Chapter II. DETERMINATION OF THE GENGASWORK DIMENSIONS

The term regas plant includes the complete equipment required for the production of regas. This includes the main components gas generator, purifier, cooler and mixer as well as pipes and dampers. Every. these details must be carefully adapted to the current engine size and prevailing driving conditions in order to obtain a good operating result.

GENERATOR SIZE AND PERFORMANCE

Appropriate generator size must be selected taking into account

a) the engine's minimum gas consumption at idle
b) the engine's maximum gas consumption at full load

The generator must provide tar-free gas during a) and leave good gas and have a moderate pressure drop during b).

The maximum gas consumption is mainly determined by the engine's cylinder volume, speed and conversion method (full natural gas operation or diesel gas operation). The gas consumption at idle is also strongly influenced by the secondary air setting.

The engine's gas requirement at idle and full load can theoretically be calculated using a formula, which gives gas consumption ± Nin3/h (standard cubic meters per hour). The formula can be expressed

K*n*V

k = constant, as in diesel gas operation, idle is 0.0025, full is 0.0082
Full throttle operation, idle is 0.0024, full throttle is 0.0094
n = engine speed in r/m (revolutions/minute)
V = engine cylinder volume in litres

Guided by the obtained values of the engine's gas demand, calculated for low idle speed and maximum speed with a loaded engine, the appropriate size of the generator is first determined. This is done with the help of table 1, which provides a compilation of more important data on the State Machine Testing's four different types of gas generators. Under the heading "Gas quantity" four different capacities are specified for each generator type depending on the dimensions of the hearth details. The generators overlap somewhat in terms of

capacity. The blueprints are still only complete for type F-3, F-5 and F-7.

As far as installation space is available, the larger generator type should be selected, when the engine's gas requirement is in the border area between two sizes.

Once the size has been determined, a more accurate adaptation of the selected generator to the engine's gas demand must be made by selecting appropriate dimensions of the hearth details. These are also obtained from table 1 under the heading "Dimensions" and are read on the line where the engine's calculated maximum gas demand is closest to a table value.

The size determination of the gas generator and dimensioning of the hearth part, which is obtained with the aforementioned calculation bases, refers to vehicles within a normal area of use. Under other operating conditions, it may be necessary to depart from these recommendations, for the best operating results to be obtained. Therefore, a vehicle operating in long-term heavy loads at high engine speed may perform better if a larger hardening was used, while very light driving may require a smaller hardening. In case of uncertainty, considering the hardening load at lower speeds, it is more appropriate to choose a smaller hardening. In both cases, hardening mode and nozzle dimensions must be determined by the selected hardening.

Calculation example

An engine with a cylinder volume of 7.0 1, idle speed of 600 r/m and a maximum speed of 2,200 r/m with the engine under load must be converted to diesel gas operation. Generator size and hearth dimensions must be determined.

The engine's gas consumption at idle is 0.0025 * 600 * 7.0=11 Nm3/h
maximum is 0.0082 * 2,200 * 7.0 = 126 Nm3/h

Gas volumes of 126 Nm3/h can be produced by both generator types F-5 and F-7. The larger generator should be selected if the mounting space allows. Table 1 shows that the gas amount of 135 Nm3/h is closest to the maximum volume calculated above. The table then gives dh = 130, h = 150, dm 10.5 and lm = 70.

There is a relatively large difference between the calculated value and the table value of the minimum gas quantity, 11 Nm3/h or 17 Nm3/h.

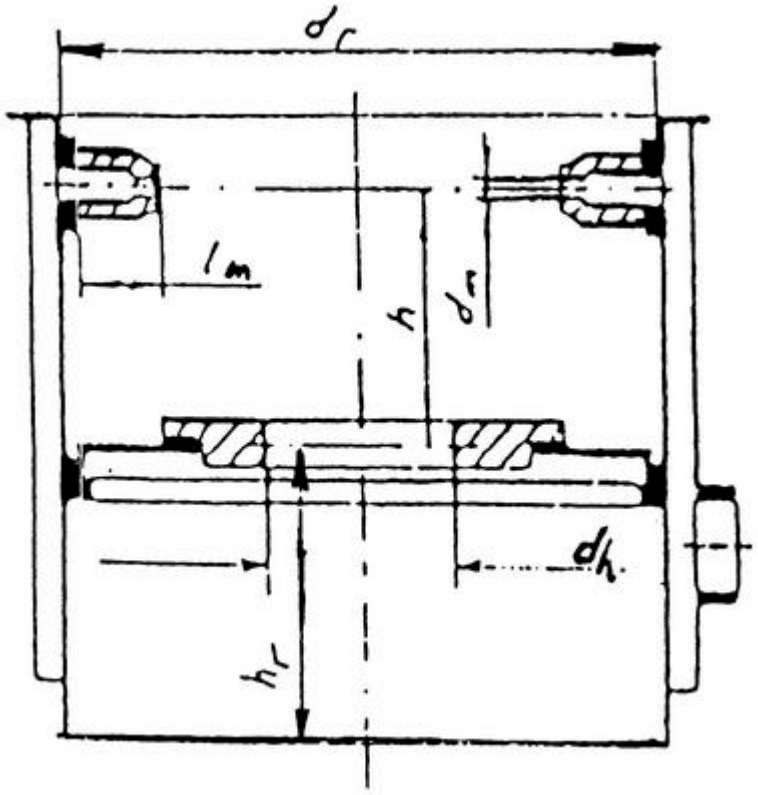
So that the generator load does not become too low when idling the engine, its low idle speed should be increased from 600 r/m to 950 r/m. With the above method of calculation, the gas consumption is then obtained at 17 Nm3/h. The maximum wood consumption given in the table is based on continuous maximum generator load. In practical operation, lower consumption figures are obtained.

The designation of the generator will be hardened ø 130, F-7 / 130, F-700 / 130

Table 1

Generator-type-	Hearth designtion d_r/d_h	Dimensions (designations according to adjacent picture)						Gas amount		Maximum fire-wood usage kg/h
		d_h mm	h mm	h_r mm	n st	d_m mm	l_m	max. Nm^3/h	min. Nm^3/h	
F-1/ 50-120 1)	300/50	50	100	135	6	6,5	40	25	4	12
	300/80	80	110	125	6	6,5	40	50	6	25
	300/100	100	120	115	6	9,5	30	80	8	35
	300/120	120	130	105	6	11,5	30	110	12	50
F-3 60-120 F-300 60/120	310/60	60	115	175	6	7,0	50	25	4	12
	310/80	80	125	165	6	8,0	50	50	6	25
	310/100	100	135	155	6	9,5	40	80	8	35
	310/120	120	145	145	6	11,5	40	115	12	50
F-5 80-150 F-500 80/150	370/80	80	125	205	7	9,0	60	60	7	25
	370/100	100	135	195	7	10,0	60	80	10	35
	370/125	125	145	185	7	11,0	50	120	13	55
	370/150	150	155	175	7	12,0	50	165	18	75
F7 110-180 F-700 100/180	430/110	110	140	275	9	9,5	70	105	13	50
	430/130	130	150	265	9	10,5	80	135	17	60
	430/155	155	160	255	9	12,0	50	170	22	80
	430/180	180	170	245	9	14,0	50	220	28	100

1) Dimensioning of this generator type is only provisionally established and only refers to the hearth jacket. Drawings have not been prepared.



dr=core jacket diameter
dh=hardening diameter
h=distance between nozzles and curing
dm=nozzle diameter
lm=nozzle length
n=number of nozzles
hr=distance between hardening and the lower edge of the hardening mantle

Cylinder volume - gas requirement.

The safest way to choose a generator is with the calculation procedure described earlier. A clearer picture of the relationship between engine size (cylinder volume) and generator type can be found in the table. 2, but as the compilation has been based on an assumed maximum engine speed, it cannot be universally valid. The table should therefore only be used as an indicative compilation.

When calculating the table values for the generators F-3, F-5 and F-7, the maximum engine speed with a loaded engine has been set to approx. 2,500 r/m and conversion to diesel gas operation has been assumed. For generator F-1, which is primarily intended for passenger cars, the calculation has been based on the speed of 4,500 r/m and conversion to full gas operation.

Table 2

Generator type	Cylinder volume l
F-1	1 -2,5
F-3, F-300	2 - 4,5
F-5, F-500	3,5 - 8
F-7, F-700	6 -11

For generator types F-3 and F-5, there are two versions of the location of the primary air intake on the outer casing. The intakes are placed at an angle of 600 on either side of the center line through the ash hatch. Design with the intake on the left side of the generator seen towards the ash hatch was used on tractors and the right side on trucks. If required, holes can be made in the outer casing for other positions as well.

SCRUBBER

The purifier's filter surface must be adapted to the gas volume flowing through. An undersized cleaner becomes clogged more quickly and therefore needs to be cleaned more often, while an oversized cleaner becomes unnecessarily bulky.

Table 3 shows the approximate relationship between generator size and filter area.

Table 3

Generator type	Filter surface m2
F-1	1,5 - 2
F-5, F-300	2 - 4
F-5, F-500	4 - 6
F-7, F-700	6 - 10

The variation of the generator capacity with the dimensions of the hearth means that different filter surfaces can be considered for one and the same generator type. As far as the installation space allows, a filter surface as large as possible for the generator type should be used, as maintenance work is

thereby reduced due to longer driving intervals between cleaning.

GAS COOLER

Three sizes of gas cooler cover the need for the four generator sizes. The coolers' type designations (State Machine Testing's performance) and cooling surfaces appear in table 4.

Table 4

Generator type	Cooler type	cooling surface, m2
F-1		
F-5, F-300	D 3	
F-5, F-500	Lv	5,6
F-7, T-700	Lv	5,6

GAS MIXER WITH VALVE HOUSING

The gas mixer is selected based on the size of the gas generator. Table 5 shows the suitable mixer size for the four generator sizes. The mixer includes two damper housings, one for the secondary air and one for the gas air mixture. There are two types, A and B, of each mixer size from the the State's Machine Testing execution of gas mixers. Type A has gas supply in the center of the mixing tube, while type B has air supply there. Dimensions and design of these two types, as well as the associated damper housing, can be seen in the picture. 2.1. The mixing function is the same in both cases, but the different designs provide greater freedom of choice for piping and connections.

Table 5

Generator type	Gas mixer type
F-1	G 1/A or G 1/B
F-3, F-300	G 5/A or G 3/B
F-5, F-500	G 5/A or G 5/B
F-7, F-700	G 7/A or G 7/B

GAS LINES AND SHUT-OFF VALVES

Table 6 lists the pipe dimensions that should be used between different components in the regas plants. A thin-walled quality with a material thickness of approx. 1.5 mm can be used.

Table 6

Generator type	Inside diameter of gas pipe in section between Generator - cleaner - cooler - mixer		
F-1	61	48	48
F-3, F-300	61	61	48
F-5, F-500	75	75	61
F-7, F-700	75	73	61

SETTING THE PRESSURE SWITCH'S OPERATING PRESSURE

Before the pressure switch is connected to the gas plant, its control pressure must be set in a specific relationship to the used generator size. The setting values are shown in table 7.

Table 7

Generator type	The pressure switch's operating pressure cm water column
F-1	50
F-3, F-300	55
F-5, F-500	50
F-7, F-700	65