Project Report

Title-Modelling of SCADA and PLC Programming for Standardization and Optimization of network communication topology between BIW and PT/ED line in Paint-shop

Submitted By:

Amiy Yadav

Mechatronics Engineering

UPES, Dehradun

Utkarsh Singh

Electronics & Comm. Engineering

LNMIIT, Jaipur

Under the Guidance of:

Mr Naushad A. Ansari

(DGM, Paintshop TATA Motors,Lko)

Mr V Saravanan

(SM, Paintshop TATA Motors,Lko)

ACKNOWLEDGEMENT

The internship opportunity I had in TATA Motors, Lucknow was a great chance for learning and professional development. Thus, I consider myself immensely grateful as I was provided an opportunity to be a part of it. I am also grateful for having a chance to interact with so many wonderful people and professionals who led me through this this internship period.

Bearing in mind I am using this opportunity to express my deepest gratitude and special thanks to Mr. Vishal Agrawal (GM of Paint Shop) who in spite of being immensely busy with his schedule, took time out to hear, allowing me to proceed with my project at this esteemed organization.

I express my deepest gratitude to Mr. Naushad A. Ansari (DGM Paint Shop) and Mr. Murugan S (DGM Paint Shop), for guiding me and keeping me on right track by giving necessary advices.

It is my radiant sentiment to place on record my best regards, deepest sense of gratitude to Mr V Sarvanan(Senior Manager Paint Shop), Mr Mayank Bajpai(Senior Manager Paint Shop), Ms Nupur Singh(FTC Paint Shop) and Mr Ashutosh Shukla(Senior Manager Paint Shop) for their precious guidance which was extremely valuable for my study both theoretically and practically.

I perceive as this opportunity as a big milestone in my career development. I will strive to use gained skills and knowledge in the best possible way.

Yours Sincerely,

Amiy Yadav

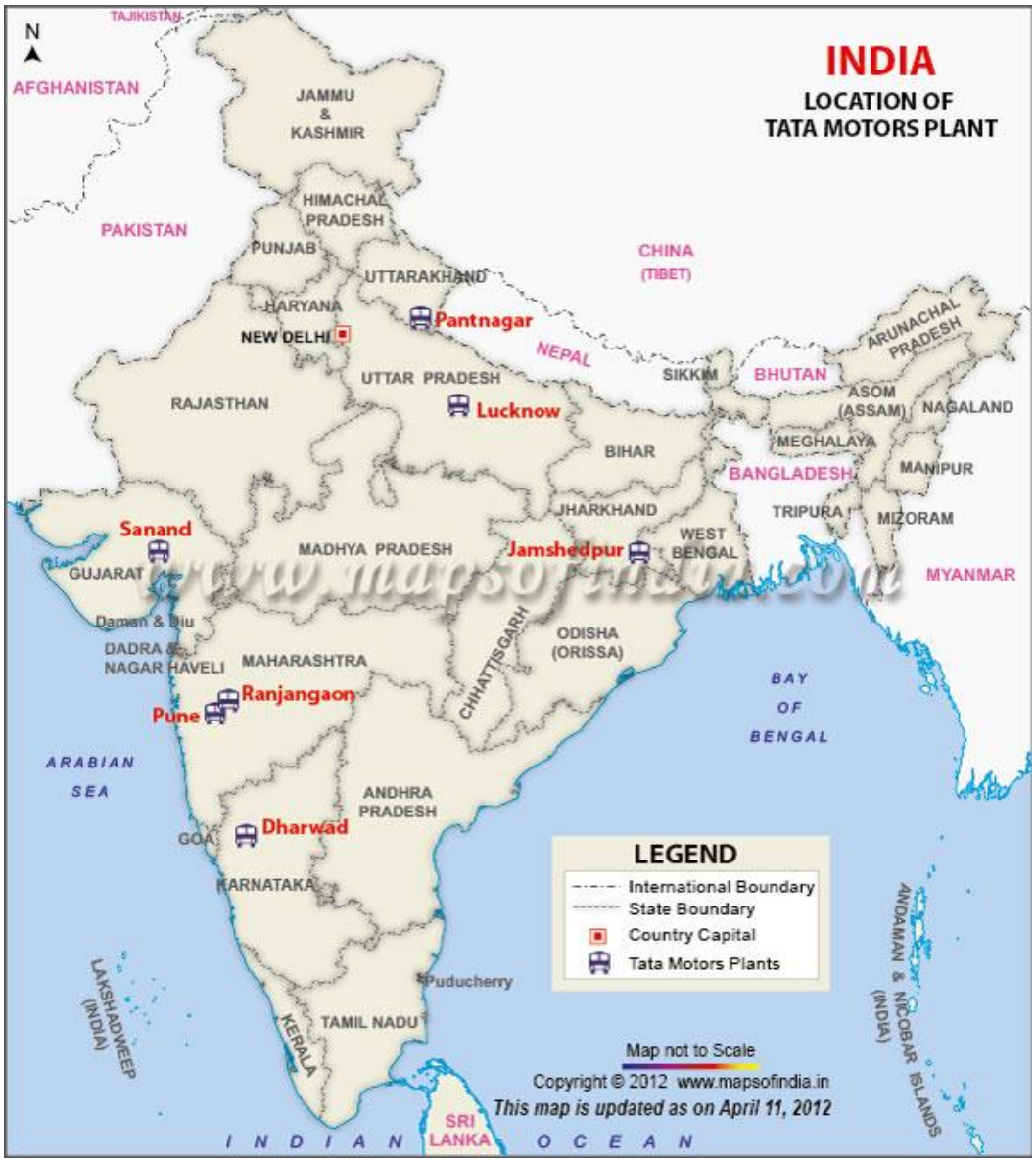
Utkarsh Singh

INDEX

Chapter1-TATA Motors

Tata Motors Limited (formerly **TELCO**, short for **Tata Engineering and Locomotive Company**) headquartered in Mumbai, Maharashtra is an Indian multinational automotive manufacturing company and a member of the Tata Group. Its products include passenger cars, trucks, vans, coaches, buses, sports cars, construction equipment and military vehicles.

Tata Motors has auto manufacturing and assembly plants in Jamshedpur, Pantnagar, Lucknow, Sanand, Dharwad, and Pune in India, as well as in Argentina, South Africa, Great Britain and Thailand.



It has research and development centre in Pune, Jamshedpur, Lucknow, and Dharwad, India and in South Korea, Great Britain and Spain.

- Tata Motors' principal subsidiaries purchased the English premium car maker *Jaguar Land Rover* (the maker of Jaguar and Land Rover cars) and the South Korean commercial vehicle manufacturer Tata Daewoo.
- Tata Motors has a bus-manufacturing joint venture with *Marcopolo S.A.* (Tata Marcopolo), a construction-equipment manufacturing joint venture with *Hitachi* (Tata Hitachi Construction Machinery), and a joint venture with Fiat Chrysler which manufactures automotive components and Fiat Chrysler and Tata branded vehicles.
- Founded in 1945 as a manufacturer of locomotives, the company manufactured its first commercial vehicle in 1954 in a collaboration with Daimler-Benz AG, which ended in 1969.
- Tata Motors entered the passenger vehicle market in 1991 with the launch of the Tata Sierra, becoming the first Indian manufacturer to achieve the capability of developing a competitive indigenous automobile. In 1998, Tata launched the *first fully indigenous Indian passenger car, the Indica*, and in 2008 launched the *Tata Nano, the world's cheapest car*.
- Tata Motors is listed on the (BSE) Bombay Stock Exchange, where it is a constituent of the BSE SENSEX index, the National Stock Exchange of India, and the New York Stock Exchange.
- The company is *ranked 226th on the Fortune Global 500 list* of the world's biggest corporations as of 2016.
- On 17 January 2017, *Natarajan Chandrasekaran* was appointed chairman of the company Tata Group.

Chapter-2 TATA MOTORS, LUCKNOW

Established in **1992** to meet the growing demand for commercial vehicles in the Indian market, the Lucknow plant of TML is strongly backed up by an ERC and service setup to support the latest technology and cater to the complexities of automobile manufacturing.

It is specialized in the designing and manufacturing of a range of modern buses which includes low-floor, semi low-floor, high deck and CNG buses. This facility also specializes in integral bus manufacturing and has commissioned a JV company - Tata Marcopolo Motors Limited - in the premises.

TML-Lucknow is setup on a land of 600 acres in the Chinhut Industrial Area, while Deva Road cuts the plot in almost two halves.

The Western Complex was commissioned first and includes facilities such as:

- Vehicle Factory - Assembly plant for trucks and bus chassis
- Integral Bus Factory - Assembly plant for module buses catering to the needs of Tata Marcopolo Motors Ltd. and FBV operations
- Transmission Factory - Gear parts, crown wheel and pinion, and heat treatment facility
- Production Engineering Shop - Catering to the tool design and manufacturing needs
- A well-established Training Centre which trains around 500 apprentices in various trades
- Engineering Research Centre with a focus on buses. Facilities include a digital prototyping lab, use of PLM software, etc.
- Service Training Centre providing training to the drivers and technicians of the STUs
- Other facilities include the Prolife Factory (for reconditioning business), the satellite plant of TMML which caters to the hi-end buses for the northern market, etc.

The recently commissioned Eastern Complex augments the vehicle production capacity in TML's Lucknow plant to 640 vehicles per day. It houses state-of-the-art facilities like a paint shop, BIW shop, and TCF factory with automated lines which have been benchmarked with the best in the world.

FACT FILE

- Spread across an area of 600 acres
- Started production in 1992
- Facilities include weld shops, paint shop, axle shops and assembly lines
- Nearly 5,500 employees
- Manufactures 640 vehicles per day

MILESTONES

- First vehicle rolled out in 1992
- First assembled vehicle inaugurated in 1995
- First CNG vehicle rolled out in 2001
- Fully built vehicle business started in 2002
- Unveiled the prototype of low floor and high capacity bus in 2007
- Production began at the newly constructed eastern wing of the facility in 2009
- Argon CO2 facility inaugurated in 2013
- Inaugurated New Frame Bend Removal Machine and Roll on/Roll off facility in 2014
- Axle celebrated its 1 lakh milestone in 2015
- Heat recovery system inaugurated in paint shop in 2015
- Rolled out prototype of LPO 1622 FE Diesel Hybrid from ERC in 2015

The training was majorly done in the eastern half of the Lucknow plant. Following are the departments (shops) allocated in the same:

- **BIW shop**: The BIW shop is the body in white shop where different metallic components of the cowl or cab are welded together to from whole of the cab/cowl. This shop comprised of 9 robotic arms for the welding purposes which mainly is spot welding. There are many mechanized welding pseudo-arms which are manually used by

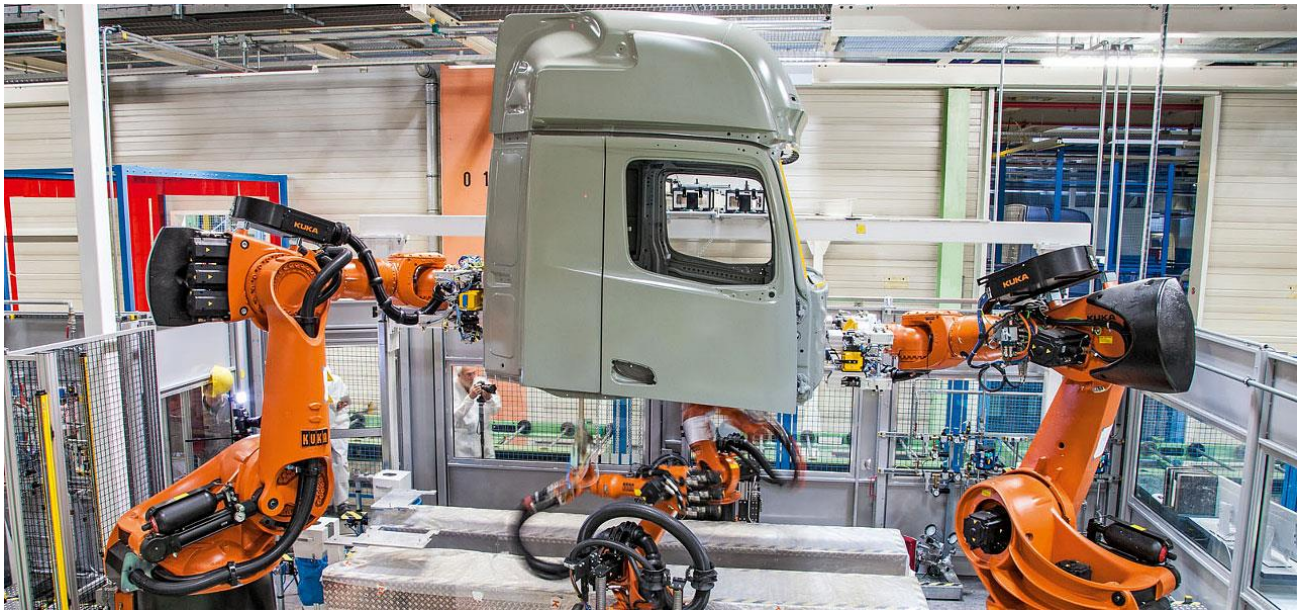
- **Paint shop**: The cowl/cab is then carried in the Paint shop where it undergoes a number of processes mainly such as ED coat and Top coat after which the body is fully painted with a coat of approx 55 micron.

- **Trim Line-2/3(as per preference of cowl or cab):** Now after the paint shop the body is dropped into the trim shop where the assembly of cab/cowl parts

is done comprising of the components such as exhaust, dashboard, communication systems, lights, etc.

- **Assembly Line-2/3(As per received from respective Trim Line):** The inner chasis to the first station of the assembly line on which components such as axle, drive train, wheel shafts, driver shafts, and the engine, fuel tank and the cowl from the trim line are assembled completing the assembly of the whole truck.

Chapter-3 BIW SHOP



Body In White or **BIW** refers to the stage in automobile manufacturing in which a car body's components have been joined together, using one or a combination of different techniques: welding (spot, MIG/MAG), riveting, clinching, bonding, laser brazing etc. BIW is termed before painting & before the engine, chassis sub-assemblies, or trim (glass, door locks/handles, seats, upholstery, electronics, etc.) have been assembled in the frame structure.

The name derives from manufacturing practices before steel unibody monocoques — when automobile bodies were made by outside firms on a separate chassis with an engine, suspension, and fenders attached. The manufacturers built or purchased wooden bodies (with thin, non-structural metal sheets on the outside) to bolt onto the frame. The bodies were painted white prior to the final color.

A folk etymology for *Body in White* suggests the term derives from the appearance of a car body after it is dipped into a white bath of primer (undercoat paint)—despite the primer's actual gray color. This could also refer to when car bodywork would be made of timber - all timber products, furniture etc., are considered to be "in the white" when at the stage of raw timber before finishing/varnishing.

In car design, the Body in White phase refers to the phase in which the final contours of the car body are worked out, in preparation for ordering of the expensive production stamping die. Extensive computer simulations of crash-worthiness, manufacturability, and automotive aerodynamics are required before a clay model from the design studio can be converted into a Body in White ready for production.

Factories may offer BIW cars to racers, who then may replace up to 90% of the car with aftermarket parts, and niche manufactures like *Ruf Automobile* start their cars with BIWs from other makers.

- The **six-axis welding robot** is adept for all complex welding applications
- Proven to **increase productivity,** TAL BRABO Welding Robot with 6 Kg payload capacity**, priced at approximately Rs. 8.5 Lakhs**
- Can be **integrated with any power source and is easy to program with low cost of ownership**
- Will primarily cater to Tier 3 and 4 suppliers, two-wheeler OEMs and the MSME sector
- Promises to **increase productivity and efficiency** and **ensure safety** in welding processes
- Is backed by a **trained and well-equipped System Integrator Network**

TAL Manufacturing Solutions, a subsidiary of Tata Motors, today announced the launch of its indigenously developed, **TAL BRABO Welding Robot**. Exhibited for the first time at the Automation Expo from 09 – 12 August 2017 in Mumbai, the TAL BRABO Welding Robot has been developed for welding operations with highly reliable features and ensures utmost safety as it is equipped to seamlessly perform all dangerous actions associated with welding.

Priced at approximately Rs. 8.5 Lakh Welding Robot is cost-effective offering easy-to-use robotic technology that caters to Tier 3 and 4 suppliers. With a reach of 850 mm and payload capacity of 6 kilograms.

Conceptualized to automate welding not only for OEMs but also MSME players, the TAL BRABO Welding Robot has been developed from an industrial user

perspective. A complex and dangerous task, welding is associated with many health hazards such as damage to physical heath, serious medical complications due to exposure to fumes and high decibel noise that can potentially destroy the hearing ability of the welder. The design and in-house style of the TAL BRABO Welding Robot addresses all these concerns and performs welding functions consistently and precisely.

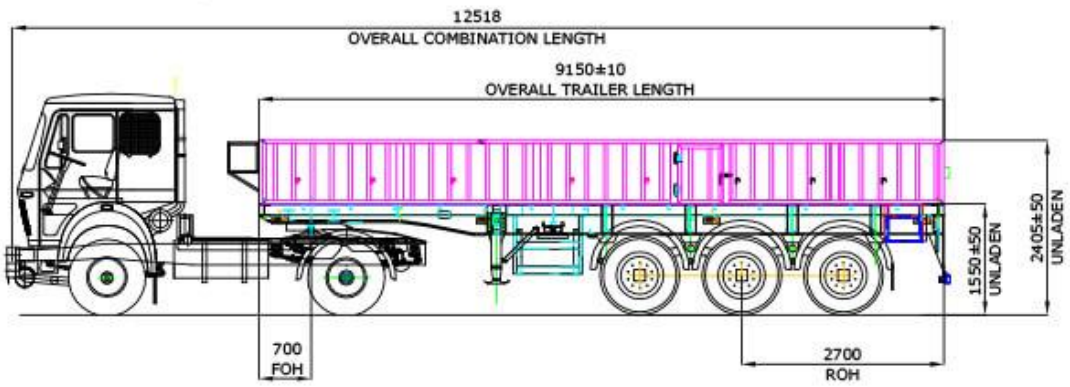
Speaking at the launch, Mr. R S Thakur, Non-Executive Director & Chairman – TAL Manufacturing Solutions Ltd., said, "India is a growing market for technology and innovation with a conducive atmosphere for development of automation. Robotics and Automation can revolutionize the industrial scenario and change the way various functions are performed across industries.

Earlier this year, TAL Manufacturing Solutions launched first Indian conceptualized, designed, and manufactured articulated industrial robot used for varied applications for tasks like pick and placement of materials, assembly of parts etc.

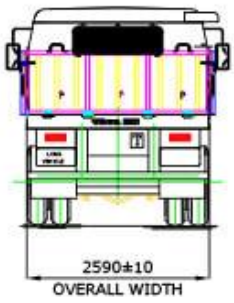
About TAL BRABO

- The TAL BRABO is the country's first Indigenously developed, 'Made in India' solution, developed to cater to micro, small and medium enterprises, as well as for large scale manufacturers who require cost competitive automated solutions in manufacturing. The robot is available robot in 3 variants, with payloads of 2,6 and 10 kilos, priced between INR 5 – 8.5 lakhs.
- Designed and styled in-house at TAL Manufacturing and Tata Elxsi respectively, Tata AutoComp manufactured some of the critical components of the robot. Conceptualized to complement human workforce and perform repetitive, high volume, dangerous and time-consuming tasks, the TAL BRABO robot, can be deployed across industries.
- Having successfully tested the TAL BRABO in over 50 customer work streams so far, TAL Manufacturing is ready to supply these robots to several sectors including Automotive, Electronics, Software Testing, Plastics, Logistics, Education, Aerospace and Heavy Engineering among others, simplifying industrial manufacturing, improving quality and productivity.
- Chassis and exterior account for around 35% of total vehicle value – We estimate a stamped component value of EUR 1,100 per vehicle

9 M TRIDEM AXLE SIDE WALL TRAILER



FRONT ELEVATION



END ELEVATION

SPECIFICATIONS

Trailer weight (Unladen)	6.4 T (APPROX)
Chassis	All steel welded construction. 2 Nos Main longitudinal members are high strength lighter weight Parallel flange Beam of ST 52 (or) Equivalent grade steel running along full length of the trailer. Cross members - Rolled or Folded of material IS-2062/ST-52 are positioned at suitable locations. 3.15 MS chequered sheet platform. Fixed front and side panel, drop down rear door shall be provided as shown in G.A drg.` 1 window shall be provided at middle on both sides.
Landing leg	Two speed landing leg shall be provided at the front end.
Axles	3 Nos. 13T Axle Shall be provided
king pin	2'' king pin equivalent to IS : 6763 Part I provided
Suspension	12T capacity Tandem axle leaf spring suspension with load equalizing brackets.

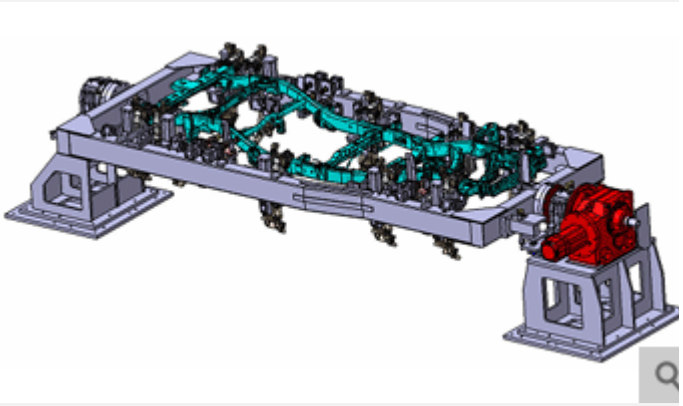
Tyre Wheel rim	10.00 x 20 – 16 PR – 12 Nos. 7.50 x 20 – 12 Nos.
Brakes	Twin line air brake system coupled to tractor brake system. Trailer brakes are actuated from tractor. T24 brake chamber shall be provided on all axles. Limiting & Quick Release Valve shall be provided for brake efficiency. Parking brake shall be manually actuated.
Electrical	24 V DC electrical include tail lamp, brake lamp and direction indicator lamps fitted at rear end of trailer. Side Marker lamps shall be provided on both sides.
Surface preparation	Trailer surface shall be Shot blasted and cleaned.
Painting	Two coats of mono coat finish paint with colour of customer choice.
Other fitments	Fitments such SUPD, RUPD, reflectors on both sides and rear shall be provided as per CMVR.

BIW has a highly skilled team that can meet the expectations with innovative but simple solutions in BIW welding.

The team has at its credit the experience of handling almost all vehicle projects in Tata Motors Limited at turnkey level across all its plants through its in-house and supplier-based resources.

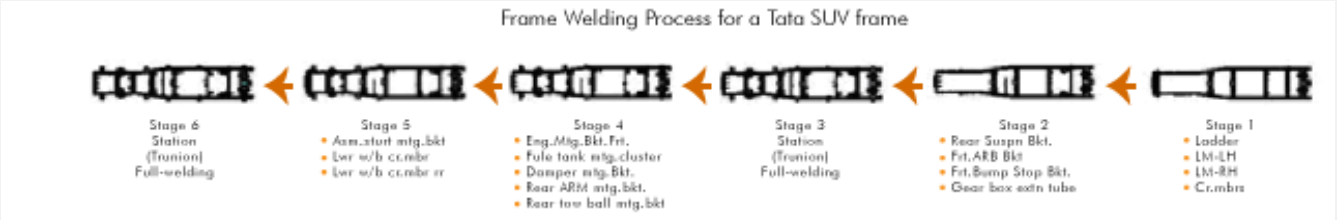
BIW takes utmost care during design and manufacturing of welding fixtures for safety aspects during BIW production. With use of modular bases and units and high quality standard items the fixtures are most reliable and consistent in performance.

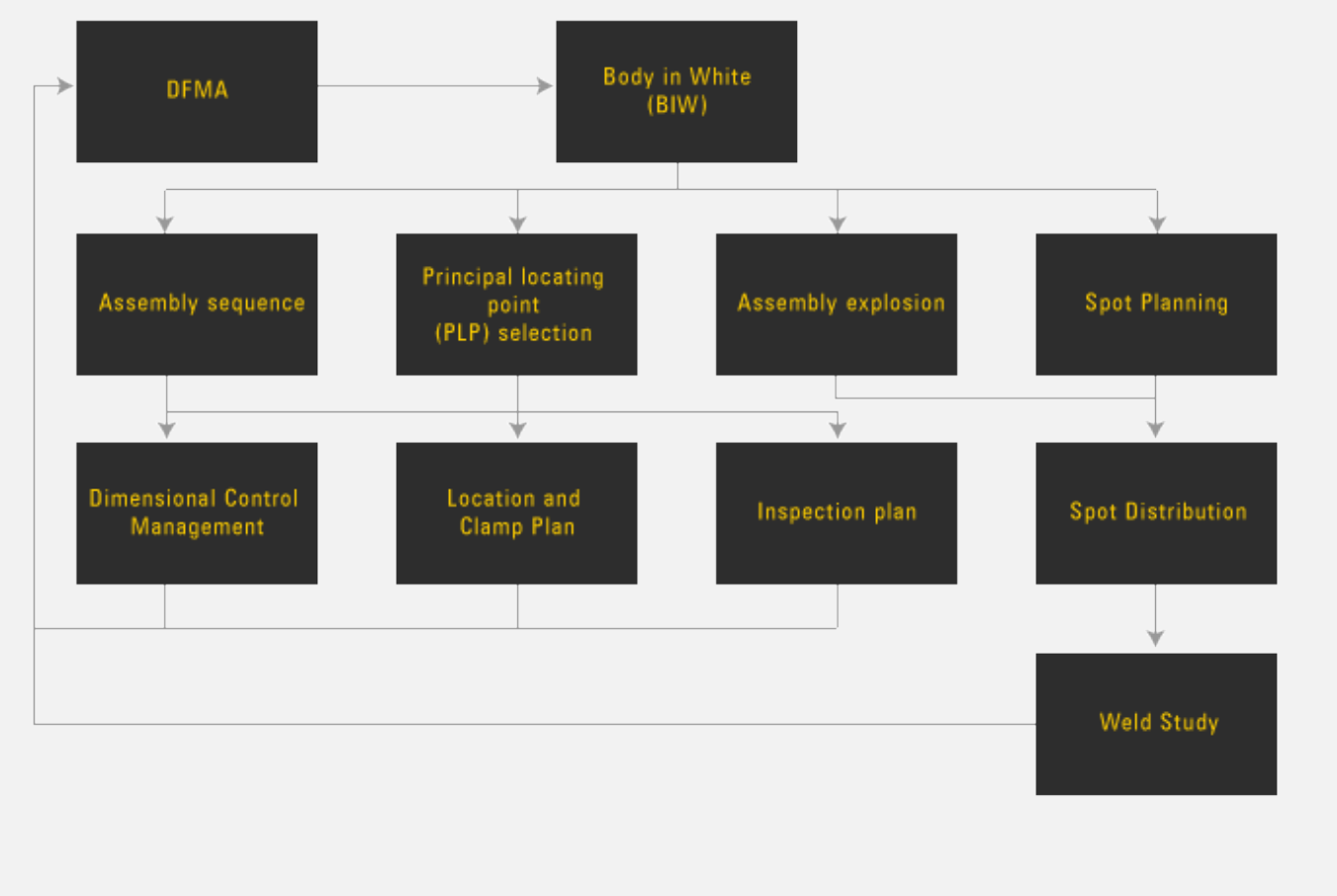
BIW has a highly experienced team to design and manufacture welding fixtures for various types of chassis / frames. Frames of many Tata vehicles known for their reliable performance on rugged Indian road conditions have been tooled in BIW.



PE masters the process engineering for welding of car bodies in all conceivable variants, from the smallest bracket to the complete body-in-white (BIW).

Work includes defining the family tree for BIW, defining locating and clamping strategy and PLP co-ordination through stages, defining the sequence of loading parts assembled, and spot allocation to meet tack time. In executing this process the overall product quality is enhanced and an assembly process facilitates trouble free manufacturing.




DFMA
Body in White (BIW)
Assembly sequence
Principal locating point (PLP) selection
Assembly explosion
Spot Planning
Dimensional Control Management
Location and Clamp Plan
Inspection plan
Spot Distribution
Weld Study

Chapter-4 Trim Lines

There are various quality tools being implemented in the Tata Motors Ltd., and helped in the improvement of quality standards by presenting a method with work instructions and a control plan. TCF is the car assembly shop in TATA MOTORS PVBU. It consists of 6 assembly lines:

1) Trim 1
2) Trim 2
3) Trim 3
4) Underbody1&2
5) Mechanical 1&2
6) Canopy 1&2

The operations performed on each line can be summarized as given below:

- Trim 1: Under carpet wire harness routing, fitment of AC unit, fitment of stud, fitment of rack and pinion, VIN plate fitment and floor unit.

- Trim 3: Air bag unit fitment, dashboard fitment, Cockpit tightening and Fuel and AC line Fitment.

- Trim 2: Front Strut fitment, windshield fitment, rear bumper fitment, seatbelt fitment.

- Underbody 1&2: Fuel tank, engine dress up and crossbar fitment. • Mechanical 1&2: GSL fitment, electrical testing and fuel filling.

- Canopy 1&2: Wheel alignment, brake testing and overall car testing.

The work instruction sheet is used to provide the detailed information about the sequence of operations carried out which converts the raw material into the final product.

This will also provide the list of tools and gauges used in every process, tool International Conference on Ideas, Impact and Innovation in Mechanical Engineering (ICIIIME 2017) changing instructions and the diagrammatic representation of the component.

It also contains the name of the operation to be carried out, machine name and the codes for tools, gauges, jigs and fixtures, if any. Total Quality Management (TQM) and Total Quality Control (TQC) literature make frequent mention of seven basic tools which are FIFO, KANBAN, 5S, Kaizen, JIT, Control charts, Ishikawa.

Quality Tools

- Check Sheets: The main purpose of Check Sheets is to insure that the date collected is carefully and accurately by operating personnel.
- Pareto Diagram: The Pareto (pah-ray-toe) chart is a very useful tool whenever one needs to separate the important from trivial A Pareto Chart is simply a frequency distribution (or Histogram) of attribute data arranged by category.
- Scatter Diagrams: The scatter diagram is the simplest of the seven tools and one of the most useful. The scatter diagram is used to determine the correlation (relationship) between two characteristics (variables).
- Flow Charts: The Flow Chart provides a visual representation of the steps in a process or a diagram that uses graphic symbols to depict the nature and flow of the steps in a process.
- Histogram: Histogram is a special bar chart for measurement data. Histograms are used to chart frequency of occurrences.
- Control Charts: Variable control charts are used to study a process when characteristics is a measurement, for example, cycle time, processing time, waiting time, highest, area, temperature, cost or revenue. Measurement data provides more information than attribute data: consequently, variables charts are more sensitive in detecting special cause variation than are attribute charts.
- Cause and Effect Diagram: The Cause-and-Effect (C&E) diagram is a tool used to organize the possible factors that could be negatively impact the stability, center, spread, and shape of a critical to quality (CTQ) characteristics measure.

3. QUALITY TOOLS USED IN TATA MOTORS

3.1 Poka Yoke Poka Yoke is an essential technique to ensure error free functioning and hence is implemented in all manufacturing industries.

Tata Motors being one of the largest automobile manufacturing companies in the world realizes the importance of it. Numbers of Poka Yoke's are installed in each manufacturing plant for safety purpose as well as to ensure error free functioning of the plant. These Poka Yoke's can be broadly classified into two types:

i. Fail safe: They are installed from safety point of view. They ensure the safety of the operator by installing specific triggers which stop the functioning of the line if the operator activates them, willingly or by mistake.
ii. Fool proof: They are installed from quality point of view. They ensure that no quality lapse takes place in error prone procedures by full proofing hence eliminating any margin of error present. There were a total of 130+ Poka Yoke installed in the TCF shop with 80+ fool proof and the rest of them being fail safe.

3.2 Ishikawa Diagram Diagrams are posted in key locations to stimulate continued reference as similar or new problems arise. The diagrams are revised as solutions are found and improvements are made.

The diagrams are useful in:

1. Analyzing actual conditions for the purpose of product or service quality improvement, more efficient use of resources and reduced costs.

2. Elimination of conditions causing nonconforming product or service and customer complaints.

3. Standardization of existing and proposed operations.

4. Education and training of personnel in decision-making and corrective-action activities.

FIFO (First In First Out)

Implementation of FIFO in TATA MOTORS:

- The parts used while assemblies were stored in bins.
- Operator was expected to lift the part and complete the procedure but was unable to differentiate the old part from new ones.
- To avoid this confusion the bins were kept on sloping surface as shown in figure.
- The bins were kept on the surface according to their manufacturing dates, which would create a flow and the object which was old was used first thus avoiding the stacking up of old parts.

3.3 Kaizen

Kaizen is a system that involves everyone – upper management to the cleaning team. Everyone is encouraged to come up with small improvement suggestions on a regular basis.

Kaizen is based on making changes anywhere improvements can be made. Kaizen is an approach that ,

1. Starts with people.
2. Focuses its attention on people‘s efforts.
3. Processes are continually improved.
4. Improved processes will improve results.
5. Improved results will satisfy the customers.

4. WORK INSTRUCTION SHEET

A standard operating procedure, or SOP, is a set of step-by-step instructions compiled by an organization to help workers carry out routine operations.

SOPs aim to achieve efficiency, quality output and uniformity of performance, while reducing miscommunication and failure to comply with industry regulations "detailed, written instructions to achieve uniformity of the performance of a specific function". The focus is always set on repeated application of unchanged processes and procedures and its documentation, hence supporting the segregation of origins, causes and effects.

The Quality Assurance Unit are individuals who are responsible for monitoring whether the study report and tests are meeting the SOP. SOPs can also provide employees with a reference to common business practices, activities, or tasks.

New employees use an SOP to answer questions without having to interrupt supervisors to ask how an operation is performed.

The international quality standard ISO 9001 essentially requires the determination of processes (documented as standard operating procedures) used in any

manufacturing process that could affect the quality of the product. Procedures are extensively employed to assist with working safely.

They are sometimes called safe work method statements (SWMS). They are usually preceded by various methods of analyzing tasks or jobs to be performed in a workplace, including an approach called job safety analysis, in which hazards are identified and their control methods described.

Procedures must be suited to the literacy levels of the user, and as part of this, the readability of procedures is important

4.2 Contents of Work Instruction Sheet

• Sequence of operation to be performed by team member : This column provides the operations to be performed in proper orderly manner. Every activity is precisely described.

• Photographs/pictures to be referred to perform activity clearly: To provide more clarity for workers to perform their task by looking at the photographs. These photographs are put up in order of the activity to be performed or they are numbered according to the activity.

• Operation symbols: In a particular operation there are certain tasks which are important from quality and safety point of view. Such operations are marked using certain operation symbols.

• Check method: Certain operations are to be inspected by using touch, feel, count, listen. These are called check methods.

• Safety and quality: Critical safety and quality requirements for certain operations are mentioned in this section.

• Part details: Part number and details used in the operation are mentioned in this section.

• Equipment/tool details: All the equipment used in that operation is mentioned with all their details and specification. Team leader has to keep updating this section with introduction of new equipment. This also helps to track the faulty equipment while down tracking some malfunction.

• If the activity not done what is the effect on next customer: Whenever some operator doesn't perform his activity according to the given quality norms, its effects on the next customer are mentioned in this column. This column is important for reminding the operators to work keeping in mind the quality outcome.

• Reaction plan: If at any point of time while performing a certain operation an error is incurred, proper reaction plan for such error are mentioned in this column. These reaction plans are to be worked out by the team leader.

• Personal protective equipment to be used: All the protective equipment to be used by the operators from safety point of view is mentioned in this section.

Chapter-5 Paint Shop

Automotive paint is paint used on automobiles for both protection and decoration purposes. Water-based acrylic polyurethane enamel paint is currently the most widely used paint for reasons including reducing paint's environmental impact.

Modern automobile paint is applied in several layers, with a total thickness of around 100 μm(0.1mm). Paint application requires preparation and primer steps to ensure proper application. A basecoat is applied after the primer paint is applied. Following this, a clear coat of paint may be applied that forms a glossy and transparent coating. The clear coat layer must be able to withstand UV light.

Processes and coatings

Preparation

- High-pressure water spray jets are directed to the body. Without proper pretreatment, premature failure of the finish system can almost be guaranteed.
- A phosphate coat is necessary to protect the body against corrosion effects and prepares the surface for the E-Coat.
- The body is dipped into the Electro-Coat Paint Operation (ELPO/E-Coat), then a high voltage is applied. The body works as a cathode and the paint as an anode sticking on the body surface.
- It is an eco-friendly painting process. In E-Coat, also called CED paint, utilization is approximately 99.9% and has great salt spray test life compared to other painting processes.

Primer

- Primer is the first coat to be applied. The main functions of the primer are to act as a leveler and protector, and to make the base coat easier to apply to the component to which it is applied.
- The primer serves several purposes. It serves as a leveler, which is important since the cab often has marks and other forms of surface defect after being manufactured in the body shop.
- A smoother surface is created by leveling out these defects and therefore a better final product. It serves as a protector, the primer will protect from

corrosion, heat differences, bumps, stone-chips, UV-light, etc. It also improves ease of application by making it easier for paints to stick to the surface, a more varied range of paints can be used.

Base Coat

- The base coat is applied after the primer coat. This coat contains the visual properties of color and effects, and is usually the one referred to as the paint. Base coat used in automotive applications is commonly divided into three categories: solid, metallic, and pearlescent pigments.

Solid paints have no sparkle effects except the color. This is the easiest type of paint to apply, and the most common type of paint for heavy transportation vehicles, construction equipment and aircraft. It is also widely used on cars, trucks, and motorcycles. Clear coat was not used on solid colors until the early 1990s.

Metallic paints contain aluminium flakes to create a sparkling and grainy effect, generally referred to as a metallic look.

This paint is harder to manage than solid paints because of the extra dimensions to consider. Metallic and pearlescent paints must be applied evenly to ensure a consistent looking finish without light and dark spots which are often called "mottling". Metallic basecoats are formulated so that the aluminium flake is parallel to the substrate. This maximises the "flop".

This is the difference in the brightness between looking perpendicularly at the paint and that at an acute angle. The "flop" is maximised if the basecoat increases in viscosity shortly after application so that the aluminium flake which is in a random orientation after spraying is locked into this position while there is still much solvent (or water) in the coating. Subsequent evaporation of the solvent (or water), leads to a reduction in the film thickness of the drying coating, causing the aluminium flake to be dragged into an orientation parallel to the substrate.

This orientation then needs to be unaffected by the application of the clear coat solvents. The formulation of the clear coat needs to be carefully chosen so that it will not "re-dissolve" the basecoat and thus affect the orientation of the metallic flake but will still exhibit enough adhesion between the coatings so as to avoid delamination

of the clear coat. A similar mode of action occurs with pearlescent pigmented basecoats.

Pearlescent paints contain special iridescent pigments commonly referred to as "pearls". Pearl pigments impart a colored sparkle to the finish which works to create depth of color. Pearlescent paints can be two stage in nature (pearl base color + clear) or 3 stage in nature (basecoat + pearl mid-coat + clear-coat).

Clearcoat

Usually sprayed on top of a colored basecoat, clearcoat is a glossy and transparent coating that forms the final interface with the environment. For this reason, clearcoat must be durable enough to resist abrasion and chemically stable enough to withstand UV light. Clearcoat can be either solvent or water-borne.

One part and two part formulations are often referred to as 1k and 2k respectively. OEM (original equipment manufacture) clear coats applied to the metal bodies of cars are normally 1K systems since they can be heated to around 140 deg C to effect cure. The clear coats applied to the plastic components like the bumpers and wing mirrors however are 2K systems since they can normally only accept temperatures up to about 90 deg C.

These 2 K systems are normally applied "off line" with the coated plastic parts fixed to the painted metallic body. Owing to the difference in formulation of the 1K and 2K systems and the fact they are coated in different locations they have a different effect on the "redissolving" of the metallic base coat.

This is most easily seen in the light metallic paints like the silver and light blue or green shades where the "flop" difference is most marked.

Processes:

Post Wash operation:-

After the quenching process the metaquench42 oil layers needs to be cleaned from the components.

To remove this oil layer we perform the post wash operation in which the components are dipped and wash with the spray of warm water which is maintained at the temperature of 60°C.

Method used to raise the water temperature:- LPG burner were used to raise the temperature of water to 60°C.

Method used to raise the water temperature:-

Now a modification is made in the system in which the heat of the flue gases are extracted and used to raise the temperature of water used for post wash. The temperature of flue gases when burnt is 275°C and with the help of heat exchanger we recovered the heat. And this extracted heat is used to raise the water temperature of post wash to the required level.

Optimisation of Cooling Zone:–

Fans operation at Paint Shop Paint shop gets the Cowl from BIW Shop (Weld shop) for painting.

In Paint shop, it passes first from Pretreatment stage, where oil, grease, dust & dirt is removed by hot water spray. Next, the Cowl body passes from Phosphate Station to make it ready for primer coat in ED (Electro- Deposition).

A layer of primer is applies over the surface of cowl by CED process and reaches to the oven for baking & drying at defined temperature i.e. 150°C.

This oven is horizontally connected with cooling zone, where cowls gets cooled by two axial flow fans i.e.. 22KW & 30 KW.

The Cooling Zone –

Axial flow fans are interlocked with the Pretreatment Stage conveyor as shown below. The Cooling fans automatically comes into operation as soon as the conveyor starts. It is found always in running mode once the line gets started.

Cowl takes almost 6 min time to reach the oven from Pretreatment stage.

In the latest technologies, Position sensor has been provided at the starting end of cooling zone, which senses the entry of cowl into oven subsequently it gives the start signal to the axial flow fan to run.

The electrolytic bath is basic (caustic), like lye, so wear goggles and rubber gloves and keep a bucket of water or a hose nearby in case you spill or splash some on yourself.

Alligator clip cables work well for suspending small parts like nuts and bolts from the hook.

Painted rusty objects can take much longer because paint impedes electricity. For better results, scratch up the paint first, or use a paint remover before treatment.

Ordinarily, you can dispose of the used bath liquid down the drain. But if you removed lead paint or you suspect that heavy metals (chrome in particular) have leached from your items, let the water evaporate to form a sludge (not a dust!) and bring it to a local toxic materials processor.

TATA Paintshop Shop:

The Paint and Final Assembly Systems business unit offers complete paint shops for the automotive industry, tier 1 / 2 suppliers and the non-automotive industry, and also systems for vehicle final assembly.

Our main concern is the flexibility of the production we offer and the quality that can be reached through our systems.

As a general contractor we offer everything from a single source: Plant, application and environmental technologies as well as conveyors, control, automation and manufacturing executions systems and last but not least service and modernization solutions.

TATA paintshop provides unique and proven solutions to surface finishing quality:

TATA paintshop plans and executes full turnkey paint shops on all five continents.

Familiarize ourselves with your process environment so as to implement customized, cost effective and environmentally sustainable solutions.

TATA paintshop's Ecopaint products and plants stand for innovation, highest quality and lowest operating costs along the entire process: from surface preparation of the product through to top coat painting and curing.

Conveyors:

The FASmotion control software allows flexible control of mobile conveyor trolleys such as electric monorails or skillet conveyors with individual drive and up to four axles.

- Added flexibility and precision for the transport in the line – these goals are achieved by the use of the enhanced FASmotion control software.
- With an optimized and standardized control platform and software, the conveyor trolleys can be better adjusted to the specific requirements in the fields of production as well as of service and maintenance.
- The consistency of the components used and their standardized handling make the new development even more attractive.
- This is a very important feature for automotive final assembly where different conveyor systems can now be operated with the same software and hardware.

The possibility to use »

FASmotion – flexible use up to four axle movements makes FASmotion furthermore a valuable asset in other fields of application calling for flexible movement in space. Depending on the cost-benefit ratio, power supply to FASmotion can be either inductive, i.e. non-contact or via busbars. Non-contact communication with and among the trolleys is implemented by means of Wi-Fi wireless technology. Almost

anything can be transported on the conveyors: entire car bodies, automotive parts or aircraft turbines. Using different conveyor types, parts with a weight from 200 kg to more than 5 tons can be moved.

1.Electric Monorail System :The Electric Monorail System is found both on pure transport sections at high speed and on work lines with adjustable rates. The variable tracking of the line through the plant allows the transport of components or even entire vehicles.

2.Twin Trolley System (TTS): With the drives being located in the rails, an onboard control is not necessary. Additional advantages include the high speed, the absence of slipping and the low maintenance costs.

3.Inverted TTS :The Twin Trolley System (TTS) developed by TATA paintshop also proves its capabilities as the floor conveyor inverted TTS. This versatility makes it possible to use a single conveyor system from the body shop to final assembly and thus to reduce spare parts requirements significantly

4.Skid Conveyors: Thanks to the robust technology and the resistance to moisture and dirt, Skid Conveyors are used in all manufacturing areas, from body shop to final assembly. Based on our experience in the painting area, we offer a highly advanced product.

SKID CONVEYORS

The bodies are transported on transport skids for the connections from the paint shop and as a decoupling buffer.

TATA paintshop is a competent partner for delivering everything from various roller bed designs, turntables, cross transfer cars and cross-chain conveyors to elevators.

1.ROLLER BEDS

Various roller bed designs are available according to the process requirements and environment. TATA paintshop supplies designs for buffer sections, wet areas, spray booths, UBS lines and work zones.

All roller beds are modular and use common system components such as the frame structure, motors, support belts and rollers. They are characterized by maximum availability. Horizontal and vertical changes to the direction of transport are achieved with cross and vertical conveyors.

2.SUSPENSION CHAIN CONVEYORS

Suspension chain conveyors are available in steel or plastic. They are used wherever several bodies are transported in continuous operation with only one drive. Applications include ovens, spray booths, buffer sections and various other work zones.

3.FRICTION CONVEYORS (SKIDLESS)

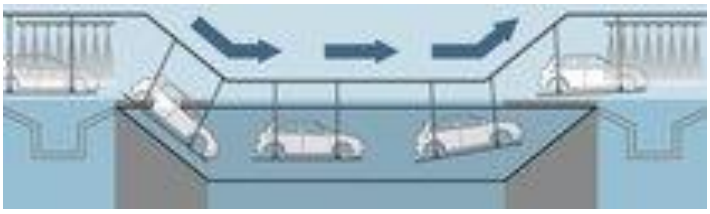
The skidless Friction Drive System rounds off our portfolio. The body is transported directly on the drive trolley here. Stationary drives, which are mounted along a single-track rail system consisting of straight section elements, curves and track switches, push the drive trolleys through the plant.

4.INVERTED MONORAIL CONVEYORS

Upon customer request, TATA paintshop supplies inverted monorail conveyors (IMCs) specifically for applications in hot areas such as ovens. IMCs permit the simple implementation of U-shaped ovens

PT/ED:

ECOPAINT WETSYSTEM –
Optimal Vehicle Preparation:



AirBiDip assures high capacity throughput even when building heights are restricted or large bodies are involved

TATA paintshop plans, implements and modernizes complete painting systems.

Focus is on resource conserving consumption and environmentally compatible water treatment: integrated recovery systems ensure that you save energy, water, chemicals and EC paint.

Ecopaint WetSystem is the brand name of our modular wet treatment systems. It stands for perfect corrosion protection for your vehicle body and for its quality and value retention.

It successfully unites all components and modules via design integration to form a complete and reliable system.

In the entire PT /ED process, TATA paintshop has for many years relied on Ecopaint RoDip, an efficient rotary dip process which can be used as a conveyor system in the complete pretreatment and cathodic dip painting stages.

Ecopaint RoDip ensures high quality results with uniform coating thicknesses and few faults, thus considerably reducing the extent of rework. Ecopaint RoDip reduces the length of the facility and saves valuable space. And the result is always convincing: excellent corrosion protection, first-class surface quality and low operating costs.

Ecopaint RoDip M Ecopaint RoDip M features a chain drive on either side of the tank. The chain drive pulls the carrier through the process line.

Rotation is initiated by V-shaped guide tracks arranged on the side of the tank. This facilitates both linear and rotating movements.

The robust mechanical Ecopaint RoDip M version is excellently suited for high production rates of 40 to 100 units per hour.

Ecopaint RoDip E Ecopaint RoDip E is operated with electrically driven carrier units on one side of the tank where both the conveyor and the rotary drives are arranged. An absolute displacement measurement system and a WLAN radio system ensure optimal communication among the carrier units.

A new control that is compatible with all leading SP controls has been developed for Ecopaint RoDip E. Safe operation without any disturbances is achieved by means of a 5-GHz frequency band for data communication. An optimized Job Manager, i.e. software specifically developed for programming body-specific process sequences, allows up to 20 different dip curves and high production capabilities.

Ecopaint RoDip for commercial vehicles Based on the development of a new heavy-duty carrier, Ecopaint RoDip E is also suitable for coating commercial vehicles. This carrier unit transports commercial vehicles and minivans through the pretreatment and dip painting stages.

OPTIMIZED OVERALL SYSTEMS OPTIMIZED OVERALL SYSTEMS

Intelligent planning to be optimal, any process must start with planning the particular car body in a dedicated way.

Using standardized components and parts as well as a perfectly adapted conveyor system, we are able to implement efficient and high quality facilities:

» Dip and spray tanks

» Modular tunnel segments with integrated systems

» Filter systems for bath management

» Pump, filter and heat exchanger assemblies

» Ultrafiltration units for paint and oil

TATA motors ensures that workflows are smooth, from the pump and conveyor systems to the overall system.

Increased bath quality – Increased coating quality Optimal bath management extends bath service times, thus reducing the consumption of chemicals and water. To achieve this, different options ranging from simple bag or band filters to highly efficient separation systems such as EcoMultiCyclone or magnetic separators.

Magnetic separator with continuous operation are newly developed magnetic separator allows continuous operation without any interruption. Due to the downward movement of the helically arranged magnets, the particles are continuously removed and discharged to the bottom.

- EcoMultiCyclone – high bath cleaning efficiency with its two EcoMultiCyclone Micro and Nano versions, which offers efficient and low-maintenance options for cleaning the bath. EcoMultiCyclone Micro removes particles in excess of 25 μm from degreasing zones I and II in a continuous process. Subsequently, EcoMultiCyclone Nano removes particles in excess of 10 μm

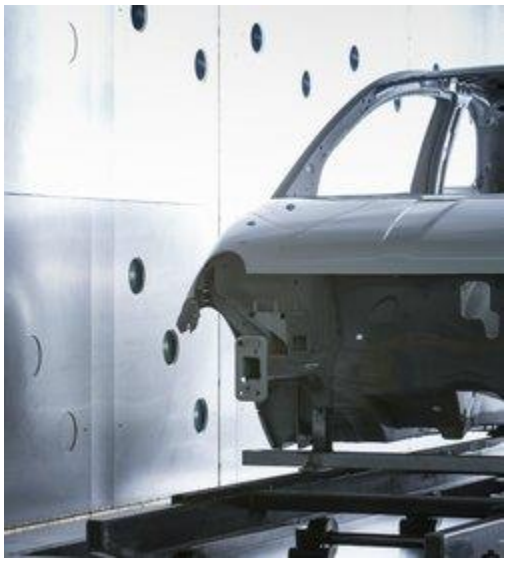
Water Treatment

Ta focuses on minimized water consumption in every process step. Nevertheless, the processes consume large volumes of water which moreover has to be prepared to achieve an optimal painting process in the pretreatment and dip painting stages. Reverse osmosis or the Ion EX ion exchanger helps TATA paintshop to reach the desired water purity for the various process stages.

» Modular and powerful waste water treatment systems. Individually designed water treatment Before it is introduced into the public discharge systems, the waste water is treated appropriately. TATA paintshop relies on its broad experience and designs the waste water treatment as individually required by local requirements and regulations. The process flow depends on the contamination degree, the particular national legislation, and the throughput rate in the facility. TATA paintshop offers a wide product range which allows the modular setup of any facility in a particular case, including all dosing and storage devices. Processes resulting from precipitation, neutralization, separation, and filtration are individually coordinated with each other and monitored continuously before the water can be discharged to the sewer system.

Oven:

ECOPAINT OVEN –
MODULAR DRYING SYSTEMS FOR HARDENING AND PROTECTION



The drying process is used to cure coatings and to turn the paint finish into a perfect surface. TATA paintshop delivers appropriate systems for each stage along the painting line: for gelling, intermediate drying and drying processes.

We plan and implement new installations and extend or modernize existing systems according to your requirements using the latest technology:

- EcoInCure
- EcoSmart VEC
- EcoC-IC

TATA paintshop ovens are modular built systems which are based on standardized individual components. They are delivered as completely pre-assembled modules. In this way we speed up installation and commissioning.

Ecopaint Oven Modules For Optimized Total Systems:

- Oven tunnels with various heat transfer systems
- Air and gas recirculation units
- Fresh air supply and heating systems
- Exhaust air purification systems

- Cooling zones

The key to optimal curing of surfaces TATA paintshop plans, delivers and installs turnkey paint shops. At the same time we work our way deep into your complex process environment to implement an individual solution.

The Ecopaint brand name carried by our products and plants stands for innovation and maximum customer value. TATA paintshop guarantees highest quality and lowest costs per unit throughout the entire process.

Ecopaint Oven is a modular drying system, ideally uniting all components and modules via integrative interfaces, to form complete systems that assure:

- Highest quality
- Minimum costs per unit
- Resource and energy conserving operation E Ecopaint copaint Oven Oven By using TATA paintshop ovens you gain much more than the product alone. As a leading technology developer we offer you:
- In-depth process know-how » Many years of experience and
- A global presence

Drying Systems For Perfect Surfaces:

The drying process is used to cure coatings and to turn the paint finish into a perfect surface.

Ecopaint Oven modules for optimized total systems:

- Oven tunnels with various heat transfer systems
- Air seals
- Heater units operated with recirculated air and recirculated gas
- Fresh air supply and heating systems
- Exhaust air purification systems
- Cooling zones
- Integrated conveyor systems

We plan and implement new installations and extend or modernize existing systems according to your requirements and using the latest technology.

In doing so we supply modular built systems which are based on standardized individual components and are delivered as completely pre-assembled modules. In this way we speed up installation and commissioning.

Modularity also has its advantages when the system is in operation: innovative solutions with fewer filters or optimized nozzles are the basis for quality and lower unit costs.

As in all other stages of the painting process, the drying process is all about avoiding dirt coming into contact with the vehicle body so as to attain high value levels. Our plants, with their precise air nozzle and air directing systems, protect your vehicles by preventing dirt particles from being blown onto them and thus assure optimum application quality.

Ecopaint Oven systems ensure uniform heating of the vehicle body and create ideal drying conditions with their fast and carefully managed energy input.

Controlled heating up of the entire vehicle body is guaranteed – matched to the shape and material thickness so that thinner body parts are not overheated. With TATA paintshop you opt for quality. Our plants, with their precise air nozzle and air directing systems, protect your vehicles by preventing dirt particles from being blown onto them and thus assure optimum application quality.

CLEANLINESS CREATES QUALITY CLEANLINESS CREATES QUALITY

The new CIC oven optionally implements this. It consists of a complete oven module with integrated roller bed and external drives. With the possible pulse operation mode we achieve high flexibility.

The integrated conveyor system ensures that no heat is discharged from the oven and the oven is very easy to clean.

The design of every oven system is individual and dependent on the plant layout as well as on the requested or existing conveyor systems. We have the necessary interface and process competence to develop the solution tailored to your specific needs.

Straight-through ovens: a high standard with a minimum footprint TATA paintshop straight-through ovens with classic skid conveyor technology stand out because of their compact design, offer high standards with a minimum footprint and are energy efficient.

The efficiency of the air seals not only prevents hot air from escaping out of the oven but also keeps the amount of dirt carried into the oven to a minimum. The design of every oven system is individual and dependent on the plant layout as well as on the requested or existing conveyor systems.

We have the necessary interface and process competence to develop the solution tailored to your specific needs.

INTERFACES AND PROCESSES THAT FIT PROCESSES THAT FIT

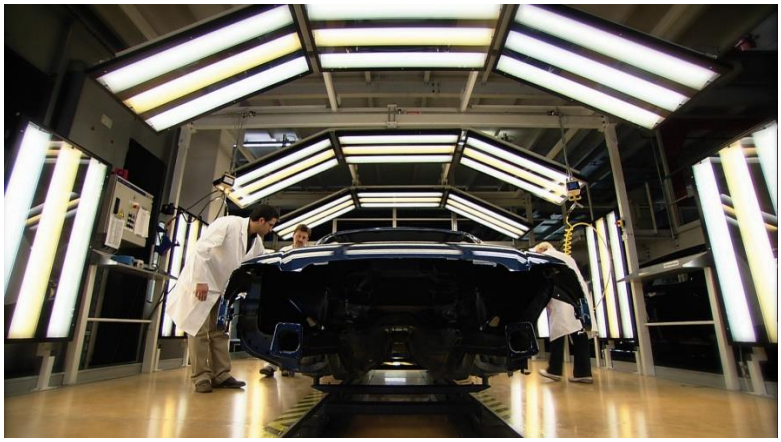
- TATA paintshop systems meet the most stringent environmental requirements and function in an extremely energy efficient manner. Through the continuous development and improvement of our products, we equip your plants with the latest technology and provide environmentally friendly processes.
- The oven with its high temperatures contains enormous energy savings potential.
- Ecopure TAR cleans the exhaust air by incineration and the purified gas arising from this process generates energy for the EcoHotBox.
- With the EcoHotBox we offer a standard module for the economical heating and filtration of air for the drying process. Your vehicle body is thus heated up optimally with an efficiently managed supply of energy yet with the minimum influx of dirt particles.
- The EcoCoolBox ensures an adequate supply of air to the cooling zones and handles filtration, heating and cooling. Reduced demand for fresh air in the air seals Our optimized dryer air seal, EcoAirSeal, results in less fresh air being needed in the air seal area which then no longer needs to be heated. We are able to reduce to levels approaching 50% of the original amount of air needed with unchanged performance.
- Thus, the amount of fresh air is precisely adapted to the current needs; the system responds independently to production conditions such as underutilization, ramp-up, shut-down or pause modes. The annual energy consumption can be reduced to such an extent that the investment pays for itself in just two years.
- Fresh air heat exchanger with higher efficiency The fresh air heat exchanger is the last link in the process chain. Our new generation heat exchanger cools the outgoing purified air to 120 °C and uses the recovered heat energy to heat the fresh air. This way the efficiency of the heat exchanger from TATA paintshop is significantly higher than the previous standard. We combine this sustainable technology into a compact design that unites all the components like heat exchangers, fans, filters and sound damper.

Paint Inspection

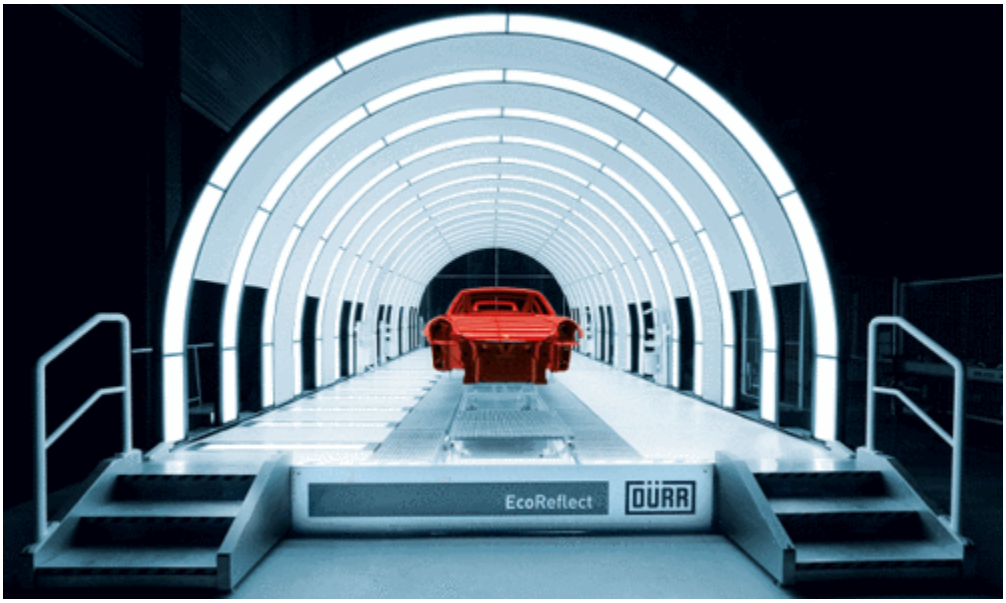
ECOREFLECT –

INNOVATIVE LIGHT TUNNEL FOR CHECKING SURFACE QUALITY

EcoReflect is a novel work deck for inspecting surface quality. It permits exact, highly focused visual inspection with an innovative lighting design and an ideal ergonomic environment. This allows paint irregularities to be identified consistently and with the best possible accuracy.



Unlike conventional systems, **Eco**Reflect uses vertical contrast lines to produce a reflected image that is bright but not too stimulating. It is not necessary to raise and lower your head to follow the body contours. Adapted luminance conditions between the interior and the surroundings permit concentrated, fatigue-free work.



The new EcoReflect lighting tunnel offers the ideal prerequisites for reliable surface quality inspection. It permits exact, highly focused visual inspection with its innovative lighting design and an ergonomically ideal environment. Paint irregularities can be reliably detected over long periods

- Continuous reflected image The LED-based lighting technology was developed specially to permit reliable detection of point defects using high-contrast elements. Additional low-contrast light zones help to identify defects over a large area. The arced lighting tunnel uniformly illuminates the body, ensuring ideal inspection. It makes efficient use of the emitted light, thereby greatly reducing energy consumption.
- Ergonomic work Adapted luminance conditions between the interior and the surroundings prevent nearly all glare and provide the ideal visual working environment.
- Unlike conventional systems, EcoReflect uses continuous contrast lines to avoid blind spots and overlooked defects. The vertical reflected image ensures ergonomic, fatigue-free work. Special prisms greatly reduce direct glare. Innovative space design.
- The open space design allows for relaxed, concentrated work and conveys a sense of transparency. Fabric strips between the light arcs prevent distracting reflections from the shop lighting, windows or other light sources. The textiles used in the wall areas provide pleasant acoustic conditions thanks to their enhanced damping properties. Individual fabric strips can be implemented as integrated ducts for direct, draft-free ventilation of the inspection station.
- Flexible work zones EcoReflect can be implemented as a single station or as a line solution. The customer can select from various light colors and wall materials, and can also adapt the work zone dimensions. Working equipment can be carried along as required. Quality assurance monitoring is possible by tablet computer using the iTAC.MES.Suite Quality module.

Paint Robot

Ecopaint paint robots are used in robotic painting stations for automatic surface coating of bodies and add-on parts in ESTA, AIR and powder applications. All paint materials such as solvent-based paints, water-borne paints and powder paints can be used.

Elegant design with practical details and a lot of performance to spare for day-to-day operation:

The third Ecopaint Robot generation from TATA paintshop scores with many innovative functions for automated painting.

1. **Greater mobility through seven-axis kinematic system**
   Thanks to its additional movement options, the **Eco**RP E043i model with seven-axis kinematic system enlarges the work zone and can often be used instead of a solution with linear displacement rail. This can significantly reduce investment and maintenance costs in the painting booth.
2. **Six or seven axes: the right solution for every application**
   The six-axis variants are still available in the product range. Apart from the missing seventh axis, they are identical to the seven-axis robot and are used with or without displacement axis. The **Eco**RP E/L133i robots operate on a top- or bottom-mounted rail. In addition to painting, they also serve as lid openers in interior painting.
3. **World premiere: Scara robots with tool cleaner**
   New Scara robots (**Eco**RP L030i/L130i) as door openers with extended Z-stroke complete the new product line. The newly developed swivel head with optional tool cleaner from TATA paintshop is unmatched worldwide.

The **Eco**RCMP2 robot controller is a key module of the Smart Factory. An integrated interface makes the robot "cloud ready" and provides all relevant data to meet current and future demands in the Industry 4.0 environment.

Ecopaint Robot PAINTING STATIONS PAINTING STATIONS

» Exterior painting station Leading the market for years – with The System covers all aspects of efficiency, which TATA paintshop uses to support its customers in the production process so that unit costs are sustainable – while ensuring highest quality. The continuous development of all key technology serves as the basis for and makes us the international leading provider in application technology.

- Ecopaint Robot painting stations are designed for the automatic surface coating of automobile bodies and their small parts in series painting.
- Ecopaint Robots coat the entire range of interior and exterior areas and are suitable for ESTA, AIR and powder applications with all paint materials, including solvents, waterborne and powder paints. The paint and application robots from the Ecopaint Robot product family are based on the concept, systematically improving production efficiency and keep unit costs sustainable while ensuring highest quality.

- The system covers all aspects of efficiency and optimizes the production process, with respect to material and energy usage, assembly, start-up times and maintenance. The Ecopaint Robot improves the flexibility and profitability and guarantees highest quality in the entire painting process. Energy efficiency The sustainable use of energy is more relevant than ever today. Due to our improved drive technology, cooling and robot movement, up to 30 % of energy can be saved. Modular layouts Upgrade projects and new systems business show the advan tages of modular building concepts.

Ecopaint Robot –

HIGHEST FLEXIBILITY DURING PAINTING

Ecopaint Robot painting stations provide customer-specific solutions due to flexible modular designs:

» Modular robot arm concepts allow for flexible integration of the TATA paintshop paint dosing and color change systems: EcoPurge ICC, EcoPurge MCC and EcoPurge LCC

» Robots can be installed in either pedestal or rail-mounted designs

» Application robots for opening, holding and closing of doors and hoods

» TATA paintshop control concept to drive all robot variants with inte grated safety PLC, operating unit, PC and monitor Simulation capabilities are used to design the painting station including consideration for and optimization of process-specific parameters such as conveyor-type, spray booth characteristics and painting requirements.

With the aid of 3D models of the car bodies to be painted, the EcoScreen 3D OnSite software designs the paint path and spray patterns for the complete painting station. The robot control system transfers the data for the motion sequence and the painting. Teaching of the robot is only necessary when dealing with difficult parts for fine-tuning.

Controls, safety controls and power supplies for the robots are located at a user-friendly height in the control panels next to the booths.

The EcoScreen visualization and operator panel is located on the station control panel.

» EcoScreen 3D OnSite offline simulation

» Standard version of the robot with a EcoBell2 ICC rotation atomizer Two processes for the operation of Ecopaint Robot painting stations: In stop-and-go operations the car body is conveyed into the booth and held stationary while painting.

For tracking operations, the car body is conveyed at a constant speed through the spray booth for painting. Stop-and-go robots typically move on rails or travelling axes; tracking robots can be either pedestal-mounted (line tracking) or rail-mounted (rail tracking).

EcoRP HANDLING ROBOT RP HANDLING ROBOT

Opening, holding and closing during interior painting The Scara robots have been developed to assist with application tasks for interior door painting. This provides a greater process control with higher line speeds, as the painting robots do not have to take over the tasks of the handling robots. The modular construction of the hood and trunk openers is identical in construction to the painting robot and instead of the atomizer; each is equipped with panel opening tools. Areas of application: Stop-and-go and tracking operations. Description: This robot is used to open, hold and close engine and trunk hoods with gripper tools. This improves the flexibility by three degrees of movement in the opening process. Areas of application: Stop-and-go and tracking operations. Description: This door opener is constructed following the Scara Principle. The axes 1 and 2 are used for horizontal positioning and the Z axis is used for the vertical positioning. The gripper tool on the axis is usually in the form of a hook. Safe, reliable performance is achieved through sensors that register the various operating statuses, thus avoiding handling errors and collisions.

The door opener is placed on a travelling axis.

» Modular construction for easy service and maintenance

» Streamlined, easy-to-clean, slim yet robust construction

» Special opening tools for safe and repeatable processes

» Different arm lengths and spaces allow equipment to be adapted to customer-specific painting processes Technical data

» EcoRP E133 as hood opener

» Same drives and controllers are used for the door openers and painting robots

» Hood opener and painting robot identical in construction

EcoR Rail TRAVELLING AXES TRAVELLING AXES

Mobility for painting and application robots Robots can be moved parallel to the conveyor direction in the painting booth using EcoRail E and EcoRail C travelling axes. The travelling axis is a freely programmable horizontal axis of motion for robots.

With the Clean Wall solution, the travelling axis is integrated into the booth wall to save space. EcoRail E The possibility exists to install the EcoRail E travelling axis at different heights – according to the specific painting job. This ensures that painting and application robots are mounted at the optimum height.

The advantages are:

» Accessibility to all areas to be painted

» Interference- free view inside the booth

» Greater flexibility during painting jobs EcoRail C The EcoRail C travelling axis is installed low on the booth wall. The advantages are:

» Automatic mastering

» Explosion-protected version

» Reduced booth width

» Expansion of workspace for robots

» Capacity for 24 circulating colors, max. 36 random colors An optional EcoRail C cover strip has been designed for protection during assembly.

ROBOT AND PROCESS CONTROL

The EcoRPC is the control used for the Ecopaint robot system.

Benefits:

» Multikinematic / multiprocessor–capable with up to three movement / process units

» Integrated SPS system for simple adjustment and diagnosis of both process and automation functions

» Simple maintenance Modular switch cabinets Control, security control and voltage supply of TATA paintshop painting stations is supplied by modular switch cabinets.

The modular construction enables optimal configuration for respective application processes. The switch cabinets are differentiated according to the function: EcoRCMP (Robot Control Modular Panel): modular control cabinet for the steering of all Ecopaint robot variants. EcoSCMP (Station Control Modular Panel): station SPS control with integrated safety-related part and operating panel with a PC and an integrated monitor. EcoPSMP (Power Supply Modular Panel): input panel for up to 6 robots. Visualization The user interface and plant visualization system EcoScreen

serves an important function as go-between between man and paint shop. It is the task of EcoScreen, through operator guidance, to simplify the operation of the systems and to make the complex parameterization transparent for the user.

Benefits:

» Quick integration, installation and maintenance due to plug and socket connections

» Space saved due to compact construction

» The positioning of the booth can be followed independently and flexibly due to the closed design.

» Spare part stocking is reduced

» Service and maintenance work is easy, as the individual booths are built the same.

» All booths are pre-tested and thus secured of a high level of reliability.

» Lower energy use

» The booths are subject to permanent product maintenance by TATA paintshop and are documented with serial numbers » For the US market, a UL variant is available. (Underwriters Laboratories) » For the Japanese market, a TIIS-certified variant is available.

Pumps:

EcoPump

Pumps from TATA paintshop can be used in a wide variety of applications in many different industrial sectors – from liquid paints to highly viscous sealants, adhesives, and coating materials.

EcoPump HPE

The **Eco**Pump HPE is a horizontal piston pump with an electric drive unit to achieve superior performance with lower operating costs. Typically handled fluids include water- and solventborne paints, varnishes, enamels and lacquers.

- Electrical drive provides superior performance with lower operating costs
- Horizontal two-piston design guarantees equal thrust on both strokes
- Four-ball design
- Lubricant free

EcoPump HP

The **Eco**Pump HP is an air-driven horizontal piston pump. Typically handled fluids include water- and solventborne paints, varnishes, enamels and lacquers.

- Low ice change-over by thermal isolation of the muffler and optimized air flow
- Rapid pump change-over with quick release valve for reduced surge
- Modular pump design, easy to maintain

EcoPump VP

The **Eco**Pump VP is a pneumatically driven vertical piston pump for medium and high-pressure applications. Proven design and long term durability make these pumps a perfect choice for small and middle applications of paint, mastics and adhesives to furniture, steel structures or walls, car bodies and other objects.

- Wide range of accessories available
- Material supplying parts in stainless steel
- Suitable for airless and air assisted applications.

EcoPump AD

A wide choice of manufacturing materials for the pump housing makes the **Eco**Pump AD the best solution for different kinds of fluid handling such as abrasive and particle containing fluids. The typical field of application of the **Eco**Pump AD is to handle oil and water, viscos and waste liquids with and without solid particle debris, water- and solventborne paints, varnishes, enamels and lacquers, operating in circulation or direct fluid delivery.

- Selected chioce of materials for housing
- Easy maintenance and service
- Highly flushable
- Suitable for abrasive fluids and media containing solids.

PUMP PACKAGES

EcoPump VP Package

Standardized pump packages contain all components for an easy and safe paint application.

EcoPump VP-Package

- **Eco**Pump VP
- Application methods airless and airassist
- Air inlet modules – airless / airassist
- Paint supply options (suction hoses for barrels, direct suction pipe, 5 liter pot)
- Pressure release modules
- Transportation – Stand, trolley or bracket
- Filter HP – material filtration on output, pulsation elimination
- Other accessories:
  - Nozzle cleaner
  - Manual or automatic spray guns
  - Hoses - wide range of hoses for high-pressure applications.

PRESSURE POTS AND REGULATORS

Pressure Pot 10

The Pressure Pots have a volume range from 7,5 to 48 liters. They are suitable for all fluids and solvents supplying either manual or automatic spray guns.

- Suitable for paint shops
- Easy operation
- Simple and robust design

AGITATORS

Pneumatic agitators

Agitator A Fix R PR

It has been designed for preparation of paint before application or to prevent paint settling during spraying.

- Suitable for paint shops
- Different propellers available
- Revolution speed regulation
- Stainless steel shaft and propeller
- Easy operation

Sealing

Automated solutions for the application of highly viscous materials are dramatically increasing. TATA paintshop offers complete solutions for such applications which include qualified specialists, process safe solutions, and our own high quality products.

- Seam sealing
- Hem flange
- Underbody coating (UBC)
- Rocker panel coating (PVC and paint)
- LASD application
- Covering window flanges (PVC)
- Cavity wax application

For all requirements in sealing applications TATA paintshop offers the latest technologies and products:

- Sealing robots EcoRS
- Material supply EcoRAM
- Material Pumps EcoPump
- Temperature control EcoTemp and EcoHeat
- Dosing products EcoDose PCL and EcoDose SM

- Applicators EcoGun 1D, EcoGun2 3D and EcoGun MD
- Sealing nozzles EcoJet
- Nozzle cleaner EcoGun Cleaner

Ecoscreen(HMI)

- Control units
- Control equipment, plant visualization system
- Movement and process controls
- Reliability and maintainability of software
- Offline 3D robot programing
- Cables

Control, security control and voltage supply of TATA paintshop painting stations is supplied by modular switch cabinets. The modular construction enables optimal configuration for respective application processes.

The control systems from TATA paintshop stand for maximum customer utility and set the standard worldwide.

High-Speed Rotating Atomizer EcoBell2 SL/EcoBell2 SL M for External Charging.

EcoBell2 SL - External Charging with New Performance Painting Results The EcoBell2 SL (Straight Line) high-speed rotating atomizer is

MANUAL PAINTING STATION - DUAL EFFICIENT

EcoMACC Reflow Station

It is a manually operated painting station with automatic color change technique. It convinces through high efficiency in paint recovery
(> 80 %).

- 1 booth integrated cabinet housing
- 1 double color changer with paint pressure controller and paint pressure control
- 2 gun cleaning devices
- 2 hand sprayguns
- 2 pigging stations per paint spraying hose
- 2 dosing pumps, purgeable 6cm3/rev.

The **Eco**MACC Reflow was designed for AIR applications in automobile painting installations and can be used for all manual painting processes in the inside and outside area of car bodies.

This is valid for all paint materials usual in the automotive industry, such as solventborne paint materials and waterborne paint materials.

EcoDose 2K

The **Eco**Dose 2K is an electronic dosing system suitable for high and low pressure applications. It can be used in manual and automatic processes.

SPRAY GUNS:

The manual and automatic spray guns have a large range of possible uses – water- or solventborne paints, as well as adhesives, glazes and other materials.

Manual spray guns for air spray, airless and air assisted spraying

EcoGun MAN:

- Complete line of spray guns for professional applications in automotive, auto refinishing, wood processing and general industry and many other applications

Automatic spray guns for air spray, airless and air assisted spraying

EcoGun AUTO:

- Automatic spray guns for automated application of paints, glues, glazes enamels, UV lacquers and many other materials
- Air spray or high-pressure airless and air assisted spray applications
- Special spray guns for glues and cooling water
- Air regulation via internal valves or remote control
- Spray guns for robotic applications

COLOR CHANGING AND PURGING EQUIPMENT

Color changing and purging equipment - flexible, fast and efficient

In the automatic painting installations of automotive manufacturers and subcontractors, the paints must be provided flexibly in the color desired by the customer. Manufacturer expect short color change times and minimal paint losses.

EcoLCC2 - the benchmark in efficient color changing

- Short color change times (<10 seconds)
- Lowest paint losses (ca. 10 ml)
- No common paint channel anymore
- Color mixing is prevented by design
- Usable with basic technology and high performance
- Suitable for all paint and charging systems in the exterior and interior painting
- The color changer along with the EcoPump9 dosing pump have both ample space on the robot's second arm (Yet the robot arm remains flat and can access all areas of the car body interior)
- Low complexity of the system
- Permanently low servicing and maintenance costs

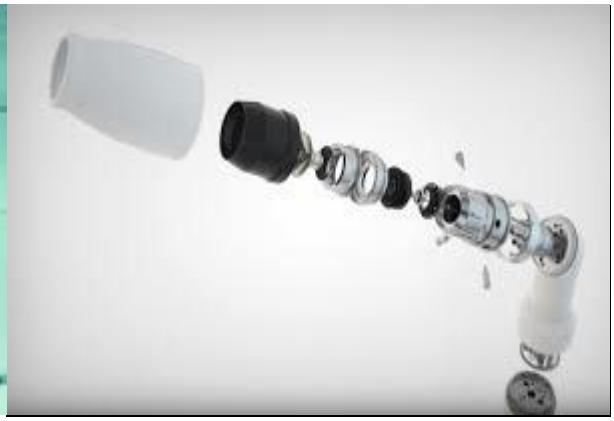
EcoMCC3 20 - the economical solution for color changes in atomizer color supply

- Flexible upgrades through modular design
- Compact design allows easy accessibility
- Special TATA paintshop insertion nipple for connecting color hoses allow component exchanges without hose cutting
- Pneumatic hose connections without screw joints
- Paint circulation directly up to the needle seat
- Tested according to TATA paintshop quality standards
- Purging time reduced by up to 14% through optimized purging programs

EcoMCC 200 - for airless or air-mix varnishing of waterborne and solventborne paint

- Standard offer includes up to 10 valves
- Material pressure up to 200 bar
- Carbide valve seat and needle for longer downtime periods
- Minimal flushing due to reduction of dead space
- Second chamber for plasticizers

Faster valve change during maintenance



HIGH VOLTAGE SYSTEMS

EcoHT3

The **Eco**HT3 High Voltage Supply System produces and monitors the high-voltage for TATA paintshop's electrostatic application systems.

- Only one controller for all generator types
- Automatic recognition of the connected generator
- Maximum application flexibility thanks to mixed operation
- Flexible installation thanks to high protection class and ATEX permit
- Reduction in error-prone, directly wired interfaces through fieldbus connection

DOSING AND REGULATING EQUIPMENT

EcoPump9 - Gear Wheel Pump

The **Eco**Pump9 is a highly efficient gearwheel pump for 1K and 2K dosing of water- and solventborne paint.

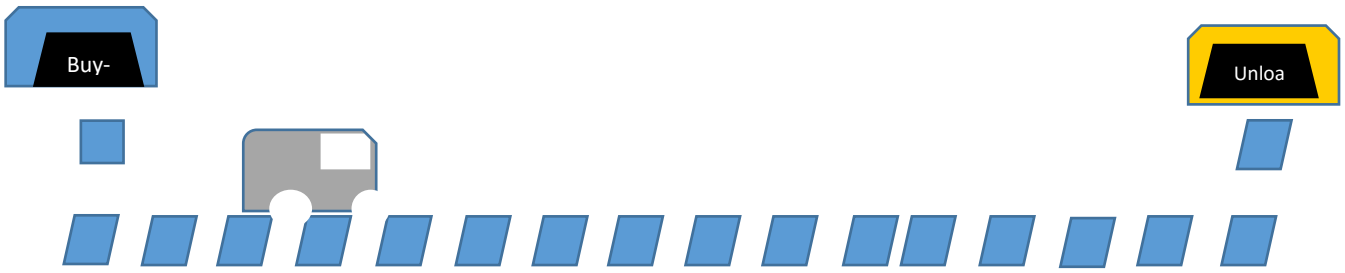
- Extended work envelope (> 30 %) by increasing the max. permissible speed
- Reduced dead volume of components helping to reduce paint loss (> 30 %)
- Reduction in color change time (10 %)
- Elimination of regular, manual gaging
  (≈ 18 h/pump/a)
- Reduction in flushing time (10%) and flushing agent consumption (> 30 %)
- Increase in service life thanks to improved wear resistance (> 50 %)
- Consistently high metering accuracy through automatic pressure adjustment
- Key functional parts made of stainless steel
- Maintenance-free to a large extent
- Compact metering pump design with integrated paint pressure regulator, weight and size-optimized for robot applications
- Easy installation thanks to simple, modular design with reduced number of components

Chapter-6 Problem Statement

Whenever there was a breakdown in the Ethernet communication amongst the Control Desks, there was no transfer of data. For this, an individual has to look into it personally without any clue where the fault in the communication was.

The affected area :

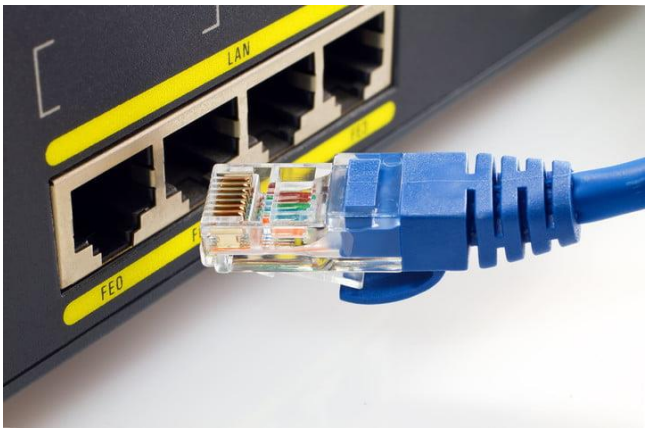
- The area which was assigned to us was the floor connecting the BIW shop Buy Off Station to that of the Unloading Station of the Paintshop.
- It comprised of total 26 Control Desks which are connected to a single main panel.
- Their main function is check the proper transfer of the body from BIW Buy Off to Unloading Station of Painshop.



Chapter-7 Objective

- Our **objective** is to detect if there is any fault or no feedback from the Control Desk(CD) of the Ethernet connections for a comprised area or processes and if present we will be notified about it immediately with the help of the SCADA interface indicating with the change in the appearance of the respective connection(s).

Chapter-8 Ethernet Communication



Ethernet is the most widely installed local area network (LAN) technology. Ethernet is a *link layer* protocol in the TCP/IP stack, describing how networked devices can format data for transmission to other network devices on the same network segment, and how to put that data out on the network connection.

It touches both Layer 1 (the physical layer) and Layer 2 (the data link layer) on the OSI network protocol model. Ethernet defines two units of transmission, packet and frame.

The frame includes not just the "payload" of data being transmitted but also addressing information identifying the physical "Media Access Control" (MAC) addresses of both sender and receiver, VLAN tagging and quality of serviceinformation, and error-correction information to detect problems in transmission.

Each frame is wrapped in a packet, which affixes several bytes of information used in establishing the connection and marking where the frame starts.

Control Desks and Panels:

Industrial control panels covered by UL product category NITW (Industrial Control Panels) are factory-wired assemblies of industrial control equipment, such as motor controllers, switches, relays and auxiliary devices. The panels may include disconnect means andmotor branch-circuit **protective** devices.

Chapter-9 Topology

The CDs are inter-connected with the Ethernet cables connecting from link-1 from one to link-2 of another. Following is the topology chart from the BIW shop to Paintshop linking the CDs with same configurations.

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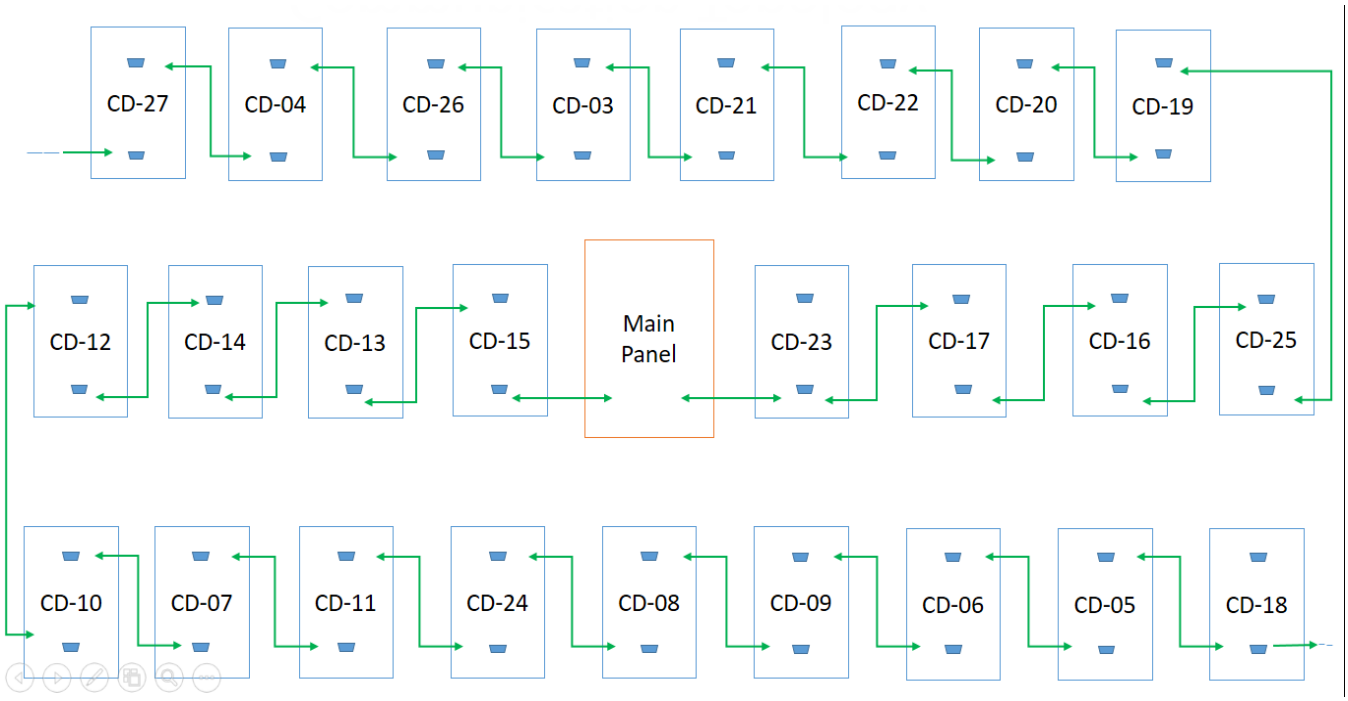


Chapter-10 PLC Programming

Programming Languages

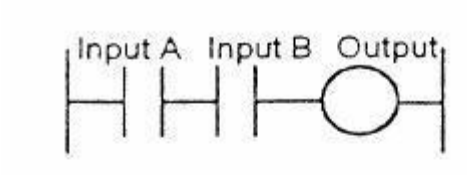
A program loaded into PLC systems in machine code, a sequence of binary code numbers to represent the program instructions.
Assembly language based on the use of mnemonics can be used, and a computer program called an assembler is used to translate the mnemonics into machine code.
High level Languages (C, BASIC, etc.) can be used.

Programming Devices
PLC can be reprogrammed through an appropriate programming device:
- Programming Console
- PC
- Hand Programmer

Introduction to Ladder Logic
Ladder logic uses graphic symbols similar to relay schematic circuit diagrams. Ladder diagram consists of two vertical lines representing the power rails. Circuits are connected as horizontal lines between these two verticals.

Ladder diagram features

- Power flows from left to right.
- Output on right side can not be connected directly with left side.
- Contact can not be placed on the right of output.
- Each rung contains one output at least.
- Each output can be used only once in the program.
- A particular input a/o output can appear in more than one rung of a ladder.
- The inputs a/o outputs are all identified by their addresses, the notation used depending on the PLC manufacturer.



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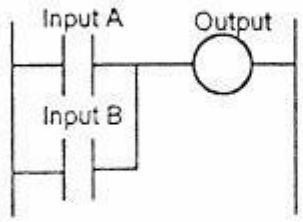

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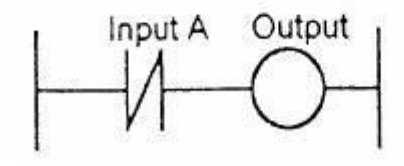
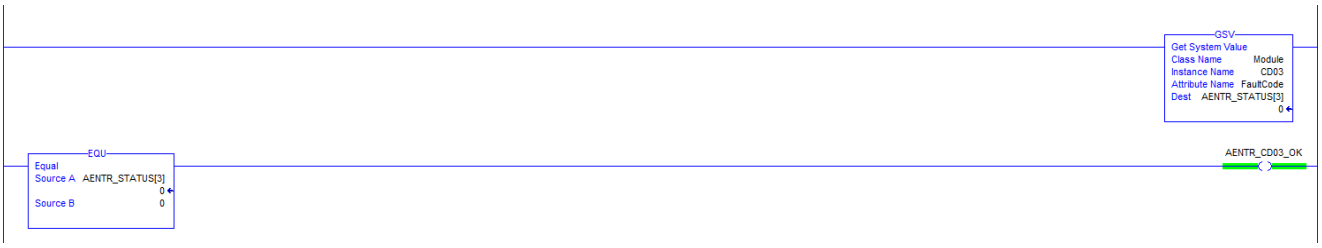


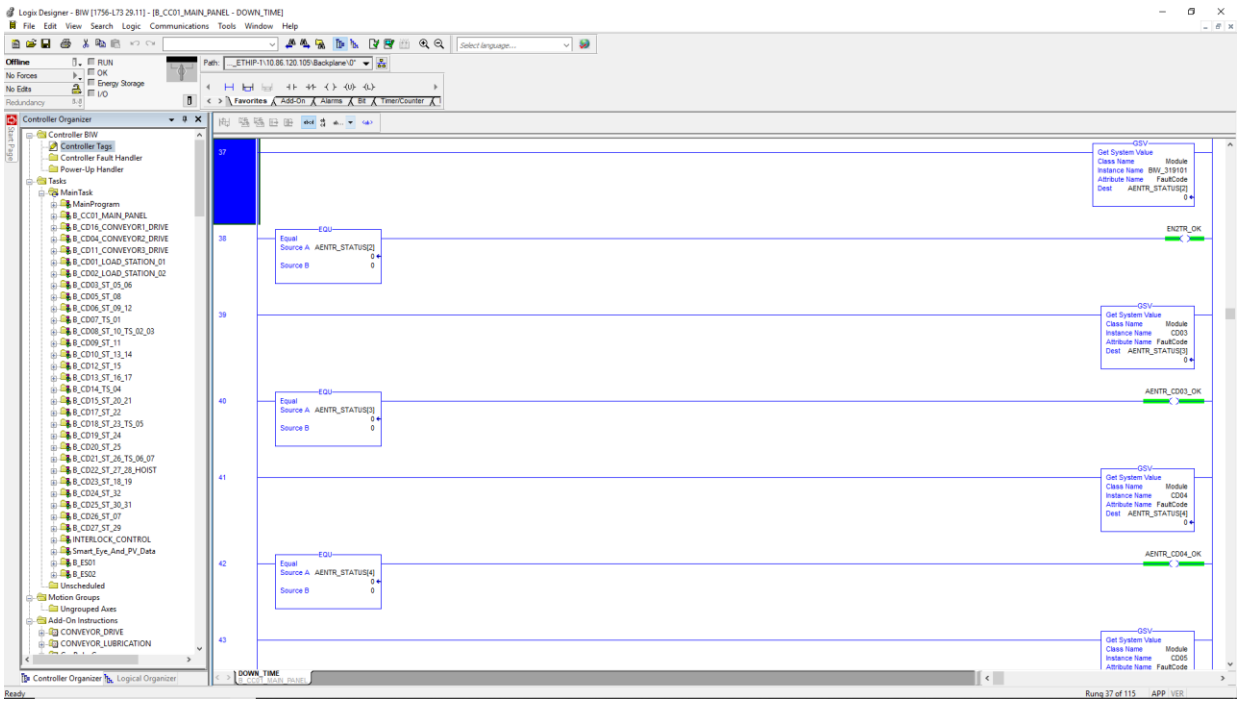
NOT

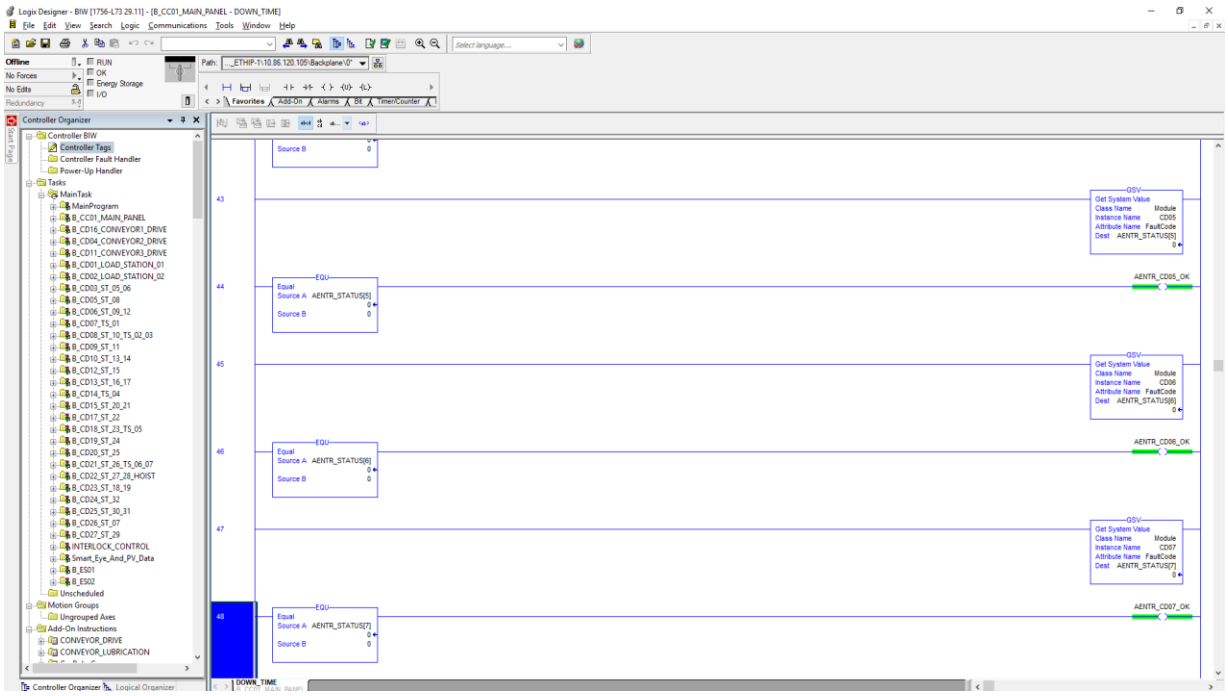
Introduction to Statement list

Statement list is a programming language using mnemonic abbreviations of Boolean logic operations. Boolean operations work on combination
of variables that are true or false.
A statement is an instruction or directive for the PLC.

- The fault (if any) will be taken from a respective module and is then fed into a variable namely AENTR_STATUS[].
- For example: In the GSV; Class name: Module; Instance name: CD03(Name of the Control Desk); Attribute Name: FaultCode; Dest: AENTR_STATUS[3](Variable Name)
- This value is then compared with zero value and if equal another variable AENTR_OK is true and if not it is fed false.



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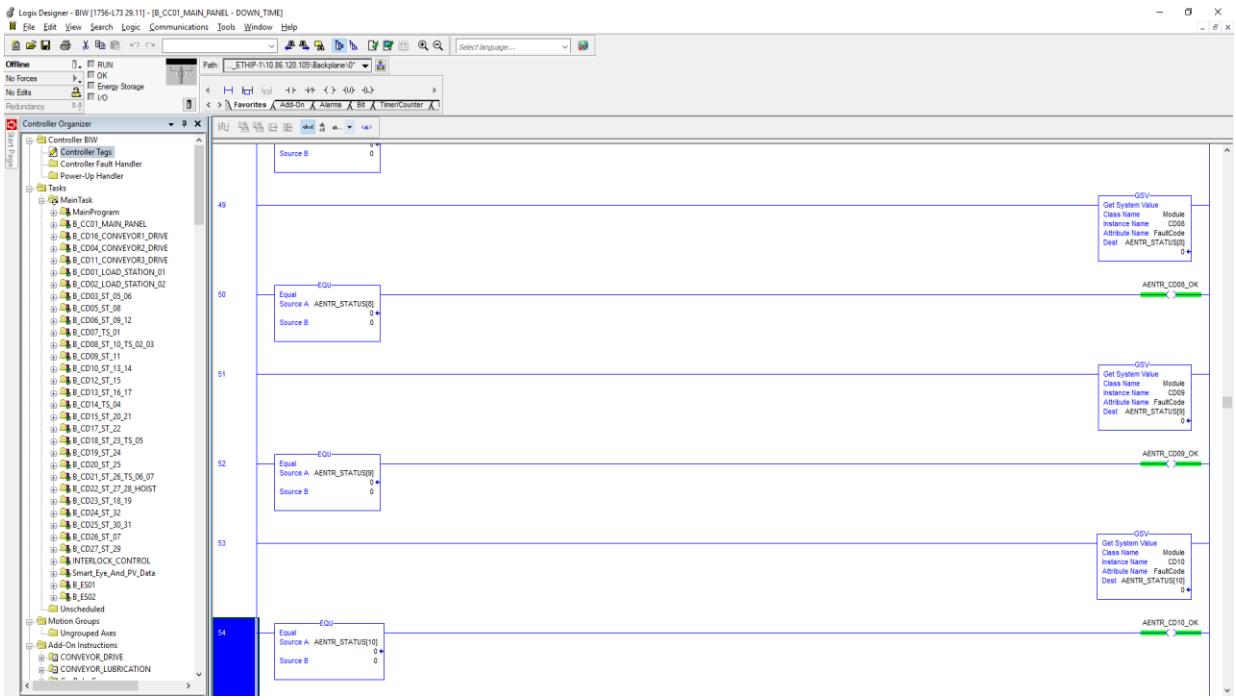
Controller Organizer
Controller BIW
Controller Tags
Controller Fault Handler
Power-Up Handler
Tasks
MainTask
MainProgram
B_CC01_MAIN_PANEL
B_CD16_CONVEYOR1_DRIVE
B_CD04_CONVEYOR2_DRIVE
B_CD11_CONVEYOR3_DRIVE
B_CD01_LOAD_STATION_01
B_CD02_LOAD_STATION_02
B_CD03_ST_05_06
B_CD05_ST_08
B_CD06_ST_09_12
B_CD07_TS_01
B_CD08_ST_10_TS_02_03
B_CD09_ST_11
B_CD10_ST_13_14
B_CD12_ST_15
B_CD13_ST_16_17
B_CD14_TS_04
B_CD15_ST_20_21
B_CD17_ST_22
B_CD18_ST_23_TS_05
B_CD19_ST_24
B_CD20_ST_25
B_CD21_ST_26_TS_06_07
B_CD22_ST_27_28_HOIST
B_CD23_ST_18_19
B_CD24_ST_32
B_CD25_ST_30_31
B_CD26_ST_07
B_CD27_ST_29
INTERLOCK_CONTROL
Smart_Eye_And_PV_Data
B_ES01
B_ES02
Unscheduled
Motion Groups
Ungrouped Axes
Add-On Instructions
CONVEYOR_DRIVE
CONVEYOR_LUBRICATION
GSV
Get System Value
Class Name Module
Instance Name CD05
Attribute Name FaultCode
Dest AENTR_STATUS[5]
EQU
Equal
Source A AENTR_STATUS[5]
Source B
AENTR_CD05_OK
Get System Value
Class Name Module
Instance Name CD06
Attribute Name FaultCode
Dest AENTR_STATUS[6]
Equal
Source A AENTR_STATUS[6]
Source B
AENTR_CD06_OK
Get System Value
Class Name Module
Instance Name CD07
Attribute Name FaultCode
Dest AENTR_STATUS[7]
Equal
Source A AENTR_STATUS[7]
Source B
AENTR_CD07_OK
DOWN_TIME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B_CD05_ST_08
B_CD06_ST_09_12
B_CD07_TS_01
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B_CD09_ST_11
B_CD10_ST_13_14
B_CD12_ST_15
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B_CD18_ST_23_TS_05
B_CD19_ST_24
B_CD20_ST_25
B_CD21_ST_26_TS_06_07
B_CD22_ST_27_28_HOIST
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B_CD26_ST_07
B_CD27_ST_29
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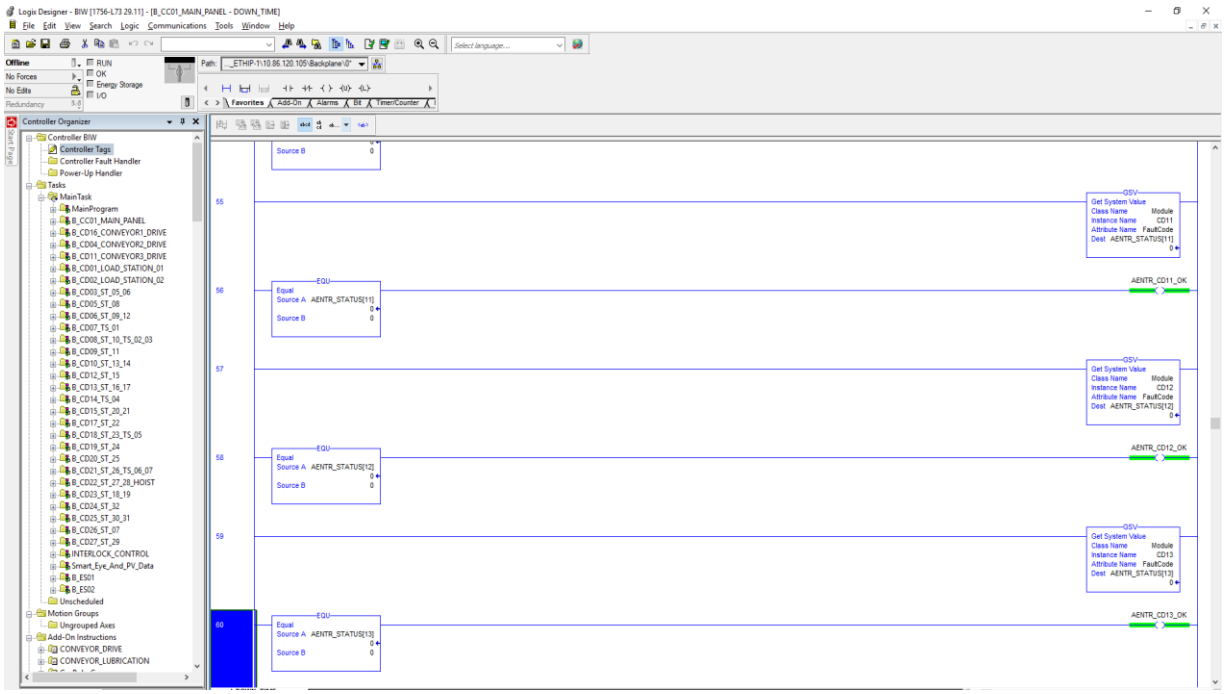
B_ES01
B_ES02
Unscheduled
Motion Groups
Ungrouped Axes
Add-On Instructions
CONVEYOR_DRIVE
CONVEYOR_LUBRICATION
GSV
Get System Value
Class Name Module
Instance Name CD08
Attribute Name FaultCode
Dest AENTR_STATUS[8]
EQU
Equal
Source A AENTR_STATUS[8]
Source B
AENTR_CD08_OK
Get System Value
Class Name Module
Instance Name CD09
Attribute Name FaultCode
Dest AENTR_STATUS[9]
Equal
Source A AENTR_STATUS[9]
Source B
AENTR_CD09_OK
Get System Value
Class Name Module
Instance Name CD10
Attribute Name FaultCode
Dest AENTR_STATUS[10]
Equal
Source A AENTR_STATUS[10]
Source B
AENTR_CD10_OK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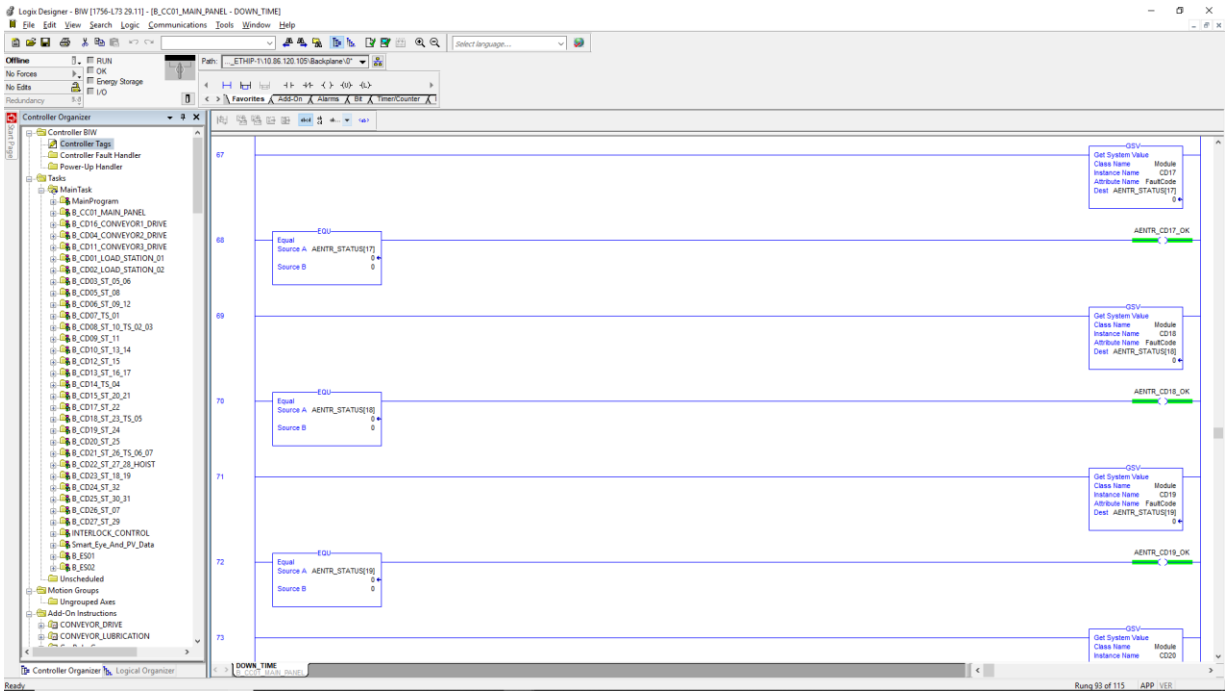
B_ES01
B_ES02
Unscheduled
Motion Groups
Ungrouped Axes
Add-On Instructions
CONVEYOR_DRIVE
CONVEYOR_LUBRICATION
Source B
55
GSV
Get System Value
Class Name Module
Instance Name CD11
Attribute Name FaultCode
Dest AENTR_STATUS[11]
56
EQU
Equal
Source A AENTR_STATUS[11]
Source B
AENTR_CD11_OK
57
GSV
Get System Value
Class Name Module
Instance Name CD12
Attribute Name FaultCode
Dest AENTR_STATUS[12]
58
EQU
Equal
Source A AENTR_STATUS[12]
Source B
AENTR_CD12_OK
59
GSV
Get System Value
Class Name Module
Instance Name CD13
Attribute Name FaultCode
Dest AENTR_STATUS[13]
60
EQU
Equal
Source A AENTR_STATUS[13]
Source B
AENTR_CD13_OK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B_CD27_ST_29
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Smart_Eye_And_PV_Data
B_ES01
B_ES02
Unscheduled
Motion Groups
Ungrouped Axes
Add-On Instructions
CONVEYOR_DRIVE
CONVEYOR_LUBRICATION
67
GSV
Get System Value
Class Name Module
Instance Name CD17
Attribute Name FaultCode
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68
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Equal
Source A AENTR_STATUS[17]
Source B
AENTR_CD17_OK
69
GSV
Get System Value
Class Name Module
Instance Name CD18
Attribute Name FaultCode
Dest AENTR_STATUS[18]
70
EQU
Equal
Source A AENTR_STATUS[18]
Source B
AENTR_CD18_OK
71
GSV
Get System Value
Class Name Module
Instance Name CD19
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72
EQU
Equal
Source A AENTR_STATUS[19]
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73
GSV
Get System Value
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Instance Name CD20
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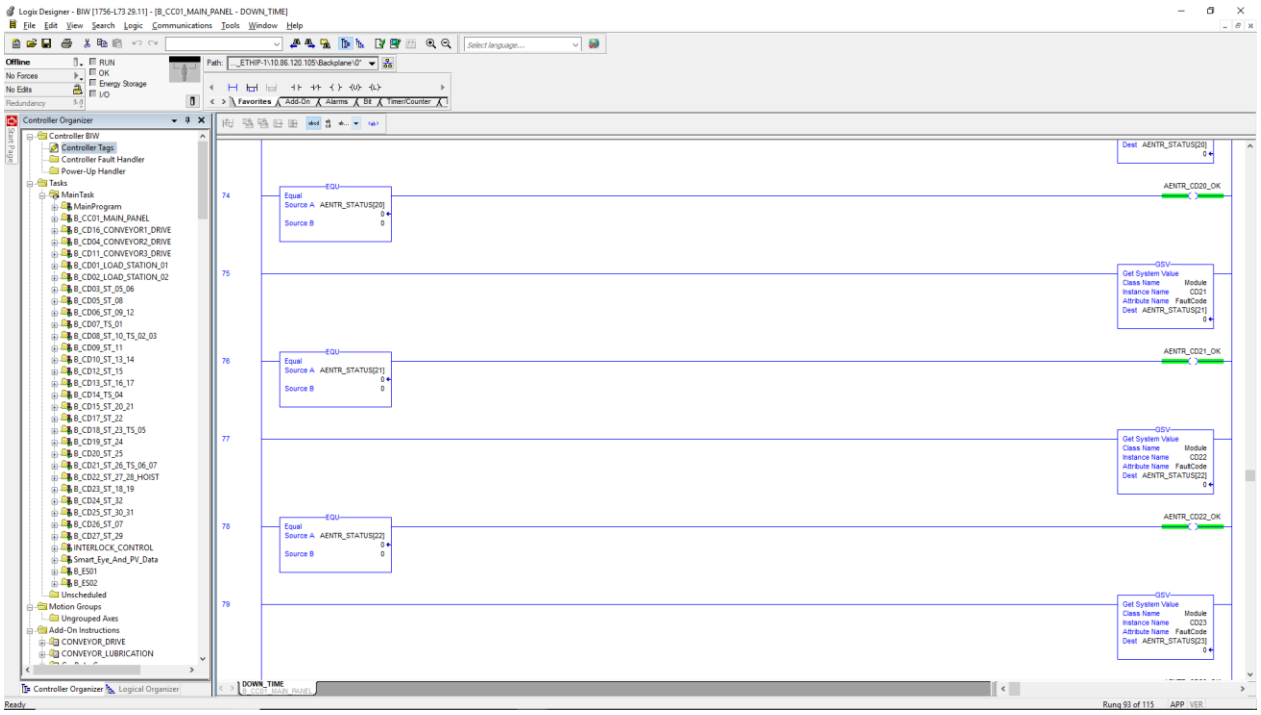
Rung 93 of 115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Ungrouped Axes
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CONVEYOR_LUBRICATION
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Get System Value
Class Name Module
Instance Name CD22
Attribute Name FaultCode
Dest AENTR_STATUS[22]
AENTR_CD22_OK
Source A AENTR_STATUS[22]
Get System Value
Class Name Module
Instance Name CD23
Attribute Name FaultCode
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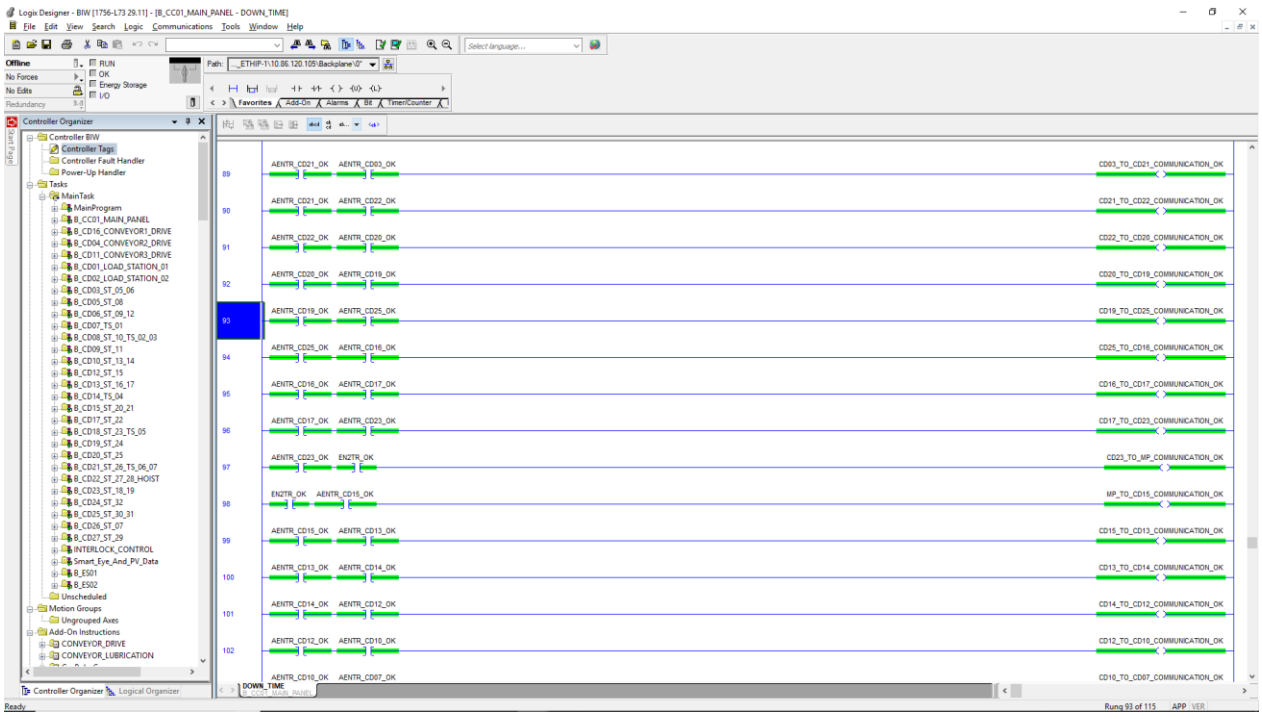
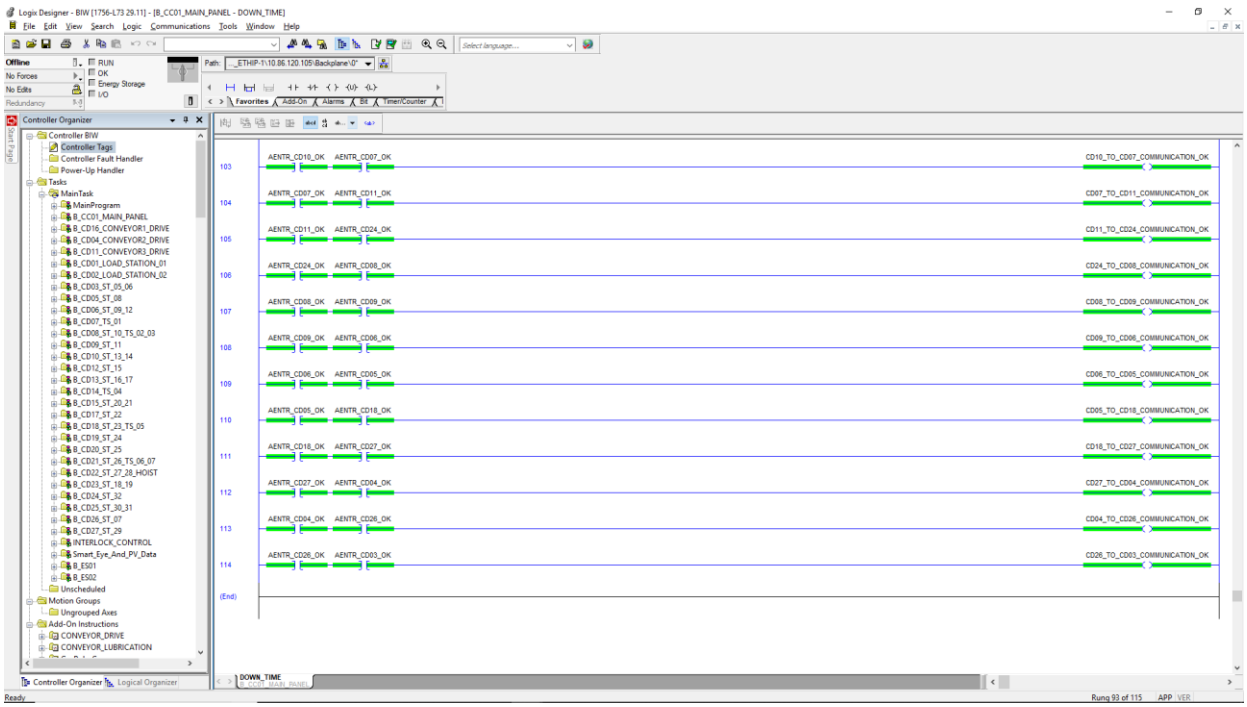
DOWN_TIME
Ready
Rung 93 of 115


Logix Designer - BIW [1756-L73 29.11] - [B_CC01_MAIN_PANEL - DOWN_TIME]
AENTR_CD21_OK AENTR_CD03_OK CD03_TO_CD21_COMMUNICATION_OK
AENTR_CD21_OK AENTR_CD22_OK CD21_TO_CD22_COMMUNICATION_OK
AENTR_CD22_OK AENTR_CD20_OK CD22_TO_CD20_COMMUNICATION_OK
AENTR_CD20_OK AENTR_CD19_OK CD20_TO_CD19_COMMUNICATION_OK
AENTR_CD19_OK AENTR_CD25_OK CD19_TO_CD25_COMMUNICATION_OK
AENTR_CD25_OK AENTR_CD16_OK CD25_TO_CD16_COMMUNICATION_OK
AENTR_CD16_OK AENTR_CD17_OK CD16_TO_CD17_COMMUNICATION_OK
AENTR_CD17_OK AENTR_CD23_OK CD17_TO_CD23_COMMUNICATION_OK
AENTR_CD23_OK EN2TR_OK CD23_TO_MP_COMMUNICATION_OK
EN2TR_OK AENTR_CD15_OK MP_TO_CD15_COMMUNICATION_OK
AENTR_CD15_OK AENTR_CD13_OK CD15_TO_CD13_COMMUNICATION_OK
AENTR_CD13_OK AENTR_CD14_OK CD13_TO_CD14_COMMUNICATION_OK
AENTR_CD14_OK AENTR_CD12_OK CD14_TO_CD12_COMMUNICATION_OK
AENTR_CD12_OK AENTR_CD10_OK CD12_TO_CD10_COMMUNICATION_OK
AENTR_CD10_OK AENTR_CD07_OK CD10_TO_CD07_COMMUNICATION_OK
DOWN_TIME
Ready
Rung 93 of 115

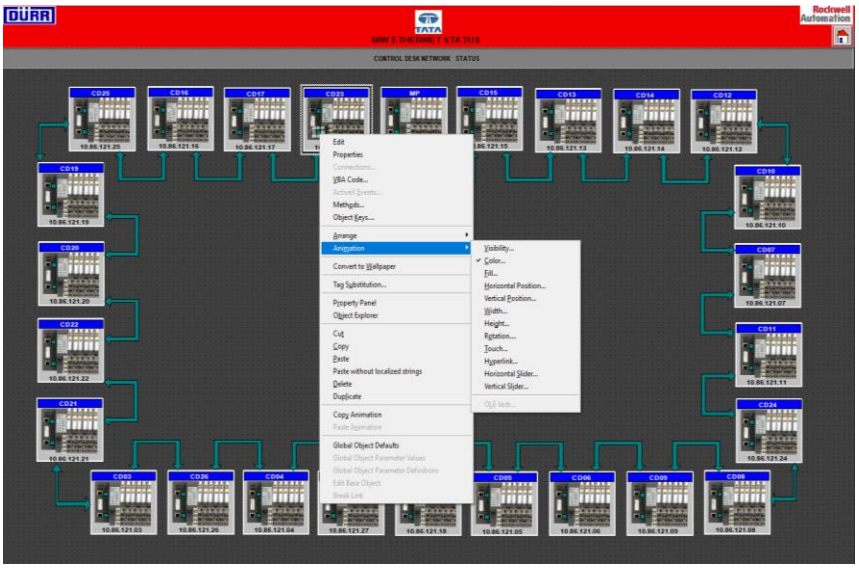

Logix Designer - BIW [1756-L73 29.11] - [B_CC01_MAIN_PANEL - DOWN_TIME]
File Edit View Search Logic Communications Tools Window Help
Offline
No Forces
No Edits
Redundancy
RUN
OK
Energy Storage
I/O
Controller Organizer
Controller BIW
Controller Tags
Controller Fault Handler
Power-Up Handler
Tasks
MainTask
MainProgram
B_CC01_MAIN_PANEL
B_CD16_CONVEYOR1_DRIVE
B_CD04_CONVEYOR2_DRIVE
B_CD11_CONVEYOR3_DRIVE
B_CD01_LOAD_STATION_01
B_CD02_LOAD_STATION_02
B_CD03_ST_05_06
B_CD05_ST_08
B_CD06_ST_09_12
B_CD07_TS_01
B_CD08_ST_10_TS_02_03
B_CD09_ST_11
B_CD10_ST_13_14
B_CD12_ST_15
B_CD13_ST_16_17
B_CD14_TS_04
B_CD15_ST_20_21
B_CD17_ST_22
B_CD18_ST_23_TS_05
B_CD19_ST_24
B_CD20_ST_25
B_CD21_ST_26_TS_06_07
B_CD22_ST_27_28_HOIST
B_CD23_ST_18_19
B_CD24_ST_32
B_CD25_ST_30_31
B_CD26_ST_07
B_CD27_ST_29
INTERLOCK_CONTROL
Smart_Eye_And_PV_Data
B_ES01
B_ES02
Unscheduled
Motion Groups
Ungrouped Axes
Add-On Instructions
CONVEYOR_DRIVE
CONVEYOR_LUBRICATION
Favorites
Add-On
Alarms
Bit
Timer/Counter
103 AENTR_CD10_OK AENTR_CD07_OK CD10_TO_CD07_COMMUNICATION_OK
104 AENTR_CD07_OK AENTR_CD11_OK CD07_TO_CD11_COMMUNICATION_OK
105 AENTR_CD11_OK AENTR_CD24_OK CD11_TO_CD24_COMMUNICATION_OK
106 AENTR_CD24_OK AENTR_CD08_OK CD24_TO_CD08_COMMUNICATION_OK
107 AENTR_CD08_OK AENTR_CD09_OK CD08_TO_CD09_COMMUNICATION_OK
108 AENTR_CD09_OK AENTR_CD06_OK CD09_TO_CD06_COMMUNICATION_OK
109 AENTR_CD06_OK AENTR_CD05_OK CD06_TO_CD05_COMMUNICATION_OK
110 AENTR_CD05_OK AENTR_CD18_OK CD05_TO_CD18_COMMUNICATION_OK
111 AENTR_CD18_OK AENTR_CD27_OK CD18_TO_CD27_COMMUNICATION_OK
112 AENTR_CD27_OK AENTR_CD04_OK CD27_TO_CD04_COMMUNICATION_OK
113 AENTR_CD04_OK AENTR_CD26_OK CD04_TO_CD26_COMMUNICATION_OK
114 AENTR_CD26_OK AENTR_CD03_OK CD26_TO_CD03_COMMUNICATION_OK
(End)
DOWN_TIME
Controller Organizer
Logical Organizer
Ready
Rung 93 of 115
APP VER

Chapter-11 SCADA

- Following the ladder programming, the SCADA screen is to be designed and the program to be imported into it.
- First, the CDs are designed or imported from the respective file in the system.
- The CDs are to be installed with tags for the respective CD (tags to the links in it) in the actual field of the plant.

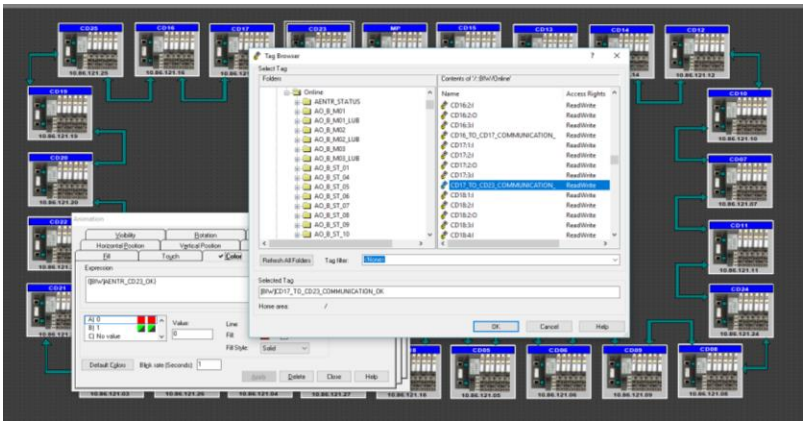
Insertion of TAGS

- The tags are then animated with colour codes for the fault and error detection.
- We want the boxes designated to Link 1 and Link 2 to indicate whether there is a fault or not. Thus, we will import an animation into it.
- In the animation segment, color option is selected.



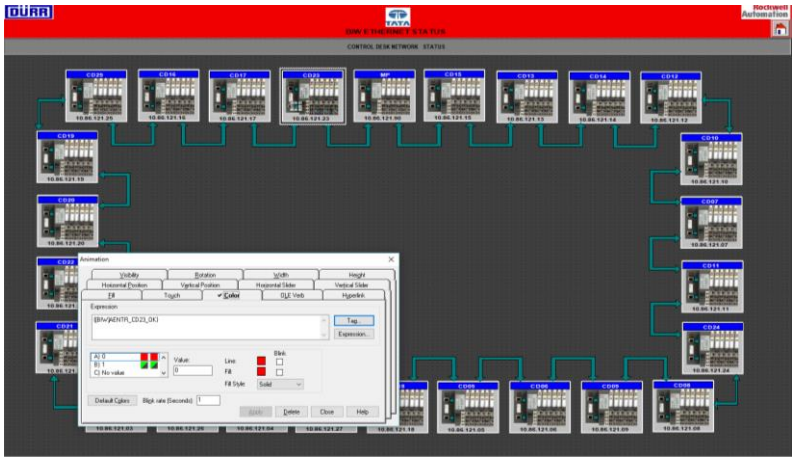
- Then, a tag for the respective CD is imported into it.

- For example, from the folders BIW/Online is selected and respective CD tag is selected.

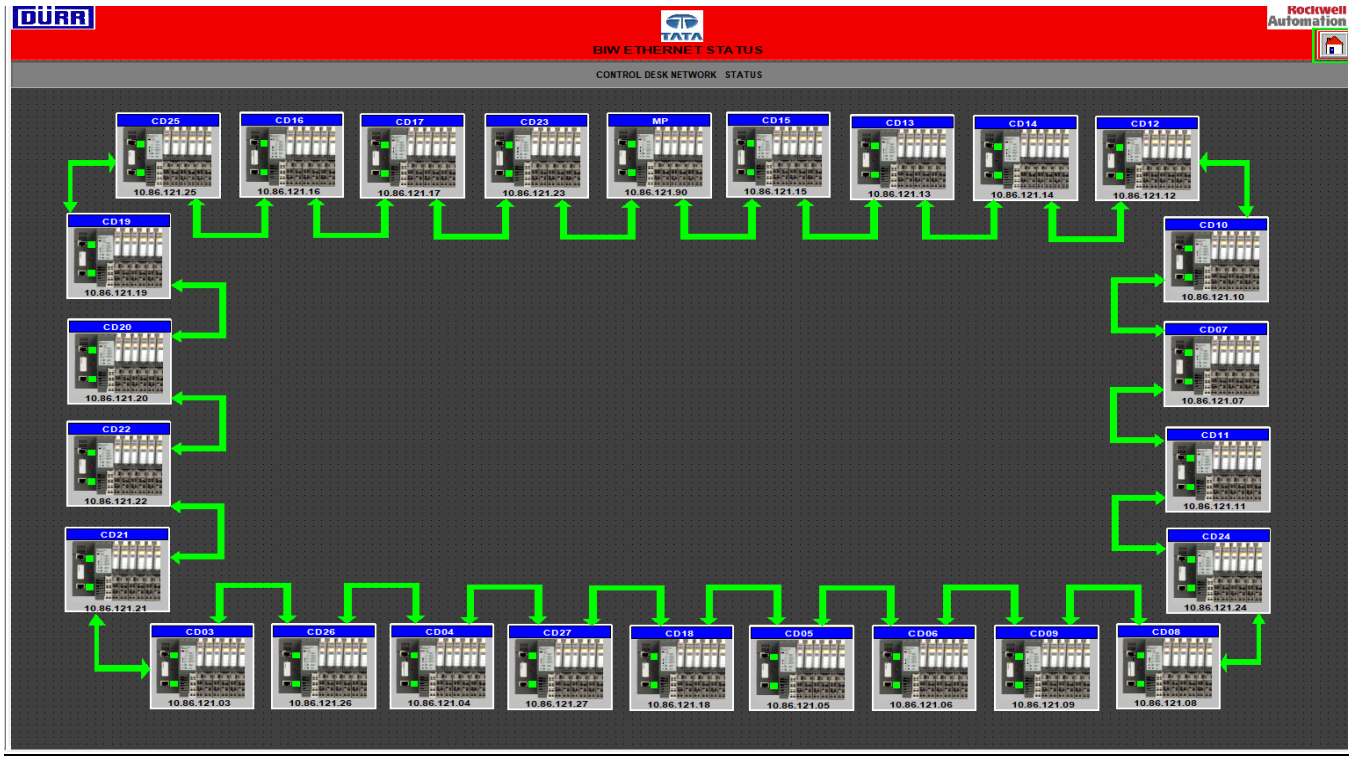


- Following that, the tag is animated, i.e. when there is connection in link 1 and link 2 and every thing is ok, the connection shows green.

- But, when there is some fault in the connection (such as the cable unplugs), the connection shown turns red and the fault can be rectified.



THE FINAL LAYOUT



Chapter 12- Conclusion

Now, whenever there will be a fault in the communication a red light will be shown in the SCADA and then the person sitting in the control room will alert the engineer to the exact location of miscommunication and rectify the error.

This thus, saves time and load for all the personnel.

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6. http://www.TATA paintshop-paint.com/fileadmin/user_upload/pfs/02_documents/02_Products/04_PT_ED/Ecopaint_Wetsystem_en.pdf
7. http://www.TATA paintshop-paint.com/fileadmin/user_upload/pfs/02_documents/02_Products/10_Conveyors/Conveyor_Systems_by_Duerr.pdf
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