ISSN: 1231-4005
e-ISSN: 2354-0133
DOI: 10.5604/12314005.1213576

DATABASE OF RECIPROCATING INTERNAL COMBUSTION ENGINES SELECTED MANUFACTURERS

Jan Monieta

Maritime University Szczecin, Institute of Marine Power Plant Operation
Wały Chrobrego Street 1-2, 70-500 Szczecin, Poland
tel.: +48 91 48-09-415, 48-09-479, fax: +48 91 480-95-75
e-mail: j.monieta@am.szczecin.pl

Adrian Sendecki

MPSV vessel – Bourbon Evolution 804
Chevron in Angola
e-mail: adriansend@o2.pl

Abstract

During research works concerning piston internal-combustion engines specifications of these objects are often needed. This data is usually dispersed and reaching to some is hampered or impossible. Therefore, an electronic database was drawn up about the most important ship producer's piston internal-combustion engines for needs of exploitation investigations in the destination of gathering the necessary information. This paper presents a database of global marine diesel engines. For example, engines of the following companies were described: Akasaka Diesel, CAT, Cummins, Fiat, Hyundai, MTU, Niigata Power Systems, Pielstick, Scania, Volvo Penta etc.

Information was obtained from various sources, so as websites of producers, advertising catalogues, or books and magazines about subject matter associated with marine diesel engines. This information was collected and written with the help of the program Microsoft Office. Gathered data was divided in engines of the main drive and emergency, containing details about producers, types and parameters of 2-stroke engines and four-stroke. The base enables supplementing and the alteration of entered data. Produced engines are usually operated by several dozen years after producing on swimming objects. Produced internal combustion engines are usually operated by several dozen years after producing on floating objects, and producers are merging or are stopping existing.

Keywords: *reciprocating marine engines, selected producers, technical parameters, database*

1. Introduction

To drive the ships are normally applied the reciprocating internal combustion engines [26, 27]. To use the information about them is necessary database. The database is an organized collection of information, including a uniform type of data, which are thematically linked and stored in computer memory [2, 21]. Current databases on manufacturers of marine diesel engines are inadequate, because it is difficult to reach the global and specific information about both the manufacturers of engines, and about the same marine engines. There are difficulties associated with lack of universal sufficient knowledge and its sharing. Some manufacturers of marine diesel engines combine or fall, and the engines are still in operation and access to information and spare parts is difficult.

Another problem is the lack of database developed in the form of electronic tables, where you would find information related to marine technology, ship owners, shipyards, suppliers of the main targets of the drive, so that ships can fulfil their tasks [22]. Such data is useful to the considerable circle of producers and users, among others for persons wanting to obtain information about internal combustion engines. This information would also be useful for builders, conducting experimental investigations, students and graduates of maritime universities, seeking information

about the objects of their future operation.

In order to maximize the use of resources, on a help topic, you need to collect and catalogue them according to specific project, allowing the collected data to find later. For that purpose archives are being drawn up, or more and more often, electronic databases that in the significant way are facilitating writing information, cataloguing them and searching. This method allows reducing the workload and eliminates the problem of keep the traditional archive [3, 22].

2. Being of the database

Databases are being developed to gather information on various topics. You can develop a set of information on reliability objects [3] conditions of use [1], the wear of spare parts or information may relate to any other subject area, for which currently there is a demand [17]. The database can be elaborated for selected institution.

By collecting, storing and analysing information, you can predict all sorts of conditions and prevent damage to critical. By collecting data on failures of objects, you can improve the level of reliability, availability and maintainability. Damage can exclude the object from operational use and result in losses.

The method of data collection should be structured in such a way that designers can easily interpret information on the development of damage. The data should describe in detail any damage, the cause of the damage and the measures taken for the prevention of damage.

It is possible to use the data in technical diagnostics [21, 22, 25]:

- interpreted the provisions from the technical manual,
- the measures describing the input, output and states diagnosed object,
- the messages transmitted by the surveillance systems use the facility,
- records of documents executed by the service machine,
- records of maintenance documents.

In-operating investigates is required knowledge [21]:

- declarative to the set of parameters to select symptoms susceptible to damage,
- procedural concerning the methods of estimating the values of diagnostic signals,
- procedural choose a subset of attributes relative.

These features of the state of the object are the set size, which describe the composition and structure:

$$C = \{c_1, c_2, ..., c_i ..., c_n\}, \tag{1}$$

where i – finite a string of indices.

The feature of an ordered pair of $\langle C$, war $(C)\rangle$, where C is an attribute of features and war (C) is a value [21, 22]. Features can be numeric (point) and functional. Functional feature is a set of pairs $\langle x, y\rangle$, where $y = f(x)$. For marine engines, they are important design features c_k, geometric c_g material c_m, quality c_j etc., affecting the technical parameters:

$$C_{so} = \{c_k, c_g, c_j, ..., c_i ..., c_n\}. \tag{2}$$

Databases are subsystem of the computer system of the company that saved [25]:

$$S_I = <U_I, A_I, B_I, A_F, A_P, O_I, T_I, R>, \tag{3}$$

where:

U_I – users of the computer system,
A_I – system administrator,
B_I – knowledge base,
A_F – algorithm in the system,
A_P – data processing algorithm,

O_I – software,
T_I – technical means of information,
R – relationships.

The computer system with the database and knowledge is used for collecting, archiving, processing, transmission and presentation of information.

3. Current state of bases

Databases are being developed for many years and are constantly under development. In literature and on the Internet you can find some information about manufacturers and their products.

Development of [3] describes the database of ships operated by the Polish Steamship Company for reliability investigations, the publication [22] for diagnostic purposes. With this database, you can find the lot of information on ships and engines mounted on them. Another character has the database of failures to aviation technology, where the authors describe a system for the development of the consumption of spare parts on the basis of the documentation storage [17].

After the literature, review can be concluded that the information on the problem under consideration is partially available and very scattered. A person who wants to find information on manufacturers or their products is often a daunting task. Some information can also search the Internet or publications, research institutions and the retention of information for internal combustion engines.

Computer databases can be expanded by adding new information. These arguments for this to develop the knowledge base that is relevant today.

There are online databases of manufacturers of engines produced for the shipbuilding industry. To find information on manufacturers, type the desired word in the search engine. Websites can be a source of information, but these are the marketing side, where manufacturers can promote their products by encouraging the purchase. It is difficult to find the information-produced engines, and with the old product, especially not existing manufacturers, it is very difficult or impossible.

4. Information about the world's manufacturers of marine diesel engines

4.1. Introduction

Data such as engine type, power, number of cylinders, speed etc. used in the preparation of this work has in part taken directly from the manufacturers' websites and literature. Typing in a search engine slogan „database of manufacturers“ there is the lot of answers that match entered the questions. You should carefully review the displayed password to find a suitable. An example of online data information can be hand [5-15] and publication of the items [4, 16, 18, 20, 24, 26, 27].

The collected data from these sources used in an electronic database developed. In the work [23], the database was presented for Polish producers of marine diesel piston engines.

4.2. Description of selected producers in world

The company Akasaka Diesl Ltd. is a Japanese company that produces two- and four-stroke marine engines. The first four-stroke engine was built by the company in 1933. In 1960, Akasaka Company started the construction of two-stroke engines under license from Mitsubishi [5]. Examples of the types and parameters offered by engines are presented in [5, 20].

Caterpillar is the company based in Hamburg [6, 20], which produces four-stroke engines. The Caterpillar company since 1997 entered the company MAK [10], which produces marine engines engaged in since 1922 [10]. Examples of the types and parameters of engines offered by the company are showing Fig. 1 and Tab. 1.

Fig. 1. View engine type M20C Company MAK [10]

Tab. 2. Types and parameters of engines of the CAT company [6]

Engine type	Speed [r/min]	Number of cylinders	N_e cylinder [kW]	p_e [bar]	Bore/stroke [mm]
Cat 3056	2100 – 2600	6 L	16 – 26	7.2 – 13.2	100/127
Cat C7	2400 – 2600	6 L	31 – 52	12.9 – 20.0	110/127
Cat C12	800 – 2300	6 L	42 – 75	14.2 – 22.8	130/150
Cat C7 ACERT	2800	6 L	57	20.0	110/127
Cat C18	1800 – 2300	6 L	56 – 124	12.5 – 21.5	145/183
Cat 3500/B/C	1200 – 1925	8, 12, 16 V	72 – 140	12.3 – 20.2	170/190
Cat C32	2300	12 V	68 – 103	16.7 – 19.8	145/162
Cat C32 ACERT	1800 – 2300	12 V	112	21.8	145/162
Cat C280	900 – 1000	6, 8 L/ 12, 16 V	288 – 339	20.0 – 23.9	280/300

Cummins is a US company founded in 1919 in Columbus, Indiana, which produces four-stroke engines. The name of the company comes from Clessie Lyle Cummins [7]. Examples of the types and parameters of the engine of the company are presented in [7].

The company Fiat is an Italian company, based in Strada Torino, which produces four-stroke marine engines. In the 80's, the company was called Fiat Grandi Motori. It is a well-known and respected manufacturer in the world [12]. Examples of the types and parameters of the engine of the company are presented in [12, 24, 26].

Hyundai is a Korean company, since 1978, producing engines for the maritime industry. Hyundai addition to manufacturing its own engines produces engines under license MAN and Sulzer firms [9]. Examples of the types and parameters of the engine of the company are presented in [9, 20].

MTU is a German company founded in the first half of the twentieth century. MTU is engaged in production of four-stroke engines. In addition, the company produces diesel engines for trains,

military vehicles and agriculture [12]. Examples of the types and parameters of the engine of the company are presented in Table [8, 12, 20].

Niigata Power Systems Company is the Japanese company producing the four-stroke internal combustion engines. The company produced the first engine in 1919. In 1974, Niigata Diesel signed the license agreement with the French S.E.M.T. [13]. Examples of the types and parameters of the engines of the company are presented in [13].

Company S. E. M. (Society d'Etudes de Machines Thermiques) Pielstic is a French company founded in 1988 with headquarters in Villepinte [24]. In 2006, the company was merged into MAN Diesel SA. Pielstick engaged in production of four-stroke marine engines [11]. Examples of the types and parameters of the engines of the company are presented in publications [11, 24].

The Scania Company is a Swedish company founded in 1891, dedicated to the production of four-stroke engines. Scania is the manufacturer of industrial and marine engines. The company operates in about 100 countries and [20]. Examples of the types and parameters of the engine of the company are presented in [20].

Volvo Penta is the Swedish company that produces four-stroke engines. The company was founded in 1868 [15]. The Volvo Company took over the Penta Company in 1935, and from that moment, Volvo Penta is part of the Volvo Group. Examples of the types and parameters of the engines of the company are presented in [8, 15].

The list of producers of this type is long [8, 20].

4.3. The electronic database of manufacturers of marine diesel engines

There was developed the electronic database of manufacturers of the marine diesel engines. Information taken from various sources such as websites of manufacturers, advertising catalogues, or books and magazines, on topics related to internal combustion engines, have been collected and stored by the computer program Microsoft Office. After starting the program, select the main menu (Fig. 2) selection button "database of manufacturers of marine diesel engines", and then display a form called "two-stroke and auxiliary" (Fig. 3), containing data on manufacturers, types and parameters of two-stroke and four-stroke.

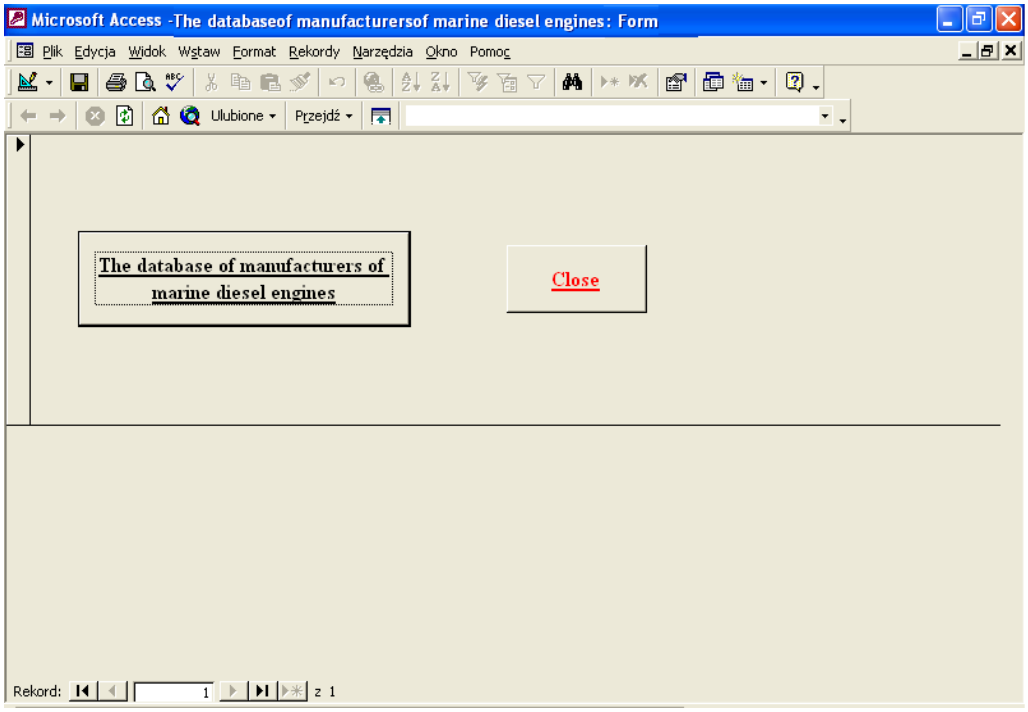

Fig. 2. View of the form main menu

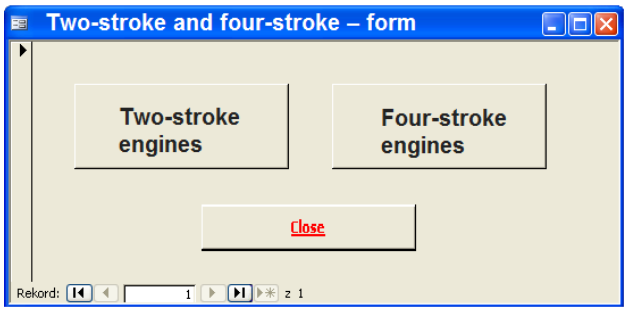

Fig. 3. View of the of forms containing date of engines two- and four-stroke

Next, by choice of applying engines the list of producers of main engines is shown on Fig. 4 and of the four-stroke engines (Fig. 5). Choice of the type of the engine is the further step (Fig. 6) and review of his data. On Fig. 7, exemplary data of the four-stroke EU type engine manufactured by Mitsubishi were presented.

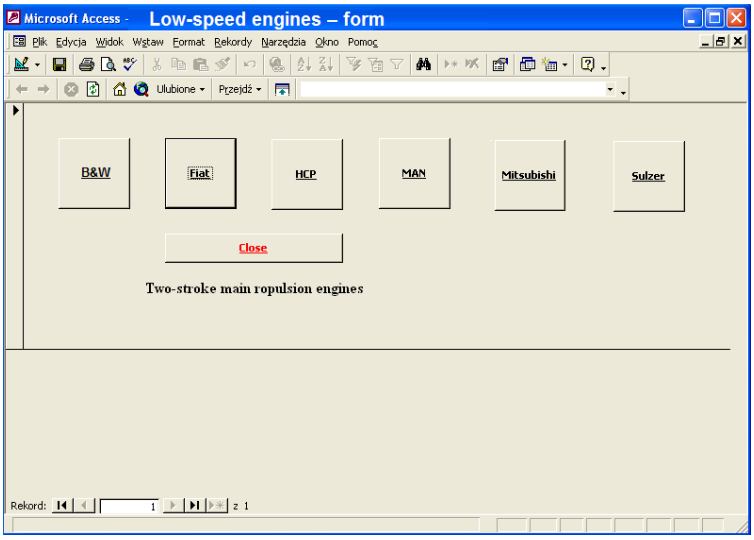

Fig. 4. View form the main engines

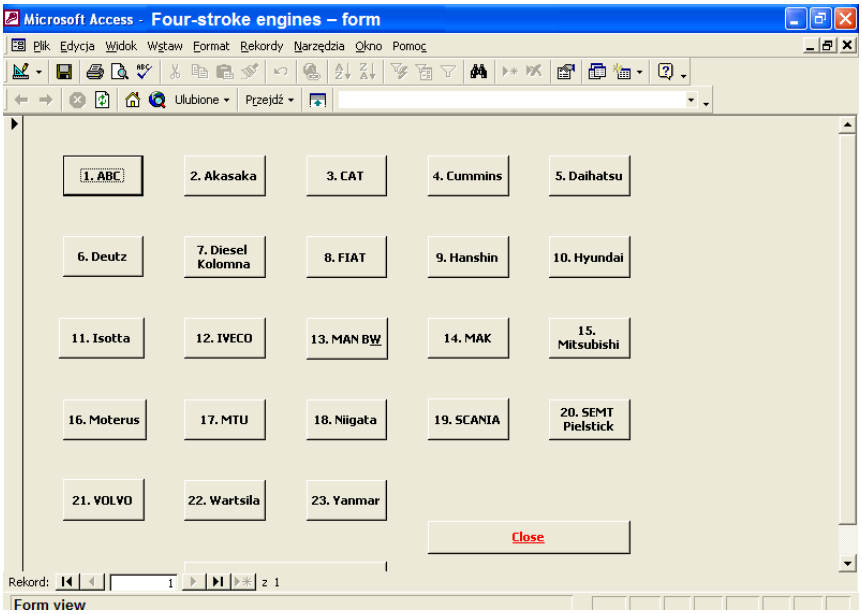

Fig. 5. The form four-stroke engines

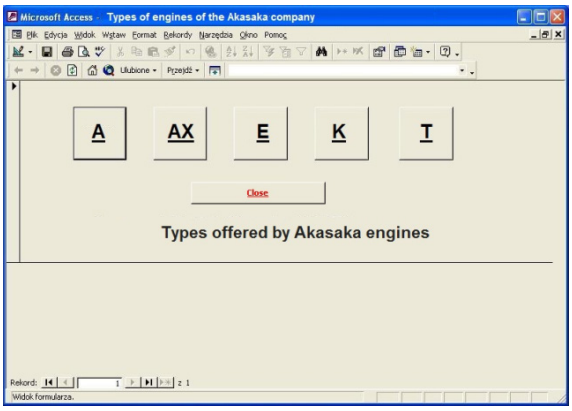

Fig. 6. The form contains information about the types of engines the manufacturer

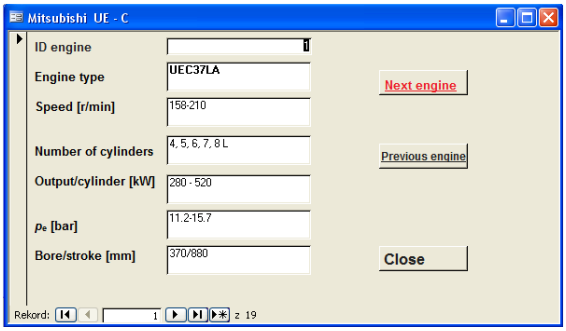

Fig. 7. The form contains data about the parameters of the engine

5. Conclusions

The electronic database is the collection of information on manufacturers of internal combustion engines, their products and parameters. Details of manufacturers have been collected and catalogued by the computer program Microsoft Office, which is an advanced tool for creating data banks, giving the possibility of sorting the appropriate information and their subsequent modifications.

This database contains a wealth of information. This database contains the wealth of information. Data on manufacturers of marine diesel engines are being dispersed; therefore, they were collected, tidied up and in the planned way, in order to increase their availability.

The visualization of information is uncomplicated and placed data is tidied up into the transparent manner. You can extend the database of the extension of the database exists for the additional information, or removing information out of date.

Storing and analysing information may be helpful in predicting all sorts of unfitness, so you can also prevent the occurrence of failures, improve the efficiency of the operational use and maintenance of object. The database can be used in the computerized system management the enterprise.

Developed electronic database should be helpful for designers, technologists and exploiters piston engines, as well as people interested in the subject of the sea, and in particular engines that are installed on ships. Currently, such information cannot be found on the websites of the manufacturers.

References

[1] Balcerski, A., Kneba, Z., *The database of the actual working conditions of ship engines and the possibility of its use for diagnosis*, Congress Technical Diagnostics, pp. 43-46, Gdansk 1996.

[2] Banachowski, K. Stencel, K., *Database Management Systems*, Polish-Japanese Edition of Information Technology, Warsaw, 2007.
[3] Gąsior, K., Monieta, J., *Database of ships and marine diesel engines for testing reliability*, XXXIV Winter School of Reliability, pp. 103-111, Szczyrk 2006.
[4] Gryko, K., Rachuba, M., Przewoźny, W., *New generation two-stroke engines made by H. Cegielski – Poznan S.A. – A leap into the XXI century*, II International Scientifically – Technical Conference, Vol. 1, pp. 103-114, Gdansk – Międzyzdroje – Kopenhaga 2001.
[5] http://www.akasaka-diesel.jp/en/about-us/history/, accessed 27.10.2015.
[6] http://www.cat.com/en_US/products/new/by-industry/marine.html, accessed 27.10.2015.
[7] http://www.cummins.com/, Accessed 20.05.2016.
[8] https://en.wikipedia.org/wiki/Category:Marine_engine_manufacturers, accessed 20.05.2016.
[9] http://www.hyundai-engine.com, accessed 20.05.2016.
[10] http://www.mak–global.com, accessed 28.09.2019.
[11] http://www.mshs.com/semt-pielstick.htm, accessed 21.01.2016.
[12] http://www.mtu–online.com, accessed 28.09.2009.
[13] http://www.niigata-power.com/english/index.html, accessed 27.05.2016.
[14] http://www.simp.poznan.pl, accessed 28.09.2009.
[15] http://www.volvopenta.com, accessed 20.05.2016.
[16] Januszkiewicz B., Wejchan-Kozielewska H.: *From the steam engine to the ship's engine*, Combustion Engines, No. 116, pp. 1-9, Poznan 1998.
[17] Jaźwiński, J., Żurek, J., Kaleta, R., *The birth and development of the system of collecting and processing information about the damage of aviation*, XXXIII Winter School of Reliability, pp. 221-232, Szczyrk 2005.
[18] Kopyczyński, M., Mańczak, J., Przewoźny, W., *Evalution of two-stroke marine diesel engines design in H. Cegielski-Poznan S.A*., Combustion Engines, No. 3, pp. 3-37, Poznan 2006.
[19] Listewnik, J., Marcinkowski, J., *The development of low-speed marine constructions combustion engines*, Ed. WSM, Szczecin 2000.
[20] *Marine engine index* (*MEX*), Schiff & Hafen, No. 12, pp. 60-74, 2009.
[21] Moczulski, W., *Methodology of acquisition of knowledge concerning diagnostics of machinery and processes*, Diagnostics, No. 4(48), pp. 123-127, Olsztyn 2008.
[22] Monieta, J., *A database of selected marine diesel engines for diagnostic needs*, Journal of Energy and Power Engineering, Vol. 7, No. 6, pp. 1032-1039, Telstar 2013.
[23] Monieta, J., Sendecki, A., *A database of piston marine diesel engines produced in H. Cegielski Poznan S. A. and ZUT Zgoda,* Combustion Engines, No. 3, pp. 108-109, cd. pp. 278-285, Poznan 2015.
[24] Niewiarowski, K., *Reciprocating internal combustion engines*, WKiŁ, Vol. 2, Ch. 23.1, Warsaw 1983.
[25] Niziński, S., Żółtowski, B., *Management Information Systems Exploitation of Technical Obje*cts, Ed. University of Warmia and Mazury, Olsztyn – Bydgoszcz 2001.
[26] Piotrowski, I., Witkowski, K., *Marine Diesel Engines*, Trademar, Gdynia 2004.
[27] Valland, H., *Impacts of Low Load Operation of Modern Four-Stroke Diesel Engines in Generator Configuration,* Norwegian University of Science and Technology, Norwegian University of Science and Technology, Trondheim 2014.