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## CONTRIBUTIONS TO THE DEVELOPMENT OF AN APPLICATION USING THE AUTOLISP ROUTINE

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**Abstract:** In this paper is presented the importance of using and developing new functions in AutoLISP routine. By calling these functions it is more quickly and easily to get regular geometric shapes. The application was created in order to reduce the execution time of some drawings in the AutoCAD design software. The main advantage of using these features is that the desired shape will be obtained automatically based on the input parameters.

**Key words:** AutoLISP, AutoCAD, flange, section plan, cylindrical flange

### 1. INTRODUCTION

The AutoCAD is a computer aided design software (CAD), developed by Autodesk Inc. California, USA. This software is used by designers from several fields, such as: mechanics, robotics, electronics, electro mechanics, civil engineering, architecture, industrial design, a.o. The AutoCAD software contains also the AutoLISP programming tool which is used to define easily different geometric shapes. AutoLISP uses the default functions and codes in order to model the parts of a drawing. The user developed functions contains also parts of the default functions and new commands written by the users which help to define the new algorithm required to obtain the wanted complex geometric shapes [1], [2], [3], [6], [7].

The advantage of using functions written in AutoLISP is that the drawings will be obtained in a shorter time and in an easy way. These codes are saved in separate files and it can be used whenever needed.

### 2. THEORETICAL DEVELOPMENT

The AutoLISP environment uses the LISP language, which, with elegance and simplicity,

performs a symbolic processing of the input data without neglecting the numerical solving.

The functions used in an AutoLISP routine are mathematical objects that return a numerical value starting from the input data.

The AutoLISP routine is a simpler and concise programming language compared to the other ones and this make it to be often used to create complex geometrical shapes in AutoCAD.

This kind of functions contain different objects, such as: variables, constants, other functions, macros, classes and object oriented methods.

In this article is presented an AutoLISP function used to draw a cylindrical flange.

The flanges are objects used in detachable assembling of two pipes, tubes or other components of the fluid installations.

There are many companies that produce different type of flanges of variable sizes but using standardized values for the parameters that define these objects. Considering the geometry of the flanges, there are: cylindrical, square, triangular, rectangular, rhomboid or oval [5].

The specific geometric elements which characterize any type of flange are:

- the central hole, which is concentric with the hole of the body that will contain the flange;
- the plane surface for the gasket placement;
- the screw holes or other clamping elements.

Based on the studied articles it is obvious that the most widely used flanges, are the cylindrical ones. Usually, the cylindrical flanges have an even or odd number of mounting holes placed equidistantly on a bearer circle.

The flanges usually are represented in two projections: a longitudinal section that shows the thickness of the flange, the shape of the mounting holes (smooth or threaded holes) and the way in which the flange is linked to the rest of the components; the second projection is a front or a back view of the flange that show us the type of the flange, the number and the layout of the mounting holes. The section plan commonly passes through the mounting holes axis (figure 1), but in some cases, when is needed another view of the flange for some details the section plan does not pass through this holes (figure 2).

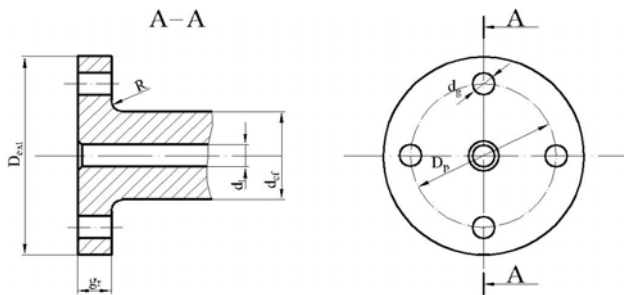


Fig. 1. The section plan passes through the mounting holes [4]

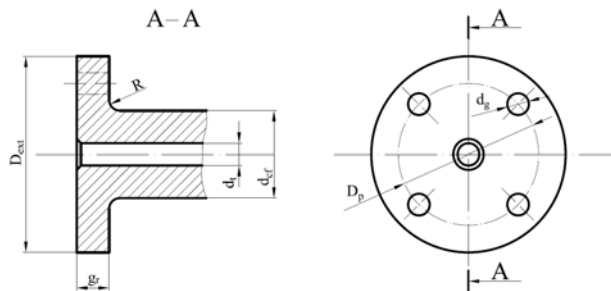


Fig. 2. The section plan does not pass through the mounting holes [4]

The mandatory parameters that fully define a flange are:

$D_p$  - the diameter of the bearer circle;  
 $D_{ext}$  - the external diameter of the flange;  
 $d_g$  - the diameter of the mounting holes;  
 $d_t$  - the diameter of the center hole;  
 $g_r$  - the collar thickness of the flange;  
 $R$  - the radius of the fillet between the collar and the tube of the flange.

### 3. THE AUTOLISP ROUTINE

In order to define a function in AutoLISP the users need to use the **"defun"** keyword at the beginning of the new algorithm, then in the body of the function can be written other commands or call other functions.

Taking into account the above mentioned conditions, the developed AutoLISP program, designed to draw cylindrical flanges, contains the **"defun"** keyword, the parameters that define the flanges and the specific LISP commands.

A part of the code written in AutoLISP that contains the input data is presented below:

```
(defun c:flansa() ;Drawing a flange
;Input data
(setq pt1 (getpoint "Coordinates of the starting
point: "))
(setq dtint (getreal "Inner diameter of the pipe:
"))
(setq dtext (getreal "External diameter of the
pipe: "))
(setq dfext (getreal "External diameter of the
flange: "))
(setq dga (getreal "Bearer circle diameter of the
mounting holes: "))
(setq dg (getreal "Diameter of the mounting
holes: "))
(setq nrg (getint "Number of mounting holes
(2,4,6,8,10): "))
(setq b (getreal "The thickness of the flange: "))
(setq l (getreal "The length of the pipe: "))
(setq rac (getreal "Fillet radius: "))
(setq tes (getreal "Chamfer depth: "))
```

Using an approach based on the polar coordinates the external contour of the flange, the chamfers and the fillets were drawn, obtaining the section view of the cylindrical flange with an even number of mounting holes. In this case the section plan passes through the mounting holes.

The part of the code written by the authors in order to create the cylindrical flange section is presented below:

**;Calculated data - the radius of the circles of the flange**

```
(setq rtint (* 0.5 dtint))
(setq rtext (* 0.5 dtext))
(setq rfext (* 0.5 dfext))
(setq rga (* 0.5 dga))
(setq rg (* 0.5 dg))
```

**;Drawing the front view of the flange**

```
(command "circle" pt1 rtint "")
(command "circle" pt1 rtext "")
(command "circle" pt1 rfext "")
```

**;Drawing the fixing holes on the front view**

```
(setq ang (/ 360.0 nrg)) ; the angle between the axis
of the mounting holes
```

```
(setq i 0)
(while (< i nrg)
  (setq ptg (polar pt1 (+ (/ (* ang i pi) 180.0) (/ pi
    2.0)) rga))
  (command "circle" ptg rg "")
  (setq i (+ i 1)))
```

**;Determination of the coordinates of the starting point for the section view**

```
(setq pt2 (polar pt1 0 (* 2.0 rfext)))
```

**;Drawing the upper part of the section view**

```
(command "line" pt2 pint1_1 pint1_2 pint1_3 "")
;the top front part of the flange
```

```
(command "arc" (command "c" pint1_4 pint1_3
  pint1_5 "")) ; the fillet between the collar and the
tube of the flange
```

```
(command "line" pint1_5 pint1_6 pint1_7 "") ;the
top back part of the flange (the tube)
```

```
(command "line" pint1_8 pint1_9 "") ;the mounting
hole
```

```
(command "line" pint1_10 pint1_11 "")
(command "line" pint1_12 pint1_13 pint1_14 "") ;
the top inner part of the flange in the section view
```

**;The lower part of the section view**

```
(command "line" pt2 pint2_1 pint2_2 pint2_3 "")
(command "arc" (command "c" pint2_4 pint2_5
  pint2_3 ""))
```

```
(command "line" pint2_5 pint2_6 pint2_7 "")
```

```
(command "line" pint2_8 pint2_9 "")
```

```
(command "line" pint2_10 pint2_11 "")
```

```
(command "line" pint2_12 pint2_13 pint2_14 "")
```

Before an object can be built, complete information about both the size and shape of the object must be available. The process of adding size information to a drawing is known as dimensioning the drawing. This process was also included in this program developed in

AutoLISP and a part of these commands are presented below.

**;Dimensioning the drawing**

```
(command "_dimlinear" pint1_1 pint1_2 (polar
  pint1_1 (/ pi 2.0) (* texth 3.0)) ) ;Thickness of the
collar
```

```
(command "_dimlinear" pint2_9 pint2_11 "t" (strcat
  "%%%c" (rtos dg 2 2)) (polar pint2_9 (* pi 2.0) (*
  texth 3.0)) ) ;Diameter of the mounting holes
```

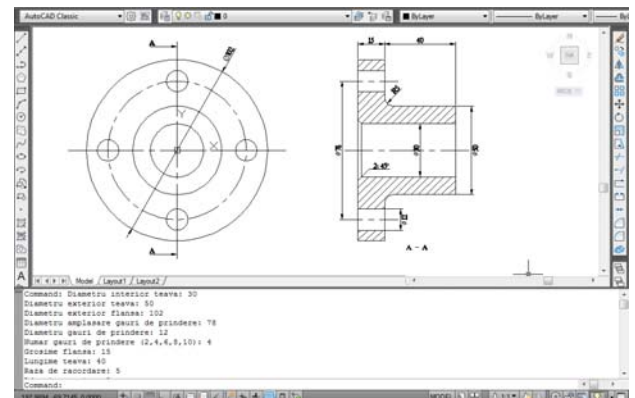
...

```
(command "_dimradius" pint1_3 (polar pint1_4 (*
  (/ pi 4.0) 5.0) (* 0.2 rac)) ) ;Fillet radius
```

```
(command "_dimdiameter" (polar pt1 (* (/ pi 180.0)
  88.0) rfext) (polar pt1 (* (/ pi 6.0) 2.0) (* 1.2 rfext))
  ) ;Outer diameter of the collar
```

## 4. OBTAINED RESULTS

The authors have developed a function named **FLANSA** using the AutoLISP program. This function contains the above presented code, necessary to draw a cylindrical flange using the AutoCAD software (figure 3).



**Fig.3 Calling the "FLANSA" function in AutoCAD**

The first step in order to create the cylindrical flange is to call the function by introducing its name in the AutoCAD command line [8].

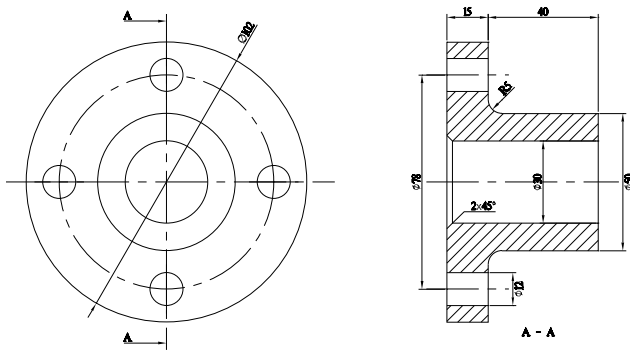
**Command: FLANSA**

The second step is to introduce the numerical values for the parameters that define the flange, these values also are set using the command line of the AutoCAD software. For each parameter a text message will be displayed, that will indicate to the user which parameter must be introduced. An example of using this function is presented below:

Inner diameter of the pipe: 30

External diameter of the pipe: 50  
 External diameter of the flange: 102  
 Bearer circle diameter of mounting holes: 78  
 The mounting holes diameter: 12  
 Number of the mounting holes (2, 4, 6, 8, 10): 4  
 The thickness of the flange: 15  
 The pipe length: 40  
 Fillet radius: 5  
 Chamfer depth: 2

After introducing the numerical values of the parameters, the cylindrical flange is automatically drawn (figure 4).



**Fig.4 The cylindrical flange**

In figure 4 is presented the obtained cylindrical flange completely dimensioned.

## 5. CONCLUSIONS

The developed AutoLISP program was used to create a drawing for a cylindrical flange with

an even number of mounting holes. The main advantage of using functions and codes written in AutoLISP is that the drawings are obtained in a shorter time, if there are parts of the drawing that must be drawn more than once or must be create drawings for the same mechanical parts but with different dimensions.

## 6. REFERENCES

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## CONTRIBUȚII LA DEZVOLTAREA UNEI APLICATII CU AJUTORUL LIMBAJULUI AUTOLISP

**Rezumat:** În cadrul acestei lucrări este prezentată importanța utilizării și dezvoltării de noi funcții folosind codul din limbajul AutoLISP. Prin apelarea acestor funcții se obțin rapid și ușor forme geometrice regulate. Aplicația a fost creată cu scopul de a reduce timpul de execuție al unor desene realizate în cadrul soft-ului de proiectare AutoCAD. Avantajul principal al utilizării acestor funcții este acela că prin apelarea lor se realizează automat piesa pe baza unor parametri de bază.

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