

FREE JET hydroEngine®

Typical plant layout

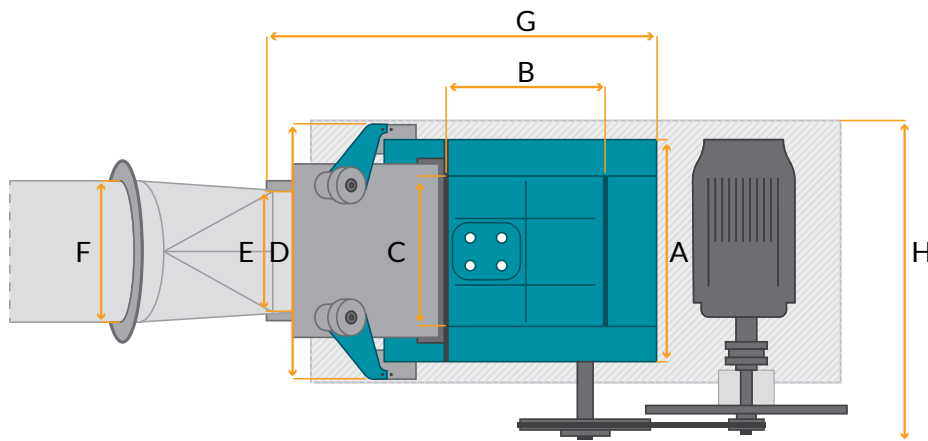
The hydroEngine is delivered to the project site assembled and factory-tested. Commissioning time and cost are reduced as installation into the prepared powerhouse is a simple process. In most gravity-head situations (run-of-river or in-dam), the following guidelines are recommended:

- Top of intake should be submerged below the upper pool in accordance with best practices to avoid formation of air vortices.
- Where desired, the Free Jet design allows for the capture of some head below the turbine. To accomplish this, the exit of the plinth, or outlet, must be below plant afterbay water level.

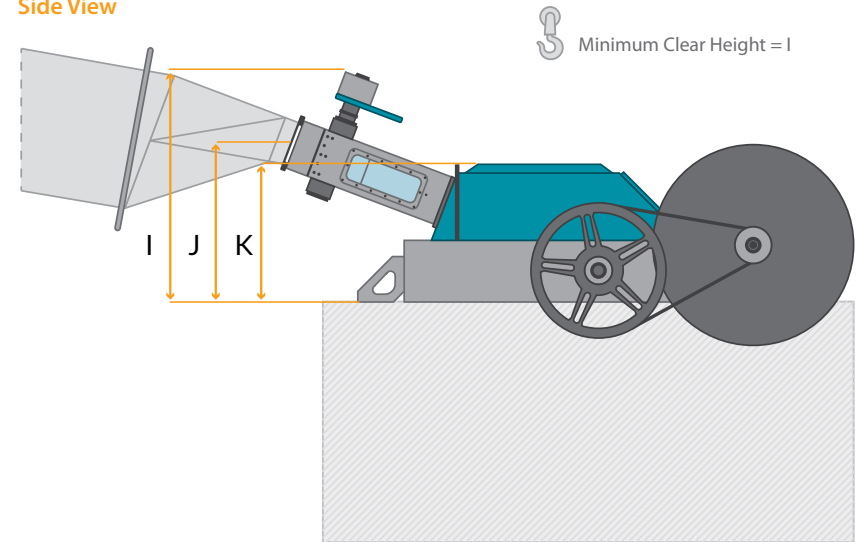
	A	B	C	D	E	G	H	I	J	K
FJ-7A	1,033	504	574	1,175	550	1,800	1,330	1,080	735	650
FJ-7A-L	1,033	1,029	574	1,175	550	2,325	1,330	1,294	949	864
FJ-7A-XL	1,033	1,624	574	1,175	550	2,920	1,330	1,537	1,192	1,107
FJ-4.5C	3,040	1,344	1,880	4,190	1700	4,850	4,650	2,490	2,060	1,570
FJ-4.5C-L	3,040	2,688	1,880	4,190	1700	6,730	4,650	3,230	2,350	2,080
FJ-8C	2,410	1,344	1,252	3,550	1072	4,120	4,010	2,200	1,770	1,570
FJ-8C-L	2,410	2,688	1,252	3,550	1072	6,000	4,010	2,950	2,060	2,080
FJ-12C	2,100	1,344	940	3,240	760	3,750	3,700	2,065	1,630	1,570
FJ-12C-L	2,100	2,688	940	3,240	760	5,670	3,700	2,820	1,940	2,080
FJ-20C	1,780	1,344	626	2,930	446	3,390	3,390	1,925	1,489	1,570
FJ-20C-L	1,780	2,688	626	2,930	446	5,670	3,390	2,820	1,940	2,080

F = per application, subject to standard penstock efficiency calculations
 Minimum interior plinth area should exceed $B \times C \times 2$
 B (axle to axle) and C (blade length) are interior dimensions

Top View



Side View

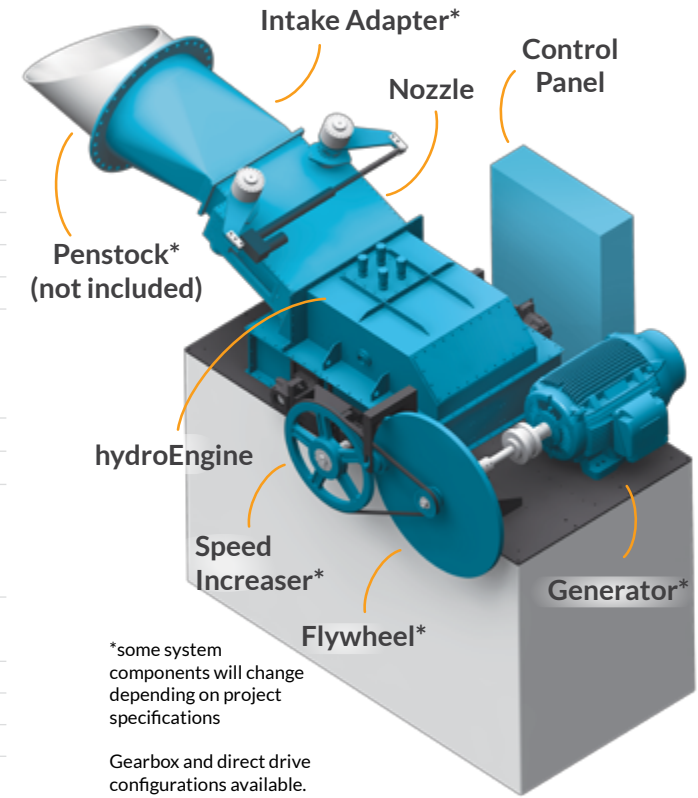


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Equipment included in the water-to-wire package

ITEMS INCLUDED

	Base hydroEngine	Water-to-wire Package
Hydro-mechanical equipment		
hydroEngine	•	•
Intake adapter	•	•
Inlet nozzle	•	•
Design guidance for outlet or plinth	•	•
Speed increaser (gearbox or belt drive)		•
Special assembly tools	•	•
Electrical equipment		
Generator		•
Power Factor Correction (if required, and as specified, by customer)		•
Generator protection relay (as specified by customer)		•
Grid protection relay (as specified by customer)		•
Instrumentation and control equipment		
Unit SCADA control system (hardware and software)	•	•
Integrated Sensors:		
- hydroEngine shaft speed	•	•
- Nozzle flow control	•	•
- Powertrain health	•	•
- Generator output		•
- Water levels (upper and lower pools)		•



Operating envelope

Natel currently offers two basic configurations: a Fully Flooded model, and a Free Jet model. See table below to explore flow and power rating for each Free Jet unit.

To optimize profitability, projects should be designed such that installed hydroEngine will operate near maximum flow capacity, given the available net head.

	max head (m)	max flow (m³/s)	max power (KW)		max head (m)	max flow (m³/s)	max power (KW)
FJ-7A	7	1.2	66	FJ-8C-L	8	14	911
FJ-7A-L	7	2.3	135	FJ-12C	12	5.7	562
FJ-7A-XL	7	3.7	214	FJ-12C-L	12	12	1,191
FJ-4.5C	4.5	7.8	289	FJ-20C	20	4.3	711
FJ-4.5C-L	4.5	16	613	FJ-20C-L	20	9	1,506
FJ-8C	8	6.6	430				

ITEMS NOT INCLUDED

All other related balance of plant designs, hardware, and civil works are not part of Natel's scope of supply, including, but not limited to, the following:

- Intake and bypass gates
- Trash rack or screen
- Power house
- Draft tube or plinth
- Plant wiring
- Transformers and utility interconnection hardware