Branislav Rajković, Dragoljub Cvetković*, Radmilo Rajković**

SELECTION OF INDUSTRIAL PROCESS FAN WITH APPLICATION OF SOFTWARE

Abstract

This paper presents the procedure of fan selection by the software ProSelecta2 on the example of an industrial process fan with given technical characteristics. For the selected fan, the detailed technical characteristics are given, as well as a drawing of the fan with built-in dimensions. In brief, the basic alternative options for selecting the fan using this software are explained.

Keywords: industrial process fan, software ProSelecta2

1 INTRODUCTION

Process air fans have a wide application in the industry and they represent an important component of equipment and plants in many branches of the process engineering. These fans generate a forced circulation of air that can be used for cooling, drying, ventilation, extracting, combustion in furnaces, etc. The fan manufacturer Nicotra Gebhardt, which is the author of the ProSelecta2 software, has the classified industrial process fans in four series covering the application area for capacity up to 100000 m³/h, and total pressure rise up to 8000 Pa [1]. Maximum medium temperature is 300°C. There are also the fan versions for explosive and dusty environment, as well as various variants of drives, various types of materials and accessories. This paper will show a fan selection procedure on the example of industrial process fan for clean air with maximum temperature of 35°C, capacity of 71632 m³/h and total pressure rise of 3706 Pa.

2 EXPERIMENTAL AND RESULTS

The fan selection starts in the 'Selection-input data' window (Figure 1) where the criteria for selection are listed. In this case, the industrial process fan of P4M series was selected. The fans of this series consist of a base frame, spiral housing in a robust steel construction with a single circular axial suction connection, and a rectangular tangential discharge connection, as well as a welded impeller with backward curved blades mounted on the shaft of the electromotor-direct drive. In this window you enter the values of the required capacity, the total pressure rise, as well as the density and maximum temperature of medium. It contains the sub-options for the selection of drives, materials and degree of anti-explosion protection. In this case, a direct drive was selected with an electromotor with a frequency inverter for the net frequency of 50 Hz and arbitrary number of poles, non-alloy steel as a material and a standard fan version without anti-explosion protection. For the given pa-

* Mining and Metallurgy Institute Bor, e-mail: branislav.rajkovic@irmbor.co.rs

parameters, the program gives the listing of fans from which the user selects one fan. A fan with the P4M-T3B62-RBC label was selected here.

proSELECTA II NICOTRA Gebhardt

Logged in

Summary	Actual selection	Help	Default values	Quit
Selection - input data				
Specified data for installation:				
Application	P4M	Material	Steel	
Flow rate	71632	m3/h		☐ ATEX
Total pressure	3706	Pa		
Static pressure	0	Pa		
Type of conveying media				
Density	1.20	kg/m³		
Max. temperature	35	°C		
☒ Drive specification:				
Drive:	☒ Direct drive - standard motor ☐ Direct drive - external rotor motor ☐ Belt drive ☐ Coupling ☒ Frequency inverter			
No. of poles:	All			
Net frequency:	50 Hz ☒ 60 Hz ☐			
Go back		Next		

Figure 1 Criteria for the fan selection-window “Selection-input data”

proSELECTA II NICOTRA Gebhardt

Logged in

Summary	Actual selection	Help	Default values	Quit
Options P4M-T3B62-RBC fulfills the ErP requirements 2015				
Options	Casing Execution: Stich welded Cond. water drain - no horiz. install or 180°Pos. without Inspection door without Extractable motor impeller unit without Shaft seal without Copper inlet cone without Sound and thermal insulation without			
Motor	Accessories/options Suction side: DIN 24154/R4 ☐ Adapter piece ☐ Inlet guard ☐ Mating flange ☒ Flex. connection: ZHEBJ round (max. 80 °C) ☐ Silencer: RDK 1 LV99 LP:89			
Data	Coating, colour galvanised ☐ Fan: RAL 7039 Motor: RAL 7030			
Fan curves	Installation Installation system: Rubber type anti vibration mounts Motor protection hood ☐ Second baseframe ☐			
Dimensions	Reset options At discharge: DIN 24154/R4 ☐ Adapter piece ☒ Transition piece to circular, welded ☐ Mating flange ☒ Flex. connection: ZHEBJ round (max. 80 °C) ☐ Silencer: RDK 1 LV100 LP:90			
Sound data	Go back Inquiry Your order Save Accept			
Description				
Prices				
Data list				
One more selection				
Reset				

Figure 2 Options for the fan selection-window “Options”

The fan selection is continued selecting the corresponding equipment of selected fan in the 'Options' window (Figure 2). In this window, the user has the ability to define the characteristics of the housing, type of anti-corrosion coating, methods of installation and options regarding suction and discharge connection. In this case, the options related to the selection of a flexible connection, i.e. a compensator on suction connection and discharge connection, as well as a transition piece from rectangular to circular on a discharge connection are checked, while all other options are left as default. The method of installing the fan here is via rubber type anti-vibration pads.

In the "Motor selection" window, the user has the option of selecting an electromotor from the list of electro motors. An electromotor marked ACM315 M-6/HE was selected here.

The angular position of fan discharge connection and rotation direction is defined in the 'Inquiry' window.

Having completed the selection of fan and electromotor the software shows output data in the windows "Data", "Fan curves", "Dimensions", "Sound data" and "Description". Technical characteristics of the fan are given in the 'Data' window at the operating point and at the best efficiency point. Operating curves of the total pressure rise or static pressure rise, efficiency and power consumption on shaft in relation to volumetric flow rate are given in the 'Fan curves' window. Figure 3 shows a diagram of the total pressure rise, efficiency and power consumption on a fan shaft in the function of volumetric flow rate for a fan speed of 1185 rpm and air density of 1.2 kg/m^3 .

Figure 3 Total pressure rise, efficiency and power consumption on a fan shaft in the function of volumetric flow rate of the fan P4M-T3B62-RBC

A drawing with the built-in dimensions of the fan is given in the 'Dimensions' window. The fan sketch is shown in Figure 4. In the 'Sound data' window, the values of noise level in db for various frequencies are given (see Table 1). In the 'Description'

window, a technical description of the fan is given. Using option 'Print inquiry' in the 'Inquiry' window, the user has the ability to print all output data. The output data with the technical characteristics of the fan and electromotor are shown in Table 2.

Table 1 Noise level for the fan P4M-T3B62-RBC

	LWA	63 [Hz]	125 [Hz]	250 [Hz]	500 [Hz]	1000 [Hz]	2000 [Hz]	4000 [Hz]	8000 [Hz]	LPA (1m)	
Casing brake trough level L_2:	100	70	85	90	95	94	93	89	85	83	dB
Level for free intake L_5:	110	86	100	102	105	103	101	98	93	100	dB
Level for free outlet L_6:	112	87	101	104	107	106	103	99	94	102	dB

Figure 4 Drawing with built-in dimensions of the fan P4M-T3B62-RBC

3 DISCUSSION

As the presented procedure for the fan selection shows, the fan selection using the specified software is quite easy when the selection criteria are known. The fan P4M-T3B62-RBC belongs to a series of direct-drive fans where the impeller is mounted on a shaft of electromotor. In the other process fans series, the impeller may be mounted on its own shaft with bearings where the power transmission from electromotor is carried out via a coupling or a pulley. The advan-

tage of the selected fan relative to the other series is the reduced size of machine, and there is no power loss in bearings or belt transmission for the belt drive option. By selection the frequency inverter, it is possible to achieve the set operating point of the fan, i.e. precise regulation of its operation, as well as more favorable starting conditions. The selected fan works at the operating point in an optimal operating regime with high efficiency

Table 2 *Technical characteristics of the fan P4M-T3B62-RBC and electromotor ACM 315M-6/HE*

PROCESS AIR FAN		P4M-T3B62-RBC				
Efficiency status (single speed motors)		fulfills the ErP requirements 2015				
Fan data in operating point: (warranty according to DIN 24166)						
Offered accessory which is in contact with the transport medium can alter the characteristic curve and lead to a performance reduction.						
Gas type:			Atmospheric air			
Air flow by inlet:		q _v		71632	m ³ /h	
Total pressure increase		p _F	3706	3706	Pa	
Static pressure increase		p _{sF}	3341	3341	Pa	
Pressure at inlet:		p _a	101300	101300	Pa	
Density of media:	inlet	ρ	1.2	1.2	kg/m ³	
Temperature media:	inlet	t	35	20	°C	
Max. allowable media temperature:	inlet	t _{max}		35	°C	
Speed:		n		1185	1/min	
Max. allowable impeller speed:		n _{max}		1831	1/min	
Efficiency:	at optimum	η _{opt}		86	%	
Efficiency:	at operating point	η		86	%	
Required power:	at fan shaft	P _a	86.22	86.22	kW	
Required power:	at motor shaft	P _m	86.22	86.22	kW	
Max. required power:	at motor shaft	P _{max}	87.91	87.91	kW	
Inertia:	at fan shaft	I		67.63	kg*m ²	
Start-up time by direct start, calculated with Siemens-motor:		t _A		5.9	sec	
Sound pressure in 1 m distance, free suction:		L _{PA5}		100	100	dB
Sound pressure in 1 m distance, casing break out (without motor)		L _{PA2}		83	83	dB
Sound data according to DIN45635 part 38 (without sound attenuation equipment)						

MOTOR DATA

Motor type:	Standard						
Manufacturer:	AC			Type:	ACM 315 M-6/HE		
Degree of protection:		IP55*			Mounting type:	B3	
Insulation class:		F			Eff-/Temp.Cl.:	IE2	
Rated power:	P_{mot}	90.00		kW			
Rated speed:	n_{mot}	985		1/min	Weight approx.:	G	1013 kg
Frequency:	f	50		Hz			
Voltage:	U	400/690		V	Sound pressure:	L_{pA}	68 dB
Rated current approx.:	I	by 400 V:	160.00	A	Sound power:	L_{WA}	82 dB

ErP-data at optimum efficiency and density 1.20 kg/m ³		
Measurement- / Efficiency category	B / total	
Design status of VSD	has to be installed	
Overall efficiency (η_{opt})	80.7	%
Achieved efficiency grade (N_{ist})	78.3	
Required efficiency grade in 2013 / 2015 (N)	61 / 64	
Air flow rate (V_{opt})	66837	m ³ /h
Pressure rise (Δp_{opt})	3922	Pa
Fan speed (n_{vopt})	1185	1/min
Motor power input (P_{1opt})	90.22	kW
Specific ratio (d_{dpopt})	1.039	

CONCLUSION

Application of ProSelecta2 software significantly facilitates the designer work on a fan selection as it enables faster fan selection than selecting a fan by calculation [2], and it provides a detailed information about the selected fan in a digital format as an output. The example of fan selection in this paper does not include all the possibilities of this software that, besides the industrial process fans, enables the selection of other types of fans from the production program of Nicotra Gebhardt.

REFERENCES

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