

Power Clamping on Adjustable Steering Columns – An Innovation in Steering Systems that Brings More Value to the End Customer

ZF-Lenksysteme

Vehicle Dynamics

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Power Clamping

- 1. Overview**
- 2. Technical Description**
- 3. Vehicle Integration**
- 4. Performance**
- 5. Timing**
- 6. Q&A**

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Opportunity

Vehicle manufacturers are challenged to deliver to their customers:

- ☐ More comfort
- ☐ More safety
- ☐ More value

For the steering column, the issues to overcome are:

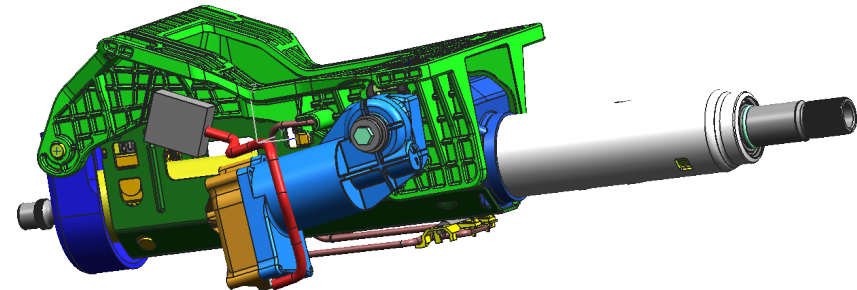
- ☐ Lever operation (ergonomics)
- ☐ Knee impact (unbelted case)
- ☐ Premium for electric adjustment

Solution

ZF Steering Systems has developed a new system where the clamping lever is replaced by an electric device:

The **Power Clamping** steering column:

- ☐ Replaces the manual lever by a switch
- ☐ Clears the space needed in crash for knee intrusion and helps knee airbag deployment
- ☐ Modular system add-on to manual column



In addition, the adjustment function gets full visibility as it appears as a switch on the steering wheel or the dashboard:

More value for the customer!

Operation

The interface with the driver is a button on the steering wheel:

- Pressing the button unlocks the clamping device and allows the adjustment.
- The column remains unlocked while the button is depressed.
- As soon as the button is released, the device clamps and the column is locked in position.

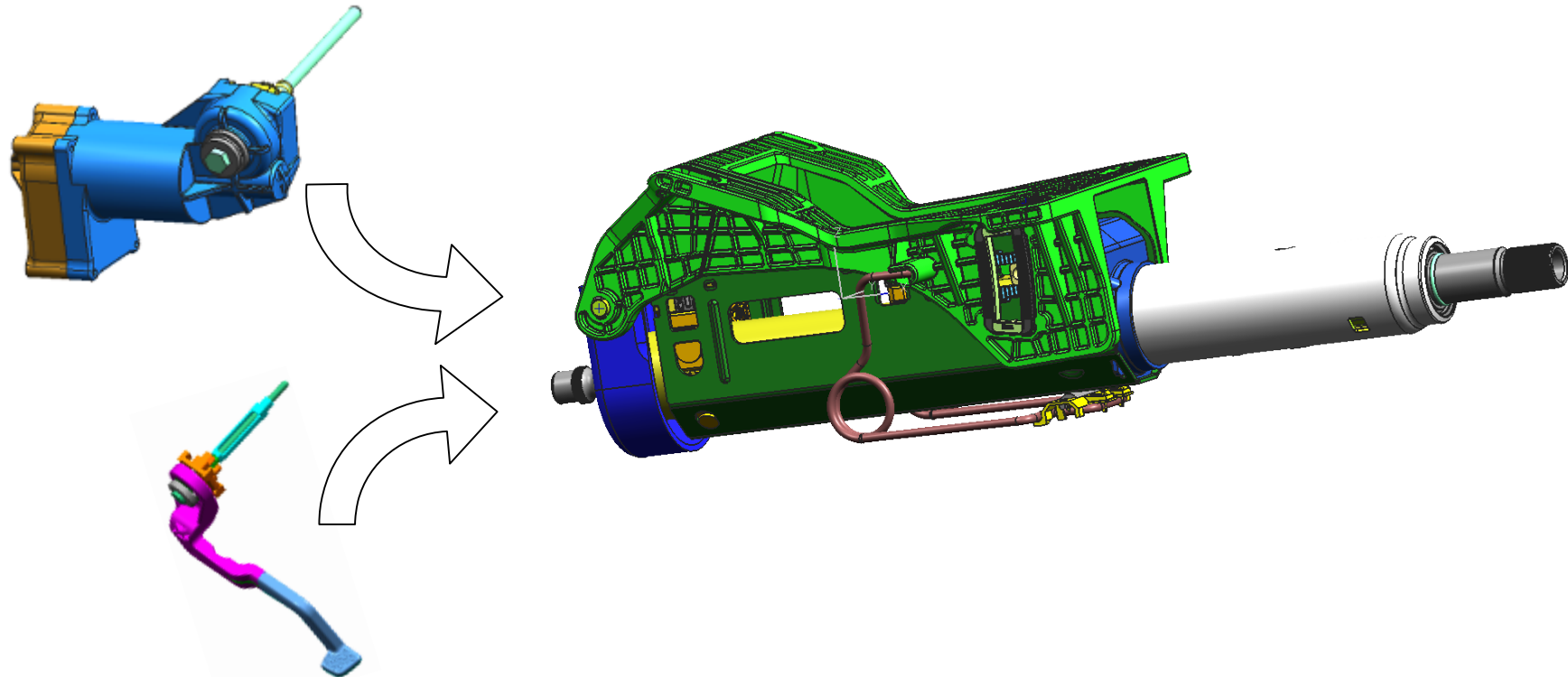
Power Clamping Control Switch



Modularity

This device is an additional feature which can replace the original clamping device on most columns.

This modular execution also allows this to be an optional feature: A portion of the volume can remain adjustable using a rake lever, and a portion can have Power Clamping



Power Clamping

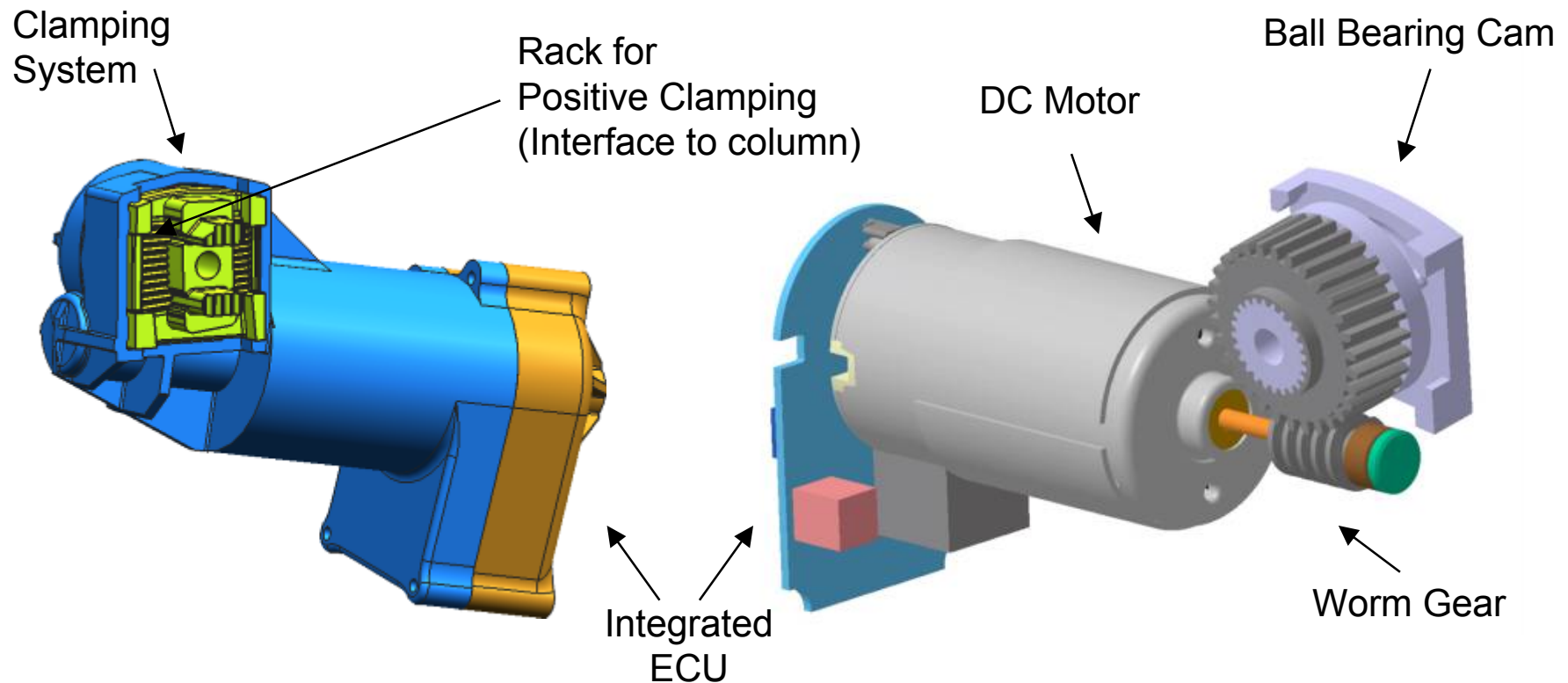
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Concept

This is a stand alone system which can fit on a manual column by replacing the lever and the clamping device (cams or needle system.)

The device integrates an electrical motor, a gear, a ball cam and the command ECU.

The system is actuated with a button ideally located on the steering wheel.



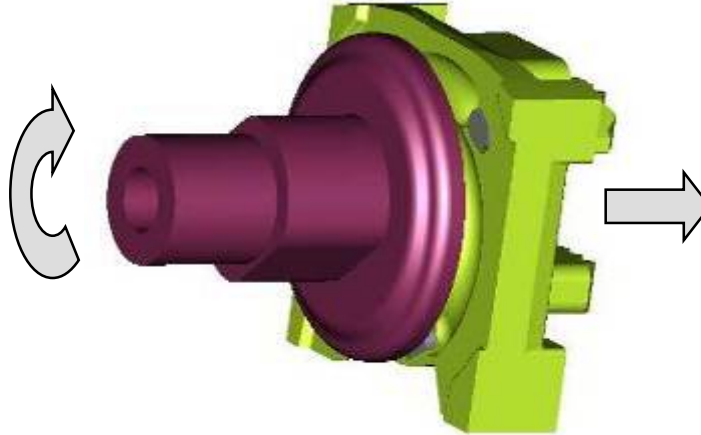
Ball Bearing Cams

ZF-Lenksysteme has developed a new set of cams, adapted to the e-motor.

Three 5 mm dia. balls roll between the cams on an optimized profile with a variable radius that allows:

- ❑ Large angular movement which helps to reduce the high rotational speed of the e-motor
- ❑ Small packaging, equivalent to a manual cam system
- ❑ High efficiency, the radius is minimum when the load is maximum

The mobile cam rotates on a 400° angular stroke



The fixed cam translates on 3 mm stroke



Mobile cam with balls



Fixed cam

Ball bearing cam design is ZF-LS patented

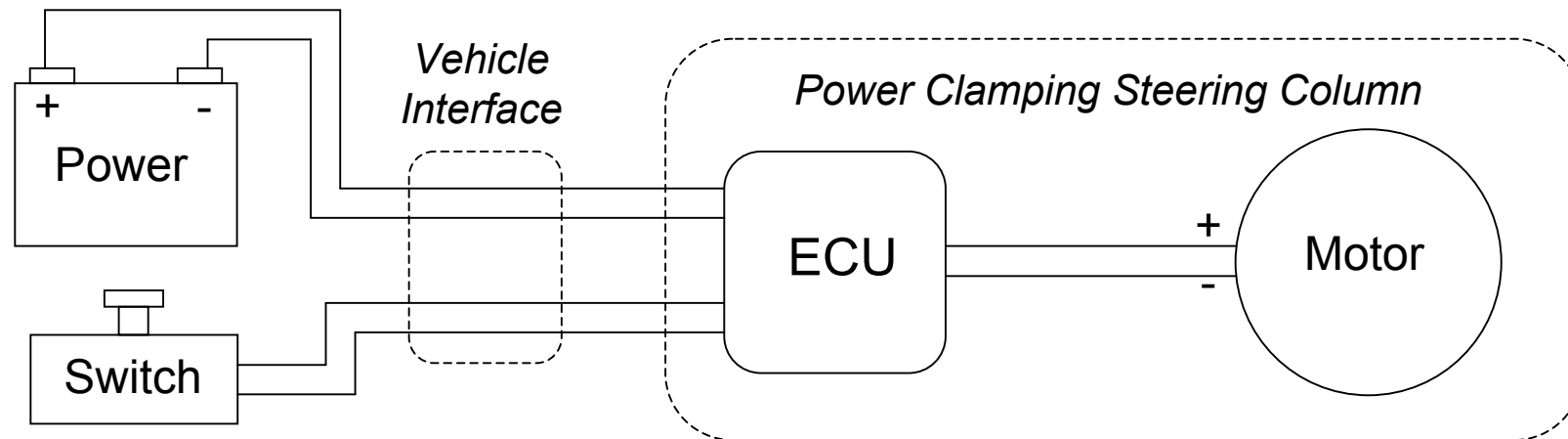
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Electrical Integration

A control unit is required to actuate the motor according to the driver request, to manage the positive clamping system and for low noise operation (soft opening and closing stops.)

ZF-Lenksysteme proposal is to offer a comprehensive solution packaging the ECU into the column for a seamless electronic vehicle integration.



Switch & Power Supply

Multiple options:

- ☐ Direct switch
- ☐ Signal from vehicle ECU
- ☐ Wake Up on Switch

Integrated Electronic Control Unit

- ☐ Plug-n-Play, no line calibration needed
- ☐ Built-in tooth-on-tooth management
- ☐ No CPU time required from Vehicle ECU
- ☐ No need for more complex Vehicle ECU
- ☐ Easy manual / power clamping handling

Motor

- ☐ Optimized Cam
- ☐ Thermal Protected

Electronic Vehicle Interface

Two strategies can be considered for the ECU:

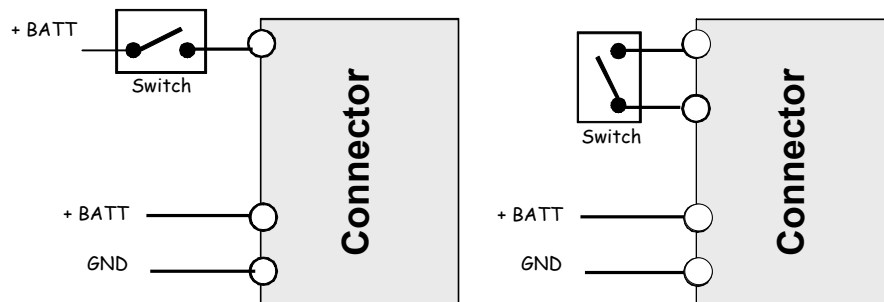
1. System is waken-up when driver pushes the Power Clamping switch
2. Use of Power Clamping is granted by a dedicated ENABLE signal as an output of a vehicle ECU (for example to enable / disable the Power Clamping function above a certain speed)

For both cases, only a very low drawn current is required.

System connection to the vehicle harness is to be made by any VM approved connector

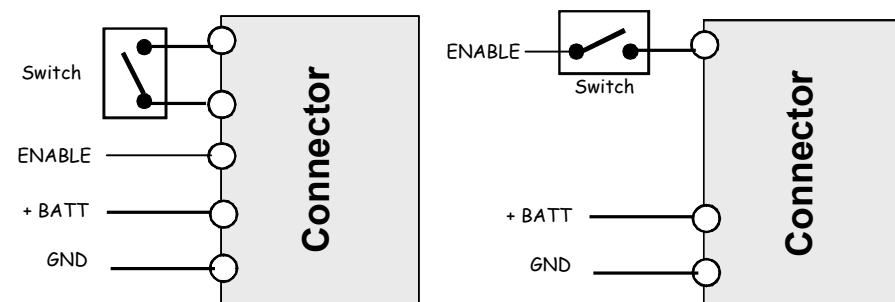
1/ System is waken-up by pressing the Power Clamping switch

2 wirings are possible:



2/ System use is granted by an ENABLE (vehicle ECU output)

2 wirings are possible:



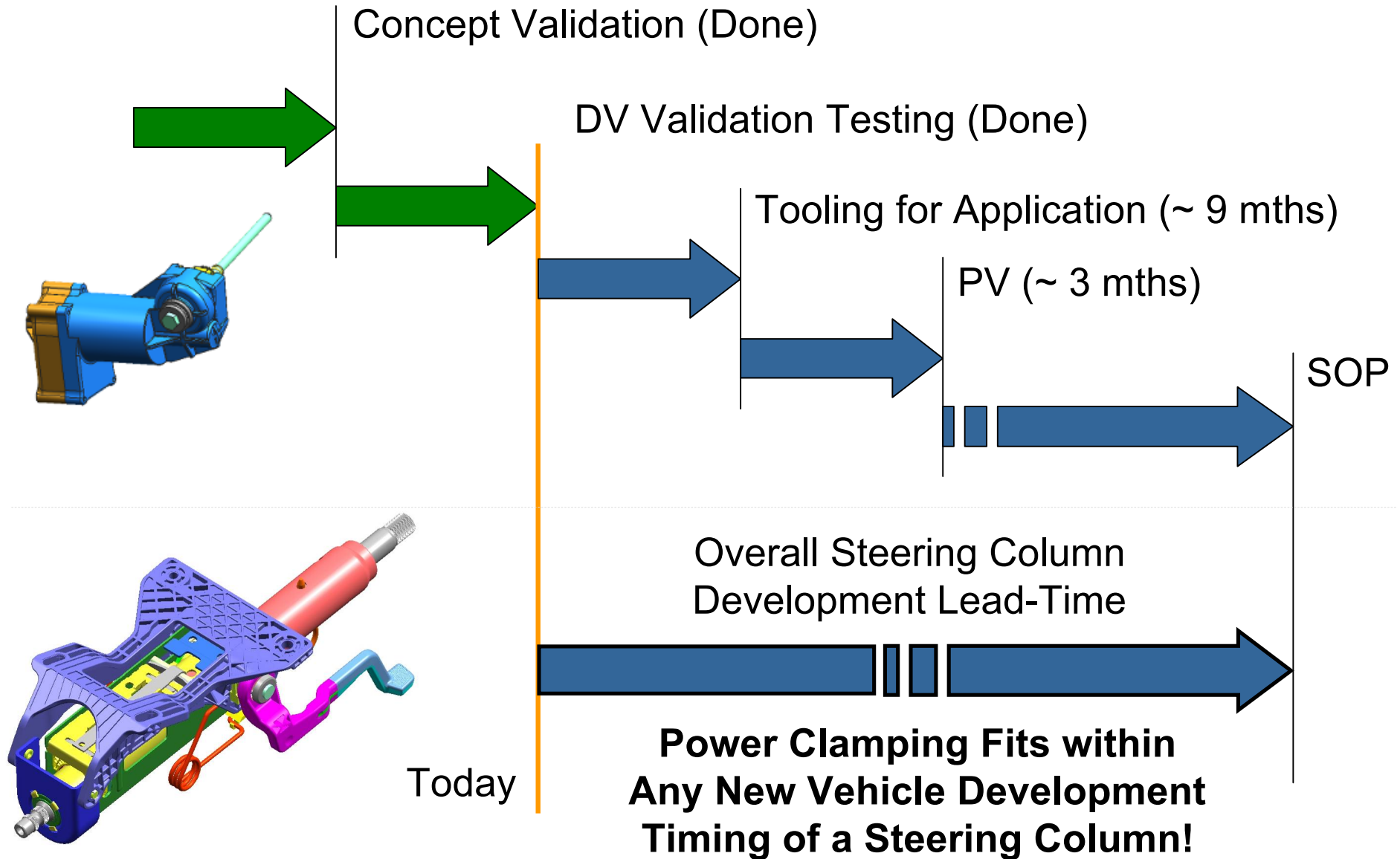
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| Item | Value | Comment |
|-----------------------|----------------------------------|---|
| Operating time | 0.5s max | |
| Working temperature | -40°C to +85°C | |
| Max clamping load | 5000 N | Over manual systems |
| Max clamping stroke | 3 mm | |
| Frequency | Not impaired | |
| Mass | Approx. +235 gr. | Additional mass on column is 0.235 kg after removing a lever mass of 0.265 kg |
| Noise level | 55dB _(A) (peak noise) | @ 50 cm of S/W towards driver |
| Operating voltage | 9V to 16V | May be extended upon request |
| Stand-by current | <100 µA | |
| Max operating current | 14.5 A (10 A) | @ 5000 N, 12V & 25°C (@ 3000 N, 12V & 25°C) |
| Stall current | < 25 A | During 50 ms max |

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*Thank you for
your attention...*

