

Autoliv India Pvt. Ltd



Internship Report on
**“TEARDOWN ANALYSIS ON AN EMERGENCY LOCKING RETRACTOR AND
PRODUCT RESEARCH THROUGH SURVEY”**

Submitted by
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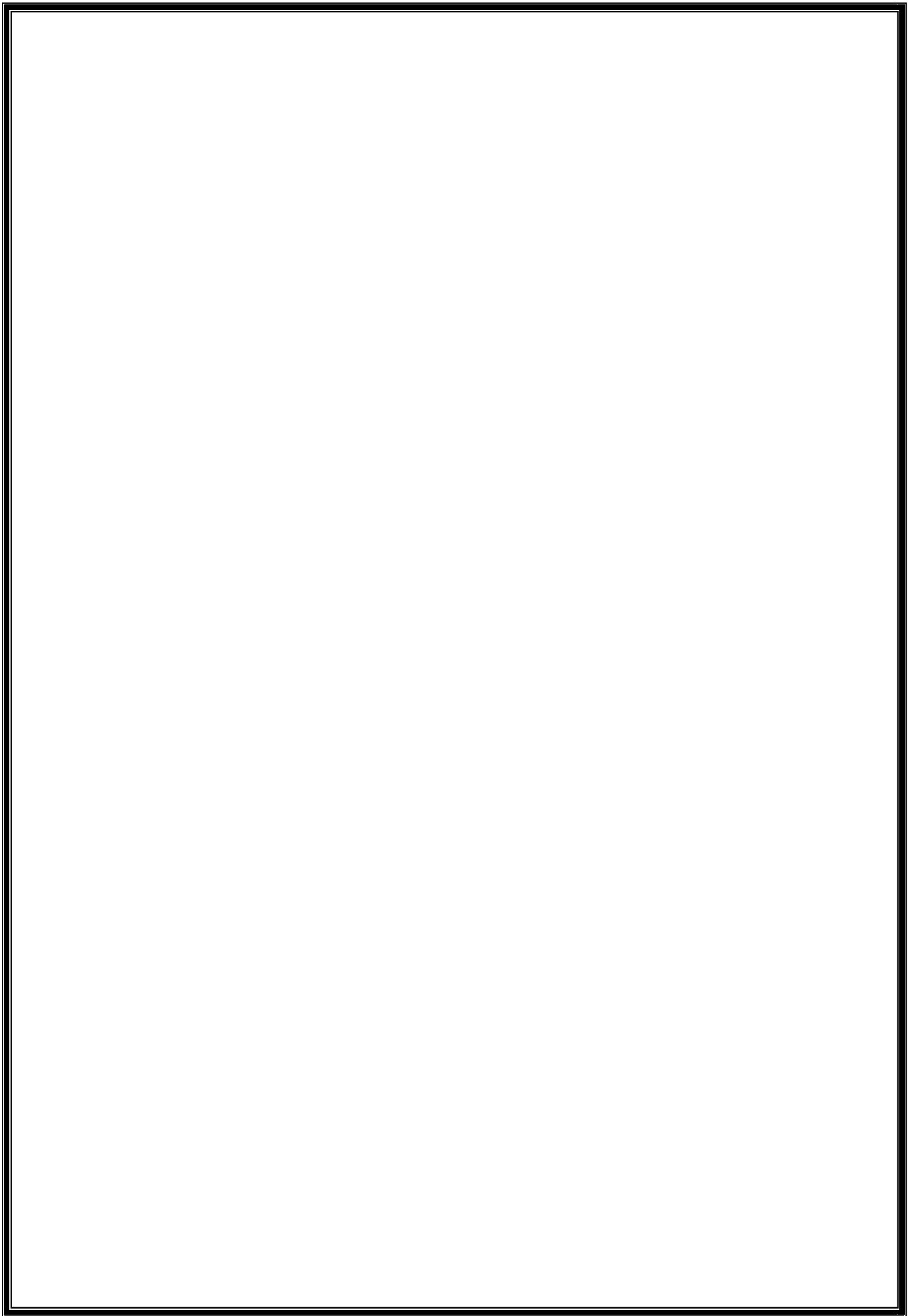
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2020-21



ACKNOWLEDGEMENT

I wish to thank Autoliv India Pvt. Ltd for providing an opportunity to undergo an internship program, I would like to thank Mr. Vijay Shetty sir for providing me an excellent opportunity of being an intern at Autoliv. I would also like to thank my mentor Abhijeet Atwadkar who provided an excellent training and guided me throughout the internship and also in completing the internship successfully.

It gives a person an immense sense of achievement in learning a new task. Acquiring knowledge is a very important and constant task which one must endure. The mentors we meet along this journey of acquiring knowledge play an immensely important role in shaping the learning process. It is an honor to thank all those who have been helpful in completing this internship successfully.

ABSTRACT

Being a part of the automobile industry, we know how Seatbelt plays a crucial role in the entire passive restraint system in the passenger vehicles. Automotive safety in this context is primarily concerned with ensuring the overall safety of the passengers.

Here in the internship, a product research is conducted on the cars available in India regarding the type of retractor used in different vehicles and simultaneously a teardown is conducted on the emergency locking retractor.

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CHAPTER 1

NEED FOR PASSIVE RESTRAINT SYSTEMS IN PASSENGER VEHICLES

1.1 Passive restraint safety systems :

These protect the occupant of the vehicle in a crash if not reduce impact of an accident or the level of injury. In other words, passive safety technology is all about mitigating the consequences of an accident during and after impact, as from the moment that first contact is made. Sometimes these measures are referred to as ‘secondary’ safety technology.

Today, a range of built-in mechanisms protect occupants of a car in case of a crash, such as:

- **DEFORMATION ZONES:**

Also known as crumple or crush zones, deformation zones take out the kinetic energy of a crash in a controlled way. This is done through specifically designed areas of the vehicle that deform and crumple during an accident to absorb the impact.

- **SEATBELTS:**

Seatbelts (or safety belts) are restraint systems that keep passengers correctly positioned during an accident or sudden stop, thereby reducing the impact of the vehicle interior on the body and preventing people from being ejected. Seatbelts have significantly evolved since they were first introduced. Today’s seatbelts are pre-tensioned: they are tightened almost instantly upon impact in order to prevent passengers from being jerked forward excessively.

- **AIRBAGS:**

Airbags are cushions that are inflated extremely quickly upon impact (and subsequently deflated) to protect passengers during a collision. They provide a soft restraint between the occupants and the vehicle interior during the crash, which can reduce or even prevent injuries. Early airbags protected front-seat occupants from frontal collisions. Since the turn of the century, they are combined with more advanced side-impact airbags as well.

Over the past decades, passive safety systems have made a major contribution to road safety by reducing the consequences of accidents. As a result, most vehicles now score highly in crash tests and passive safety technology is reaching a level of maturity.

Passive measures will remain essential in the future and Will not disappear from vehicles. Technologies and design measures that limit the impact of a crash may be taken for granted today, but in the absence of the passive measures the death toll on roads would be far greater.

CHAPTER 2

REGULATIONS

- The use of seatbelts in vehicles was made mandatory in India in 1994 for the front row seats and the use of seatbelt in the rear row was made mandatory in 2002. [\[1\]](#)
- The use of driver airbag was made mandatory in India in July 2019. [\[2\]](#)
- Vehicles manufactured on and after the 1st April 2021, in the case of new models, and 31st August 2021, in the case of existing models, shall be fitted with airbag for the person occupying the front seat, other than the driver. [\[3\]](#)

2.1 About NCAP(New Car Assessment Program):

Global NCAP's serves as a platform for co-operation among new car assessment programmes worldwide and promotes the universal adoption of the United nation's most important motor vehicle safety standards worldwide.

From Euro NCAP's assessment protocol – safety assist

It is well recognised that the correct wearing of seat belts is the most effective way of providing protection for vehicle occupants in a crash. Currently, wearing rates vary greatly across the European Union and research has shown that many of the non-wearers would use their seat belt with some encouragement. A small proportion of non-wearers will not be persuaded to use their belts.

- Seat Belt Reminder (SBR) systems are intended to encourage the first of these groups to use their seat belt, whilst at the same time not be so annoying that the second group would take undesirable action to disable the system. Such action could include, tampering with or cutting electrical connections which might have undesirable consequences.
- It is intended that habitual users who always put their seat belt on, before starting their Journey, would hardly notice the existence of the system and would not be annoyed by it.
- To avoid the danger that dedicated non-users would try to tamper with the system, Euro NCAP recommends that SBR systems are capable of being deactivated. Deactivation could be long term and/or short term for individual journeys.
- Although, simple seat belt reminder systems have been available for some time, the technology behind the more sophisticated systems is new. Euro NCAP has set some minimum requirements but wishes to allow the development of increasingly improved systems.
- Some recommendations are made for how improvements may occur and these may eventually become Euro NCAP requirements. The expectation is that the requirements will develop in the light of further knowledge.

2.2 NCAP in India:

The Bharat New Vehicle Safety Assessment Program (BNVSAP) is a proposed New Car Assessment Program for India nowadays it is called as BNCAP. Cars sold in the country will be assigned by star ratings based on their safety performance. It will be implemented in phases, according to the plans being drawn up by the National Automotive Testing and R&D Infrastructure Project. It is the 10th NCAP in the world and is being set up by the government of India

The program was expected to begin mid-2014, but postponed to start from 2017. (Because of delay in setting up labs and other facilities) Within two years of implementation, new cars sold in India will need to comply with voluntary star ratings based on crash safety performance tests. Critical safety features such as airbags, ABS, and seat belt reminders will become standard in cars sold in India resulting from rankings and mandatory crash testing. Offset front crash, side, and rear impact tests will be required by 2017. Cars will gradually have to meet more stringent norms such as pedestrian protection, whiplash injury and child restraint systems standards and requirements.^[4]

It is proposed that this BNVSAP would start the official testing from October 2017 onwards. The car testing protocols is defined by ARAI as follows:

- Frontal offset testing (64 km/h proposed)
- Side impact testing
- Pedestrian protection testing
- Rear impact testing
- Child dummy dynamic crash testing.

CHAPTER 3

INTRODUCTION

The internship began with understanding the basic knowledge of passive restraint systems and specifically understanding Primary restraint system that is the seatbelt as well as its components, their functions.

3.1 Seatbelt

The seatbelt is the part of passive restraint system which is used to restrain the occupant in the case of an accident or impact. They are further classified as Primary restraint system under the Passive restraint systems. In today's world the structural design has to be built in a very robust way so as to protect the occupant in the event of the crash, there is a necessity for the designers to make sure that there is a perfect harmony between the structural safety of the vehicle as well as the restraint system of the vehicle.

3.2 Purpose

The main purpose of a seat belt is to keep vehicle occupants safe in the event of a crash. The seat belt functions by keeping the occupant in a more static motion despite a sudden stop or change in momentum. A car moves with inertia, which is an object's tendency to move until something works against the motion of that object. When the vehicle hits something, or is hit by something, that inertia changes. Without the seat belt, occupants can be thrown into various parts of the interior of the car, or thrown completely out of the car. The seat belt usually stops this from happening.

3.3 Working

The Webbing itself is made of fabric generally made up of Polyester. The retractor mechanism sits in the retractor housing on the floor or on the interior wall of the vehicle, and contains the spool and spring that the belt is rolled onto. The seat belt unspools from the spiraling spring that allows the vehicle occupant to pull the seat belt out. When the seat belt is unhooked, that same spiraling spring will automatically re-spool due to the spring tension. Lastly is the lock itself. When the seat belt is unspooled and is across the person's body, the webbed fabric ends in a metal tab, called the tongue. The tongue is inserted into the buckle. While the seat belt is being fastened, the vehicle occupant should have the seat in an upright position, and be sitting in the seat with hips and back against the back of the seat. If worn correctly at all times, the seat belt is the best safety device on a vehicle today.

CHAPTER 4

TEARDOWN

A product teardown, or simply teardown, is the act of disassembling a product, such that it helps to identify its component parts and system functionality, and component costing information.

In this case, a standard emergency locking retractor was obtained and the process of teardown was followed.

Components:

1]THE BELT:



FIG 3.1 The Seatbelt

The typical seatbelt consists of the setup as shown in the figure above it consists of ANCHOR PLATE, RETRACTOR, TONGUE, PILLAR MOUNT, RETRACTOR HOUSING. These are the major components of the seat belts (Some seatbelts also are equipped with pretensioners or load limiters, the one considered here is an Emergency Locking Retractor).

2]RETRACTOR ASSEMBLY:



FIG 3. 2 The Retractor assembly

The retractor assembly houses the mechanism which is responsible for locking the belt and ensuring that the passenger is restrained during a crash or collision, this is an emergency locking type retractor. This is the essential component of the seatbelt.

2.01] Retractor:**FIG 3.3 The Retractor**

The retractor is the mechanism that helps in locking and unlocking the webbing or restraining the occupant in case of an accident. The retractor mechanism is webbing sensitive and car sensitive, which means that the locking up and unlocking depends on the speed at which the webbing is being retracted out and the car sensitivity includes the deceleration of vehicle the tilt of the vehicle etc .

2.02] Retractor housing:**FIG 3.4 The Retractor housing**

The retractor housing as the name suggests houses the mechanism of the retractor which includes the Car sensor mechanism on one side and the torsional spring on the opposite side . It is made up of steel and manufactured using press tool operation.

2.03] Spindle shaft gear assembly:**FIG 3.5 Spindle shaft with gears**

This is the shaft which is essential for establishing a connection between the webbing and the mechanism of the retractor. The spindle shaft-gear assembly is connected to the webbing and rotates when the webbing is spooled or unspooled. This part also is webbing sensitive, and if the necessary parameters are met then the mechanism engages the gear locking plate which interferes with the spindle gear and stops the gear's rotation, thus essentially stopping the webbing from being pulled out. It is hollow and has space for the main shaft. It is made up of steel and manufactured using press tool operation.

2.04] Retraction Spring:

FIG 3.6 Retraction Spring

The retraction spring helps the webbing to retract whenever left free it is a very powerful component and proper care should be taken while dismantling it. It is made up of Steel using CNC spring machine.

2.05] Shaft(mechanism):

FIG 3.6 Shaft

This is part that connects the spindle gear assembly to the mechanisms. It has the main mechanism on one side and the retraction spring on the other side. It is made of Steel and by sheet metal press tool operation.

2.06] Steering Disc:

FIG 3.7 Steering Disc

This is the part of mechanism that is connected to the shaft and rotates along with it. It is used to lock up or the stop the rotation of the shaft whenever necessary. It is made up of Plastic using Plastic injection molding process.

2.07] Tread head:**FIG 3.8 Tread head**

This part is coupled with the steering disc which works on the principle of centrifugal force it also has a return spring. the tread head is made up of aluminum and from Die casting process. The tread head also consists of a Webbing sensor which is sensitive to the speed with which the webbing is being extracted. It is attached to the tread head.

2.08] Internal gear disc:**FIG 3.9 Internal gear disc**

This part has internal gears which interfere with the gear teeth of the steering disc to restrict the motion of belt. It is made up plastic and from Plastic injection molding process.

2.09] Car sensor housing:**FIG 3.10 Car sensor housing**

This part houses the car sensor mechanism which has a mass which is machined out of Brass and a mass actuated Plastic lever which work together in activating the or allowing the internal gear to lock up with the steering disc. The housing itself is made up of plastic and from Plastic injection molding process. This is a Pendulum type car sensor. The car sensor is sensitive to the dynamics of the car (the motion of the car and the characteristics of the motion), which means that if the car is decelerating at certain rate then the car sensor is actuated. It is also actuated by Tilt sensitivity, the range of values where the car sensor gets actuated are given below:

- The value for deceleration sensitivity lies between 0.3g to 0.45g ($g=9.81\text{m/s}^2$).
- The value for tilt sensitivity lies in the range of 12° (degrees) to 27° (degrees).

2.10] Gear locking plate:

FIG 3.11 Gear locking plate

This plate is used to stop the retraction of webbing. It is actuated by the mechanism depending on the necessary parameters. Once it is actuated it interferes with the spindle gear wheel which stops the movement of the webbing. It is made of Steel and by sheet metal press tool operation.

2.11] Spring cover:

FIG 3.12 Spring cover

This is used to cover the torsional spring so that it does not get affected by external factors. It is made up plastic and from Plastic injection molding process.

2.12] Mechanism cover:

FIG 3.13 Mechanism cover

This is used to cover the mechanism so that external excitations, dust humidity and other factors do not hamper the functional ability of the mechanism as the seatbelt has to maintain its functionality throughout. It is made up plastic and from Plastic injection molding process.

2.13] Spring:

FIG 3.14 Spring

A Mechanical Spring is a device that can also be defined as an elastic or resilient member, whose main function is to deflect under the action of load and recovers its original shape when the load is removed. It is also used for storing energy. It is made up of Spring steel and manufactured using CNC spring machine.

2.14] Circlip:

FIG 3.15 Circlip

This is used to lock the keyed shaft along with the steering disk together so that the mechanism is together. It is made of Steel and by sheet metal press tool operation.

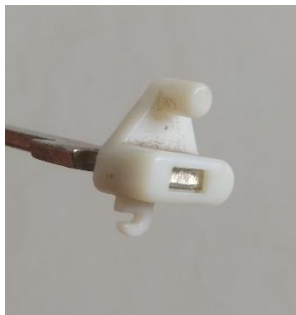
2.15] Locking cam:

FIG 3.16 Locking cam

The locking cam is used to connect the locking plate to the internal gear disc. It is made up of plastic and from Plastic injection molding process.

2.16] Bushing (on retractor housing):



FIG 3.17 Bushing

Bushing is used to reduce the metal to metal contact which results in reducing the noise produced due to vibrations and also wear and tear. It is made up of Rubber and by the process of Elastomer injection molding.

3] WEBBING ASSEMBLY:

The webbing assembly consists of the webbing, the stitching and the label.

3.1] Webbing:



FIG 3.18 Webbing

Webbing is the part of the seat belt system that is pulled around the person and is tightened to support the person upon impact. It is made from polyester.

3.2] Thread:



FIG 3.19 Stitched thread

It is used to stitch the free end of the webbing to the belt after it is made to pass through the anchor plate.

3.3] Label :



FIG 3.20 Label

This is used to specify the type of seatbelt , the manufacturer's name , date of manufacture. It is stitched to the belt usually made from polyester.

4]PILLAR LOOP ASSEMBLY:

The pillar loop assembly consists of the components that are used to fix the seatbelt to the pillar of the vehicle.

4.1] Pillar loop:



FIG 3.21 Pillar loop

The pillar loop is used to fix the seatbelt to the pillar of the vehicle. . It is made up of Sheetmetal and Plastic and by Sheetmetal with Plastic injection over molding process.

4.2] Pillar Loop bolt:



FIG 3.22 Pillar Loop bolt

The pillar loop bolt is used to fix the pillar loop along with the seatbelt to the pillar. It is made up of Steel and by the process of Forging and Thread rolling.

4.3] Washers:

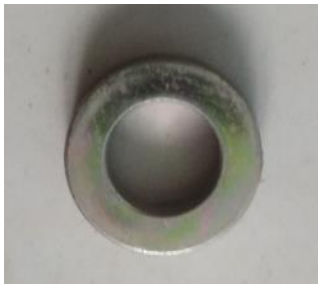


FIG 3.23 5mm washer



FIG 3.24 2mm washer

The primary purpose of most washers is to evenly distribute the load of the threaded fastener with which they are used. The various types of washers used here are the ones shown above along with transport washer and helical washer as shown below.



FIG 3.25 Transport washer



FIG 3.26 Helical washer

5] ANCHOR PLATE ASSEMBLY:

It consists of an anchor plate and a nut to ensure that the anchor plate stays in its place.

5.1] Anchor plate:



FIG 3.27 Anchor plate

Anchor plates are used to reduce the chance of the belt bolt tearing through the floor when the belt is under load. The angle is given so that the belt has clearance when the plate is attached to the support. It is made of Steel and by sheet metal press tool operation.

5.2] Anchor plate bolt:



FIG 3.28 Anchor plate bolt

The Anchor plate bolt is used to fix the Anchor plate along with the seatbelt to the pillar. It is made up of Steel and by the process of Forging and Thread rolling.

4.1 Bill of Materials for the seatbelt:

NUMBER	PART NAME	MATERIAL	MANUFACTURING PROCESS	QUANTITY
0	Seatbelt assembly	NA	NA	1 No.
1	Retractor assembly	NA	NA	1 No.
1.1	Retractor housing	Steel	Sheetmetal Press tool	1 No.
1.2	Spindle shaft gear assembly	Steel	Sheetmetal Press tool	1 No.
1.3	Torsional Spring	Brass	CNC spring machine	1 No.
1.4	Spring cover	Plastic	Plastic injection molding	1 No.
1.5	Shaft (mechanism)	Steel	Sheetmetal Press tool	1 No.
1.6	Steering Disc	Plastic	Plastic injection molding	1 No.
1.7	Tread head (mechanism)	Aluminium	Die casting	1 No.
1.8	Spring (with the plate)	Spring Steel	CNC spring machine	1 No.
1.9	Gear locking plate	Steel	Sheetmetal Press tool	1 No.
1.10	Circlip	Steel	Sheetmetal Press tool	1 No.
1.11	Pawl lock	Plastic	Plastic injection molding	1 No.
1.12	Locking cam	Plastic	Plastic injection molding	1 No.
1.13	Return spring	Spring Steel	CNC spring machine	1 No.
1.14	Screws	Steel	Forging and Thread rolling	2 Nos
1.15	Bushing (on retractor housing)	Rubber	Elastomer injection molding	2 Nos
1.16	Internal gear disc	Plastic	Plastic injection molding	1 No.
1.17	Mechanism cover	Plastic	Plastic injection molding	1 No.
1.18	Car sensor housing	Plastic	Plastic injection molding	1 No.
1.19	Car sensor mass	Brass	Machining	1 No.
1.20	Car sensor lever	Plastic	Plastic injection molding	1 No.
2	Webbing assembly			
2.1	Webbing	Polyester	NA	3 meters
2.2	Stitching thread	Polyester	NA	
2.3	Label	Polyester	NA	1 No.
3	Pillar loop assembly			
3.1	Pillar Loop	Sheetmetal and Plastic	Sheetmetal with Plastic injection over molding	1 No.
3.2	Pillar Loop bolt	Steel	Forging and Thread rolling	1 No.
3.3	Transport washer	Cardboard	Dinking tool	1 No.
3.4	Washer (5) mm	Steel	Sheetmetal Press tool	1 No.
3.5	Washer (2mm)	Steel	Sheetmetal Press tool	1 No.
4	Tongue	Steel and Plastic	Sheetmetal with Plastic injection over molding	1 No.
5	Tongue stop male	Plastic	Plastic injection molding	1 No.
6	Tongue stop female	Plastic	Plastic injection molding	1 No.
7	Anchor plate assembly			
7.1	Anchor plate	Steel	Sheetmetal Press tool	1 No.
7.2	Anchor plate bolt	Steel	Forging and Thread rolling	1 No.

CHAPTER 5

TYPES OF SEATBELT TECHNOLOGIES

1] Automatic locking retractor:

An Automatic Locking Retractor (ALR) locks when the continuous motion of spooling the belt out is stopped. Once the occupant has pulled the lap belt into place and the seat belt tongue is inserted into the buckle, the ALR allows the extra seat belt webbing to retract into the retractor until the webbing is tight around the occupant's hips and all slack in the belt is removed. At this point a bar locks into a spool with gears, and prevents any further webbing from being released. The limitation of an ALR is that once the webbing is locked in place, it can become uncomfortable and tight for the occupant if they try to move, because more webbing cannot be withdrawn from the retractor. This function is also called child restraint mode, as the ALR function can be used for securing child seats. ALRs are an older design, though still popular today.

2] Emergency locking retractors (ELR):

The Emergency locking retractors are the An Emergency Locking Retractor (ELR) is a seat belt retractor that locks only in response to the rapid deceleration of a vehicle or rapid spooling out of the seat belt webbing from the retractor, this type of seatbelt generally consist of retractor that responds to the input from sensors namely the Webbing sensor as well as the car sensor which if the criteria is met allow the belt to be locked. The disadvantage of this type of belts is that the load acting on the occupant remains constant which results in huge amount of load acting on the chest and rib cage of the occupant.

3] ELR with load-limiter:

This system uses load limiters to minimize belt-inflicted injuries. The basic idea of a load limiter is to ensure controlled release of webbing when a great deal of force is applied to the belt. The simplest load limiter is a fold sewn into the belt webbing. The stitches holding the fold in place are designed to break when a certain amount of force is applied to the belt. When the stitches come apart, the webbing unfolds, allowing the belt to extend a little bit more. More advanced load limiters rely on a torsion bar in the retractor mechanism. A torsion bar is just a length of metal material that will twist when enough force is applied to it. In a load limiter, the torsion bar is secured to the locking mechanism on one end and the rotating spool on the other. In a less severe accident, the torsion bar will hold its shape, and the spool will lock along with the locking mechanism. But when a great deal of force is applied to the webbing (and therefore the spool), the torsion bar will twist slightly. This allows the webbing to extend a little bit farther.

4] Seatbelts having pretensioners with load limiter

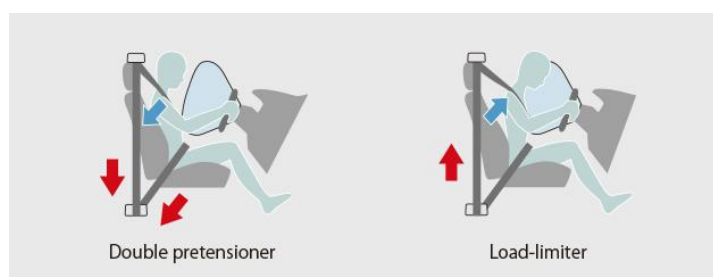


FIG 5.1 Pretensioner and Load limiter

A pretensioner is designed to retract and remove slack of a seatbelt the instant a collision occurs, tightening the seatbelt to restrain occupants quickly and reducing the amount they are thrown forward in a moderate or severe frontal crash. Load limiters help protect occupants from seatbelt-inflicted injury. In the event of a crash, the pretensioner restrains the occupant until certain amount of force is applied. At this point the load limiter releases the webbing gradually so as not to exert too much force on the chest of the occupant.

5] Motorized seatbelt:

Motorized Seat Belt (MSB) technology can supply fast and strong reversible retraction of the seatbelt during critical driving situations. The MSB responds to input from the vehicle allowing pre- and in-crash phase occupant protection. In addition to improving pre-crash restraint performance, our MSB creates a more ergonomic feeling for the occupant by lowering the chest pressure of the seatbelt. MSB design is capable of providing vibro-tactile seatbelt warnings in critical takeover situations. This feature improves effectiveness of visual and acoustic vehicle signals alone.

CHAPTER 6

MARKET SURVEY

A market survey was conducted on a list of vehicles regarding the type of seatbelt technology being used in the vehicle. A variety of cars of different categories were taken into account.

6.1] Purpose of the survey:

The main purpose of the survey was to gather information related to the type of seatbelt that are being used to identify the level of safety that is being provided in the vehicle.

6.2] Data collected:

6.2.1] Front row:

OEM	TYPE	CAR	TYPE OF RETRACTOR	MANUFACTURER
GENERAL MOTORS	HATCHBACK	BEAT	ELR(EMERGENCY LOCKING RETRACTOR)	DBI INDIA AUTOTECH PVT. LTD.
GENERAL MOTORS	HATCHBACK	CRUZE	PRETENSIONER	GENERAL MOTORS
MAHINDRA AND MAHINDRA	SUBCOMPACT CROSSOVER SUV	TUV 300	PRETENSIONER	AUTOLIV INDIA PVT. LTD.
MAHINDRA AND MAHINDRA	SUV	SCORPIO	PRETENSIONER	AUTOLIV INDIA PVT. LTD.
MAHINDRA AND MAHINDRA	SUBCOMPACT CROSSOVER SUV	XUV300	PRETENSIONER	RANE TRW SYSTEMS
MAHINDRA AND MAHINDRA	SUV	BOLERO	ELR(EMERGENCY LOCKING RETRACTOR)	AUTOLIV INDIA PVT. LTD.
MAHINDRA AND MAHINDRA	SUV	XUV 500	PRETENSIONER	RANE TRW SYSTEMS
TATA MOTORS	HATCHBACK	NANO	ELR(EMERGENCY LOCKING RETRACTOR)	AUTOLIV INDIA PVT. LTD.
TATA MOTORS	HATCHBACK	NANO	ELR(EMERGENCY LOCKING RETRACTOR)	AUTOLIV INDIA PVT. LTD.
TATA MOTORS	HATCHBACK	NANO	ELR(EMERGENCY LOCKING RETRACTOR)	AUTOLIV INDIA PVT. LTD.
TATA MOTORS	HATCHBACK	NANO	ELR(EMERGENCY LOCKING RETRACTOR)	AUTOLIV INDIA PVT. LTD.
NISSAN MOTOR CORPORATION	SUV	TERRANO	ELR(EMERGENCY LOCKING RETRACTOR)	RANE TRW SYSTEMS
NISSAN MOTOR CORPORATION	HATCHBACK	MICRA	ELR(EMERGENCY LOCKING RETRACTOR)	TAKATA INDIA PVT. LTD.
TOYOTA MOTOR CORPORATION	MPV	INNOVA	PRETENSIONER	AUTOLIV INDIA PVT. LTD.
HONDA MOTOR COMPANY	SEDAN	CITY	PRETENSIONER	TAKATA INDIA PVT. LTD.
HONDA MOTOR COMPANY	HATCHBACK	JAZZ	ELR(EMERGENCY LOCKING RETRACTOR)	TAKATA INDIA PVT. LTD.
HONDA MOTOR COMPANY	SUBCOMPACT CROSSOVER SUV	WRV	ELR(EMERGENCY LOCKING RETRACTOR)	TAKATA INDIA PVT. LTD.

HONDA MOTOR COMPANY	SEDAN	AMAZE	ELR(EMERGENCY LOCKING RETRACTOR)	AUTOLIV INDIA PVT. LTD.
HYUNDAI MOTOR COMPANY	HATCHBACK	I 20	ELR(EMERGENCY LOCKING RETRACTOR)	SS MANUFACTURING
HYUNDAI MOTOR COMPANY	HATCHBACK	I 10	ELR(EMERGENCY LOCKING RETRACTOR)	AUTOLIV INDIA PVT. LTD.
HYUNDAI MOTOR COMPANY	SEDAN	XCENT	ELR(EMERGENCY LOCKING RETRACTOR)	SS MANUFACTURING
HYUNDAI MOTOR COMPANY	SEDAN	VERNA	PRETENSIONER	SS MANUFACTURING
HYUNDAI MOTOR COMPANY	HATCHBACK	EON	ELR(EMERGENCY LOCKING RETRACTOR)	SS MANUFACTURING
HYUNDAI MOTOR COMPANY	SUBCOMPACT CROSSOVER SUV	VENUE	PRETENSIONER	SS MANUFACTURING
MARUTI SUZUKI INDIA LTD	MPV	ERTIGA	PRETENSIONER	RANE TRW SYSTEMS
MARUTI SUZUKI INDIA LTD	HATCHBACK	ALTO	ELR(EMERGENCY LOCKING RETRACTOR)	AUTOLIV INDIA PVT. LTD.
MARUTI SUZUKI INDIA LTD	HATCHBACK	BALENO	PRETENSIONER	TAKATA INDIA PVT. LTD.
MARUTI SUZUKI INDIA LTD	SEDAN	DZIRE	PRETENSIONER	AUTOLIV INDIA PVT. LTD.
MARUTI SUZUKI INDIA LTD	HATCHBACK	CELERIO-X	ELR(EMERGENCY LOCKING RETRACTOR)	AUTOLIV INDIA PVT. LTD.
MARUTI SUZUKI INDIA LTD	HATCHBACK	WAGON-R	ELR(EMERGENCY LOCKING RETRACTOR)	KSS ABHISHEK
MARUTI SUZUKI INDIA LTD	SEDAN	CIAZ	PRETENSIONER	ASHIMORI INDIA PVT LTD
FORD MOTOR COMPANY	SUBCOMPACT CROSSOVER SUV	ECO-SPORT	PRETENSIONER	RANE TRW SYSTEMS
FORD MOTOR COMPANY	SEDAN	FIGO-ASPIRE	ELR(EMERGENCY LOCKING RETRACTOR)	RANE TRW SYSTEMS
VOLKSWAGEN GROUP(SKODA)	SEDAN	RAPID	ELR(EMERGENCY LOCKING RETRACTOR)	KSS ABHISHEK
VOLKSWAGEN GROUP	SEDAN	VENTO	ELR(EMERGENCY LOCKING RETRACTOR)	KSS ABHISHEK
FIAT CHRYSLER AUTOMOBILES	HATCHBACK	PUNTO	ELR(EMERGENCY LOCKING RETRACTOR)	RANE TRW SYSTEMS
MITSUBISHI MOTORS CORPORATION	SUV	PAJERO	ELR(EMERGENCY LOCKING RETRACTOR)	TAKATA INDIA PVT. LTD.
GROUPE RENAULT	HATCHBACK	KWID	ELR(EMERGENCY LOCKING RETRACTOR)	SS MANUFACTURING

TABLE 6.1 Front row

6.2.2] Rear row:

HYUNDAI MOTOR COMPANY	HATCHBACK	I 20	ELR(EMERGENCY LOCKING RETRACTOR)	SS MANUFACTURING
MARUTI SUZUKI INDIA LTD	MPV	ERTIGA	ELR(EMERGENCY LOCKING RETRACTOR)	AUTOLIV INDIA PVT. LTD.
MAHINDRA AND MAHINDRA	SUV	XUV 500	ELR(EMERGENCY LOCKING RETRACTOR)	RANE TRW SYSTEMS
HYUNDAI MOTOR COMPANY	SEDAN	XCENT	ELR(EMERGENCY LOCKING RETRACTOR)	SS MANUFACTURING
VOLKSWAGEN GROUP(SKODA)	SEDAN	RAPID	ELR(EMERGENCY LOCKING RETRACTOR)	KSS ABHISHEK
FORD MOTOR COMPANY	SEDAN	FIGO ASPIRE	ELR(EMERGENCY LOCKING RETRACTOR)	RANE TRW SYSTEMS
TATA MOTORS	HATCHBACK	BOLT	ELR(EMERGENCY LOCKING RETRACTOR)	AUTOLIV INDIA PVT. LTD.
GROUPE RENAULT	HATCHBACK	KWID	ELR(EMERGENCY LOCKING RETRACTOR)	SS MANUFACTURING
HONDA MOTOR COMPANY	HATCHBACK	JAZZ	ELR(EMERGENCY LOCKING RETRACTOR)	TAKATA INDIA PVT. LTD.
MITSUBISHI MOTORS CORPORATION	SUV	PAJERO	ELR(EMERGENCY LOCKING RETRACTOR)	TAKATA INDIA PVT. LTD.
MARUTI SUZUKI INDIA LTD	HATCHBACK	BALENO	ELR(EMERGENCY LOCKING RETRACTOR)	KSS ABHISHEK
FIAT CHRYSLER AUTOMOBILES	HATCHBACK	PUNTO	ELR(EMERGENCY LOCKING RETRACTOR)	AUTOLIV INDIA PVT. LTD.
VOLKSWAGEN GROUP	SEDAN	VENTO	ELR(EMERGENCY LOCKING RETRACTOR)	KSS ABHISHEK
MARUTI SUZUKI INDIA LTD	SEDAN	DZIRE	ELR(EMERGENCY LOCKING RETRACTOR)	KSS ABHISHEK
MARUTI SUZUKI INDIA LTD	HATCHBACK	CELERIO-X	ELR(EMERGENCY LOCKING RETRACTOR)	TAKATA INDIA PVT. LTD.
TATA MOTORS	SUV	HEXA	ELR(EMERGENCY LOCKING RETRACTOR)	AUTOLIV INDIA PVT. LTD.
MAHINDRA AND MAHINDRA	COMPACT SUV	XUV 300	ELR(EMERGENCY LOCKING RETRACTOR)	RANE TRW SYSTEMS
MAHINDRA AND MAHINDRA	SUV	SCORPIO	ELR(EMERGENCY LOCKING RETRACTOR)	AUTOLIV INDIA PVT. LTD.
MARUTI SUZUKI INDIA LTD	SEDAN	CIAZ	ELR(EMERGENCY LOCKING RETRACTOR)	KSS ABHISHEK
HYUNDAI MOTOR COMPANY	HATCHBACK	EON	ELR(EMERGENCY LOCKING RETRACTOR)	SS MANUFACTURING
MAHINDRA AND MAHINDRA	SUV	TUV 300	ELR(EMERGENCY LOCKING RETRACTOR)	AUTOLIV INDIA PVT. LTD.
FORD MOTOR COMPANY	COMPACT SUV	ECO-SPORT	ELR(EMERGENCY LOCKING RETRACTOR)	RANE TRW SYSTEMS

TABLE 6.2 Rear row

6.2.3] Count of car by type:

TYPE	Count of CAR
HATCHBACK	15
MPV	2
SEDAN	9
SUBCOMPACT Crossover SUV	5
SUV	7

TABLE 6.3 Cars and type

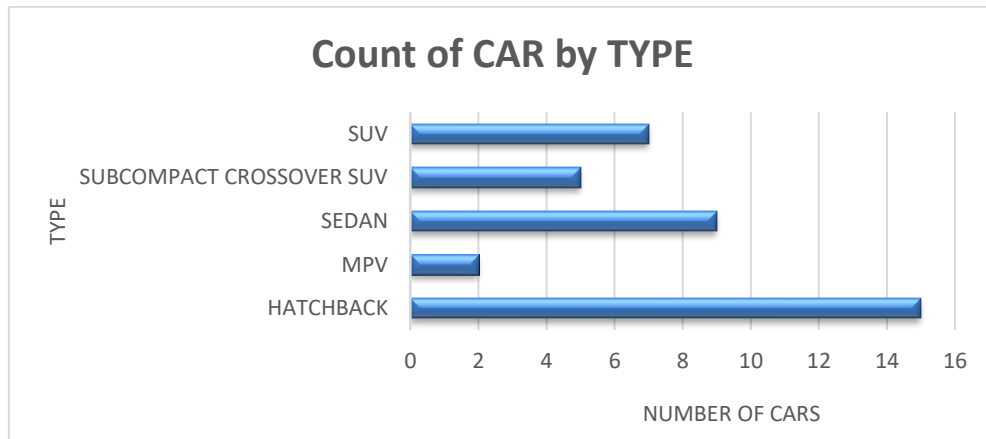


FIG 6.1 Cars and type

6.2.4] Manufacturer of front row belt :

MANUFACTURER	Count of CAR
ASHIMORI INDIA PVT LTD	1
AUTOLIV INDIA PVT. LTD.	13
DBI INDIA AUTOTECH PVT. LTD.	1
GENERAL MOTORS	1
KSS ABHISHEK	3
RANE TRW SYSTEMS	7
SS MANUFACTURING	6
TAKATA INDIA PVT. LTD.	6

TABLE 6.4 Manufacturer of front row belt

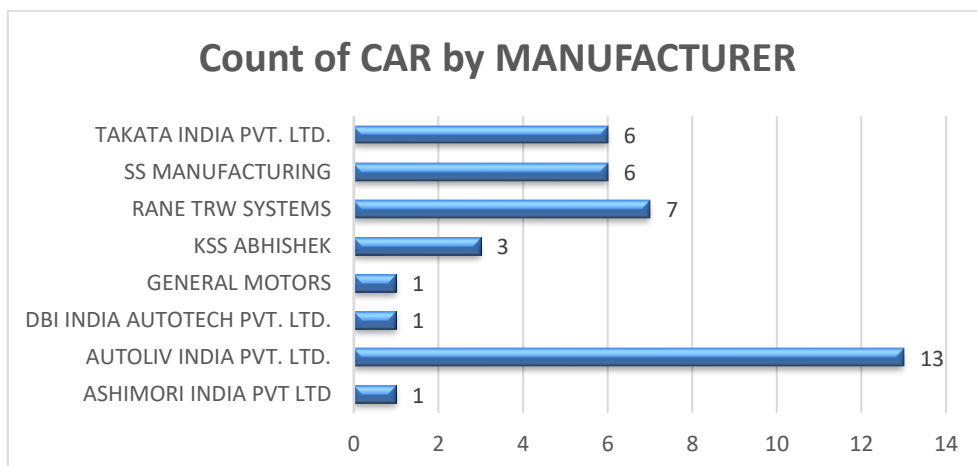


FIG 6.2 Manufacturer of front row belt

6.2.5] Count of car by type of retractor on the front row:

TYPE OF RETRACTOR	OEM	Count of CAR
<input checked="" type="checkbox"/> ELR(EMERGENCY LOCKING RETRACTOR)	FIAT CHRYSLER AUTOMOBILES	1
ELR(EMERGENCY LOCKING RETRACTOR)	FORD MOTOR COMPANY	1
ELR(EMERGENCY LOCKING RETRACTOR)	GENERAL MOTORS	1
ELR(EMERGENCY LOCKING RETRACTOR)	GROUPE RENAULT	1
ELR(EMERGENCY LOCKING RETRACTOR)	HONDA MOTOR COMPANY	3
ELR(EMERGENCY LOCKING RETRACTOR)	HYUNDAI MOTOR COMPANY	4
ELR(EMERGENCY LOCKING RETRACTOR)	MAHINDRA AND MAHINDRA	1
ELR(EMERGENCY LOCKING RETRACTOR)	MARUTI SUZUKI INDIA LTD	3
ELR(EMERGENCY LOCKING RETRACTOR)	MITSUBISHI MOTORS CORPORATION	1
ELR(EMERGENCY LOCKING RETRACTOR)	NISSAN MOTOR CORPORATION	2
ELR(EMERGENCY LOCKING RETRACTOR)	TATA MOTORS	3
ELR(EMERGENCY LOCKING RETRACTOR)	VOLKSWAGEN GROUP	1
ELR(EMERGENCY LOCKING RETRACTOR)	VOLKSWAGEN GROUP(SKODA)	1
<input checked="" type="checkbox"/> PRETENSIONER	FORD MOTOR COMPANY	1
PRETENSIONER	GENERAL MOTORS	1
PRETENSIONER	HONDA MOTOR COMPANY	1
PRETENSIONER	HYUNDAI MOTOR COMPANY	2
PRETENSIONER	MAHINDRA AND MAHINDRA	4
PRETENSIONER	MARUTI SUZUKI INDIA LTD	4
PRETENSIONER	TATA MOTORS	1
PRETENSIONER	TOYOTA MOTOR CORPORATION	1

TABLE 6.5 Count of car by type of retractor on the front row

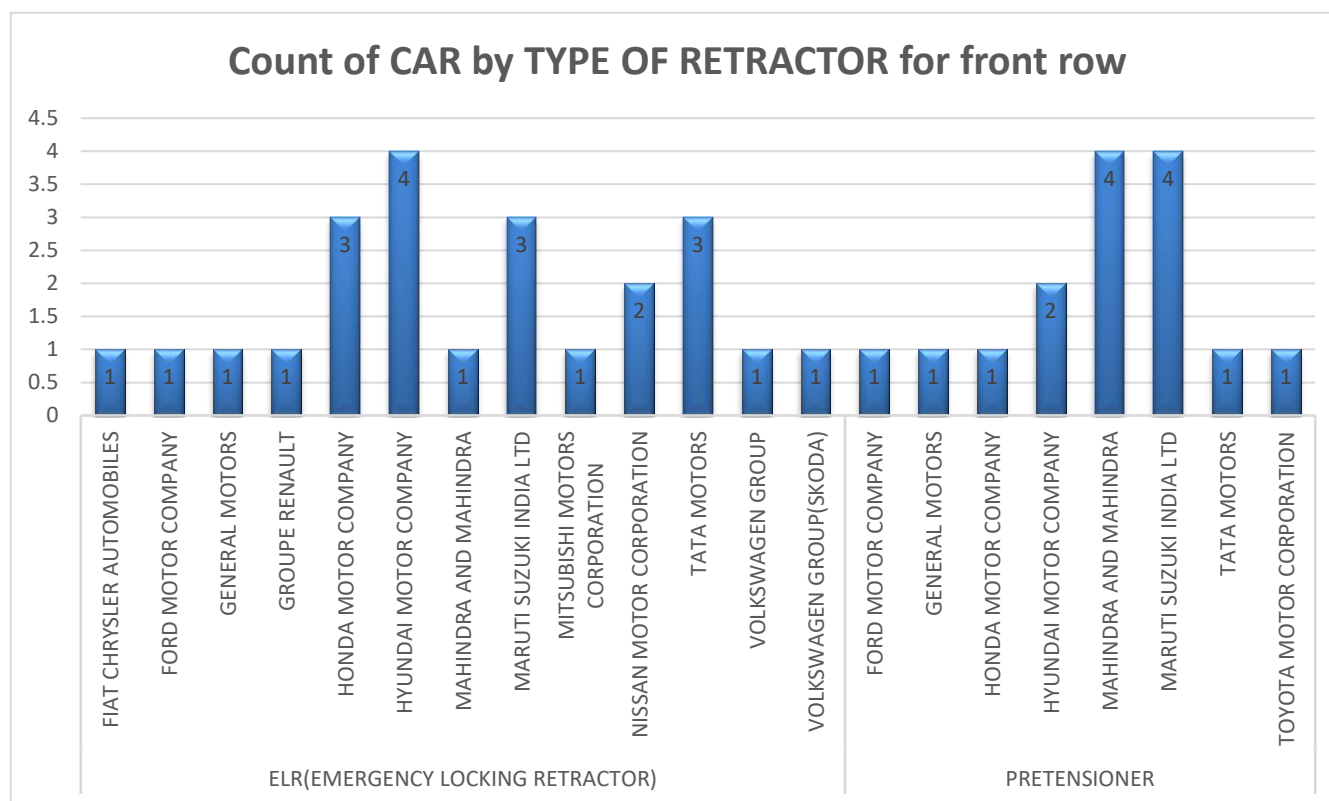


FIG 6.3 Count of car by type of retractor on the front row

6.2.6] Manufacturer of rear row belt :

MANUFACTURER	Count of CAR
AUTOLIV INDIA PVT. LTD.	6
KSS ABHISHEK	5
RANE TRW SYSTEMS	4
SS MANUFACTURING	4
TAKATA INDIA PVT. LTD.	3

TABLE 6.6 Manufacturer of rear row belt

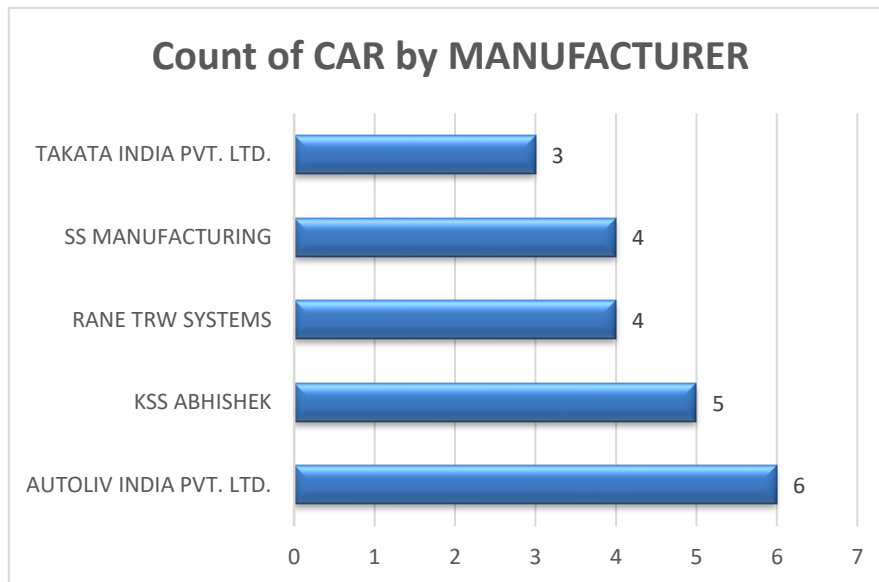


FIG 6.4 Manufacturer of rear row belt

6.2.7]Type of retractor in the rear:

TYPE	TYPE OF RETRACTOR	Count of CAR
COMPACT SUV	ELR(EMERGENCY LOCKING RETRACTOR)	2
HATCHBACK	ELR(EMERGENCY LOCKING RETRACTOR)	8
MPV	ELR(EMERGENCY LOCKING RETRACTOR)	1
SEDAN	ELR(EMERGENCY LOCKING RETRACTOR)	6
SUV	ELR(EMERGENCY LOCKING RETRACTOR)	5

TABLE 6.6 Type of retractor in the rear along with type of car

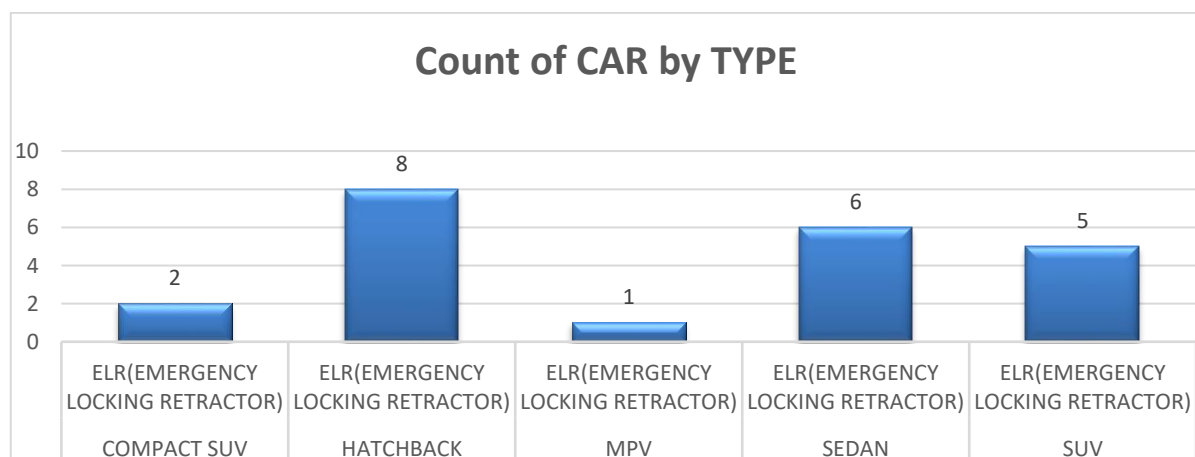


FIG 6.5 Type of retractor in the rear along with type of car

CHAPTER 7

CONCLUSION

- From the survey conducted from table 6.5 we can see that 60.5% (23 out of 38) of the cars considered for the front row have **ELR (Emergency Locking Retractor)** in them and 39.5% (15 out of 38) cars have **Pretensioner** in them. Thus, it is advisable for Original Equipment Manufacturers to use **Pretensioners** so as to reduce the slack and tighten the belt before the occurrence of crash or collision. Also **Load limiters** can also be used in the front row for all vehicles as it reduces the load acting on the rib cage of the passenger. This also would prove beneficial to old people who are prone to injuries more easily. Thus, Original Equipment Manufacturers should emphasize on providing **Pretensioners** along with **Load-limiters** in the front row.
- From table 6.6 and figure 6.5 it can be seen that all the type of vehicles use an **Emergency Locking Retractor** in the rear and the **Pretensioner** is not found in any of the vehicle. Here, as we know that the rear passengers are also not provided with Airbags at the rear they are prone to more injuries. Thus, adding a **Pretensioner** helps in reducing the slack and increase the safety of the passenger also, using a **Load limiter** might reduce the injury inflicted on the occupant. This system would be a boon to the elderly people who usually tend to accommodate the rear row of the vehicle, as they are more prone to injuries the lack of **Pretensioner** and **Load limiter** could lead to the fracture of rib cage of the occupant. Thus, Original Equipment Manufacturers should try to provide **Pretensioners** along with **Load-limiters** in the rear row as well.