NOHAB DIESEL

F20

NOHAB DIESEL
Background and future

In 1911 the Norwegian explorer Roald Amundsen carried out his world-renowned expedition to the South Pole. His ship "FRAM" with its dependable 180 BHP Polar engine made a valuable contribution to his success and this vessel—together with its original Polar engine—can still be seen in "Frammuséet" at Bygdøy, Oslo, Norway. The historic event resulted in the choice of the trade name NOHAB Polar for engines earlier produced by the Company.

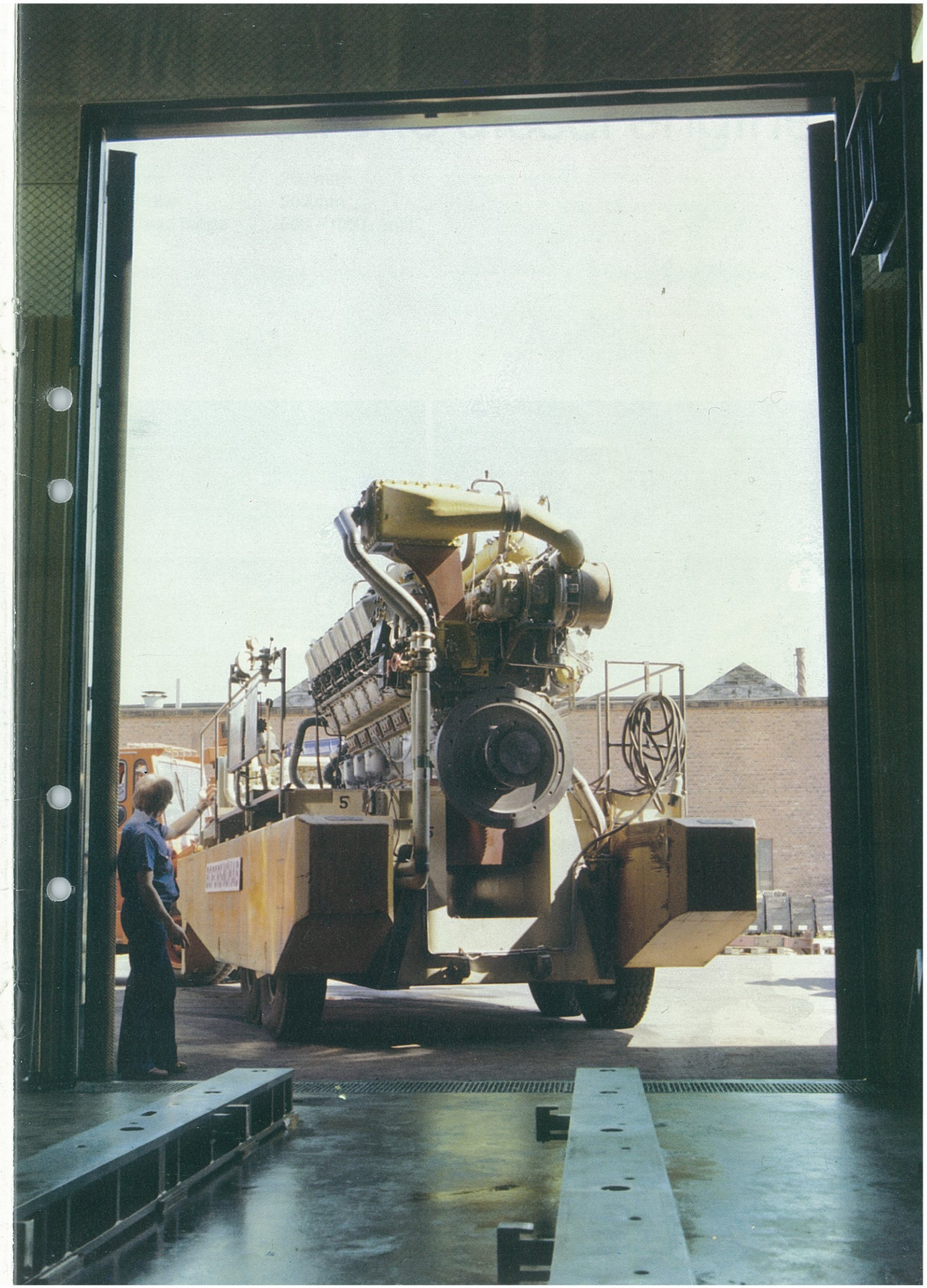
NOHAB DIESEL's engine production can be directly traced to the licence agreement signed in 1898 between Rudolf Diesel and a group of Swedish financiers. It was on the basis of this agreement that diesel engines were manufactured and developed by both Ludvig Nobel Co. in St. Petersburg and AB Diesels Motorer in Stockholm, later re-christened AB Atlas Diesel. The Polar engines were introduced onto the market just before the beginning of World War I. In 1925 NOHAB took over manufacture from Ludvig Nobel Co. and in 1948 the production of diesel engines carried out by Atlas Diesel was also incorporated. This means that the F-type engines of today are based on more than 80 years of diesel experience.
A large number of type F engines are in service all over the world as main and auxiliary engines in ships and also in diesel generator sets on land.

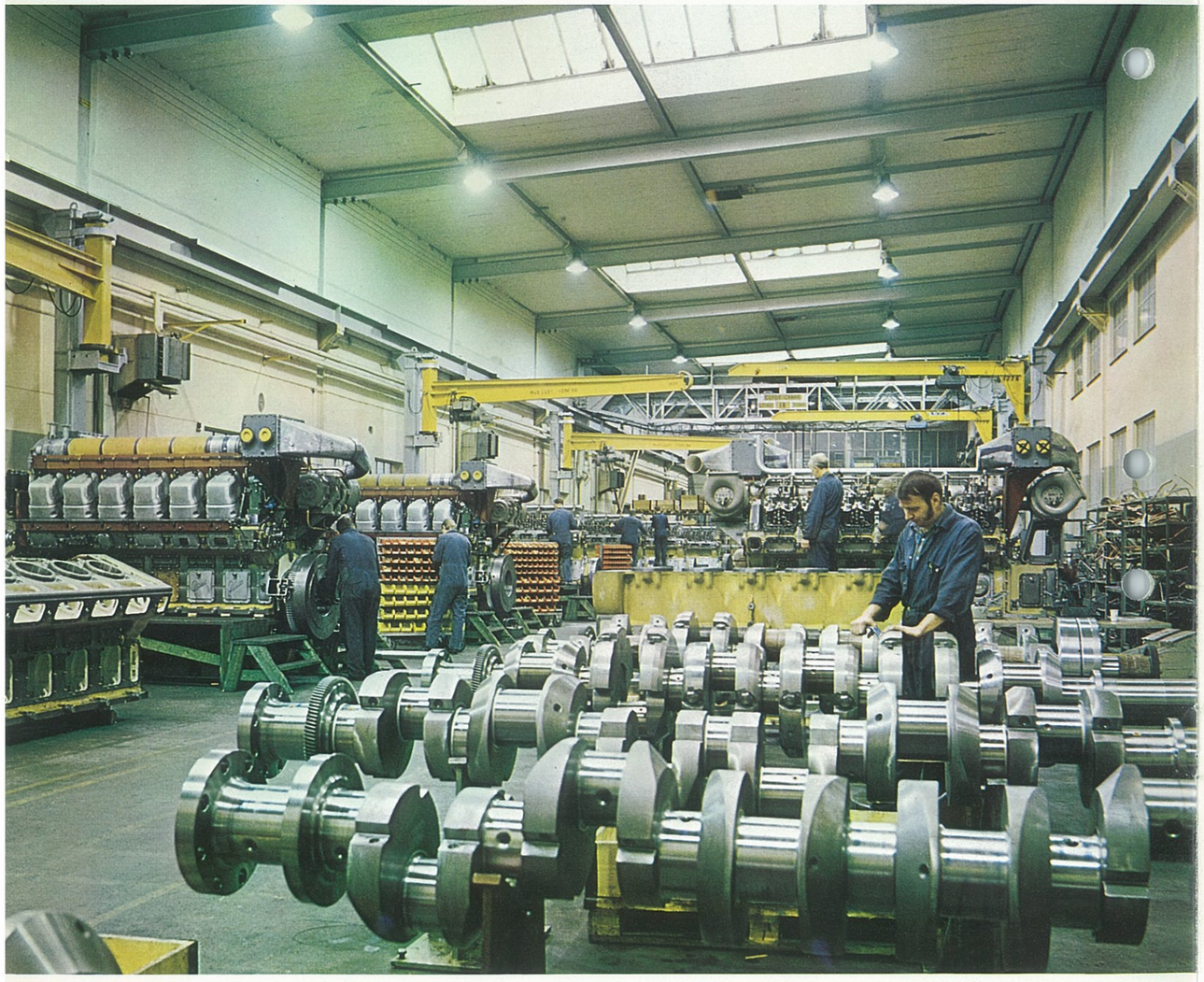
Even as early as the design stage of the F engine, due consideration has been taken to the gradual increase of brake mean effective pressure and engine speed in the future. This means that the full development potential of the type F engine has not yet been utilized—an important factor with respect to service and replacement parts in the future. The type F engine satisfies advanced demands concerning:

- ☐ Multi-engine installations in unmanned engine-rooms
- ☐ Generator set operation with rapid changes in loading
- ☐ The capacity to accept a load quickly after a cold start in the case of land-based installations and stand-by power plants

In October, 1978, Bofors in Sweden and Wärtsilä in Finland signed an agreement of co-operation within the diesel engine field. To facilitate this co-operation, diesel engine operations are assigned —from January 1, 1979—to a special company titled NOHAB DIESEL AB, with its own sales, design, installation, service and production facilities.

Oy Wärtsilä Ab and AB Bofors have the intention to develop the activities of both NOHAB DIESEL and the Wärtsilä Vasa Factory so that both units will have strong independent profiles. The two companies have complementary product lines comprising medium-speed, marine and stationary diesel engines, with outputs up to 5760 kW (7800 BHP). Cylinder bores are between 220 and 320 mm.

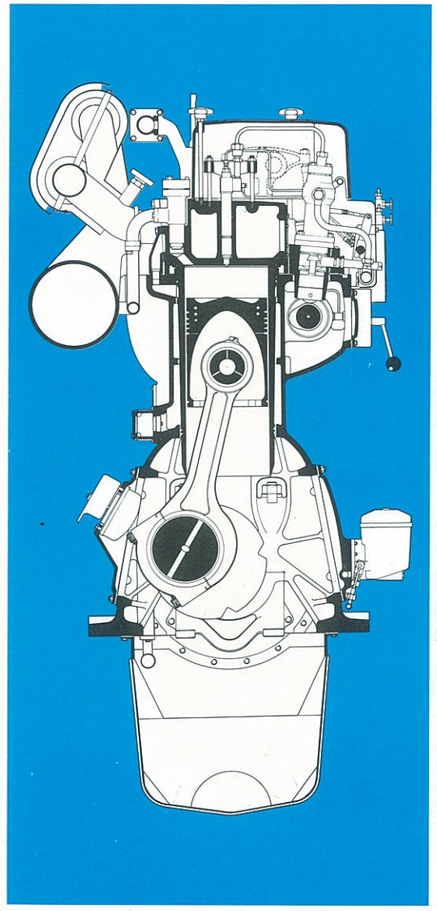


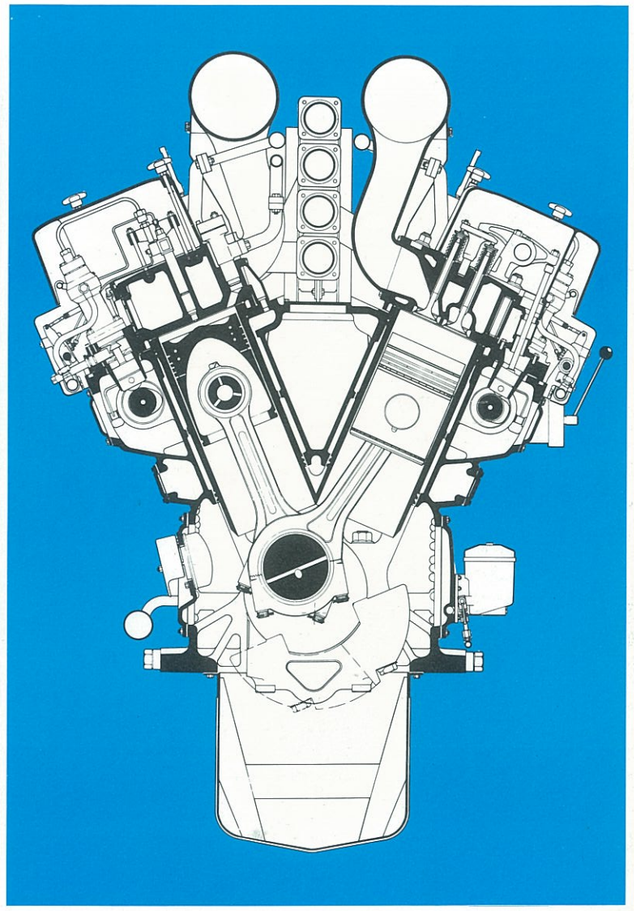


NOHAB DIESEL engines are assembled in workshops which are quite separated from machining and test running shops. This eliminates the risk of getting dust or foreign matter into the engines during assembly.

NOHAB Type F20
Four-stroke diesel engine

Bore	250 mm
Stroke	300 mm
Speed range	600—1000 r/min





IN-LINE ENGINES

4 and 6 cylinder versions
470—1060 kW (600—1440 BHP)

V-ENGINES

8, 12 and 16 cylinder versions
940—2810 kW (1270—3820 BHP)

UNIFORM MACHINERY* Outputs up to appr. 25000 kW (34000 BHP)

* Main engines and auxiliary engines of the same type.

NOHAB DIESEL has at its disposal special machines for rational production. The cylinder block—the "back-bone" of the engine—is cast of SG iron and machined with meticulous accuracy by using numerically controlled equipment.

NOHAB Type F20 Some of the particular advantages

Wide output range

The in-line and V-engines in the type F-series with identical cylinder units cover an output range of 470—2810 kW (600—3820 BHP).

Outputs of up to 25000 kW (34000 BHP), in the form of UNIFORM MACHINERY, are obtained by combining type F engines to power the ship and also drive generators.

Long lifetime—long intervals between overhauls

The design of NOHAB F engines is aimed at a long life and also long intervals between overhauls—for example cylinder head overhaul at intervals of 10,000 hours of operation, piston removal at intervals of 20,000 hours of operation.

Compact and easy to install

The NOHAB Type F is a compact engine with low weight and short overall length in relation to output and speed. A V12 engine with a rating of 1940 kW (2640 BHP) at 825 r/min weighs only about 14 tons and is about 4.2 m long.

Type F engines are delivered completely ready for installation by using special lifting tools from NOHAB DIESEL.

Good accessibility and light-weight parts

The top surface of the cylinder heads is located at a convenient working level in relation to the floor grid. The main and big end bearings are readily accessible through well-dimensioned castings. All components are directly replaceable and the individual parts are easy to handle because of their low weight.

Low fuel oil and lubricating oil consumption

For example:
Specific fuel consumption at 3/4 load and 750 r/min, 203 g/kWh (149 g/BHPh). At 1/1 load and 750 r/min, 205 g/kWh (151 g/BHPh).

Lubricating oil consumption per kWh/at 1/1 load: Approx. 2 g (1,5 g/BHPh).

Cylinder heads and cylinder block of nodular (SG) iron

The latest version of the F20 engine has both cylinder heads and cylinder block made of SG iron. This material has the good damping qualities of cast-iron, twice the tensile strength of grey iron and the high shock strength of steel. See also page 10.

Rapid load take-up after starting

In the case of generator sets, the demand is often made that load take-up after starting must be rapid and this has been taken into account in design work. It takes about 4 seconds from standstill to reach operating speed and a further 6 seconds until the engine supplies full output.

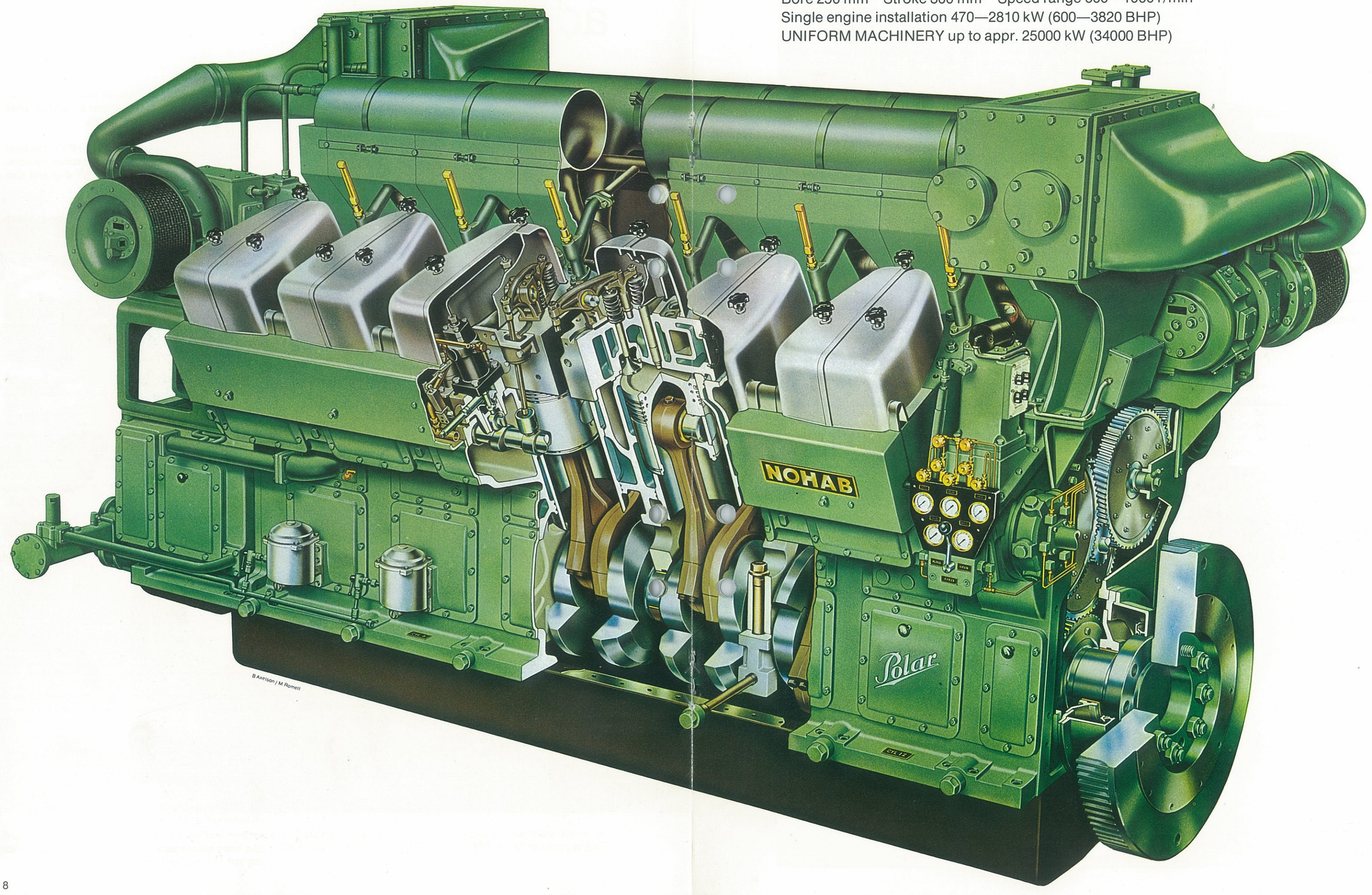
Extra power take-off

An extra power take-off for full engine output can be fitted to the front end of the engine.

NOHAB TYPE F20

Four-stroke diesel engine

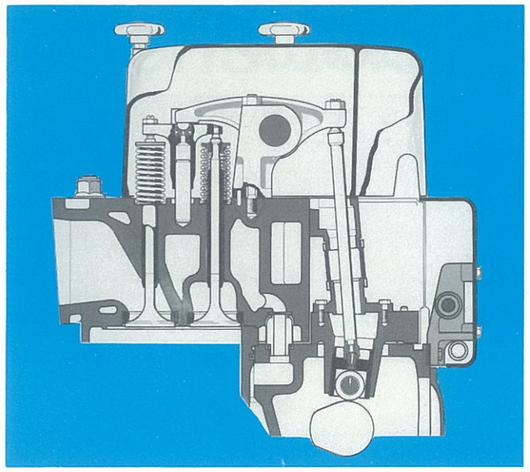
Bore 250 mm Stroke 300 mm Speed range 600—1000 r/min
Single engine installation 470—2810 kW (600—3820 BHP)
UNIFORM MACHINERY up to appr. 25000 kW (34000 BHP)

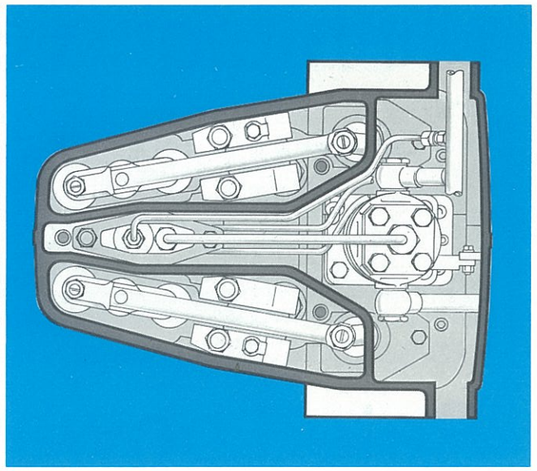


B Axelson / M Romell

NOHAB Type F20
Interesting design features

Cylinder block	The cylinder block—the "backbone" of the engine—is a one-piece casting and carries the crankshaft. This design ensures a very rigid engine. No bedplate is needed and the fabricated sump is of light design. In 1968 cylinder blocks of SG iron were introduced and the advantages provided compared with normal cast-iron are as follows: 1. Tensile strength has been increased from 22 to about 50 kp/mm² (31290—71120 psi). 2. Fatigue strength is nearly twice as high. 3. SG iron provides about the same shock resistance as steel, this being vitally important for marine vessels such as icebreakers and naval units as well as for power stations in earthquake areas. 4. SG iron has an elongation of about 10% which decreases the risk of stress concentrations. 5. SG iron has a modulus of elasticity which is about 60% higher than that of normal cast-iron, this reducing deformation due to internal forces and moment.
Cylinder liners	The wet type cylinder liners are easily replaceable, the cooling system being designed so as to provide optimum cooling. A support on the middle of each liner reduces vibration to a minimum.
Main and big end bearings	The main and big end bearings are of pre-finished tri-metal type with thin-walled steel backs. The upper and lower halves can be replaced individually.
Pistons	The F20 engine is fitted with two alternative standard types of light-alloy pistons. One piston type has a cast-iron cooling coil and ring carrier for the upper piston ring. It is fitted with four compression rings—the upper two chromium-plated and barrel formed. Two oil scraper rings, one on each side of the piston pin. The other type of standard piston is a forged light-alloy design with shaker cooling. The upper part of the piston crown is electron-welded. Three compression rings and two oil scraper rings are placed above the piston pin.
Cylinder heads	The cylinder heads are easy to remove and are cast of SG iron. A high level of volumetric efficiency is attained by the design of the heads, each of which has two inlet and two exhaust valves. Both types of valves have chrome-plated stems. The valve seats in the cylinder heads are replaceable. The rocker arm cover over the cylinder heads has separate cavities for injection equipment and the pressure-lubricated valve mechanism. This eliminates the risk of the lubricating oil becoming contaminated by any fuel oil which may leak out.
Camshaft	The camshaft is carried in white metal lined steel shells in the upper part of the cylinder block and is driven by the crankshaft through gears at the flywheel end of the engine. The camshaft is removed longitudinally and is sub-divided so that each section covers one cylinder.
Fuel injection equipment	There is a separate injection pump for each cylinder and a standard type injection valve. Delivery pipes are short and have the same length on each cylinder. Uncooled nozzles are fitted on engines which are to run on distillate fuels. Engines which are to run on non-distillate fuels are fitted with cooled nozzles. The coolant, (thermostat-controlled), normally consists of fuel oil taken from the fuel system.
Lubricating oil system	The F engine is fitted with a lubricating oil system with carefully selected components. The main filter consisting of coarse and fine cartridges which trap dirt particles as small as 0.005 mm. The fine filter includes paper cartridges of the micro-type. Furthermore, standard equipment on type F engines includes bypass filters of the centrifugal type. The lubricating oil temperature remains constant over the entire speed and load range through a thermostat valve.
Governor	The standard equipment includes a hydraulic governor of the Woodward UG8 type. Alternatively the F engines can be supplied with the PG governor providing for multi-engine installation load sharing systems and for CP propeller installation basic load control. The F20 engine can also be equipped with an all-electric governor of Barber Colman type.





A high degree of volumetric efficiency is attained by having two inlet and two exhaust valves on each cylinder. Both types of valves have chrome-plated stems.

The rocker arm cover over each cylinder head has separate cavities for injection equipment and the pressure-lubricated valve mechanism.
This avoids the risk of the lubricating oil becoming contaminated by any fuel oil which may leak out.

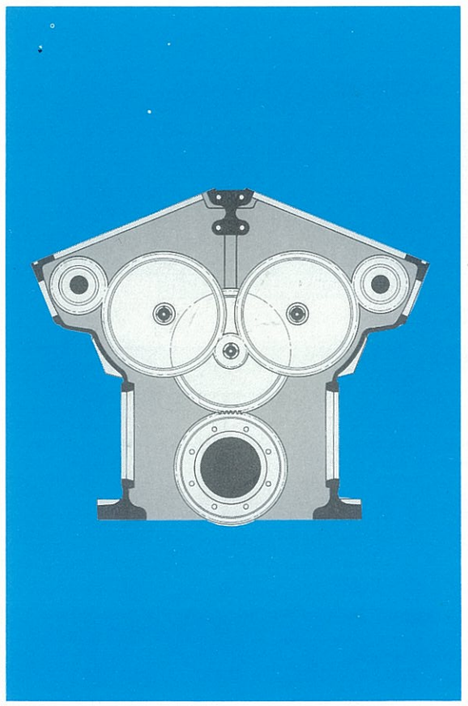
Inside information

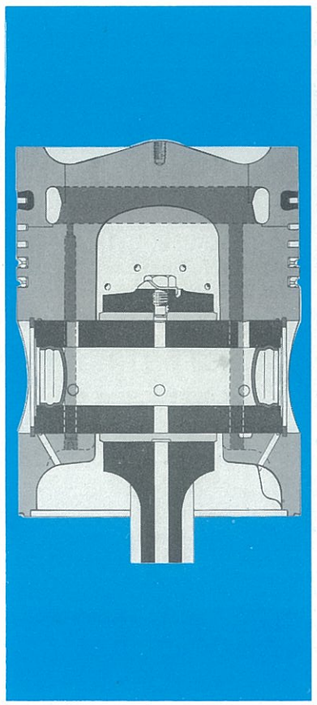
The figures show the design of some important components

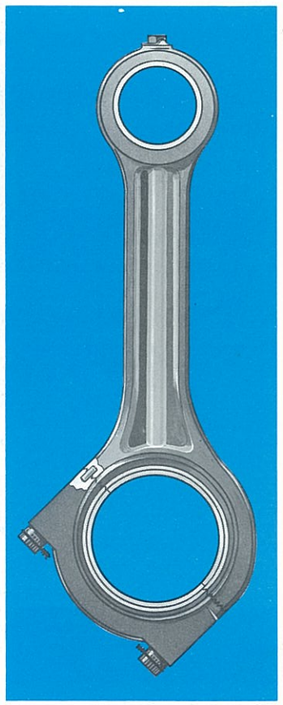
The camshaft is driven by the crankshaft through gears at the flywheel end of the engine.

The piston with shaker cooling has a ring-shaped cooling chamber in the piston crown, where the oil pulsates with the piston motion. The efficient cooling provides optimum operating conditions for the piston rings.

The connecting rods are dropforged and diagonally divided at the big end bearing to facilitate removal of the bearing shells, the upper and lower halves of which are individually replaceable.







Main technical data

Speed	600—750 r/min.	825 r/min.	900 r/min.	1000 r/min.
BMEP at continuous rated power	1.60 MPa (16.0 bar)	1.60 MPa (16.0 bar)	1.50 MPa (15.0 bar)	1.43 MPa (14.3 bar)[1]
Mean piston speed	6.0—7.5 m/s	8.3 m/s	9.0 m/s	10.0 m/s
Specific fuel consumption per kWh (BHPh)[2]				
1/1 load	205 g (151 g)	210 g (155 g)	215 g (158 g)	220 g (162 g)
3/4 load	203 g (149 g)	208 g (153 g)	212 g (156 g)	218 g (160 g)
1/2 load	204 g (150 g)	209 g (154 g)	215 g (158 g)	220 g (162 g)
Specific lubricating oil consumption per kWh (BHPh) at 1/1 load	Approx. 2 g (1.5 g)	Approx. 2 g (1.5 g)	Approx. 2 g (1.5 g)	Approx. 2 g (1.5 g)

[1]) Valid for intermittent rated power.
[2]) These values apply with a tolerance of +5% and assume the use of a fuel oil with a calorific value of at least 42,000 kJ/kg (10,030 kcal/kg)

Rated power

Marine main propulsion engines

Engine design-ation	No. of cyl.	Max. continuous rated power[1], [2] (Fuel stop power) 720 r/min. kW (BHP)	750 r/min. kW (BHP)	825 r/min. kW (BHP)
F24R	4	565 (768)	590 (802)	650 (884)
F26R	6	850 (1156)	885 (1204)	970 (1319)
F28V	8	1130 (1537)	1180 (1605)	1300 (1768)
F212V	12	1700 (2312)	1770 (2407)	1940 (2638)
F216V	16	2260 (3074)	2355 (3203)	2600 (3536)

Marine auxiliary generating sets

Engine design-ation	No. of cyl.	Max. continuous rated power[1], [3] 720 r/min.—60Hz Engine kW (BHP)	Generator kVA[7])	750 r/min.—50 Hz Engine kW (BHP)	Generator kVA[7])	900 r/min.—60 Hz Engine kW (BHP)	Generator kVA[7])
F24R	4	565 (768)	665	590 (802)	695	660 (898)	775
F26R	6	850 (1156)	1000	885 (1204)	1040	1000 (1360)	1175
F28V	8	1130 (1537)	1330	1180 (1605)	1385	1325 (1802)	1555
F212V	12	1700 (2312)	2000	1770 (2407)	2080	2000 (2720)	2350
F216V	16	2260 (3074)	2655	2355 (3203)	2765	2650 (3604)	3115

Stationary base-load generating sets

Engine designa-tion	No. of cyl.	Max. continuous rated power[4], [5] 600 r/min.—50 Hz Engine kW (BHP)	Generator kVA[7])	720 r/min.—60 Hz Engine kW (BHP)	Generator kVA[7])	750 r/min.—50 Hz Engine kW (BHP)	Generator kVA[7])	900 r/min.—60 Hz Engine kW (BHP)	Generator kVA[7])
F24R	4	470 (639)	550	565 (768)	665	590 (802)	695	660 (898)	775
F26R	6	710 (966)	835	850 (1156)	1000	885 (1204)	1040	1000 (1360)	1175
F28V	8	940 (1278)	1105	1130 (1537)	1330	1180 (1605)	1385	1325 (1802)	1555
F212V	12	1415 (1924)	1665	1700 (2312)	2000	1770 (2407)	2080	2000 (2720)	2350
F216V	16	1885 (2564)	2215	2260 (3074)	2655	2355 (3203)	2765	2650 (3604)	3115

Peak-load and emergency generating sets

Engine designa-tion	No. of cyl.	Intermittent rated power[4], [6] 720 r/min.—60Hz Engine kW (BHP)	Generator kVA[7])	750 r/min.—50 Hz Engine kW (BHP)	Generator kVA[7])	900 r/min.—60 Hz Engine kW (BHP)	Generator kVA[7])	1000 r/min.—50 Hz Engine kW (BHP)	Generator kVA[7])
F24R	4	600 (816)	705	625 (850)	735	700 (952)	825	700 (952)	825
F26R	6	900 (1224)	1060	940 (1278)	1105	1060 (1442)	1245	1060 (1442)	1245
F28V	8	1200 (1632)	1410	1250 (1700)	1470	1405 (1911)	1650	1405 (1911)	1650
F212V	12	1800 (2448)	2115	1880 (2557)	2210	2120 (2883)	2490	2120 (2883)	2490
F216V	16	2400 (3264)	2820	2500 (3400)	2940	2810 (3822)	3300	2810 (3822)	3300

[1]) Engine ratings according to ISO 3046/1 (Pr=100 kPa, Tr=300 K, Tcr=300 K, Ør=60%). They also meet the conditions according to the classification societies of max 45° C ambient and 32° C sea water temperature. DIN 6270, BS 649, SAE 816b and DEMA also accepted.

[2]) Overload not allowed during operation. 10% overload during workshop test only. Propeller to be designed for 90% of the max. continuous rated power at flywheel end and gearbox and propeller shaft losses to be deducted.

[3]) 10% overload available only for transient loads.

[4]) Engine powers according to ISO 3064/1 (Pr=100 kPa, Tr=300 K, Tcr=300 K, Ør=60%). DIN 6270, BS 649, SAE 816b and DEMA also accepted.

[5]) 10% overload available for 1 h each 12 h

[6]) No overload available.

[7]) Based on a generator efficiency of 94% and P.F.=0.8.

Dimensions and weights

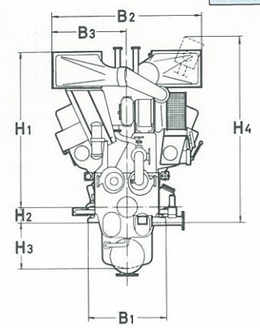
In-line engines

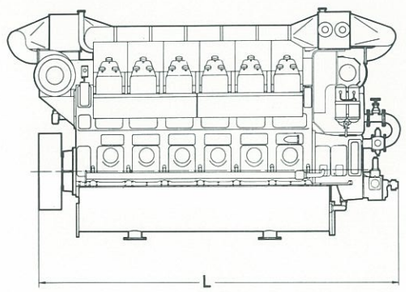
Engine type	No. of cyl.	Weight, engine with flywheel*, tons	B1 mm	B2 mm	B3 mm	H1 mm	H2 mm	H3 mm	H4 mm	L mm
F24R	4	6.1	840	1180	630	1495	180	610	2250	3100
F26R	6	8.2	840	1260	640	1495	180	610	2250	3860

*Weight of flywheel in normal engine, 1000 kg

V-engines

F28V	8	10.7	920	1800	900	1565	180	540	2140	3315
F212V	12	14.2	920	1800	900	1865	180	540	2140	4225
F216V	16	17.9	920	1800	900	1865	180	540	2140	5065

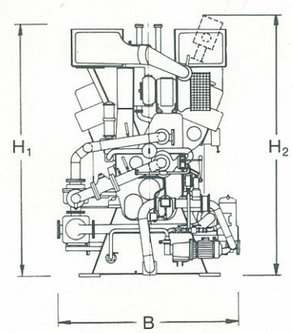


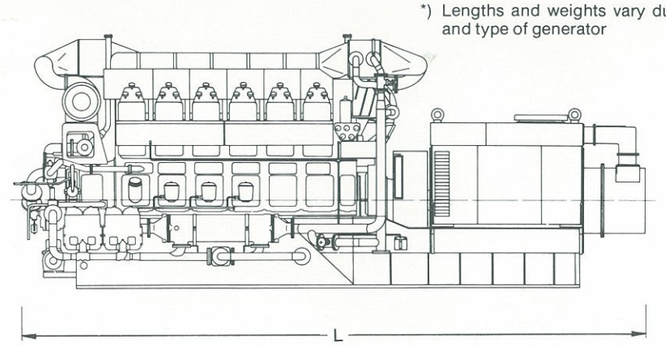


Generator sets

Type of diesel generator set	Weight*) tons	B mm	H_1 mm	H_2 mm	L[1]) mm
F24R	12.5	1900	2600	3000	4900
F26R	16.5	1900	2600	3000	5800
F28V	20.5	1900	2870	2960	5900
F212V	27.0	2100	2870	2960	6600
F216V	35.0	2100	2870	2960	7600

*) Lengths and weights vary due to make and type of generator





NOHAB DIESEL engines operating all over the world

1 The NOHAB DIESEL Uniform Machinery (main and auxiliary engines of the same type) in the two sister-ferries "Visby" and "Gotland", each with a rating of 13300 kW (18000 BHP), consists of six 16-cylinder type F engines coupled in sets of three for each propeller shaft and two 12-cylinder type F auxiliary generator sets. Two of the main engines are also fitted with shaft generators which can be cut in when necessary.

2 NOHAB DIESEL has delivered five 8-cylinder F28V diesel generator sets to supply the power needed aboard the "Safe Astoria" accomodation platform. Total generator output is 7800 kW. The semi-submersible, 80×53 m rig provides quarters for 600 and operates world-wide.

3 Norwegian-built "Umanaq" is a 1,200 dwt factory stern-trawler. The propulsion machinery consists of a 16-cylinder, 2600 kW (3520 BHP), NOHAB F216V engine.

4 Italian ferry "Ulisse" which operates in the Strait of Messina, is powered by two 12-cylinder NOHAB F212V engines, totalling 3680 kW (5000 BHP).

5 "Pellos", 141,000 dwt tanker, built in Sweden for a Finnish owner, has three 12-cylinder NOHAB DIESEL auxiliary generator sets. Two of these are also direct-coupled to cargo pumps. Total generator output, 4125 kVA, and total engine output for cargo pumps operation, 3240 kW (4400 BHP).

6 NOHAB DIESEL stationary engines are in successful operation in many parts of the world. The Hayir Power Plant in Saudi Arabia with a total output of 4000 kVA has four 12-cylinder NOHAB DIESEL generator sets.

7 Eight NOHAB DIESEL generator sets have been delivered for the emergency power sets of the Ringhals nuclear power plants No. 3 and 4 in Sweden. One of the 3450 kVA sets ready for testing at the NOHAB DIESEL works.

8 NOHAB DIESEL is one of the world's leading suppliers of propulsion engines for offshore vessels. U.S.-owned "Northern Worker" has two NOHAB DIESEL main engines with a total output of 1700 kW (2310 BHP).

9 Italian tug "Piemonte" has a 12-cylinder 1840 kW (2500 BHP) main propulsion engine from NOHAB DIESEL.

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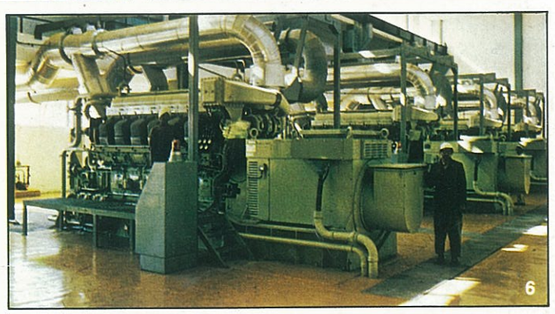
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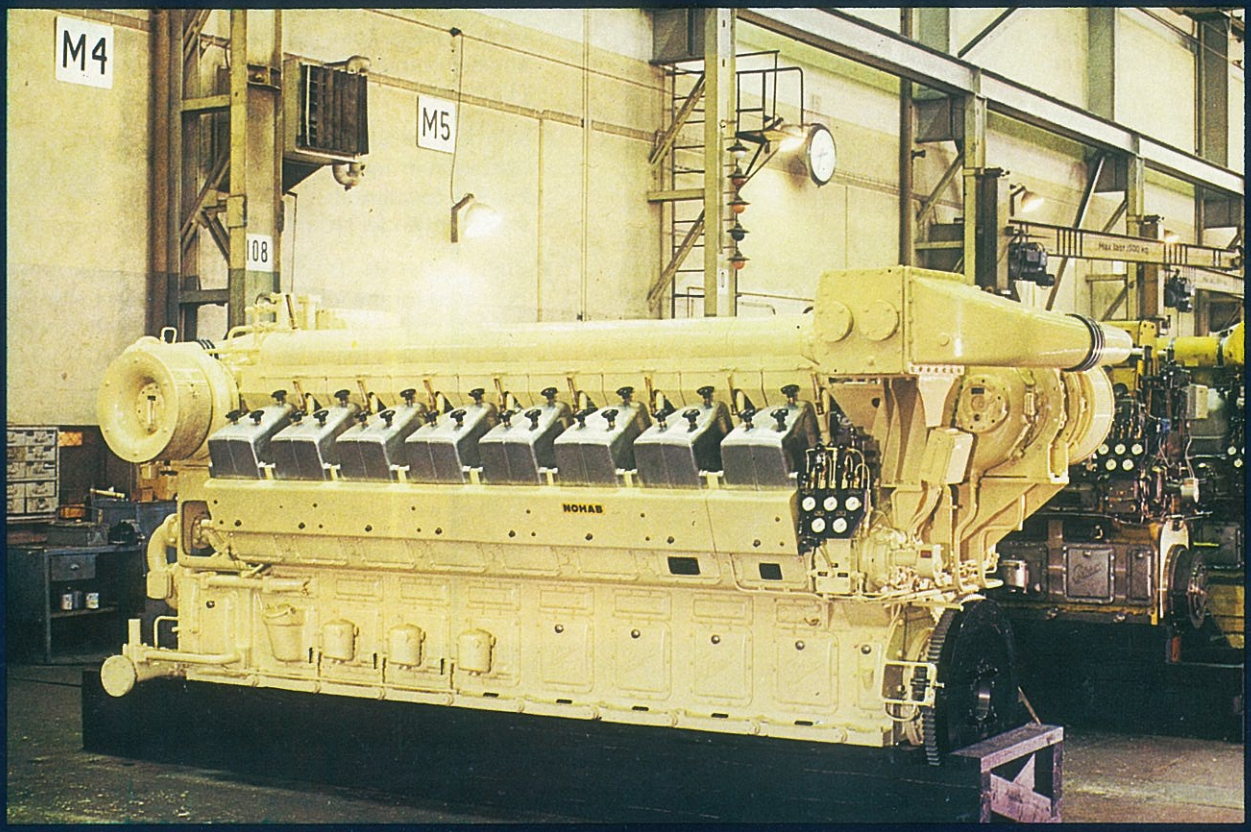
NOHAB DIESEL
all over the world



NOHAB DIESEL

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