Multi-cubicle type switchboard systems

NorPower® 5000

NORELCO

Nordic Electric Company

NorPower® 5000 (EHKE)

Multi-cubicle type switchboard systems

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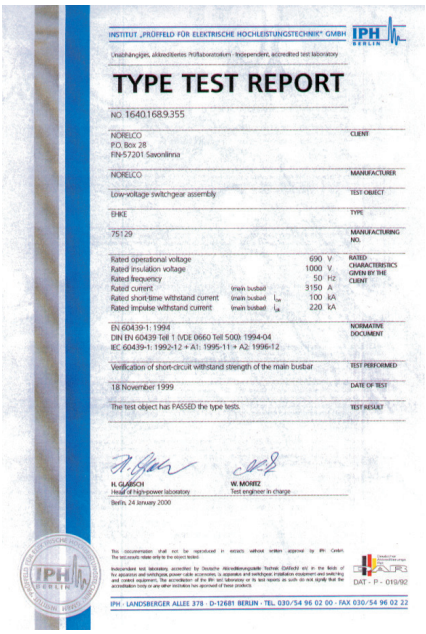


INSTITUT „PRÜFFELD FÜR ELEKTRISCHE HOCHLEISTUNGSTECHNIK" GMBH

TYPE TEST REPORT

NO. 1640.168.9.355

NORELCO
P.O. Box 28
FIN-57201 Savonlinna

CLIENT

NORELCO

MANUFACTURER

Low-voltage switchgear assembly

TEST OBJECT

EHKE

TYPE

75129

MANUFACTURING NO.

Rated operational voltage 690 V
Rated insulation voltage 1000 V
Rated frequency 50 Hz
Rated current 3150 A
Rated short-time withstand current 100 kA
Rated impulse withstand current 220 kA

RATED CHARACTERISTICS GIVEN BY THE CLIENT

EN 60439-1: 1994
DIN EN 60439 Teil 1 (VDE 0660 Teil 500): 1994-04
IEC 60439-1: 1992-12 + A1: 1995-11 + A2: 1996-12

NORMATIVE DOCUMENT

Verification of short-circuit withstand strength of the main busbar

TEST PERFORMED

18 November 1999

DATE OF TEST

The test object has PASSED the type tests.

TEST RESULT

H. GLÄSCH
Head of high-power laboratory

W. MÖRTZ
Test engineer in charge

Berlin, 24 January 2000

IPH · LANDSBERGER ALLEE 378 · D-12681 BERLIN · TEL. 030/54 96 02 00 · FAX 030/54 96 02 22

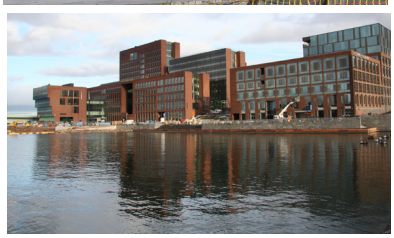
General description

Versatile electrical power supply for industry, machinery, housing and power plants

NorPower 5000 is a modular switchgear for all power supply needs, e.g.

- prosess industry: withdrawable motor feeder units (cassette)
- power plants: power control systems with bus-controlled equipment
- machinery: customer specified control cabinets
- housing: main distribution switchboards
- DC-voltage switchboards
- Automation switchboards

NorPower 5000 switchboards have already been delivered to every continent and for all kind of applications. Norelco has over 50 years of experience in project management. Norelco provides their extensive project knowledge with their quality products.



Type approved NorPower® 5000 switchgear is reliable and safe

- NorPower 5000 switchboards are made according to the latest EN,- IEC- and SFS-standards
- the switchboards are certified and type tested (SGS FIMKO) assemblies according to EN 61439-1 and -2
- NorPower 5000 is a short circuit and arc fault -tested structure
- every switchgear is inspected according to extensive ISO 9001-quality system and EN61439-standards

PICTURE: NorPower 5000 is arc-tested at the test laboratory

Easy installation and maintenance

NorPower 5000 has been designed and developed in co-operation with customers for customers. Easy installation and low need of maintenance is achieved by:

- versatile and user-safe solutions for installation and cabling
- spacious cubicles for connection, also in cabling section
- thermal imaging possibility from the roof
- standard equipment includes terminals for the incoming and outgoing cables

Good quality engineering ensures successful project

Norelco offers the industry's best know-how for component selection, technical solutions and product engineering. NorPower 5000 switchgear's metal parts are all Norelco's own design and products. Also many of the terminals and flanges used are Norelco's own products that have been engineered to the meet customer needs. Norelco uses components from well-known western manufacturers for added reliability and longer lifetime.

Pick your own technical solutions of Norelco's extensive selection

Wide range of structural solutions include :

- variety of cubicle depths and widths
- fixed or withdrawable motor feeders
- fused or fuseless system
- busbars are made of copper or aluminium
- IP-protection for indoor use or for spill-water proof environments
- one- or two-sided switchboards
- form of internal separation up to class 4a
- integrated power factor compensation unit for easy site installation/cabling
- L- or U-shaped switchboards
- possibility to make special structual elements and sizes

PICTURE: NorPower 5000 can be equipped with various fixed and/ or withdrawable units

Everything is built on a solid structure

Modular structure

NORELCO switchboard systems are made of standardized modular parts (see table below) which are joined together by reliable bolt fixing. These also guarantee a good earthing of the structure. The metal parts are made of hot dip zinc coated steel plates. All doors and visible frontal parts are painted with epoxy powder.

Basic structural features:

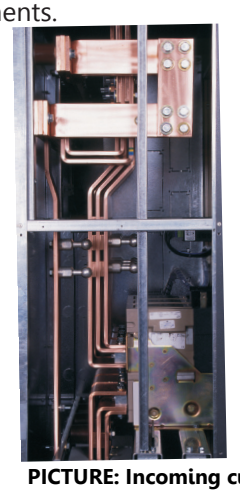
- durable and stylish profile frame
- weather and corrosion proof materials, standard material: steel plate with strong hot-zinc coating of 275 g/ m2
- arc pressure release channels that guide arc pressure out from the top of the switchgear
- component cubicles, busbars and cable sections are separated by steel subframes and steel fall-off guards
- Internal protection can be manufactured to meet IP 20 -class even with doors open. This enables safe maintenance work at live switchgear.
- 50mm high pedestal is always included in the delivery

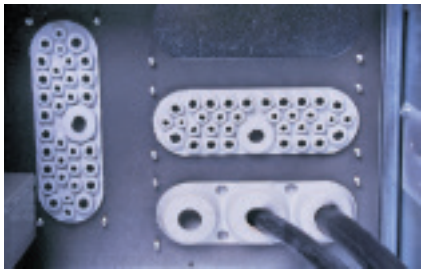
Incoming

The incoming cabling or NorBus 5000-busbar connection can be made from the top or the bottom of the switchgear. The switchgear has N/PE-connection ready at incoming cubicle when 4-pole system (TN-C) is connected to 5-pole (TN-S) switchgear. Both 4- and 5-pole switchboards can be made.
Rated currents from 1250A and up have earthing points as standard (for switchboards without separate earthing switch). The most critical projects are made with arc-protection relays that help to minimize the effects of a arc.

Terminals

The switchgear is always equipped with terminals specifiedby the cables in the ordering documents (by customer). Terminals are either crimped or screw type and for Al- or Cu-cables. PE-terminals are primarily located in cabling section. PE-terminals are quick-connection type and are easily disconnected for necessary measurements. Alternatively outgoing units can be equipped with separate PE-terminals.





PICTURE: Incoming cubicle has earthing points as standard. Multigate-style flanges are selected and used for cable pass-troughs according to the customer documents.

Compartments and cabling

The switchgear has three basic structural elements: equipment compartment, busbar compartment and cable compartment.

Every compartment is separated with metal subframes and fall-off-guards. Internal sectioning and metal housing help to limit any damage in case of a fault. Form 4-internal sectioning can be achieved by using insulation material for flanges and pass-throughs. Connection space and cable routes are spacious and have installation-friendly solutions. The frame is assembled onto a C-profile busbar and that gives plenty of fixing points in the cabling compartment. Incoming and outgoing cabling can be done from the top or the bottom of the switchboard. All frame parts are reliably connected to PE-busbar. Roof and bottom plates can be equipped with C-flanges, cable ends or membrane seals.

Busbars

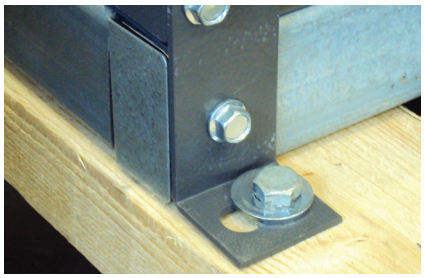
The busbars are normally made of E-AlMgSi aluminium flat bar. Copper bar can also be used if necessary. The busbar-system is always in a separate compartment. Joints are made using bolts and nuts. The horizontal busbar can be placed either in the upper or the lower part of the switchboard. An additional product is an inter-connection busbar for connecting a switchboard to another one or to a transformer. Busbars are made according to customer specification and can be open or enclosed.

Doors, locks & hinges

In NorPower 5000 the opening angle of the doors is 180 degrees. Special metal cast hinges are used. Doors are equipped with one-point locking. Various types of handles are available: manual, tool operated, key-locked and triangle key.

Other structural parts

PICTURE: A channeling system has been designed for arc fault depressurizing. In a fault situation the pressure flows safely through the pressure hatches on top of the switchboard. NorPower 5000 is arc fault tested.



PICTURE: NorPower 5000 is always equipped with a solid metal plinth and fixing hooks. These can be used to fix the switchboard reliably on the floor.

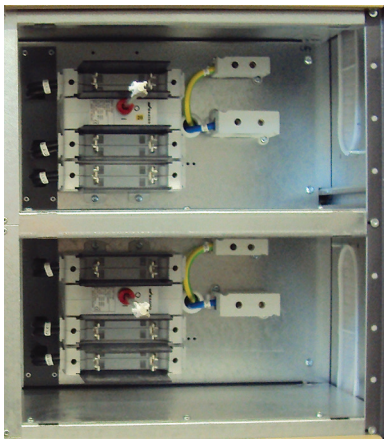
PICTURE: In NorPower 5000 both aluminium and copper busbars can be used. There can be 1 - 3 bars for each phase in both vertical and horizontal busbars. All equipment sections are equipped with horizontal busbars. The complete busbar system is in a separate metal-enclosed compartment.

PICTURE: The switchboard is equipped with the necessary cabling sections. Each section has ample space for cable fasteners. Connection of the cables in each unit is easy, because the connection space is one of the design parameters.

Versatile equipment

The alternatives for equipping the NorPower 5000 system are virtually infinite. The switchboard can be built with feeder specific units or centralized equipment. The outgoing units can be removable, withdrawable or fixed. The system can be equipped with various types of automation, e.g. frequency inverters, PLC´s, distributed I/O, smart network-connected motor control and power factor compensation units.

Fixed units



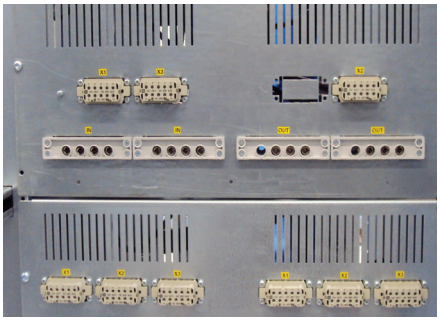
An economical and safe solution is reached by using fixed outgoing units especially when high currents are used and when it is required to switch off the switchboard during the maintenance. The fixed outgoing units are always the safest and most reliable units and especially for the high power components. The switchboard can be either one or two sided. If necessary the switchboard can be built according to the special requirements of the process industry Often the desired flexibility can be obtained by using a section-specific switch and fixed units. Then any section can be switched off without interrupting the functioning of other sections and the maintenance of the switched off section can be carried out without any danger to people or equipment. A variation of this type is the EHKE-M, the low voltage switchboard for a medium voltage indoor or outdoor sub-station.

Withdrawable outgoing units (cassette)

The best solution from the point of view of process usability, maintenance and service. The savings of total cost and switchboard space app. 30 - 60%. A withdrawable (cassette) unit can be removed and changed while the rest of the switchboard has power. This ensures unbreakable usage. Testing and preventive maintenance can be done under power. A withdrawable unit can contain motor control units up to 132 kW. Any switchboard section can contain both withdrawable, removable and fixed units. The main power connector and the control circuit connector of a withdrawable unit are self-guiding, so that the connection is always reliable. The power cables and control cables are connected at the factory to the terminal blocks in the cabling section. The testing mode is achieved by disconnecting the main power of the unit, which also opens the mechanical locking of the unit. The control voltage of the unit remains connected but the main power is off. The withdrawable units are equipped with handles for easy handling of the units (cassettes).

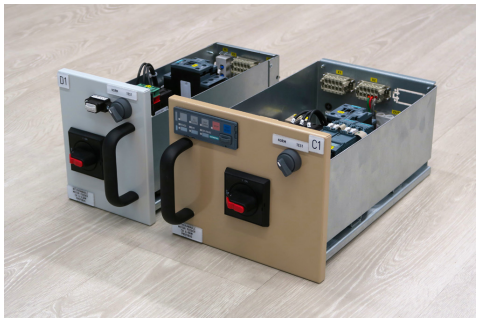
The cassette has mechanical lever that prevents opening, when the unit's main switch is in "closed" position (I). The cassette can be withdrawn when the main switch is in "open" position (0). The unit slides out on rails until it reaches the voltage-free position. The unit can be taken out fully by releasing the separation latch. Cassette units are IP 20 -class protected when withdrawn.
There are five different sizes of cassettes. Each size suits to different size of motor feeder. The size depends on the power of the motor and whether the feeder is fused or fuseless. The cassette layout varies by project but the main and control power terminals stay at the same place. This enables easy revisions and additions to existing switchboards.

CASSETTE SIZES	
*Dimensions (height *width)*	*Max.current*
200*150mm	32A
200*250 mm	50A
200*500 mm	100A
400*500 mm	250A
400*750 mm	400A



PICTURE: The backplate of the cassette. The main and control power terminals are IP 20 -protected when withdrawn.

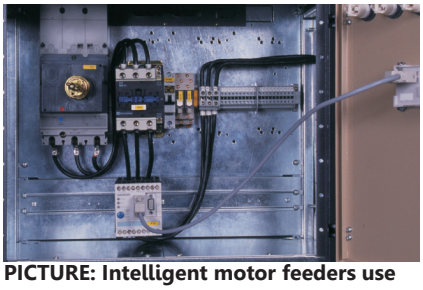
PICTURE: Cassette is drawn out into the separating position. It can be fully taken out by releasing the separation latch.



PICTURE: NorPower 5000 cassettes are manufactured according to the project specification.

Intelligent motor feeders

Intelligent motor feeders use bus-connected and -controlled components to replace traditional thermal overload relays. Most common used industry buses are Profibus and Modbus. The internal bus is wired and tested to meet the requirements of the bus-connected equipment. Fixed outgoing units have their bus cable terminals in the unit itself. Withdrawable units have their cable terminals in the cable compartment. Intelligent motor feeders can be parametrized at the factory before the delivery to the site. This helps and speeds up the commissioning at the site. Intelligent motor feeders also have advantages over traditional solutions in maintenance and in preventive maintenance.



PICTURE: Intelligent motor feeders use e.g. Siemens Simocode with Profibus.

Inverters

The frequency inverters and soft starters can easily be incorporated with the NorPower 5000. The ventilation type is selected on the basis of heat dissipation calculations. The EMC-protection is taken into consideration in the selection of e.g. cable types and cable glands.

Automation systems

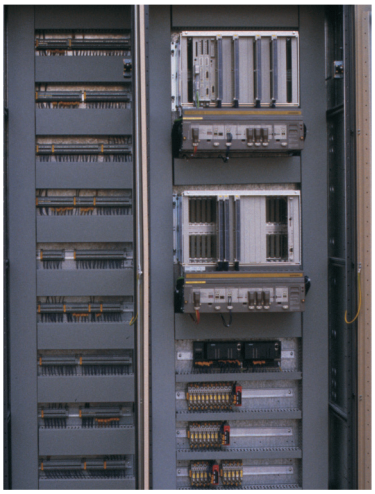
The automation systems can be executed in NorPower 5000 either with PLC´s or distributed I/O-modules. In both cases, the Norelco Automation Concept is applied. This concept specifies various aspects of the installation and function of the equipment.

Power Factor Compensation

The Norelco power factor compensation systems can be integrated in the NorPower 5000 system. This solution produces considerable savings in the installation costs, and significantly speeds up commissioning.
The compensation systems are equipped with either electronic or microprocessor based control units.

PICTURE: NorPower 5000 with integrated power factor compensation unit.

PICTURE: NorPower 5000 with outgoing frequency inverters.



PICTURE: NorPower 5000 with I/O -components.

Technical Information

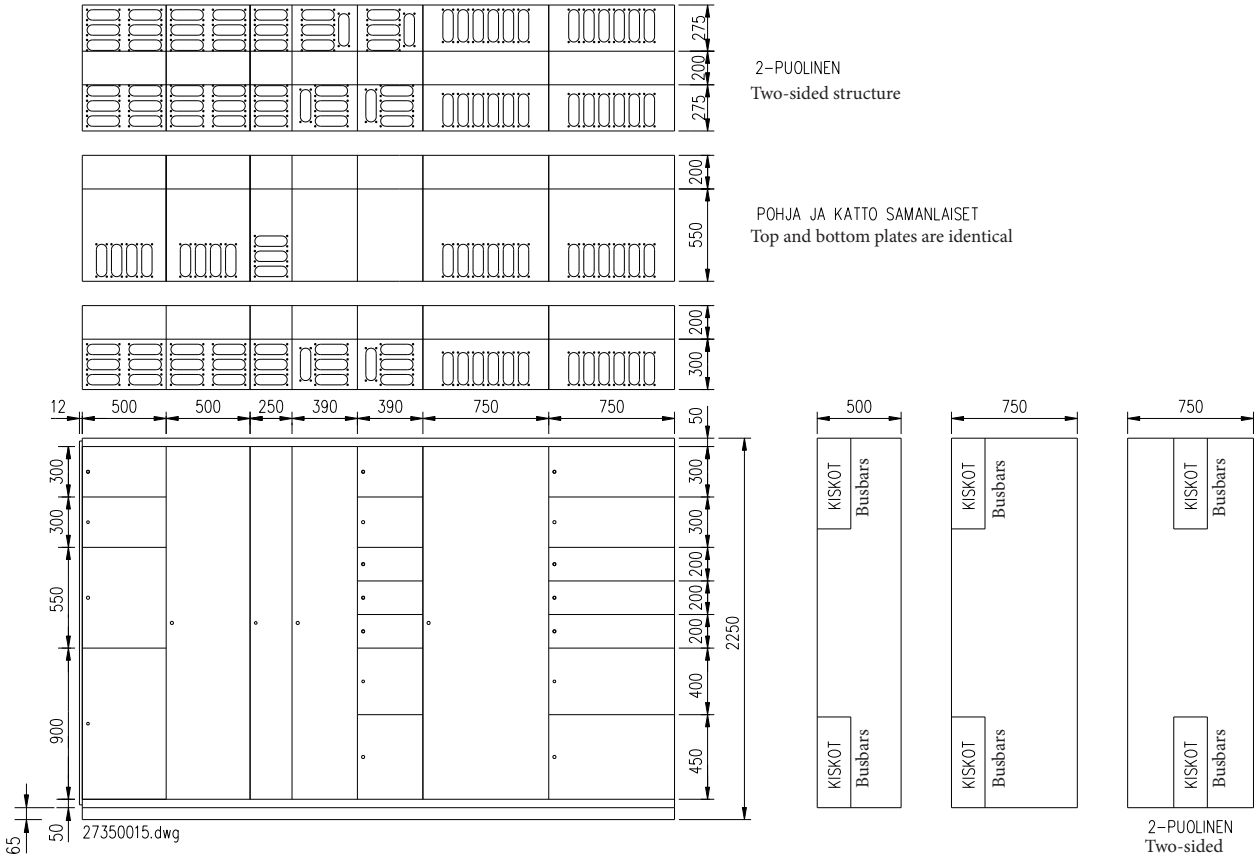
NorPower 5000	
STANDARDS	
Standards	SFS-EN 61439-1,IEC 61439-1, SFS-EN 61439-2, IEC 61439-2; VDE0660 TEIL 500/0.4/94+Bbl2; SFS 6000
ELECTRICAL SPECIFICATION	
Rated voltage Un	400 - 690 VAC
Rated currents In vertical busbars	400-5000A
horizontal busbars	400-5000A
Rated short-time withstand current Icw (1s)	max. 100kA, 1s
Rated peak withstand current Ipk	max. 220kA
Internal arc test	50kA, 725V, 0.3s
AC test voltage	2000V
MECHANICAL SPECIFICATION	
Degree of protection	IEC 60529: IP20...IP54
Insulation class	Class I
Material	-hot dip zinc coated steel plate -busbars Al or Cu
Standard colour	doors and panels: light brown Oxyplast 928 (equal to RAL 1001), other visible frontal parts (EHKE): dark grey, other colours on special request
Surface treatment	multi-phase surface treatment and epoxy powder painting in 220 °C (doors, covers and side panels)
Thickness of the epoxy paint	minimum 80 µm
Thermographic pictures	can be taken from the ceiling
Opening angle of the doors	180 °
Ambient temperature max.av.in 24h period	+35 °C
max.momentarily	+40 °C

PICTURE: Norelco's skilled engineers inspect all switchboards according to ISO9001 and Norelco's own inspection protocol.

Module dimensions

MODULAR STRUCTURE SYSTEM	EHKE	EHKE
	Withdrawable	Fixed
Height of te structure (mm)	2230	2230
Height of the pedestal (mm)	50 mm,included	50 mm,included
Depth modules		
500mm	-	X
750mm	X	X
1000mm	X	X
750mm, 2-sided structure	-	X
1000mm, 2-sided structure	X	X
With modules		
250mm	X	X
390mm	-	X
500mm	X	X
750mm	X	X
1000mm	-	X
Height modules		
150mm	-	X
200mm	X	X
250mm	-	X
300mm	-	X
350mm	-	X
400mm	X	X
450mm	-	X
550mm	-	X
600mm	-	X
850mm	-	X
900mm	-	X
1200mm	-	X
1800mm	-	-
2050mm	-	X
Cabling channel widths		
250mm	X	X
390mm	X	X

Illustration of the modular system



Transportation and installation of the switchboard

To be noted before transport

The multi-cubicle type switchboard systems are transported in separate parts when the total length of the switchboard exceeds four meters. Separate lifting hooks (option) can be installed into each part.

When planning the transportation also the external parts like the handles should be taken into consideration when calculating the required space.

Principle of the transportation joint

The joining of the transportation parts is usually done at the construction site. In order to make a good joint, the floor should be reasonably even (approx. 2mm/m).

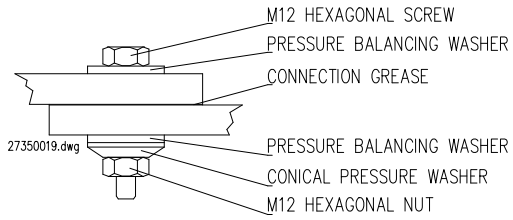
Making the joint is quite simple but to avoid any problems these instructions should be followed.

Making the busbar connection

Connection of the busbars is usually made in the cable channel. First the cable compartment shield is removed and the switchboard parts are placed so that the heads of the busbars are on the same level. The busbars are connected by using the delivered connection pieces, bolts, nuts and washers.
When making the connection one should note that

- the bolts to be used are the galvanized M12 bolts and nuts (hardness 8.8), pressure levelling washers (SFS3738) and cone-shaped pressure washers (SFS3737) according to picture 3. With these washers the connection keeps tight all the time. The bolt hole size is 13.5 mm.
- brush lightly with a steel brush and put connection grease on it before connection (Al-busbar)
- finally all the M12 bolt-joints are tightened to a momentum of 75 Nm. When using other bolt-sizes please use the momentum values of table 1.

After the connection has been made, the cable compartment shields should be attached back on.



PICTURE: Making a busbar connection

BOLT / NUT SIZE	TIGHTENING MOMENT Nm
M6	9
M8	22
M10	44
M12	75

TABLE The tightening momentum of the busbar connection bolts according to the bolt size

Installation hints

There are features that make the installation easier e.g.

- there are lots of C-profiled bars in the cable channel. These can be used to fix cable connectors and cables
- the cabling can be made either from above or from below. It is always made through the standard bottom or ceiling plate (see pictures 1 and 2)
- it is easy to connect the cables directly to the poles and connectors inside the switchboard

Installation

Fixing onto the floor is made by using the external fixing hooks. This is the easiest way to fix a switchboard on a floor.

To be noted in the calculation of the required space

A saving in the required space is achieved because of the large opening angle of the doors.
When calculating the height of the space an extra 250 mm empty space should be reserved for the opening of the pressure hatches.

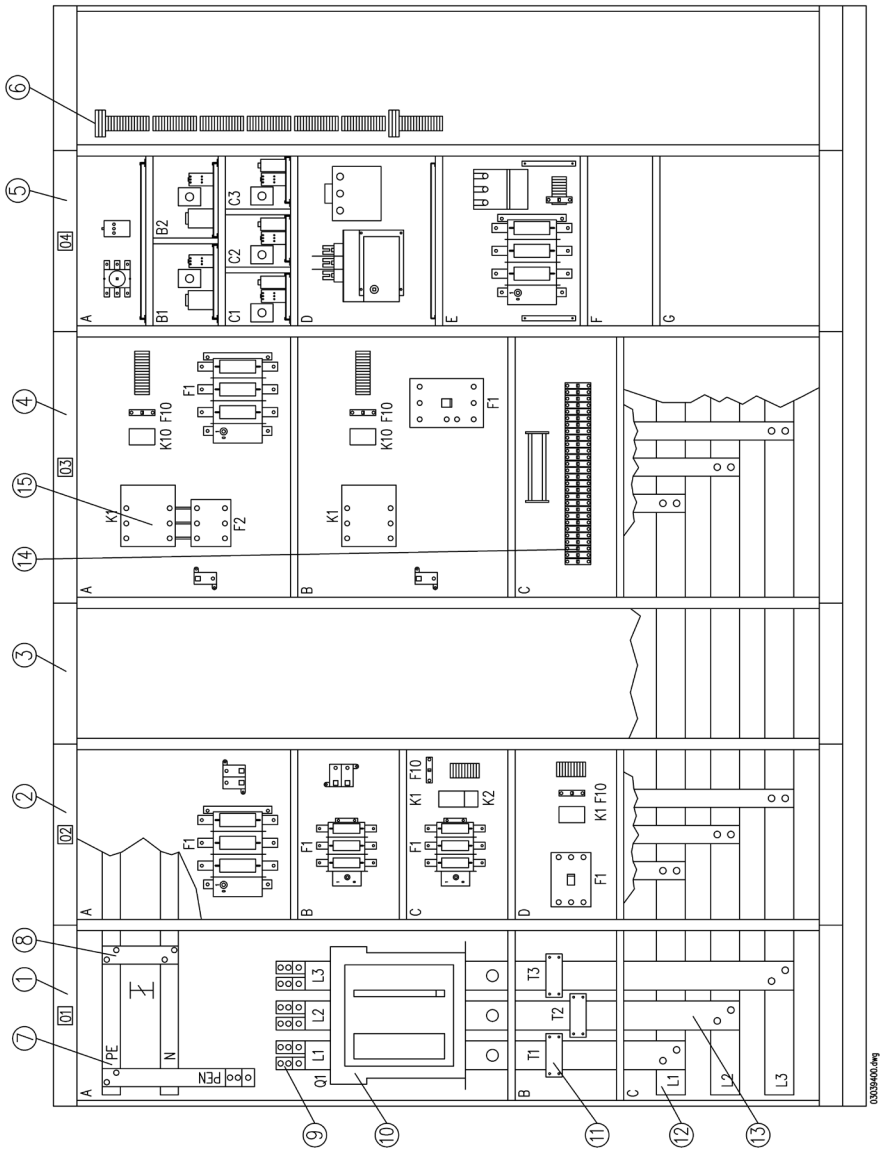
Maintenance of the switchboard

To facilitate preventive maintenance the thermographic pictures can be taken from above after removing the ceiling plates. Also a re-tightening of the busbar connections can be made by removing the back or ceiling plates.

Storing the switchboard at the construction site

If a switchboard is not immediately taken into use at the site it is better to keep it in the original plastic packing. If the storage time is long it is advised that small holes are made into the bottom of the packing so that the humidity gets out and there will be no harmful condensation of water inside the switchboard.

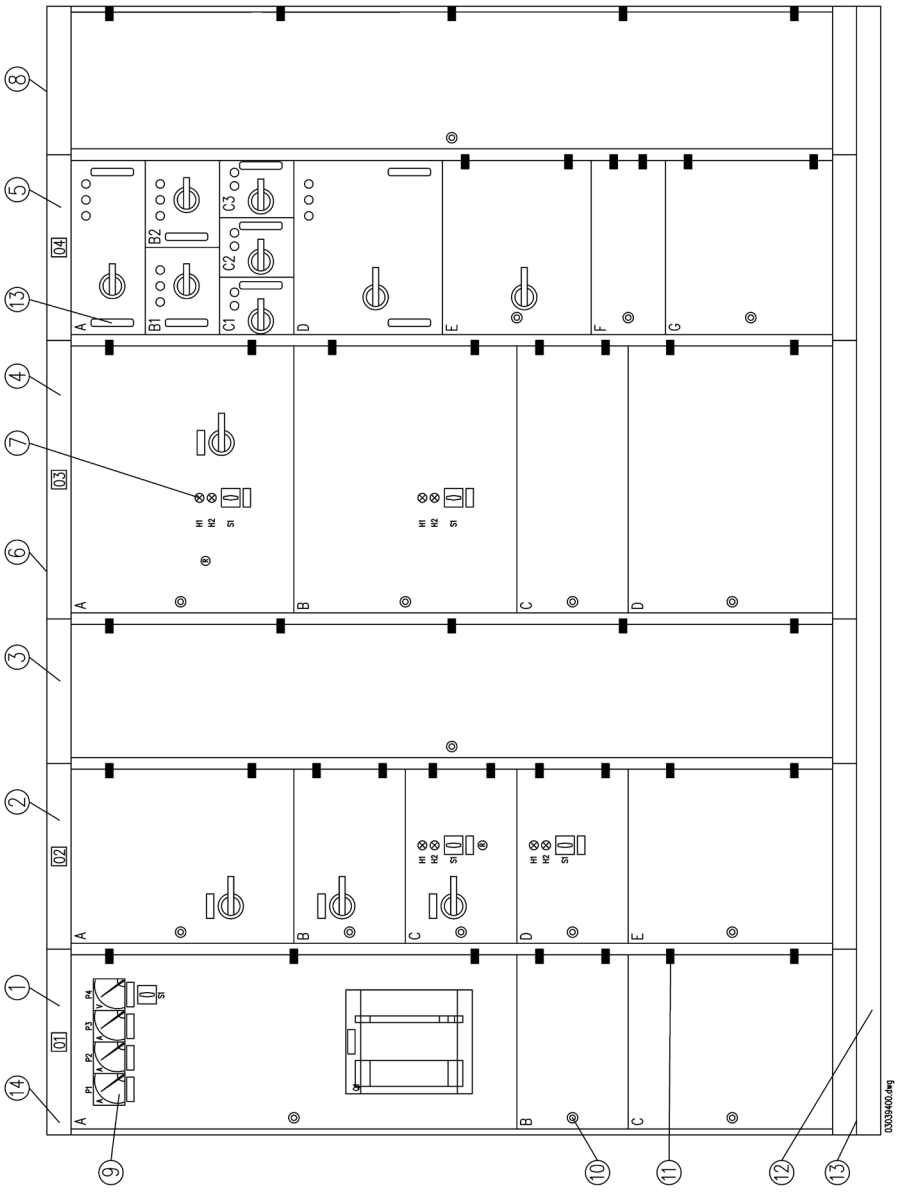
Basic drawing of a NorPower 5000 switchboard: Inside



This drawings present some of the major elements and components of a typical NorPower-type switchboard with the doors and protective covers open.

1. The incoming section, width 500mm
2. An outgoing section, circuits with fuse- switches and moulded case circuit breakers
3. Cabling section for incoming and outgoing cables with plenty of space for the connections
4. An outgoing section with motor control feeders, one with a fuse-switch and the other with a MCCB
5. An outgoing section with withdrawable (cassette) and removable units, a 500mm section can also have 250mm units
6. The terminal blocks for the withdrawable units are in the cabling section.
7. PE- and N-busbars cover the whole length of the switchboard
8. N/PE- shunt
9. The terminals for the feeder cable
10. Main switch (E.g. withdrawable air circuit breaker)
11. Current transformers
12. Horizontal busbar (Cu or Al) can be built in the upper or lower part, the whole busbar is compartmented by steel plates
13. Vertical busbar which connects to the components with flexible copper bar or cable
14. Miniature circuit breakers in a compartment
16. Contactor with a thermal overload relay

Basic drawing of a NorPower 5000 switchboard: Doors closed



1. The incoming section, width 500mm, one module of 1200mm (height) and two modules of 300mm (height)
2. An outgoing section with fixed units, width 500mm, one module of 600mm and four modules of 300mm
3. Cabling section for incoming and outgoing cables, width 390mm
4. An outgoing section with motor control feeders, width 750mm, two modules of 600mm and two modules of 300mm
5. An outgoing section with with-drawable (cassette) and removable units, two modules of 400mm, three modules of 200mm (width 500) and four modules of 200mm (width 250)
6. The pressure hatches for short circuit situation pressure relief
7. Pilot lights with the CAM-switch (manual-0-automatic)
8. Flanges and sealing for outgoing cables (top and bottom)
9. A- and V-meters with a 7-position CAM-switch
10. Each door is operated from one handle using either key-, tool- or hand- operated locks
11. The reliable metal hinges
12. The 300mm pedestal (optional in NKE)
13. The bottom plates
14. The strong modular structure is made of galvanized steel

This drawings present a typical NorPower-type switchboard with the doors closed.

Fixed outgoing units

VOLTAGE LEVEL 400V, FUSED				
Type	**max. power kW**	**Over-current protection**	**Dimensions h x w mm**	**Alternative dim. h x w mm**
Direct	<4	Fuse 25A	200 x 390	200 x 500
''	5-15	Fuse switch 63A	250 x 390	200 x 500
''	18,5	Fuse switch 63A	300 x 500	250 x 750
''	22-45	Fuse switch 125A	300 x 500	
''	55-75	Fuse switch 250A	450 x 500	450 x 750
''	90	Fuse switch 250A	550 x 750	
''	110-132	Fuse switch 400A	550 x 750	
''	160	Fuse switch 630A	600 x 750	
	200-250	Fuse switch 630A	900 x 750	
Reversing	<4	Fuse 25A	300 x 390	200 x 750
''	5-15	Fuse switch 63A	300 x 390	200 x 750
	18,5	Fuse switch 63A	400 x 500	
	22	Fuse switch 125A	400 x 500	
Y/D- starter	<18,5	Fuse switch 63A	400 x 500	200 x 750

VOLTAGE LEVEL 690V, FUSED				
Type	**max. power kW**	**Over-current protection**	**Dimensions h x w mm**	**Alternative dim. h x w mm**
Direct	<18,5	Fuse switch 63A	250 x 390	200 x 500
''	22	Fuse switch 63A	300 x 500	250 x 750
''	30-45	Fuse switch 125A	300 x 500	
''	55	Fuse switch 125A	400 x 500	
''	75-90	Fuse switch 250A	450 x 500	450 x 750
''	110-160	Fuse switch 250A	550 x 750	
''	200-250	Fuse switch 400A	600 x 750	
''	315	Fuse switch 630A	900 x 750	

The withdrawable units

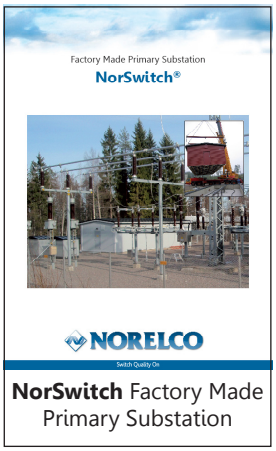
The table below presents the fuse and circuit breaker protected standard withdrawable units for 400V and 690V.
For each project the contents of the cassette unit can be modified. This kind of planning requires the technical expertise of the Norelco design department.

FUSE, VOLTAGE 400 V			
Type	**Max. Power kW**	**In/A**	**Dim. hxw mm**
Direct	<11kW	50	200x250
"	15-22	100	200x500
"	30-45	160	200x500
"	55-75	250	400x500
"	90-132	400	400x750
Reversing	<11kW	50	200x250
"	15-22	100	200x500
YD	<18.5	100	200x500
CIRCUIT BREAKER, VOLTAGE 400 V			
Direct	<5.5kW	32	200x150
"	<11kW	50	200x250
"	15-22	100	200x500
"	30-45	160	200x500
"	55-75	400	400x500
"	90-132	400	400x750
Reversing	<5.5	32	200x150
"	<11	50	200x250
"	15-22	100	200x500
YD	<18.5	100	200x500

FUSE, VOLTAGE 690 V			
Type	**Max. Power kW**	**In/A**	**Dim. hxw mm**
Direct	<11	50	200x250
"	15-22	100	200x500
"	30-45	160	200x500
"	55-90	250	400x500
"	110-160	400	400x750
Reversing	<11	50	200x250
"	15-22	100	200x500
YD	<18,5	100	200x500
CIRCUIT BREAKER, VOLTAGE 690 V			
Direct	<5.5	32	200x150
"	<11	50	200x250
"	15-22	100	200x500
"	30-45	160	200x500
"	55-90	250	400x500
"	110-160	400	400x750
Reversing	<1.1	32	200x150
"	<11	50	200x250
"	15-22	100	200x500
YD	<18.5	100	200x500

Large selection of high quality LV and MV switchboards and substations

The main products of Norelco include:

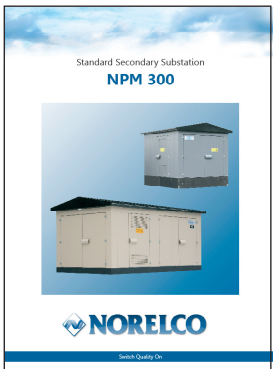


NorSwitch Factory Made Primary Substation

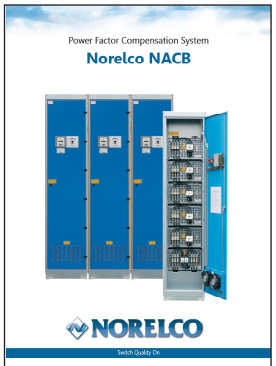
NorMega Withdrawable MV Switchgear

Modular MV Switchboard System **NorMax**

Modular Secondary Substation **NPM 200**



Standard Secondary Substation **NPM 300**



Power Factor Compensation Systems **NACB**

Modular IP54 Switchboard System **NorPower 1250**

Modular IP30 Switchboard System **NorLine 800**

Motor Control Center **NorPower 5000**

Busbar Trunking System **NorBus 5000**

NORELCO

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