轮机专业

新版

全国海船船员适任考试培训教材

轮机英语

English of Marine Engineering

中国海事服务中心组织编审

大连海事大学出版社
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前　　言

《中华人民共和国海船船员适任考试、评估和发证规则》（简称 04 规则）已于 2004 年 8 月 1 日生效，新的《中华人民共和国海船船员适任考试大纲》也自 2006 年 2 月 1 日实施。为了更好地帮助、指导船员进行适任考前培训和进一步提高船员适任水平，在交通部海事局的领导下，中国海事服务中心组织全国有丰富教学、培训经验和航海实际经验的专家共同编写了与《中华人民共和国海船船员适任考试大纲》相适应的培训教材。本教材的编写将改变长期以来船员适任培训使用本、专科教材的现状，消除由于教材版本众多所造成知识内容上存在的混淆和分歧，对今后的船员适任培训具有重要的指导意义。

本套教材知识点紧扣考试大纲，具有权威、准确、系统、实用的特点，重点突出船员适任考前培训和航海实践需掌握的知识，旨在培养船员在实践中应用知识的能力，并可作为工具书为船员上船工作使用。本套教材在着重于航海实践的同时，紧密结合现代船舶的特点，考虑到将来有关船舶技术的发展，教材内容涉及最新的航海技术，与时俱进，进一步拓展船员的知识层次。

本套教材由航海学、船舶值班与避碰、航海气象与海洋学、船舶操纵、海上货物运输、船舶结构与设备、船舶管理（驾驶）、船长业务、航海英语、轮机英语、轮机长业务、轮机工程基础、主推进动力装置、船舶辅机、船舶电气、轮机自动化、轮机维护与修理、船舶管理（轮机）组成。

本套教材在编写、出版工作中得到中华人民共和国海事局、各航海院校、海员培训机构、航运企业、人民交通出版社、大连海事大学出版社等单位的关心和大力支持，特致谢意。

中国海事服务中心

2008 年 2 月

编 者 的 话

2004 年中国海事局通过了新的《中华人民共和国海船船员适任考试、评估和发证规则》，业内简称“04 新规则”。此后修订并发布了新的考试大纲，与此对应，老题库的改造和新题库的建设也同步开展，至 2006 年 4 月新题库初稿已基本完成。

本书是专为轮机英语考证而作，因此内容紧扣新的考试大纲。全书分为三部分：第一篇专业阅读，第二篇业务书写，第三篇练习题。阅读部分按新大纲的要求选材，将各等级考试中知识点重复的内容合并统一，精选阅读材料，每课课文，附生词及短语，并对其中难句进行了注释。业务书写部分，完全按考试大纲的章节目录编写，针对考证需要，作了精要讲解和举例。练习题参照考试大纲的顺序定位排列。题目类型与全国统考试题类型完全相同。本书按教、培、考、训一条线（大纲），讲、练、学、用一本书的思路编写，力求做到讲解省心，学练省功，考用一致，学有所得。

本书第 1、第 9、第 10、第 19 和第 22 课由大连海事大学宋永欣讲师编写；第 13 至第 18 课，第 23 至第 33 课，第 35、第 37 及第 42 课由上海海事大学韩厚德教授编写；第 2 至第 8 课，第 11、第 12、第 20、第 21、第 34、第 36 课，第 38 至第 41 课，第 43 至第 56 课由大连海事大学党坤副教授编写。上海海事大学阚安康、梅国梁、廖留柱、周丽雯、纪珺，大连海事大学杜玉桓、鹿学军、从波、孙丽红、王晓锐、郑庆功也参加了本书的编写工作。全体编写人员参与了练习题部分的编写。本书由党坤副教授、韩厚德教授共同主编（排名不分先后），由党坤统稿。

本书在编写过程中，根据审核专家的意见，多次进行了修改，个别生词可能没在课文中出现，给广大读者带来了不便，请谅解。因编者水平所限，其他错漏之处，恳请读者谅解并给予批评指正。

编 者

2008 年 1 月

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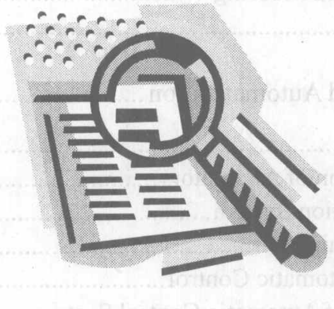
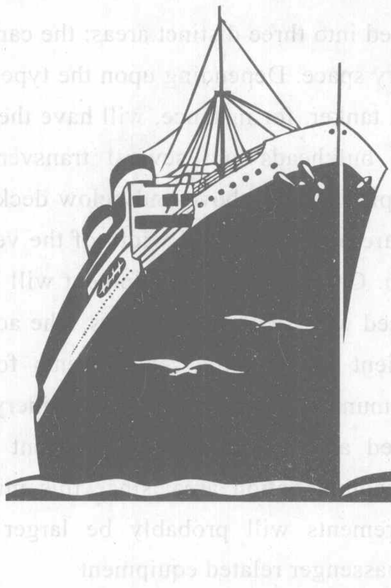


Part One Reading

第一篇 专业阅读



Unit 1 Main Propulsion Plant

Lesson 1 Ships and Machinery

Ships

Ships are large, complex vehicles which must be self-sustaining in their environment for long periods with a high degree of reliability. A ship is the product of two main areas of skill, those of the naval architect and the marine engineer. The naval architect is concerned with the hull, its construction, form, habitability and ability to endure its environment. The marine engineer is responsible for the various systems which propel and operate the ship. More specifically, this means the machinery required for propulsion, steering, anchoring and ship securing, cargo handling, air conditioning, power generation and its distribution. Some overlap in responsibilities occurs between naval architects and marine engineers in areas such as propeller design, the reduction of noise and vibration in the ship's structure, and engineering services provided to considerable areas of the ship.

A ship might reasonably be divided into three distinct areas: the cargo-carrying holds or tanks, the accommodation and the machinery space. Depending upon the type each ship will assume varying proportions and functions. An oil tanker, for instance, will have the cargo-carrying region divided into tanks by two longitudinal bulkheads and several transverse bulkheads. There will be considerable quantities of cargo piping both above and below decks. The general cargo ship will have various cargo holds which are usually the full width of the vessel and formed by transverse bulkheads along the ship's length. Cargo handling equipment will be arranged on deck and there will be large hatch openings closed with steel hatch covers. The accommodation areas in each of these ship types will be sufficient to meet the requirements for the ship's crew, provide a navigating bridge area and a communications centre. The machinery space size will be decided by the particular machinery installed and the auxiliary equipment necessary. A passenger ship, however, would have a large accommodation area, since this might be considered the "cargo space". Machinery space requirements will probably be larger because of air conditioning equipment, stabilizers and other passenger related equipment.

Ship's types

Depending on the nature of their cargo, and sometimes also the way the cargo is loaded/unloaded, ships can be divided into different categories, classes, and types, some of which are mentioned in Table 1.

The three largest categories of ships are container ships, bulk carriers (for bulk goods such as grain, coal, ores, etc.) and tankers, which again can be divided into more precisely defined classes and types. Thus, tankers can be divided into oil tankers, gas tankers and chemical tankers, but there are also combinations, e.g. oil/chemical tankers.

Table 1 provides only a rough outline. In reality there are many other combinations, such as "Multipurpose bulk container carriers", to mention just one example.

Table 1 Ships'type

Dry Cargo		Liquid Cargo	Passenger
Unit Cargo -Container vessel -Roll-on/Roll-off -Heavy cargo vessel -Refrigerated ships -Cattle ship	Bulk Cargo -Bulk carrier -Ore carrier	-Crude carrier -Product tanker -Chemical tanker -LPG/LNG carriers	-Passenger ship -Car and passenger ferries -Cruise ship
Multi-purpose ship			
Navy	**Fishing**	**Dredgers, etc**	**Work ships**
-Aircraft carrier -Cruiser -Destroyer -Frigate -Submarine -Mine sweeper	-Trawler -Other types of fishing vessels	-Trailing hopper suction dredger -Cutter suction dredger -Rock-dumper	-Crane vessel -Cable-layer -Buoy-layer -Oil-recovery vessel -Shearleg crane
Auxiliary craft	**Pleasure craft**	**Various**	**Offshore material**
-seagoing tug -Harbor tug -Icebreaker -Pilot vessel Coast guard vessel -Research vessel	-Motor yacht -Sailing yacht	-Hydrofoil -Floating dock -Submersible platform -Pontoon, barge	-Drilling rig/Jack up -Drill-ship -Pipe layer -Floating storage and offloading vessel

Ship's size

When a ship is in loaded condition, which floats at arbitrary water line, its displacement is equal to the relevant mass of water displaced by the ship. Displacement is thus equal to the total weight, all told, of the relevant loaded ship, normally in seawater with a mass density of 1.025 t/m^3. Displacement comprises the ship's light weight and its deadweight, where the deadweight is equal to the ship's loaded capacity, including bunkers and other supplies necessary for the ship's propulsion. The deadweight at any time thus represents the difference between the actual displacement and the ship's light weight, all given in tons:

deadweight = displacement–light weight

Incidentally, the word "ton" does not always express the same amount of weight. Besides the metric ton (1,000 kg), there is the English ton (1,016 kg), which is also called the "long ton". A "short ton" is approx. 907 kg.

The light weight of a ship is not normally used to indicate the size of a ship, whereas the deadweight tonnage (dwt), based on the ship's loading capacity, including fuel and lube oils etc, often is.

Machinery

Arrangement

Three principal types of machinery installation are to be found at sea today. Their individual merits change with technological advances and improvements and economic factors such as the change in oil prices. It is intended therefore only to describe the layouts from an engineering point of view. The three layouts involve the use of direct-coupled slow-speed diesel engines, medium-speed diesels with a gearbox, and the steam turbine with a gearbox drive to the propeller.

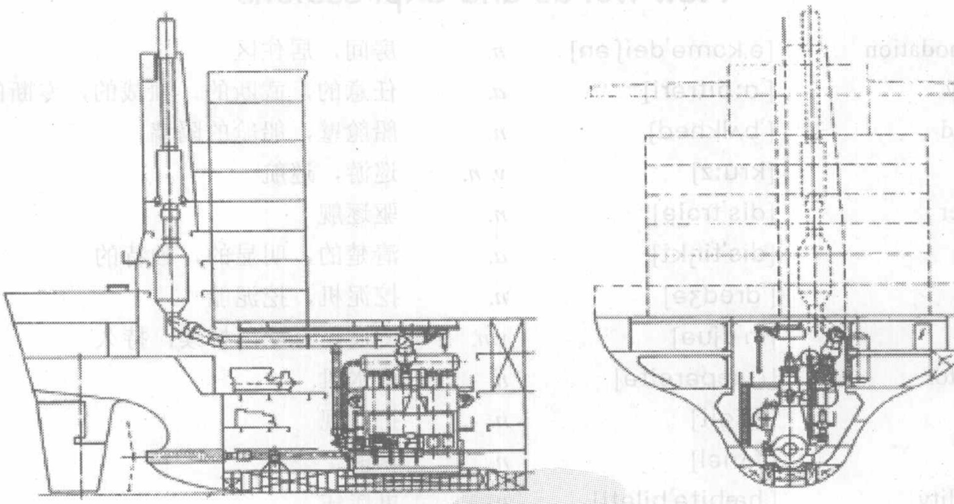
A propeller, in order to operate efficiently, must rotate at a relatively low speed. Thus, regardless of the rotational speed of the prime mover, the propeller shaft must rotate at about 80 to 100 r/min. The slow-speed diesel engine rotates at this low speed and the crankshaft is thus directly coupled to the propeller shafting. The medium-speed diesel engine operates in the range 250–750 r/min and cannot therefore be directly coupled to the propeller shaft. A gearbox is used to provide a low-speed drive for the propeller shaft. The steam turbine rotates at a very high speed, in the order of 6,000 r/min. Again, a gearbox must be used to provide a low-speed drive for the propeller shaft.

Slow-speed diesel

The usual plan and elevation drawings of a typical slow-speed diesel installation are shown in Fig. 1-1. A six-cylinder direct-drive diesel engine is shown in this machinery arrangement. The only auxiliaries visible are a diesel generator on the upper flat and an air compressor, below. Other auxiliaries within the machinery space would include additional generators, an oily-water separator, an evaporator, numerous pumps and heat exchangers. An auxiliary boiler and an exhaust gas heat exchanger would be located in the uptake region leading to the funnel. Various workshops and stores and the machinery control room will also be found on the upper flats.

Geared medium-speed diesel

Four medium-speed (500 r/min) diesels are used in the machinery layout of the rail ferry shown in Fig. 1-2. The gear units provide a twin-screw drive at 170 r/min to controllable pitch propellers. The gear units also power take-offs for shaft-driven generators which provide all power requirements while at sea. The various pumps and other auxiliaries are arranged at floor plate level in this minimum-height machinery space. The exhaust gas boilers and uptakes are located port and starboard against the side shell plating.



Section looking to port　　　　Section looking to forward

Fig. 1–1 Low–speed diesel machinery arrangement

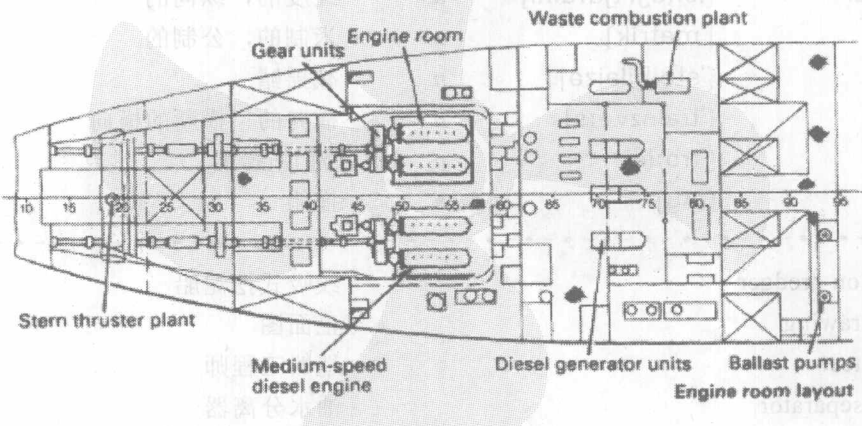


Fig. 1–2 Medium–speed diesel machinery arrangement

A separate generator room houses three diesel generator units, a waste combustion plant and other auxiliaries. The machinery control room is at the forward end of this room.

Notes

1. Depending upon the type each ship will assume varying proportions and functions.
   根据船舶的类型，每艘船舶各个部分的大小和功能都多种多样。

2. The gear units also power take-offs for shaft-driven generators which provide all power requirements while at sea.
   该传动装置还用于起动轴带发电机，为船舶在海上航行提供所需电力。

New words and expressions

accommodation	[əˌkɔmə'deiʃən]	*n.*	房间，居住区
arbitrary	['ɑ:bitrəri]	*a.*	任意的，武断的，独裁的，专断的
bulkhead	['bʌlkhed]	*n.*	船舱壁，船舱的隔墙
cruise	[kru:z]	*v. n.*	巡游，巡航
destroyer	[dis'trɔiə]	*n.*	驱逐舰
distinct	[dis'tiŋkt]	*a.*	清楚的，明显的，独特的
dredger	['dredʒə]	*n.*	挖泥机，挖泥船
endure	[in'djuə]	*v.n.*	度过，忍受，持续；持久
evaporator	[i'væpəreitə]	*n.*	造水机
frigate	['frigit]	*n.*	护卫舰
funnel	['fʌnəl]	*n.*	烟囱
habitability	[ˌhæbitə'biləti]	*n.*	可居住
hatch	[hætʃ]	*n.*	舱口
layout	['leiˌaut]	*n.*	规划，设计，布局图
longitudinal	[lɔndʒi'tju:dinl]	*a.*	经度的，纵向的
metric	['metrik]	*a.*	米制的，公制的
stabilizer	['steibilaizə]	*n.*	减摇鳍
transverse	['trænzvə:s]	*a.*	横向的，横断的横向
trawler	['trɔ:lə]	*n.*	[渔]拖捞船
tug	[tʌg]	*n.*	拖船

cutter suction dredger	绞吸式挖泥船
elevation drawing	正面图
naval architect	造船工程师
oily-water separator	油水分离器
prime mover	原动机
self-sustaining	自维持，自稳定
trailing hopper suction dredger	耙吸式挖泥船
twin-screw drive	双桨推进

Lesson 2 How Does a Marine Diesel Engine Work

The diesel engine is a type of internal combustion engine which ignites the fuel by injecting it into hot, high pressure air in a combustion chamber. The marine diesel engine is a type of diesel engine used on ships. The principle of its operation is as follows:

A charge of fresh air is drawn or pumped into the engine cylinder and then compressed by the moving piston to very high pressure.

When the air is compressed, its temperature rises so that it ignites the fine spray of fuel injected into the cylinder. The burning of the fuel adds more heat to the air charge, causing it to expend and force the engine piston to do work on the crankshaft which in turn drives the ship's propeller.

The operation between two injections is called a cycle, which consists of a fixed sequence of events. This cycle may be achieved either in four strokes or two. In a four-stroke diesel engine, the cycle requires four separate strokes of the piston, i.e. suction, compression, expansion and exhaust. If we combine the suction and exhaust operations with the compression and expansion strokes, the four-stroke engine will be turned into a two-stroke one, as shown in Fig. 2-1(a)-(d).

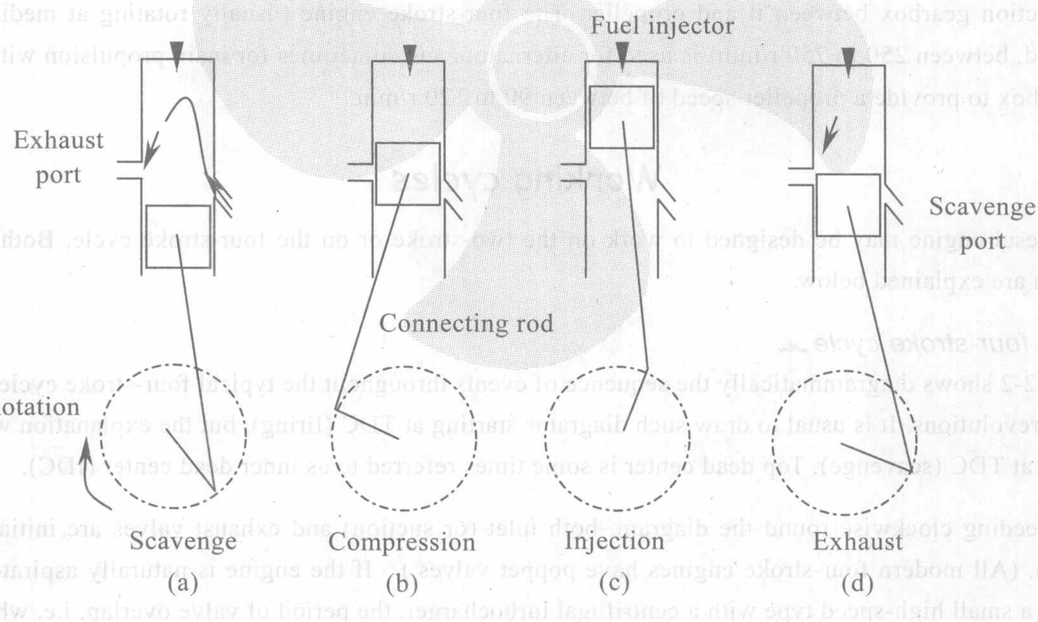


Fig. 2–1 Working principal of a diesel engine

The two-stroke cycle begins with the piston coming up from the bottom of its stroke, i.e. bottom dead center (BDC), with the air inlet ports or scavenge ports in the sides of the cylinder being opened (Fig. 2-1 (a)). The exhaust ports are uncovered also. Pressurized fresh air charges into the cylinder, blowing out any residual exhaust gases from the last stroke through the exhaust ports.

As the piston moves about one fifth of the way up, it closes the inlet ports and the exhaust ports. The air is then compressed as the piston moves up(Fig. 2-1（b）).

When the piston reaches the top of its stroke, i.e. the top dead center (TDC), both the pressure and the temperature of the air rise to very high values. The fuel injector injects a fine spray fuel oil into the hot air and combustion takes place, producing much higher pressure in the gases.

The piston is forced downward as the high pressure gases expand(Fig. 2-1(c)) until it uncovers the exhaust ports. The burnt gases begin to exhaust (Fig. 2-1（d）)and the piston continues down until it opens the inlet ports. Then another cycle begins.

In the two-stroke engine, each revolution of the crankshaft makes one power or working stroke, while in the four-stroke engine, it makes two revolutions to make one power stroke. That is why a two-stroke cycle engine will theoretically develop twice the power of a four-stroke engine of the same size. Inefficient scavenging and other losses, however, reduce the power advantage to about 1.8.

Each type of engine has its application on board ship. The low speed (i.e. 90 to 120 r/min) main propulsion diesel operates on the two-stroke cycle. At this low speed the engine requires no reduction gearbox between it and propeller. The four-stroke engine (usually rotating at medium speed, between 250 to 750 r/min) is used for alternators and sometimes for main propulsion with a gearbox to provide a propeller speed of between 90 to 120 r/min.

Working cycles

A diesel engine may be designed to work on the two-stroke or on the four-stroke cycle. Both of them are explained below.

The four-stroke cycle

Fig. 2-2 shows diagrammatically the sequence of events throughout the typical four-stroke cycle of two revolutions. It is usual to draw such diagrams starting at TDC (firing), but the explanation will start at TDC (scavenge). Top dead center is some times referred to as inner dead center (IDC).

Proceeding clockwise round the diagram, both inlet (or suction) and exhaust valves are initially open. (All modern four-stroke engines have poppet valves.) If the engine is naturally aspirated, or is a small high-speed type with a centrifugal turbocharger, the period of valve overlap, i.e. when both valves are open, will be short, and the exhaust valve will close some 10° after top dead center (ATDC).

Propulsion engines and the vast majority of auxiliary generator engines running at speeds below 1000 r/min will almost certainly be turbocharged and will be designed to allow a generous throughflow of scavenge air at this point in order to control the turbine blade temperature. In this case the exhaust valve will remain open until exhaust valve closure (EVC) at 50-60° ATDC. As the piston descends to outer or bottom dead center (BDC) on the suction stroke, it will inhale a fresh charge of air. To maximize this, balancing the reduced opening as the valve seats against the slight ram or inertia effect of the incoming charge, the inlet (suction) valve will normally be held open until about 25-35° ABTC (145-155° BTDC). This event is called inlet valve closure (IVC). The charge is then compressed by the rising piston until it has attained a temperature of some 550°C. At about 10-20° BTDC (firing), depending the type and speed of the engine, the injector admits finely atomized fuel which ignites within 2-7° (depending on the type again) and the fuel burns over a period of 30-50°, while the piston begins to descend on the expansion stroke.

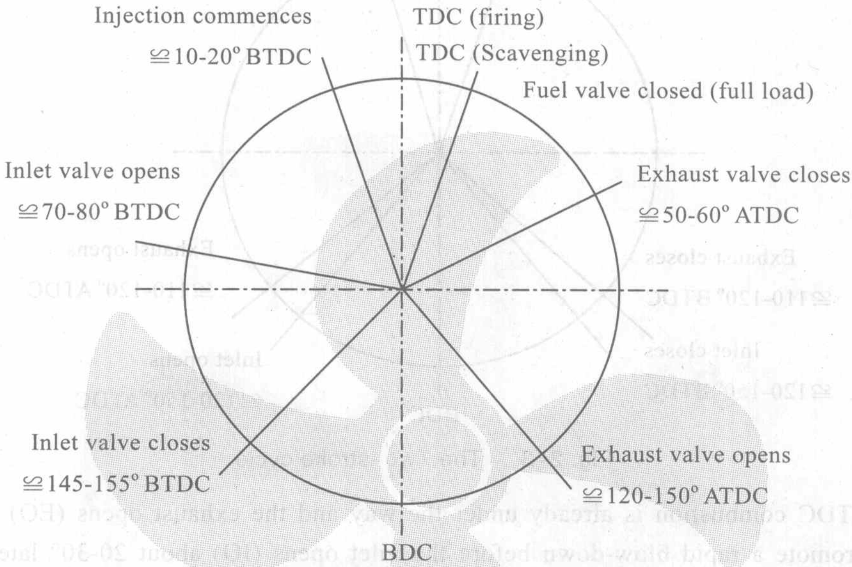


Fig. 2–2 The four–stroke cycle

At about 120-150° ATDC the exhaust valve opens (EVO), the timing being chosen to promote a very rapid blow-down of the cylinder gases to exhaust. This is done: (a) to preserve as much energy as is practicable to drive the turbocharger, and (b) to reduce the cylinder pressure to a minimum by BDC to reduce pumping work on the "exhaust" stroke. The rising piston expels the remaining exhaust gas and at about 70-80° BTDC the inlet valve opens (IVO) so that the inertia of the outflowing gas, plus the positive pressure difference, which usually exists across the cylinder by now, produces a through flow of air to the exhaust to "scavenge" the cylinder.

If the engine is naturally aspirated the IVO is about 10°BTDC. The cycle now repeats.

The two-stroke cycle

Fig. 2-3 shows the sequence of events in a typical two-stroke cycle, which, as the name implies, is accomplished in one complete revolution of the crank. Two-stroke engines invariably have ports to admit air when uncovered by the descending piston. The exhaust may be via ports adjacent to the air ports and controlled by the same piston (loop scavenge) or via poppet exhaust valves at the other end of the cylinder (uniflow scavenge).