

NAGYTELJESÍTMÉNYŰ ELŐVEZÉRLŐ SZELEP FEJLESZTÉSI PROJEKT A GYAKORLATBAN

PRODUCT DEVELOPMENT PROJECT OF HIGH PERFORMANCE ELECTRICAL POWER PILOT VALVE IN PRACTICE

Soltész László, MSc

ÖSSZEFOGLALÁS

Egy elővezérlő szelep fejlesztésén keresztül kaphatunk betekintést egy nemzetközi nagyvállalat által ipari környezetben kivitelezett termékfejlesztési projektbe. A projekt célkitűzéseit, termékspecifikációját ismerhetjük meg. Az elkészült termék részleteit, a tervezés legfőbb irányvonalait mutatja be a cikk.

ABSTRACT

We get an overview and understanding of a product development project of a pilot valve at a multinational company in an industrial environment. Project goals, product specifications will be explained in detail. This article explains the main goals of the project, the details of the final product.

1. INTRODUCTION

Companies to keep competitiveness must continuously find new and newest ways for creative and cost efficient solutions. Usually purchasing and product development departments are working together to find changes, improvement to deliver cost saving in running production. Parallel to this, a big challenge is to focus on quality level and keep same or better quality product, from specification point of view. Several perspectives are checked during this process to be successful. In this article we will see influences between departments, how possible it is to make an environmentally friendly, effective product development project in sustaining engineering area to deliver massive advantage for the company by cooperation.

2. DESCRIPTION OF PRODUCT

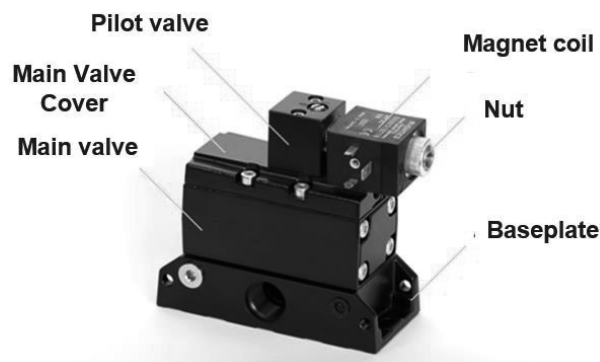
The 3/2 pilot valve family, which is the subject of this article, regulates, controls the operation of the high-performance valves. The products are combined by electro-pneumatic components converting the electric controller signal to pneumatic signals. Two versions of the pilot

valves were designed. 10W and 5W power consumption versions. In both cases the switching time, flow volume is highly important and influence the switching speed of the main valve. These are measured in the test laboratory within the company. On the next illustration we can see how one of the pilot valves is built onto a main valve.

3. PROJECT TARGETS, SPECIFICATION

Companies that produces industrial products, the most important goal to helps their customers to increase their performance [1]. That's why main properties of the pilot valve family were defined at the start of development process as key factors for customer's performance increase:

- switching time
- environmental efficiency (for example anodizing instead of painting)
- energy efficiency
- stable operation
- usage of less packaging (replacing supplier import)
- design for assembly/automation



1. Figure. Parts of valve system

Pilot valve operates between 0,1-10 bar pressure, however, it is able to control valves operating on higher pressure. This means, that the air pressure required to the control is not the same as the air pressure in the main valve. Those main valves, where the pressure of the pilot is smaller, than the pressure of the air flowing through them, are

called high pressure valves. The pressure of these units can be as high as 30 bars. Most important market advantage of the valves compared to similar products is the short opening-closing time. These values can be found in the next chart, furthermore, we attach the data sheet of the catalog.

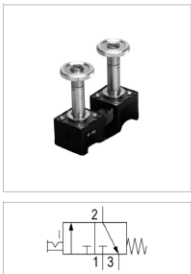
1. Table. Switching time specification

	Switching time [ms]	
	Open	Close
5W version	12	15
10W version	16	30

Final specification for customer in catalogue page contains main technical data what is important first step of product selection in first step.

2. Table. Product catalogue sheet

Pilot valve
- Manual override with detent



Working pressure min./max. 0 ... 10 bar
Ambient temperature min./max. -15 ... 50 °C
Medium Compressed air
Protection class with connection IP65
Duty cycle 100 %
Weight See table below

Part No.	Operational voltage DC	Operational voltage AC 50 Hz	Operational voltage AC 60 Hz	Power consumption DC
0493818805	24 V	230 V	110 V	5 W
0493818902	24 V	-	-	2 W

Part No.	Power consumption	Weight
0493818805	-	0,031 kg
0493818902	Low power consumption	0,03 kg

Technical information

The min. control pressure must be adhered to, since otherwise faulty switching and valve failure may result!
The pressure dew point must be at least 15 °C under ambient and medium temperature and may not exceed 3 °C.
The oil content of compressed air must remain constant during the life cycle.
Use only the approved oils from AVENTICS. Further information can be found in the "Technical information" document (available in the MediaCentre).

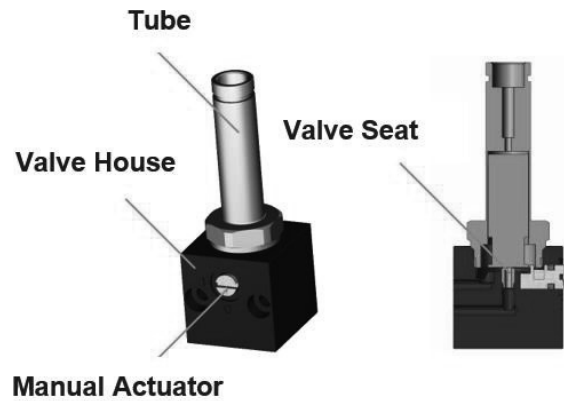
Further details are available by Emerson during product selection and tailoring for final application of product.

4. PRODUCT DESIGN DETAILS

Our all-time goal is to serve our customers, with the required quality and innovative solutions created with optimal extent of energy investment. Besides, to set an example with our work on the domestic and national market with our intention to help the Hungarian industry and economy. Therefore, we involved and developed the 3/2 CNOMO French automobile industry

standard satisfying, 10 watt and 5 Watt, in 0,1-10 bar pressure interval operating pilot valves in the domestic production. In 2018, we reacted to the current customer needs, because the products were popular and were requested in a big quantity by the heavy industry.

On the next illustration the most essential parts of the 10W pilot valve can be seen.



2. Figure. 10W product model

Considering the 10W pilot, the valve house, manual actuator and the seat is formed with chipping. In case of the other construction these parts are manufactured with molding. In both cases, the manufacturing process happens in our Hungarian factory, therefore we don't import it from supplier anymore. As a result, the manufacturing cost of the products got significantly lower, also, the way of the material flow got simpler. In the case of the 10W pilot valve the material of the house is black color anodized aluminum. The manual actuator is made of brass, which guarantees the resistance and the long lifetime of the parts against corrosion and the extreme temperature intervals.

As for the 5W pilot the house is made of glass-fiber reinforced plastic. The manual actuator is made of brass. The lifetime of the pilot valves is measured in switching cycles. The guaranteed value is 10 million cycles for every product. Considering the products' pressure stress, we calculate with triple safety factor, in both cases, which means that for a short period of time they can bare three times the maximal 10 bar operating pressure. As a result of the 10W valve development, on 10 bar operating pressure it grants a more stable and more reliable function than before. The usage of the product is relevant, because it is used as a pilot valve in the high flow-rate valve terminals, in heavy industry.

80% of the usage comes from ship and train industry.

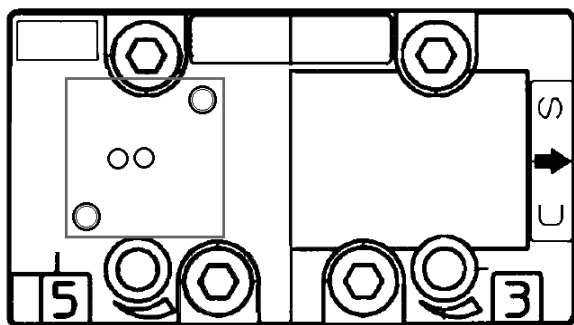
4. PRODUCT APPLICATION AREAS

The pilot for example the type 565, built onto main valves operating on 30 bar are used at the starting of two stroke ship engines. In case of this process, it is indispensable, that the required amount of air on a specified pressure to be available. Otherwise, the drive unit will not be able to start the ship engine or can only be carried out beside/along unfavorable torque features. On a long term this can result in the decrease of the engines lifetime. Because of this it is possible, that in the case of the pilot even on extreme temperature intervals (-40°C...+80°C) to achieve stabile function.

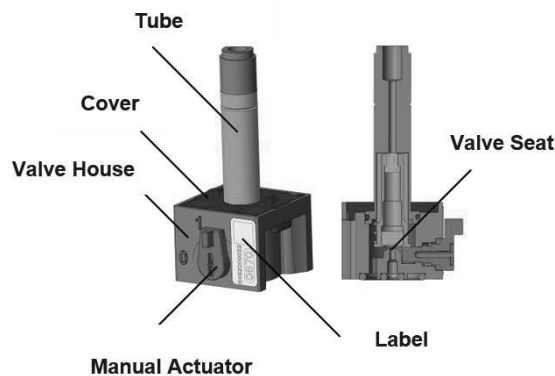
Products can be found in railway train switchboards, that among other roles has use in the following applications: the opening and closing of passenger cabins, air and retarder brakes, as well as the control tasks of couplers.

5. VARIABILITY OF PILOT VALVE

Due to the unique shape of the 5W pilot valve chamber, it became easier to mount the valve onto the main valve. This manifests in the process of the assembly. Before this, in some cases, the cover of the main valve had to be fixed to the main valve itself in order to mount the pilot valve to the cover. In older versions, there was no space for fastening screws. Because of this, only two superpositions were possible. However, due to the new design, the side of the case is sunk, which provides free space for the fastening screws in any position, enabling to mount the pilot valve to the cover in four available positions. (for example, in case of ISO 1) Thus, the order of fastening can be freely modified. We can see an example about the positioning of the valve cover and the pilot valve on the following figure.



3. Figure. Positioning of pilot valve



4. Figure. 5W product model

6. VERIFICATION

During design of the pilot valve, it was an important aspect to develop a construction and function structure which defines the consumer interest as a primary aspect. The pilot valves have a wide range of consumers. This means that its usage has various locations, temperature ranges and functioning mediums. The valves have to stand against climate impacts and disturbing factors. Example: high temperature, low temperature, vibration, salt saturated medium.

From a design point, you have to consider these outer impacts during the functioning of the product. The 10 Watt and 5 Watt 3/2 pilot valves have a lower function range of -40°C, and the higher function range is +80°C. In this case when valves work on this low or high temperature, we cannot neglect the importance of the testing phase. In order to guarantee our customers the functioning on these extreme temperature ranges, in our company, an officially developed and investigated testing laboratory is in service, where testing engineers are working to create a product with better quality. Even satisfy special non-series needs, they are testing the half-done products, in a simulated, close to real life circumstances. Therefore, eliminating the errors occurring during function and raising safety. We can confirm our different tests with one test plan template and one test record sheet example. This record sheet displays the function speed of the whole 563 valve, using a pilot valve developed by us. The accurate measurement results cannot be published due to privacy.

7. MARKET SITUATION

Generally, in normal product life cycle in ramp-up phase product is produced to domestic market and after sufficient marketing and production knowledge are built up, next step can be

international market introduction. [2] In our case, because of predecessor product already in the beginning pilot valve was available in European market. The product family of pilot valves has shown a potential to improve, based on former functions and inner customer feedbacks. Therefore, we took a commitment to further improve them, as well as to create new ones. The results are the current 10W and 5W products.

The yearly selling potential of the valve product family is approximately 8000 pieces. This includes the spare parts and the controls built on the main valves. We market these as incorporated products towards end-users. The new product shows improvement in several aspects (For example: Reliability, Switching time) contrary to its predecessor. Therefore, the expansion of the market segment is expected both in internal and foreign areas, even where former products were not in competitive state.

Most customers who purchase the pilot valve and main valve come from the far East, thus the training and implementation on American and European continents signify an important market potential, including the domestic market too. Within the European market we deliver to Sweden, Finland and Germany. We are collaborating with multiple customers in this market now for example in railway and ship industry segments. The product family of pilot valves can be bought individually or as spare parts in the market. We can also expand the customer circle of the pilot valve family, based on the positive feedback that we have received during the improvement of products with similar usage and function.

We have sold multiple 10W and 5W pilot valve products developed by us, and to our customers content, they are working in a secure process. This is proven by the fact, that since the introduction of the 10W pilot valve, the July of 2018., we have not received a single external complaint. 5W pilot valve was introduced to the market during the April of 2019., and similarly, no complaint was received. Based on the positive experience granted by the successful project, we began the development of the „brother” products. The development of the 2,1 Watt pilot valve deserves a highlight among these future projects.

8. SUMMARY

This new pilot valve family with two members could take over position of predecessor. In several area like producibility, economy, energy efficiency and environmentally friendly solution can overdeliver original product to fulfill requirement of company management. Customers will be satisfied with stable working in hard environment in heavy industry area parallel high speed and quick reaction time. Especially nice achievement to execute this design work with focus for manufacturing. Because of these actions most suppliers of raw materials, half made parts are delivering products from near of final assembly. The High performance electrical power pilot valve family won Value and Quality award from independent jury in 2019.

9. REFERENCES

- [1] Hannu Kärkkäinen, Petteri Piippo, Markku Tuominen: Ten tools for customer-driven product development in industrial companies, *Int. J. Production Economics* 69 (2001) 161-176
- [2] J.C. Wortmann et a. (eds.), *Customer-driven Manufacturing*, Chapman & Hall 1997