建井工程工具书系列

Construction

Handbook of Mine Shaft Drilling

钻井施工手册

张永成 主编　　史基盛　王占军　副主编

煤炭工业出版社

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序

21世纪以来，随着国民经济快速发展对煤炭需求的不断增加，我国不仅煤炭产量和煤矿建设规模持续增长、达到世界领先水平，而且在规划建设大型现代化煤炭基地、不断提高矿井设计水平、加快井巷机械化施工速度、创新技术管理、采用先进技术装备、开发建设优质高效矿区等方面也居世界前列，同时矿区建设正向安全、节约、清洁、循环经济、提高资源回收利用的科学发展方式转变。

钻井法凿井是煤矿建设立井井筒施工中一种完全机械化作业的凿井施工方法，虽然在世界上已有上百年历史，但在我国煤矿应用仅有四十余年。近十几年来，随着我国国力的增强和科技水平的提升，钻井装备能力和钻进技术水平均有了长足发展。我国以通过冲积层为主的钻井工程已完成80个立井井筒，总深度超过22km，最大钻井直径达10.8m，最大成井直径达8.3m，最大钻井深度达660m；以通过岩层及硬岩为主的钻井工程已完成20余个，钻井总深度达6700多米，大部分钻井直径在2.5~3.6m之间，最大钻井深度达714m；已完成数百个反井钻井工程，大部分井孔直径在1.0~3.0m之间，个别钻井直径达5.0m，最大钻井深度达560m，总深度达4万多米。我国钻井技术、装备、工艺等综合水平已步入世界先进行列。钻井施工技术水平的提高对煤矿建设乃至矿山工程建设的发展有着重要意义。

钻井法施工与其他凿井方法施工相比，具有明显的优越性，即全部凿井作业在地面操作，作业安全，机械化程度高、劳动强度低，井壁工程质量好，工程造价较低。因此在条件适合的工程建设中得到了广泛推广应用，并取得了良好的经济和社会效益。钻井技术的应用非常广泛，不仅适用于煤矿建设工程，而且适用于其他矿山建设工程、水电工程、隧道工程、地下工程、桥基建设工程等，尤其适合于我国东部通过第四系深厚冲击层和西部松软含水岩层的井筒施工。

1986年出版的《建井工程手册》，显然已不适应目前钻井施工的迫切需

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要。为了更加全面系统地总结钻井施工在煤矿建设中的应用和发展，更好地服务矿山建井领域，不断推动煤矿施工机械化、现代化，我们组织编写出版的《钻井施工手册》必将对全过程指导钻井工程施工、进一步提高我国的钻井技术水平、推动建井事业的发展有着极其重要的意义。

本书由中国煤炭建设协会组织，由中煤矿山建设（集团）有限责任公司作为主编单位并积极提供人力财力，业内各有关施工、设计、研制、建设等单位参加编写。总结了几十年来国内外钻井施工技术装备发展、施工工艺、操作规范、经验教训，具有行业标准和规程的作用。

希望读者在使用本书的过程中不断总结、完善、改进、创新、提高，结合我国国情和具体地质、水文条件，发展有中国特色的钻井施工技术和方法。

最后，代表煤炭建设行业向中煤矿山建设（集团）有限责任公司和业内专家、学者、工程技术人员以及参与本书编审的各位同仁表示衷心的感谢！

2010 年 1 月

PREFACE

Since the 21 Century, with the continued increasing requirements of coal to the national economic rapid development, the coal production and coal mine construction scale in China are not only continuously increased and reached to the world leading level, but also the large modernized coal bases to be constructed in plan, the coal mine design level to be continued improved, the mechanized construction speed of the mine shaft and roadway to be speed up, the innovation technology management, the application of the advanced technology and equipment, the excellent quality and high efficient mining area to be developed and built are all in the world leading position. Meanwhile, the construction of the coal mining areas is turned to a safe, saving, clean, circulated economy, improved resources recovery and utilization scientific development mode.

The mine shaft sinking with the mine shaft drilling is a fully mechanized operated mine shaft sinking method of the mine shaft construction in the mine construction. Although the mine shaft drilling method has a history over 100 years in the world, the application of the mine shaft drilling to the coal mines in China only has a history about 40 years. In the recent decade years, with the national power enhanced and the science and technology level improved in China, the mine shaft drilling equipment capacity and drilling capacity level all have a high development. The mine shaft drilling projects mainly passed through alluvium in China has completed about 80 mine shafts. The total depth of the mine shaft drilling is over 22 km, the max diameter of the mine shaft drilling was about 10. 8 m, the max diameter of the mine shaft completed was about 8. 3 m and the max depth of the mine shaft drilling was about 660 m. The mine shaft drilling projects mainly passed through rock strata and hard rocks have completed over 60 mine shafts, the total depth of the mine shaft drilling was about 6700 m, the diameters of the major mine shaft drilling were ranging from 2. 5 to 3. 6 m and the max depth of the mine shaft drilling was about 714 m. There were several 100 raise boring projects completed, the diameters of the major mine raises were ranging from 1. 0 to 3. 0 m, the diameter of the some raise boring was reached to 5. 0 m, the max depth of the raise was reached to 560m and the total depth of the mine raise borings was 40,000 m. The mine shaft drilling technology, equipment, technique and comprehensive level in China are in the world advanced level. The improvement of the mine shaft drilling construction technical level has a great significance to the developments of the coal construction as well as the mine project construction.

In comparison with the other mine shaft sinking constructions, the mine shaft drilling construc-

tion has the obvious advantages, such as all mine shaft sinking operations at the surface, the operation safety, mechanization high, low labor intensity, good quality of mine shaft liner and low project cost. Therefore the mine shaft drilling could be widely promoted and applied to the project constructions with the suitable conditions and have obtained with good economic and social benefits. The wide application of mine shaft drilling technology could not only suitable to the mine construction projects, but only suitable to the other mine construction projects, hydropower projects, tunnel projects, underground project, bridge foundation construction projects and others, specially suitable to the shaft mechanized drilling constructions passed through the deep thick alluvium in the Quaternary System at the east part of China and through the soft and weaken water bearing rock strata at the west part of China.

The《Handbook of Mine Shaft Construction Engineering》issued in 1986 is obviously not suitable to the needed requirements of the present mine shaft drilling construction. In order to well and full systematically summarize the application and outlook of the mine shaft drilling construction in the mine construction, to better serve the mine shaft constructions and continuously promote the mechanization and modernization of the mine construction,《Handbook of Mine Shaft Drilling Construction》organized, prepared and published by us will have extreme important significances to the full process guidance of the mine shaft project design and construction, to the further improvements of the Chinese mine shaft drilling technology level and to the promotion of the mine shaft drilling development.

The handbook is organized by the China Coal Construction Association. China Coal Mine Construction Group Corporation Limited is the main editing unit with the contributions of the manpower and finances. The related design, research and development, construction and other units in the mine construction sector in China are involved in the editing and preparation. The handbook has summarized the technical equipment development, construction technique, operation regulations, experiences and lesson of the mine shaft drilling construction at hone and abroad in the passed several decades and has the functions of the industrial standards and regulations.

It is sincerely to hope that the readers would continuously summarize, perfect, improve, innovate, upgrade the mine shaft drilling technology during the application of the handbook and in combination with the Chinese national condition, certain geology and hydrology, the readers could develop the mine shaft drilling technology and method with Chinese characteristics.

Finally, it is sincerely to express our thanks to China Coal Mine Construction Group Corporation, the experts, scholars, technical personnel and each person involved in the editing on behalf of the coal construction industry.

An Heren

January 2010

前　言

矿山事业的蓬勃发展带动了钻井技术的快速进步。1984年出版的《建井工程手册》第四卷第十八章中的钻井法施工技术，适应当时的钻井设备和钻井工艺水平，对指导施工起到了积极的作用。近二十多年来，钻井设备和钻井工艺有了很大的进展。到目前为止，原有的ZZS－1型、BZ－1型、ND－1型等旧型钻井机已完成历史使命，光荣“退休”了。为适应钻井直径加大和钻井深度加深对钻井机的需求，对部分钻井设备，如SZ9/700型（AS9/500型）和L40/800型等进行了技术改造，生产了完全新型的钻井机，如AS12/800型，以及大型的全液压动力头式的钻井机，如AD120/900型、AD130/1000型。技术的进步、设备的更新和工艺的改进催生了新的《钻井施工手册》的诞生。

钻井技术水平的提高主要表现在以下几个方面：第一，钻井设备有创新，设计、制造、使用了新型的全液压钻井机；第二，钻井井壁采用了高性能混凝土和新的制作工艺；第三，反井钻井已广泛应用于矿山工程，如盲井的反井掘进等；另外在钻井施工管理方面也积累了许多宝贵经验。这些方面的发展进步，促使我们按照“科学性、先进性和实用性”的原则重新修编了这本《钻井施工手册》，使之能适应当前的发展水平，在钻井施工中更好地发挥指导作用。

为使手册的编写工作顺利进行，我们成立了《钻井施工手册》编审委员会，中国煤炭建设协会为组织单位，中煤矿山建设（集团）有限责任公司为主编单位，洛阳矿山机械工程设计研究院、华煤建设特殊工程技术有限责任公司为参编单位，北京煤科联应用技术研究所为具体承办单位。为提高本书的质量，除编写人员进行两次修改外，于2009年9月在合肥又召开了由设计单位、施工单位、业主单位和参编各单位及编写人员参加的审稿会，根据会议提出的修改意见，又进行了最后一次修改。本书共7章，编写的具体分工为：

张永成：1.1～1.2、2.8

邹恒、晁焕清：1.3～1.4、2.7

张路明、王占军：2.1～2.4

丁明：2.5

周真云：2.6

史基盛：3.1～3.4

许宜坤：4.1～4.7

郑翔鲲、沈长柱：5.1～5.2

魏红兵：6.1～6.2、7.1～7.2

本书可供矿山技术人员，特别是钻井技术人员在设计、施工中参考，同时可供科研、设计、院校等单位的有关人员参阅。本书在编写过程中得到各施工、科研、设计等单位同行的大力支持和帮助，在此一并表示衷心感谢。由于水平所限，错误、不足之处在所难免，恳请读者批评指正。

《钻井施工手册》编审委员会

2010.1

INTRODUCTION

The vigorous development of the mine enterprises had promoted the rapid progress of the mine shaft drilling technology. The mine shaft drilling construction technology in the Chapter 18 of No. 4 Volume of《Handbook of Mine Shaft Construction Engineering》published in 1984 was suitable to the mine shaft drilling equipment and mine shaft drilling technique level at that time and had played the active role to guide the mine shaft construction. In the passed twenty years, the great progress has been made to the mine shaft drilling equipment and the mine shaft drilling technique. Up to today, the previous ZZS－1 mode, BZ－1 mode, ND－1 mode and other old mine shaft drilling machines have been completed their historical missions and were "retired" gloriously. In order to meet the requirements of the mine shaft drilling diameter increased and the drilling depth deepened for the mine shaft drilling machine, the technical rebuilding have been made to some of the mine shaft drilling equipment, such as SZ9/700 mode (AS9/500 mode), L40/800 mode and others. The completed brand－new mine shaft drilling machines have been manufactured, such as AS12/800 mode and as well as the mine shaft drilling machine with the large full hydraulic driving cutting head has been manufactured, such as AD120/900 mode and AD130/1000 mode. The technical progress, equipment improvement and technique improvement have promoted the birth of the new《Construction Handbook of Mine Shaft Drilling》.

The main expressions of the mine shaft drilling technology improvements are as the followings: First, the mine shaft drilling equipment shall have the innovations and shall be a new full hydraulic mine shaft drilling machine in the design and manufacturing. Second, the high performance concrete and the new preparation technique shall be applied to the mine shaft liner of the mine shaft drilling. Third, the mine raise boring has been widely applied to the mine engineering, such as the raise boring excavation of the mine blind shaft and others. There are many valuable experiences in the mine shaft drilling construction management. The development progresses in the above have encouraged to revise the《Construction Handbook of Mine Shaft Drilling》base on the principle of the science, advance and practices in order to suit the present development level and better play the guidance role to the mine shaft drilling construction.

In order to successfully prepare the handbook, the Preparation and Editing Committee of《Construction Handbook of Mine Shaft Drilling》was established. China Coal Construction Association was the organization unit. China Coal Mine Construction Group Corporation Limited was the main preparation unit. Luoyang Mining Machinery Engineering Design Institute and Huamei

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Construction and Special Engineering Technology Corporation Limited were the preparation involved units. Beijing Research Institute of Coal Technology United Applied Technology was the main sponsor unit. In order to improve the quality of 《Construction Handbook of Mine Shaft Drilling》, except to the twice revises by the writing and preparation staffs, in September 2009, a national meeting was held and the design units, construction units, owner units as well as the preparation units with the writing and preparation staffs. According to the revise comments from the national meeting, a final revise was conducted. There are 7 chapters in the Handbook and the certain writing and preparation works were individually conducted by the followings:

The 1.1 - 1.2 Chapters and 2.8 Chapter by Zhang Yongcheng;

the 1.4 - 1.6 Chapers and 2.8 Chapter by ZOU Heng and CHAO Huanqing;

the 2.1 - 2.4 Chapters by Zhang Luming and Wang Zhanjun;

the 2.5 Chapter by Ding Ming;

the 2.6 Chapter by Zhou Zhenyun;

the 3.1 - 3.4 Chapters by Shi Jisheng;

the 4.1 - 4.7 Chapters by Xu Yikun;

the 5.1 - 5.2 Chapters by Zheng Xiangkun and Shen Changzhu and

the 6.1 - 6.2 Chapters and the 7.1 - 7.2 Chapters by Wei Hongbing.

The handbook could be references to the mine technical personnel and specially to the mine shaft drilling construction personnel in design and construction and meanwhile could be the reading material to the related personnel in the research and development units, design units and schools. During the preparation of the handbook, sincere acknowledgements shall be made to the great supports and assistances made and provided by the different construction units, research and development units, design units and the units in the mine shaft drilling. Due to the writing and preparation level limited, the occasional mistakes and errors could be occurred and the comments from the readers are welcome.

The Preparation and Editing Committee of
《Construction Handbook of Mine Shaft Drilling》
February 2010

目　　次

1　钻井法施工特点、工艺及其应用 …… 1

1.1　钻井法施工特点及工艺 …… 1

1.1.1　钻井法施工的特点 …… 1

1.1.2　钻井法施工工艺 …… 8

1.1.3　反井钻井施工发展及工艺 …… 9

1.2　钻井施工的实际应用 …… 21

1.2.1　通过冲积层的钻井应用 …… 21

1.2.2　通过岩层的钻井应用 …… 21

1.2.3　反井钻井在国内的应用 …… 24

1.3　刀具破岩原理 …… 30

1.3.1　刮削刀具的破岩原理 …… 30

1.3.2　滚动刀具的破岩原理 …… 32

1.4　钻井技术的特点及发展趋势 …… 36

1.4.1　国外技术发展趋势 …… 36

1.4.2　国内技术发展趋势 …… 36

2　钻井设备 …… 38

2.1　国内现有竖井钻机的类型及其主要技术性能 …… 38

2.1.1　转盘式竖井钻机 …… 38

2.1.2　动力头式竖井钻机 …… 40

2.2　竖井钻机的主要部件 …… 41

2.2.1　绞车 …… 41

2.2.2　井架(钻架) …… 45

2.2.3　天车与游车 …… 51

2.2.4　抱钩 …… 55

2.2.5　三通 …… 58

2.2.6　风管 …… 60

2.2.7　转盘 …… 61

2.2.8 钻台车与井架(钻架)行走机构 …… 64
2.2.9 封口平车 …… 67
2.2.10 抱卡 …… 74
2.2.11 动力头 …… 77
2.2.12 滑架与主提升液压缸 …… 80
2.2.13 竖井钻机主要部件的润滑 …… 84
2.3 竖井钻机钻具 …… 84
2.3.1 主动钻杆 …… 84
2.3.2 钻杆 …… 87
2.3.3 钻头 …… 90
2.4 竖井钻机液压系统 …… 100
2.4.1 液压系统的主要技术参数 …… 100
2.4.2 液压系统的系统组成和工作原理 …… 101
2.4.3 液压系统的使用与维护 …… 101
2.4.4 液压系统常见故障与排除方法 …… 102
2.5 门式起重机 …… 103
2.5.1 门式起重机的作用与结构 …… 103
2.5.2 门式起重机的主要技术参数 …… 106
2.5.3 门式起重机的安装方式 …… 109
2.5.4 门式起重机的使用要求及注意事项 …… 113
2.6 钻井井场的供电 …… 114
2.6.1 钻井井场各型钻机设备供电的运行特点 …… 114
2.6.2 转盘、绞车拖动系统 …… 118
2.6.3 AS9/500G 型钻机电控系统 …… 120
2.7 破岩刀具 …… 133
2.7.1 刀具类型及技术性能 …… 133
2.7.2 破岩滚刀系列及主要参数 …… 144
2.7.3 破岩滚刀的结构分析 …… 144
2.7.4 提高破岩刀具寿命的措施 …… 150
2.7.5 刀具在刀盘上的布置及定位 …… 152
2.7.6 破岩刀具的管理 …… 159
2.7.7 滚刀钻头和刮刀钻头使用注意事项 …… 161
2.8 反井钻井设备 …… 162
2.8.1 反井钻机类型 …… 162
2.8.2 反井钻机的构成 …… 162

2.8.3　LM 型系列反井钻机 …… 166
2.8.4　BMC 型系列反井钻机 …… 167
2.8.5　ATY 型系列反井钻机 …… 168
2.8.6　ZFYD 型系列低矮型反井钻机 …… 169

3　施工前的准备 …… 171

3.1　社会环境和自然条件调查 …… 171
3.1.1　社会环境调查 …… 171
3.1.2　自然条件调查 …… 171
3.1.3　技术文件会审和施工图供应 …… 171
3.2　施工组织设计的编制与审批 …… 172
3.2.1　施工组织设计的编制 …… 172
3.2.2　施工组织设计的审批 …… 198
3.3　井场的“四通一平”条件 …… 198
3.3.1　井场供水与排污 …… 199
3.3.2　井场供电系统 …… 200
3.3.3　运输系统 …… 203
3.3.4　通信系统 …… 203
3.3.5　场地平整 …… 203
3.3.6　工业大临施工 …… 204
3.3.7　生活大临施工 …… 209
3.4　钻井设备的安装与调试 …… 210
3.4.1　钻机的安装 …… 210
3.4.2　其他钻井设备的安装 …… 224
3.4.3　钻井设备的单机调试 …… 225
3.4.4　钻井设备的联合调试 …… 227

4　钻进 …… 229

4.1　钻井施工方案的确定 …… 229
4.1.1　钻井深度的确定 …… 229
4.1.2　钻进直径的确定 …… 232
4.1.3　钻进的分级 …… 234
4.1.4　钻进的顺序 …… 234
4.1.5　我国钻井法凿井部分井筒钻井方案实例 …… 235
4.2　钻井机及附属设备的选择 …… 235

4.2.1 钻井机 …… 235
4.2.2 龙门吊 …… 237
4.2.3 泥浆除砂旋流器 …… 237
4.2.4 压风机 …… 238
4.3 钻进参数的选择 …… 238
4.3.1 钻压的选择 …… 238
4.3.2 转速的选择 …… 239
4.3.3 泥浆循环量的选择 …… 240
4.3.4 我国部分井筒的钻进参数 …… 240
4.4 钻进工艺操作 …… 242
4.4.1 AS9/500G 型钻机主要工艺操作 …… 243
4.4.2 AD130/1000 型钻机主要工艺操作 …… 244
4.4.3 AS12/800 型钻机主要工艺操作 …… 245
4.5 钻进过程中的检查维护 …… 247
4.6 防偏与测井 …… 247
4.6.1 产生钻孔偏斜的原因 …… 247
4.6.2 钻孔产生缩径或扩径的原因 …… 248
4.6.3 钻孔纠偏 …… 249
4.6.4 井径井斜的测量技术 …… 249
4.7 钻进中井下常见故障和处理 …… 252
4.7.1 泥包钻头 …… 252
4.7.2 掉钻具 …… 253
4.7.3 掉刀具 …… 257
4.7.4 卡钻 …… 258
4.7.5 塌孔和埋钻 …… 259
4.7.6 掉风管 …… 260
4.7.7 跳钻和蹩钻 …… 261

5 钻井泥浆 …… 262

5.1 泥浆 …… 262
5.1.1 泥浆的功用 …… 262
5.1.2 钻井泥浆的选择原则 …… 262
5.1.3 泥浆分类 …… 265
5.1.4 泥浆的性能参数 …… 268
5.1.5 泥浆性能参数的测量 …… 271

5.1.6　泥浆及处理剂的配制 …… 274
5.1.7　钻井泥浆的处理 …… 282
5.1.8　废泥浆的处理 …… 285
5.1.9　朱集西矸石井钻井泥浆固化现场实验情况 …… 285
5.2　钻井洗井 …… 287
5.2.1　洗井方式 …… 287
5.2.2　泥浆冲洗量的确定与验算 …… 288
5.2.3　压气反循环系统及参数计算 …… 289
5.2.4　空气压缩机容量的确定 …… 289
5.2.5　泥浆净化 …… 293
5.2.6　沉淀池设计计算 …… 294
5.2.7　净化设备 …… 295
5.2.8　地面泥浆循环系统 …… 296

6　井壁预制与漂浮下沉 …… 298

6.1　钻井井壁预制 …… 298
6.1.1　钻井井壁结构 …… 298
6.1.2　井壁预制施工准备 …… 323
6.1.3　井壁预制施工工艺 …… 349
6.2　井壁漂浮下沉 …… 371
6.2.1　井壁漂浮下沉计算分析 …… 371
6.2.2　井壁漂浮下沉施工准备 …… 383
6.2.3　井壁漂浮下沉工艺 …… 386
6.2.4　井壁漂浮下沉稳定性分析 …… 394
6.2.5　井壁漂浮下沉时可能发生的故障及其预防和处理 …… 396
6.2.6　钻井井筒扶正 …… 397

7　固井与井筒移交 …… 400

7.1　壁后充填固井 …… 400
7.1.1　壁后充填施工准备 …… 400
7.1.2　壁后充填施工 …… 409
7.1.3　井壁在壁后充填时的稳定性分析 …… 414
7.1.4　壁后充填固井时可能发生的故障及其预防和处理 …… 416
7.1.5　壁后充填的有关问题 …… 416
7.1.6　井壁在长期使用中的稳定性 …… 419

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