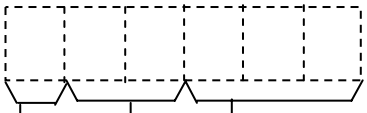
Appendix 8 Principal Dimensions of Generators[*1]

1. Selection of Turbine

(1) Type of Generator

Table 1 Symbolization of Generator

Synchronous Generator



indicates output frame

	Generator output frame
003	30 kVAframe
005	50 〃
007	75 〃
010	100 〃
015	150 〃
020	200 〃
030	300 〃
040	400 〃
050	500 〃
075	750 〃
100	1000 〃
150	1500 〃
200	2000 〃

indicates pole

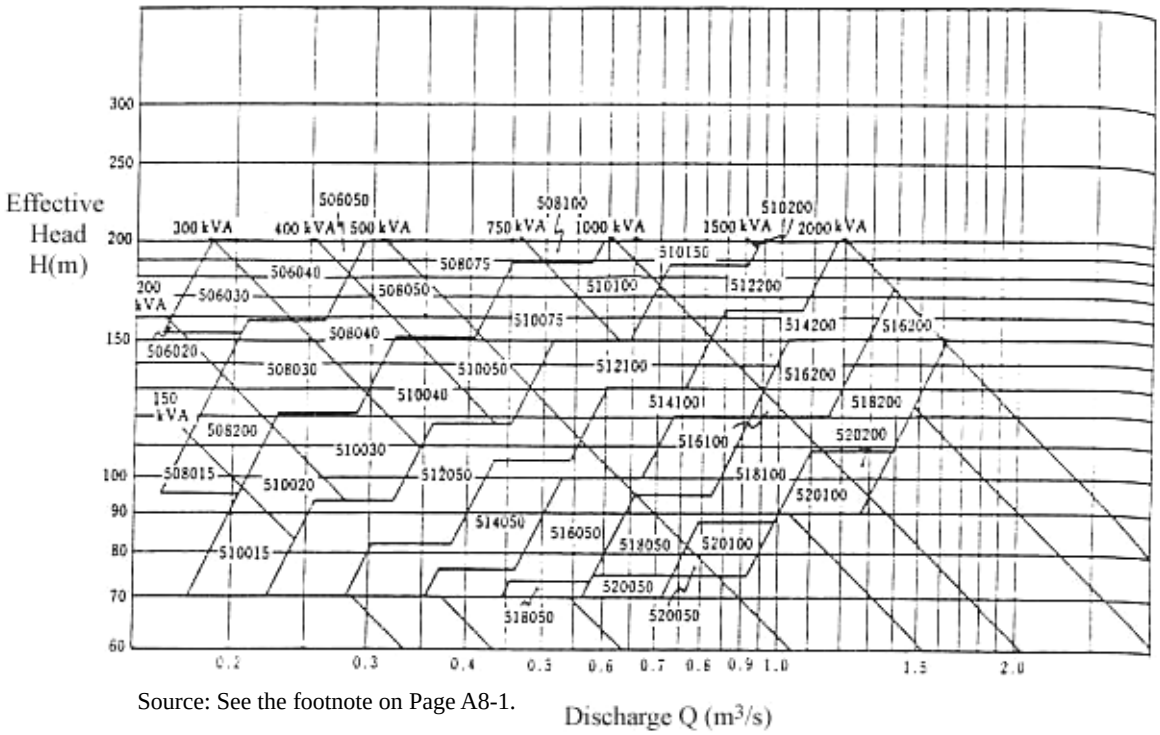
	Nos. of generator
06	6 poles
08	8 〃
10	10 〃
12	12 〃
14	14 〃
16	16 〃
18	18 〃
20	20 〃
22	22 〃
24	24 〃

	Frequency
5	50 Hz
6	60Hz

Source: See the footnote on Page A8-1.

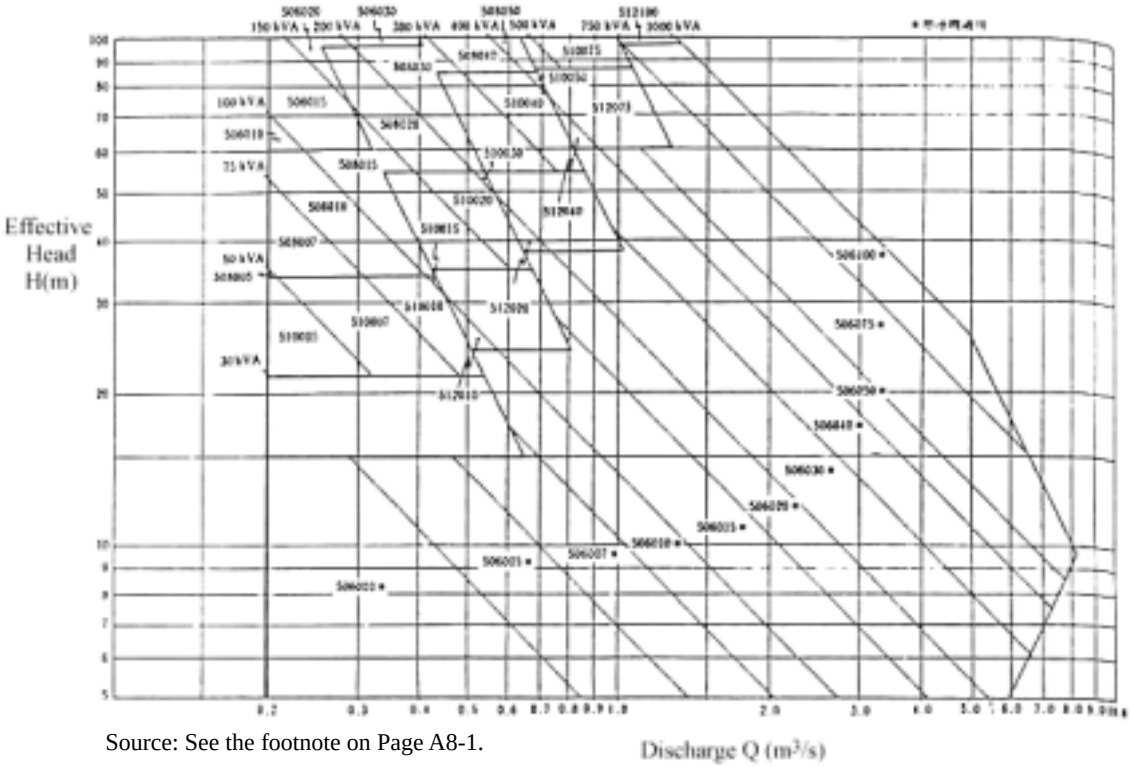
*1: Source from "Technical Guideline for Plan and Design of Steel Structures (Part of Small Hydroelectric Power Generation), Ministry of Agriculture, Forestry and Fisheries, Japan".

(2) Decision of Type Number



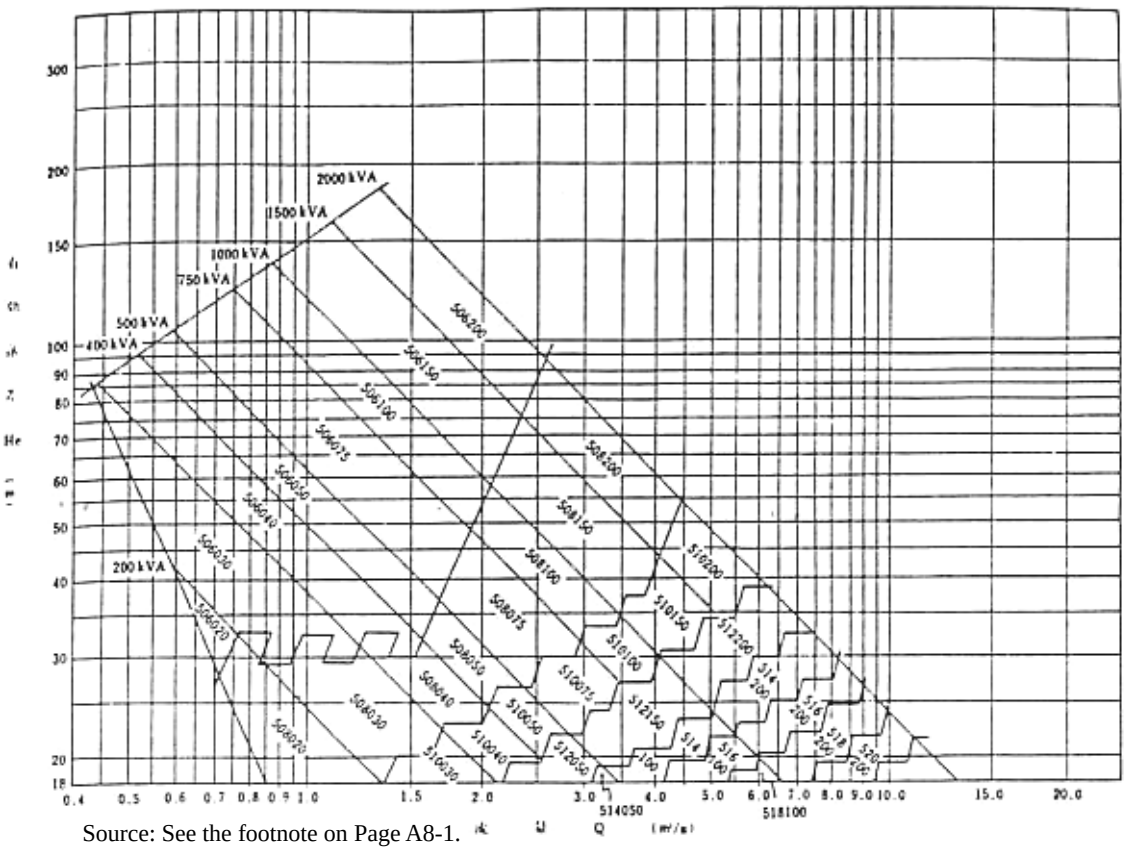
Source: See the footnote on Page A8-1.

Figure 1 Type Number of Synchronous Generator for Pelton Turbine



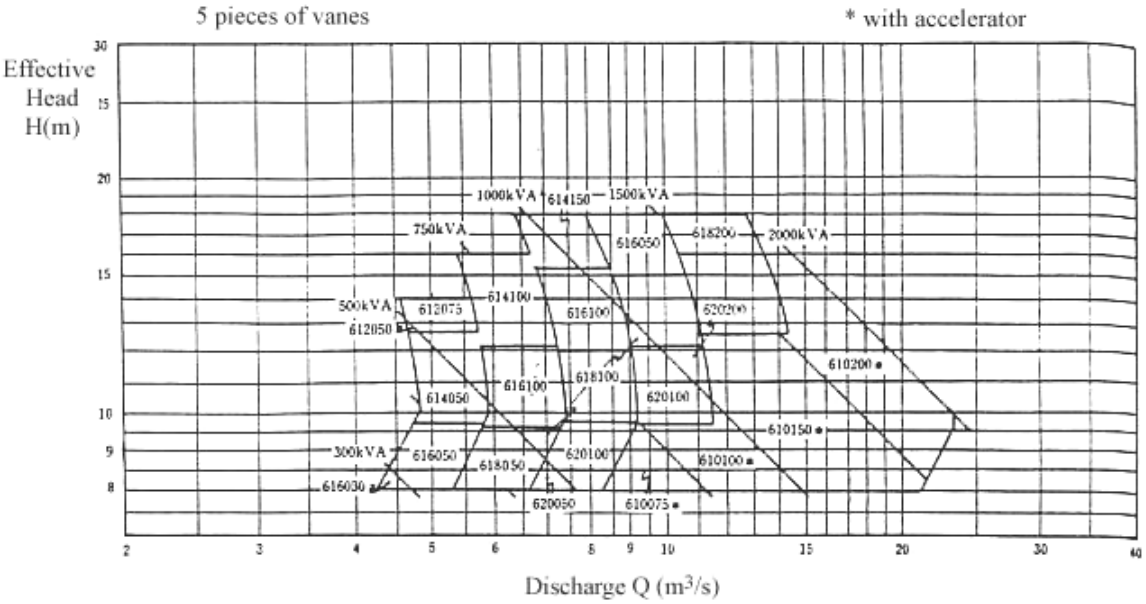
Source: See the footnote on Page A8-1.

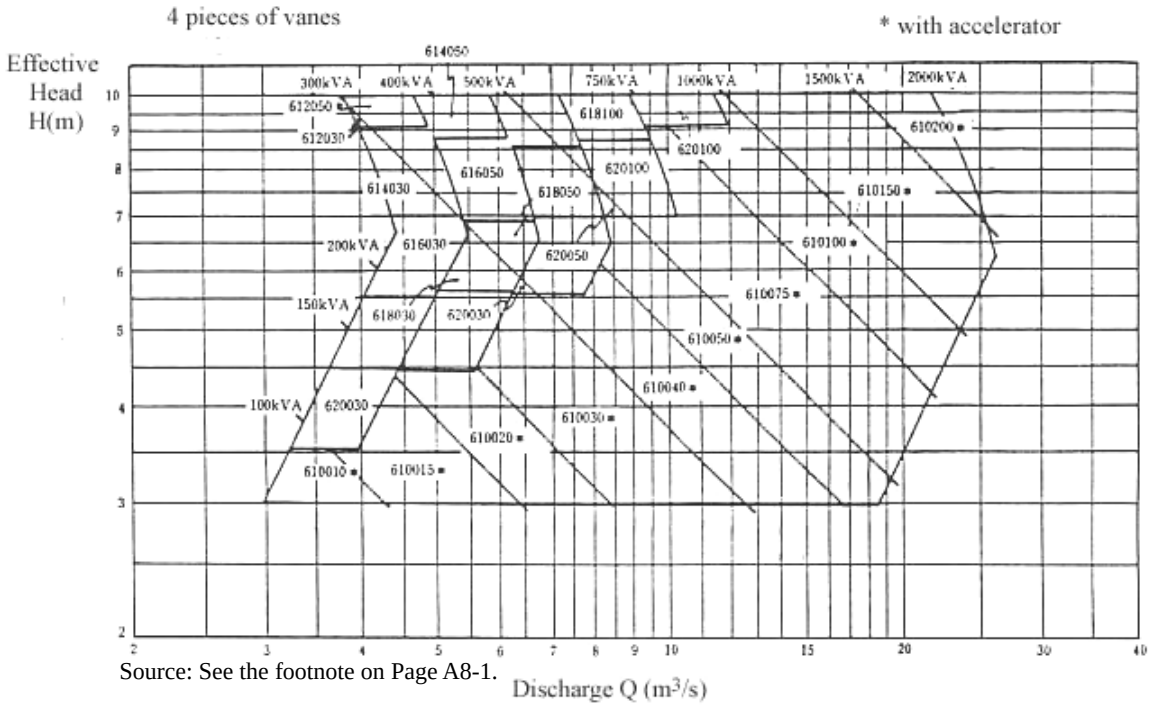
Figure 2 Type Number of Synchronous Generator for Crossflow Turbine



Source: See the footnote on Page A8-1.

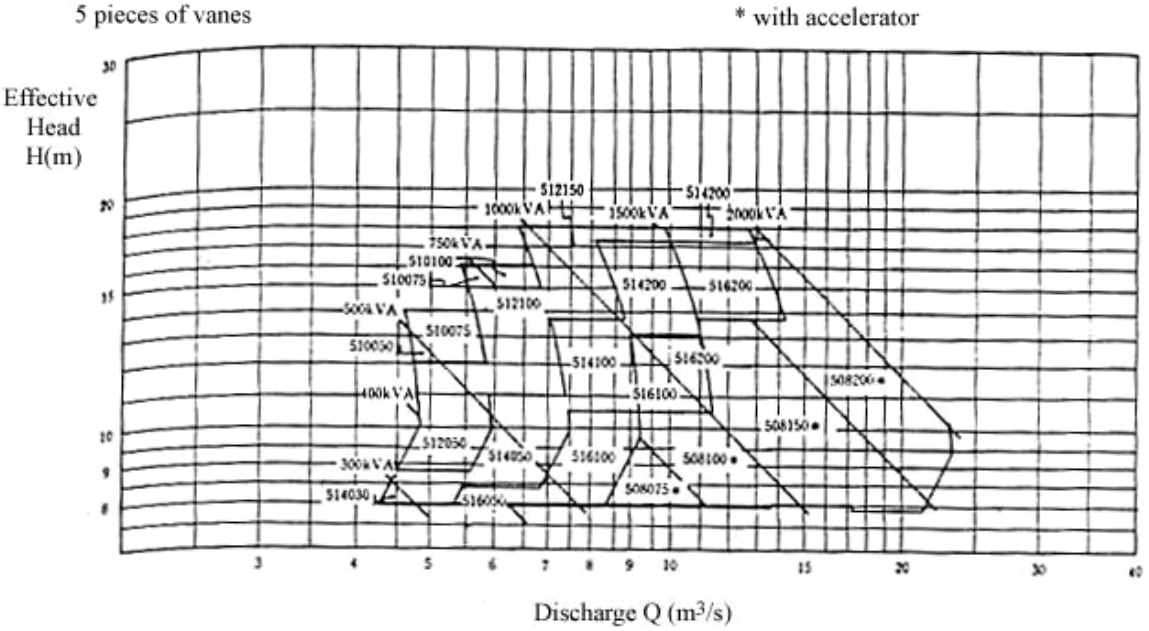
Figure 3 Type Number of Synchronous Generator for Francis Turbine

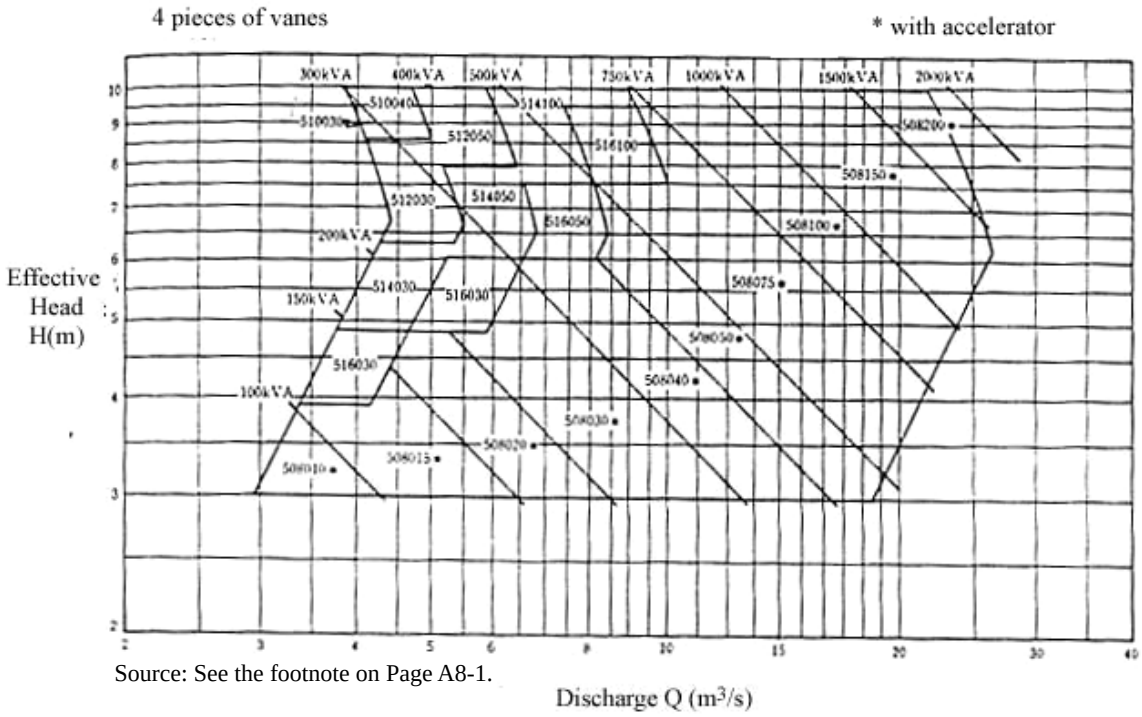




Source: See the footnote on Page A8-1.

Figure 4 Selection Table of Synchronous Generator for S-shaped Tubular Turbine



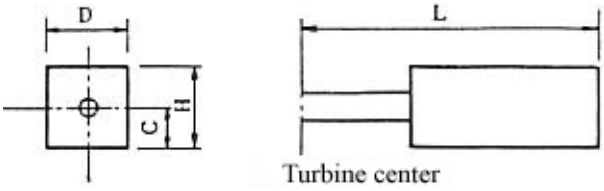


Source: See the footnote on Page A8-1.

Figure 5 Type Number of Synchronous Generator for S-shaped Tubular Turbine

(1) Dimension of Synchronous Generator

a. Pelton Turbine

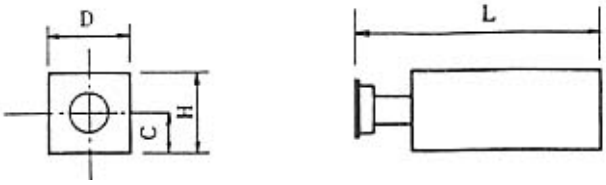


(unit mm)

Type nos.	Weight (kg)	D	H	C	L		Pull out dimension	Note
506020	1500	770	1010	375	1890			
506030	1940	850	1010	425	2160			
506040	2540	900	1080	425	2400			
506050	3150	1150	1080	450	2450			
506075	3750	1300	950	400	2550			
508015	1930	886	1010	400	2020			
508020	2400	850	1010	425	2150			
508030	3140	1060	1010	490	2320			
508040	3750	1150	1130	540	2520			
508050	4100	1140	1130	540	3240			
508075	4690	1300	1200	450	3430			
508100	6070	1500	1270	450	3600			
510015	2260	850	930	425	2170			
510020	2640	900	1010	450	2260			
510030	3200	1150	1010	490	2450			
510040	4240	1140	1130	540	3270			
510050	5030	1350	1240	600	3450			
510075	5630	1500	1270	450	3600			
510100	7170	1650	1510	560	3700			
510150	7920	1900	1530	500	3730		2430	
510200	9250	2200	1770	560	3750		2470	
512050	5880	1500	1370	560	3650			
512100	7930	2200	1770	560	3640		2340	
512200	10920	2500	1720	560	4070		2540	
514050	5565	1700	1390	500	2990		1690	
514100	8700	2200	1770	560	3810		2510	
514200	12890	2500	1720	560	4400		2870	
516050	6300	1700	1390	500	3530		2230	
516100	9510	2200	1770	560	4000		2700	
516200	13550	2500	1720	560	4570		3040	
518050	6460	1700	1390	500	3680		2380	
518100	10700	2500	1720	560	4110		2580	
518200	15300	2590	1800	560	4550		2920	
520050	6890	2000	1610	560	3810		2510	
520100	11000	2500	1720	560	4330		2800	
520200	15950	2590	1800	560	4810		3180	

Source: See the footnote on Page A8-1.

b. Cross Flow Turbine

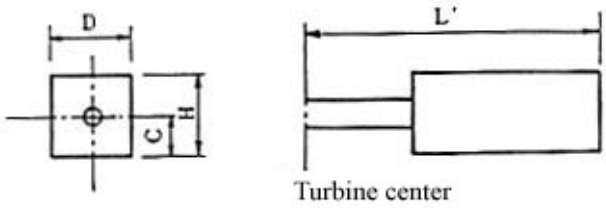


(unit mm)

Type nos.	Weight (kg)	D	H	C	L		Pull out dimension	Note
506003	800	656	860	280	1435			
506005	800	656	860	280	1435			
5060075	800	656	860	300	1435			
506010	990	656	860	300	1435			
506015	1190	660	920	335	1520			
506020	1430	770	1010	375	1600			
506030	1850	850	1010	425	1800			
506040	2420	900	1080	425	2050			
506050	3000	1150	1080	450	2110			
506075	3570	1300	950	400	2210			
506100	4570	1300	1200	450	2850			
5080075	1140	660	900	335	1470			
508010	1480	750	900	375	1600			
508015	1820	886	1010	400	1660			
508020	2290	850	1010	425	1800			
508030	2290	1060	1010	490	1900			
508040	3570	1150	1130	540	2110			
508050	3900	1140	1130	540	2800			
510005	950	656	900	335	1435			
5100075	1140	660	900	335	1470			
510010	1480	750	900	375	1660			
510015	2150	850	930	425	1750			
510020	2520	900	1010	450	1850			
510030	3050	1150	1010	490	2000			
510040	4040	1140	1130	540	2750			
510050	4790	1350	1240	600	2980			
510075	5360	1500	1270	450	3030			
510100	6760	1650	1510	560	3130			
512010	1650	850	930	425	1900			
512020	3050	1140	1130	450	2550			
512040	4500	1350	1200	450	2980			
512075	6240	1900	1530	500	2900		1600	
512100	7550	2200	1770	560	2980		1680	

Source: See the footnote on Page A8-1.

c. Francis Turbine

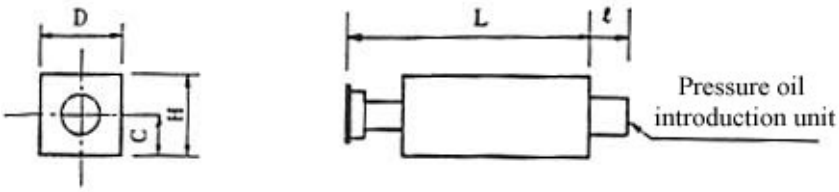


(unit mm)

Type nos.	Weight (kg)	D	H	C	L		Pull out dimensio	Note
506020	1700	770	1010	375	2250			
506030	2100	850	1010	425	2530			
506040	2550	900	1080	425	2800			
605050	3400	1150	1080	450	2930			
506075	4100	1300	950	400	3120			
506100	5100	1300	1200	450	3660			
506150	5670	1140	1130	450	3860			
506200	7080	1350	1200	450	3990			
508020	2700	850	1010	425	2530			
508030	3400	1060	1010	490	2680			
508040	4100	1150	1130	540	2970			
508050	4300	1140	1130	540	3510			
508075	5000	1300	1200	450	3730			
508100	6240	1500	1270	450	3940			
508150	7600	1650	1510	560	4030			
508200	8740	1650	1510	560	4180			
510020	2800	900	1010	450	2600			
510030	3400	1150	1010	490	2780			
510040	4500	1140	1130	540	3530			
510050	5400	1350	1240	600	3710			
510075	5900	1500	1270	450	3840			
510100	7280	1650	1510	560	3960			
510150	8270	1700	1450	560	4060		2350	
510200	9570	2000	1610	560	4110		2400	
512050	6100	1500	1370	560	3880			
512100	8320	2200	1770	560	4110		2250	
512200	11250	2500	1720	560	4430		2400	
514050	5800	1700	1450	500	3650		1950	
514100	9050	2200	1770	560	3980		2350	
514200	13100	2500	1720	560	4530		2550	
516100	9830	2200	1770	560	4060		2400	
516200	13750	2500	1720	560	4600		2600	
518100	10950	2500	1720	560	4360		2400	
518200	15400	2590	1800	560	4660		2600	
520200	16050	2590	1800	560	4720		2650	

Source: See the footnote on Page A8-1.

d. S-Shaped Tubular Turbine



(unit mm)

Type nos.	Weight (kg)	D	H	C	L		Pull out dimension	Note
508015	1820	886	1010	400	1660	0		
508020	2290	850	1010	425	1800	0		
508030	2290	1060	1010	490	1900	0		
508040	3570	1150	1130	540	2110	0		
508050	3900	1140	1130	540	2800	0		
508075	5480	1330	1240	600	2900	0		
508100	5780	1500	1270	450	3130	0		
508150	6870	1650	1510	560	3130	0		
508200	8010	1650	1510	560	3280	0		
510030	3050	1150	1010	490	2650	800		
510040	4040	1140	1130	540	3390	800		
510050	5300	1350	1280	600	3670	800		
510075	6090	1500	1270	450	3720	800		
510100	7600	1650	1510	560	3860	800		
512030	3800	1140	1130	450	3240	800		
512050	6300	1500	1370	560	3760	800		
512100	8430	2200	1770	560	3790	800	2370	
512150	10400	2500	1720	560	4090	800	2490	
514030	3950	1140	1130	450	3280	800		
514050	6000	1700	1390	500	3520	800	2150	
514100	9160	2200	1770	560	3850	800	2430	
514200	13350	2500	1720	560	4350	800	2600	
516030	4600	1350	1200	450	3520	800		
516050	6700	1700	1390	500	3590	800	2220	
516100	9940	2200	1770	560	3910	800	2490	
516200	14000	2500	1720	560	4390	800	2640	

Source: See the footnote on Page A8-1.

2. Turbine Output

(1) Rated Output of Generator

Rated output of generator is given by rated power calculated from rated frequency and rated current.

C: Capacity (kVA)

V: Rated Voltage (kV)

I: Rated Current (A)

Case of single phase C = VI

Case of three phases C = $\sqrt{3}VI$

(2) Power Factor of Generator

Power factor of generator is determined by power factor of supplied power at load side from generator terminal.

Generally it is between 0.8 and 0.95. When rated power factor of generator exceeds load side power factor, excitation may be insufficient during power supply.

Rated power factor of generator has a design limit, and it is up to 0.8 in common.

Accordingly, when load power factor is less than rated power factor of generator, it is needed to improve load power factor by connecting capacitor in parallel in the load side.

The larger rated power factor of a generator the more cost design of effective generator will be. Power factor of a generator may be 1.0 when it is operated in parallel with a large grid and isolated operation is rare, or load during isolated operation is less than 1/2 of its rated output.

(3) Effective Power of Generator Output

a. Calculation from generator rated output

An effective power of generator output is given by the following formula:

P_g: Effective power of generator output (kW)

C: Rated output of a generator (kVA)

$cos\,\phi$:Generator rated power factor (unit)

$$P_g = C\cos\phi$$

The P_g value has to match the effective power calculated from turbine output.

b. Calculation from turbine output

P_g: Effective power of generator output (kW)

P_t: Turbine output (kW)

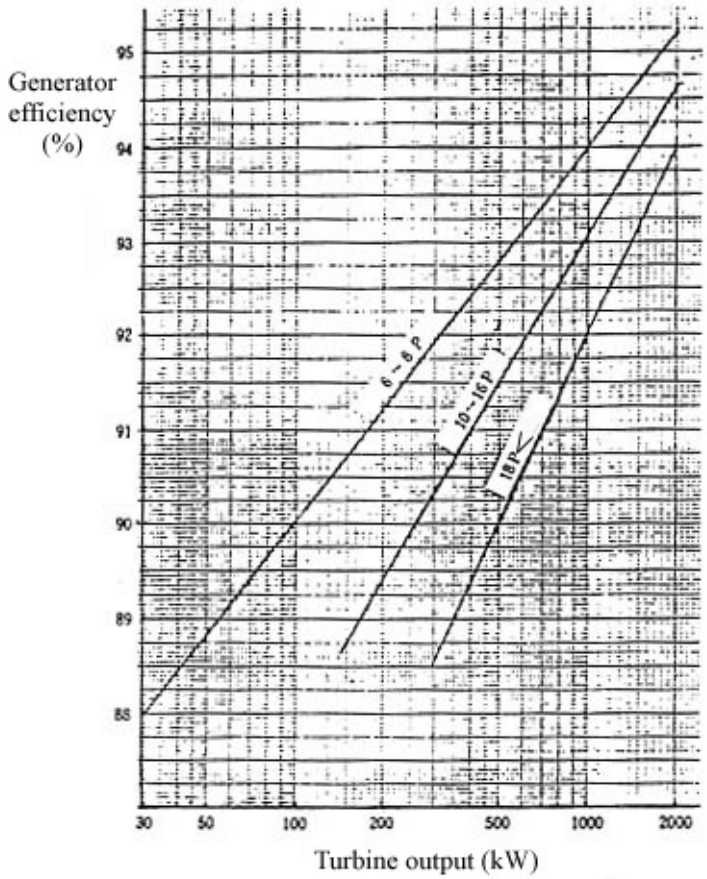
η_g: Generator efficiency (unit) when rated power factor

η_m: Speed increaser efficiency (unit) when speed increaser is applied

$$P_g = P_t \quad \eta_g \quad \eta_m$$

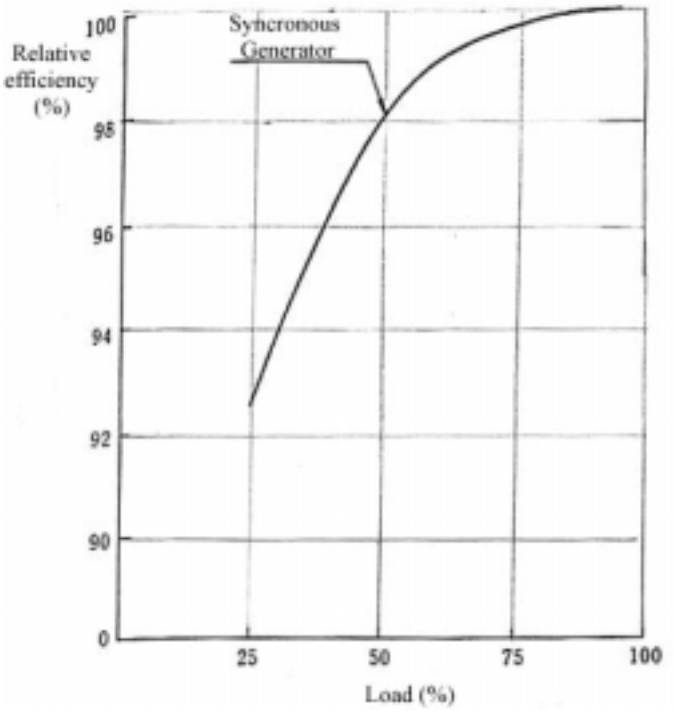
(4) Generator Efficiency

a. Efficiency of rated output



Source: See the footnote on Page A8-1.

Figure 6 Efficiency at Generator Rated Output (standard)



Type \ Load	100	75	50	25
Synchronous generator	100	99.7	98	92.5

Source: See the footnote on Page A8-1.

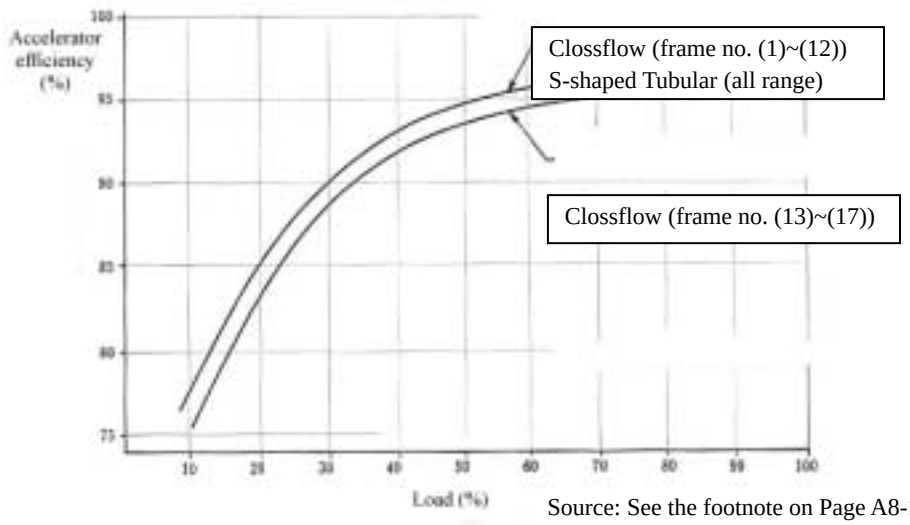
Figure 7 Generator Partial Load Efficiency (standard)

(5) Efficiency of Speed Increaser

Efficiency standard is shown in the Figure 8. Load stands for generator and the value is given by the following formula that input kW, that is. Generator output divided by generator efficiency.

$$\text{Load (\%)} = \frac{\text{Generator output x Generator Efficiency}}{\text{Speed Increaser Rated Output (kW)}}$$

e



Source: See the footnote on Page A8-1.

Figure 8 Efficiency of Speed Increaser

Appendis 9 CONVERSION TABLE OF WEIGHTS AND MEASURES

(1) LENGTH

1 m	1 feet	1 yard	unit
1	0.3048	0.9144	m
3.2808	1	3.0	ft.
1.0936	0.3333	1	yd.

1 cm	1 inch	unit
1	2.5400	cm
0.3937	1	inch

1 mile	1 feet	1 m	unit
1	0.000189394	0.000621371	mi.
5,280	1	3.2808	ft.
1609.344	0.3048	1	m

(2) AREA

1 ha	1 a	1 m^2	unit
1	0.01	0.0001	ha
100	1	0.01	a
10,000	100	1	m^2

1 a	1 acre	unit
1	40.469	a
0.0247	1	acre

(3) VOLUME

1 lit.	1 imperial gallon	1 US gallon	unit
1	4.5463	3.7852	lit.
0.2199	1	0.8325	imperial gal.
0.2642	1.2010	1	US gal.

(4) WEIGHT

1 kg	1 pound	unit
1	0.45359	kg
2.20462	1	lb.