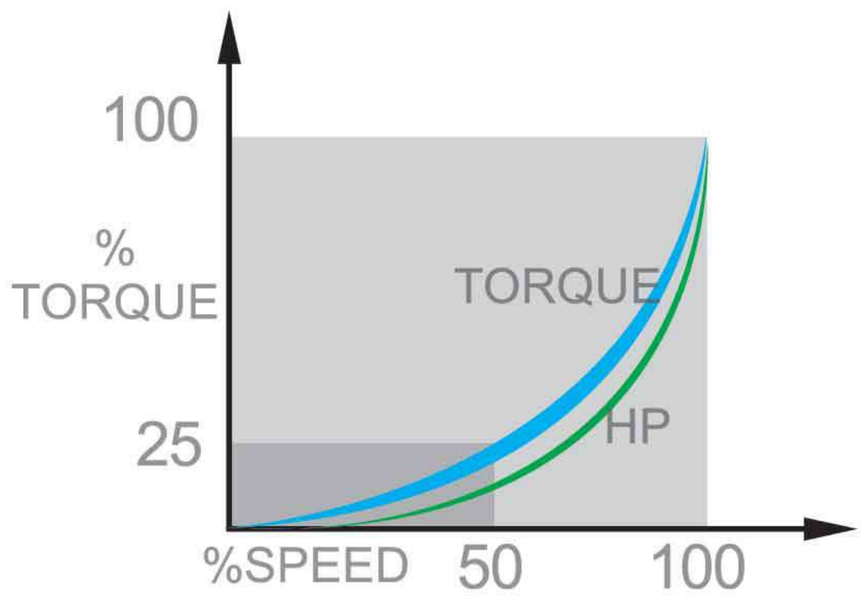
Crusher is a kind of machinery that is widely used in the cement production industry. It is mainly used in the material preparation process to crush the raw materials into proper size particles. These loads are components of constant power loads. This program requires high torque and the ratio of load torque to rated torque is larger than 1.4.

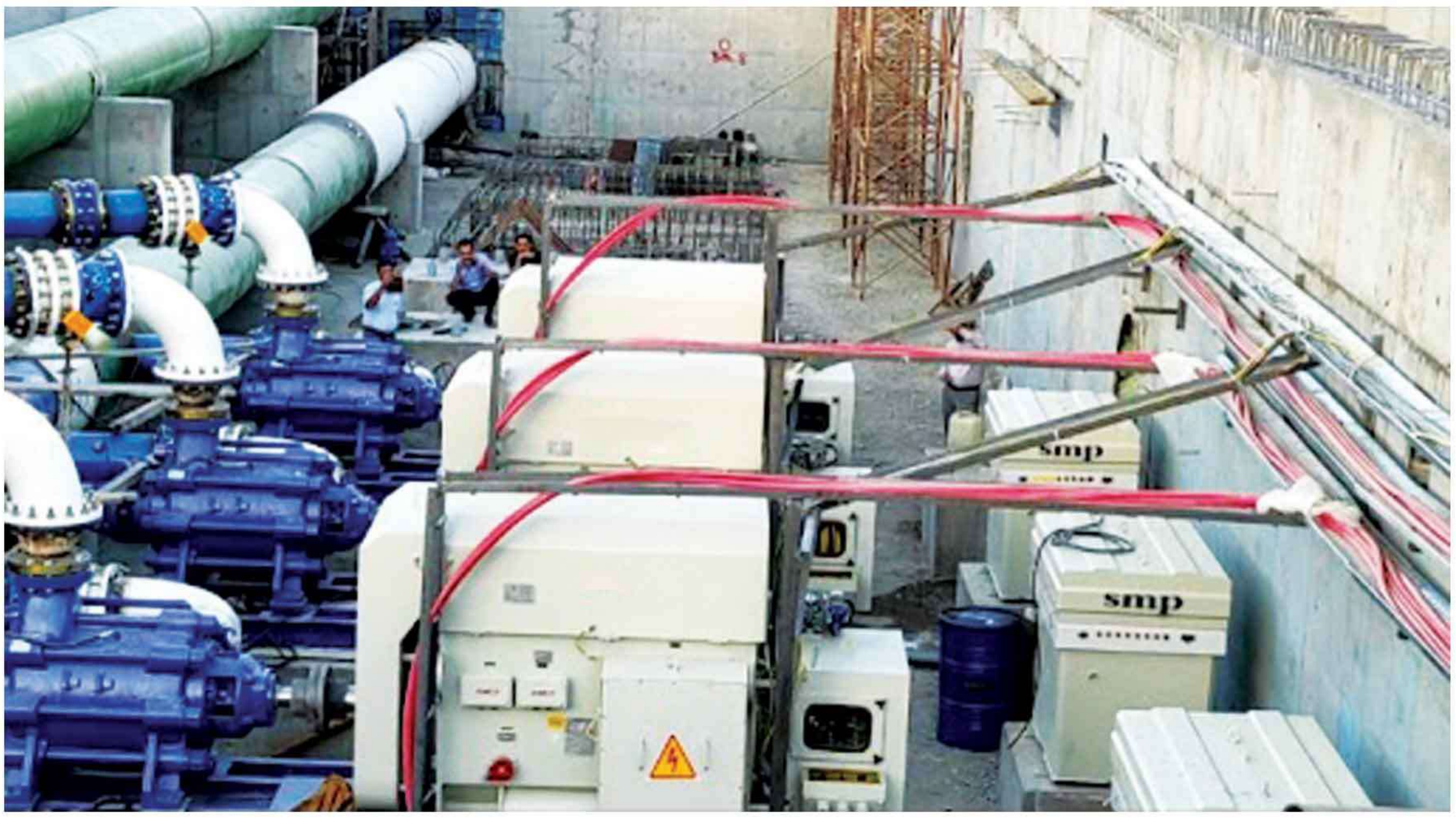
Conveyors are durable and reliable components used in automated distribution and warehousing, as well as manufacturing and production facilities. Belt conveyors are the most commonly used powered conveyors because they are the most versatile and the least expensive. These loads are components of constant torque loads. Constant torque loads require the same amount of torque at low speeds as at high speeds.

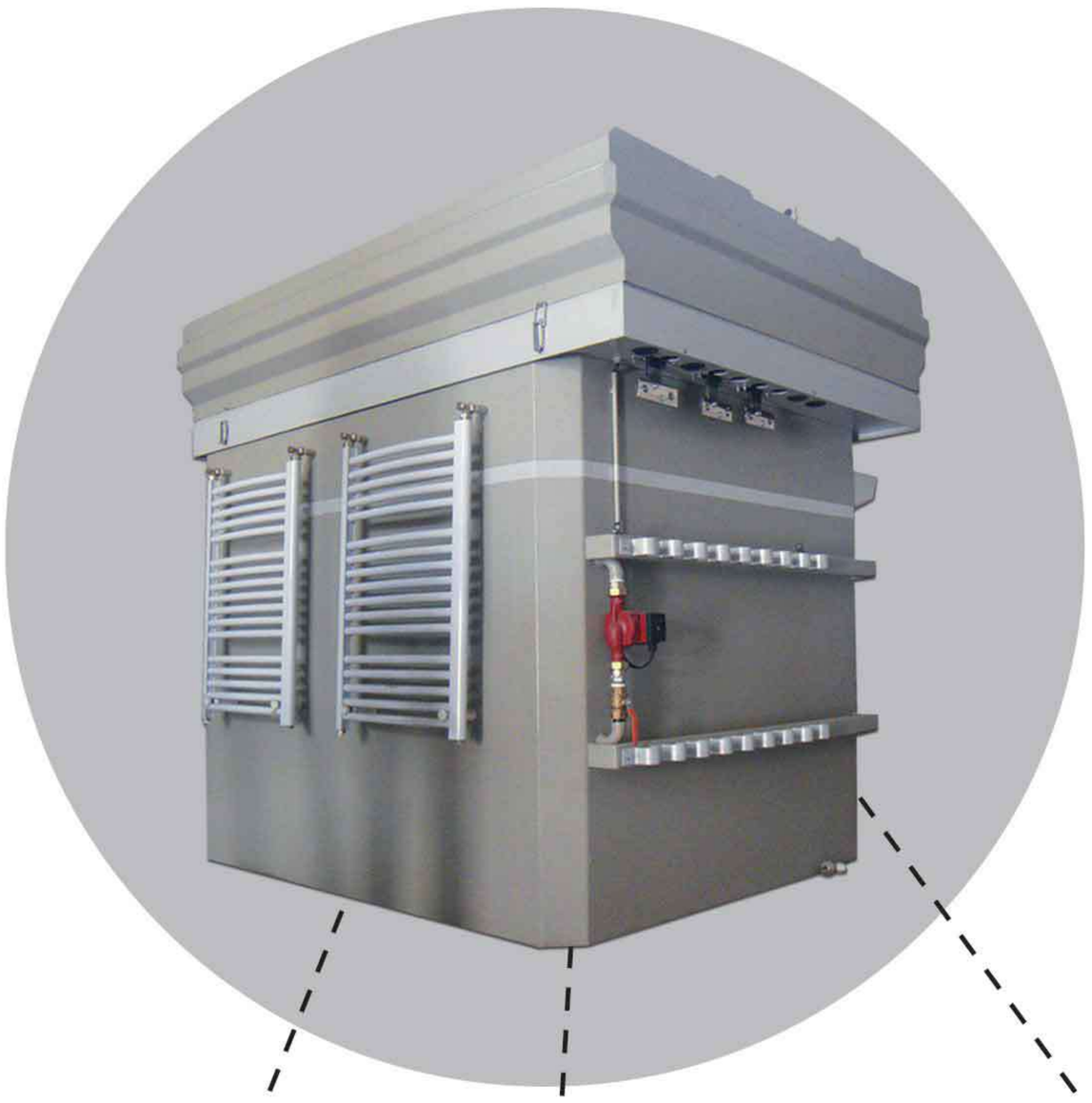
Torque remains constant throughout the speed range, and the horsepower increases and decreases in direct proportion to the speed. Constant torque loads include most positive displacement and reciprocating pumps and compressors as well as traction drives and conveyors. With constant torque loads, the torque is not a function of speed. As speed is changed, the load torque will remain fairly constant and the horsepower will change linearly with the speed.

PUMP & FAN

Centrifugal pumps are commonly used for pumping water, solvents, organics, oils, acids, bases, and any ‘thin’ liquids in both industrial, agricultural and domestic applications. This program requires a semi-torque and the load torque`s ratio to rated torque is less than 1. These loads are components of Variable torque loads. Variable torque loads require much lower torque at low speeds than at high speeds. The torque required varies as the square of the speed and the horsepower required varies as the cube of the speed. Variable torque loads include most centrifugal and axial pumps, fans and blowers and many mixers and agitators. As the speed is decreased, the torque will decrease by the square of the speed decrease and the horsepower required decreases by the cube of the speed decrease. (normal)








SMP


smp

SMP GROUP

Vertical Liquid Starter

Vertical liquid starter is used to start the 3 phase wound rotor induction motor without the motor current exceeding the allowable range.

Liquid starters store the heat generation during the starting process and slowly release it through their surface.Because the electrolyte is composed of water and sodium carbonate, it can absorb a lot of heat from the resistor. Starting requirements such as electrolyte quality and electrode depth.

The energy to volume ratio is high in this starter.These starters are almost 20-25% more economical than a conventional contactor and timer-operated oil-cooled rheostatic starters discussed earlier.

APPLICATION

Suitable for using with wide range of heavy industrial machines such as;

- Cement and hammer mills
- fans and compressors
- crushing
- ventilation
- pumps
- shredders
- rolling mills
- wood grinders
- boiler feed pumps
- pony motors for gas turbines
- mines
- cement plants
- water treatment

associated industries.

MOUNTING

- The device should be mounted on a flat surface.
- The device must be installed away from vibration, inflammation, mechanical stress.
- The device should be mounted near their motors.
- The device must be transported with empty tank.
- For device transportation, use the lifting eye embedded on the cover.
- A space of is necessary around the SMP starter to provide access to the tank (for cover removal) and to avoid a reduction in heat dissipation. A minimum of 1 m clear above the equipment is necessary for the same reason. It is worth noting that the contactor enclosure must be removed when inspecting or replacing the electrodes.
- If these distances are reduced, maintenance and operations will become considerably more difficult, (it may be impossible in certain cases, without moving the starter) likewise, the thermal characteristics of the starters would be derated
- Do not put anything on around the SMP starter.
- To replace the steel electrodes with cast electrodes, it is necessary to perform a modification on the mechanism support.

ADVANCES FEATURES

- The starters and the individual components used within them are adaptable to Extreme Weather Conditions. Whether in the snow fields, or the desert regions of the outback,
  the starters are operating almost maintenance free. The range of liquid resistor starters are designed for controlling of large kW to MW slip ring motors and extended, up to 10000 kW, or any higher rating required.
- SMP's unique design, with horizontal movement of the moving contact system prevents from regular mechanical problems.
- SMP's direct involvement in all elements of production from conception through to the design and manufacturing ensures a superior level of quality control, consistency of product that promise high efficacy and dependable results.
- By means of its logistics services SMP guarantees the availability of a high-quality spare parts service. Moreover, the mechanical life time of the motor and driven machine are substantially extended via the uniqe horizental moving electrode system.
- Robust and non-flammable construction
- Simple in operation
- Low maintenance costs
- Due to the shape of the electrodes and more compatibility with the nature of the electric current in the electrolyte, best resistor changes are made and it can have positive effects on increasing the life of the electrode.
- In liquid starters, unlike oil-cooled starters, the resistance is density , and this resistance in the vertical type has more symmetry, which further reduces the mechanical fluctuations in the load and the motor.
- Due to the mechanism of reducing the starter resistance, the moving parts of the electrode are placed in water. Therefore, to deal with the destructive effects of water on moving parts, the material and connections of the electrode drive system are protected against scale and corrosion.

Operation

Three-phase asynchronous motors can be considered among the most reliable electrical machines. they carry out their function for many years with reduced maintenance and adapt themselves to different performances according to the requirements of both production as well as service applications.

Direct-on-line starting, which is often abbreviated as DOL, is perhaps the most traditional system and consists in connecting the motor directly to the supply network, thus carrying out starting at full voltage.

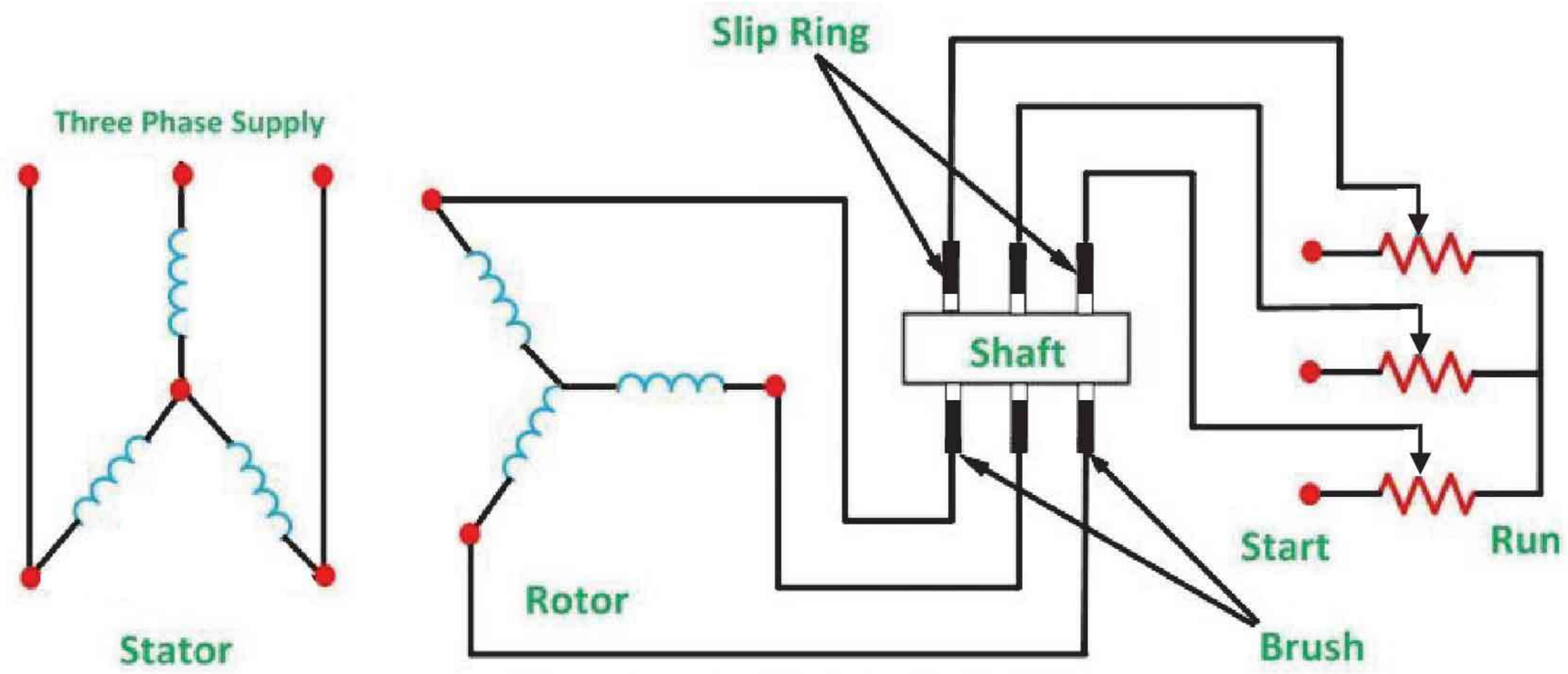
Direct-on-line starting represents the simplest and the most economical system to start an asynchronous motor and it is the most used. it provides the direct connection to the supply network and therefore starting is carried out at full voltage and with constant frequency, developing a high starting torque with very reduced acceleration times.

The typical applications are relevant to small power motors also with full load starting. These advantages are linked to some problems such as the high inrush current, which in the first instants can reach values of about 10 to 12 times the rated current, then can decrease to about 6 to 8 times the rated current and can persist to reach the maximum torque speed.

The effects of such currents can be identified with the high electro-dynamical stresses on the motor connection cables and could affect also the windings of the motor itself; besides, the high inrush torques can cause violent accelerations which stress the transmission components (belts and joints) generating distribution problems with a reduction in the mechanical life of these elements.

Finally, also the possible electrical problems due to voltage drops on the supply line of the motor or of the connected equipment must be taken into consideration.

Further it is possible to generate a smoother starting curve which protects electrical as well as mechanical components of the application and the motor and assures a smooth startup of the system. In order to overcome the disadvantage many starting technique was presented.



Among various techniques, the method of rotor resistor control has been widely used for the medium and large wound-rotor induction motors, especially when high starting torque is required or long starting periods are encountered.

It is found that excellent starting performance is obtained by controlling the rotor resistance properly. Besides, adjustable speed operation can also be provided by this method. Conventionally, rotor resistance control scheme is achieved by connecting a set of three-phase resistor to the rotor circuit via slip rings to increase the rotor resistance so that the inrush current is reduced and the starting torque is increased during the starting period. The resistor is designed to match the load conditions in the entire run-up period.

During this period, the resistors are decreases slowly to permit the motor to come up to the operating speed under the constraint of the current limitation and torque requirement.

Types of AC Motor Starting Method

1. DIRECT–ON–LINE STARTER OR DOL STARTER

Applications of Direct-on-line Start or DOL Start:

I. DOL start are used with up to 7.5 KW Induction Motors.

II. DOL start acts as normally ON/OFF switch so it is used where frequently start and stop of the motor is required.

III. DOL start are used to conveyor belt and compressor.

Advantages of Direct-on-line Start or DOL Start:

I. It is very simple in construction.

II. It is reliable than other start.

III. It can give overload and short-circuit protection.

Disadvantages of Direct-on-line Start or DOL Start:

I. It cannot be used with more than 7.5 kW motors.

II. It cannot reduce the magnitude of starting current of the motor acts only normal ON/OFF switch.

2. STATOR RESISTANCE STARTER

Applications of Stator Resistance Starter:

I. This types of starter are suitable for more than 7.5 KW rating motors.

Advantages of Stator Resistance Starter:

I. It is very simple in construction.

II. It reduces the terminal voltage of the motor during the starting time hence the starting current also decreases.

III. It is also a low-cost starter.

Disadvantages of Stator Resistance Starter:

I. It lowers the starting torque of the motor.

II. It increases the accelerating time of the motor

III. A huge amount of power loss in by the starting resistance.

3. AUTO TRANSFORMER STARTER

Advantages of Auto-Transformer Starter:

I. Simple operation
II. Very low power loss as it has no resistance
III. Easy to control

Disadvantages of Auto-Transformer Starter:

I. It lowers the starting torque of the motor
II. There is a chance of sparking.

4. STAR–DELTA START

Applications of Star-Delta Start:

It used in heavy industries for starting high power motors.

Advantages of Star-Delta Start:

I. Star-delta start can be controlled automatically by using electronic circuits
II. Low power losses
III. Smooth operation
IV. Starting current is reduced to one-third of full load current

Disadvantages of Star-Delta Start:

I. Low starting torque
II. Six terminals motor required.

5. ROTOR RESISTANCE STARTER

Application of Rotor Resistance starter:

I. These starters are used to start slip-ring induction motors.

Advantages of Rotor Resistance starter:

I. It cannot decrease starting torque.
II. Smooth speed control is possible.

Different types of starters such as liquid starter, oil cooled starter and dry resistor are recommended for this purpose.

LIQUID STARTER

Electrolytic starter is one of the best slip ring motor starting method and can be used to start slip ring motors from 500 kW to 20,000 kW.

For liquid starters, the electrolyte solution of Na_2CO_3 acts as resistor, which resistivity in turn depends on the soda concentration. By changing the distance between upper and lower electrodes, the resistance is reduced smoothly. The starter slowly decreases the resistance, ensuring a progressive starting of the driven machine, unlike step starting due to starters with fixed electrodes. At the end of the starting process, the resistance is short circuited.

Following the liquid starter, the energy is then slowly dissipated to the atmosphere over the tank surface (heat exchanger for faster cooling can be supplied optionally).

NOTE

Feel free to contact us and explain us about your requirements (Use the section Necessary information to quote a starter), our staff will quote the suitable starter and the eventual necessary options.

ELECTROLYTE

The liquid starter needs an inexpensive and simple solution of sodium carbonate and water as an electrolyte various concentrations of sodium carbonate are normally employed for varying the base resistance.The electrolyte level is monitored by a float switch and the temperature is controlled by thermostats, thus eliminating the costly and scarce insulating oil.liquid starter needs inexpensive and simple solution of sodium carbonate and water as an electrolyte

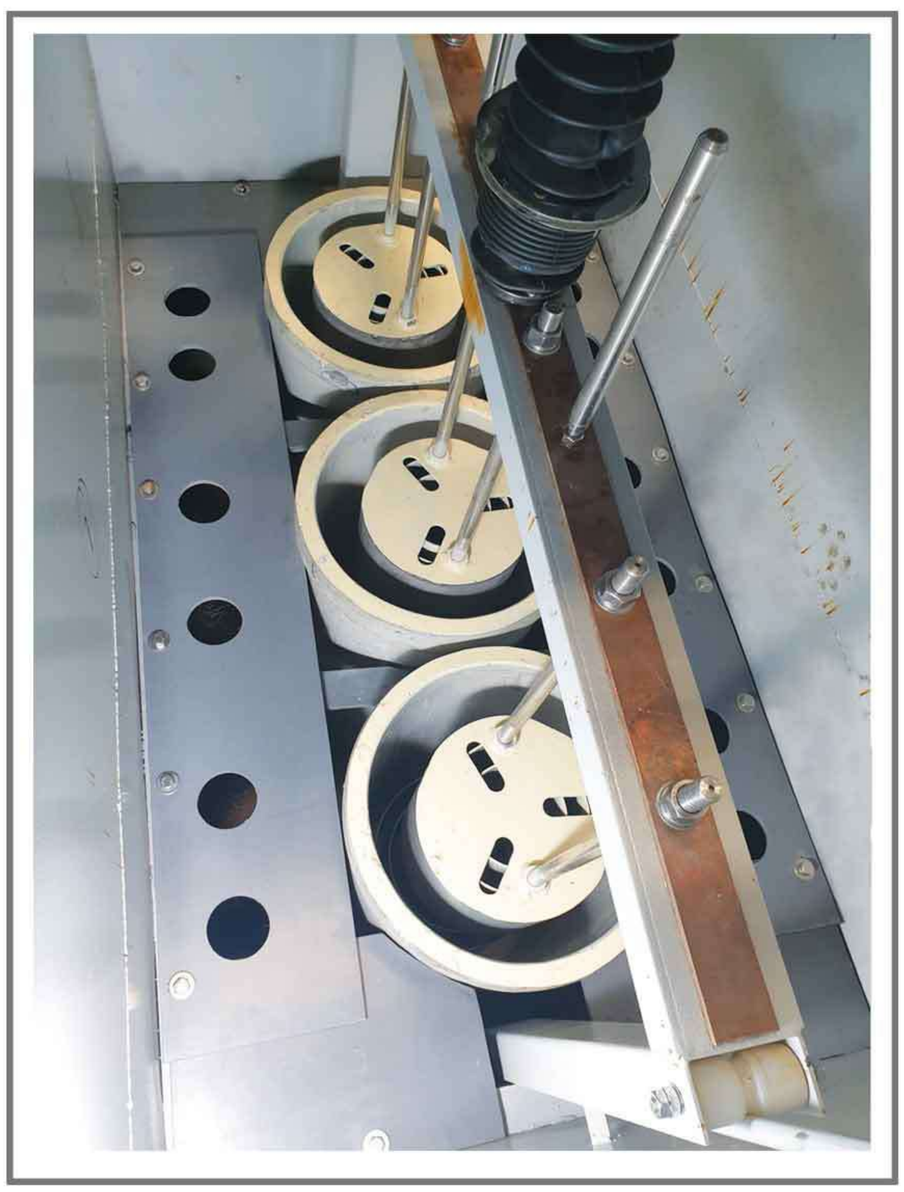
NOTE

Composition: In powder or crystal form for mixing with drinking water and anti-evaporation oil

Liquid starter is designed and manufactured in 2 types: horizontal and vertical

Model size	Electrolyte Volume (l)	Weight without electrolyte (kg)	Length A (mm)	Width B (mm)	Heigth C (mm)
500	500	430	995	1295	1745
1000	1000	600	1450	1400	1745
1500	1500	700	1700	1550	2000
2000	2000	900	1700	1800	2000
3000	3000	1100	1650	1900	2000
5000	5000	1700	1875	2650	2600

ELECTRODE ASSEMBLIES



A set consists of three fixed and three moving electrodes; fiberglass insulator cover the fixed electrodes to provide adequate isolation between phases.

The stainless steel electrodes consist of concentric cylinders which merge with each other in the minimum resistance position.

The fixed electrodes, located inside the insulating containers, are fed from an insulated copper bar. Since this bar does not pass through the tank wall, there is no danger facing electrolyte leakage.

The moving electrodes move vertically inside the insulating container. Current density is extremely low (typically 1 amp/cm²) resulting in extremely long electrode life.

ELECTRODE PROPERTIES

Material	Stainless steel	Gear box	Manual	Jack screw 40
Movement course length: 60 cm	Shape: Cylindrical		Motor	M GEAR BEVEL 17 T-27T

Equipped with short circuit contactor in accordance with the technical specifications of the rotor.
Supported handwell for move electrode manually

ELECTRODE CONTROL SYSTEM

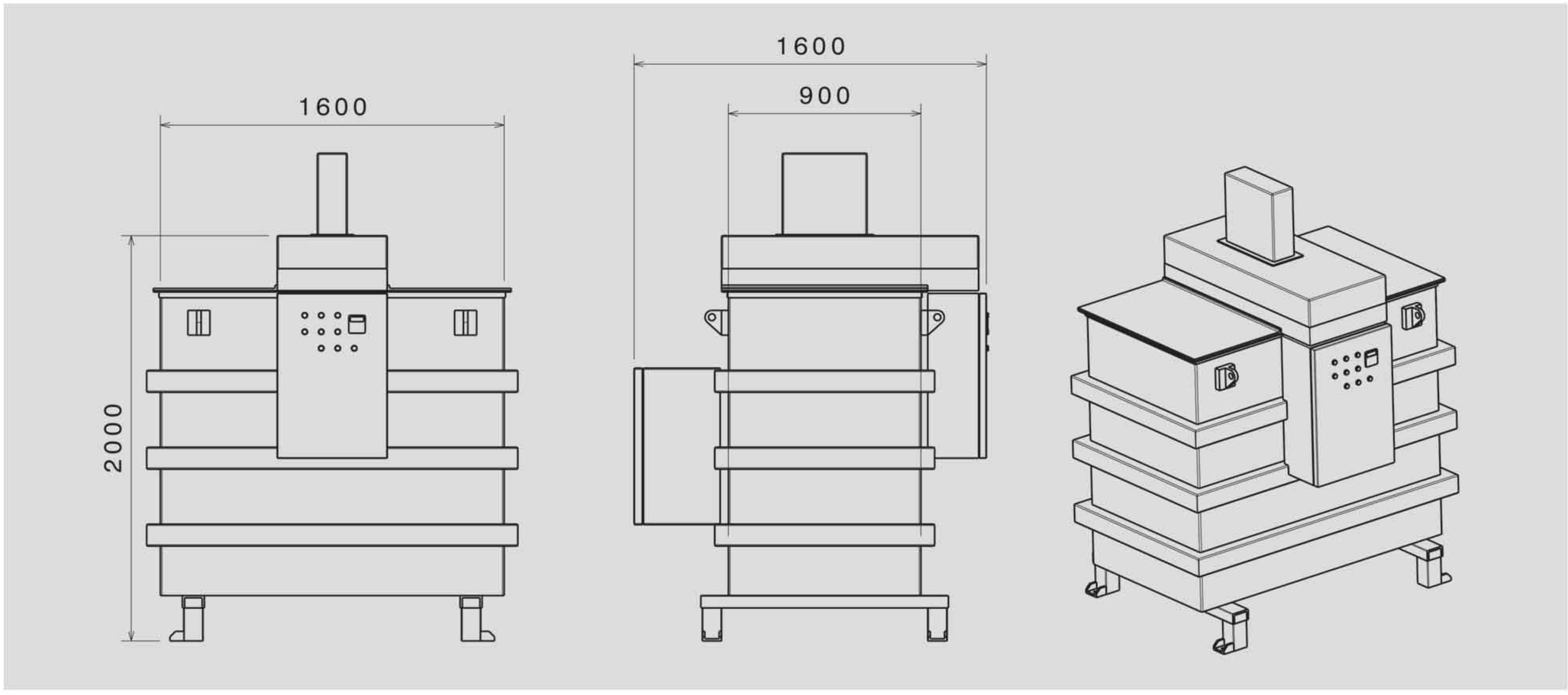
Displacement of the electrodes is effected by a motor driven. This is normally controlled by either a geared motor or a servomotor depending on the application. An inverter may also be used for certain applications. A hand wheel is also provided for emergency operation.
Starting times are adjustable from 10 to 50 seconds.

Control and interlocking Limit switches are incorporated to control the geared motor, and to energize the Shorting contactor which shorts out the residual resistance at the end of the starting time. The geared motor is design with an overload relay, which is used to provide protection in case of the drive mechanism jamming. An electrical interlock prevents a restart before the electrodes return to the initial maximum resistance position.

If a power failure occurs during starting, the electrodes return automatically to the start position when the supply is restored, so that a new start is possible. The mechanism of transfer of motion from the motor to the electrodes is done through a Screw type gearbox.

ADVANCE FEATURES

- Dust and pollution do not make it difficult to move the electrode
- Accordion cover
- Steel shaft



1 Emergency hand winding crank

2 protection hood

3 cover

4 leg

5 electrolyte container

6 lifting eye

7 movable electrode

8 fix electrode

9 spindle drive

10 liquid level indicate

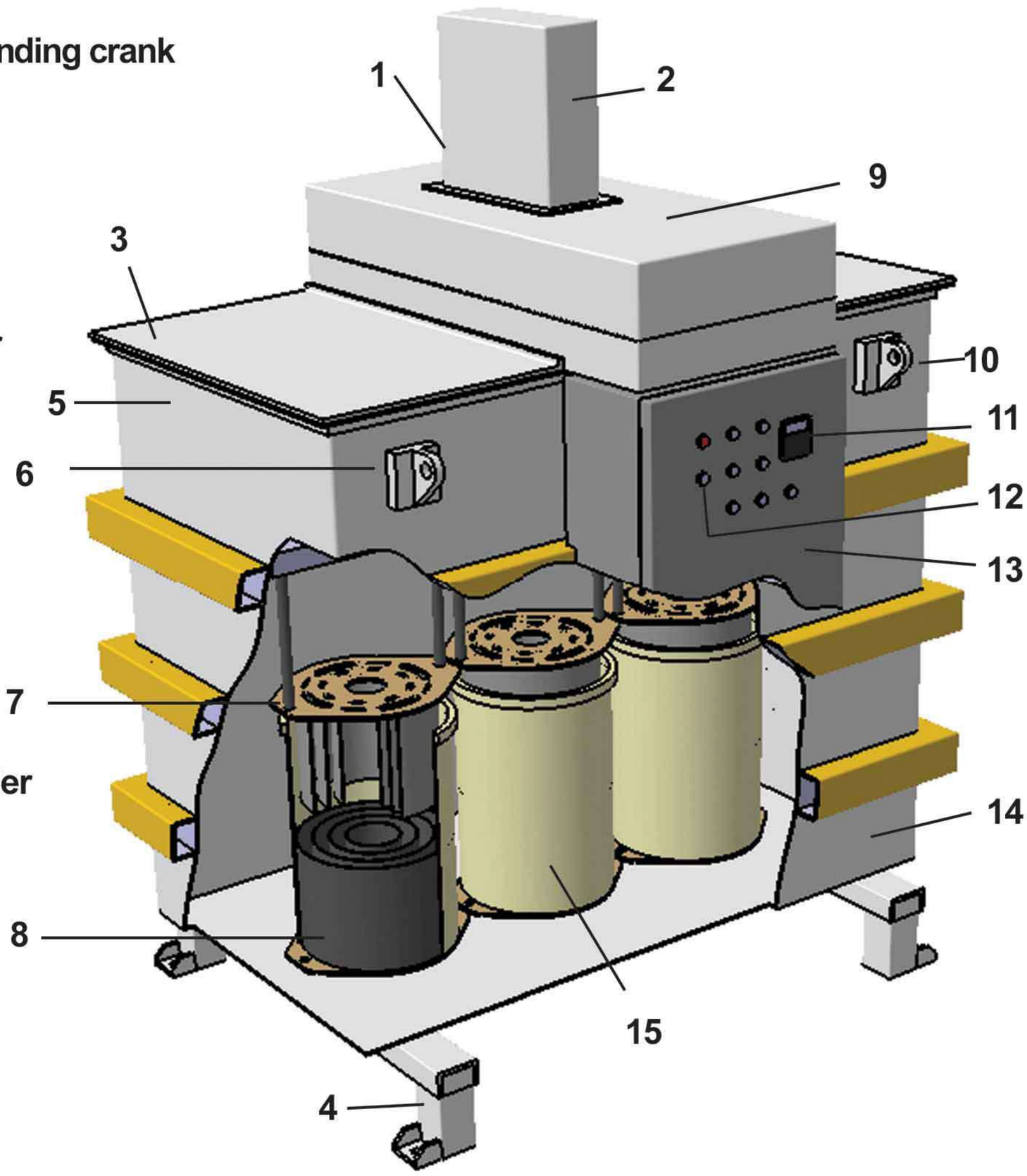
11 temperature controller

12 signal lamp

13 control box

14 drain valve

15 insulator unit



TANK

The cooling of the electrolyte inside the tank is LFAN (liquid forced air natural). Therefore, the technology of manufacturing sheets should have the following characteristics. The First, it has high strength in critical conditions, & The Second, it is resistant to corrosion, and The third, heat exchange with the environment is done in the best way. The tank is made in three layers in the following order.

FIRST LAYER
ELECTROSTATIC PAINT

Low pollution, better heat exchange, longer durability, higher quality and higher corrosion resistance are among the most important advantages of using electrostatic paint. All parts are with Ral code colors with a thickness of 0.6 mm with the best electrostatic paint quality

SECOND LAYER
ST 37

The tank is manufactured with heavy duty sheet steel 30 to 50 mm gauge. For more strength, the thickness of the floor sheet is 4 mm and the thickness of the wall sheet is 3mm.
Tank capacity and dimensions are determined by the motor rating. Tank can be custom designed for specific applications.

THIRD LAYER
FIBER GLASS & RESIN

Fiberglass and resin have been used to create fire resistance, prevent scale formation and increase mechanical strength.

TANK PROPERTIES			
Material : ST 37	Dimensions	L = 160 - 200 cm W = 90 - 130 cm H = 180 - 220 cm	Weight (Kg) Empty=1000 Full=3000
wall thickness: 3mm	Volume: 2000 Lit		Tank Protection: IP57
Floor thickness: 4mm	Exterior Color		electro static

INSULATOR

One of the advantages of SMP's liquid starter over similar types is the technology of designing and manufacturing internal insulation.

The most important design advantage of this insulation is

- The insulation cover is unbreakable and is unique to the design of SMP Group
- Permeability is 0%
- In insulation, the edge is designed to facilitate the movement of the electrodes

INSULATOR	
internal diameter	505 mm
External diameter	575 mm
Height	630 mm
Weight	50 kg
Number of floor holes	1 center 6 (Symmetric)
Electrical standard	IEC 60383,IEC/TS 60815,IEC 60216,IEC 62371

ELECTRICAL PUMP

During the start time of the slip ring motor, the resistance of the rotor is high and current passing through this resistance increases the heat energy input to the electrolyte. This energy leads to an increase in the temperature of the electrolyte at the location of the electrodes. The circulated pump is used to rotate the electrolyte and distribute the electrolyte heat throughout the tank.

ELECTRO PUMP				
AC voltage	380 V (3ph)	Type	Asynchronous motor	
Frequency	50 Hz	Output power	0.75 Kw	
Protection class	IP54	Protect feature	Totally enclosed	
Insulation class	F	Efficiency	IE2	

INVERTER

The electrode drive motor must be started smoothly. To start these engines, start-stop time, torque and motor speed are very important. An inverter is used for the motor drive system.

INVERTER				
Motor rating	0.75 Kw	Output capacity	1.1 KVA	
AC voltage	380~ 460 v	Breaking circuit	On board	
Frequency	0.1 ~ 400 Hz(±5%)	Control method	V/f	
Start Signal	Forward, Reverse	Cooling Method	Natural Air Cooling	
Display Keypad	Operation Information	Output Frequency, Output Current, Output Voltage, Frequency Value Setting, Operating Speed, DC Voltage		
	Trip Information	Indicates Fault when Protection Function Activated, Memorizes Up to 5 Faults		
Protection	Inverter trip	Over Voltage, Under Voltage, Over Current, Inverter Overheating, Motor Overheating, Input/output Phase Loss, Overload Protection, Communication Error, Loss of Speed Command,Hardware Fault		
	Inverter alarm	Stall Prevention, Overload Alarm IP54		
	Momentary Power Loss	Less than 15 msec: Continuous Operation, More than 15 msec: Auto Restart (Programmable)		

LOGO

All sensors outputs and signals sent and received by the operator, enter in the logo. Also, all control circuits are implemented in the logo.

LOGO 230 RC				
Dimensions (WxHxD)	72 x 90 x 55 mm	Input voltage	115 …. 240 v	
Permissible range	85 ... 265 (v) AC 100 ... 253 (v) DC	Voltage failure buffering	10 ms 20 ms	
Continuous current Ith	10 (A)	Permissible mains frequency	47 ... 63 Hz	

MOTOR CIRCUIT BREAKER

MOTOR CIRCUIT BREAKER		
Device application motor	Trip unit technology: Thermal-magnetic	
[In] rated current = 1.6 A	Rated operational voltage: 690 VAC 50/60 Hz conforming to IEC 60947-2	
Breaking capacity: 100 kA Icu at 400/415 VAC 50/60 Hz conforming to IEC 60947-2	Dimension (mm) H = 89 W = 45 D = 78.5	
Thermal protection adjustment range: 1 … 1.6 A	Standard: EN/IEC 60947 CSA C22.2 No 60947-4-1 UL 60947-4-1	

FREQUENCY RELAY

SMP 's frequency relay is designed and manufactured to measure the frequency of slip ring motors, the variations of which have variable cracking or variable mechanical force or variable load at start-up. If the frequency does not reach the specified level at a certain time, the relay Switches and sends relevant alarms

FREQUENCY RELAY				
Input voltage	600 V (rms)	Auxiliary voltage	24 (v) DC	
Setting range	20 – 60 (Hz)	Contact	1 changeover(DPDT)	
Thermal current	4 (A)	Switching capacity	3 (A)	
Temperature	-10 … +50	Protection	IP55	
Weight	0.4 Kg	Dimention	W 115 mm	
Screw mounting	2*40 mm		H 70 mm	
Housing	ABS		D 50 mm	

Disconnector (or isolator):

This switch is a manually-operated, lockable, two position device (open/closed) which provides safe isolation of a circuit when locked in the open position. Its characteristics are defined in IEC 60947-3. A disconnector is not designed to make or to break current and no rated values for these functions are given in standards.

Load-breaking switch

This control switch is generally operated manually (but is sometimes provided with electrical tripping for operator convenience) and is a non-automatic two-position device (open/closed). It is used to close and open loaded circuits under normal unfaulted circuit conditions.

Impulse relay

This device is extensively used in the control of lighting circuits where the depression of a pushbutton (at a remote control position) will open an already-closed switch or close an opened switch in a bistable sequence.

Contactor

The contactor is a solenoid-operated switching device which is generally held closed by (a reduced) current through the closing solenoid (although various mechanically-latched types exist for specific duties). Contactors are designed to carry out numerous close/open cycles and are commonly controlled remotely by onoff pushbuttons.

Fuses

The first letter indicates the breaking range:
b “g” fuse-links (full-range breaking-capacity fuse-link)
b “a” fuse-links (partial-range breaking-capacity fuse-link)

POWER BOARD

The power board is used to place the short-circuit contactor and its accessories. It is used to make a short circuit and the liquid resistor from the rotor circuit after the starting process.Bus bar installation is done according to IEC 61439 standard using fireproof insulations plates. Therefore, the safety and reliability of the starter (when the liquid resistor is removed from the rotor circuit) is significantly increased.

Standards

Industrial circuit-breakers must comply with IEC 60947-1 and 60947-2 or other equivalent standards.
Domestic type circuit breakers must comply with IEC standard 60898, or an equivalent national standard

POWER CONTACTOR

Contactor Type		kW	Contacts of short circuit Contactor
3RT10	54-1AP36	45	95 A
3RT10	54-1AP36	55	115 A
3RT10	55-6AP36	75	150 A
3RT10	56-6AP36	90	185 A
3RT10	65-6AP36	110	225 A
3RT10	75-6AP36	132	265 A
3RT10	76-6AP36	160	300 A
3×3RT10	75-6AP36	200	400 A
3×3RT10	76-6AP36	250	550 A

FLOW CHART FOR THE SELECTION OF CABLE SIZE AND PROTECTIVE DEVICE RATING

Power demand
- kVA to be supplied
- Maximum load current I_B

Conductor sizing
- Selection of conductor type and insulation
- selection of method of installation
- Taking account of correction factors for different environment conditions
- Determination of cross-sectional areas using tables giving the current carrying capacity

Vertication of the maximum voltage drop
- Steady state conditions
- Motor starting conditions

Calculation of short -circuit currents:
- Upstream short-circuit power
- Maximum values at conductor end

Selection of protective devices :
- Rated current
- Breaking capability
- Implementation of cascading
- Check of discrimination

HMI

Human Machine Interface (HMI) is a graphical interface that allows humans and machines to interact. HMI products feature the necessary electronics to control and signal various types of automation equipment in an industrial setting.

The greatest advantage of an HMI in SMP 's liquid starter is the user friendly graphical interface.SMP can use HMI for the device based on the needs of esteemed customers, depending on the type of application of the resistor driver.

Many parameters such as start, stop, temperature, electrode movement time setting, etc can be displayed by HMI. Using this system, the operator can work with the device easier and better.

ADVANCES FEATURES

- HMI Systems encompass all the elements a person will touch, see, hear, or use to perform control functions and receive feedback on those actions.
- HMI devices are now extremely innovative and capable of higher capacity and more interactive, elaborate functions than ever before.
- Converting hardware to software
- Allowing kinesthetic human/computer interaction
- Eliminating the need for mouse and keyboard
- Reliable Messaging. ...
- Easier Overall Management of Plant. ...
- Accurate Testing With Simulation.

SMP GROUP

Double Vertical Starter

(slip ring motor liquid starter)

SMP's electrolytic starter can be used to start slipring motors from 500 kW to 20,000 kW. It will supply the power necessary to drive the motor by resistance variation. Designed for controlled starting and speed control of large slipring motors in demanding applications, the liquid rotor starters ensure a smooth progressive acceleration of installations such as:
Ventilation ,Crushing ,Milling ,Conveyors & Pumps...

They are widely used in various industries such as mines, quarries, cement plants, water treatment and associated industries. They are also adapted to specific applications such as car fragmentizers, plastic mixers and sugar cane knives. Several models and options are available according to the starting power required, the inertia of the driven machine and the application. It is suitable to start induction motor in the same time.

APPLICATION

Suitable for using with wide range of heavy industrial machines such as;
Cement and hammer
mills, fans and compressors, pumps, shredders, rolling mills, wood grinders , pony motors for gas turbines, test stands.

key features

- Simple operation
- Smooth progressive acceleration (Smooth and stepless cutting of resistance leads to the reduction of the starting current and torque in slip ring (WR) induction motors.)
- Minimum investment requirements and low maintenance cost
- Wide range of applications
- Adaptable to different motors
- Reliable performance, rugged design
- Customized for each application, available in various sizes for motors up to 10 MW

Oil Cooled Starter

SMP GROUP

To accelerate a slip ring induction motor from standstill to full speed with full load, resistor connected in the rotor circuit is cut out in steps. During acceleration it is required that current and torque peaks are restricted to reasonable limit. Limitation of current peaks is necessary to prevent excessive line voltage drop and also overstressing of the switching devices.

Oil- cooled starters are stepped resistance starters with cast iron resistors in a tank filled with mineral based insulating oil. Oil-cooled starters store the heat generated by the resistor during starting time and slowly release it to the environment via the tank surface. Therefore, they are suitable for large drives in applications with low starting frequency.

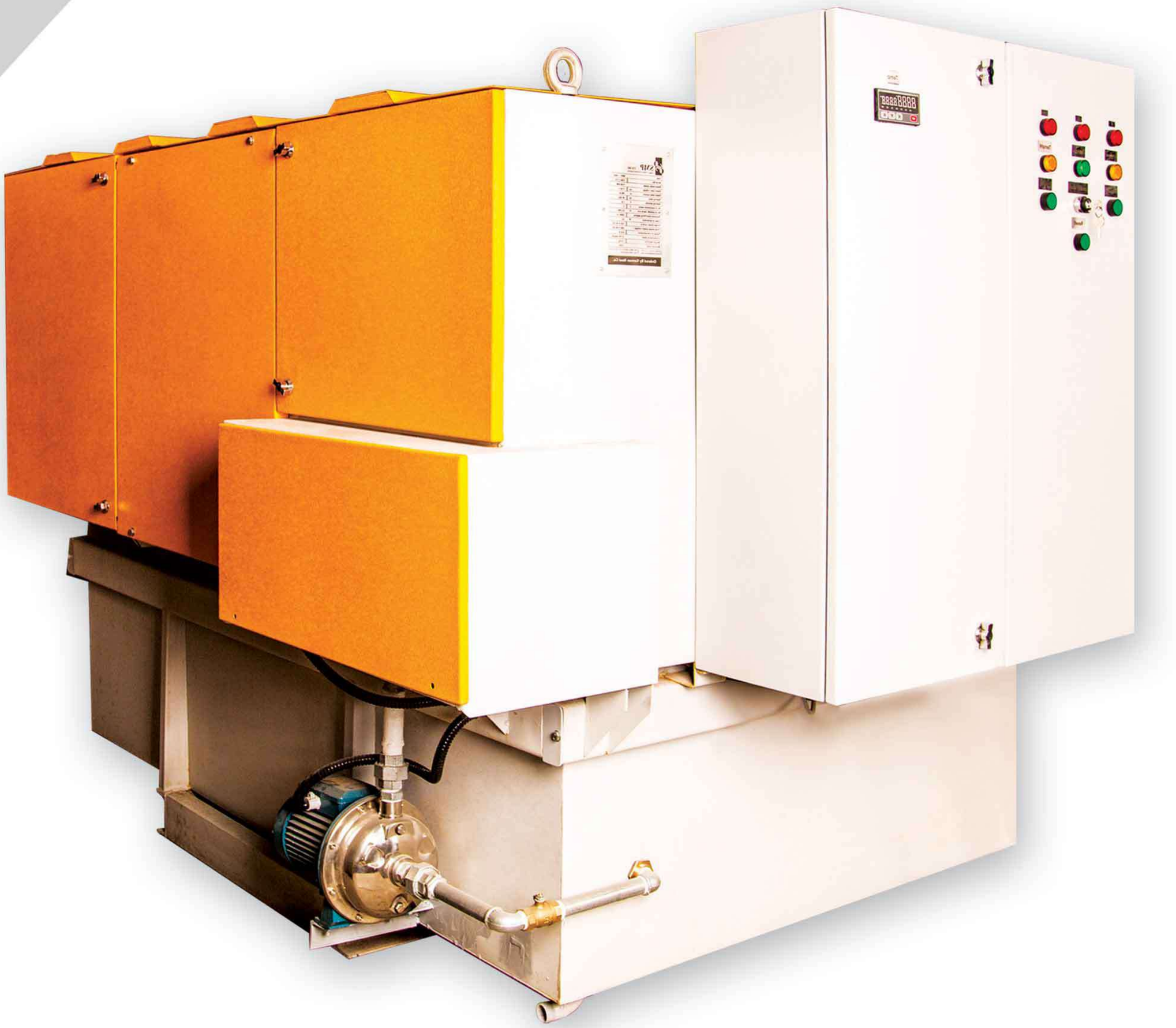
Oil-cooled is a resistor used to start slip ring induction motors.
This type of starter removes the resistor from the rotor circuit
in astep and limits the starting current.

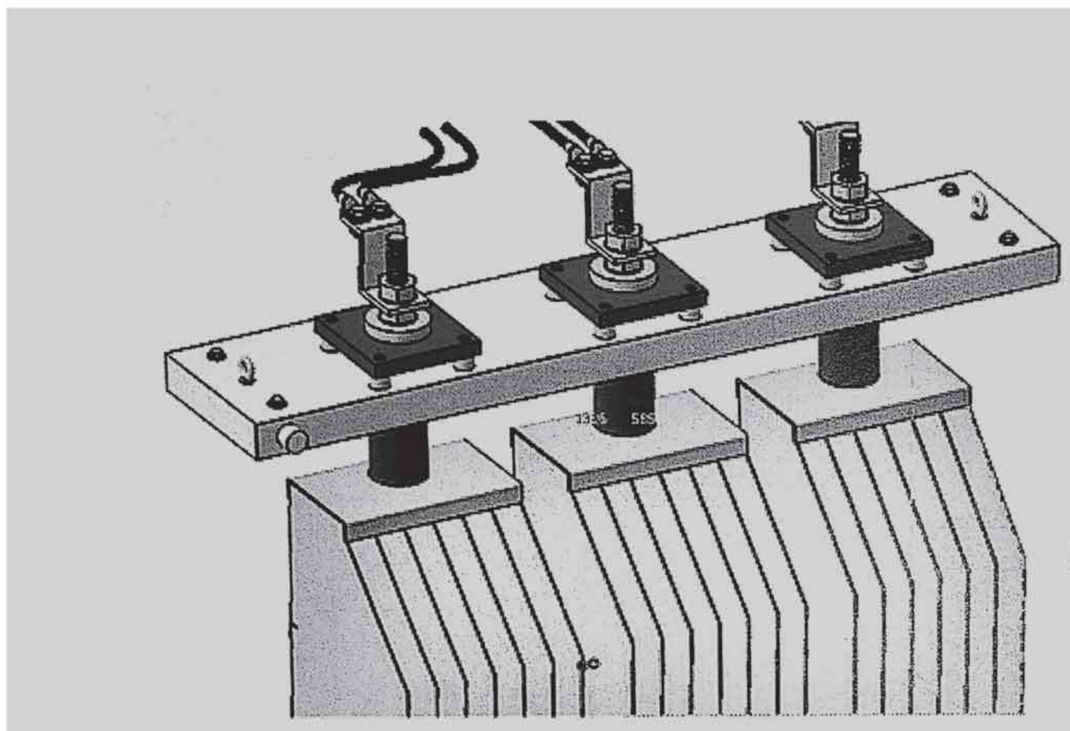
APPLICATION

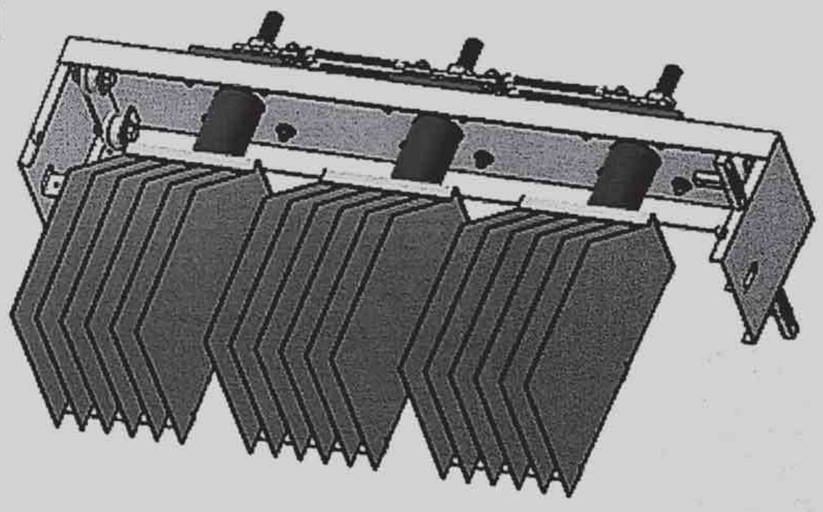
Suitable for using with wide range of heavy industrial machines such as;

- Cement and hammer mills
- fans and compressors
- crushing
- ventilation
- pumps
- shredders
- rolling mills
- wood grinders
- boiler feed pumps
- pony motors for gas turbines
- mines
- cement plants
- water treatment

Associated industries.







ADVANCE FEATURES

- The starters and the individual components used within them are adaptable to Extremely Weather Conditions. Whether in the snow fields, or the desert regions of the outback,
- The starters are operating almost maintenance free. The range of liquid resistance starters are designed for controlling of high kW slip ring motors and extends, up to 5000 kW, or any other high rating required.
- SMP's unique design, with horizontal movement of the moving contact system prevents from regular mechanical problem.
- SMP's direct involvement in all elements of production from conception through to design and manufacturing ensures a superior level of quality control, consistency of product that promise high efficacy and depended results.
- By means of its logistics services SMP 's guarantee the availability of a high quality spare parts service.
- Moreover, the mechanical life of the motor and driven machine are substantially extended via the uniqe horizental moving electrod system.
- Robust and non-flammable construction

SIMPLE IN OPERATION

LOW MAINTENANCE COSTS

The movement mechanism in this type is horizontal and unlike the vertical type, it does not occupy much height but occupies more space on the surface.

Since there is no height problem in this type, the movement course of horizontal starters can be calculated up to 1.5 meters, so the resistance can be reduced at a lower speed.

Makes the electric motor start smoother.The internal channels of the starter are coalescent.

Which reduces the connection between the electrodes and the device to zero.

All starter connections are out of water, which improves the insulation properties and increases the reliability of the starter.

Due to the construction of the electrode drive system and the method of power transmission, the visual inspection of the starter is much easier than the vertical type.

The drive shafts of the electrodes are installed above the tank and outside the electrolyte. Therefore, its mechanical system is not defective and has no mechanical impediment

PRESENTATION

ELECTRODE ASSEMBLIES:

A set consists of three fixed and three moving electrodes; fiberglass insulator cover the fixed electrodes to provide adequate isolation between phases.

The cast alloy electrodes consist of Parallel blade type which merge with each other in the minimum resistance position.

The fixed electrodes, located inside the insulating containers, are fed from an insulated copper bar. Since this bar does not pass through the tank wall, there is no danger of electrolyte leakage. The moving electrodes travel horizontaly inside the insulating container. Current density is extremely low (typically 1 amp/cm^2) resulting in extremely long electrode life.

TANK

The cooling of the electrolyte inside the tank is LFAN (liquid forced air natural). Therefore, the technology of manufacturing sheets should have the following characteristics. First, it has high strength in critical conditions, & second, it is resistant to corrosion, and thirdly, heat exchange with the environment is done in the best way. The tank is made in three layers in the following order.

FIRST LAYER
ELECTROSTATIC PAINT

Low pollution, better heat exchange, longer durability, higher quality and higher corrosion resistance are among the most important advantages of using electrostatic paint. All parts are with Ral code colors with a thickness of 0.6 mm with the best electrostatic paint quality.

SECOND LAYER
STAINLESS STEEL

The tank is manufactured with heavy duty sheet steel 30/10 to 50/10 mm gauge. For more strength, the thickness of the floor sheet is 4 mm and the thickness of the wall sheet is 3mm.
Tank capacity and dimensions are determined by the motor rating. Tank can be custom designed for specific applications.

THIRD LAYER
FIBER GLASS & RESIN

Fiberglass and resin have been used to create fire resistance, prevent scale formation and increase mechanical strength.

Tank			
Material: ST 37	Dimensions	L = 200-300 cm W=110 cm H=120 cm	Weight (Kg) Empty=1200 Full=4800
wall thickness: 3mm	Volume: 2000 - 3600 Litr		Tank Protection: IP57
Floor thickness: 4mm	Exterior Color		electro static


SMP

SMP GROUP

Double Liquid Starter

(slip ring motor liquid starter)

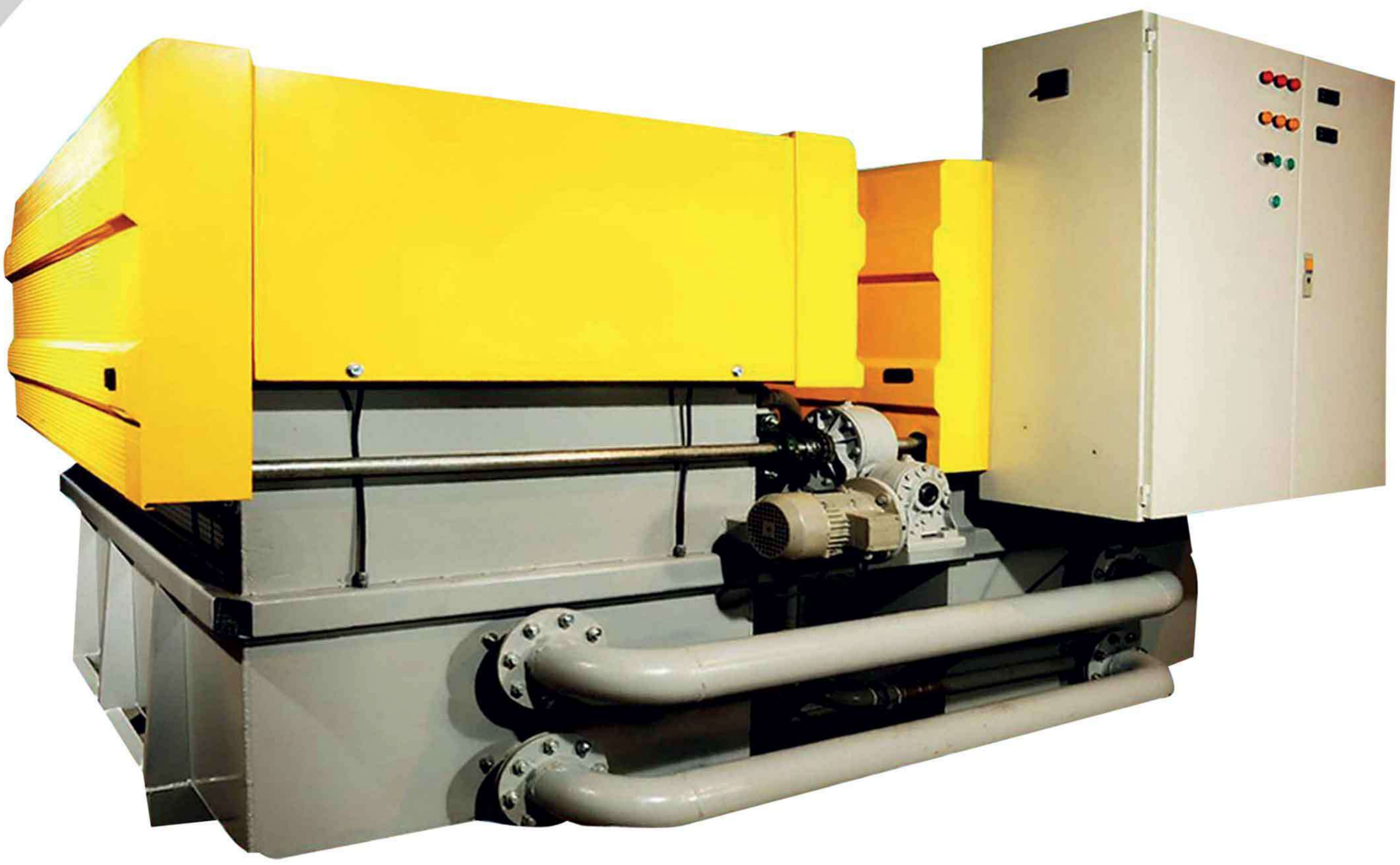
SMP's LIQUID STARTERS are used for inserting external resistor in slip ring (wound rotor)induction motors in order to reduce starting current and increase starting torque. It will supply the power necessary to drive the motor by resistance variation in various industries.

APPLICATION

Suitable for using with wide range of heavy industrial machines such as;
Cement and hammer mills, fans and compressors, pumps, shredders, rolling mills, wood grinders, boiler feed pumps, pony motors for gas turbines, test stands.

key features

- Simple operation
- Smooth progressive acceleration (Smooth and stepless cutting of resistance leads to the reduction of the starting current and torque in slip ring (WR) induction motors.)
- Minimum investment requirements and low maintenance cost
- Wide range of applications
- Adaptable to different motors
- Reliable performance, rugged design
- Customized for each application, available in various sizes for motors up to 10 MW



USEFUL CONTENT FOR ORDER

The problems associated to motor starting operations are fundamentally linked to the type of motor which a determined motor operational torque "T_M" offers, to the starting modality and to the connected load which has a determined load torque "T_L".

The necessary starting torque "T_{acc}" can be expressed as $T_{acc} = T_M - T_L$ and must be well calibrated to prevent it from being either too low, so as starting is not too long and heavy which causes risks of temperature rise for the motor or from being too high on the joints or on the operating machines.

ATTENTION

- Load type has a significant effect on load torque. Please carefully consider the type of load in the specification form
- T_S represents the inrush torque and T_{max} the maximum torque is different with motor opera tional torque, please complete the form carefully

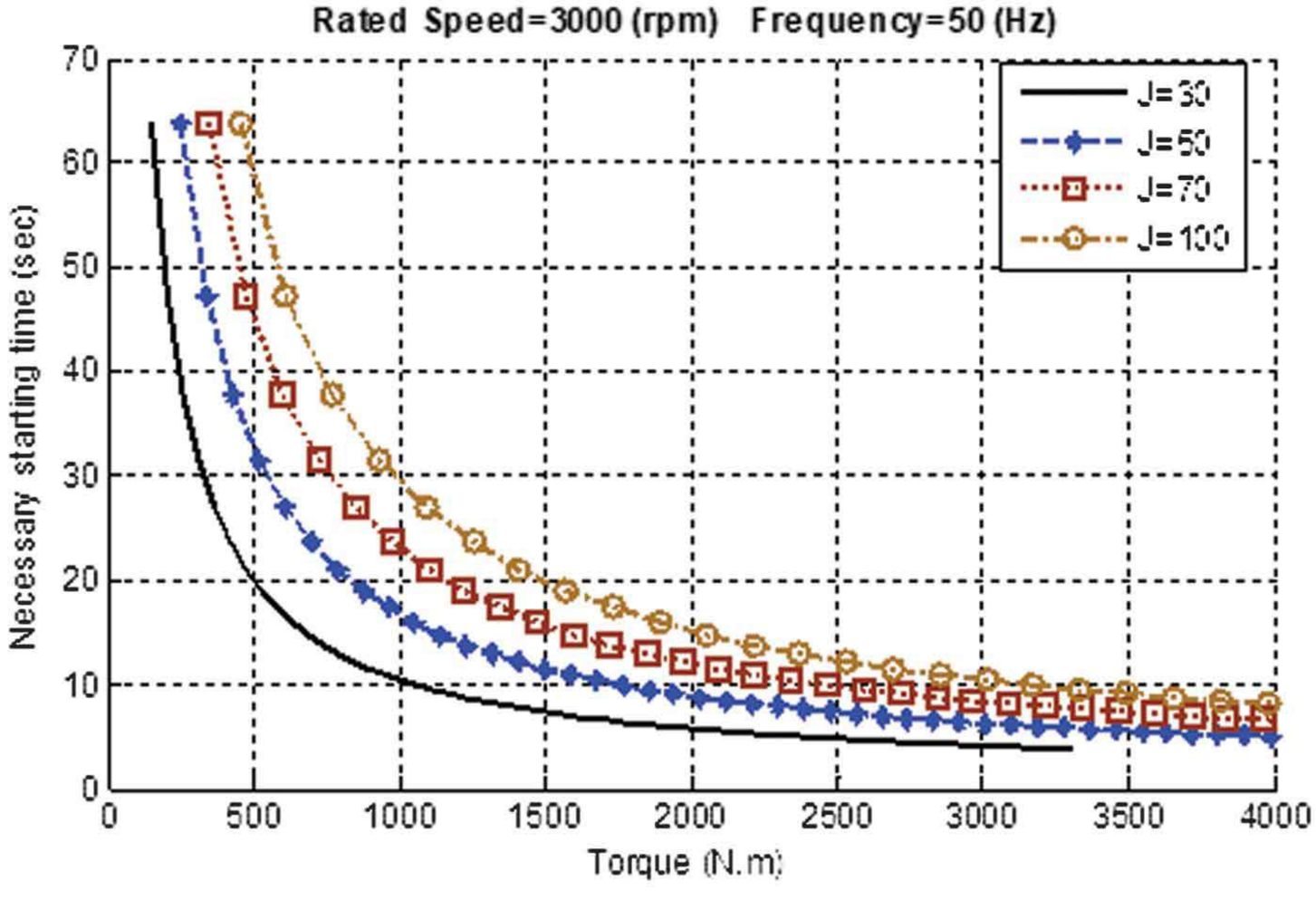
This information allows to obtain the starting time with the aid of the following formula

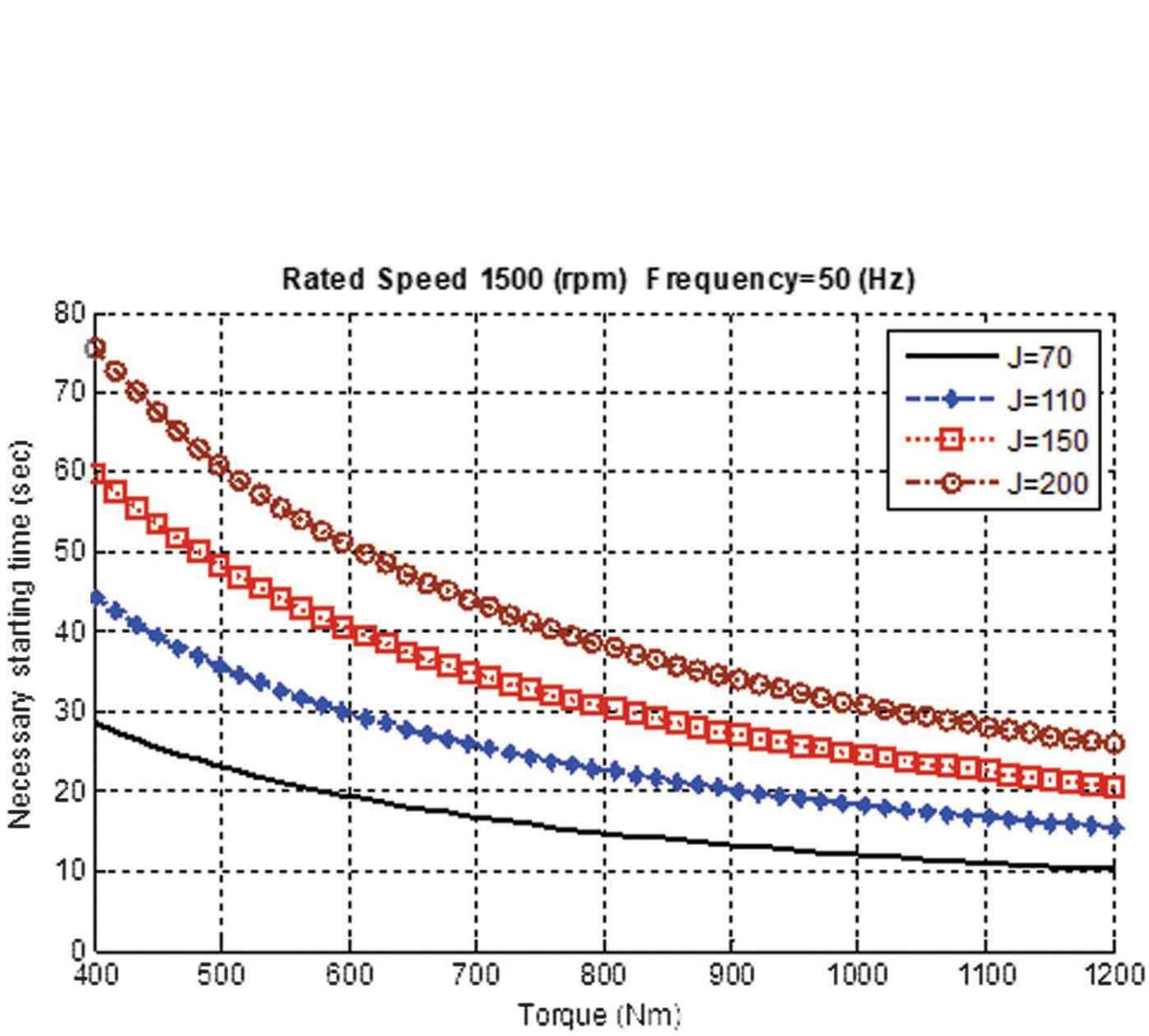
$$t_a = \frac{n_r J}{9.55\, T_{acc}}$$

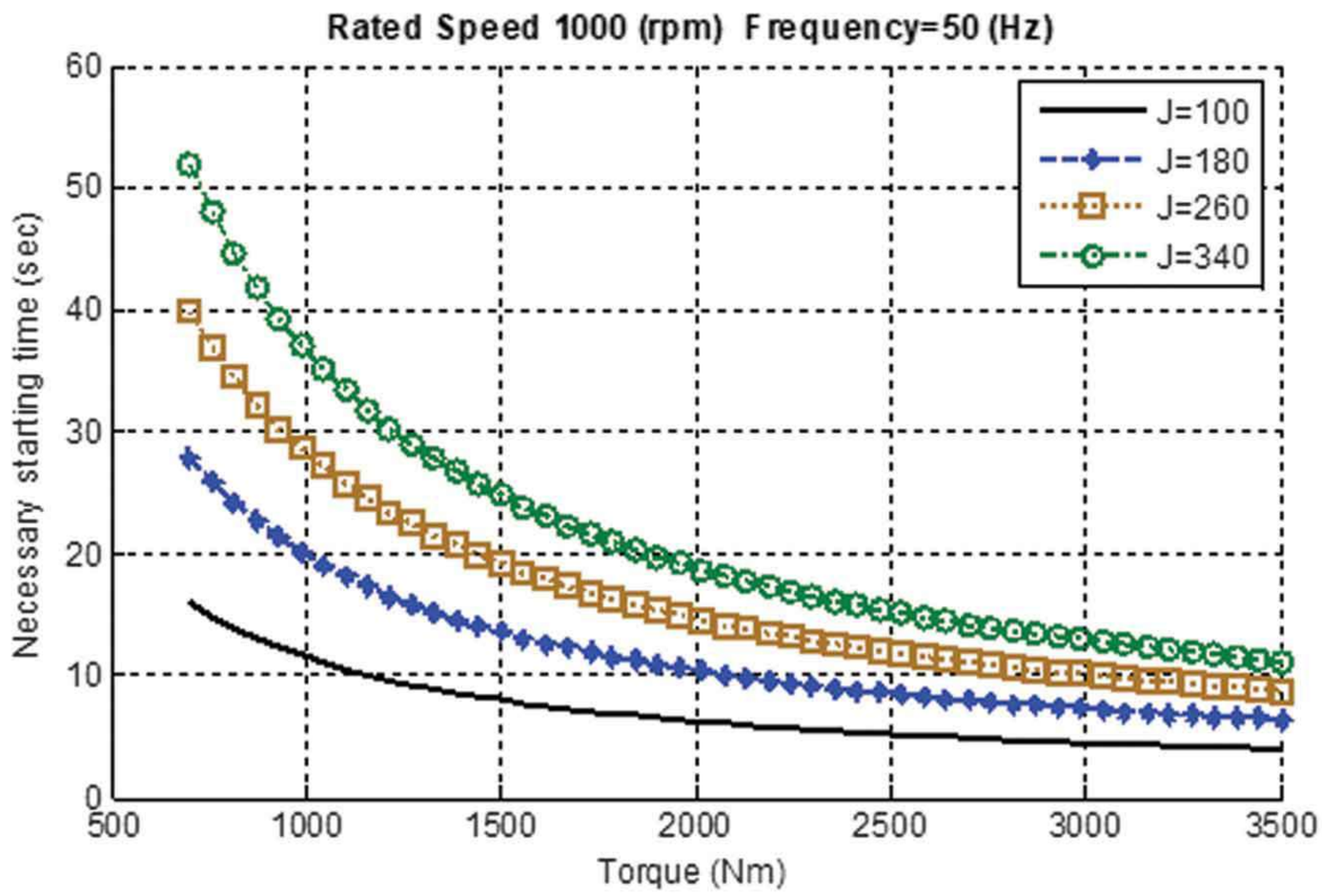
n_r= Motor rated speed

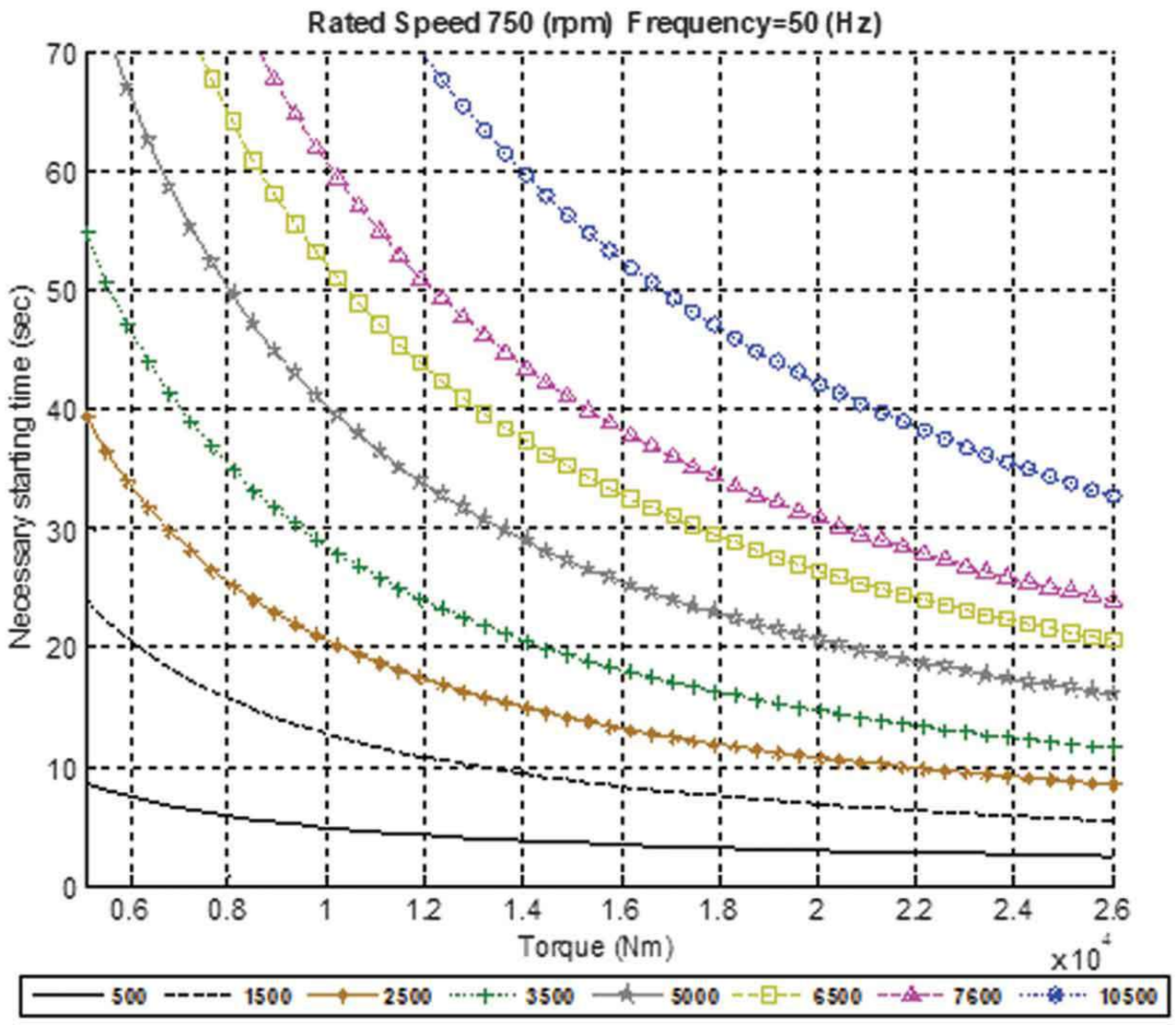
t_a is a necessary starting time at mean acceleration torque. The starter setting time has always to be larger than required starting time in order not to exceed the starting current or the starting torque.

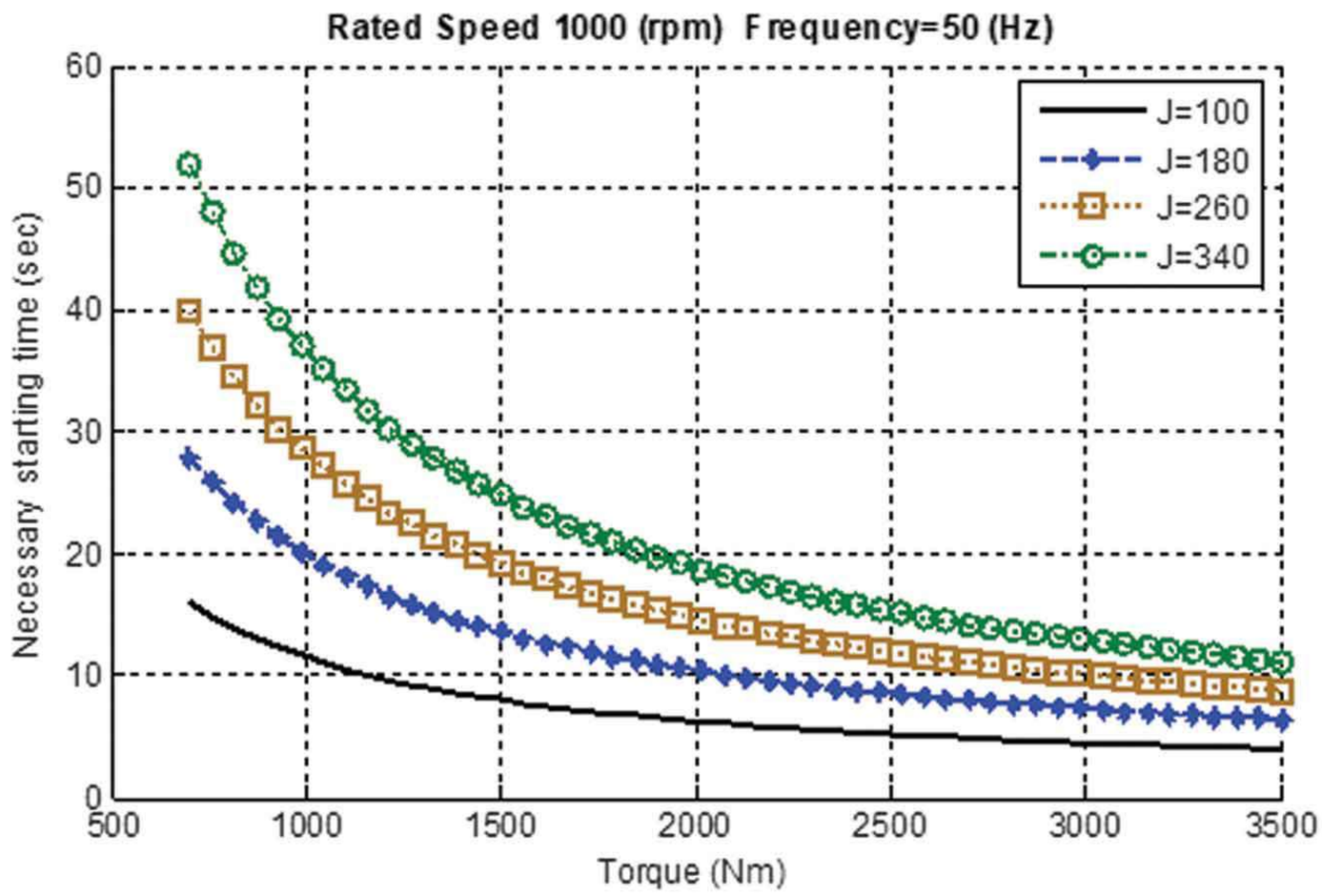
You can also use the following figures to determine ta

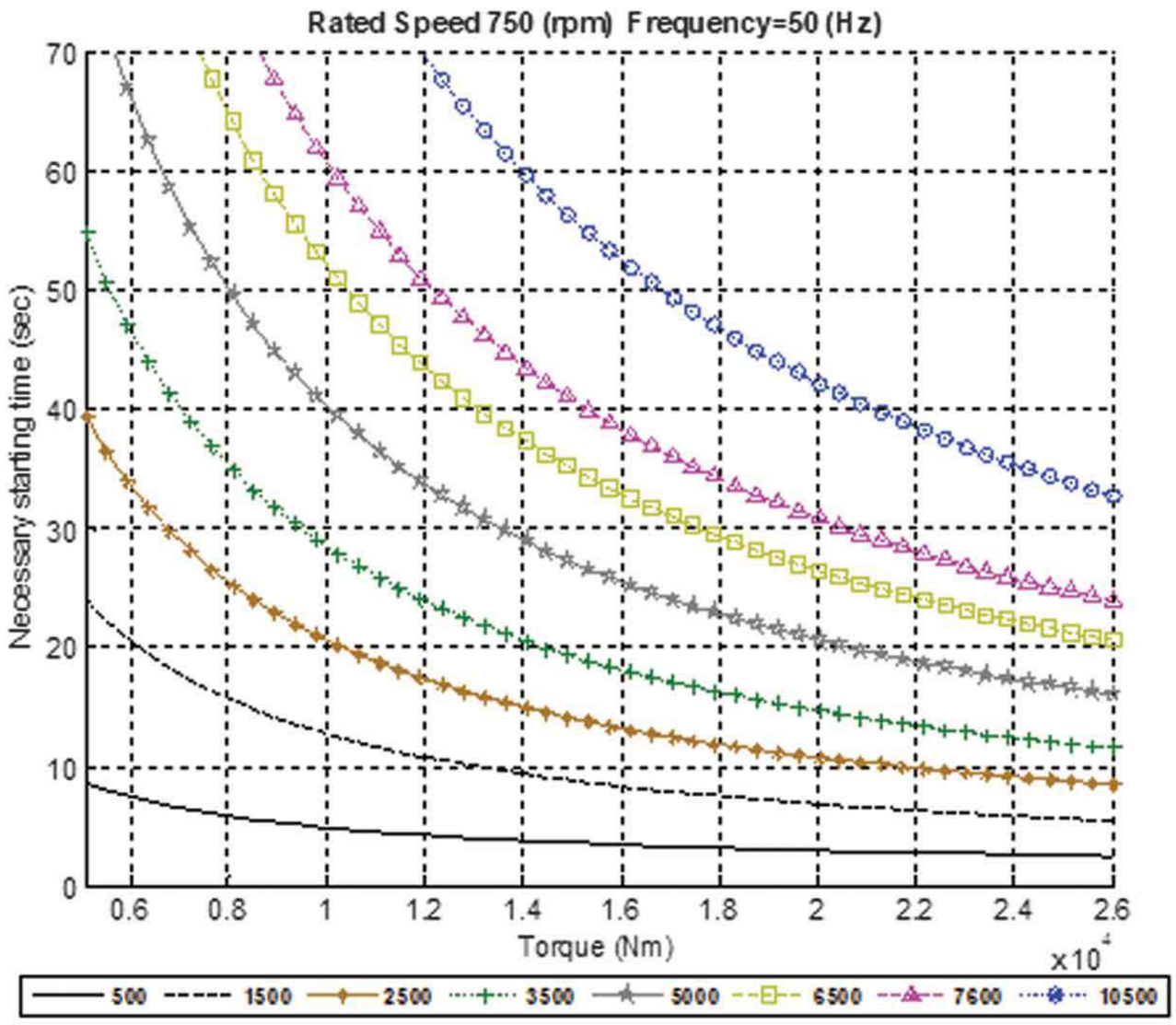

Rated Speed=3000 (rpm) Frequency=50 (Hz)
Necessary starting time (sec)
Torque (N.m)
J=30
J=50
J=70
J=100
0
10
20
30
40
50
60
70
0
500
1000
1500
2000
2500
3000
3500
4000


Rated Speed 1500 (rpm) Frequency=50 (Hz)
Necessary starting time (sec)
Torque (Nm)
J=70
J=110
J=150
J=200
0
10
20
30
40
50
60
70
80
400
500
600
700
800
900
1000
1100
1200


Rated Speed 1000 (rpm) Frequency=50 (Hz)
Necessary starting time (sec)
Torque (Nm)
J=100
J=180
J=260
J=340
0
10
20
30
40
50
60
500
1000
1500
2000
2500
3000
3500


Rated Speed 750 (rpm) Frequency=50 (Hz)
Necessary starting time (sec)
Torque (Nm)
x10^4
0
10
20
30
40
50
60
70
0.6
0.8
1
1.2
1.4
1.6
1.8
2
2.2
2.4
2.6
500
1500
2500
3500
5000
6500
7600
10500


Rated Speed 1000 (rpm) Frequency=50 (Hz)
Necessary starting time (sec)
Torque (Nm)
J=100
J=180
J=260
J=340
0
10
20
30
40
50
60
500
1000
1500
2000
2500
3000
3500

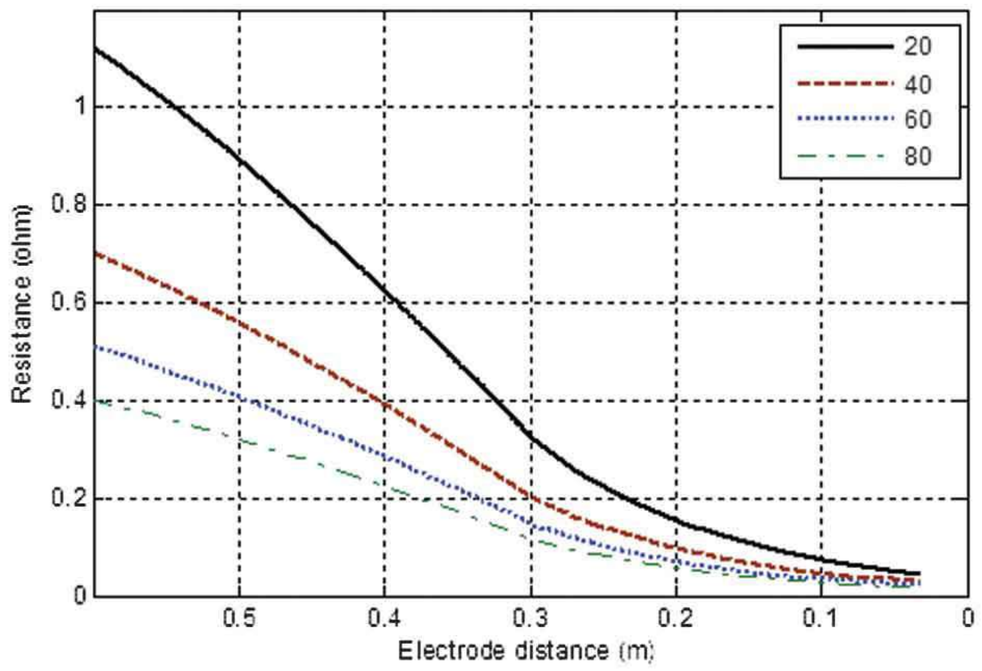

Rated Speed 750 (rpm) Frequency=50 (Hz)
Necessary starting time (sec)
Torque (Nm)
x10^4
0
10
20
30
40
50
60
70
0.6
0.8
1
1.2
1.4
1.6
1.8
2
2.2
2.4
2.6
500
1500
2500
3500
5000
6500
7600
10500

SMP's liquid starters offer a particular advantage with the easy adaptation of the electrolyte to the requested operating condition.

Basically, the liquid rheostat consists of metal electrodes in a tank of electrolyte. Usually the solution used is a few per cent of sodium carbonate(na_2co_3) by weight in clean water. The rating plate shows the salt quantity in kg required for a basic filling. Tap water with max. 8 °d hardness should be used. If water of this quality is not available, distilled water must be filled till max. 8 °d hardness has been reached. The final electrolyte concentration is adapted to the requested operating conditions when commissioning the plant.

If the electrolyte concentration has to be increased due to the starting current too low, add dissolved starter sat in little quantity till requested value is reached. If the concentration is too high (the starting current is too high or startup too fast) drain off some electrolyte and add water.

The current flows between the electrodes through the electrolyte solution, the resulted resistance between electrodes being approximately proportional to the distance between them. Sodium Carbonate concentration is defined according to the starter data, the driven machine data (such as necessary starting torque) and ambient conditions. Resistance properties of the electrolyte depend upon the concentration of sodium carbonate in the electrolyte and upon the temperature of the solution. Figure 53 shows the variation in smp liquid starter resistance due to temperature and electrode distance. From the curves, the resistance at 65 degrees centigrade is roughly 50 percent of the resistance at 20 degrees centigrade. In other words, the electrolyte has a negative temperature coefficient of resistance.



Ir	setting current of the thermal protection
Ti	tripping time of the thermal protection
V_L	network voltage between lines (phase-to-phase)
Zw	impedance of the winding
Ie	rated current
Iw	current in the motor windings under standard conditions
Iw*	current in the motor windings under anomalous conditions
Pe	rated power of the motor
Isp	inrush current 12 x Ie
Iavv	starting current 7.2 x Ie
I3	magnetic tripping threshold
In	rated current of the relay
η	rated eficiency
cosφ	rated power factor
Y	star connection
Δ	delta connection
n_S	synchoronous speed or speed of the magnetic field of the stator
f	frequency of the supply network
p	number of pole pair
n_r	rotation speed of rotor
n_{SL}	slip speed
s	slip
T_M	motor operational torque
T_L	load torque
T_{start}	starting torque
ta	starting time
J_M	moment of inertia of the motor
J_L	moment of inertia of the load
w	motor angular speed
$\frac{dw}{dt}$	angular acceleration
T_S	inrush torque
T_{max}	maximum torque
T_{acc}	acceleration torque
K_L	multiplying factor
S..	duty type

The important thing is that now we can insert resistors and control the torque of the motor. The secondary volts (or rotor volts) and secondary amps (or rotor amps) are given by the motor manufacturer and usually appear on the nameplate. These two values are necessary to calculate resistor values. If only one of these values and the motor horsepower are available, we can calculate the other value with reasonable accuracy. If we want 500 amps of current to flow through a resistor when a 1500 V voltage is applied, then its resistance must be 1500 volts divided by 500 amps = 3 ohms. This simple type of calculation is the basis for sizing motor control resistors.

Resistors are required in each leg, or phase, of the rotor circuit. These three identical resistors are, almost without exception, WYE connected. In other words, the three phases are tied to a common neutral point. The secondary voltage (from nameplate or measured) is a line-to-line value. The voltage across WYE connected resistors is a line-to-neutral value. To get from the line-to line value to the desired value, simply divide by 1.732 (square root of three). For example, if the secondary volts are 200, the volts across the resistors will be

200 /1.732 = 115.47 volts.

According to motor starting condition, maximum starter resistance obtain with the following formula

$$R_{max} = \frac{V_{ro}\, m_n}{\sqrt{3}\, I_r\, m_m}$$

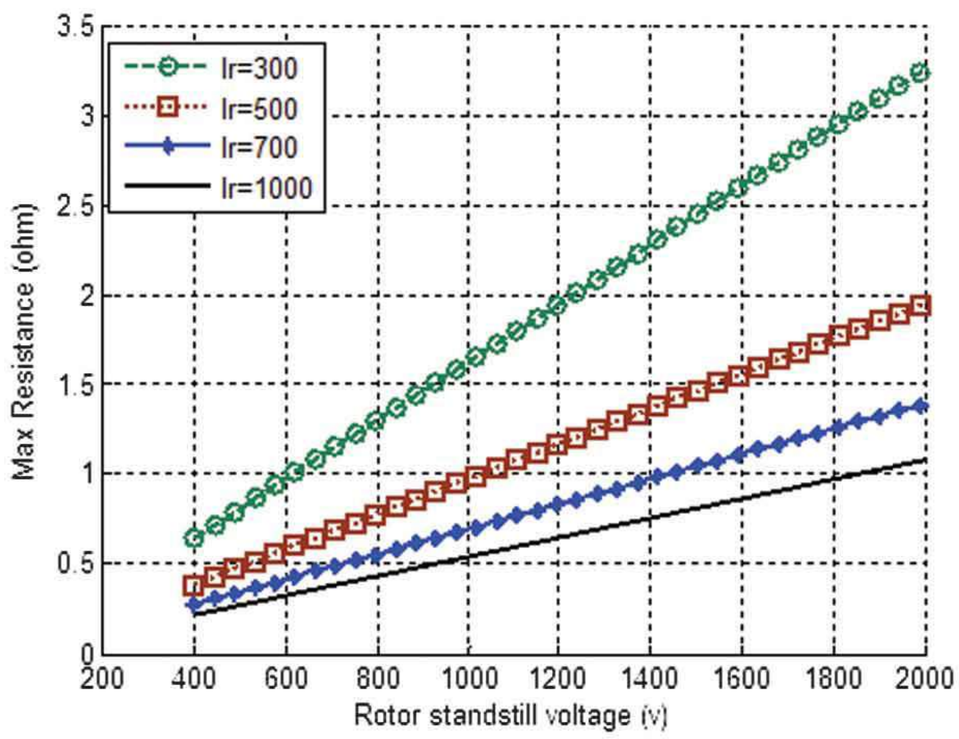
V_{ro} = Rated Rotor Voltage

I_r = Rated Rotor Current

Mean starting torque=T_{ST}

Rated torque=T_n

	SEMI LOAD START	RATED LOAD START	FULL LOAD START	HEAVY LOAD START
T_{ST} / T_n	0.7	1	1.4	1.8



The energy lost during starting time is one of the most important factors in choosing a starter. Temperature of electrolyte directly affected by energy losses in starter. Energy loss calculated with following formula

$$W_h = \frac{P_{nr}\, t_a\, T_{ST}}{2T_n} \qquad \frac{R_{nm}}{2T_n} = \text{Rotor loss}$$

P_{nr} is electrical rotor loss and calculate according to following formula

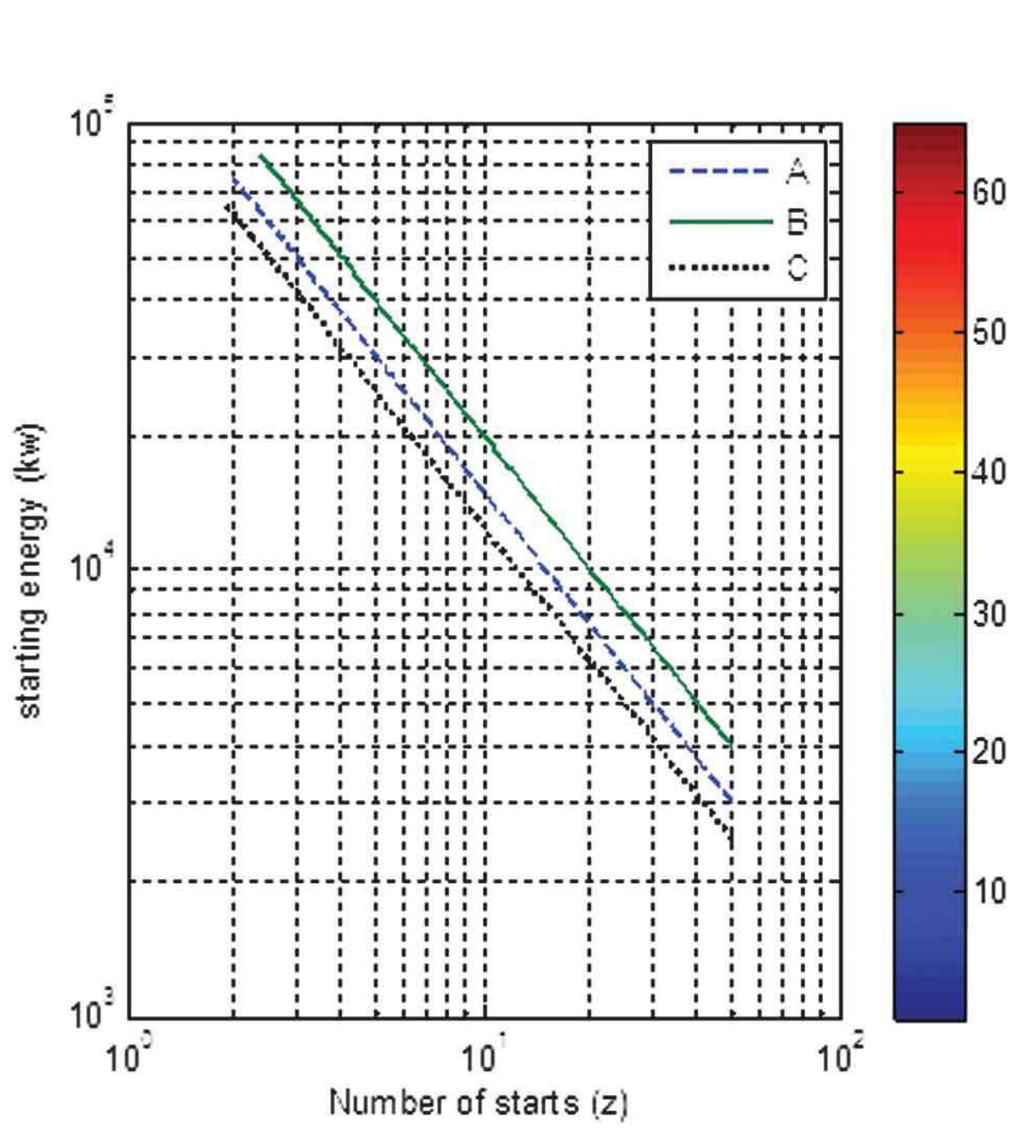
$$P_{nr} = \sqrt{3} V_{ro}\, I_r$$

θ_2 is starters electrolyte Temperature & changing according to following formula

$$\theta_2 = \frac{\triangle W_h}{m_1 c_1 + m_2 c_2} + \theta_1$$

Z is the Number of starts and depends on possible starting energy and calculation according to

$$Z = \frac{\text{possible starting energy}}{\text{actual starting energy}}$$



Starting frequency is the number of admissible starts per hour each at equal intervals Without exceeding the limit temperature of 80

Maximum power of engine given for 1 start/hour and 3 consecutive starts from cold state.

Different models exist to suit the power of the starter(s) and the inertia of the driven machine. The ranges of SMP liquid starters given above are theoretical only, as ranges will depend on many further non negligible parameters such as starting conditions, starting time, torque, type and load of the driven machine, ambient temperature…

Rotor voltage between rings: 3000 V max

Standard starting times: 20, 30, 40 s

factory preset Level of electrolyte monitored by magnetic floating system

Electrolyte temperature monitored by thermostats

Electrolyte cooling down by natural convection and agitator mixing

Low current density of electrodes: about 1 A/cm².

SELECTIVE EXAMPLE

Example (1):

Rated power: 1800 (kw)

Nm=990 (rpm)

Jm=130 Kgm^2

Jl=4700 Kgm^2

Vr=1500 v

Ir=740 A

T=15.895

Full load start

Temperature = 45 - 80

STEP 1

Ta Calculated based on Page 50.

$$t_a = \frac{990*4830}{9.55*15895} = 31.5$$

t_a is theoretical necessary starting time and for starting motor in actual condition real starting time (tb) considered larger than ta. For example, for this motor ta and tb are considered 30 and 40 sec respectively.

STEP 2

Maximum resistance of rotor calculated based on Page 55.

$$R_{max} = \frac{V_{ro}\, m_n}{\sqrt{3} I_m\, m_m} = \frac{1500}{\sqrt{3} * 740 * 1.4} = 0.83$$

Be attention that the electrolyte depends on temperature of the solution based on

$$R = \frac{R_0}{1 + 0.03\theta}$$

STEP3

based on maximum resistance of liquid starter, suitable model is required from Page 56

That for this example chose model B

STEP4

Now energy losses in electrolyte can be calculated Page 56 equation. For this example, energy loses in starter is

$$P_{nr} = \sqrt{3}\, V_{ro}\, I_{rn} = \sqrt{3} * 1500 * 740 = 1922.576 \text{ (kw)}$$

$$W_h = \frac{P_{nr}\, t_b\, m_m}{2m_m} = \frac{1922.576 * 40 * 1.4}{2} = 53832.128$$

STEP5

According to the calculated amount of energy lost in starting time from step 5, a necessary energy is 53832.128

And the Number of starts (z) and starting frequency (h) will be obtained according to diagrams page 57.

Z=3

H=1

If one of the values falls below, the next larger design will have to be selected.

No of starts z = 3 means that 3 consecutive starts from cold with intervals of double the starting time are possible.

starting frequency h = 1 means that 1 starts per hour are possible in steady intervals at warm condition.

The starter thus permits the 3 times starting of 1800 kW motor from cold with intervals of 2 x 45 = 90 s at a starting time ta = 45 s. The start can be repeated every 60 min from warm condition.

Example (2):

Rated power: 1300 (kw)

Nm=994 (rpm)

Jm=90 Kgm^2

Jl=3200 Kgm^2

Vr=1640 v

Ir=650 A

T=1431.9

Heavy load start

Temperature= 50-80

STEP 1

t_a Calculated based on Page 50.

$$t_a = \frac{994*4100}{9.55*14319} = 30.44$$

t_a is theoretical necessary starting time and for starting motor in actual condition real starting time (tb) considered larger than ta. For example, for this motor ta and tb are considered 30 and 40 sec respectively.

STEP 2

Maximum resistance of rotor calculated based on Page 55.

$$R_{max} = \frac{V_{ro}\, m_n}{\sqrt{3} I_{rn}\, m_m} = \frac{1440}{\sqrt{3 * 610 * 2}} = 0.681$$

Be attention that the electrolyte depends on temperature of the solution based on

$$R = \frac{R_0}{1 + 0.03\theta}$$

STEP 3

based on maximum resistance of liquid starter, suitable model is required from Page 56.

That for this example chose model B

STEP 4

Now energy loses in electrolyte can be calculated Page 56. equation. For this example, energy loses in starter is

$$P_{nr} = \sqrt{3}\, V_{ro}\, I_{rn} = \sqrt{3} * 1440 * 610 = 1521.443(kw)$$

$$W_h = \frac{P_{nr}\, t_b\, m_m}{2m_m} = \frac{19521.443 * 40 * 2}{2} = 60857.72$$

STEP 5

According to the calculated amount of energy lost in starting time from step 5, a necessary energy is 60857.72

And the Number of starts (z) and starting frequency (h) will be obtained according to diagrams page 57

Z=3

H=1.2

If one of the values falls below, the next larger design will have to be selected.

No of starts z = 3 means that 3 consecutive starts from cold with intervals of double the starting time are possible.

starting frequency h = 1.2 means that 1 starts per 40 min are possible in steady intervals at warm condition.


SMP
Group

NECESSARY INFORMATION FOR PROVIDE A SMP'S LIQUID STARTER

ROW	TITLE	UNIT	VALUE
1	TYPE OF MACHINE		
2	MOTOR OUTPUT	P_{OUT} (KW)	
3	MOTOR FREQUENCY	F (HZ)	
4	ROTOR STANDSTILL VOLTAGE	V_r (V)	
5	ROTOR RATED CURRENT	I_r (A)	
6	RATED SPEED	N_m (RPM)	
7	MOMENT OF INERTIA OF MOTOR	J ($Kg.m^2$)	
8	RATED MOTOR TORQUE	(N.m)	
9	MOTOR RATED VOLTAGE	V_N (V)	
10	MOTOR RATED CURRENT	I_n (A)	
11	STARTING TORQUE	T_{START} (N.m)	
12	LOAD MOMENT OF INERTIA AT RATED SPEED	J_L ($Kg.m^2$)	
13	LOAD TORQUE CHARACTERISTIC	LINEAR □ CONSTANT □ PROPORTIONAL □	
14	WORKING AMBIENT TEMPERATURE (MIN & MAX)	T_{min} -T_{max} (°C)	
15	X_S Or L_S		
16	R_S		
17	X_m Or L_m		
18	X_r Or L_r		
19	R_r		
20	TECHNICAL ADVICE SERVICES		
21	OTHER DESCRIPTION:	YES □ NO □	

Oil Cooled Starter

SMP GROUP

To accelerate a slip ring induction motor from standstill to full speed with full load, resistor connected in the rotor circuit is cut out in steps. During acceleration it is required that current and torque peaks are restricted to reasonable limit. Limitation of current peaks is necessary to prevent excessive line voltage drop and also overstressing of the switching devices.

Oil- cooled starters are stepped resistance starters with cast iron resistors in a tank filled with mineral based insulating oil. Oil-cooled starters store the heat generated by the resistor during starting time and slowly release it to the environment via the tank surface. Therefore, they are suitable for large drives in applications with low starting frequency.

Oil-cooled is a resistor used to start slip ring induction motors.
This type of starter removes the resistor from the rotor circuit
in astep and limits the starting current.

APPLICATION

Suitable for using with wide range of heavy industrial machines such as:

- Cement and hammer mills
- Fans and compressors
- Crushing
- Ventilation
- Pumps
- Rolling mills
- Wood grinders
- Boiler feed pumps
- Pony motors for gas turbines
- Mines
- Cement plants
- Water treatment

Associated industries.

SPECIFICATION

The starters correspond to the "Specification for L.V.(Low voltage) devices switching VDE,0660, DIN 4606 2 and the IEC-Publication 292-3 with made by siemens

Contactors Type		kw	Current of short circuit Contactor
3RT10	54-1AP36	55	160 A
3RT10	55-6AP36	75	185 A
3RT10	56-6AP36	90	275 A
3RT10	65-6AP36	110	330 A
3RT10	75-6AP36	132	430A
3RT10	76-6AP36	160	630A
3×3RT10	65-6AP36	3×110	700A-1000A
3×3RT10	75-6AP36	3×132	1100A-1300A
3×3RT10	76-6AP36	3×160	1400A-2000A

DEGREE OF PROTECTION

400-4000 have a degree of protection IP54 according to IEC 60529 resp. The starters IEC 144. The protection can be increased to IP55.

AMBIENT TEMPERATURE

The permissible ambient temperature is -25º C up to +45º C. At higher ambient temperatures the number of starts, the starting frequency and the permissible rotor rated current and stator rated current have to be reduced by 7% each for every additional 5º C temperature raise.

Starters with additional water cooling require a reduction of the starting frequency if the cooling water temperature rises above 20º C; permissible values on inquiry.

starter ORC315 opened In synchrone & asynchrone motors with dry resistance it is possible that to be speed control step for normal speed.

CONSTRUCTION

The Starters consist of :

1. The resistor unit in the oil tank

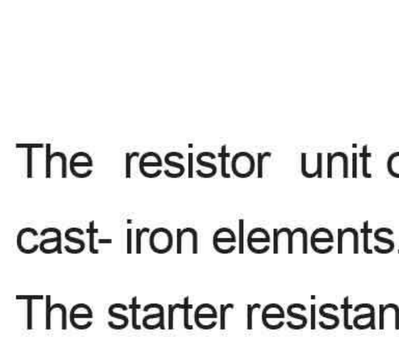
2. The cover plate which carries the control section and also closes off the oil tank

3. The sheet steel cover which protects the control section

4. The cable cover

The resistor unit of starters type ORC 315 is assembled by standard type resistor units ORC 315 with cast- iron elements.
The starter resistances are shorted-out step - by - step with rotor contactors which are controlled by time relays. Each starting position is indicated by means of a lamp.

Twin starters consist of two starters whose rotor contactors are controlled by the time relays of one device.
Starters with additional water cooling are delivered with attention cooling aggregate.



OIL FILLING

ATTENTION:

In oil starters only you must use Without acid oil according to standard DIN 51 370 and VDE 0370 (e.g.univolt 62/ESSO,Shell Diala D , BP T166 SGF + or Texaco GK2) which can be obtained from specialized dealers. On the front side of oil tank is an oil level indicator.

TEMPERATURE MONITOR

To prevent an undue high temperature rise of the oil by incorrect operation of the starter one Digital thermostats(with two normally closed contact and normally opened contact each)are fitted in the starter.
A contact adjust in 60ºC that active system alarm.
One contacts opens at approx. 60ºC oil temperature,interrupts the starting and witches off the motor (re-set point 60ºC to 100º C).

In 2000 kw starter at starting time when the temperature of motor increase the circulation pump start automatically and motor will trip.
Cut off command is optional between 90-120 ºC
The other contact,which is connected to terminals, opens at approx. 60 ºC oil temperature and indicates that the temperature rise of oil.

features: cooling pump in high power resistance alarm in low power resistance both features are adjustable (reset point 70 ºC to 90 ºC).

TECHNICAL DATA OF THERMOSTATS:

	MTC-MHC 12	MTC-MHC 27	MTC-MHC 31
Dimensions	77×35×77mm	54×90×70mm	96×48×138mm
Operating temp.	-10º…….+50ºc	-10º…….+50ºc	-10º…….+50ºc
Range	-50º..+150ºc/0..100% r.H.	-50º..+150ºc/0..100% r.H.	-50º..+150ºc/0..100% r.H.
Resolution	1ºc/1% r.H.	1ºc/1% r.H.	1ºc/1% r.H.
Input	PTC 1000/0…1V	PTC 1000/0…1V	PTC 1000/0…1V
Relay power rating	Refer to data on unit	Refer to data on unit	Refer to data on unit
Connections	Screw term.blocksØ2mm2	Screw term. blocks $Ø_2$ mm^2	Fastons
Supply Voltage	Refer to data on unit	Refer to data on unit	Refer to data on unit
Consumption	2VA	3VA	3VA
Front protection	IP54	IP40	IP40

TECHNICAL DATA OF THERMOSTATS:

We reserve the right to make modifications without prior notice.

STATOR CONTACTORS

The starters type ORC 90 up to ORC 315 are also delivered with built-in stator contactor for max. 660 V incl. thermal delayed overcurrent relay

Starter type	Contactor Type	Rated Operating Current Ie/AC2 A	Overcurrent relay Type	Rated Current A	Setting Range A	Permissible back up use for contactor and relay NH-type- insert 3NA1 A
ORC 90	**3RT10 55-6AP36**	180	**3RB12 53-0FM00**	200	81-125	**250**
					110-170	**250**
					130-200	**250**
ORC 200	**3RT10 75-6AP36**	400	**3RB12 57-0KM00**	400	162-250	**400**
					208-320	**500**
					260-400	**500**
ORC 315	**3RT10 76-6AP36**	630	**3RB12 62-0LM00**	630	325-500	**630**
					409-630	**630**

In the case of models without the stator contactor, a suitable contactor or circuit breaker must be provided for disconnection from the system.

OVER LOAD PROTECTION

When 3RT10 contactors are separately used for switching the stator,the 3UA thermal overcurrent relay is to be used as overload protection. When using protective breakers the corresponding releases (overcurrent release,under voltage release) have to be used.

SHORT CIRCUIT PROTECTION

Suitable short circuit protection equipment (fuses , protective breakers Fase control Relay) for stator contactor , over current relay , motor and motor cables are to be ordered separately.

CONTROL

The control section is factory wired and tested with control contactors, time relays,indication lamps and the key type momentary - contact switch. In case of available motor data (motor rating , rated speed , rated rotor current rotor standstill voltage),

torque (characteristic & value) and the moment of inertia of motor and driven machine (J) , or having the starting duty and starting time available, the switching or stepping times will be adjusted by the works according to these operating conditions. The shortest adjustable starting time is 10 sec. If the actual operating conditions are not known at time of order, the operating data mentioned on page 18 will be used.In this case the switching / stepping times must be adapted to the torque of the driven machine during commissioning of the equipment.

In starters with stator contactor and overcurrent relays installed the control circuits are ready wired in the factory. The stator contactor is interlocked with the step contactors in such a way that the starter can only be switched on with full starting resistance.

In starters without stator contactor the auxiliary switches of the separate stator switching device (e.g. protective breaker or contactor) and the overload relay are to be included in the control-circuit in a suitable way (see wiring diagram page100). If the rated currentof the magnet coil of the stator contactor is higher than 5A, an auxiliary contactor (e.g. 3TRH8) has to be used.

The starter is switched on and off with a key type push button . Terminals for further command devices for remote control of starters are provided.

When the "on" command with the key type push button is given the stator contactor is energized and all time relays will be started , which in return will control the rotor contactors according to their pre-set times.

Then the rotor short circuit contactor closes the rotor circuit. The time relays are reset and the rotor contactor will be released.

At " **OFF** " command the stator contactor and the rotor short circuit contactor will be released.

With twin starters the rotor contactors of both starters will be controlled by the time relays of one starter ; both starters have to be connected with control cables via the built-in terminals according to the wiring diagrams.

AUXILIARY CONTACTS

The starters are normally delivered with auxiliary Contacts , which signal beginning and end of the starting procedure . One normally open contact is connected to terminals , which is operated either by the stator contactor or the rotor short circuit contactor (see wiring diagram page 102.

In starters without stator contactor an auxiliary contactor of the separate stator switching device must be used to announce the beginning of starting.
Additional auxiliary switches on inquiry

Technical data of auxiliary contacts

Rated insulation voltage Ui:	660 V
Rated operating current Ie/AC11 at 220 V	6 A
380 V	4 A
500 V	2,5 A

POSITION INDICATION

Every starting position is indicated by means of a pilot light. The normal sequence of starting can be observed at the position indication. The last indication lamp (rotor circuit is short circuited) is steadily lighting up and indicates that the starting process is finished.

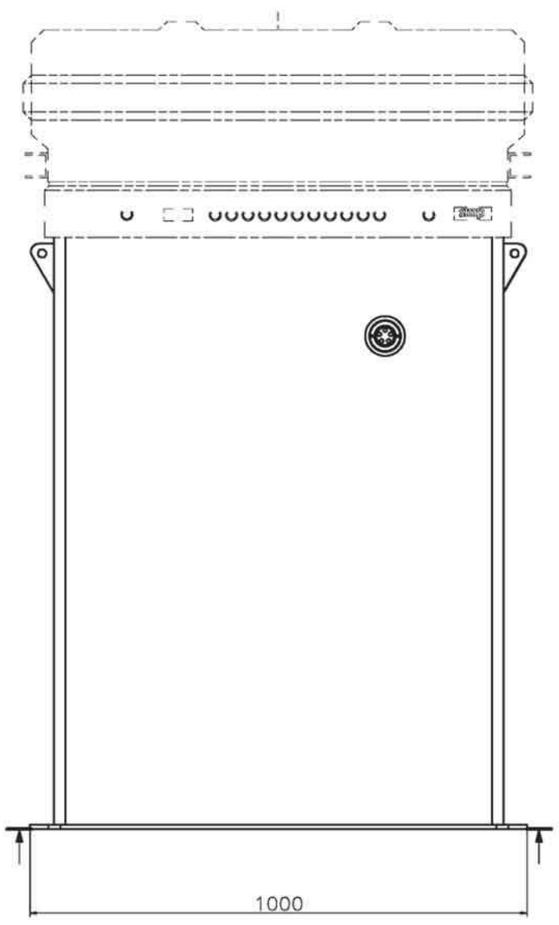
CONTROL VOLTAGE

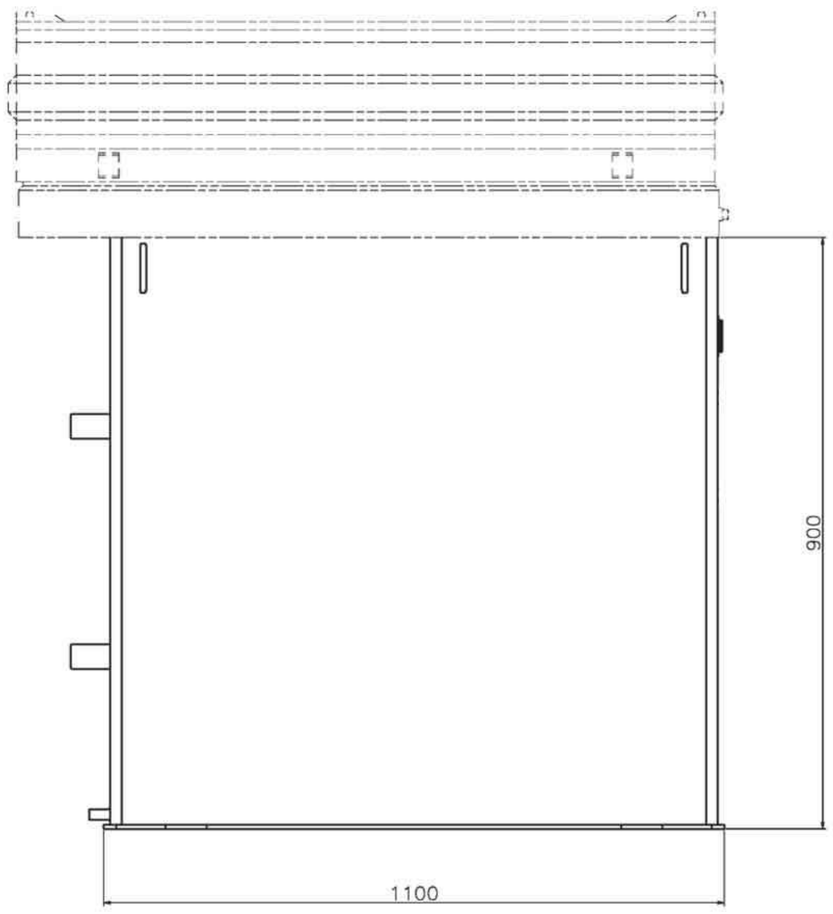
The starters will be delivered for a control voltage of 220V, 50Hz. For other control voltage a design with built-in control power transformer can be delivered(see selection and order data, page 82 .

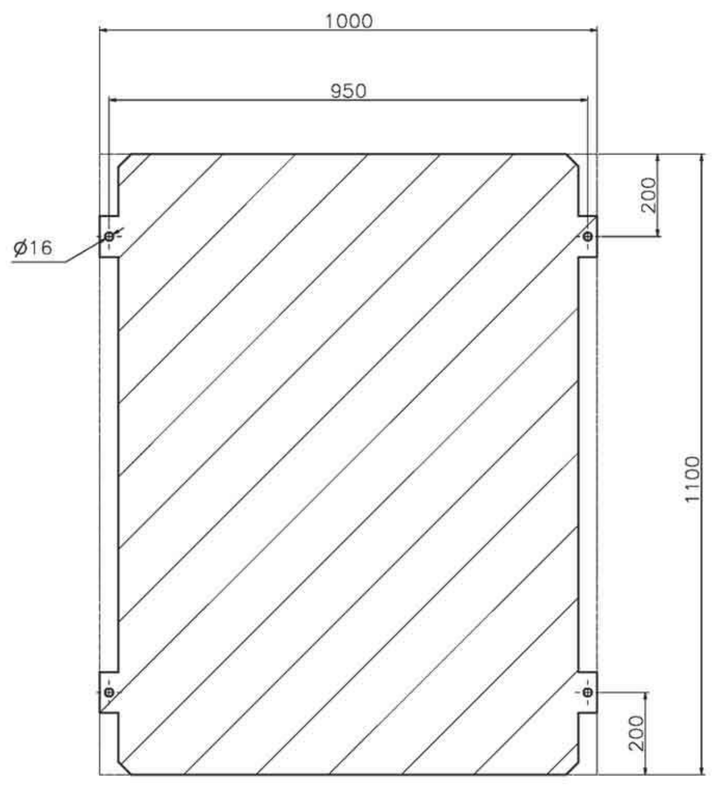
CABLE CONNECTION

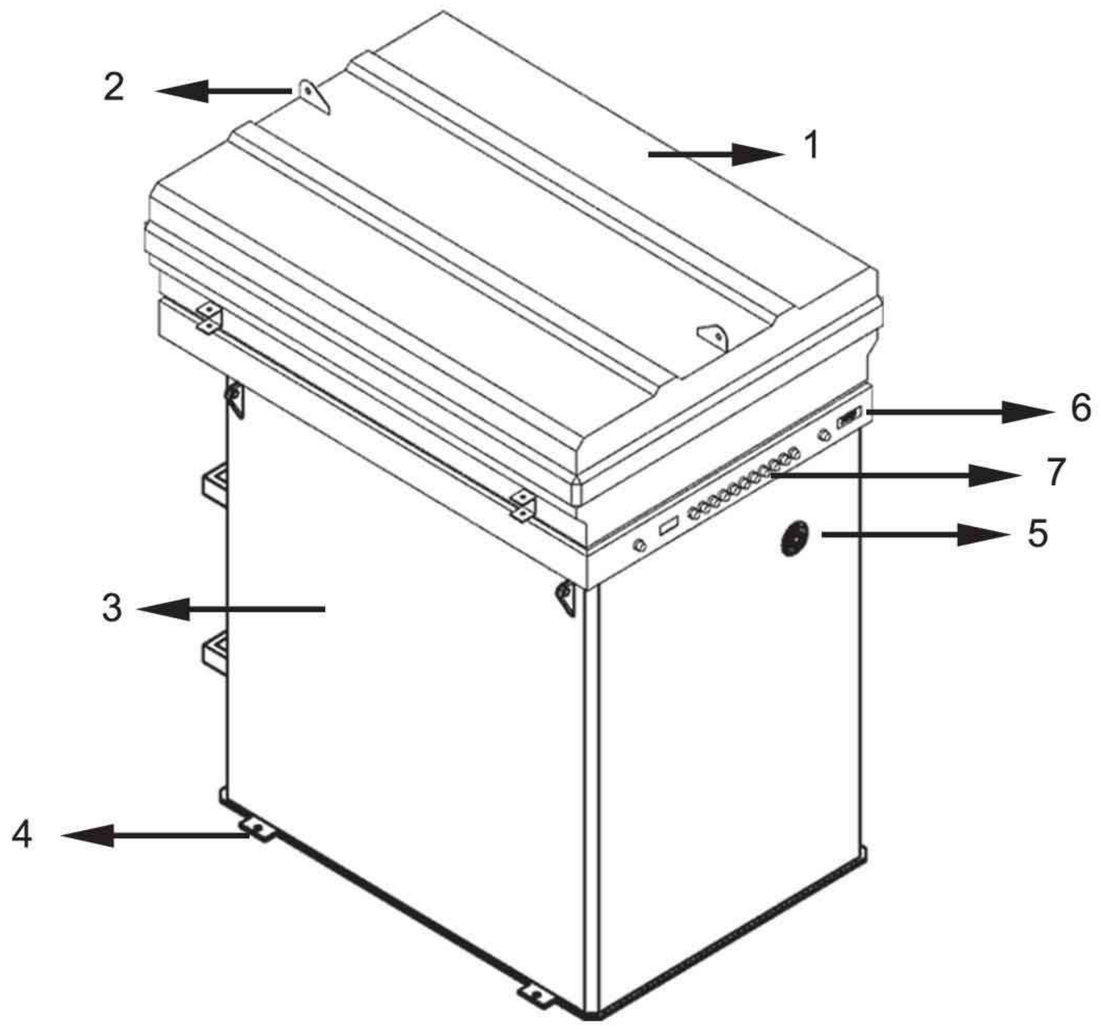
Resistance voltage is selectable as in order 220 v.
For cable inlet cable sleeves are foreseen which guarantee degree of protection IP54. The inlets for control cables are provided with rubber sleeves by the factory, which can be replaced by PG16 glands with nut, if necessary. For protection of cables against mechanical damage a cable cover is deliverable,which can be mounted to the cable fixing points at the starter

DIMENSIONS









1). Lid

2). Lifting Lugs

3). Tank

4). Fixing Point

5). Oil Level Gage

6). Local Control

7). Signal Lamp

Number of necessary conductors as well as possible connection cross sections perphase:

ROTOR CIRCUIT				STATOR CIRCUIT		
Starter type	Rated current (A)	Conductor phase	Connection cross section/phase (mm^2)	Stator current (A)	Conductor phase	Connection cross Section/phase (mm^2)
ORC90	150 250	1 1	16-35 25-70	180	1 1	50-120
ORC200	250 450	1 2	25-70 70-150	400	2 2	150
ORC315	250 450	1 2	25-70 70-150	630	2 2	300

INSTRUCTION FOR SELECTION

The starter size can be selected according to given motor ratings of the motor to be started;see schedule page 86 The motor ratings indicated in the schedule are maximum values and must not be exceeded.

Dependent on available rotor current a starter either in the basic version or the high rated model has to be selected.On three phase motors with brush lifting device the peak values of the indicated rotor currents can be exceeded. (Values on inquiry).

NORMAL STARTING CONDITIONS

Normal starting conditions are defined as those in which the moment of inertia (JG≤10xJM) is not very high and the desired starting data correspond to the given data.

The necessary model can be selected from the schedule on page 82 .The values indicated in the schedule on page 83 for motor ratings at half load, fan-assisted , full load and overload starting are valid at a number of starts $z \geq 2$. The values indicated for starting time and starting frequency must not be exceeded.

SPECIAL STARTING CONDITIONS

With special starting conditions .eg. long or short starting time, high starting frequency, heavy starting duty (f>2), high moment of inertia-the type of starter has to be determined by means of the starting energy (W), which will be supplied to the starter per start.

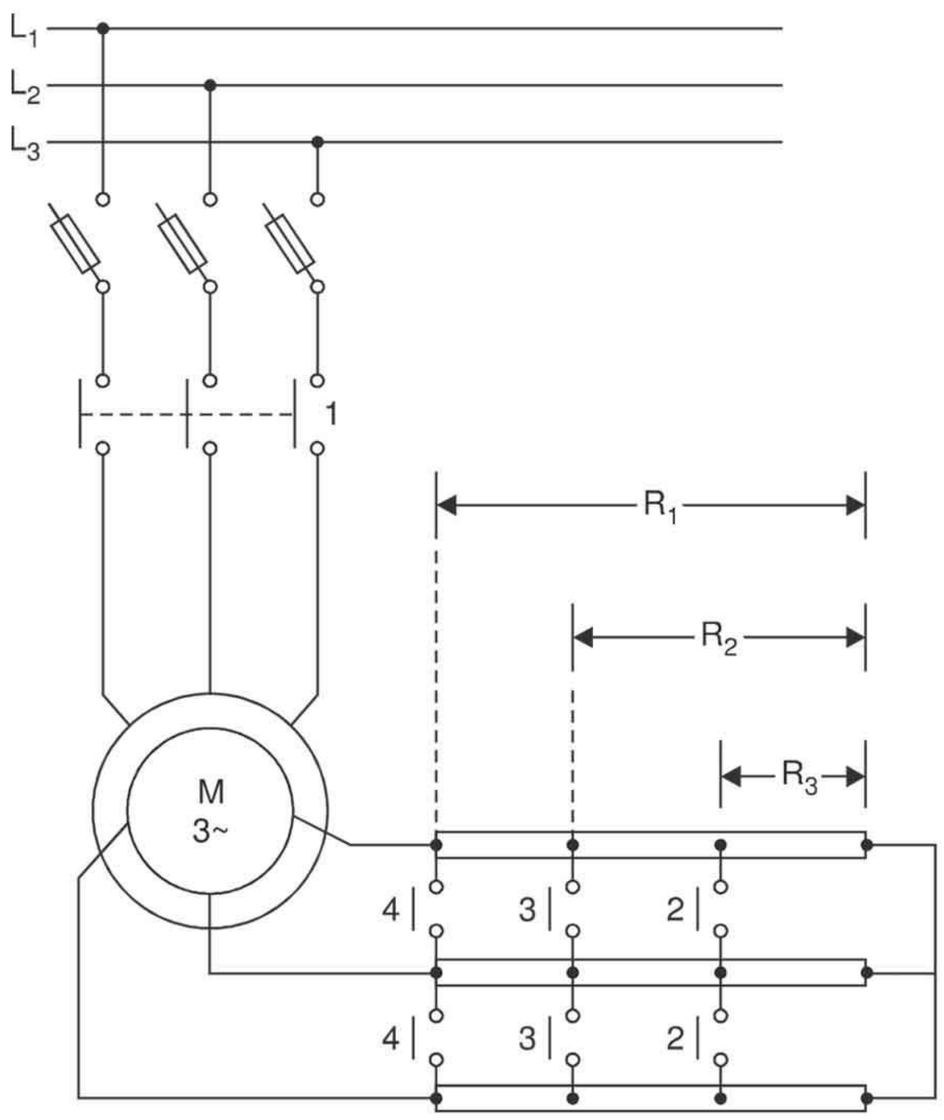
This is also valid for an exact selection of the starter, if the starting diagram or the torque-speed characteristic is available.

USEFUL CONTENT FOR ORDER

Limitation of torque peaks is required to prevent overstressing of the mechanical parts of the driven machinery. Figure pg.78 shows connection of a slip-ring induction motor with extra resistance in the rotor circuit.

To accelerate the motor smoothly, first the contacts 1 should close and energies the stator winding with whole of resistance in the rotor circuit.

The total value of resistance should be such as to limit the torque and current to 1.5. to 2.00 times the full-load values. These values, however, would depend upon the type of load connected and the permissible current limit.



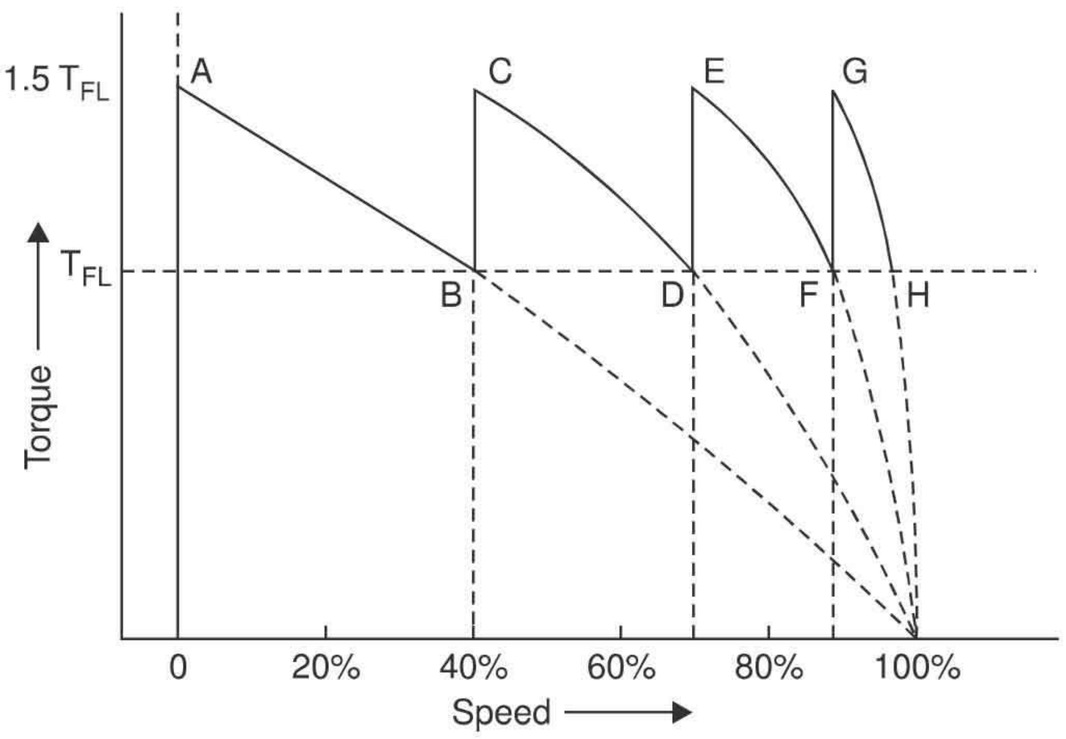
The motor should accelerate according to the torque versus speed curves shown in Figer pg. 79 When the main contacts 1 close, starting torque equal to 1.5 times full load, equal to OA in Figer pg. 79 is developed.

The motor will accelerate along curve AB. When motor torque balances the full load torque at point B the contacts 2 should close and thereby cutting off resistance R3 from the rotor circuit. As the resistance is cut off the motor should again develop higher torque with resistance (R1– R3) in circuit and the accelerate along curve CD.

At point D, contacts 3 should close to cut off resistance R2 from the rotor circuit. Motor will now accelerate along curve EF and reach about 80% of Synchronous speed at point F. At this instant contact 4 should close to cut-off the remaining resistance. Now, the whole of resistance R1 is cut-off. The motor will now develop torque equal to point G and then accelerate along curve GH.

DETERMINING EXTERNAL RESISTANCE AND TIME OF START

The choice of the external resistance to be introduced in the rotor circuit during start up will depend upon the torque requirement or limitation in the stator current, without jeopardizing the minimum torque requirement. Since T start and I are interrelated limitation in one will determine the magnitude of the other. Making use of the circle diagram or the torque and current curves available from the motor manufacturer, the value of the stator current corresponding to a particular torque and vice versa can be determined. The slip at which this torque will occur on its operating region can also be found from these curves.



Speed / Torque Curve

$$\beta = \sqrt[\alpha]{S_{max}}$$

$$\beta = \frac{I_{min}}{I_{max}}$$

α = number of step

$$R_n = \beta R_{n-1}$$

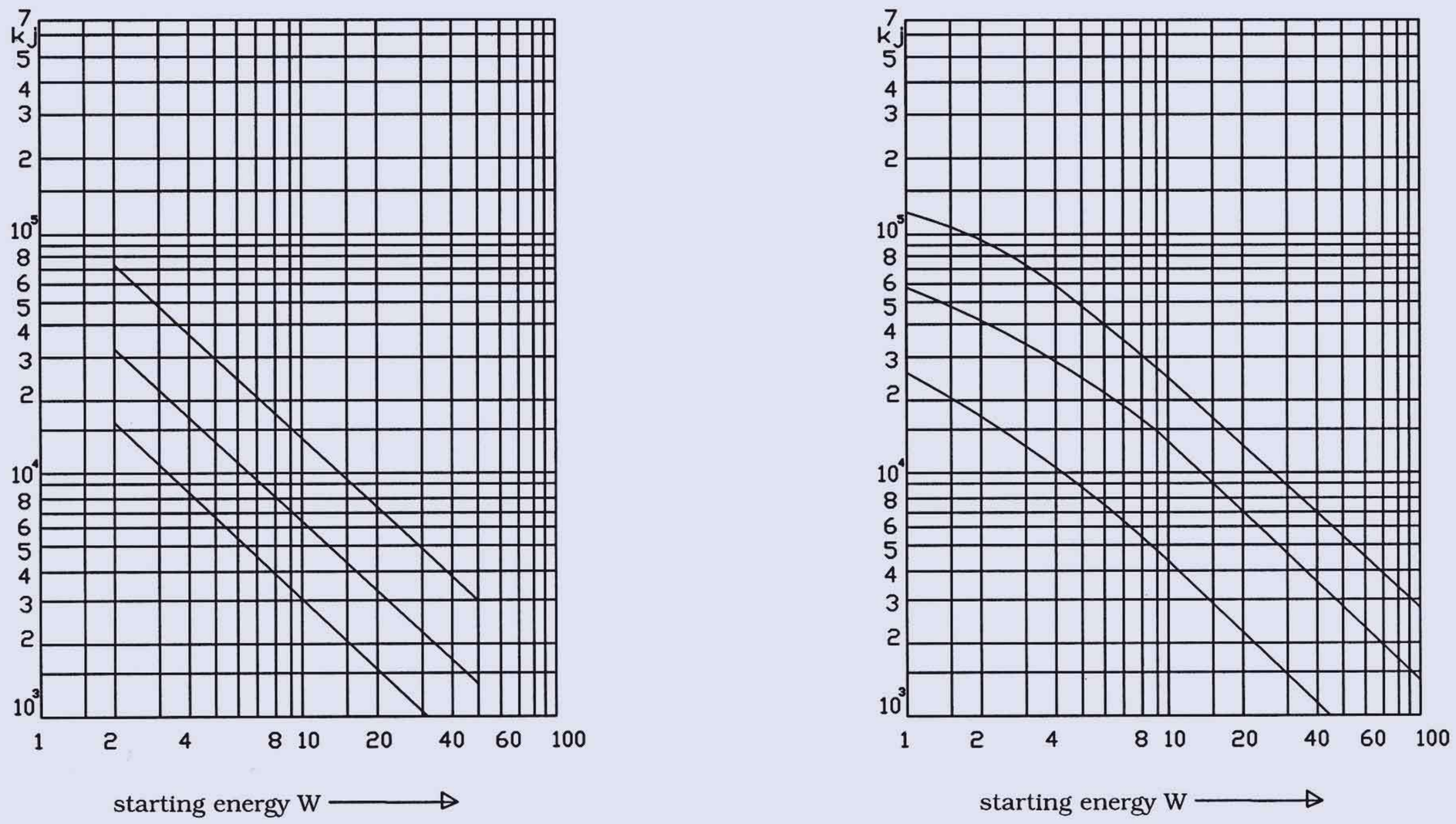
S_{max} = slip at the end of step

Starter duty factor ka

Factor for the starter calculated by dividing 1.4 times the starter duty rating of the motor by the starting load factor.

Rotor duty factor k

Calculated using the rotor data for standstill voltage and rated rotor current of the motor.



STARTER PARAMETER K_a

For further determination of the required starter the starter parameter ka is necessary. It is calculated from this formula:

$$K_a \approx 1.4 * \frac{K}{f} \quad (\Omega)$$

K = rotor parameter of motor (Ω)

$$K = \frac{u_r}{\sqrt{3} * i_r} = \frac{\text{rotor standstill voltage}}{\sqrt{3} * \text{rotor rated current}}$$

The starter parameter ka and the corresponding index letter can be taken from this diagram:

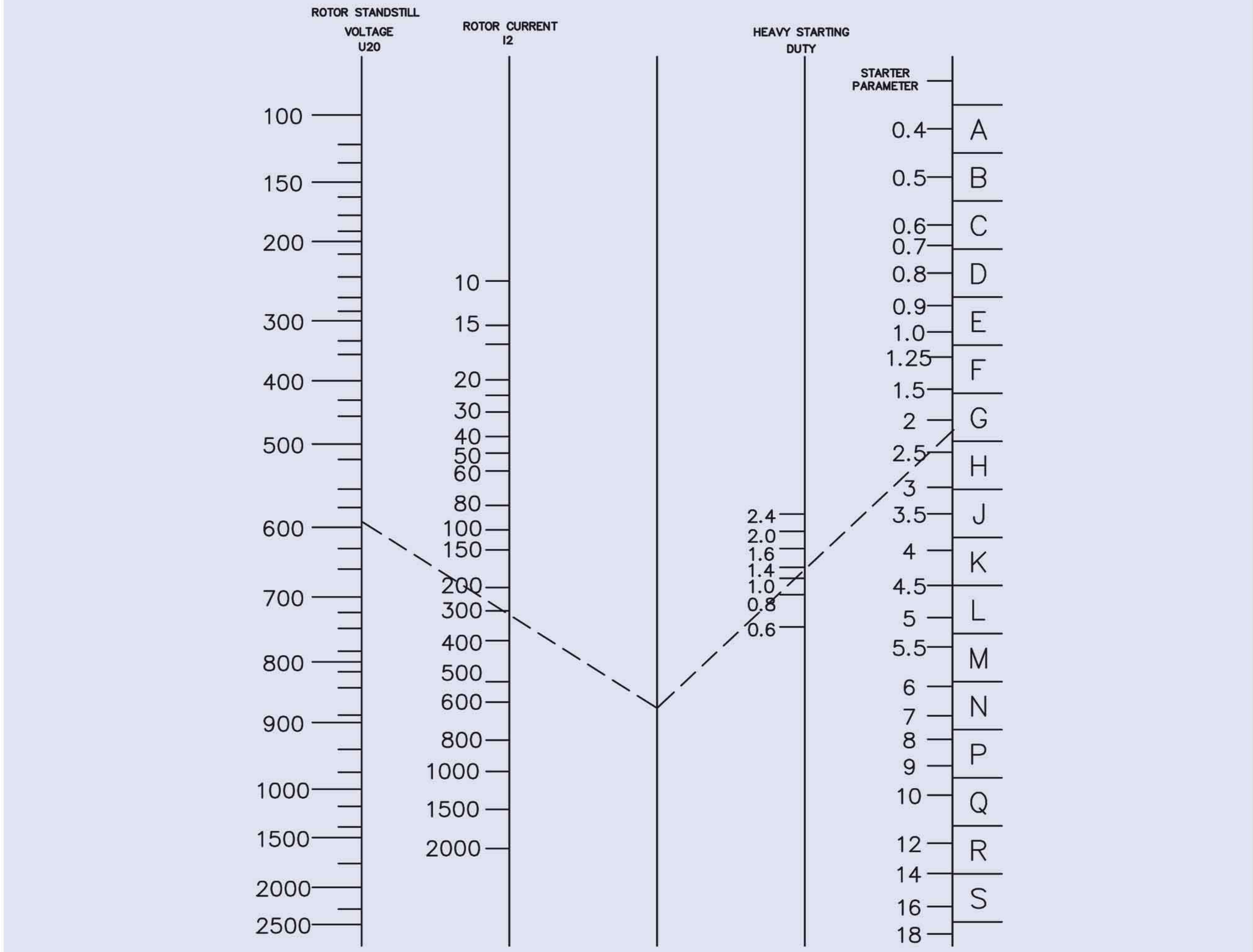


Diagram for determination of starter parameter k_a and the index letter.

SELECTIVE EXAMPLES

Example 1

Slip ring induction motor, type 1RS6 314-6AA10 (Siemens) with:

Motor rating	P_N = 160 kw
Rated voltage	U_e = 380 V
Rated current	J_e = 306 A
Rotor standstill voltage	u_r = 285 V
Rotor rated current	i_r = 347 A

Driven machine with:

Starting duty	F = 1/4 (mill)
Starting time	t_a = 16s (determined acc. to motor and driven machine data)

Required:
Starter with stator contactor

Degree of protection	IP54
Control voltage	220 V, 50Hz
No. of starts	z ≥ 5
Starting frequency	h ≥ 1,5

Determination of model by starting energy (W) :

$$W = 0.5 * p_N * t_a = 0.5 * 160kw * 1.4 * 16s = 1792\ kj$$

At a necessary starting energy of 1792 KJ the required no. of starts z≥5 and the starting frequency h≥1,5 will be obtained according to diagrams 4 and 5 with model ORC 200

If one of the values falls below, the next larger design will have to be selected.

The no. of starts z can also be determined with:

$$Z = \frac{\text{Possible starting energy}}{\text{actual starting energy}} = \frac{\text{9450 Kj (ORC200)}}{\text{1792 Kj}} \approx 5$$

No of starts z= 5 means that 5 consecutive starts from cold with intervals of double the starting time are possible.

Starting frequency **h** = 1,5 means that 1,5 Starts per hour are possible in steady intervals at warm condition.

The starter ORC200 thus permits the 5 times starting of 160 kw motor from cold with intervals of 2×16 = 32 s at a starting time $\mathbf{t_a}$ = 16 s. The start can be repeated every 40 minutes from warm condition.

FURTHER DETERMINATION OF ORDER NO.

The requirement of control voltage 220 (V), 50 Hz results in order no. ORC200

For the rotor current in hand $\mathbf{i_2}$ = 347 (A) the reinforced desing ORC250 with a max.
Rotor rated current of 450 (A) has to be selected.

According to the above (with stator contactor $\mathbf{U_e}$ = 380 (V), $\mathbf{J_e}$ = 306 (A)) the starter ORC250 with stator contactor and over current relay setting range 208 to 320 A has to be selected.

The starter parameter ka results as:

$$K_a \approx 1.4 * \frac{k}{f} \quad \text{and} \quad K = \frac{u_{20}}{\sqrt{3} * i_2}$$

$$K_a = \frac{1.4 * 285\ v}{1.4 * \sqrt{3} * 347\ A} = 0.47 \quad \text{Ohms}$$

It can also be taken from the diagram Then the order no. is ORC250 and the starting time and starting duty is in order.

Example 2

	Wound rotor induction motor
Motor rating	P_N = 5000 kw
Rotor standstill voltage	U_{2o}=1990 V
Rotor rated current	i_2 = 1580 A

	Driven machine:
Starting duty	f = 0.7 (lathe)

	Required: Starter without stator contactor:
Degree of protection	IP54
Control voltage	220v, 50Hz

DETERMINATION OF MODEL:

According to schedule "Technical Data", page 81 the model ORC5000 in reinforced design ($\mathbf{i_2}$= 1600A) is suitable to start a 5000 kw motor at a starting duty of **f** = 0,7 (half loadstart).
The starting time $\mathbf{t_a}$ = 40, the no. of starts **Z** = 2 and the starting frequency **h** = 0.2 of the Starter have to be observed.

Further determination of the order no.:

The required control voltage 220(V), 60Hz results in order no. ORC5000

For the rotor current $\mathbf{i_r}$ = 1580 (A) the reinforced design ORC5000 with a max . rated rotor current of 1600A and, as required , without stator contactor has to be selected.

The starter parameter ka results as $\mathbf{u_r}$ = 1990 (V), $\mathbf{i_r}$ =1580 (A) and **f** = 0.7 from the diagram on page 81 figure 2 in $\mathbf{k_a}$ = 1.45 ohm.

In this formula M_B is unknown . The average accelerating torque $\mathbf{M_B}$ is calculated from:

$$\mathbf{M_B = M_m - M_L}$$

The torque $\mathbf{M_L}$ is given with $0.5 \times \mathbf{M_N}$

The average starting torque is $\mathbf{M_m \approx f \times M_N = 0.78 \times M_N}$

The rated torque $\mathbf{M_N}$ is calculated from

$$\mathbf{M_N = \frac{P_N * 9550}{n_N} = \frac{900 * 9550}{1480} = 5800\ N_m}$$

Result:

$$\mathbf{M_B = (0.78 - 0.5) * M_N = 0.28 * 5800\ N_m = 1620\ N_m}$$

$$\mathbf{t_a = \frac{J_G * n_N}{9.55 * M_B} = \frac{566 * 1480}{9.55 * 1620} = 54\ (s)}$$

$$\mathbf{W = 0.5 \times P_N \times f \times t_a = 0.5 \times 900\ kw \times 0.78 \times 54s = 18900\ kJ}$$

At a required starting energy of 18900 (**kJ)**, the required no. of starts **z** ≥3 and starting frequency **h** ≥ 4 , is obtained only with the starter ORC 900 with additional water cooling

SELECTION AND ORDER DATA

With/without stator contactor Control voltages 220 (V) 50 Hz or 220 (V) 60 Hz degree of protection IP54 (with cable covering IP55), without oil.

Basic design		
Rated rotor current i_2 A	Control voltages 220 (V), 50 Hz Order No	Weight Without oil approx. kg

Starter with stator contactor

150	ORC 200	350
250	ORC 250	400

Starter with additional water cooling
Without stator contactor

450	ORC 500	950
630	ORC 800	1500
1100	ORC 1100	1800

REINFORCED DESIGN

Rated rotor current i_2 A	Control voltages 220 (V) , 50Hz Order No	Weight Without oil approx. (kg)
		Starter with stator contactor
250	ORC250	400
450	ORC450	550
450		
		Twin starter without stator contactor
1600	ORC 2000	1800
		Starter with additional water cooling Without stator contactor
630	ORC 800	1200
1100	ORC 1100	1560
1600	ORC 2000	1800

SMP GROUP

Design & Production Of Technical Equipment

SPECIAL DESIGNS

With built-in control-voltage transformer (additional price)

For control voltages deviating from 220 v/50 Hz a design with built-in control power transformer with input voltages of 400 v, 380 v, 360 v and 220 v is available.

SPECIAL STARTING CONDITIONS

When special starting conditions exist.e.g.long or short starting times, high starting frequecy,heavy starting duty (f = 2) ,high moment of inertia – the optimal starting time be will set by the factory. Instead of ta and **f** starter diagram or the drive motor data (rated power, rated speed, rotor current, rotor standstill voltage) can be indicated.

Without additional price

CABLEINLET

Type	Main cables No. Of Max. cable cross Section mm^2	cable cross Section mm^2
ORC 200	16	25
ORC 400	25	25
ORC 500	25	25
ORC 800	35	25
ORC 1100	35	25
ORC 1200	50	25
ORC 1400	50	25
ORC 2200	70	25
ORC 2500	70	25
ORC 3200	95	25
ORC 4000	95	25

SMP GROUP

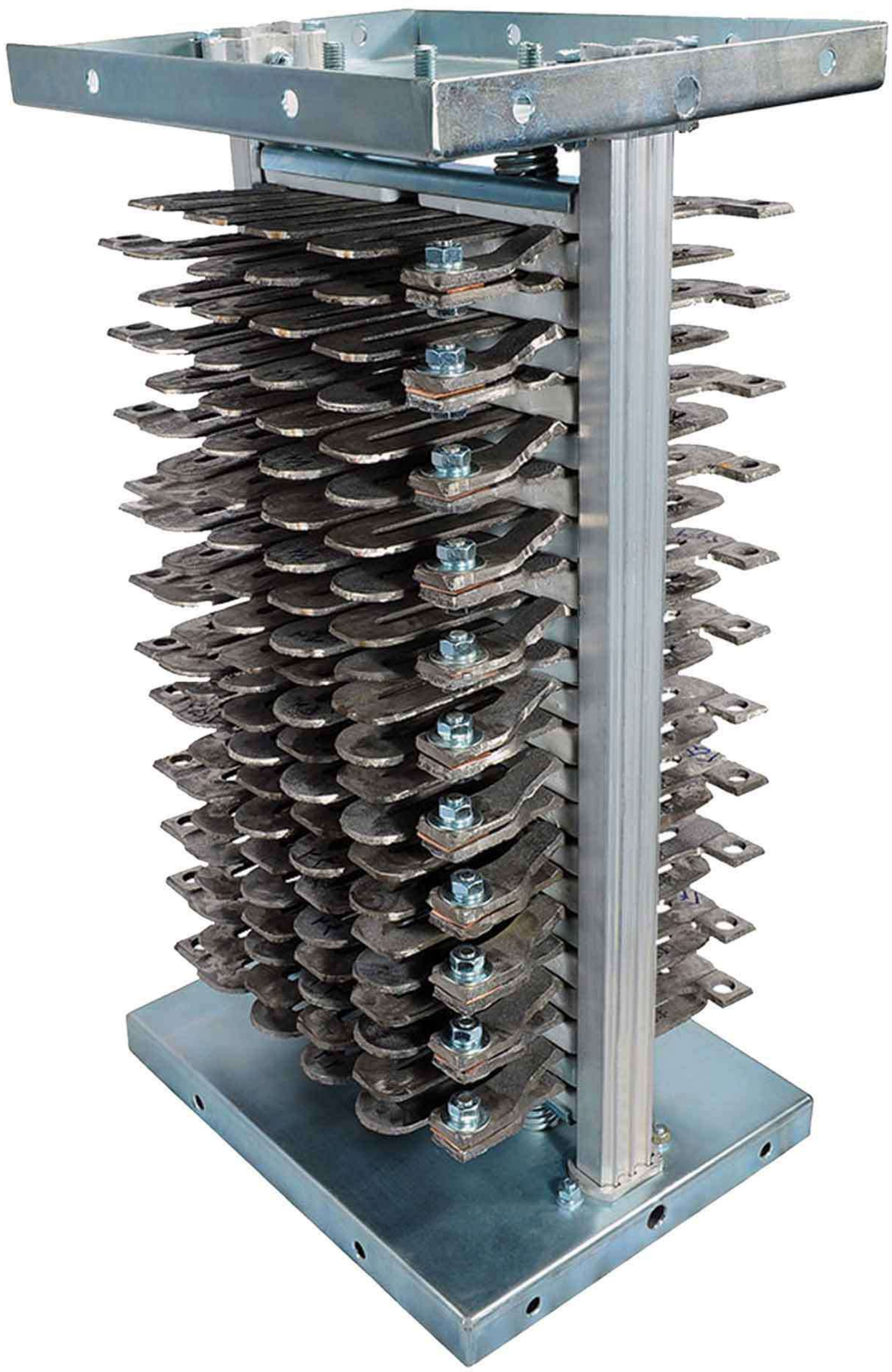
Resistor for drive Engineering

The number of components of these units is optimized for each individual application where standard bank units are not economical or too large in size.

This model of resistors is suited as starting, slip resistor and load resistor. The resistor is suited for indoor and outdoor insulation in industrial and maritime

Cast iron resistors are used in drive engineering in combination with Motor Starters or contactor controls for the starting and Stepping of the three phase slip-ring rotor or three phase motors.

They can also be applied as slip, series or load resistors. Cast iron resistors are characterized by high overload capacity and are mainly used for short-term or intermittent operation.



APPLICATION

• Starting resistors or starters

limit the starting current in motor circuits and start the motor by being switched off stepwise.

• Control resistors

are suited to reduce the motor speed. The speed can be controlled by switching different steps on and off.

• Slip resistors

reduce the motor speed. Depending on the load, the motor lags behind its nominal speed. The drive is “softer”, mechanical load surges are attenuated and the impact on the system is reduced.

• Braking resistors

convert the energy of masses in motion to heat by electrically braking the motor driven by kinetic energy.

Resistors for power engineering

• Neutral grounding resistors

installed between the neutral point of a generator or transformer and the functional earth, they limit the ground-fault current to admissible values in case of a defect.

• Damping resistors

in filter circuits. Installed in parallel to the reactance coils, they dampen the

circuits and enlarge the filter band width.

• Load resistors

in simulated test circuits act as substitute loads instead

of real loads and allow to simulate operating conditions.

THE MOST IMPORTANT ADVANTAGE OF A RESISTANCE BANK

- SMP’ s resistor banks are suitable for installation in high vibration equipment.
- Can be designed according to customer order.
- They have high reliability
- They are produced from the best quality raw materials

STANDARDS

DIN EN 60322 / VDE0115 Part 440

Regulations for power resistors in open design

DIN EN 50124-1 / VDE 0115 Part107-1

Insulation coordination, creepage and clearances for all electrical and electronic equipment

DIN EN 61 373 / VDE 0115 Part 106

Equipment for rail vehicles, vibration and shock tests

DIN EN 60068-2-1

Environmental tests: coldness

DIN EN 60068-2-2

Environmental tests: dry heat

DIN EN 60068-2-3

Environmental tests: test Ca, moist heat

DIN EN 60068-2-52

Environmental tests: test Kb, salt spray test

DIN VDE 0100-410

Protective measures, protection against electric shock

DIN VDE 0470-1

EN 60529

Protection afforded by housings (IP Code)

IEC 60077-1

Railway applications , Electric equipment for rolling stock

SMP GROUP

Brake Resistor

The Brake Resistor is an external , low impedance resistor.In order to acieve the correct power handling capacity for a specific application, resistors can be connected in series and parallel keeping within the limits in table.

choice of brake resistor

General

when you choose the brake resistor for your drive, start from the requirements of the prcess/drive.The choice of brake resistor is influenced by

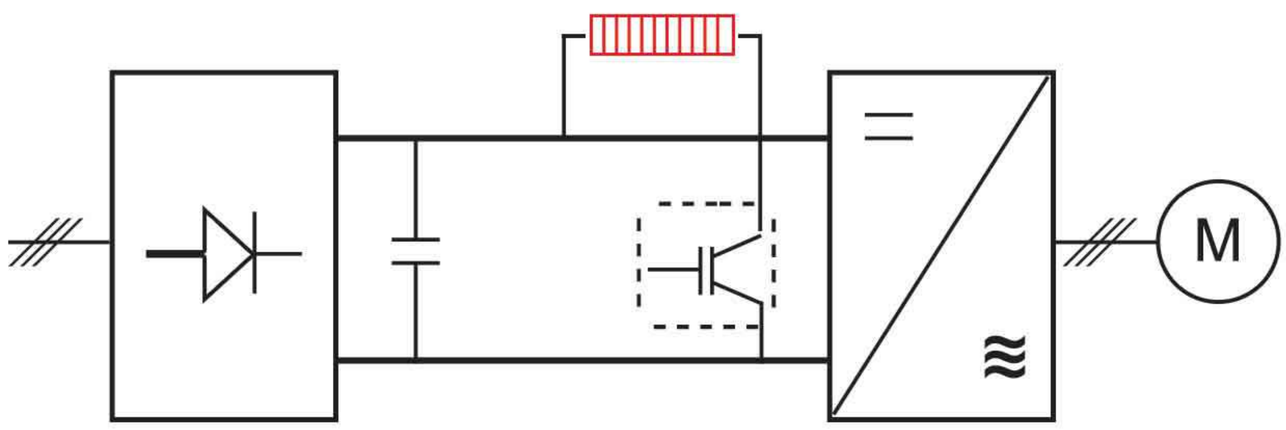
a). the average braking power during one cycle,this defines the power dissipation required of the brake resistor

b). the maximum power dissipation , this defines the instantaneous power handing capacity of brake resistor and

c). the maximum current of the brake switch , this defines the minimum resistance for the brake resistor

SMP' s Technical Support will assist you in all matters concerning braking

BRAKE RESISTOR



Breaking Resistor

SMP GROUP

There are two kinds of braking processes involved during the stopping phase of a railway vehicle: frictionbraking and electrical braking.

The purpose of a brake resistor is to help perform motor braking or overhauling by absorbing regenerated braking energy and dissipating it as heat with rheostatic resistors. Brake resistor is used for fast stopping of conveyor, cranes and high power motors in steel, cement, mining, etc. Among the important points in the design of braking resistance are the inertia of the load and the rated current of the motor.

APPLICATION

Railway applications
Electric equipment for rolling stock,
Resistance elements are installed in a metal box protected to prevent accidental contact with a perforated sheet. In some models, they can be protected with a finned sheet.

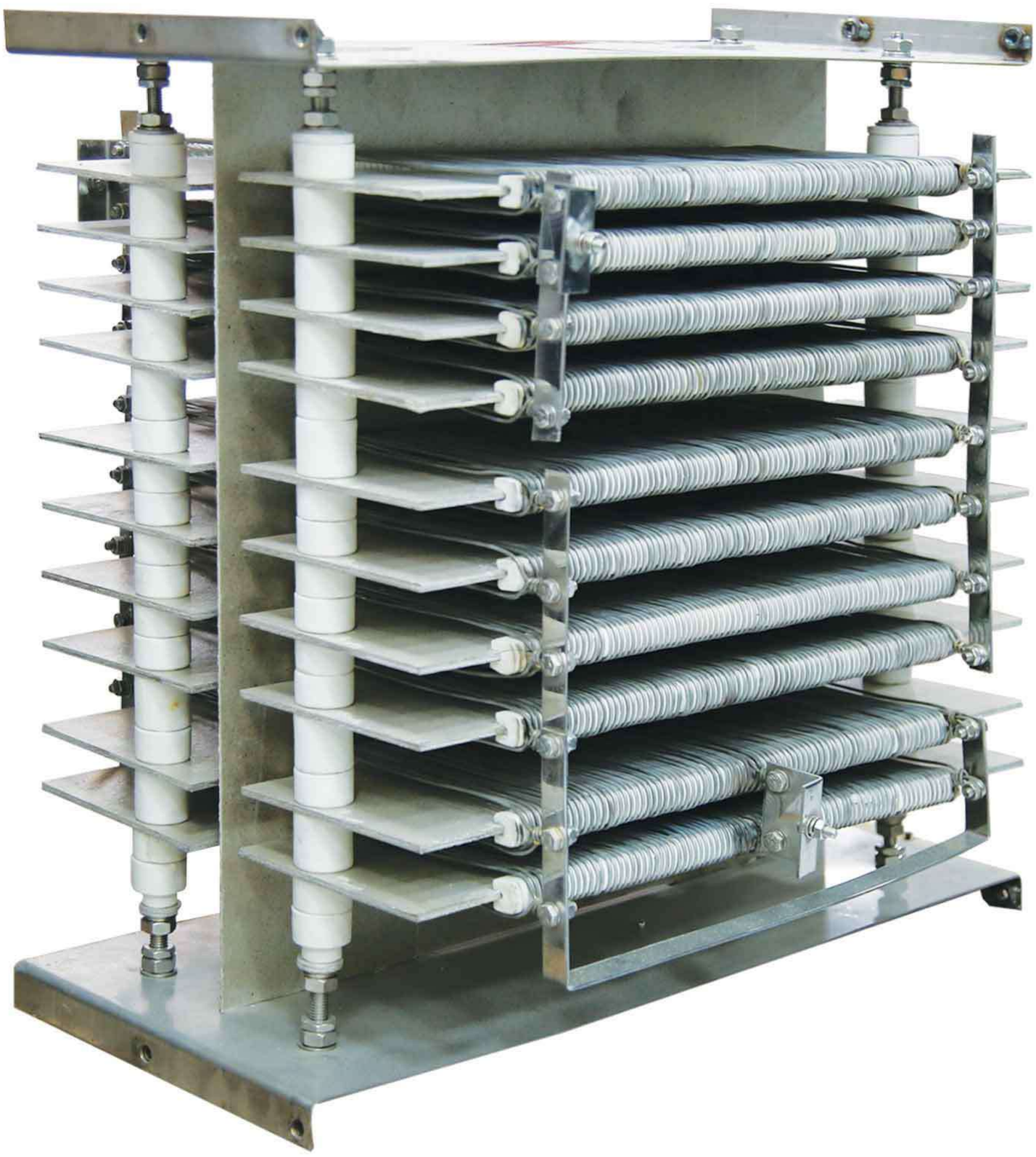
At the bottom or on one side of the device, there are all the connections to connect the contactors and the rotor.
Resistors do not require forced cooling and cool naturally.

The average power on the braking resistor during braking time will be:

$$P_{BREAKING}\,(W) = \frac{E_{KINETIC}\,(J)}{P_{BREAKING}\,(W)}$$

The amount of resistance required for braking is determined from $R = \frac{V^2}{P_{BREAKING}}$

Mission profile and kinetic energy levels are necessary to correctly size the braking resistor. Brake resistance keeps the motor voltage level at the desired level so that the power supply is not damaged.



ADVANCED FEATURES

- Faster braking of DC and AC motors
- Lower wear and tear of friction braking components
- Longer equipment life
- Safe voltage levels
- Eliminate risk of thermal runaway due to friction brakes
- Improved service reliability
- Designed to absorb thermal expansions and contractions

CLIMATE

The resistors are suited for Up to a thousand meters above sea level, indoor and outdoor installation in industrial and maritime atmosphere pursuant to DIN 50 010/T1.

Wire wound resistors

Wire-wound resistors use wire made from special alloys as resistor conductor. SMP's tubular resistors are available as single tube, double tube and multi tube resistors, demonstrating the flexibility of this highly durable product range. Resistance coils which can also be designed to be low inductance are attached to ceramic tubes of various diameters.

Clips that also act as electrical connections are used for securing the resistance wire at either end of the coil.

Properties like tolerance and temperature coefficient can be adjusted by selecting the appropriate wire and material.

Wire-wound resistors are mainly used for applications in the lower load range up to several kilowatts at low current and/or higher ohm values with the exception of the range of very small ratings at low application temperatures, wire-wound resistors are always Wound on heat-resistant carriers with insulating properties or embedded in such masses. Very thick wires can also be used without a carrier.applications in the lower load range up to several kilowatts at low current and/or higher ohm values with the exception of the range of very small ratings at low application temperatures, wire-wound resistors are always Wound on heat-resistant carriers with insulating properties or embedded in such masses. Very thick wires can also be used without a carrier. The resulting elements Are comparable to the designs of cast iron or steel grid resistors.

Wire-wound resistors

Nominal continuous power (W): 0- 280	Cooling: natural convection
Rated continuous current (A): 0.3 - 25	Max. permissible operating voltage: 600 V AC / 800 V DC
Resistance Values at 20°C (Ohm): 0.18 - 3390	Operation temperature range: -25 ... +50 °C

BELT RESISTOR
(EDGE WOUND RESISTORS)

Belt Resistors can be used for any AC or DC power application. Units are most commonly used for VFD braking, motor control, load banks and neutral grounding applications.

This resistors are suitable for continuous duty applications where low resistance and high current are required. The high element mass allows these units to withstand high current, intermittent duty applications. This characteristic, combined with the high-temperature ceramic insulation, makes the edgewound ideal for neutral grounding applications, which reach temperatures as high as 800°C.

Power ohm's Type Belt resistors are lightweight, heavy-duty units consisting of a non-corrodible, high quality stainless steel alloy. The ribbon-like element is wound on edge in the form of a helix, and then spun onto a ceramic core.

SMP's belt resistors are supported by a threaded rod passing through the center of the ceramic core. resistors are supported by a mounting bar which is slotted at either end. Fixed terminations are made by welding stainless steel tabs to either end of the element, or at various points for multiple connections. This unit includes fixed terminals, through-rods, through-bars, hardware and stainless steel element.

OPTIONS
COIL SIZES

Power values vary from 300 to 2000 watts per coil. These units are available in (15) different current ratings ranging from 10 to 100 amps continuous, and resistance values between 0.05 and 6 ohms, respectively.

ADJUSTABLE TERMINALS:

The number of output terminals can be adjusted according to the customer's order.

Multi terminal and multi-resistance, fixed, adjustable are available, out wire's length are available following customer requirement. Special terminals are available for unusual applications.

ADVANCED FEATURES

- Resistance-alloy ribbon wire is coiled on edge and supported on specially designed porcelain insulators
- Open coil construction allows efficient heat dissipation and easily accommodates reasonable overloads & surges
- Insulators provide proper turn-to-turn spacing and insulation from support bars
- Terminals are welded to the resistive wire for a reliable electrical connection
- SMP's belt resistors are manufactured in-house to maintain total control over production and quality standards.

SMP GROUP

Slip Resistor

During normal operation of large motors (crusher, mill, etc.) the object with high strength (such as harder stone, stone with larger dimensions, etc.) may become a problem for the mechanical system. In this case, a large torque is required from the motor. Slip resistors are required when excessive loads are to be expected during operation. In this case, by adding resistance to the rotor circuit, the motor generates more torque. Slip resistors limit the torque in rotor circuits in slip ring motors when the motor is starting or is in operation.

Torque limiting is normal during continuous operation. Should an overload occur, the slip resistor reduces the nominal speed and limits the motor torque.

In most cases, the calculated resistance is designed for different torques and speeds and is designed as a step (four steps on zero, 25%, 50% and 100%) for better control. Slip resistor Has a protective box with a design based on heat transfer. In designing the slip resistor, the maximum stator current and motor torque must be considered.

ADVANCED FEATURES

1- Preventing engine heat increase

2- Prevent damage to stator insulation

3- reduce inrush current

4- Preventing destructive effects on other equipment

5- Reducing mechanical damage to equipment

6- It is possible to adjust the number of stairs due to the large number of terminals.

7- Each resistor blade is connected to each other with screws and therefore has high reliability.

APPLICATION

Suitable for using with wide range of heavy industrial machines such as;

- Cement and hammer mills
- crushing
- ventilation
- rolling mills
- mines
- cement plants

SMP GROUP

Reducer Speed Resistor

Rotor Resistance Control is also one of the methods by which we can control the speed of the Induction motor. The speed of the wound induction motor can be controlled by connecting an external resistance in the rotor circuit through slip rings. This method is not applicable to cage rotor induction motor.

If the resistance of the motor is increased, then the pull out speed of the motor decreases. But the maximum torque remains constant. Thus, by Rotor Resistance Control method, the speed control is provided by the rated speed to the lower speeds. This method of speed control is very simple.

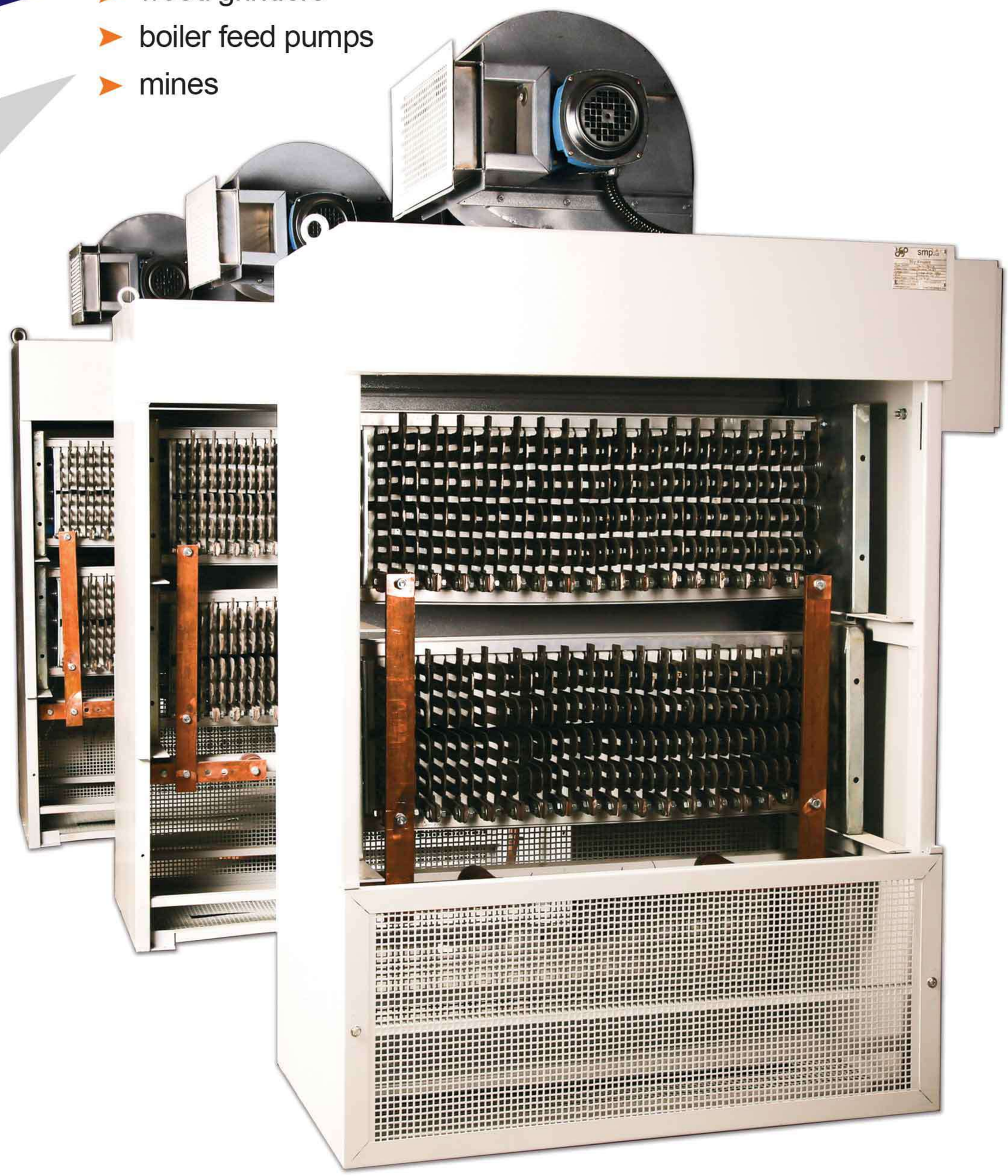
It is possible to have a large starting torque, low starting current and large values of the pullout torque at a small value of slip.

In this case the regulating resistance grids are normally continuous duty, unlike those for start-up, which are short- time duty. Equations …. can be used, for determining the total rotor circuit resistance for a particular speed variation, i.e.

APPLICATION

Suitable for using with wide range of heavy industrial machines such as;

- Cement and hammer mills
- fans and compressors
- crushing
- pumps
- rolling mills
- wood grinders
- boiler feed pumps
- mines



EXAMPLE

For the 125 kW motor wound rotor has the following parameters:

41 5 V

3phase

IS = 230 A

Vr = 500 V

Ir = 180 A

T/Tmax = 250%

R2 = 0.09 ohm (star connected)

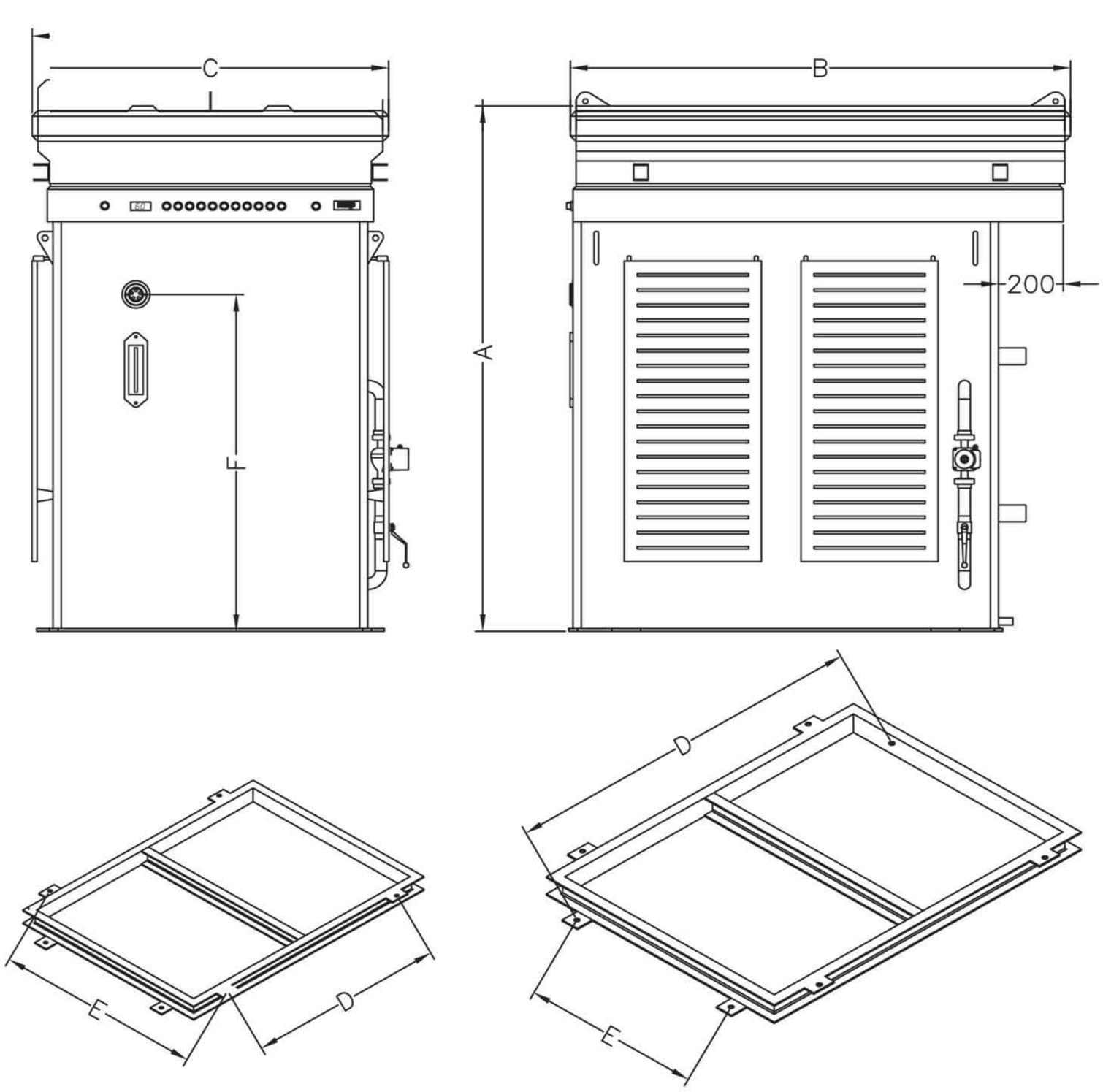
if a speed reduction is required by 50% at constant torque and the rotor current is now 73% of its rated value then the total rotor circuit resistance

$$R = \frac{500 * 0.5}{\sqrt{3} * 180 * 0.73} = 1.098\ \Omega$$

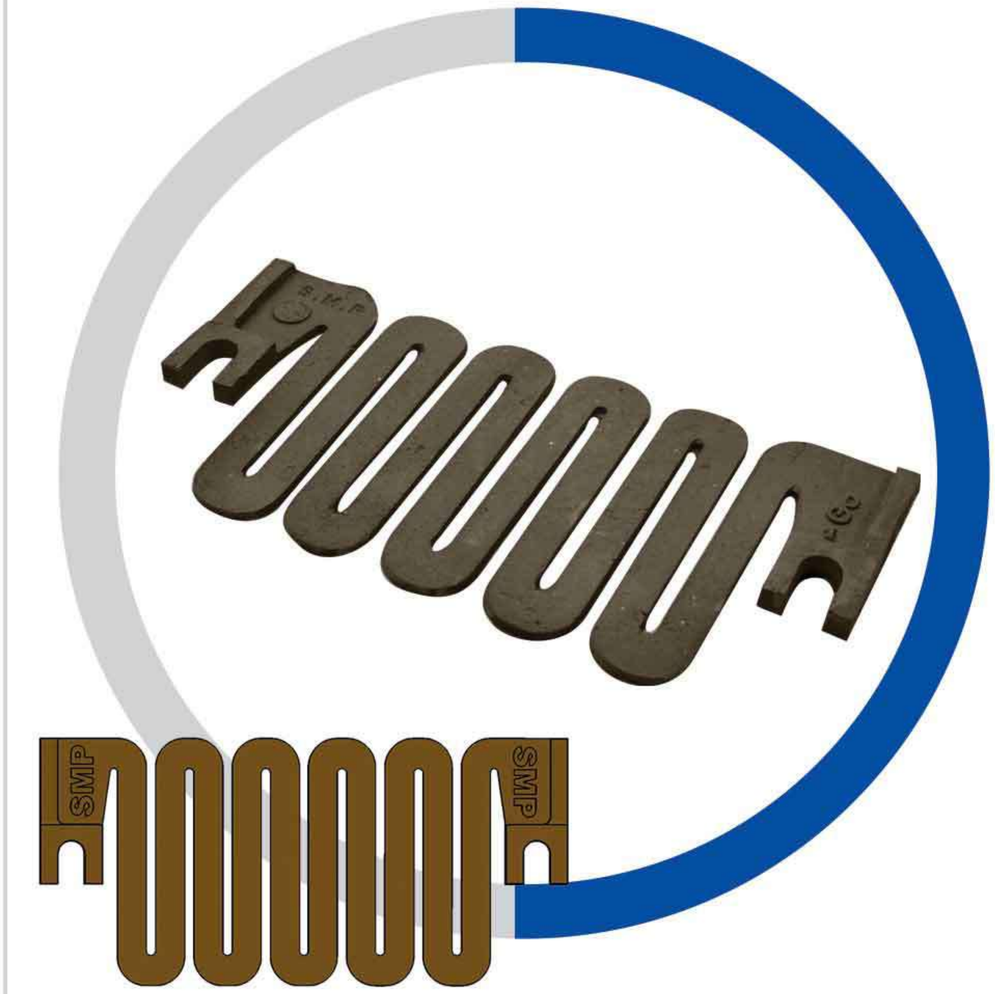
$$R_{\text{speed reduction}} = 1.098 - 0.09 = 1.008\ \Omega$$

CAST IRON PLATE

Resistance Type	Dimensions						
	Height (A)	Length (B)	Wide (C)	Anchor Lenght(D)	Anchor Wide (E)	Gage Height (F)	
Model Very small	1230	1160	1100	1100	1000	1000	With Oil Radiator
Model Small	1960	1500	1100	1110	1165	1200	Without Oil Radiator
Model Middel	1960	1730	1300	1340	1365	1200	With Oil Radiator
Model Large	1960	1730	1500	1340	1565	1200	With Oil Radiator

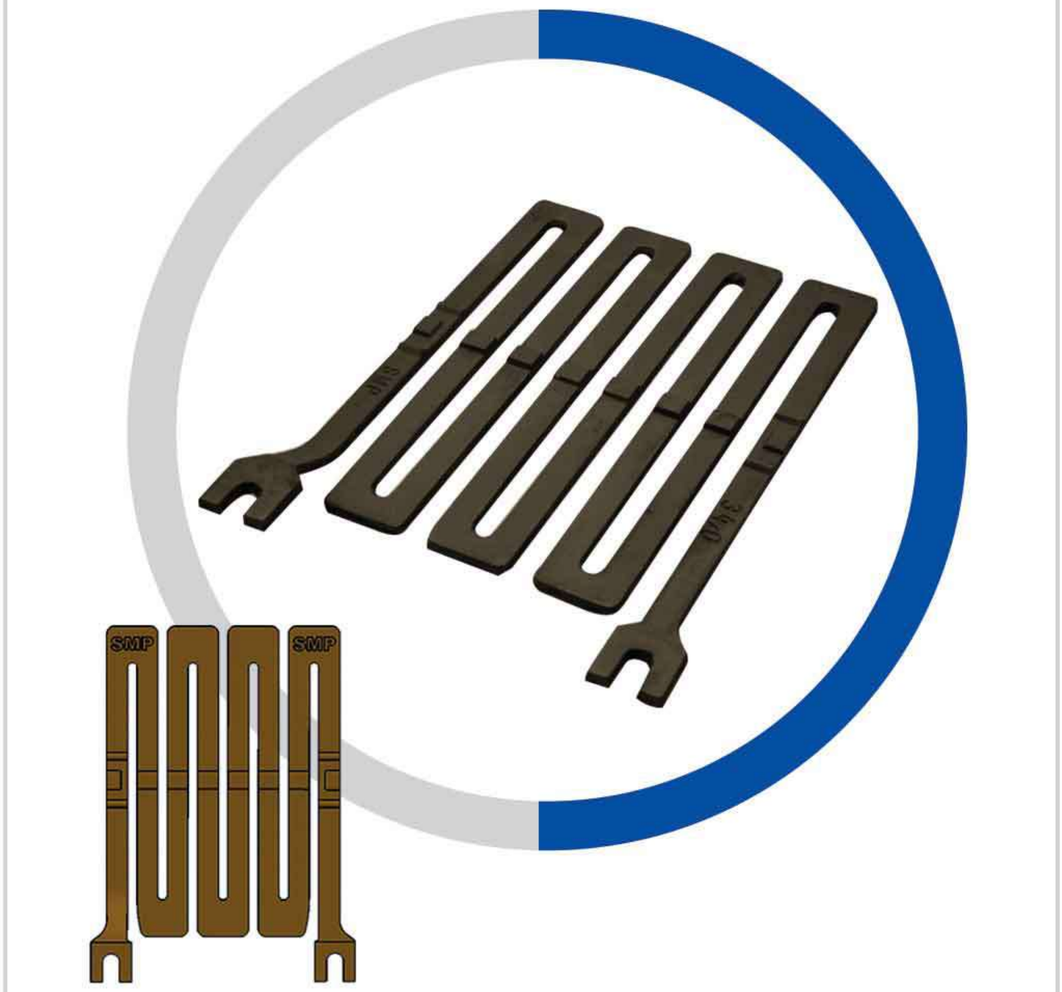


RESISTORES PLATE

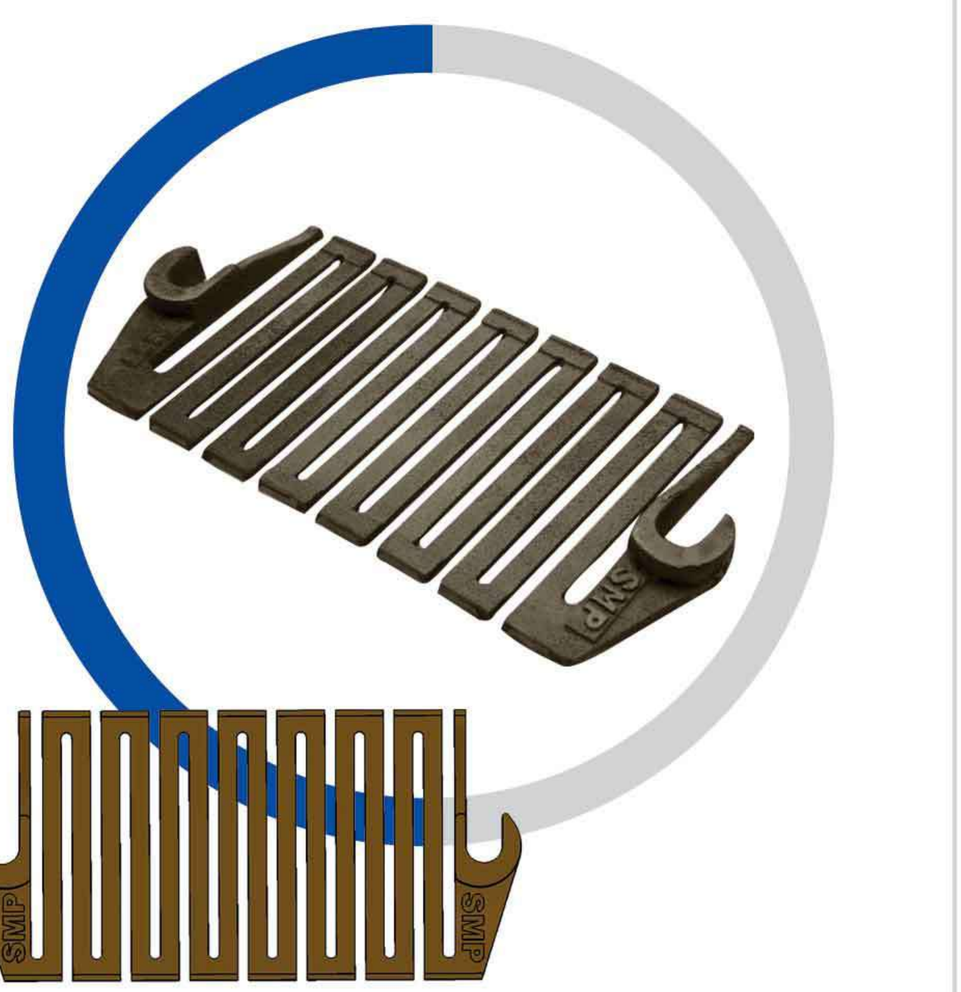


Type	Ohm (m)	Install	Weight (k)
E20	19.57	C.I	1.40

Type	Ohm (m)	Install	Weight (k)
E1.6	15.8	C.I	1.38



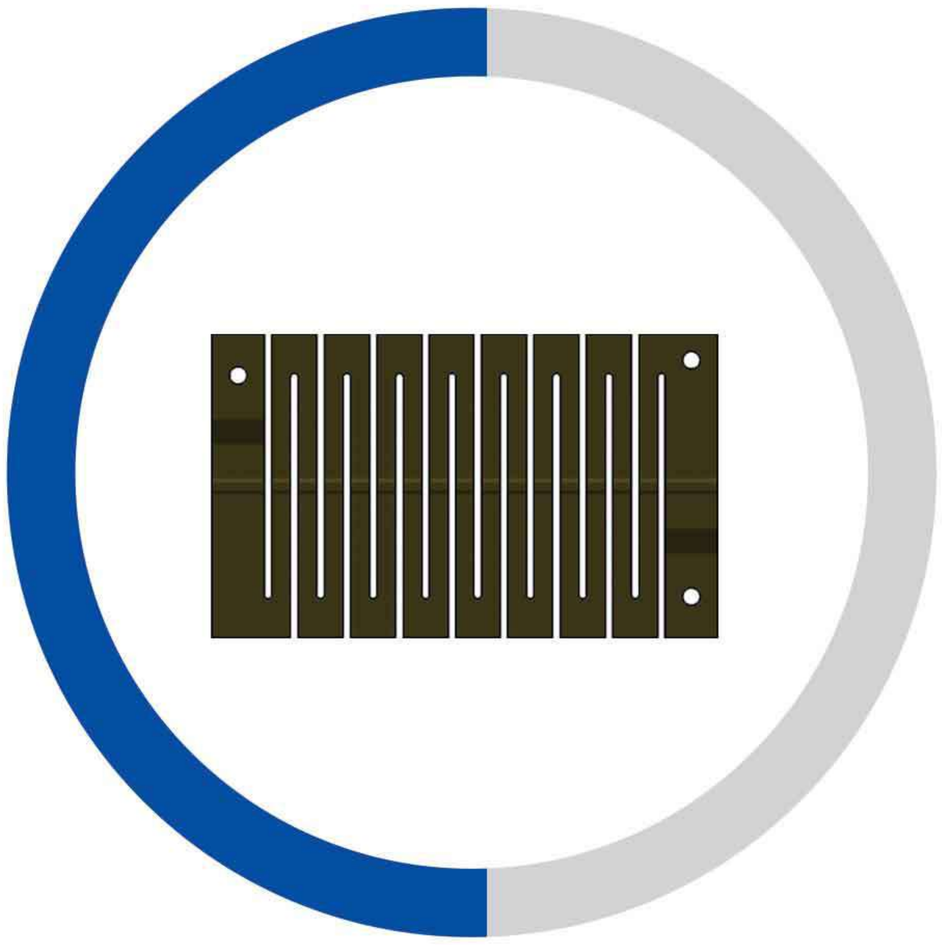
Type	Ohm (m)	Install	Weight (k)
E24	18.20	C.I	1.34



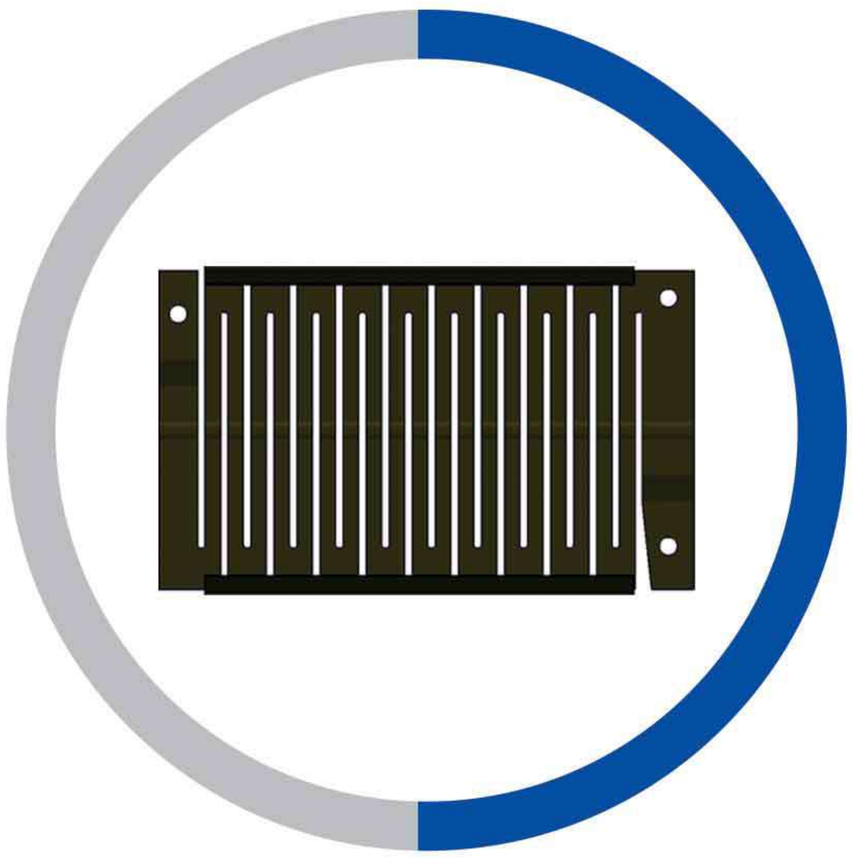
Type	Ohm (m)	Install	Weight (k)
E40	41.11	C.I	1.28

RESISTORES PLATE

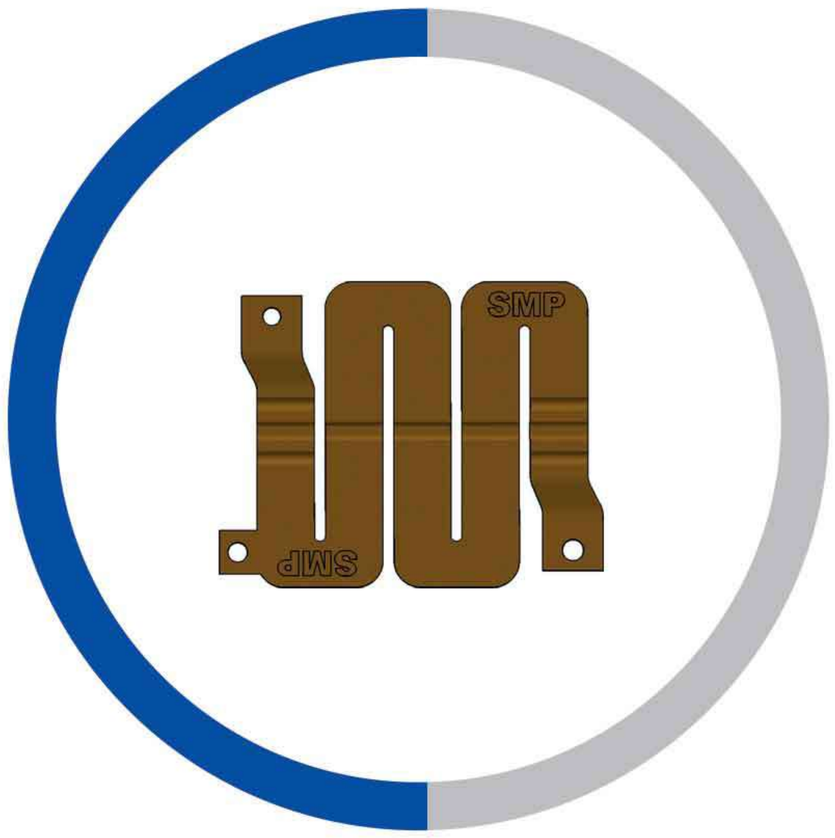
Type	Ohm (m)	Install	Weight (k)
Rss12313IL	31.5	S.S	1.30



Type	Ohm (m)	Install	Weight (k)
Rss16613IL	61.17	S.S	1.24

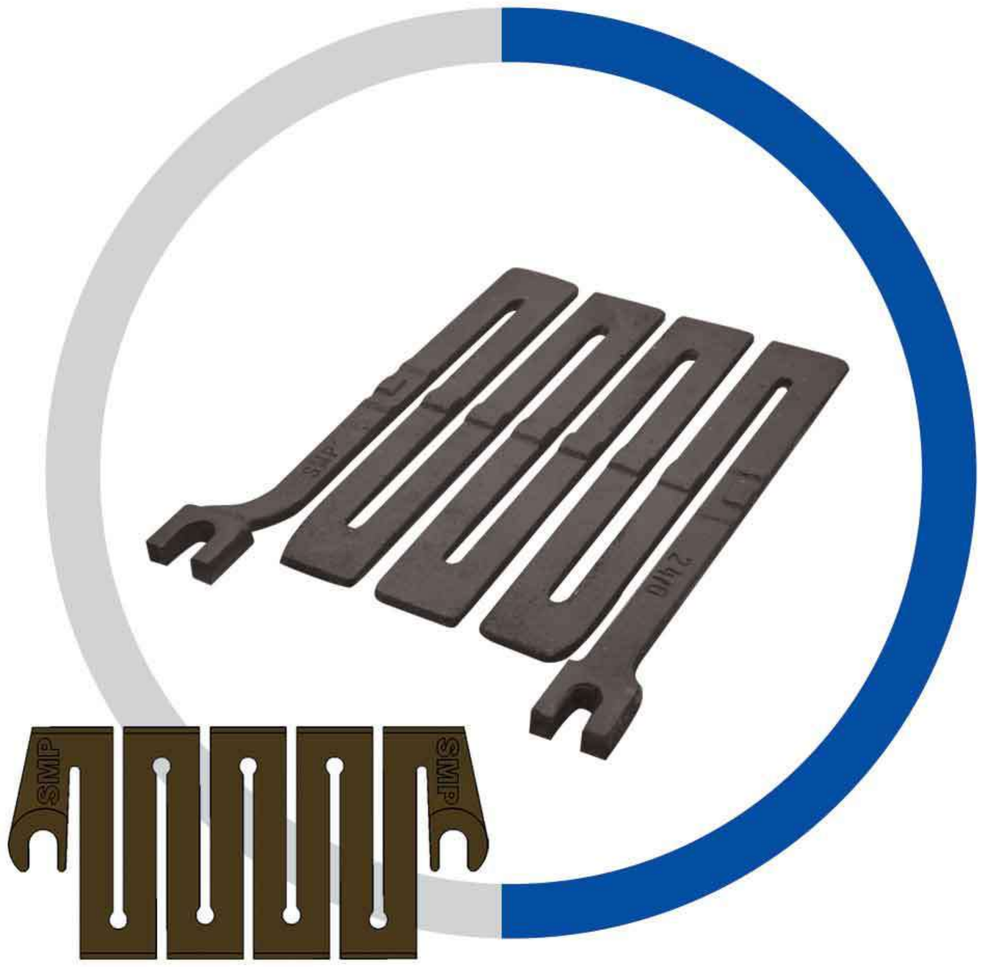


Type	Ohm (m)	Install	Weight (k)
Rss2093IL	96	S.S	1.50

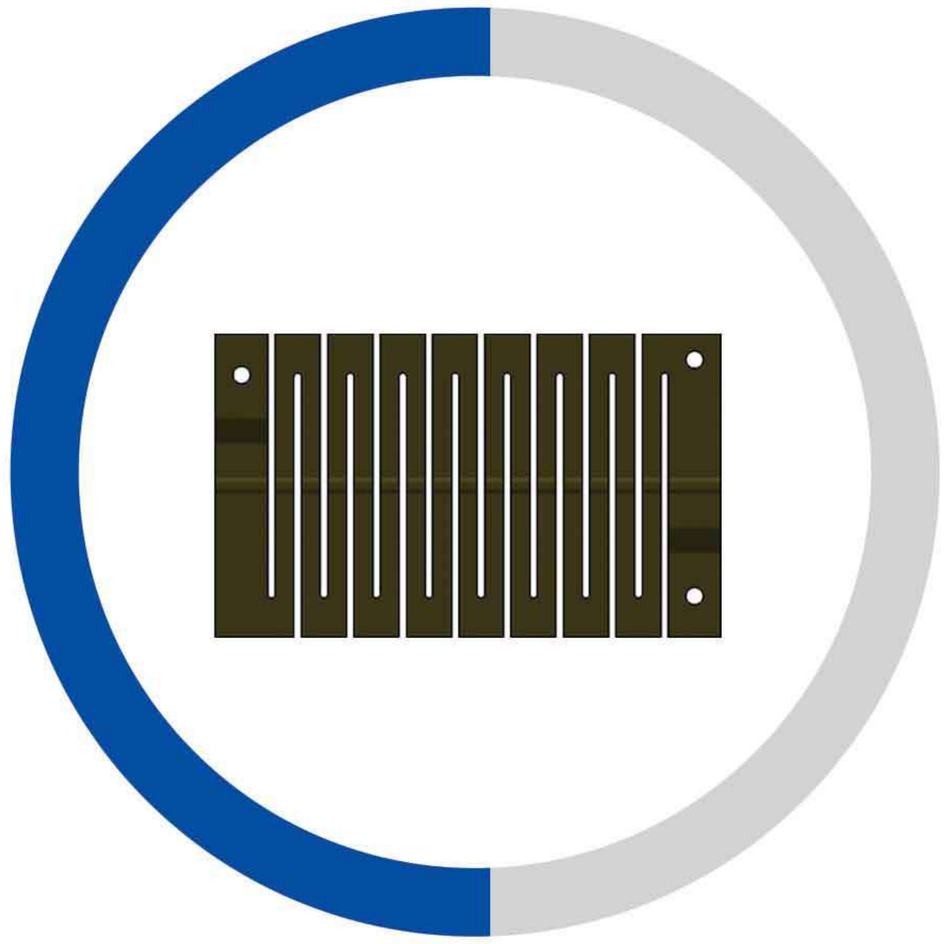


Type	Ohm (m)	Install	Weight (k)
E1	5.88	C.I	1.66

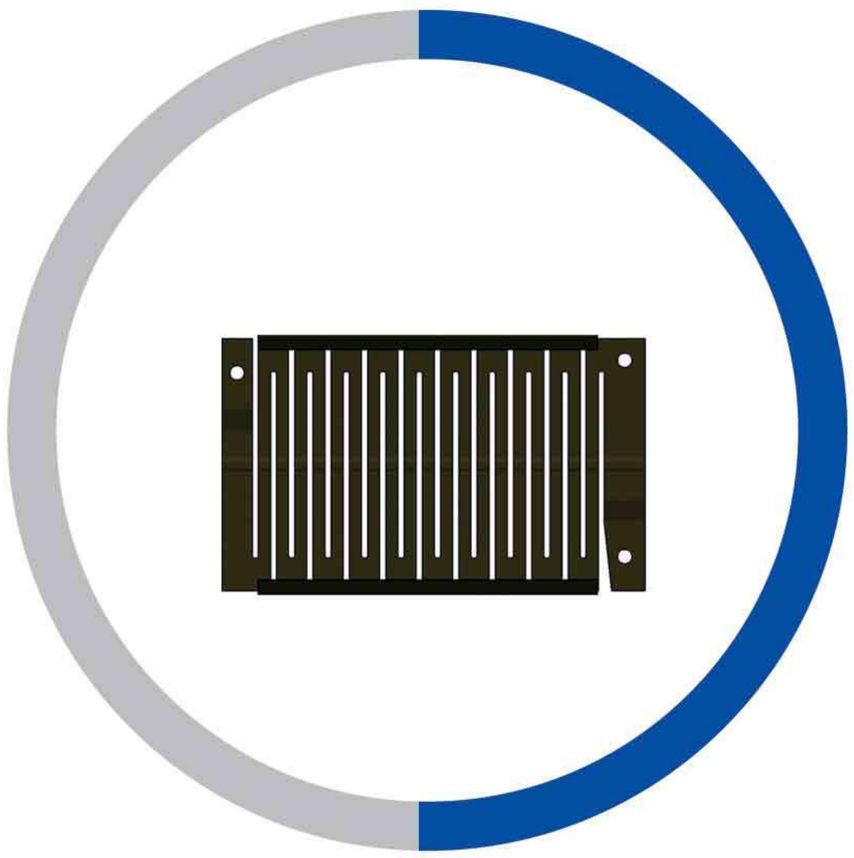
RESISTORES PLATE



Type	Ohm (m)	Install	Weight (k)
Rss12313IL	31.5	S.S	1.30

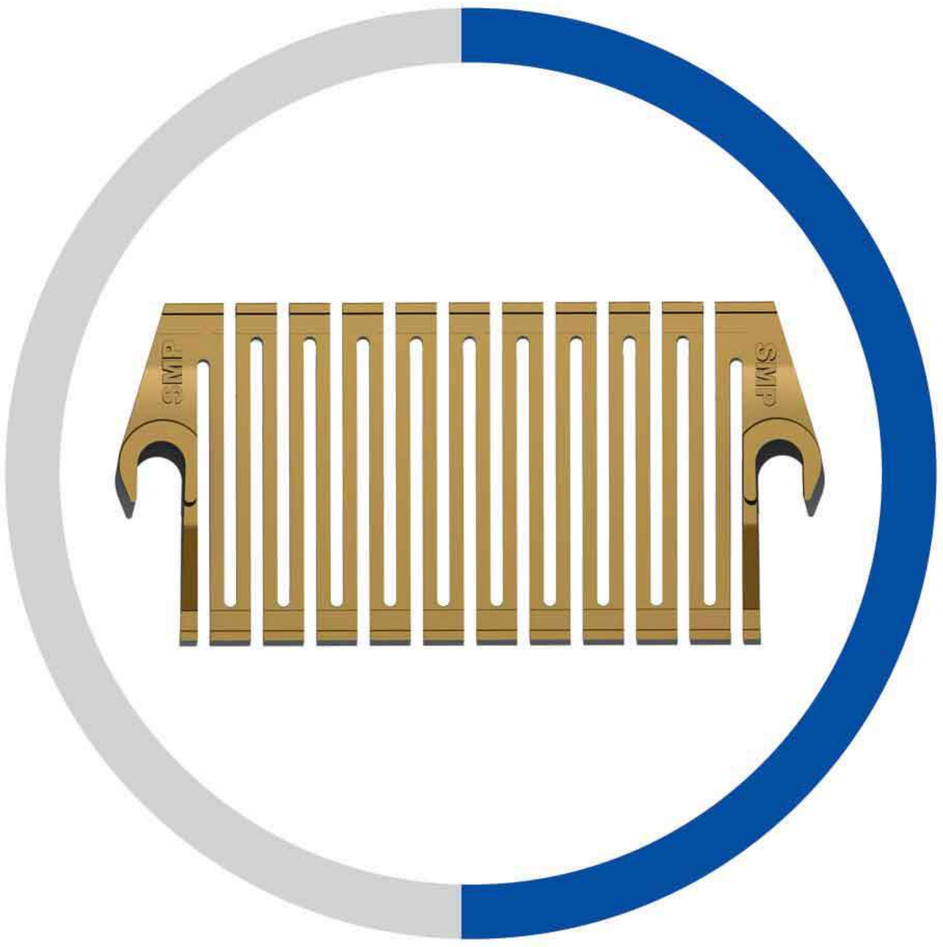


Type	Ohm (m)	Install	Weight (k)
Rss16613IL	61.17	S.S	1.24

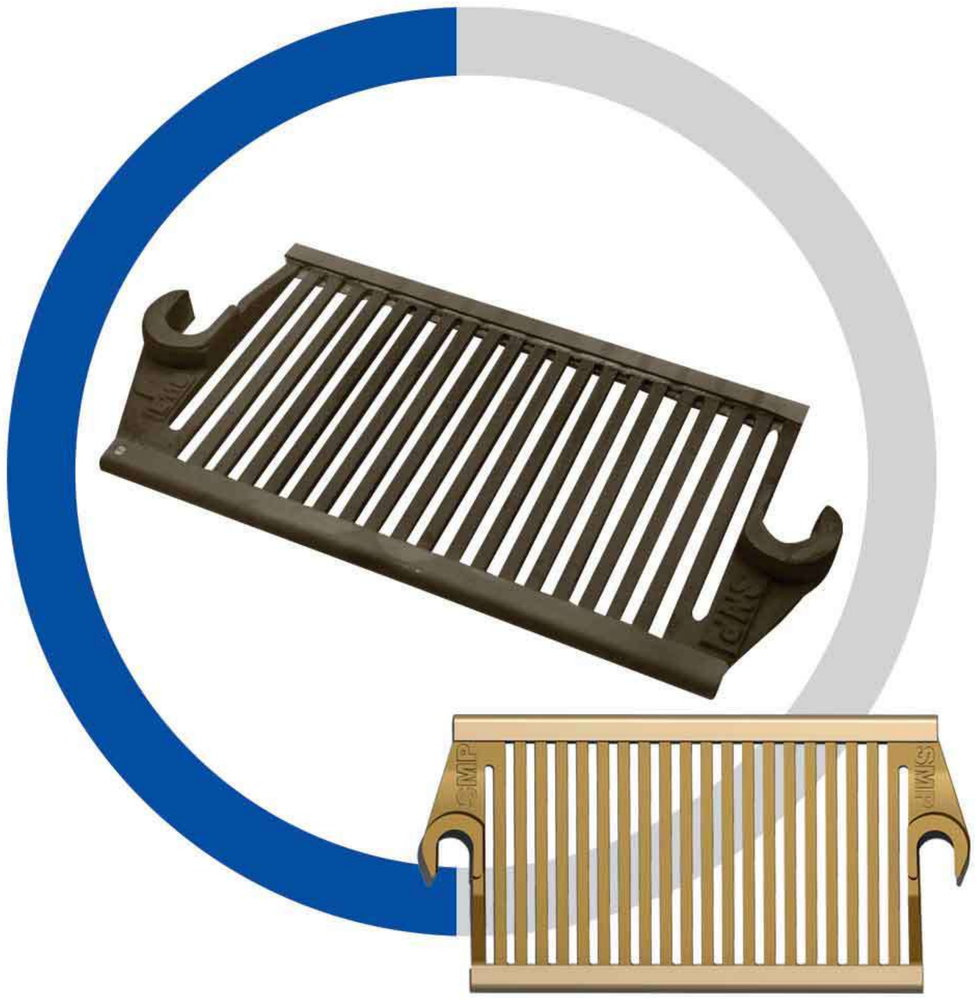


Type	Ohm (m)	Install	Weight (k)
Rss2093IL	96	S.S	1.50

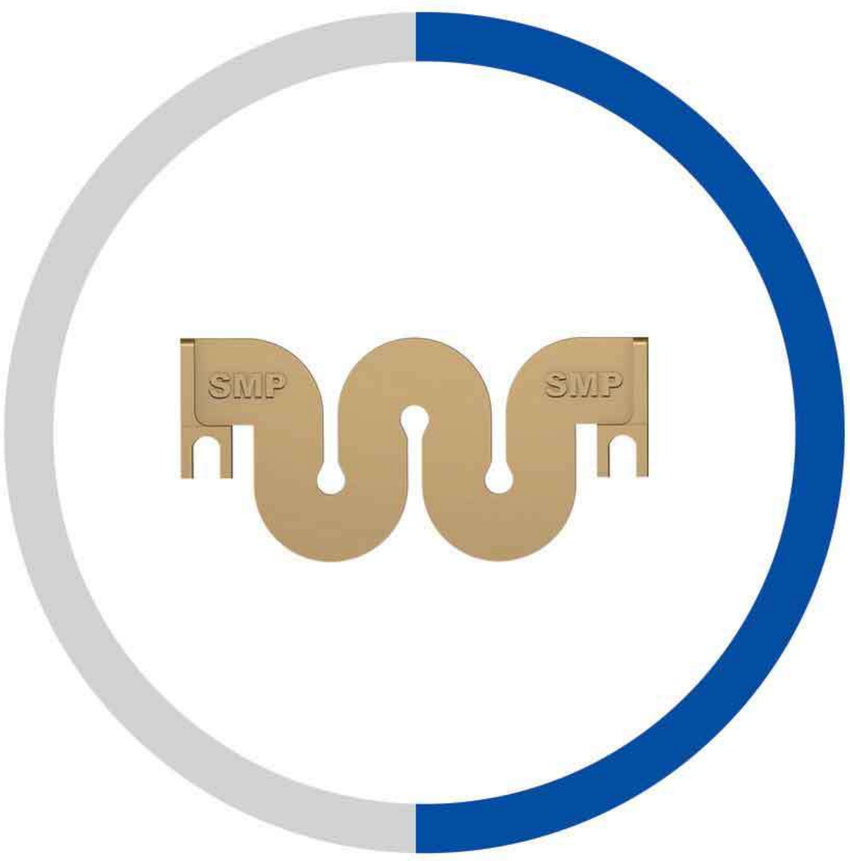
Type	Ohm (m)	Install	Weight (k)
E1	5.88	C.I	1.66



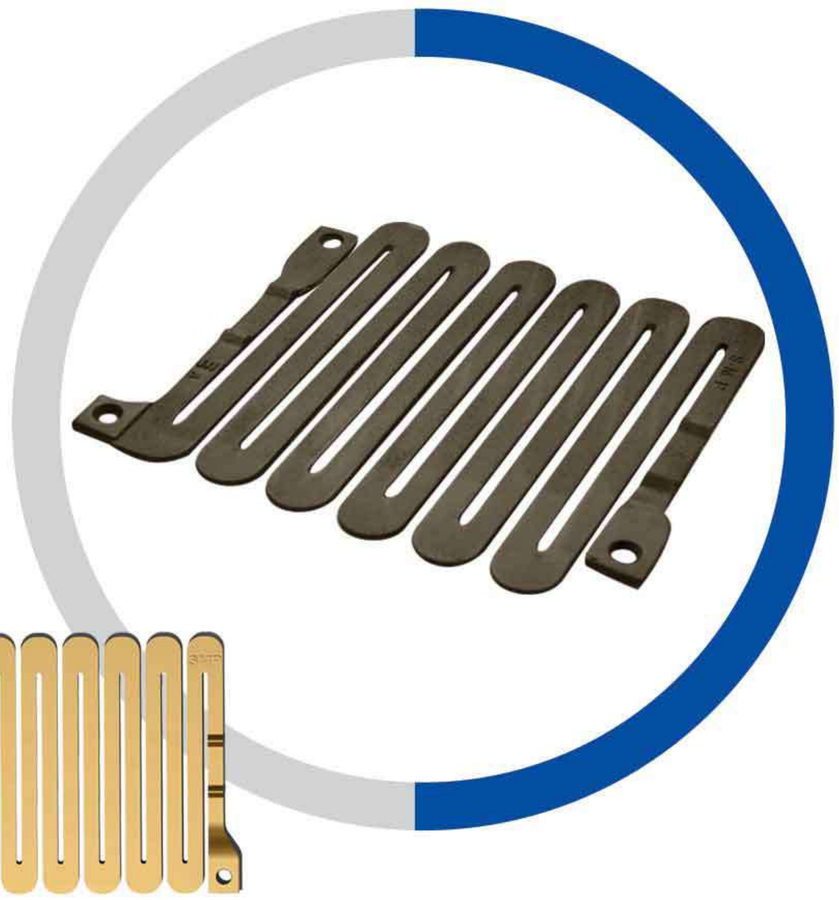
Type	Ohm (m)	Install	Weight (k)
E80	68.03	C.I	1.20



Type	Ohm (m)	Install	Weight (k)
E110	115.88	C.I	1.18



Type	Ohm (m)	Install	Weight (k)
E2	2	C.I	1.32



Type	Ohm (m)	Install	Weight (k)
E5	52	C.I	1.32

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