



钻井数据手册

DRILLING

DATA

HANDBOOK

地 质 出 版 社

钻井数据手册

Drilling Data Handbook

法国石油研究院 编

王子源 译

刘广志 李敦宝 校

地质出版社

Drilling Data Handbook

First English Edition 1978

Editions Technip, Paris and

Institut Français du pétrole, Rueil-Malmaison

Printed in France by Impimerie Chirat

钻井数据手册

法国石油研究院编

王子源 译

刘广志 李敦宝 校

地质矿产部书刊编辑室编辑

责任编辑：李顺昌

地质出版社出版
(北京西四)

地质出版社胶印厂印刷
(北京安德路47号)

新华书店北京发行所发行·各地新华书店经售

*

开本：787×1092¹/₃₂ 印张：14 字数：290,000

1982年10月北京第一版·1982年10月北京第一次印刷

印数1—3,300册·定价5.50元

统一书号：15038·新802

译 者 的 话

这本《钻井数据手册》，包括了钻井方面的各种基本数据。内容丰富，比较实用。有些数据在一般的同类手册中还是很难见到的。如各种不同尺寸的钻杆在不同井深时的临界转速；海拔高度和环境温度对内燃机功率输出的影响等等。另外，版本较新（1978年），而且采用了国际单位制，对钻井工程中采用国际计量单位，也可能起一点普及作用。

为便于读者更好地使用本手册，特作如下说明：

1. 本手册中的原文，都尽量予以保留，以便与译文就近对照。这样既有利于熟悉本专业英语词汇，又便于读者对于某些翻译不当之处，按照原文理解。

2. 本手册原文中是以逗号(,)代替小数点的。译文则根据我国的习惯，以圆点(.)作为小数点。但表格中仍保留其以逗号代表小数点。

3. 考虑到现场的习惯，螺纹有时亦译为丝扣。为了普及国家标准，在文字叙述中则称为螺纹。

4. 钻杆新旧程度的划分，过去都译为“级”，为了避免与钢“级”混淆，这次改译为“类”。但定尺长度仍译为“级”（如Ⅰ级长度、Ⅱ级长度、Ⅲ级长度）。

5. 一些图表中的单位，凡就原书贴字制版形成中英文对照有困难者，就只保留外文单位。如in（英寸）；ft（英尺）；mm（毫米）；cm（厘米）；dm（分米）；m（米）；kg/m（公斤/米）；lb/ft（磅/英尺）；bar（巴，约合一大气压，实为0.98692标准大气压）；psi（磅/英寸²）；daN（十牛顿，折合1.02公斤力）；10³daN（万牛顿，折合1.02吨）；m-daN（米-十牛顿，或10牛顿-米）；'（英尺）；"（英寸）；井（在数字前上方为序号，在数字后上方为重量的单位：磅）……

6. 压力损失（Pressure losses）有时亦译为压力降（现场俗称压降，压耗）。

7. 井涌的严重后果则为井喷，但实际上很难区分，因此井涌、井喷混用。

8. 转盘、法兰盘、防喷器等的中心孔，一律译作通孔。

9. 开端排代量是指管柱体体积。闭端排代量是指管底封闭（如套管加浮鞋后）的管柱可排代的液体体积。其关系是：管柱内容量 + 开端排代量 = 闭端排代量。

10. 凡标出单位体积的重量者，本应译为容重，但为照顾现场的习惯称呼，亦译为比重。

11. 地层压破梯度即地层耐压梯度或地层破裂梯度。为避免与压裂作业相混淆，这次未译作压裂梯度。

本手册译完后，经李敦宝同志作了校正，以后书刊编辑室又请刘广志同志作了一次校正，在此深致谢意。

由于译者的水平所限，不当和错误之处定难避免，恳请读者批评指正。

INTRODUCTION TO THE FIRST ENGLISH-LANGUAGE EDITION OF THE DRILLING DATA HANDBOOK

The great success elicited by the French edition entitled *Formulaire du Foreur* has resulted in the publication of a fifth edition. Because of this and of the many requests we have received from non-French-speaking drillers, this English version is now available under the title **Drilling Data Handbook**.

The primary purpose of this book is to provide useful information in a compact and easily accessible form for use in drilling and production work.

This first edition includes, in section A, several conversion tables which may be helpful to those who want to use the International System of Units (SI).

Sections B through M give drilling equipment characteristics according to the latest API standards, or according to manufacturer specifications. Also included are technical drilling data and procedures for drilling muds, pressure losses, cementing, directional drilling, kick-off control, etc.

This handbook is as accurate as possible but it can be improved with the help of the users. Any corrections or suggestions are cordially invited to make it work better for you.

Refer suggestions to : ENSPM - CESFEG, BP 311,
92506 Rueil-Malmaison Cedex (France).

英文第一版序言

法文钻井手册 (Formulaire du Foreur) 由于深受欢迎已出版到第五版。为了满足不会法语的钻井工作者的需要,现将其第五版译为英文,并命名为《钻井数据手册》(Drilling Data Handbook)。

本手册的主要目的是简明扼要地为钻探和开采工作者提供一些有用的数据资料。

本手册的A部份为一些单位换算表,它有助于采用国际单位制(SI)。B至M部份是根据最新出版的API标准或制造厂商的产品规格说明书,提供的一些钻井设备的特性数据资料。另外还提供了钻井泥浆、压降、固井、定向钻井以及控制井涌等方面的技术数据和技术工艺。

本手册中的数据,虽力求准确无误,但错误之处仍难免,望在读者的帮助之下,更加精益求精。我们热诚地欢迎读者提出更正或建议,以便使本手册能更好地为您服务。

来函请寄: ENSPM—CESFEG, BP 311, 92506 Rueil-Malmaison Cedex (France).

A CONVERSION TABLES AND GENERAL DATA

A 部分 换算表及主要数据

B PHYSICAL PROPERTIES OF DRILL PIPE DRILL COLLAR, KELLY

B 部分 钻杆、钻铤及方钻杆的机械性能

C PHYSICAL PROPERTIES OF CASING TUBING, LINE PIPE

C 部分 套管、油管、管道管的机械性能

D CAPACITIES AND ANNULAR VOLUMES

D 部分 容积和环形空间的容量

E ROTARY DRILLING EQUIPMENT TURBO-DRILLING

E 部分 旋转钻进设备及涡轮钻进

F WIRE ROPE • CORDAGE LIFTING EQUIPMENT

F 部分 钢丝绳、纤维绳及其吊重设备

G POWER • EFFICIENCY FLOW RATE OF MUD PUMPS

G 部分 功率、效率、泵量

H DRILLING MUD • PRESSURE LOSSES

H 部分 钻井泥浆、压力损失

I CEMENTING

I 部分 注水泥

J DIRECTIONAL DRILLING

J 部分 定向钻进

K KICK CONTROL • FISHING

K 部分 井涌的控制和打捞

L OFFSHORE

L 部分 海上(近海)

M WELL HEAD FLANGES • BOP

M 部分 井口法兰、防喷器

A 部分 换算表及主要数据

**A CONVERSION TABLES
AND GENERAL DATA****提要
Summary**

A 1	国际单位制 (SI 制)	
A 1	The International System of units (SI)	5
A 2	已废止的计量单位制	
A 2	Obsolete systems of units	6
A 3	重要说明	
A 3	Important notice	7
A 4	MKpSA 制换算为 SI 制的换算表	
A 4	Conversion table (MKpSA System into SI System) Tonne-force into 10^3 decanewtons, kilogrammes-force per square centimetre into bars, metre-kilogrammes-force into metre-decanewtons. 吨力换为万牛顿 公斤力/厘米 ² 换为巴 公斤力·米 换为十牛顿米	8
A 5	单位的十进倍数和小数	
A 5	Decimal multiples and submultiples of a unit	9
A 6	英制与公制单位的换算因数	
A 6	Conversion factors english into metric units. Conversion factors metric into english units.	10
A 7	英美单位 及其他常数	
A 7	English and american units. Miscellaneous constants	11
A 8	英寸的分数化为小数及换为毫米的对照表	
A 8	Decimal and metric equivalents of inches and fractions of an inch.	12
A 9	0—26 % 英寸换为毫米的换算表	
A 9	Conversion table inches into millimetres from 0 to 26 15/16 in.	13
A 10	27—53 % 英寸换为毫米的换算表	
A 10	Conversion table inches into millimetres from 27 to 53 15/16 in.	14

A 11	1—100 英尺换为米的换算表	
A 11	Conversion table feet into metres from 1 to 100 ft	15
A 12	100—20000 英尺换为米的换算表	
A 12	Conversion table feet into metres from 100 to 20 000 ft..	16
A 13	每分钟升数与每分钟美加仑的互换表	
A 13	Conversion table liters per minute into gallons (US) per minute and vice-versa	17
A 14	美制油桶换为立方米及换为美制加仑的换算表	
A 14	Conversion table barrels (US Oil) into cubic metres. Conversion table barrels (US Oil) into gallons (US)	18
A 15	立方英尺换为立方米的换算表	
A 15	Conversion table cubic feet into cubic metres	19
A 16	1—100 磅/英寸 ² 换为公斤力/厘米 ² 和巴 的换算表	
A 16	Conversion table pounds per square inch into kilogrammes-force per square centimetre and bars from 1 to 100 psi	20
A 17	100—10000 磅/英寸 ² 换为公斤力/厘米 ² 和巴 的换算表	
A 17	Conversion table pounds per square inch into kilogrammes-force per square centimetre and bars from 100 to 10 000 psi	21
A 18	磅/英尺换为公斤/米的换算表	
A 18	Conversion table pounds per foot into kilogrammes per metre	22
A 19	吨—英里换为万牛顿—公里及每英尺的吨—英里换为每米的万牛顿—公里的换算表	
A 19	Conversion table ton-miles into 10 ³ decanewton-kilometres. Conversion table ton-miles per foot into 10 ³ decanewton-kilometres per metre	23
A 20	英尺—磅换为+牛顿—米的换算表	
A 20	Conversion table foot-pounds into metre-decanewtons...	24
A 21	温度换算表和插值表	
A 21	Temperature conversion table. Interpolation table	25
A 22	在 15.56°C 及 760 毫米水银柱的标准状况下, 水的比重与美国石油学会规定的重度互换表	
A 22	Conversion table. Specific gravity into degrees API at 15.56 °C in relation to water at 15.56 °C and 760 mm Hg	26
A 23	常数和数学公式	
A 23	Numerical constants and mathematical formulae	27
A 24	1—25 的平方、立方、平方根、立方根、倒数、圆周长、圆面积及对数表	
A 24	Properties of numbers from 1 to 25. Powers, roots, reciprocals, circumference, area and common log	28
A 25	26—50 的平方、立方、平方根、立方根、倒数、圆周长、圆面积及对数表	
A 25	Properties of numbers from 26 to 50. Powers, roots, reciprocals, circumference, area and common log	29

A 26	51—75的平方、立方、平方根、立方根、倒数、圆周长、圆面积及对数表	
A 26	Properties of numbers from 51 to 75. Powers, roots, reciprocals, circumference, area and common log.	30
A 27	76—100的平方、立方、平方根、立方根、倒数、圆周长、圆面积及对数表	
A 27	Properties of numbers from 76 to 100. Powers, roots, reciprocals, circumference, area and common log.	31
A 28	0—23° 45' 的普通(自然)三角函数表	
A 28	Natural trigonometric functions from 0° to 23° 45'	32
A 29	24°—47° 45' 的普通三角函数表	
A 29	Natural trigonometric functions from 24° to 47° 45'	33
A 30	48°—71° 45' 的普通三角函数表	
A 30	Natural trigonometric functions from 48° to 71° 45'	34
A 31	72°—90° 的普通三角函数表	
A 31	Natural trigonometric functions from 72° to 90°	35
A 32	三角公式	
A 32	Trigonometric formulae	36
A 33	求积公式	
A 33	Mensuration formulae.	37
A 34	水平圆筒罐的容量	
A 34	Capacity of horizontal cylindrical tanks.	38
A 35	力学和材料强度	
A 35	Mechanics and strength of materials	39
A 36	力学和材料强度(续)	
A 36	Mechanics and strength of materials (continued).	40
A 37	力学和材料强度(续)	
A 37	Mechanics and strength of materials (continued).	41
A 38	电—直流电	
A 38	Electricity. Direct current.	42
A 39	电—直流电(续)	
A 39	Electricity. Direct current (continued).	43
A 40	电—交流电、三相交流电	
A 40	Electricity. Alternating current. Three-phase system	44
A 41	电—交流电、三相交流电(续)	
A 41	Electricity. Alternating current. Three-phase system (continued).	45
A 42	化学元素符号、原子序数及原子量	
A 42	Some chemical symbols, atomic numbers and weights ..	46
A 43	不同材料和液体的比重	
A 43	Specific gravity of various materials and liquids.	47
A 44	金属的物理性质	
A 44	Physical properties of metals	48

A 45	溶液中Nacl 含量与比重的关系	
A 45	Relation between NaCl content and specific gravities of solutions	49
A 46	地层年代表	
A 46	Stratigraphic scale.....	50
A 47	地图和绘图的比例尺	
A 47	Map and drawing scales	51
A 48	希腊字母表	
A 48	Greek alphabet.....	52

国际单位制 (SI制) THE INTERNATIONAL SYSTEM OF UNITS (SI)

国际单位制SI或米·千克(公斤)·秒(公厘)·秒(分)·秒(时) INTERNATIONAL SYSTEM SI or MKSA					SI制的分数单位“厘米·克·秒制” SUBMULTIPLE SYSTEM CGS			SI制的其他倍数与分数单位 OTHER MULTIPLES AND SUBMULTIPLES OF SI	
Quantity 量度名称	Dimension 量纲式	Unit 单位	Symbol 单位符号	Unit 单位	Symbol 单位符号	Unit 单位	Symbol 单位符号	SI equivalent SI制等值	OTHER MULTIPLES AND SUBMULTIPLES OF SI
Length 长度	L	metre 米	m	centimetre 厘米	cm	gramme 克	g	10 ⁻³ m = 1 mm 10 ⁻⁶ m = 1 μ m 10 ⁻⁹ m = 1 nm 10 ⁻¹⁰ m = 1 μ m 10 ⁻¹² m = 1 pm 10 ⁻¹⁵ m = 1 fm 10 ⁻¹⁸ m = 1 am 10 ⁻²¹ m = 1 zm 10 ⁻²⁴ m = 1 ym 10 ⁻²⁷ m = 1 nm 10 ⁻³⁰ m = 1 pm 10 ⁻³³ m = 1 fm 10 ⁻³⁶ m = 1 am 10 ⁻³⁹ m = 1 zm 10 ⁻⁴² m = 1 ym 10 ⁻⁴⁵ m = 1 nm 10 ⁻⁴⁸ m = 1 pm 10 ⁻⁵¹ m = 1 fm 10 ⁻⁵⁴ m = 1 am 10 ⁻⁵⁷ m = 1 zm 10 ⁻⁶⁰ m = 1 ym 10 ⁻⁶³ m = 1 nm 10 ⁻⁶⁶ m = 1 pm 10 ⁻⁶⁹ m = 1 fm 10 ⁻⁷² m = 1 am 10 ⁻⁷⁵ m = 1 zm 10 ⁻⁷⁸ m = 1 ym 10 ⁻⁸¹ m = 1 nm 10 ⁻⁸⁴ m = 1 pm 10 ⁻⁸⁷ m = 1 fm 10 ⁻⁹⁰ m = 1 am 10 ⁻⁹³ m = 1 zm 10 ⁻⁹⁶ m = 1 ym 10 ⁻⁹⁹ m = 1 nm 10 ⁻¹⁰² m = 1 pm 10 ⁻¹⁰⁵ m = 1 fm 10 ⁻¹⁰⁸ m = 1 am 10 ⁻¹¹¹ m = 1 zm 10 ⁻¹¹⁴ m = 1 ym 10 ⁻¹¹⁷ m = 1 nm 10 ⁻¹²⁰ m = 1 pm 10 ⁻¹²³ m = 1 fm 10 ⁻¹²⁶ m = 1 am 10 ⁻¹²⁹ m = 1 zm 10 ⁻¹³² m = 1 ym 10 ⁻¹³⁵ m = 1 nm 10 ⁻¹³⁸ m = 1 pm 10 ⁻¹⁴¹ m = 1 fm 10 ⁻¹⁴⁴ m = 1 am 10 ⁻¹⁴⁷ m = 1 zm 10 ⁻¹⁵⁰ m = 1 ym 10 ⁻¹⁵³ m = 1 nm 10 ⁻¹⁵⁶ m = 1 pm 10 ⁻¹⁵⁹ m = 1 fm 10 ⁻¹⁶² m = 1 am 10 ⁻¹⁶⁵ m = 1 zm 10 ⁻¹⁶⁸ m = 1 ym 10 ⁻¹⁷¹ m = 1 nm 10 ⁻¹⁷⁴ m = 1 pm 10 ⁻¹⁷⁷ m = 1 fm 10 ⁻¹⁸⁰ m = 1 am 10 ⁻¹⁸³ m = 1 zm 10 ⁻¹⁸⁶ m = 1 ym 10 ⁻¹⁸⁹ m = 1 nm 10 ⁻¹⁹² m = 1 pm 10 ⁻¹⁹⁵ m = 1 fm 10 ⁻¹⁹⁸ m = 1 am 10 ⁻²⁰¹ m = 1 zm 10 ⁻²⁰⁴ m = 1 ym 10 ⁻²⁰⁷ m = 1 nm 10 ⁻²¹⁰ m = 1 pm 10 ⁻²¹³ m = 1 fm 10 ⁻²¹⁶ m = 1 am 10 ⁻²¹⁹ m = 1 zm 10 ⁻²²² m = 1 ym 10 ⁻²²⁵ m = 1 nm 10 ⁻²²⁸ m = 1 pm 10 ⁻²³¹ m = 1 fm 10 ⁻²³⁴ m = 1 am 10 ⁻²³⁷ m = 1 zm 10 ⁻²⁴⁰ m = 1 ym 10 ⁻²⁴³ m = 1 nm 10 ⁻²⁴⁶ m = 1 pm 10 ⁻²⁴⁹ m = 1 fm 10 ⁻²⁵² m = 1 am 10 ⁻²⁵⁵ m = 1 zm 10 ⁻²⁵⁸ m = 1 ym 10 ⁻²⁶¹ m = 1 nm 10 ⁻²⁶⁴ m = 1 pm 10 ⁻²⁶⁷ m = 1 fm 10 ⁻²⁷⁰ m = 1 am 10 ⁻²⁷³ m = 1 zm 10 ⁻²⁷⁶ m = 1 ym 10 ⁻²⁷⁹ m = 1 nm 10 ⁻²⁸² m = 1 pm 10 ⁻²⁸⁵ m = 1 fm 10 ⁻²⁸⁸ m = 1 am 10 ⁻²⁹¹ m = 1 zm 10 ⁻²⁹⁴ m = 1 ym 10 ⁻²⁹⁷ m = 1 nm 10 ⁻³⁰⁰ m = 1 pm 10 ⁻³⁰³ m = 1 fm 10 ⁻³⁰⁶ m = 1 am 10 ⁻³⁰⁹ m = 1 zm 10 ⁻³¹² m = 1 ym 10 ⁻³¹⁵ m = 1 nm 10 ⁻³¹⁸ m = 1 pm 10 ⁻³²¹ m = 1 fm 10 ⁻³²⁴ m = 1 am 10 ⁻³²⁷ m = 1 zm 10 ⁻³³⁰ m = 1 ym 10 ⁻³³³ m = 1 nm 10 ⁻³³⁶ m = 1 pm 10 ⁻³³⁹ m = 1 fm 10 ⁻³⁴² m = 1 am 10 ⁻³⁴⁵ m = 1 zm 10 ⁻³⁴⁸ m = 1 ym 10 ⁻³⁵¹ m = 1 nm 10 ⁻³⁵⁴ m = 1 pm 10 ⁻³⁵⁷ m = 1 fm 10 ⁻³⁶⁰ m = 1 am 10 ⁻³⁶³ m = 1 zm 10 ⁻³⁶⁶ m = 1 ym 10 ⁻³⁶⁹ m = 1 nm 10 ⁻³⁷² m = 1 pm 10 ⁻³⁷⁵ m = 1 fm 10 ⁻³⁷⁸ m = 1 am 10 ⁻³⁸¹ m = 1 zm 10 ⁻³⁸⁴ m = 1 ym 10 ⁻³⁸⁷ m = 1 nm 10 ⁻³⁹⁰ m = 1 pm 10 ⁻³⁹³ m = 1 fm 10 ⁻³⁹⁶ m = 1 am 10 ⁻³⁹⁹ m = 1 zm 10 ⁻⁴⁰² m = 1 ym 10 ⁻⁴⁰⁵ m = 1 nm 10 ⁻⁴⁰⁸ m = 1 pm 10 ⁻⁴¹¹ m = 1 fm 10 ⁻⁴¹⁴ m = 1 am 10 ⁻⁴¹⁷ m = 1 zm 10 ⁻⁴²⁰ m = 1 ym 10 ⁻⁴²³ m = 1 nm 10 ⁻⁴²⁶ m = 1 pm 10 ⁻⁴²⁹ m = 1 fm 10 ⁻⁴³² m = 1 am 10 ⁻⁴³⁵ m = 1 zm 10 ⁻⁴³⁸ m = 1 ym 10 ⁻⁴⁴¹ m = 1 nm 10 ⁻⁴⁴⁴ m = 1 pm 10 ⁻⁴⁴⁷ m = 1 fm 10 ⁻⁴⁵⁰ m = 1 am 10 ⁻⁴⁵³ m = 1 zm 10 ⁻⁴⁵⁶ m = 1 ym 10 ⁻⁴⁵⁹ m = 1 nm 10 ⁻⁴⁶² m = 1 pm 10 ⁻⁴⁶⁵ m = 1 fm 10 ⁻⁴⁶⁸ m = 1 am 10 ⁻⁴⁷¹ m = 1 zm 10 ⁻⁴⁷⁴ m = 1 ym 10 ⁻⁴⁷⁷ m = 1 nm 10 ⁻⁴⁸⁰ m = 1 pm 10 ⁻⁴⁸³ m = 1 fm 10 ⁻⁴⁸⁶ m = 1 am 10 ⁻⁴⁸⁹ m = 1 zm 10 ⁻⁴⁹² m = 1 ym 10 ⁻⁴⁹⁵ m = 1 nm 10 ⁻⁴⁹⁸ m = 1 pm 10 ⁻⁵⁰¹ m = 1 fm 10 ⁻⁵⁰⁴ m = 1 am 10 ⁻⁵⁰⁷ m = 1 zm 10 ⁻⁵¹⁰ m = 1 ym 10 ⁻⁵¹³ m = 1 nm 10 ⁻⁵¹⁶ m = 1 pm 10 ⁻⁵¹⁹ m = 1 fm 10 ⁻⁵²² m = 1 am 10 ⁻⁵²⁵ m = 1 zm 10 ⁻⁵²⁸ m = 1 ym 10 ⁻⁵³¹ m = 1 nm 10 ⁻⁵³⁴ m = 1 pm 10 ⁻⁵³⁷ m = 1 fm 10 ⁻⁵⁴⁰ m = 1 am 10 ⁻⁵⁴³ m = 1 zm 10 ⁻⁵⁴⁶ m = 1 ym 10 ⁻⁵⁴⁹ m = 1 nm 10 ⁻⁵⁵² m = 1 pm 10 ⁻⁵⁵⁵ m = 1 fm 10 ⁻⁵⁵⁸ m = 1 am 10 ⁻⁵⁶¹ m = 1 zm 10 ⁻⁵⁶⁴ m = 1 ym 10 ⁻⁵⁶⁷ m = 1 nm 10 ⁻⁵⁷⁰ m = 1 pm 10 ⁻⁵⁷³ m = 1 fm 10 ⁻⁵⁷⁶ m = 1 am 10 ⁻⁵⁷⁹ m = 1 zm 10 ⁻⁵⁸² m = 1 ym 10 ⁻⁵⁸⁵ m = 1 nm 10 ⁻⁵⁸⁸ m = 1 pm 10 ⁻⁵⁹¹ m = 1 fm 10 ⁻⁵⁹⁴ m = 1 am 10 ⁻⁵⁹⁷ m = 1 zm 10 ⁻⁶⁰⁰ m = 1 ym 10 ⁻⁶⁰³ m = 1 nm 10 ⁻⁶⁰⁶ m = 1 pm 10 ⁻⁶⁰⁹ m = 1 fm 10 ⁻⁶¹² m = 1 am 10 ⁻⁶¹⁵ m = 1 zm 10 ⁻⁶¹⁸ m = 1 ym 10 ⁻⁶²¹ m = 1 nm 10 ⁻⁶²⁴ m = 1 pm 10 ⁻⁶²⁷ m = 1 fm 10 ⁻⁶³⁰ m = 1 am 10 ⁻⁶³³ m = 1 zm 10 ⁻⁶³⁶ m = 1 ym 10 ⁻⁶³⁹ m = 1 nm 10 ⁻⁶⁴² m = 1 pm 10 ⁻⁶⁴⁵ m = 1 fm 10 ⁻⁶⁴⁸ m = 1 am 10 ⁻⁶⁵¹ m = 1 zm 10 ⁻⁶⁵⁴ m = 1 ym 10 ⁻⁶⁵⁷ m = 1 nm 10 ⁻⁶⁶⁰ m = 1 pm 10 ⁻⁶⁶³ m = 1 fm 10 ⁻⁶⁶⁶ m = 1 am 10 ⁻⁶⁶⁹ m = 1 zm 10 ⁻⁶⁷² m = 1 ym 10 ⁻⁶⁷⁵ m = 1 nm 10 ⁻⁶⁷⁸ m = 1 pm 10 ⁻⁶⁸¹ m = 1 fm 10 ⁻⁶⁸⁴ m = 1 am 10 ⁻⁶⁸⁷ m = 1 zm 10 ⁻⁶⁹⁰ m = 1 ym 10 ⁻⁶⁹³ m = 1 nm 10 ⁻⁶⁹⁶ m = 1 pm 10 ⁻⁶⁹⁹ m = 1 fm 10 ⁻⁷⁰² m = 1 am 10 ⁻⁷⁰⁵ m = 1 zm 10 ⁻⁷⁰⁸ m = 1 ym 10 ⁻⁷¹¹ m = 1 nm 10 ⁻⁷¹⁴ m = 1 pm 10 ⁻⁷¹⁷ m = 1 fm 10 ⁻⁷²⁰ m = 1 am 10 ⁻⁷²³ m = 1 zm 10 ⁻⁷²⁶ m = 1 ym 10 ⁻⁷²⁹ m = 1 nm 10 ⁻⁷³² m = 1 pm 10 ⁻⁷³⁵ m = 1 fm 10 ⁻⁷³⁸ m = 1 am 10 ⁻⁷⁴¹ m = 1 zm 10 ⁻⁷⁴⁴ m = 1 ym 10 ⁻⁷⁴⁷ m = 1 nm 10 ⁻⁷⁵⁰ m = 1 pm 10 ⁻⁷⁵³ m = 1 fm 10 ⁻⁷⁵⁶ m = 1 am 10 ⁻⁷⁵⁹ m = 1 zm 10 ⁻⁷⁶² m = 1 ym 10 ⁻⁷⁶⁵ m = 1 nm 10 ⁻⁷⁶⁸ m = 1 pm 10 ⁻⁷⁷¹ m = 1 fm 10 ⁻⁷⁷⁴ m = 1 am 10 ⁻⁷⁷⁷ m = 1 zm 10 ⁻⁷⁸⁰ m = 1 ym 10 ⁻⁷⁸³ m = 1 nm 10 ⁻⁷⁸⁶ m = 1 pm 10 ⁻⁷⁸⁹ m = 1 fm 10 ⁻⁷⁹² m = 1 am 10 ⁻⁷⁹⁵ m = 1 zm 10 ⁻⁷⁹⁸ m = 1 ym 10 ⁻⁸⁰¹ m = 1 nm 10 ⁻⁸⁰⁴ m = 1 pm 10 ⁻⁸⁰⁷ m = 1 fm 10 ⁻⁸¹⁰ m = 1 am 10 ⁻⁸¹³ m = 1 zm 10 ⁻⁸¹⁶ m = 1 ym 10 ⁻⁸¹⁹ m = 1 nm 10 ⁻⁸²² m = 1 pm 10 ⁻⁸²⁵ m = 1 fm 10 ⁻⁸²⁸ m = 1 am 10 ⁻⁸³¹ m = 1 zm 10 ⁻⁸³⁴ m = 1 ym 10 ⁻⁸³⁷ m = 1 nm 10 ⁻⁸⁴⁰ m = 1 pm 10 ⁻⁸⁴³ m = 1 fm 10 ⁻⁸⁴⁶ m = 1 am 10 ⁻⁸⁴⁹ m = 1 zm 10 ⁻⁸⁵² m = 1 ym 10 ⁻⁸⁵⁵ m = 1 nm 10 ⁻⁸⁵⁸ m = 1 pm 10 ⁻⁸⁶¹ m = 1 fm 10 ⁻⁸⁶⁴ m = 1 am 10 ⁻⁸⁶⁷ m = 1 zm 10 ⁻⁸⁷⁰ m = 1 ym 10 ⁻⁸⁷³ m = 1 nm 10 ⁻⁸⁷⁶ m = 1 pm 10 ⁻⁸⁷⁹ m = 1 fm 10 ⁻⁸⁸² m = 1 am 10 ⁻⁸⁸⁵ m = 1 zm 10 ⁻⁸⁸⁸ m = 1 ym 10 ⁻⁸⁹¹ m = 1 nm 10 ⁻⁸⁹⁴ m = 1 pm 10 ⁻⁸⁹⁷ m = 1 fm 10 ⁻⁹⁰⁰ m = 1 am 10 ⁻⁹⁰³ m = 1 zm 10 ⁻⁹⁰⁶ m = 1 ym 10 ⁻⁹⁰⁹ m = 1 nm 10 ⁻⁹¹² m = 1 pm 10 ⁻⁹¹⁵ m = 1 fm 10 ⁻⁹¹⁸ m = 1 am 10 ⁻⁹²¹ m = 1 zm 10 ⁻⁹²⁴ m = 1 ym 10 ⁻⁹²⁷ m = 1 nm 10 ⁻⁹³⁰ m = 1 pm 10 ⁻⁹³³ m = 1 fm 10 ⁻⁹³⁶ m = 1 am 10 ⁻⁹³⁹ m = 1 zm 10 ⁻⁹⁴² m = 1 ym 10 ⁻⁹⁴⁵ m = 1 nm 10 ⁻⁹⁴⁸ m = 1 pm 10 ⁻⁹⁵¹ m = 1 fm 10 ⁻⁹⁵⁴ m = 1 am 10 ⁻⁹⁵⁷ m = 1 zm 10 ⁻⁹⁶⁰ m = 1 ym 10 ⁻⁹⁶³ m = 1 nm 10 ⁻⁹⁶⁶ m = 1 pm 10 ⁻⁹⁶⁹ m = 1 fm 10 ⁻⁹⁷² m = 1 am 10 ⁻⁹⁷⁵ m = 1 zm 10 ⁻⁹⁷⁸ m = 1 ym 10 ⁻⁹⁸¹ m = 1 nm 10 ⁻⁹⁸⁴ m = 1 pm 10 ⁻⁹⁸⁷ m = 1 fm 10 ⁻⁹⁹⁰ m = 1 am 10 ⁻⁹⁹³ m = 1 zm 10 ⁻⁹⁹⁶ m = 1 ym 10 ⁻⁹⁹⁹ m = 1 nm 10 ⁻¹⁰⁰² m = 1 pm 10 ⁻¹⁰⁰⁵ m = 1 fm 10 ⁻¹⁰⁰⁸ m = 1 am 10 ⁻¹⁰¹¹ m = 1 zm 10 ⁻¹⁰¹⁴ m = 1 ym 10 ⁻¹⁰¹⁷ m = 1 nm 10 ⁻¹⁰²⁰ m = 1 pm 10 ⁻¹⁰²³ m = 1 fm 10 ⁻¹⁰²⁶ m = 1 am 10 ⁻¹⁰²⁹ m = 1 zm 10 ⁻¹⁰³² m = 1 ym 10 ⁻¹⁰³⁵ m = 1 nm 10 ⁻¹⁰³⁸ m = 1 pm 10 ⁻¹⁰⁴¹ m = 1 fm 10 ⁻¹⁰⁴⁴ m = 1 am 10 ⁻¹⁰⁴⁷ m = 1 zm 10 ⁻¹⁰⁵⁰ m = 1 ym 10 ⁻¹⁰⁵³ m = 1 nm 10 ⁻¹⁰⁵⁶ m = 1 pm 10 ⁻¹⁰⁵⁹ m = 1 fm 10 ⁻¹⁰⁶² m = 1 am 10 ⁻¹⁰⁶⁵ m = 1 zm 10 ⁻¹⁰⁶⁸ m = 1 ym 10 ⁻¹⁰⁷¹ m = 1 nm 10 ⁻¹⁰⁷⁴ m = 1 pm 10 ⁻¹⁰⁷⁷ m = 1 fm 10 ⁻¹⁰⁸⁰ m = 1 am 10 ⁻¹⁰⁸³ m = 1 zm 10 ⁻¹⁰⁸⁶ m = 1 ym 10 ⁻¹⁰⁸⁹ m = 1 nm 10 ⁻¹⁰⁹² m = 1 pm 10 ⁻¹⁰⁹⁵ m = 1 fm 10 ⁻¹⁰⁹⁸ m = 1 am 10 ⁻¹¹⁰¹ m = 1 zm 10 ⁻¹¹⁰⁴ m = 1 ym 10 ⁻¹¹⁰⁷ m = 1 nm 10 ⁻¹¹¹⁰ m = 1 pm 10 ⁻¹¹¹³ m = 1 fm 10 ⁻¹¹¹⁶ m = 1 am 10 ⁻¹¹¹⁹ m = 1 zm 10 ⁻¹¹²² m = 1 ym 10 ⁻¹¹²⁵ m = 1 nm 10 ⁻¹¹²⁸ m = 1 pm 10 ⁻¹¹³¹ m = 1 fm 10 ⁻¹¹³⁴ m = 1 am 10 ⁻¹¹³⁷ m = 1 zm 10 ⁻¹¹⁴⁰ m = 1 ym 10 ⁻¹¹⁴³ m = 1 nm 10 ⁻¹¹⁴⁶ m = 1 pm 10 ⁻¹¹⁴⁹ m = 1 fm 10 ⁻¹¹⁵² m = 1 am 10 ⁻¹¹⁵⁵ m = 1 zm 10 ⁻¹¹⁵⁸ m = 1 ym 10 ⁻¹¹⁶¹ m = 1 nm 10 ⁻¹¹⁶⁴ m = 1 pm 10 ⁻¹¹⁶⁷ m = 1 fm 10 ⁻¹¹⁷⁰ m = 1 am 10 ⁻¹¹⁷³ m = 1 zm 10 ⁻¹¹⁷⁶ m = 1 ym 10 ⁻¹¹⁷⁹ m = 1 nm 10 ⁻¹¹⁸² m = 1 pm 10 ⁻¹¹⁸⁵ m = 1 fm 10 ⁻¹¹⁸⁸ m = 1 am 10 ⁻¹¹⁹¹ m = 1 zm 10 ⁻¹¹⁹⁴ m = 1 ym 10 ⁻¹¹⁹⁷ m = 1 nm 10 ⁻¹²⁰⁰ m = 1 pm 10 ⁻¹²⁰³ m = 1 fm 10 ⁻¹²⁰⁶ m = 1 am 10 ⁻¹²⁰⁹ m = 1 zm 10 ⁻¹²¹² m = 1 ym 10 ⁻¹²¹⁵ m = 1 nm 10 ⁻¹²¹⁸ m = 1 pm 10 ⁻¹²²¹ m = 1 fm 10 ⁻¹²²⁴ m = 1 am 10 ⁻¹²²⁷ m = 1 zm 10 ⁻¹²³⁰ m = 1 ym 10 ⁻¹²³³ m = 1 nm 10 ⁻¹²³⁶ m = 1 pm 10 ⁻¹²³⁹ m = 1 fm 10 ⁻¹²⁴² m = 1 am 10 ⁻¹²⁴⁵ m = 1 zm 10 ⁻¹²⁴⁸ m = 1 ym 10 ⁻¹²⁵¹ m = 1 nm 10 ⁻¹²⁵⁴ m = 1 pm 10 ⁻¹²⁵⁷ m = 1 fm 10 ⁻¹²⁶⁰ m = 1 am 10 ⁻¹²⁶³ m = 1 zm 10 ⁻¹²⁶⁶ m = 1 ym 10 ⁻¹²⁶⁹ m = 1 nm 10 ⁻¹²⁷² m = 1 pm 10 ⁻¹²⁷⁵ m = 1 fm 10 ⁻¹²⁷⁸ m = 1 am 10 ⁻¹²⁸¹ m = 1 zm 10 ⁻¹²⁸⁴ m = 1 ym 10 ⁻¹²⁸⁷ m = 1 nm 10 ⁻¹²⁹⁰ m = 1 pm 10 ⁻¹²⁹³ m = 1 fm 10 ⁻¹²⁹⁶ m = 1 am 10 ⁻¹²⁹⁹ m = 1 zm 10 ⁻¹³⁰² m = 1 ym 10 ⁻¹³⁰⁵ m = 1 nm 10 ⁻¹³⁰⁸ m = 1 pm 10 ⁻¹³¹¹ m = 1 fm 10 ⁻¹³¹⁴ m = 1 am 10 ⁻¹³¹⁷ m = 1 zm 10 ⁻¹³²⁰ m = 1 ym 10 ⁻¹³²³ m = 1 nm 10 ⁻¹³²⁶ m = 1 pm 10 ⁻¹³²⁹ m = 1 fm 10 ⁻¹³³² m = 1 am 10 ⁻¹³³⁵ m = 1 zm 10 ⁻¹³³⁸ m = 1 ym 10 ⁻¹³⁴¹ m = 1 nm 10 ⁻¹³⁴⁴ m = 1 pm 10 ⁻¹³⁴⁷ m = 1 fm 10 ⁻¹³⁵⁰ m = 1 am 10 ⁻¹³⁵³ m = 1 zm 10 ⁻¹³⁵⁶ m = 1 ym 10 ⁻¹³⁵⁹ m = 1 nm 10 ⁻¹³⁶² m = 1 pm 10 ⁻¹³⁶⁵ m = 1 fm 10 ⁻¹³⁶⁸ m = 1 am 10 ⁻¹³⁷¹ m = 1 zm 10 ⁻¹³⁷⁴ m = 1 ym 10 ⁻¹³⁷⁷ m = 1 nm 10 ⁻¹³⁸⁰ m = 1 pm 10 ⁻¹³⁸³ m = 1 fm 10 ⁻¹³⁸⁶ m = 1 am 10 ⁻¹³⁸⁹ m = 1 zm 10 ⁻¹³⁹² m = 1 ym 10 ⁻¹³⁹⁵ m = 1 nm 10 ⁻¹³⁹⁸ m = 1 pm 10 ⁻¹⁴⁰¹ m = 1 fm 10 ⁻¹⁴⁰⁴ m = 1 am 10 ⁻¹⁴⁰⁷ m = 1 zm 10 ⁻¹⁴¹⁰ m = 1 ym 10 ⁻¹⁴¹³ m = 1 nm 10 ⁻¹⁴¹⁶ m = 1 pm 10 ⁻¹⁴¹⁹ m = 1 fm 10 ⁻¹⁴²² m = 1 am 10 ⁻¹⁴²⁵ m = 1 zm 10 ⁻¹⁴²⁸ m = 1 ym 10 ⁻¹⁴³¹ m = 1 nm 10 ⁻¹⁴³⁴ m = 1 pm 10 ⁻¹⁴³⁷ m = 1 fm 10 ⁻¹⁴⁴⁰ m = 1 am 10 ⁻¹⁴⁴³ m = 1 zm 10 ⁻¹⁴⁴⁶ m = 1 ym 10 ⁻¹⁴⁴⁹ m = 1 nm 10 ⁻¹⁴⁵² m = 1 pm 10 ⁻¹⁴⁵⁵ m = 1 fm 10 ⁻¹⁴⁵⁸ m = 1 am 10 ⁻¹⁴⁶¹ m = 1 zm 10 ⁻¹⁴⁶⁴ m = 1 ym 10 ⁻¹⁴⁶⁷ m = 1 nm 10 ⁻¹⁴⁷⁰ m = 1 pm 10 ⁻¹⁴⁷³ m = 1 fm 10 ⁻¹⁴⁷⁶ m = 1 am 10 ⁻¹⁴⁷⁹ m = 1 zm 10 ⁻¹⁴⁸² m = 1 ym 10 ⁻¹⁴⁸⁵ m = 1 nm 10 ⁻¹⁴⁸⁸ m = 1 pm 10 ⁻¹⁴⁹¹ m = 1 fm 10 ⁻¹⁴⁹⁴ m = 1 am 10 ⁻¹⁴⁹⁷ m = 1 zm 10 ⁻¹⁵⁰⁰ m = 1 ym 10 ⁻¹⁵⁰³ m = 1 nm 10 ⁻¹⁵⁰⁶ m = 1 pm 10 ⁻¹⁵⁰⁹ m = 1 fm 10 ⁻¹⁵¹² m = 1 am 10 ⁻¹⁵¹⁵ m = 1 zm 10 ⁻¹⁵¹⁸ m = 1 ym 10 ⁻¹⁵²¹ m = 1 nm 10 ⁻¹⁵²⁴ m = 1 pm 10 ⁻¹⁵²⁷ m = 1 fm 10 ⁻¹⁵³⁰ m = 1 am 10 ⁻¹⁵³³ m = 1 zm 10 ⁻¹⁵³⁶ m = 1 ym 10 ⁻¹⁵³⁹ m = 1 nm 10 ⁻¹⁵⁴² m = 1 pm 10 ⁻¹⁵⁴⁵ m = 1 fm 10 ⁻¹⁵⁴⁸ m = 1 am 10 ⁻¹⁵⁵¹ m = 1 zm 10 ⁻¹⁵⁵⁴ m = 1 ym 10 ⁻¹⁵⁵⁷ m = 1 nm 10 ⁻¹⁵⁶⁰ m = 1 pm 10 ⁻¹⁵⁶³ m = 1 fm 10 ⁻¹⁵⁶⁶ m = 1 am 10 ⁻¹⁵⁶⁹ m = 1 zm 10 ⁻¹⁵⁷² m = 1 ym 10 ⁻¹⁵⁷⁵ m = 1 nm 10 ⁻¹⁵⁷⁸ m = 1 pm 10 ⁻¹⁵⁸¹ m = 1 fm 10 ⁻¹⁵⁸⁴ m = 1 am 10 ⁻¹⁵⁸⁷ m = 1 zm 10 ⁻¹⁵⁹⁰ m = 1 ym 10 ⁻¹⁵⁹³ m = 1 nm 10 ⁻¹⁵⁹⁶ m = 1 pm 10 ⁻¹⁵⁹⁹ m = 1 fm 10 ⁻¹⁶⁰² m = 1 am 10 ⁻¹⁶⁰⁵ m = 1 zm 10 ⁻¹⁶⁰⁸ m = 1 ym 10 ⁻¹⁶¹¹ m = 1 nm 10 ⁻¹⁶¹⁴ m = 1 pm 10 ⁻¹⁶¹⁷ m = 1 fm 10 ⁻¹⁶²⁰ m = 1 am 10 ⁻¹⁶²³ m = 1 zm 10 ⁻¹⁶²⁶ m = 1 ym 10 ⁻¹⁶²⁹ m = 1 nm 10 ⁻¹⁶³² m = 1 pm 10 ⁻¹⁶³⁵ m = 1 fm 10 ⁻¹⁶³⁸ m = 1 am 10 ⁻¹⁶⁴¹ m = 1 zm 10 ⁻¹⁶⁴⁴ m = 1 ym 10 ⁻¹⁶⁴⁷ m = 1 nm 10 ⁻¹⁶⁵⁰ m = 1 pm 10 ⁻¹⁶⁵³ m = 1 fm 10 ⁻¹⁶⁵⁶ m = 1 am 10 ⁻¹⁶⁵⁹ m = 1 zm 10 ⁻¹⁶⁶² m = 1 ym 10 ⁻¹⁶⁶⁵ m = 1 nm 10 ⁻¹⁶⁶⁸ m = 1 pm 10 ⁻¹⁶⁷¹ m = 1 fm 10 ⁻¹⁶⁷⁴ m = 1 am 10 ⁻¹⁶⁷⁷ m = 1 zm 10 ⁻¹⁶⁸⁰ m = 1 ym 10 ⁻¹⁶⁸³ m = 1 nm 10 ⁻¹⁶⁸⁶ m = 1 pm 10 ⁻¹⁶⁸⁹ m = 1 fm 10 ⁻¹⁶⁹² m = 1 am 10 ⁻¹⁶⁹⁵ m = 1 zm 10 ⁻¹⁶⁹⁸ m = 1 ym 10 ⁻¹⁷⁰¹ m = 1 nm 10 ⁻¹⁷⁰⁴ m = 1 pm 10 ⁻¹⁷⁰⁷ m = 1 fm 10 ⁻¹⁷¹⁰ m = 1 am 10 ⁻¹⁷¹³ m = 1 zm 10 ⁻¹⁷¹⁶ m = 1 ym 10 ⁻¹⁷¹⁹ m = 1 nm 10 ⁻¹⁷²² m = 1 pm 10 ⁻¹⁷²⁵ m = 1 fm 10 ⁻¹⁷²⁸ m = 1 am 10 ⁻¹⁷³¹ m = 1 zm 10 ⁻¹⁷³⁴ m = 1 ym 10 ⁻¹⁷³⁷ m = 1 nm 10 ⁻¹⁷⁴⁰ m = 1 pm 10 ⁻¹⁷⁴³ m = 1 fm 10 ⁻¹⁷⁴⁶ m = 1 am 10 ⁻¹⁷⁴⁹ m = 1 zm 10 ⁻¹⁷⁵² m = 1 ym 10 ⁻¹⁷⁵⁵ m = 1 nm 10 ⁻¹⁷⁵⁸ m = 1 pm 10 ⁻¹⁷⁶¹ m = 1 fm 10 ⁻¹⁷⁶⁴ m = 1 am 10 ⁻¹⁷⁶⁷ m = 1 zm 10 ⁻¹⁷⁷⁰ m = 1 ym 10 ⁻¹⁷⁷³ m = 1 nm 10 ⁻¹⁷⁷⁶ m = 1 pm 10 ⁻¹⁷⁷⁹ m = 1 fm 10 ⁻¹⁷⁸² m = 1 am 10 ⁻¹⁷⁸⁵ m = 1 zm 10 ⁻¹⁷⁸⁸ m = 1 ym 10 ⁻¹⁷⁹¹ m = 1 nm 10 ⁻¹⁷⁹⁴ m = 1 pm 10 ⁻¹⁷⁹⁷ m = 1 fm 10 ⁻¹⁸⁰⁰ m = 1 am 10 ⁻¹⁸⁰³ m = 1 zm 10 ⁻¹⁸⁰⁶ m = 1 ym 10 ⁻¹⁸⁰⁹ m = 1 nm 10 ⁻¹⁸¹² m = 1 pm 10 ⁻¹⁸¹⁵ m = 1 fm 10 ⁻¹⁸¹⁸ m = 1 am 10 ⁻¹⁸²¹ m = 1 zm 10 ⁻¹⁸²⁴ m = 1 ym 10 ⁻¹⁸²⁷ m = 1 nm 10 ⁻¹⁸³⁰ m = 1 pm 10 ⁻¹⁸³³ m = 1 fm 10 ⁻¹⁸³⁶ m = 1 am 10 ⁻¹⁸³⁹ m = 1 zm 10 ⁻¹⁸⁴² m = 1 ym 10 ⁻¹⁸⁴⁵ m = 1 nm 10 ⁻¹⁸⁴⁸ m = 1 pm 10 ⁻¹⁸⁵¹ m = 1 fm 10 ⁻¹⁸⁵⁴ m = 1 am 10 ⁻¹⁸⁵⁷ m = 1 zm 10 ⁻¹⁸⁶⁰ m = 1 ym 10 ⁻¹⁸⁶³ m = 1 nm 10 ⁻¹⁸⁶⁶ m = 1 pm 10 ⁻¹⁸⁶⁹ m = 1 fm 10 ⁻¹⁸⁷² m = 1 am 10 ⁻¹⁸⁷⁵ m = 1 zm 10 ⁻¹⁸⁷⁸ m = 1 ym 10 ⁻¹⁸⁸¹ m = 1 nm 10 ⁻¹⁸⁸⁴ m = 1 pm 10 ⁻¹⁸⁸⁷ m = 1 fm 10 ⁻¹⁸⁹⁰ m = 1 am 10 ⁻¹⁸⁹³ m = 1 zm 10 ⁻¹⁸⁹⁶ m = 1 ym 10 ⁻¹⁸⁹⁹ m = 1 nm 10 ⁻¹⁹⁰² m = 1 pm 10 ⁻¹⁹⁰⁵ m = 1 fm 10 ⁻¹⁹⁰⁸ m = 1 am 10 ⁻¹⁹¹¹ m = 1 zm 10 ⁻¹⁹¹⁴ m = 1 ym 10 ⁻¹⁹¹⁷ m = 1 nm 10 ⁻¹⁹²⁰ m = 1 pm 10 ⁻¹⁹²	

已废止的计量单位制 OBSOLETE SYSTEMS OF UNITS

			MTS制(米吨秒制)			MKpS制			MKpS制(米公斤力秒制)			
量度名称 QUANTITY	量纲式 Dimension	代号 Symbol	单位 UNIT	单位 符号	MKS制 MKpS制 (米公斤力秒制)	CGS	MKSA (SI)	单位 UNIT	单 位 符 号	MTS制 MTS	CGS制 CGS	MKSA制 MKSA (SI) SI制
Length	L	l	米	m	1	10 ²	1	米	m	1	10 ²	1
Mass	M	m	吨	t	$\frac{1}{9.81} \times 10^3$	10 ³	10 ³			9.81×10^{-1}	9.81×10^3	9.81
Area	L ²	S	平方米	m ²	1	10 ⁴	1	平方米	m ²	1	10 ⁴	1
Volume	L ³	V	立方米	m ³	1	10 ⁶	1	立方米	m ³	1	10 ⁶	1
Time	T	t	秒	s	1	1	1	秒	s	1	1	1
Force	MLT ⁻²	F	斯坦	sn	$\frac{1}{9.81} \times 10^4$	10 ⁵	10 ⁵	公斤力	kgf	9.81×10^{-1}	9.81×10^5	9.81
Energy-work	ML ² T ⁻²	τ ou W	千焦耳	kJ	$\frac{1}{9.81} \times 10^3$	10 ¹⁰	10 ¹⁰	公斤·米	kgm	9.81×10^{-1}	9.81×10^7	9.81
Power	ML ² T ⁻³	P	千瓦	kW	$\frac{1}{9.81} \times 10^3$	10 ¹⁰	10 ¹⁰	公斤米/秒	kgm/s	9.81×10^{-1}	9.81×10^7	9.81
Velocity	LT ⁻¹	v	米/秒	m/s	1	10 ²	1	米/秒	m/s	1	10 ²	1
Acceleration	LT ⁻²	a	米/秒 ²	m/s ²	1	10 ²	1	米/秒 ²	m/s ²	1	10 ²	1
Pressure	ML ⁻¹ T ⁻²	p	皮兹	pz	$\frac{1}{9.81} \times 10^4$	10 ⁴	10 ⁴	公斤力/平方米	kgf/m ²	9.81×10^{-1}	98.1	9.81
Dynamic viscosity 动力粘度	ML ⁻¹ T ⁻¹	η ou μ	泊	map	$\frac{1}{9.81} \times 10^4$	10 ⁴	10 ⁴	公斤力/米 ²	maSt	9.81×10^{-1}	98.1	9.81
Kinematic viscosity 运动粘度	L ² T ⁻¹	ν	厘斯	maSt	1	10 ⁴	1	厘斯	maSt	1	10 ⁴	1
Heat quantity 热量	Q	Q	兆卡	th	10 ⁴	10 ⁶	4.18×10^6	千卡或毫卡	kcal millithermie	10^{-1}	10 ⁶	4.18×10^6



重要说明 IMPORTANT NOTICE

本手册中的计量单位和公式的符号，均采用法定单位：MKSA制或SI制。

在油田，MKPS制尚在通用。该单位与SI单位相比，其数值仅相差2%。

- Measurements and formulas in this handbook are given in legal units: MKSA or International System (Système international: SI).

On oil fields the MKpS system is still commonly used. Its units have only a 2 % difference from the equivalent units of the International System (SI).

For example: 例如:

压力的法定单位为帕(斯卡)(Pa)。“巴”是公认的一种变换单位，是“帕”的一个倍数。

THE LEGAL UNIT FOR PRESSURE IS THE PASCAL. The bar, a multiple of the pascal (1 bar = 10^5 pascals), which is a convenient unit, is authorised.

(1巴(bar) = 10^5 帕(Pa))

$$1 \text{ bar} = 1.02 \text{ kgf/cm}^2 \quad 1 \text{ 巴} = 1.02 \text{ 公斤力/厘米}^2$$

$$1 \text{ kgf/cm}^2 = 0.98 \text{ bar} \quad 1 \text{ 公斤力/厘米}^2 = 0.98 \text{ 巴}$$

力的法定单位为牛顿(N)。

THE LEGAL UNIT FOR FORCE IS THE NEWTON (N)

$$1 \text{ 十牛顿} = 1.02 \text{ 公斤力} \quad 1 \text{ decanewton (daN)} = 1.02 \text{ kilogramme force (kgf)}$$

$$1 \text{ 公斤力} = 0.98 \text{ 个十牛顿} \quad 1 \text{ kgf} = 0.98 \text{ daN}$$

$$1 \text{ 万牛顿} = 1.02 \text{ 吨力} \quad 10^4 \text{ daN} = 1.02 \text{ tf (tonne-force)}$$

$$1 \text{ 吨力} = 0.98 \text{ 万牛顿} \quad 1 \text{ tf} = 0.98 \cdot 10^4 \text{ daN}$$

扭矩的法定单位为牛顿·米($\text{m} \cdot \text{N}$)，其常用的单位为十牛顿·米($\text{m} \cdot \text{daN}$ 或 $\text{daN} \cdot \text{m}$)。

THE LEGAL UNIT FOR TORQUE IS THE METRE-NEWTON ($\text{m} \cdot \text{N}$). A multiple of this unit is usually used, i.e. the metre-decanewton ($\text{m} \cdot \text{daN}$)

$$1 \text{ 十牛顿} \cdot \text{米} = 1.02 \text{ 公斤力} \cdot \text{米} \quad 1 \text{ m} \cdot \text{daN} = 1.02 \text{ m} \cdot \text{kgf}$$

$$1 \text{ 公斤力} \cdot \text{米} = 0.98 \text{ 个十牛顿} \cdot \text{米} \quad 1 \text{ m} \cdot \text{kgf} = 0.98 \text{ m} \cdot \text{daN}$$

必须牢记这些等量关系！

KEEP THESE EQUIVALENCES IN MIND

本手册无论英制、公制均采用逗号代替小数点。

**IN THIS HANDBOOK THE COMMA IS USED TO INDICATE THE DECIMAL POINT
IN BOTH ENGLISH AND METRIC VALUES**

For example:

例如:

3,125 in instead of 3.125 in 3,125 英寸代替 3.125 英寸;

1 325,4 kg instead of 1325.4 kg 1325,4 公斤代替 1325.4 公斤。

MKPSA 制换算为SI制的换算表

CONVERSION TABLE

(MKpSA System into SI System)

Tonne-force (tf) into 10^3 decanewtons (10^3 daN)Kilogrammes-force per square centimetre (kgf/cm²) into bars

Metre-kilogrammes-force (m.kgf) into metre-decanewtons (m.daN)

吨力换为万牛顿 公斤力/厘米²换为巴 米公斤力米换为十牛顿米

	0	1	2	3	4	5	6	7	8	9
0	0	0.981	1.962	2.943	3.924	4.905	5.886	6.867	7.848	8.829
10	9.810	10.79	11.77	12.75	13.73	14.72	15.70	16.68	17.66	18.64
20	19.62	20.60	21.58	22.56	23.54	24.52	25.50	26.48	27.46	28.44
30	29.43	30.41	31.39	32.37	33.35	34.33	35.32	36.30	37.28	38.26
40	39.24	40.22	41.20	42.18	43.16	44.14	45.13	46.11	47.09	48.07
50	49.05	50.03	51.01	51.99	52.97	53.95	54.93	55.91	56.89	57.88
60	58.86	59.84	60.82	61.80	62.78	63.76	64.74	65.72	66.70	67.68
70	68.67	69.65	70.63	71.61	72.59	73.57	74.55	75.53	76.51	77.49
80	78.48	79.46	80.44	81.42	82.40	83.38	84.36	85.34	86.32	87.30
90	88.29	89.27	90.25	91.23	92.21	93.19	94.17	95.15	96.13	97.11
100	98.10	99.08	100.06	101.04	102.02	103.00	103.98	104.96	105.94	106.92
110	107.91	108.89	109.87	110.85	111.83	112.81	113.79	114.77	115.75	116.73
120	117.72	118.70	119.68	120.66	121.64	122.62	123.60	124.58	125.56	126.54
130	127.53	128.51	129.49	130.47	131.45	132.43	133.41	134.39	135.37	136.35
140	137.34	138.32	139.30	140.28	141.26	142.24	143.22	144.20	145.18	146.16
150	147.15	148.13	149.11	150.09	151.07	152.05	153.03	154.01	154.99	155.97
160	156.96	157.94	158.92	159.90	160.88	161.86	162.84	163.82	164.80	165.78
170	166.77	167.75	168.73	169.71	170.69	171.67	172.65	173.63	174.61	175.59
180	176.58	177.56	178.54	179.52	180.50	181.48	182.46	183.44	184.42	185.40
190	186.39	187.37	188.35	189.33	190.31	191.29	192.27	193.25	194.23	195.21
200	196.20	197.18	198.16	199.14	200.12	201.10	202.08	203.06	204.04	205.02
210	206.01	206.99	207.97	208.95	209.93	210.91	211.89	212.87	213.85	214.83
220	215.82	216.80	217.78	218.76	219.74	220.72	221.70	222.68	223.66	224.64
230	225.63	226.61	227.59	228.57	229.55	230.53	231.51	232.49	233.47	234.45
240	235.44	236.42	237.40	238.38	239.36	240.34	241.32	242.30	243.28	244.26
250	245.25	246.23	247.21	248.19	249.17	250.15	251.13	252.11	253.09	254.07
260	255.06	256.04	257.02	258.00	258.98	259.96	260.94	261.92	262.90	263.88
270	264.87	265.85	266.83	267.81	268.79	269.77	270.75	271.73	272.71	273.69
280	274.68	275.66	276.64	277.62	278.60	279.58	280.56	281.54	282.52	283.50
290	284.49	285.47	286.45	287.43	288.41	289.39	290.37	291.35	292.33	293.31
300	294.30	295.28	296.26	297.24	298.22	299.20	300.18	301.16	302.14	303.12
310	304.11	305.09	306.07	307.05	308.03	309.01	309.99	310.97	311.95	312.93
320	313.92	314.90	315.88	316.86	317.84	318.82	319.80	320.78	321.76	322.74
330	323.73	324.71	325.69	326.67	327.65	328.63	329.61	330.59	331.57	332.55
340	333.54	334.52	335.50	336.48	337.46	338.44	339.42	340.40	341.38	342.36
350	343.35	344.33	345.31	346.29	347.27	348.25	349.23	350.21	351.19	352.17
360	353.16	354.14	355.12	356.10	357.08	358.06	359.04	360.02	361.00	361.98
370	362.97	363.95	364.93	365.91	366.89	367.87	368.85	369.83	370.81	371.79
380	372.78	373.76	374.74	375.72	376.70	377.68	378.66	379.64	380.62	381.60
390	382.59	383.57	384.55	385.53	386.51	387.49	388.47	389.45	390.43	391.41
400	392.40	393.38	394.36	395.34	396.32	397.30	398.28	399.26	400.24	401.22
410	402.21	403.19	404.17	405.15	406.13	407.11	408.09	409.07	410.05	411.03
420	412.02	413.00	413.98	414.96	415.94	416.92	417.90	418.88	419.86	420.84
430	421.83	422.81	423.79	424.77	425.75	426.73	427.71	428.69	429.67	430.65
440	431.64	432.62	433.60	434.58	435.56	436.54	437.52	438.50	439.48	440.46
450	441.45	442.43	443.41	444.39	445.37	446.35	447.33	448.31	449.29	450.27
460	451.26	452.24	453.22	454.20	455.18	456.16	457.14	458.12	459.10	460.08
470	461.07	462.05	463.03	464.01	464.99	465.97	466.95	467.93	468.91	469.89
480	470.88	471.86	472.84	473.82	474.80	475.78	476.76	477.74	478.72	479.70
490	480.69	481.67	482.65	483.63	484.61	485.59	486.57	487.55	488.53	489.51
—	0	1	2	3	4	5	6	7	8	9



单位的十进倍数和小数
DECIMAL MULTIPLES
AND SUBMULTIPLES OF A UNIT

十进倍数
MULTIPLES

UNIT MULTIPLIER 单位的倍数	Prefix to put before the name of the unit 单位名称的前缀	Symbol to put before the unit symbol 单位符号前的符号
$10^{12} = 1\,000\,000\,000\,000$	万亿, 兆, téra	T
$10^9 = 1\,000\,000\,000$	十亿, 千兆, giga	G
$10^6 = 1\,000\,000$	百万, 兆, méga	M
$10^3 = 1\,000$	千, kilo	k
$10^2 = 100$	百, hecto	h
$10^1 = 10$	十, déca	da

十进小数
SUBMULTIPLES

UNIT MULTIPLIER 单位的倍数	Prefix to put before the name of the unit 单位名称的前缀	Symbol to put before the unit symbol 单位符号前的符号
$10^{-1} = 0.1$	十分之一, 分, déci	d
$10^{-2} = 0.01$	百分之一, 厘, centi	c
$10^{-3} = 0.001$	千分之一, 毫, milli	m
$10^{-6} = 0.000\,001$	百万分之一, 微, micro	μ
$10^{-9} = 0.000\,000\,001$	十亿分之一, 毫微, nano	n
$10^{-12} = 0.000\,000\,000\,001$	万亿分之一, 微微, pico	p
$10^{-15} = 0.000\,000\,000\,000\,001$	千万亿分之一, 毫微微, femto	f
$10^{-18} = 0.000\,000\,000\,000\,000\,001$	兆万亿分之一, 微微微, atto	a

Examples: 1 megametre (Mm) = 10^6 metres (m),
1 micrometre (μ m) (micron or μ) = 10^{-6} metres (m),
1 kilonewton (kN) = 10^3 newton (N)

例: 1 兆米 (Mm) = 10^6 米 (m)
1 微米 (μ m) = 10^{-6} 米 (m)
1 千牛顿 (kN) = 10^3 牛顿 (N)

英制与公制单位的换算因数

CONVERSION FACTORS 英制换公制 ENGLISH INTO METRIC UNITS				
公换英因数	得此数 to obtain	乘此数 multiply the number of	英制单位符号	由此数 by
0.0393701	Millimetres 毫米	inches 英寸	in	25.4
3.28084	Metres 米	feet 英尺	ft	0.3048
1.09361	Metres 米	Yards 码	yd	0.9144
0.621373	Kilometres 公里	Statute miles (miles terrestres) 英里		1.60934
0.539613	Kilometres 公里	Nautical miles (UK) 英海里 (miles marins anglais)		1.15131
0.539957	Kilometres 公里	Nautical miles 国际海里 (miles marins autres pays)		1.152
0.155	Centimetres 厘米	Square inches 平方英寸	in ² sq in	6.4516
10.7639	Metres 平方米	Square feet 平方英尺	ft ² sq ft	0.0929
2.47103	Hectares 公顷 (15市亩)	Acres 英亩 (1406.87M ²)		0.404686
0.386102	Kilometres 平方公里	Square miles 平方英里	mi ² sq mile	2.58999
0.0610236	Centimetres 立方厘米	Cubic inches 立方英寸	in ³ cu in	16.3871
0.0353147	Decimetres 立方分	Cubic feet 立方英尺	ft ³ cu ft	28.3168
0.264178	Decimetres 米 (升)	Gallons (US) 美加仑	gal (US)	3.78533
0.219976	Decimetres 米 (升)	Gallons (UK) 英加仑	gal (UK)	4.54596
35.3147	Metres 立方米	Cubic feet 立方英尺	ft ³ cu ft	0.0283168
6.28994	Metres 立方米	Barrels (US) 美桶	bbl	0.158984
150.959 m ³ /时	Metres 立方米/时	Barrels per day (Barils par jour)	bbl/day 桶/日	0.00662433
15.4324	Grammes 克	Grains 格令 (0.0648克)	gr	0.0647989
0.035274	Grammes 克	Ounces 盎司	oz 盎司	28.3495
2.20462	Kilogrammes 公斤	Pounds 磅	lb 磅	0.453592
0.224809	Newtons 牛顿	Pounds force 磅力	lbf	4.44822
0.0234533	Kilogrammes 公斤	Sacks 袋 (水泥)		42.6377
1.0231	Tonnes 吨	Short tons 短吨 (US)	sh ton 美短吨	1090.7185
0.984204	Tonnes 吨	Long tons 长吨		1.01605
0.671971	Kilogrammes 公斤	Pounds 磅	lb	1.12436
8.34523	Kilogrammes 公斤	Pounds 磅	lb	0.119829
62.4278	Kilogrammes 公斤	Pounds 磅	lb	0.0160185
0.3505	Kilogrammes 公斤	Pounds 磅	lb	2.85307
0.0805214	Litres 升	Gallons (US) 美加仑	gal (US)	12.4191
14.5038	Bars 巴	Pounds force per square inch 磅力/英寸 ²	lbf/in ² psi	0.0689476
14.2233	Kilogrammes 公斤	Pounds force 磅力	lbf	0.070307
0.711167	Kilogrammes 公斤	Short tons 短吨 (US)	sh ton 美短吨	1.104614
102.408	Kilogrammes 公斤	Short tons 短吨 (US)	sh ton 美短吨	0.00976486
0.73756	Joules 焦耳	Foot pounds force 英尺-磅力	ft lbf	1.35582
7.23301	Kilogrammes 公斤	Foot pounds force 英尺-磅力	ft lbf	0.138255
0.737562	Metres 米	Feet 英尺	ft	1.35582
0.684944	Tonnes 吨	Short tons 短吨 (US)	sh ton 美短吨	1.104614
0.00134102	Watts 瓦特	Horse powers 英马	hp	745.7
0.98632	Chevaux-vapeur 公制马力	Horse powers 英马	hp	1.01387
0.00947813	Joules 焦耳	British thermal units 英热单位	Btu	1055.06
3.96797	Kilocalories 千卡	British thermal units 英热单位	Btu	0.252075
0.368553	Kilocalories 千卡	British thermal units 英热单位	Btu	2.71331
1.79943	Kilocalories 千卡	British thermal units 英热单位	Btu	0.55573
0.112335	Kilocalories 千卡	British thermal units 英热单位	Btu	8.90196
°C $\times \frac{9}{5} + 32$	Degres Celsius 摄氏温度	Degrees Fahrenheit 华氏温度	°F	$F = \frac{5}{9} C + 32$
5.61448	Metre 米	Cubic feet 立方英尺	ft ³ cu ft	0.178111
0.042	Litres 升	Gallons (US) 美加仑	gal (US)	23.8095
by 由此数	multiply the number of 乘此数	to obtain 得此数		英换公因数
CONVERSION FACTORS 公制换英制 METRIC INTO ENGLISH UNITS				