Working Principle of Gas Turbine Meter Fluxi 2000/TZ and Gas Volume Converter

Fitria Hidayanti, Haura Ishthafayna

Abstract: ***The use of natural gas in several countries, especially in Indonesia is essential. In gas distribution, every industry and household will not be separated from the measurement system that aims to find out how much natural gas has been used. For this reason, the use of a gas flow meter is necessary. There are several types of gas flow meter can be used in measuring the gas volume. Some types of gas flow meters are gas turbine meters, rotary gas meters and diaphragm gas meters. The primary difference of each type of gas flow meter is the pressure capacity and the speed of the gas flow through it. Flow meter gas turbine is one type of gas flow rate measuring device. There are moving parts consisting of a propeller whose rotation speed is proportional to the flow rate through the flow meter. The type of gas turbine meter is Fluxi 2000/TZ. Fluxi 2000/TZ is designed to measure natural gas and various non-corrosive gases. This tool can be used to measure low gas flow and high gas flow. This tool can also be used to measure flow under various pressure conditions. Corus is the name of the type of gas volume converter. Corus is one instrument that supports the reading process of various gas meters, and one of them is a gas turbine meter. Corus is designed to achieve high levels of performance and accuracy from robust electronic equipment so that the results of reading the fluid volume available on the gas turbine meter can be calculated more accurately regard to the amount of temperature, pressure and compressibility. The working principle and characteristics of the two instruments make the measurements more accurate.***

Keywords : gas turbine meter, fluxi 2000/TZ, gas volume, converter, flow meter

I. INTRODUCTION

In gas distribution, every industry and household will not be separated from the measurement system that aims to find out how much natural gas has been used. To know this, we need a tool that can read the amount of gas volume used with a good degree of accuracy to avoid the risk of loss and safety of natural gas usage. For this reason, the use of a gas flow meter is necessary. There are several types of gas flow meter can be used in measuring the gas volume. Some types of gas flow meters are gas turbine meter, rotary gas meters and diaphragm gas meters. The primary difference of each type of gas flow meter is the pressure capacity and the speed of the gas flow through it.

Gas flow meter commonly used in industry is gas turbine meter because it has a large capacity. Gas turbine meter is a tool to measure the volume of gas by utilizing the flow rate of gas fluid that drives the turbine wheel. The measurement results of the gas turbine meter will be converted by a gas volume converter or so-called Electronic Volume Converter (EVC) for a more accurate calculation of the volume value taking into account the effects of temperature, pressure and compressibility factor of the gas. The working principle and characteristics of the two instruments make the measurements more accurate.

Natural Gas

Natural gas is a fossil fuel in the form of gas. Natural gas is a mixture of hydrocarbons which has broad expandability, high compressive strength, low specific gravity and naturally present in the form of gas. In general, natural gas is collected underground with a variety of compositions contained in petroleum content (associated gas). All of the oil content is related to natural gas, where the gas dissolves in crude oil and often forms a “gas cup” above the oil content. In addition, natural gas can also gather at coal mines and natural gas fields [1]. Natural gas is a natural resource with the third-largest reserves in the world after coal and petroleum. Natural gas was not initially consumed as an energy source because of difficulties in transport and so it was always burned when produced together with petroleum. Utilization of natural gas in Indonesia is not only for transportation and households but now for industry. Natural gas in Indonesia has a quite dominant role after the role of oil as the main energy source has begun to be reduced [2].

II. MATERIALS AND METHOD

Gas Turbine Meter

Gas turbine meter is one type of gas flow rate measuring device. Inside gas turbine meter, there are moving parts consisting of a propeller whose rotation speed is proportional to the flow rate through the flow meter. Every time the propeller rotates it produces an electrical pulse at the pickoff mounted on the flow meter casing. These pulses indicate the volume of discrete gas that passes through it. The frequency of the pulses shows the volumetric flow rate and the total accumulation of pulses shows the measured total volume [3].

Gas Turbine Meter Fluxi 2000/TZ

The type of gas turbine meter is Fluxi 2000 TZ. Fluxi 2000/TZ is designed to measure natural gas and various non-corrosive gases. This tool can be used to measure low gas flow and high gas flow. This tool can also be used to measure flow under various pressure conditions [4].

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***** Correspondence Author
Fitria Hidayanti*, Engineering Physics Department, Universitas Nasional, Jakarta, Indonesia. Email: fitriahidayanti@gmail.com
Haura Ishthafayna, Engineering Physics Department, Universitas Nasional, Jakarta, Indonesia.

Fluxi 2000/TZ (Fig. 1) consists of five main parts, namely [5]:

1. A body that contains all the components;
2. Flow straightener to stabilize and accelerate the flow of gas before the turbine wheel;
3. Measuring units including turbine wheels;
4. Magnetic coupling to transmit the movement of the turbine wheel to the totaliser;
5. A totaliser to display the measured gas.

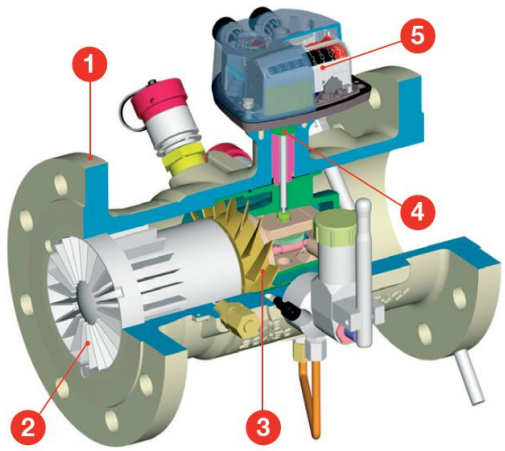

Fig. 1.Gas Turbine Meter Fluxi 2000/TZ [5]

Electronic Volume Converter

Corus is the name of the type of gas volume converter [4]. Corus is one instrument that supports the reading process of various gas meters, and one of them is a gas turbine meter. Corus shape can be seen in Fig. 2. Corus is designed to achieve high levels of performance and accuracy from robust electronic equipment so that the results of reading the fluid volume available on the gas turbine meter can be calculated more accurately with due regard to the amount of temperature, pressure and compressibility. In distributing data from reading, this tool uses flash memory so that it can store data either per unit day to per month. In the process of transferring reading and calculation data, Corus is also equipped with an infrared sensor that allows Corus users to download new firmware releases via PC or Laptop [5].

Fig. 2.Electronic Volume Converter Corus [5]

III. RESULTS AND DISCUSSION

In the gas turbine meter [6], the flow of gas that has pressure will flow through the gas turbine meter from the inlet to the outlet. The first time, the gas flow will pass through a flow straightener which makes the flow more orderly and the pressure less. After passing through a flow straightener, the gas will flow to the turbine wheel and pass through it to make the turbine wheel move. Thus, the turbine rotational speed is proportional to the rate of the gas flow through it. Turbine wheel rotation will be forwarded to the gear or measuring unit. The measuring unit is connected to a magnetic coupling that functions to transmit the mechanical movement of the measuring unit to the totalizer. Inside the totalizer, some gears move the drum and finally display how much volume of gas passes through the gas turbine meter.

Characteristics of Fluxi 2000 / TZ Gas Turbines Meter

In this section, we will discuss the features of the Gas Turbine Meter Fluxi 2000/TZ. In its characteristics, there are technical datasheet, pressure loss, dimensions, and size that can be installed on the Gas Turbine Meter Fluxi 2000/TZ. Each turbine size has different characteristics. The characteristics of each size can be known from the datasheet.

Table 1. Rangeability and pulse values [7]

G size	DN (mm)	Max Flow (m^3/h)	Range-ability	1 Imp LF & Cyble (m^3/Imp)	Freq LF Qmax (Hz)	1 Imp MF (dm^3/Imp)	Freq MF Qmax (Hz)	1 Imp HF2 (dm^3/Imp)	Freq HF2 Qmax (Hz)
G65	50	100	20	0.1	0.28	5.8947	4.71	-	-
G100	80	160	20	1	0.04	23.07692	1.93	0.07593	585
G160		250	20 or 30		0.07	23.07692	3.01	0.07593	915
G250		400	20 or 30		0.11	39.11111	2.84	0.12869	863
G160	100	250	20	1	0.07	23.07692	3.01	0.06271	1107
G250		400	20 or 30		0.11	23.07692	4.81	0.06271	1772
G400		650	20 or 30		0.18	39.11111	4.62	0.10628	1699
G400	150	650	20	1	0.18	23.07692	7.82	0.15385	1174
G650		1000	20 or 30		0.28	23.07692	12.04	0.15385	1806
G1000		1600	20 or 30		0.44	39.11111	11.36	0.26074	1705
G650	200	1000	20	10	0.03	230.7692	1.2	0.37661	738
G1000		1600	20 or 30		0.04	230.7692	1.93	0.37661	1180
G1600		2500	20 or 30		0.07	391.1111	1.78	0.63829	1088
G1000	250	1600	20	10	0.04	230.7692	1.93	0.5787	768
G1600		2500	20 or 30		0.07	230.7692	3.01	0.5787	1200
G2500		4000	20 or 30		0.11	391.1111	2.84	0.9808	1133
G1600	300	2500	20	10	0.07	218.1818	3.18	0.85763	810
G2500		4000	20 or 30		0.11	218.1818	5.09	0.85763	1296
G4000		6500	20 or 30		0.18	391.1111	4.62	1.53739	1174
G2500	400	4000	20	10	0.11	218.1818	5.09	2.04673	543
G4000		6500	20 or 30		0.18	218.1818	8.28	2.04673	882
G6500		10000	20 or 30		0.28	391.1111	7.1	3.66896	757
G4000	500	6500	20 or 30	10	0.18	218.1818	8.28	2.04673	882
G6500		10000	20 or 30		0.28	391.1111	7.1	3.66896	757

Table 1 displays the range characteristics and pulse values of each turbine size. G size is a measure of the size a gas turbine meter while DN is a measure of a flange of a gas turbine meter.

Table 2. Body materials and approximate weight [7]

DN (mm)	Length of body (mm)	ISO PN 10	ISO PN 16	ISO PN 20	ISO PN 25	ISO PN 40	ISO PN 50	ISO PN 110
50	150	A[1]	A[1]	A[1] B[1]	A[1]	A[1]	B[2]	B[2]
		8	8	8	8	8	11	11
80	240	Ac	Ac	AB	Ac	Ac	B	B
		19	19	19	19	19	30	37
100	300	Ac	Ac	AB	B	B	B	B
		22	22	22	25	25	45	55
150	335	A[3]	A[3]	A[3]	-	-	-	-
		46	46	46				
150	450	AB	AB	AB	B	B	B	B
		54	54	54	54	54	80	95
200	600	Ac	Ac	AB	B	B	B[4]	B[4]
		83	83	83	83	110	130	150
250	750	B	B	B	B	B	B[4]	B[4]
		120	120	120	120	140	220	245
300	900	B	B	B	B	B	B[4]	B[4]
		190	190	190	190	220	265	265
400	1200	B	B	B	B	B	B[4]	B[4]
		440	440	440	440	490	680	740
500	1500	B	B	B	B	B	B[4]	B[4]
		580	580	580	580	640	770	950

A: Ductile iron EN-GJS-400-18LT
B: Steel (Cast steel GS or welded steel)
c: Cast steel GS with minimum ordering quantity

[1]HF2 not available, 1 thermowell only
[2]HF2 not available
[3]HF2 and thermowells not available

Table 2 showed that the material characteristics and average weight of the gas turbine meter Fluxi 2000/TZ, the flange has different constituent materials.

Electronic Volume Converter

Electronic Volume Converter (EVC) Corus is connected to several transmitters such as pressure transmitters, temperature transmitters and LF/MF/HF transmitters that are mounted on a turbine flow meter. This temperature sensor has an IP67 protection level in accordance with EN 60529 and with a cable length of 2.50 m or 0.80 m. The Pb reference pressure and Tb reference temperature must be programmed into the device. Corus measures the volume of the gas under measurement conditions (Vm), under specific pressure (Pm) and temperature conditions (Tm).

The results of gas volume conversion will be displayed on the Corus screen. Each measurement result can also be stored in flash memory. An example of the Corus screen display can be seen in Fig. 3. There are two types of gas volumes: the gas volume calculated by the LF / MF / HF transmitter (not yet converted) and the volume of the gas that has been calculated taking into account the pressure, temperature, and compressibility factor (converted).

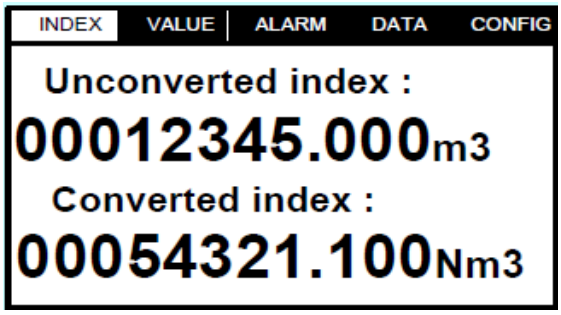

Fig. 3.Electronic Volume Converter Corus Display

The Corus characteristic is that the Corus cover is made of polycarbonate material and the dimensions of this tool are 22.2 x 14.5 x 8.6 (cm^3) with a weight of about 1.5 kg. Corus shows there are five keyboards to operate Corus and one screen, in addition to that there is also an infrared sensor downloading the new firmware release via PC. Corus has IP65 protection in accordance with EN60529 standard. The Corus reference conditions for pressure are in the range of 0.9 to 2 bar, whereas for temperatures in the range of 0-40 ^{0}C. Corus has standard RS232 & Optical communication ports and as an option can use RS485-PSTN Modem. Corus input volume is Low Frequency (LF) type connected to flow meter with a maximum of 2 Hz. Corus power supply can be an internal battery (16.5 A.h) or an external DC voltage.

IV. CONCLUSION

Gas turbine meter is a flow meter or device that measures the gas volume based on the speed of the gas flow that drives the turbine wheel. The magnitude of the flow rate is proportional to the turbine wheel's rotation speed. The working principle of the Gas Turbine Meter, the flow of gas that has pressure will flow through the gas turbine meter from the inlet to the outlet. The first time, the gas flow will pass through a flow straightener which makes the flow more orderly and the pressure less. After passing through a flow straightener, the gas will flow to the turbine wheel and pass through it so as to make the turbine wheel move. Thus, the turbine rotational speed is proportional to the rate of the gas flow through it. Turbine wheel rotation will be forwarded to the gear or measuring unit. The measuring unit is connected to a magnetic coupling that functions to transmit the mechanical movement of the measuring unit to the totalizer. Inside the totalizer, some gears move the drum and finally display how much volume of gas passes through the gas turbine meter. Corus is a gas volume converter. This tool is designed to calculate the volume of gas based on several quantities, namely the volume under measurement conditions, temperature, pressure and compressibility factors. EVC Corus will measure the volume of gas under measurement conditions (Vm), under specific pressure (Pm) and temperature conditions (Tm). This volume is converted to volume on a basic condition by Corus. The characteristics of the gas meter and EVC turbine are in the datasheet. Each size of the gas turbine meter and EVC has a different performance. So that in applying and choosing the size of the gas turbine meter can be seen through the characteristics of the tool.

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AUTHORS PROFILE

Fitria Hidayanti Ph.D. candidate at Faculty of Engineering, University of Indonesia. She obtained her bachelor degree at Bandung Institute of Technology, Indonesia and master degree at University of Indonesia. Currently. She is an Assistant Professor at Engineering Physics Department, Universitas Nasional, Jakarta, Indonesia.

Haura Ishthafayna She obtained Bachelor Degree at Engineering Physics Department, Universitas Nasional, Jakarta, Indonesia.