

# AUTOMATIC LOAD CLASSIFICATION FOR SUSPENSION SPRING, MONITORING AND DATA STORAGE SYSTEM USING PLC, ENCODER AND SCADA

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**Abstract** - In automobile ancillary units the testing of the components is very vital, to ensure the quality and to meet their customer specification. To enhance the timely delivery, we can automate the testing process. The 'AUTOMATIC LOAD CLASSIFICATION FOR SUSPENSION SPRING, MONITORING AND DATA STORAGE SYSTEM' by the help of Supervisory Control and Data Acquisition (SCADA) and Human Machine Interface (HMI). The proposed system can effectively supervise the load classification (Spring rate, load at displacement, or displacement at load are important measurements). The data received by the Programmable Logic Controller (PLC) is used to take the required decisions and also with the help of Linear scale, Load cell.

**Key Words:** Coil springs, Automatic load classification machine, PLC, SCADA, HMI, Load Cell

## 1. INTRODUCTION

Automation is used for all control systems and the technologies in PLC (Programmable Logic Controller) is used to reduce the human work and helps in increasing the production. PLC plays an important role in the world of automation industry. It acts as a major function in the automation field which tends to reduce the complexity, increases safety and cost efficient. In this project, the automation of testing in load classification for suspension springs and automatic data storage. Automation is done using PLC, SCADA, HMI, LINEAR SCALE, LOAD CELL. By this automation we can also achieve the reduced manufacturing cycle time. An engineer is always focused towards challenges of bringing ideas and concepts to life. Therefore, sophisticated machines and modern techniques have been constantly developed and implemented for economical manufacturing of products. At the same time, we should take care that there has been no compromise made with quality and accuracy. Springs isolates the drivers from road imperfections by allowing the tire to move over a bump without drastically disturbing the chassis. If the chassis remains fairly steady, then tire are better able to follow road contours automatically.

## 1.1 EXISTING SYSTEM

In the existing system load classification for suspension springs done by manual methods. The machine is designed for testing Tension and Compression springs. The machine is supplied complete with contraption for holding tension springs and a pair of compression platens for holding compression springs. The load classification process in the machine is full and full done in a manual process. In this process the worker has to apply in manual force and based on the compressions of the springs the corresponding load displacement values are displayed in the analog meter and it will be noted by the worker so in this case more manual force is needed from the worker side and perfect eye vision is needed for noting down the corresponding load values shown in the analog meter. And the values are noted in written format and based the load values noted calculations are made and classifications are made manually and it is manually painted with respective classifications for identifications. Every processing in this system is fully carried out with the help of the worker.

### Disadvantage:

In the existing system, every step requires human effort, so this system is not so efficient in timely production process.

- Performance is low,
- Low speed system architecture,
- Production cycle time is more,
- Complicated working system,
- Lack of more safety purpose,
- Lack of accurate measurements,
- More man power is needed,
- Chances of Human errors,
- Chances of causing errors during manual calculations.
- Report generation is not an easy task
- Requires manual data storage reports (written format)

### 1.2 PROPOSED SYSTEM

In the proposed system, **Automatic load classification for suspension spring, monitoring and data storage system.** Automation is done using PLC, SCADA, HMI, LINEAR SCALE, LOAD CELL. Coil Spring Testing Machine has load cell for measuring load and the rotary encoder is used for displacement purpose. It is designed and developed by using advanced technology under the guidance of our expert professionals. Apart from this, these machines are checked by our quality experts in order to ensure their durability, high quality, reduced production cycle time and safety measures.

#### Advantage:

- Efficient performance,
- Reduced production cycle time,
- High speed system architecture,
- Longer service life, work friendly system,
- Safety purpose are improved,
- Robust designs,
- Minimum maintenance,
- Accurate measurement,
- Human error is avoided to record the data,
- Automatic data storage.
- Easy report generation in 'Excel Format'
- Find fault alarm and remedy system,
- avoid manual calculation,
- set parameter recipe storage system for change the parameter product to product.

### 2. LITERATURE SURVEY

This literature survey is about Coil Suspension Spring testing method which is used in the suspension spring manufacturing industries. It is main testing process carried out in the spring manufacturing industry. The machine is designed for testing Tension and Compression springs. Spring rate, load at displacement, or displacement at load are important measurements. (EXPERIMENTAL INVESTIGATION OF SUSPENSION SPRING) Vidya S. Visave *Research Scholar, Late G.N. Sapkal COE, Nashik, Maharashtra, India.* J.R. Mahajan *Assistant Professor, Late G.N. Sapkal COE, Nashik, Maharashtra, India.*

A spring stiffness testing machine was produced which differentiates a good spring from bad one using hydraulic principle and locally sourced materials were used to produce at relative low cost and high efficiency. It also categories each spring by stiffness into one of several distinct categories based on its performance under test. This is to ensure that in the final assembly process, springs with similar performance characteristics are mated to ensure a better ride, more précised handling and improved overall vehicle or equipment performance. The construction of the machine involves basically the fabrication process which

includes such operation as cutting, benching, welding, grinding, drilling, machining, casting and screw fastening. Taken into consideration under test, were types of compression springs with varying spring loading and their different displacement recorded at different pressures to compare their stiffness.

### 3. BLOCK DIAGRAM

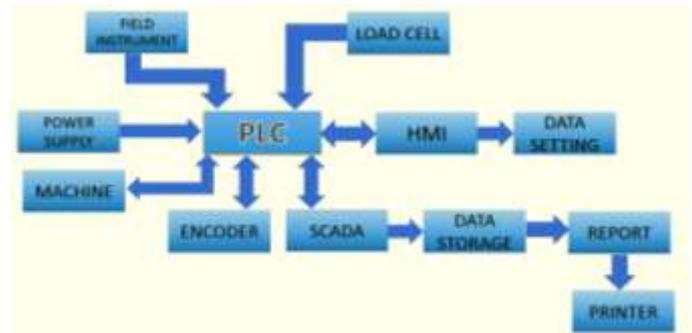


Fig -1: Block Diagram

#### FLOW CHART:

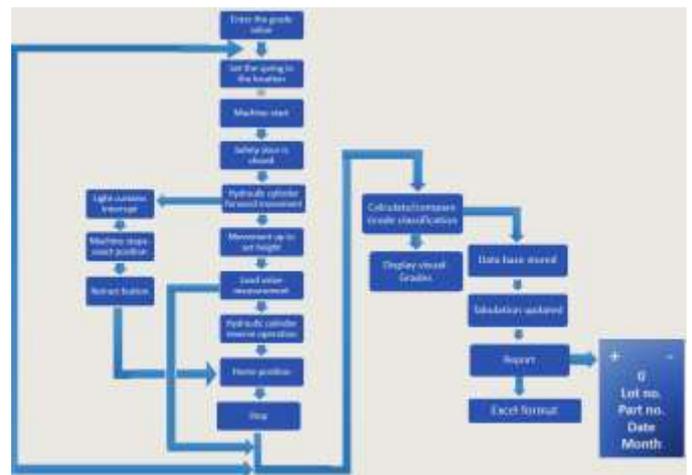


Fig -2: Flow Chart of Automatic Load Classification Machine

### 4. Operating Procedure:

#### 4.1 PLC (Programmable Logic Controller):

A programmable logic controller works by continually running a scan process that consists of three primary stages. The first step checks the status of the inputs and records the status into the image input table. The second step executes your program by executing one rung at a time. Since the programmable logic controller has already checked the status of each input, it will then decide which outputs to turn on based on the state of the corresponding inputs, and will store the results for the next step. During the final step the programmable logic controller updates the status of the

outputs onto the output image table. After these three steps have completed the programmable logic controller will repeat this process continuously.

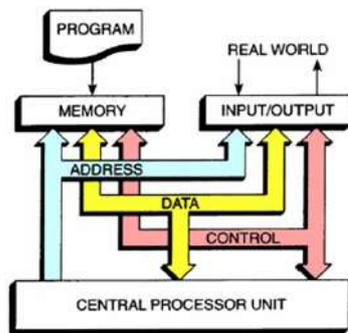
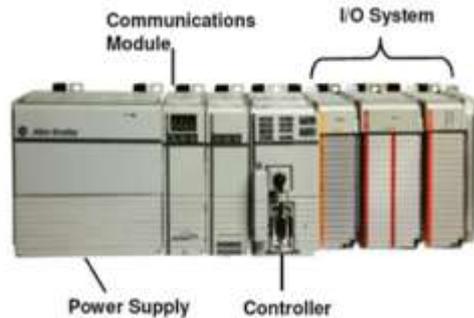
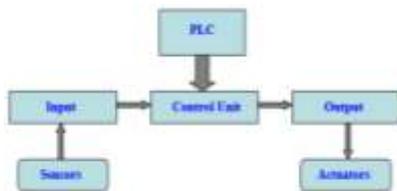


Fig -3: PLC Architecture

**PLC-GX WORKS-2**

In our Automatic Load Classification Machine, we use GX-WORKS-2 for the PLC. GX Works2 is a programming tool for designing, debugging, and maintaining programs on Windows®. GX Works2 has improved functionality and operability, with easier-to-use features compared to existing GX Developer.



**4.2. LOAD CELL**

A load cell is a device that converts a force or load into a measurable output. Load cells can come in multiple styles including hydraulic, pneumatic, strain gage, piezoelectric, and capacitance, but the scope of this project will be strain gage load cells. Strain gage load cells are the most common and are defined as a device that converts a force or load into an equivalent electrical signal.

applied is translated into a voltage by the resistance change in the strain gages, which are intimately bonded to the transducer structure. The amount of change in resistance correlates to the deformation in the transducer structure and hence the load applied

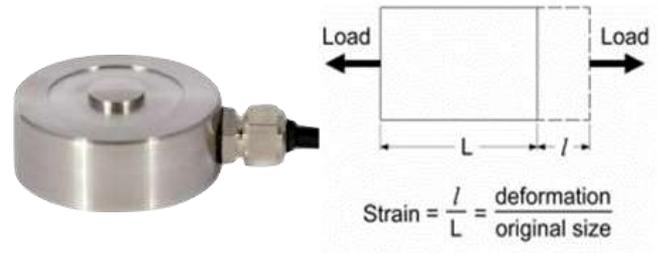


Fig -4: Button Type Load Cell

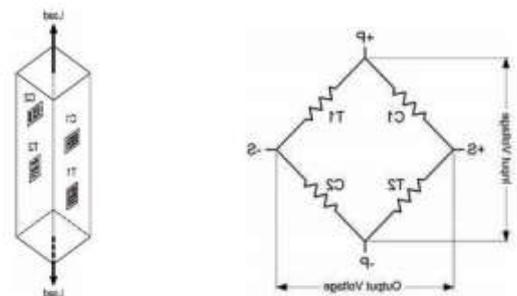


Fig -5: Model of strain gage load cell & Wheatstone Bridge

**4.3. Safety Light curtains**

**Safety Light curtains** are opto-electronic devices that are used to safeguard personnel in the vicinity of moving machinery with the potential to cause harm such as presses, winders and palletisers. Safety Light curtains can be used as an alternative to mechanical barriers and other forms of traditional machine guarding. By reducing the need for physical guards and barriers, safety light curtains can increase the maintainability of the equipment they are guarding. The operability and efficiency of machinery can also be improved by the use of safety light curtains by, for example, allowing easier access for semi-automatic procedures. In machine guarding applications safety light curtains or safety light guards are used to detect a person or part of a person which then stops the machine / hazardous condition. In automatic load classification machine these light curtains are the major safety element used, it can prevent majority of the accidents occurring in the machine during operations.

Strain gage load cells are designed for precisely measuring a static weight or quasi-dynamic load or force. The force



Fig -6: Model of Safety Light Curtains

#### 4.4. Human Machine Interface

HMI is the acronym for Human Machine Interface, and can be designed as just that; an interface between the user and the machine. An HMI is considered an interface; a very broad term that can include MP3 players, industrial computers, household appliances, and office equipment. However, an HMI is much more specific to manufacturing and process control systems. An HMI provides a visual representation of a control system and provides real time data acquisition. An HMI can increase productivity by having a centralized control center that is extremely user-friendly.



Fig -7: Model of HMI Screen

#### 4.5. DATA LOGGING AND CAPTURING

Data logging is the collection of data over a period of time, and is something often used in scientific experiments. Data logging systems typically monitor a process using sensors linked to a computer. Most data logging can be done automatically under computer control.

#### DATA LOGGING USES:

A data logger (also datalogger or data recorder) is an electronic device that records data over time or in relation to

location either with a built in instrument or sensor or via external instruments and sensors. Increasingly, but not entirely, they are based on a digital processor (or computer).

#### DATA LOGGING SCADA:

A data logger (also datalogger or data recorder) is an electronic device that records data over time or in relation to location either with a built-in instrument or sensor or via external instruments and sensors.

#### DATA CAPTURE:

A Data Capturer enters data into computer files via keyboards. The data may or may not be in a coded form. Data is then reviewed for accuracy and corrections are made. Data Capturers may also type up computer programmers and set up instructions or programmers for the computer to follow.

Here in Automatic Load classification machine the data logging and capturing of data places a major role and these data logging, capturing and data storage are helping in load classification process.

#### 4.6. ACTUATORS

An actuator is the device that brings about the mechanical movements required for any physical process in the factory. Internally, actuators can be broken down into two separate modules: the *signal amplifier* and the *transducer*. The amplifier converts the low power control signal into a high-power signal that is fed into the transducer, which actually converts the amplified control signal into the required form of energy.

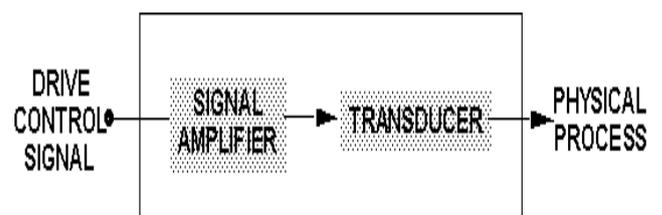


Fig -7: The Structure of an Actuator

#### 4.7. E-STOP

Emergency stop switches, generally referred to as E-Stops, ensure the safety of persons and machinery and provide consistent, predictable, failsafe control response. According to international standards, the emergency stop function must be initiated by a single human action using a manually actuated control device.



**Fig -8:** E-Stop Button

#### 4.8. SCADA interface

SCADA is not a specific technology, but a type of application. SCADA is an acronym for supervisory control and data acquisition. Any application that uses operating data from a system to control and optimize it is a SCADA application. An example of a SCADA application could be a petrochemical distillation process, a water filtration system, a pipeline compressor, or any application used to understand and improve the way a system function.

The term SCADA stands for supervisory control and data acquisition. It is one kind of a central control system which comprises of controllers, network interfaces, input/output, communication equipment & software. These systems are used to control and monitor the equipment in the process of industries which comprise production, manufacturing, fabrication and also development. The infrastructural methods comprise an electrical power supply, gas, oil and water distribution. Public services contain bus traffic system, airport. These systems take the meter readings and check the status of sensors in a fixed interval so that it needs the minimal interference of human.

The term SCADA was formed from the initials of the words "Supervisory Control and Data Acquisition". Briefly; it is the general name of a controlled and supervised system that is created from computers, communication equipment, sensors or other devices. A SCADA interface system gathers information then transfers the information back to a central site and alerts the home station about the alarm, carries out necessary analysis and control, and displays the information in a logical and 77 organized fashion. SCADA interface systems can be relatively simple, or incredibly complex.

#### Elipse Scada Software

**Elipse Scada** to create supervisory and control applications on several different areas, the definite solution is the family of products Elipse SCADA (Supervisory, Control, and Data Acquisition System). Elipse SCADA is, at the same time, accessible, friendly, and totally flexible. This is why it is the ideal tool for automation, for it eliminates the need for lengthy, expensive solutions, enabling the process with competitiveness, efficiency, and quality. Elipse Software's constant research guarantees its products permanent update, as well as the introduction of new technologies.

Elipse SCADA runs with a security device called hard key. The hard-key configuration will define which module (Development, Runtime, or Master) or which tools are available, since Elipse SCADA's executable is always the same. That way, you can exchange modules just by exchanging hard keys, with no need to install a new copy of the software.

#### E3 - Supervisory Control and Data Acquisition System

Real-time SCADA platform for mission critical applications, Elipse E3 is a well-established SCADA platform, offering scalability and constant evolution for several types of applications, from simple HMI interfaces to complex operating centers in real time. Developed to meet current and future connectivity requirements, E3 is the ideal SCADA system for your project, no matter the extent of your needs.

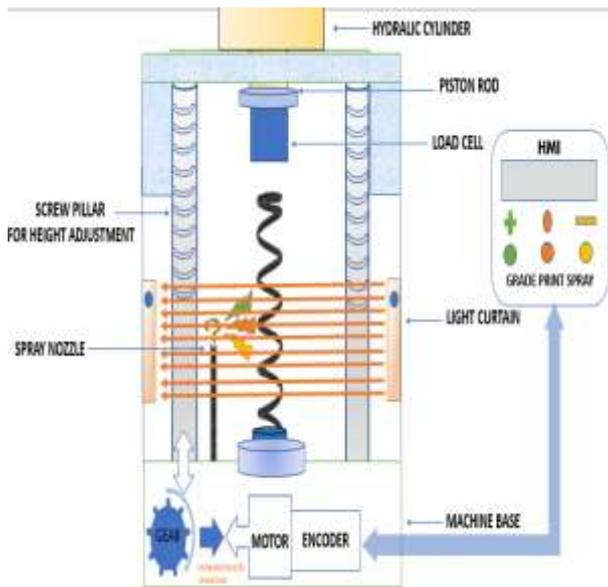
Elipse E3 is a complete system of process supervision and control, developed to meet the latest requirements of connectivity, flexibility, and reliability. This software represents the result of years of work and research made by Ellipse Software. Its distributed architecture, with totally transparent network operation, composes a real multi-layer system, offering a platform for quick development of applications, high communication capacity, and guarantee of expansion, thus preserving your investment.

#### Main advantages of Elipse E3

- Supports multiple users and projects: allows you to edit and run several databases simultaneously
- Native redundancy with databases and alarms synchronism
- Reusable graphic objects libraries and data structures
- Smart, powerful screen editor
- Transparent native connection between remote servers
- Safe, compacted data transmission
- Easy-to-manage application

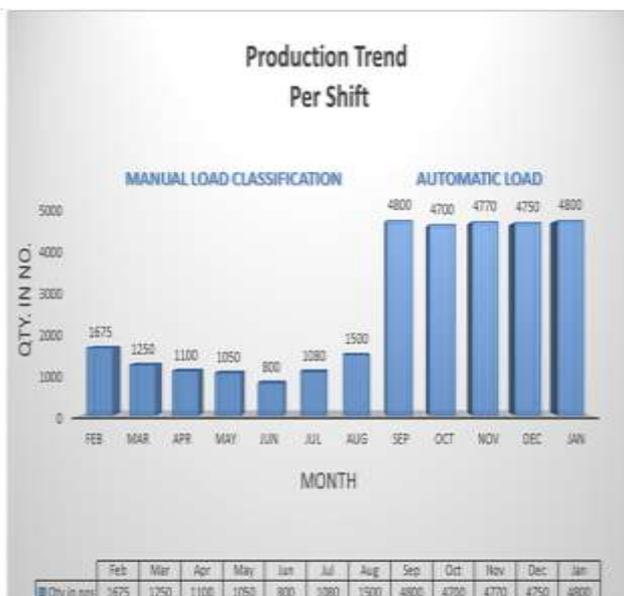
- Highly flexible alarms and events management
- Powerful scripting tool
- Native access to commercial databases
- Integrated logs, queries, and reports tool
- Highly secure and traceable

**GRAPHICAL REPRESENTATION OF THE AUTOMATIC**



**Fig -8:** Load Classification Machine

**5. RESULT AND ITS CONCLUSION:**



**MANUAL LOAD CLASSIFICATION MACHINE**

CYCLE TIME (For 1 Nos.)	16.5 seconds
1 min	4 Springs
1 Hour	218 Springs
Shift	1745 Springs

**AUTOMATIC LOAD CLASSIFICATION MACHINE**

CYCLE TIME (For 1 Nos.)	5.5 seconds
1 min	10 Springs
1 Hour	600 Springs
Shift	4800 Springs

**CONCLUSIONS**

From the above results, we can clearly see that in manual load classification system takes more processing time than the automatic load classification system. The processing time for a spring is more compared with the automatic load classification machine. The normal manual method takes 16.5sec for a spring, whereas the automated method takes only 5.5sec for a spring to be tested and classified. The manual way of load classification machine takes 11sec more than the automatic way of load classification machine. From the results we can say that automatic load classification machine is so far better and helps to improve the production cycle time and the safety purpose is the main important upgradation when compared with the old manual load classification machine method.

The PLC based automatic load classification for suspension spring, monitoring and data storage system using plc, encoder and Scada was successfully implemented and tested and the production results were recorded and compared with the old manual way of load classification. This system was beneficial in reducing the work of the worker, production cycle time was reduced, the load classification work was made simple and easier, data storages were automatically updated in excel sheets for future references and finally safety purpose for the workers were improved due this project done in industrial real time implementation

gives practical upgradation in on automation industry platform.

HMI is used for the constructive working in the automatic load classification machine, using a HMI system for control ensures a common framework not only for the development of the specific applications but also for operating the machine, where by the operator's experience "look and feel" whatever part of the experiment they want to control. It provides a very good interaction with the operator and machine, with the help of the HMI operator can easily control the machine and it is very useful for the operators to the set the load values with the help of the HMI touch screen.

#### 6. FUTURE SCOPE:

Design and develop the project for the PLC based automatic load classification for suspension spring, monitoring and data storage system by using PLC, ENCODER and SCADA to enhance the operation of the existing system. This system is very much advanced type of automation compared to the existing type. It has more advantages and the testing processing time is also reduced and so that the production cycle time is also reduced. It's the efficient and advanced technology system which when compared with the existing type.

#### 7. References:

- [1] Vidya S. Visave, J.R. Mahajan, " Experimental investigation of mono suspension spring", International Research Journal of Engineering and Technology (IRJET)
- [2] D. Abdul Budan, T.S. Manjunatha, " Investigation on the Feasibility of Composite Coil Spring for Automotive Applications", World Academy of Science, Engineering and Technology Vol:4 2010
- [3] Nikhil S. kothawade, Amol D. Halwar "Design of shock Absorber Test Rig for measurement and Analysis of Transmissibility" IJERT, ISSN:2278-0181,2014

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