

# Electrical Design

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# With 4th industrial revolution the electrical design acquired a bigger importance



Graphical  
Normative



Technological  
Innovations



Technical  
Specifications



Safety



Standard  
Outputs



Materials

1

- **Design** following normative for design, dimensioning and calculation

2

- **Train** all operators about the technological evolution

3

- **Share** with Partners the rules for standard documents, even working in different locations

4

- **Respect** all safety rules

5

- **Create** documents that can be exchanged easily: formats DWG, XLS XML DB

6

- **Select** materials that add technical and economical benefits

# 1 Graphical Design Normative

The respect of standardized rules while designing consents the creation of coherent documents. Electrical and Pneumatic drawings must be done following IEC 3-19 and ISO 1219 normative.

The project must be developed considering the interaction and effect on other design areas:

- Mechanical design
- Pneumatic and Hydraulic design
- Electronics & Electromechanical design
- SCADA and HMI
- PLC Software design
- Management of future Maintenance
- ERP processes and connections with production floor
- Cables design
- Connection with labels and identification plates plotters
- Simulation



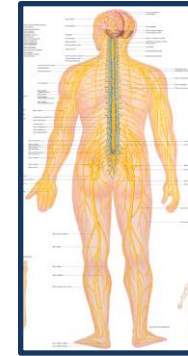
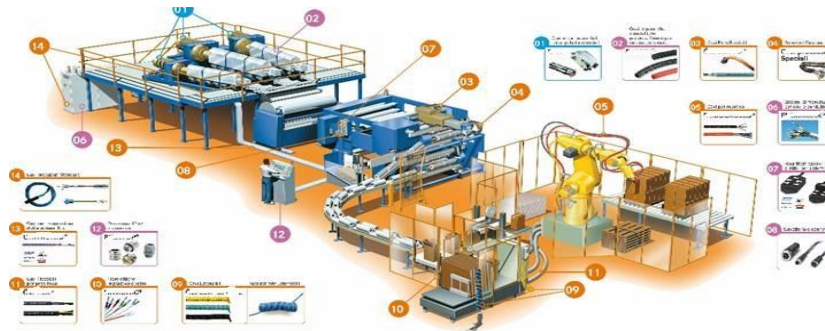
# Cables: arteries and nerves of the machine

«*Human body is like a 'machine'!*»

The 'complex system' of the organs in the human body is connected by two separate circuits, both necessary and important:



The **venous system**, the **power supply** circuit, to **transport energy** for the functioning of the organs



The **nervous system** carries **data** needed to control the **movement** or sensations

Without «**links**» no «**unit**» works.

The machine **design** must take into account from the **beginning** of the correct **choice** and **installation** of **cables**, ... **fundamental** elements for the operation.



# Electrical Design: Cabling Solutions

## Criteria of application

**Mechanical**

- Fixed installation: obstacles, bending radius
- Cut, abrasion, dragging
- Mobile installation: bending, twisting, bending radius

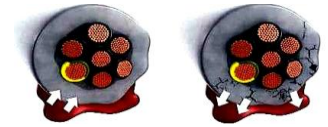
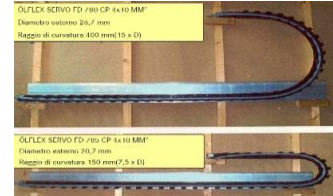
**Chemical**

- Oils (synthetic, minerals, cutting, hydraulic etc. )
- Organic or inorganic chemicals

**Enviromental**

- Internal / External (UV, ozone, ammonia, underground installation)
- Self-extinguishing, prevent the spread of flame or fire
- High and low temperatures (ovens or cold cells)

- Routes
- Positions
- Protections



## Electrical Technical Correlations

- Nominal tension	→	- Isolation
- Current capacity	→	- Section
- Impedence	→	- Dielectric
- Frequency / interference	→	- Twisting conductors, shielding



# Electrical Design: Cabling Solutions

## Risks of a design without considering the connections

- Reduced spaces for the passage of cables / narrow passages
- Insufficient size of ducts
- Bending radius too small of the cable carriers,  
resulting in breakage of the cables in a few days
- Obligation to cable selection, high-performance and high costs
- No suitable cables available





# Electrical Design: Cabling Solutions

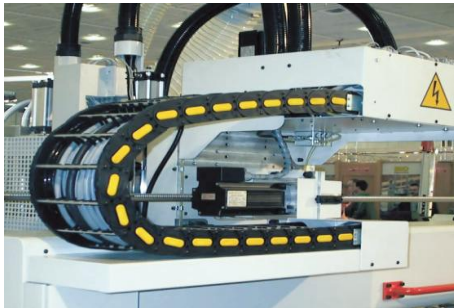
## Risks of a design without considering the connections

- Cables in contact with high temperatures
- Cables in contact with chemicals / oils
- Inevitable EMC interferences
- More installation time / labor cost
- Maintenance difficulties, times and higher cost



# Electrical Design: Cabling Solutions

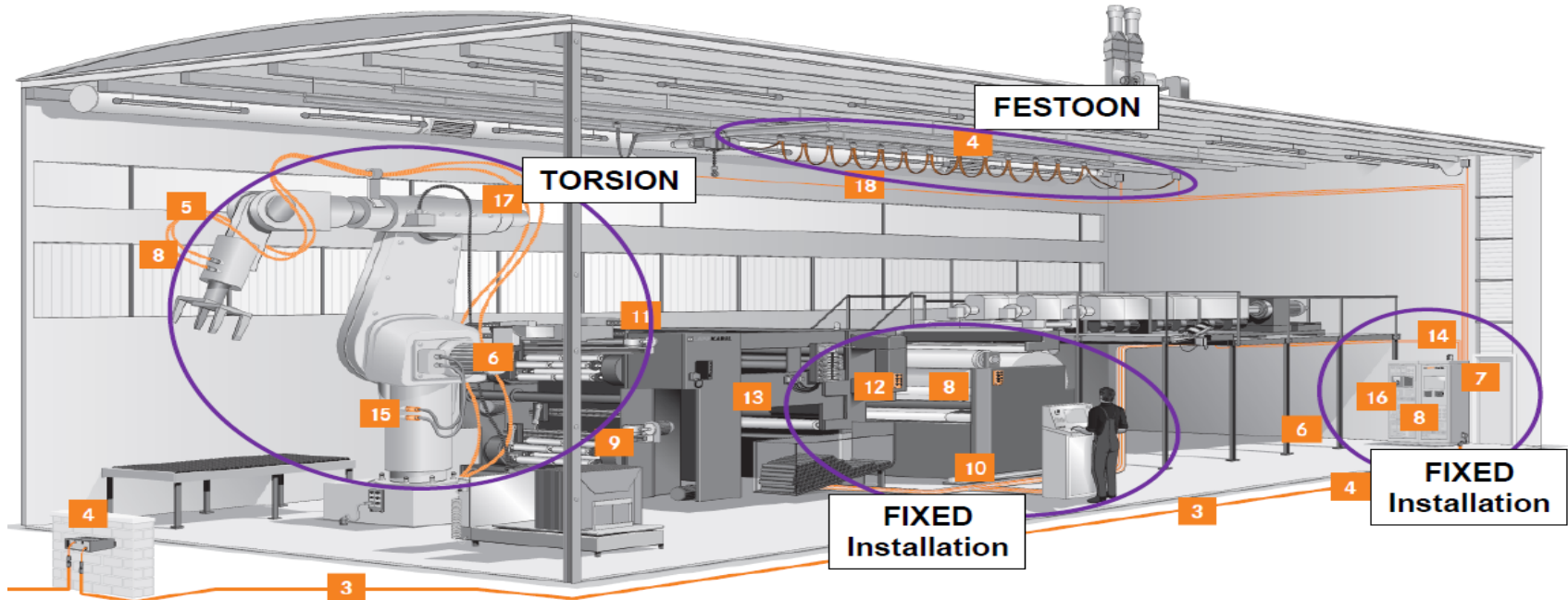
## Cabling: repetitive mobile installation





# Electrical Design: Cabling Solutions

Application and intended use of cablings



# Cabling and technological evolution

2 different cables

- a single Servo Cable Power and Signal



- a single Encoder Cable / Resolver



DSL cable

- a single Cable

- Power

- Digital signal



Control,  
Signal and Data  
Transmission Cables

*Speed / remote control / diagnostic*

Optical fibers  
(POF, PCF, GOF)

Ethernet networks  
(LAN, CAN)

BUS system (BUS, Field-BUS, Profi-BUS, CAN-bus)

Parallel connection

# Evolution of the market standards

## Compliant and approved cables and cabling solutions

**Cables UL/CSA Listed - UL /CSA AWM → North American market**

NEC e NFPA 79 e CSA C22.1 :

- LISTED



- Recognized Cables:



UL AWM Style e CSA AWM

**Cables**



**Russian Market**



**‘Cables’ ... always follow more...**

**... people’s security needs...**

**... respect for the environment**

- SELF-EXTINGUISHING
- HALOGEN FREE



**VDE → IEC → CEI → NFPA → CSA**

- RoHS2
- REACH



# Mechatronics design

- ✓ «Inventing», planning
- ✓ Studing the ways to implement
- ✓ Performing the design calculations, the necessary studies
- ✓ **Simulating** (automatic and dynamic

Integrating  
the discipline”:

Mechanics

Electrical

Electronics

.....

..... never “neglecting” the electrical connections



## 2 Technological Innovation & Training

Production Managers must realize the importance of good Hardware and Software equipment in order to optimize the design time and identify any eventual lack of technical personnel training.

If the design tools are not deeply known and understood, and if the technological innovation that manufacturers apply to their products is not followed properly, the design system will become not updated and obsolete.

It is mandatory to have a critical view of the design tools to by investing in research and development and training. Doing so, it will be possible to automate procedures and configure the tools to reduce the design and documentation time limiting drastically errors.





## 3 Technical Specifications & Sharing

Nowadays it is common to face workload peaks and manage them cooperating with other partner companies.

Share a design tool could be a problem given that the design approach could not be the same even using the same system.

In order to get a standard project, it is required to have a well defined technical specification to grant a linear and coherent final result.

The resulting project must be homogeneous to facilitate future consultancy, revisions and maintenance.





## 4 Safety & Normative

The digitalization of complete plants in future will consent self-managed and intelligent interconnected facilities with outstanding production efficiency.

In this new Industry 4.0 environment, information will be exchanged in internal and external communication networks increasing the risks for the data integrity and secrecy.

This situation was absent when all the machines were designed, manufactured and operated locally.

Training in safety must be held to improve the electrical design and data safety experts must be now a part of the design phase to assure that confidential information is safe and properly handled.





## 5 Standard Outputs & Manufacturing

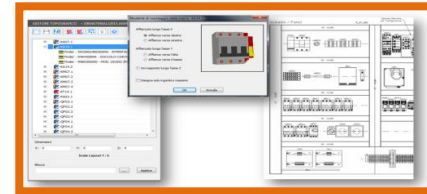
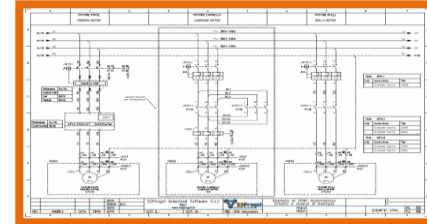
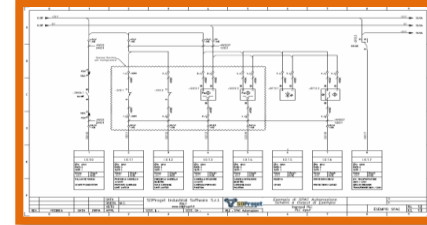
Specialized tools must be used to draw proper electrical schemes, assist the designer to standardize outputs and make faster error-free reports.

Electrical drawing sharing can be done with PDM and PLM Software.

A complete documentation must include:

- 1) **Drawings:** Functional schemes for power-supply, auxiliaries, logics, pneumatics and PLC, etc.
- 2) **Processing:** Cross-Reference, components ID, wires numbering, Cables management , terminal blocks, panel design, Bill of Materials, Labels and identification plates, cables list, etc.
- 3) **Outputs:** All the outputs must be available in exchangeable files format as DWG, XML, XLS and Database

Final documentation must be an active element in the production process.





## 6 Materials & Products Selection

Given the fast evolution pace of technology, a device used in a project could become obsolete in a short period of time.

An adequate selection of updated products makes it easier to maintain a plant in time.

The designer must use a Software that assist him in the components analysis, with the possibility to see updated components and cables datasheets available on the web.



# Conclusion



Considering the previous facts, the electrical design becomes an important element in the production lifecycle allowing to maximize time and costs savings.

