Product Knowledge Document

PASSIVE SAFETY SYSTEM- SEATBELT

325 E. Eisenhower Parkway, Suite 4

Ann Arbor, MI 48108

(734) 761-4940

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Internet email: info@omnex.com

Web: www.omnex.com

HISTORY OF THE SEATBELT

- 1913 A pilot who survived a seaplane crash proposes that occupants of vehicles involved in crashes, should be restrained.
- 1950s The first calls for compulsory belt use. Some countries start setting standards for belts in cars - all belts in passenger cars are lap belts at this time
- 1956 Volvo introduces the first diagonal belts in passenger cars, while Ford and Chrysler in the USA start to offer front seat lap belts as an option on some models.
- 1986 Seatbelt rule was made permanent.
- 1989 Seat belt wearing by rear child passengers becomes law in cars where appropriate restraints have been fitted and are available.
- 1991 Adult passengers required to wear seat belts in the back of cars.

INTRODUCTION - Automotive Seatbelt

- The function of a seatbelt is simple: keep a person from flying through the windshield or hurdling toward the dashboard or steering wheel when the car where the person is suffers an abrupt stop

Why is this necessary?

Because of inertia!!!

Seatbelts are designed to retain people in their seats, and so prevent or reduce injuries suffered in a crash. They ensure that as little contact is made between the occupant and vehicle interior as possible and significantly reduce the risk of being thrown from a vehicle.

Seatbelts are designed to work as the key part of wider injury prevention measures and safety systems, such as airbags and head restraints, which will not be as effective in reducing the risk of injury if an occupant is not wearing a seat belt.

TYPES OF SEATBELT

There are five types of seatbelts which are used in the vehicle.

As below mentioned are –

1. 2 points – Lap
2. 2 points – Thoracic
3. 3 points – Lap + thoracic
4. 3 points with retractor mechanism
5. 5 points – Lap + thoracic + between legs.

2 POINTS

A 2-point belt attaches at its two endpoints, and was invented in the early 1900s by Jack Swearingen of Louisville, Kentucky. A lap belt is a strap that goes over the waist. This was the most commonly installed type of belt prior to legislation requiring three-point belts, and is primarily found in older cars. Coaches are equipped with lap belts (although many newer coaches have three-point belts), as are passenger aircraft seats.

3 POINTS

Three-point belt is a **Y**-shaped arrangement, similar to the separate lap and sash belts, but unitized. Like the separate lap-and-sash belt, in a collision the three-point belt spreads out the energy of the moving body over the chest, pelvis, and shoulders. Volvo introduced the first production three-point belt in 1959. The three-point belt was developed by Nils Bohlin

5 POINTS

- Five-point harnesses are typically found in child safety seats and in racing cars. The lap portion is connected to a belt between the legs and there are two shoulder belts, making a total of five points of attachment to the seat. A 4-point harness is similar, but without the strap between the legs, while a 6-point harness has two belts between the legs. In NASCAR, the 6-point harness became popular after the death of Dale Earnhardt, who was wearing a five-point harness when he suffered his fatal crash; as it was first thought that his belt had broken, and broke his neck at impact, some teams ordered a six-point harness in response.[25]

3 POINTS Seatbelt with retractor mechanism consists in:

- a spool (cylinder), which is attached to one end of the webbing
- A spring
- A buckle.

In this mechanism at centre there is one spool attached on this spool one end of webbing is attached , on the centre of spool there is one spring attached with one end of spring connected to spool centre and one end to gear as shown in this fig.

When we pull the belt the spring get expanded (tension is created) and tries to come back to its original position thus when we release the belt spring will retain to its original position and seat belt will be wrap up to spool to its original position.

Figure - Seatbelt retractor mechanism

3 Points seatbelt with retractor mechanism

The locking of belt is done as per following ways

The retractor has two locking mechanisms that acts when the car is involved in a collision.

- system triggered by the car's movement
- system triggered by the belt's movement

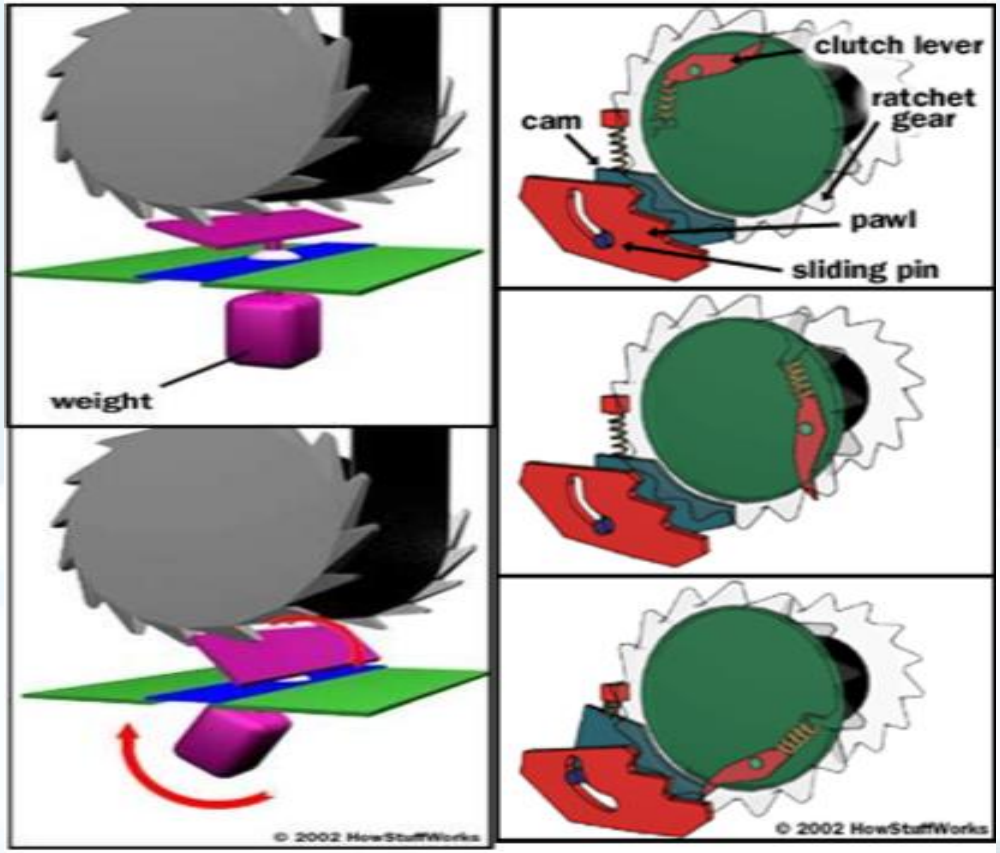


Figure - Locking mechanisms

System triggered by the car's movement

The main element in this system is a weighted pendulum connected to a pawl that hold of a toothed ratchet gear attached to the spool this prevents the spool for rotating. This system acts when the car makes a sudden stop (emergency brake or a hit). Due to sudden jerk pendulum start movement due to that the pawl will get stuck in to the ratchet gear tooth as shown in fig. due to which spool rotation is stooped and belt gets locked and therefore, keeping the passengers on the seat. As we release belt in the opposite direction the webbing loosens again after the crash, the gear rotates clockwise and the pawl disengages.

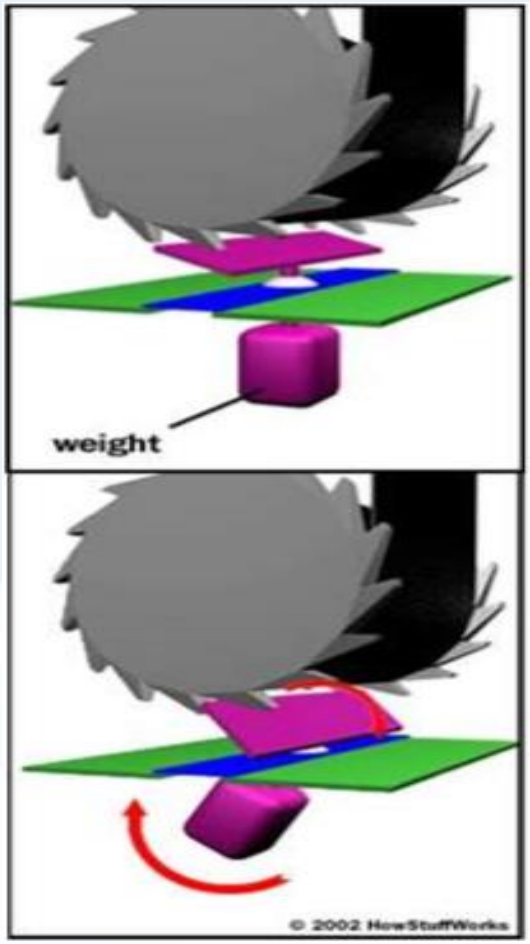


Figure - Car's movement locking mechanism

System triggered by the belt's movement

This mechanism works on the principal of centrifugal force

The trigger of this system is the speed of the spool rotation.

In this system the clutch lever is mounted on the spool through pivot joint, when we pull belt slowly the spool also rotate slowly and lever will not move from its position, but when we pull belt fast the spool will rotate fast and centrifugal force will act on the clutch lever and pull the lever outside this will push the cam upward with sliding pin which push the pawl upward , so this pawl gets lock with ratchet gear and thus restrict the rotation of spool and thus belt gets lock. therefore, keeping the passengers on the seat. As we release belt in the opposite direction, the gear rotates clockwise and the pawl disengages.

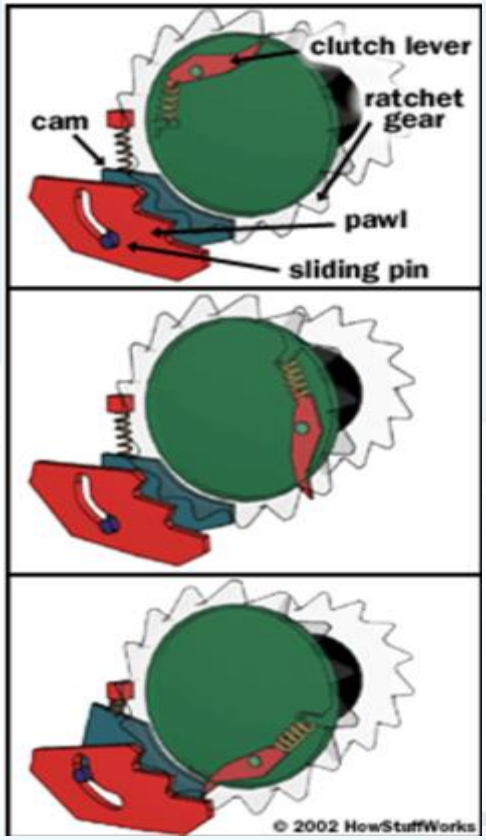


Figure - Belt's movement locking mechanism

Seatbelt Pretensioner

Pretensioner is always provided with the vehicle having airbags , The main function of Pretensioner is to land the person safely on the airbag at the time of crash.

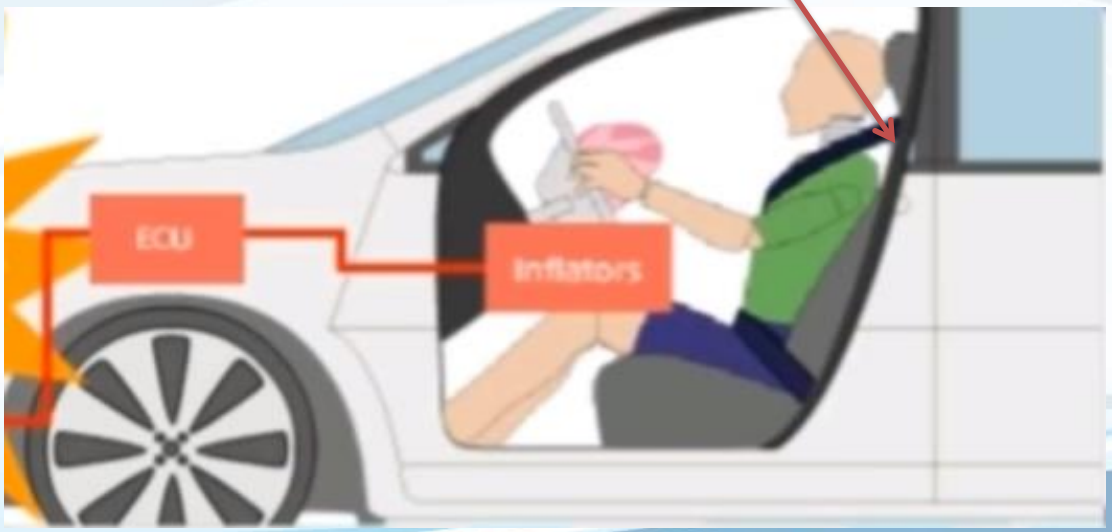
When a crash occurs the collide sensor gives the signal to the ECU that vehicle got crashed or sudden deceleration has been happened then ECU gives the signal to the inflators, which will activate the air bags and Pretensioner.

The Pretensioner tights up any slack in the belt webbing when a crash occurs. So the person will not move forward from seat

Seatbelt pretensioner

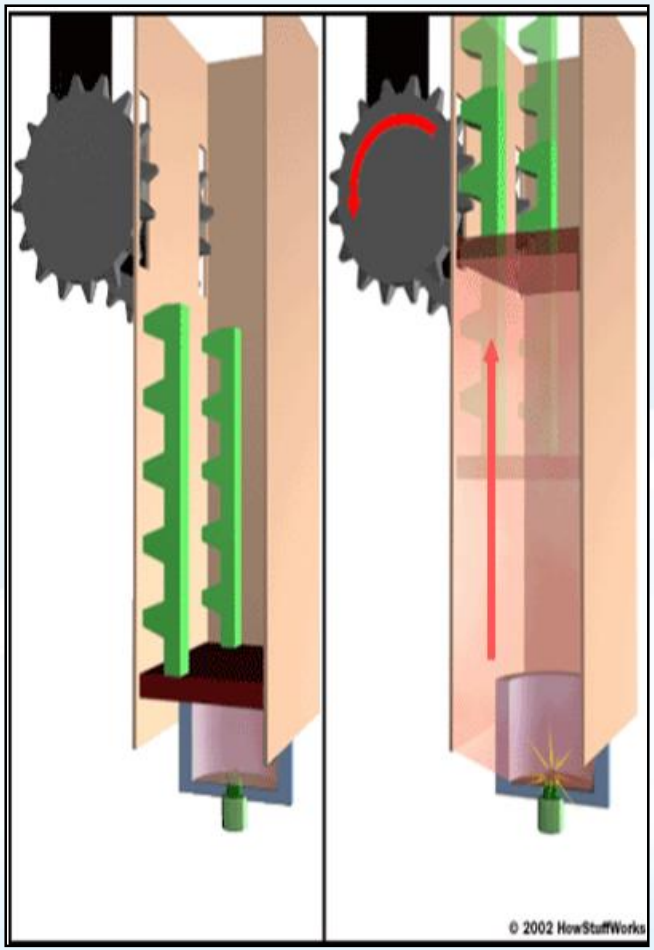
Before the pretensioner activation gap between person and chair

After the pretensioner activation gap between person and chair reduced



Seatbelt pretensioner

Some Pretensioner pull the entire retractor mechanism backward and some rotate the spool itself.



Seatbelt activation time sequence

Moment (milliseconds)	Occurrence
0	The collision occurs
10	During the initial time, the system has assessed the need of intervention of pretensioners, according to the level of deceleration recorded by the respective sensors.
12	At this moment, the passenger is still in the right position. The activation of the pretensioner occurs, beginning the process of retracting the seat belts.
24	The belt retraction is already finished (7 to 15 cm), being more close to the body of the passenger. The conditions are optimal for sustain the passenger and gradually absorb their energy when projected forward.
25	About this time, the passenger begins to move forward.

Load limiters

Some systems use load limiters to minimize the injuries caused by the belt.

A load limiter is designed to allow the seat belt force applied to the chest to rise only to a point where serious injury is unlikely. The seat belt is then allowed to extend in a controlled manner, maintaining a constant restraining force to absorb energy.

The simplest way to implement a load limiter is to sew a fold into the seat belt webbing. If the force of the impact is to high, the stitches are ripped out and the webbing unfolds, allowing a slightest forward motion.

There is also some mechanical devices that uses the same principle.

The one in the picture, have the form of a ladder. The seat belt retractor is held in place at the bottom end of the ladder and its motion restricted by the presence of the teeth. As the seat belt force increases, the teeth begin to deform, allowing the seat belt anchor to move along the length of the ladder device.

Load limiters

Due to movement of body, person will be pushed forward and there is pressure on chest and body , load limiter will be activated after certain pressure and release the belt slowly, so person will be land on airbag slowly

Load limiters

Figure 11 – Seatbelt load limiters [6]

Load limiters

An alternative type of load limiter uses a torsion bar built into the seat belt retractor. The torsion bar is a metal rod that will twist when sufficient force is applied. In minor collisions, the torsion bar will hold its shape, and the seat belt retractor will lock normally. But, when the force applied by the webbing, reaches the design limit, the torsion bar twists and allows the webbing to extend.

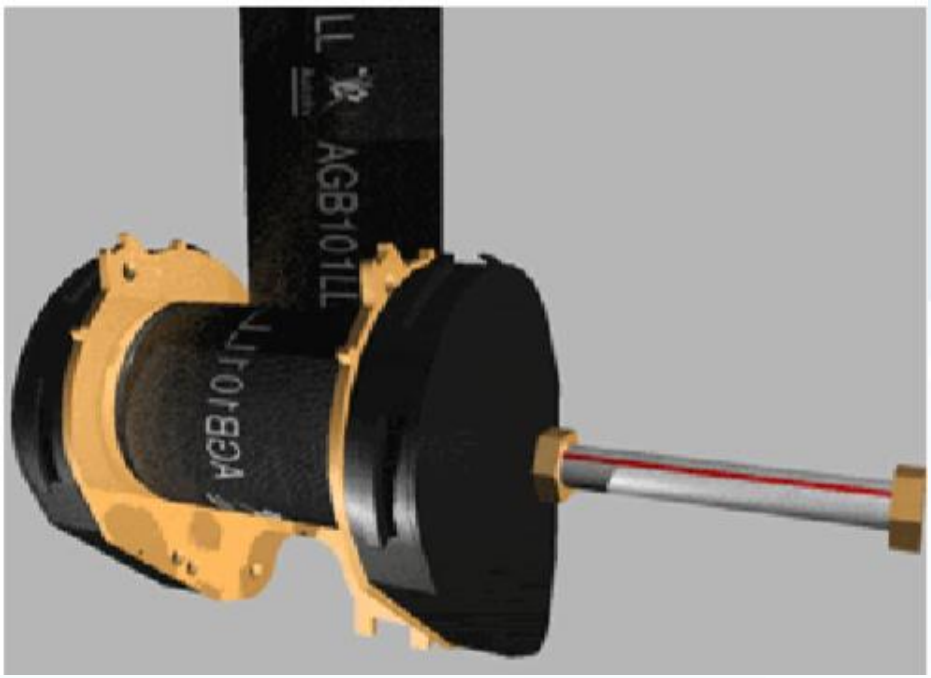


Figure 12 – Seatbelt load limiter

THANK YOU

Info-in@Omnex.com

Are there any Questions?