



# 新标准让“点钞机”有法可依

## ——解析科氏力质量流量计测量液态烃标准

New Standards Enable Bill Counter to Be Measured  
——Experts' Views on Coriolis Mass Flowmeters Measuring the Liquid Hydrocarbon

本刊记者 / 姜娜 译 / 覃珧  
Reporter/Jiang Na Translator/ Qin Yao

有人形象地将原油计量仪表比作点钞机、财务管家。计量准确度的提高对于买卖双方都将更加公平，因此只有拥有一个好的计量技术，才能实现原油的准确计量。中国每年消耗原油大约3亿吨，这三亿吨原油都要经过计量这一关。

上世纪90年代以前，国内原油计量技术相对薄弱，相关参数如压力、温度、密度等多采用人工读数或人工化验，当时美国原油计量站早已实现了自动控制。随着中国计量技术不断发展，通过引进国外先进技术和设备，尤其是新建的原油计量站，目前我国的原油计量体系已大体与国外同步。

计量技术包含硬件和软件两部分，硬件主要是指流量计，一些附属设备，密度测量、含水测量等，甚至包括体积管；软件部分是指相应的技术标准。中国石油天然气集团公司计量测试研究所所长郑琦告诉记者，ISO标准是我国采用的主要标准，在原油计量领域通常采用传统的涡轮流量计、容积式流量计来测量原油，这方面都有ISO标准，“但问题是——它们都不很完善。”

据郑琦介绍，国际上油气计量标准有几个组织在起草，API标准中专门用于石油计量的计量标准手册是最全面的一

Most people usually compare crude oil metering to bill counter. It would be more equitable for both the seller and buyer if the metering is more accurate. And only a good measuring technology can improve the accuracy of crude oil metering. China's annual consumption of crude oil is about 300 million tons, which have to go through the process of metering.

Before the 1990s, China's technical strength of crude oil metering was relatively weak. Related parameters such as pressure, temperature and density are metered by artificial tests, while at the same period US has already achieved automatic control at crude oil metering stations for a long time. As the continuous development of measurement technology and the introduction of advanced foreign technology and equipments, China has built many new oil metering stations. At present, China's crude oil metering system is synchronizing with the world.

Measurement technology includes hardware and software. Hardware mainly refers to the flowmeters, ancillary equipments, density measurements and the hydrous measurements etc. Software refers to the corresponding technical standards. President of Metrology Measurement and Test Institute of CNPC

个标准系列，其中有涉及到液态烃的计量标准。比较新的流量计像科氏力质量流量计、超声流量计都在这个标准里有反映。目前我国大量的石油标准都采用API标准。

## 无规矩不成方圆

长期以来，我们没有一个适合中国国情的自己的标准。在国内尤其在成品油液态烃的计量上，既没有好标准，又没有好的流量计。以前在原油贸易交接中，我国大多是以吨来计量，误差很大。由于缺乏计量标准，计量方式方法的不统一，采取的计量设备不相同，对贸易交接的买卖双方而言，即不公平也不准确，均造成了一定的经济损失。据记者了解，科氏力质量流量计在中国市场每年以20%的速度递增，强劲的市场需求，同样迫切需要一个准确而权威的标准来做保障。

“上世纪80年代，我们是在没有自己的标准的情况下，开始使用科氏力质量流量计，一用就是二十年。”郑琦说：“这期间我们一直想参照ISO标准来制订一个新标准，但到目前为止ISO仍没有一个用科氏力质量流量计测量液态烃的标准。ISO也有质量流量计的标准，按常理我们国家应该采用ISO的标准，但它不是方法标准。我们现在做的行业标准多数属于方法标准，石油工业标准化委员会制订的国家标准或者行业标准都以方法标准为主。从标准系列来讲我们也可采用API（美国石油协会）的标准，但当时API也没有。用科氏力质量流量计测量液态烃的标准，是在艾默生公司等生产厂家的推动下制订的，这项标准成为API标准，并在2002年推出。我们看到后，马上着手把它转换成我们的行业标准。”

作为我国用科氏力质量流量计测量液态烃的新标准的制定者，郑琦告诉记者：“在转换过程中，我们一方面要参考ISO的标准进行修改，另外从技术角度或者从使用条件上，努力让它更适应中国的国情。比如当时质量流量计的口径可能只有150毫米，而一般国内原油计量的口径都比较大，这样在使用中会受到限制。我们就做了相

Zheng Qi said, China mainly make reference to ISO standards, in the field of crude oil measurement, people commonly use traditional turbine flowmeters and volume flowmeters, which are ruled in ISO standards, "but the problem is – the standards are not so perfect."

According to Zheng, there are a number of international organizations draft the oil and gas measurement standards. API has the most comprehensive standard series on oil metering, in which the metering standards on liquid hydrocarbon are involved. Some new flowmeters such as Coriolis Mass Flowmeters, ultrasonic flowmeters are reflected in these standards. At present, many crude oil metering sectors in China use the API standards.

## Nothing can be accomplished without standards

For a long time, we do not have our own standards which are suitable for China's national conditions. Especially on the measurement of liquid hydrocarbons, there are neither good standards nor flowmeters. There was big error in crude oil trading since China used to take ton as the measurement unit. Economic damage will be caused by the lack of measurement standards. There is large demand for the Coriolis Mass Flowmeters in Chinese market, increased by 20 percent annually, and it is necessary to be ensured by accurate and authoritative standards.

"In the 1980s of the 20th century, we did not have our own criteria, so we had to used the Coriolis Mass Flowmeter, and lasted for 20 years." Zheng said, "During this period, we wanted to refer to ISO standard to formulate a new standard, but so far, ISO has not have any standards on Coriolis Mass Flowmeter metering the liquid hydrocarbon, so as API (American Petroleum Institute). The standards on Coriolis Mass Flowmeter metering the liquid hydrocarbon was finally promoted by Emerson and other manufacturers, and



2008年4月，在南京举行的原油计量论坛——质量流量计应用研讨会上，来自全国各地十余位专家和计量单位相关人员，就新原油计量标准的具体实施与可行性进行了深入的分析和研讨。大家一致认为该标准的出台对中国的原油计量发展有着深远的影响。In April 2008, a Crude Oil Seminar was held in Nanjing getting more than 10 experts' participation.

应的转换，所有的修订初衷都是强调它的应用场合和使用条件。”

郑琦指出：“在API的标准中，可采用科氏力质量流量计、超声流量计来计量液态烃，这些仪表在某些场合更适用。因为，原油计量情况很复杂，而科氏力质量流量计的基本原理源于自然的物理现象，是一种比较先进的计量技术和标准，在适宜的条件下可采用科氏力质量流量计计量原油流量，达到测量目的。”

在计量产品和计量标准上，是先有计量产品，还是先有计量标准？郑琦认为，应该是先有使用，然后再制订标准。在制订标准的过程中，当有新技术、新标准出现时，再不断改进标准。

艾默生高准公司中国区资深业务总监张运才指出：“质量流量计不管在国内还是在海外，纳入到标准，都是标准滞后于技术。”具体到用科氏力质量流量计测量液态烃，在我国已经用了20多年后才推出标准。因此有业内人士担心，制定用科氏力质量流量计计量液态烃新标准，会不会存在滞后问题？

“这个方法标准本身没有问题。”郑琦的回答很明确。“如果是产品标准就会有问题。产品标准落后于产品，就制约了产品的发展。但是作为方法标准，它不会具体到那么细，它主要从安装使用条件，从怎么进行油量计算方面来加以规范。”

## 让用户有章可循

质量流量计的使用最早在国内的炼油厂、石化厂的过程控制中，当时在炼化过程中就已经涉及到原油计量。当质量流量计发展运用到成品油的贸易交接上时，装车、装船、进油罐等都会用到。最近几年，随着成品油管道的建设，质量流量计的使用已经进入成品油管道的贸易交接计量。

关于科氏力质量流量计计量液态烃标准，在原油计量领域里面会产生怎样巨大影响呢？

如果把原油计量仪表比作点钞机，那么科氏力质量流量计计量液态烃标准就是让这台点钞机有法可依。郑琦指出，这项新标准的推出，影响巨大，意义深远。科氏力质量流量计主要运用在油田内部的原油计量上，另外运用在管道的成品油计量上。随着大口径质量标准的推出，在大口径上面也很有前景。

郑琦说：“原来没有标准时，大家用在成品油上已经起到了很好的效果，现在有了标准，对这个领域必将起到很好

introduced by API standards in 2002. We immediately converted them to be our industrial standards.”

As one of the constitutors of the standards on Coriolis Mass Flowmeter metering the liquid hydrocarbon in China, Zheng said, "In the revision process, we had to refer to the ISO standards, and technically strived to make it better meet China's national conditions." API (American Petroleum Institute) approved Emerson's standards on Coriolis Mass Flowmeter measuring the liquid hydrocarbon. We then adopted the API standards for national acceptance and highlighted the application requirements when we set up our own standards.”

Zheng said, "In the API standards, liquid hydrocarbons can be measured by Coriolis Mass Flowmeters and ultrasonic flowmeters, since they are more applicable on certain occasions.”

Does the measurement standard come before measurement product? According to Zheng, products should be used before standards. In the standard-setting process, the standards should be improved as the development of technologies.

MicroMotion Emerson's Sales Director in China Zhang Yuncai said, "No matter at home or abroad, the standards of mass flowmeters are lagged behind the metering technology." For instance, the standards on Coriolis Mass Flowmeter measuring the liquid hydrocarbon were launched late for more than 20 years since the technology was invented. So some professionals are concerned that whether the standards on Coriolis Mass Flowmeter metering the liquid hydrocarbon lag behind.

"There is nothing wrong with the standards." Zheng said, "The standards will restrict the development of the products if there is a problem in the standards. But method standards are not so specific.”

## Standardization allow users to comply with specific rules

The mass flowmeters were used in the control process of some domestic oil refineries and petrochemical plants. At that time, the measurement of crude oil was involved in the refining process. Mass flowmeters have been used in loading process. In recent years, with the construction of pipelines for petroleum products, mass flowmeters have been used in the transfer of pipelines trade of petroleum products.

How do the standards on Coriolis Mass Flowmeter metering the liquid hydrocarbon affect the crude oil metering?

If the crude oil metering is compared to a bill counter, the standards on Coriolis Mass Flowmeter metering liquid

的指导和推进作用。科氏力质量流量计计量液态烃这个标准可以使操作、安装、鉴定等过程更加标准化。”“计量仪表设备系统在石化行业很重要，不管原油产量还是石化企业的产品数量都是通过计量设备来实现的，有一个完整的系统，一个比较完善的标准，才会有一个更加科学的管理。”

作为科氏力流量计的生产者代表，艾默生高准公司中国区资深业务总监张运才告诉记者：“我们现在处在一个相当好的时期。十年以前中国客户没有标准可循，现在有了科氏质量流量计原理应用于液态烃标准，用户就可以有所参考了。”

## 科氏力质量流量计前景好

原油计量技术目前我国是参考国外的标准。国际标准化组织只有两种流量计可以在贸易交接上，即容积式流量计和涡轮流量计。容积式流量计在国内应用比较广泛，占绝对主导地位。从原理上来讲，容积式流量计就像用勺子一勺一勺地舀，感觉非常直观。这个流量计在我国国产化程度比较高，客户的使用经验也很丰富。

涡轮流量计在国外应用得比较多，但是并不适合我国的具体情况。涡轮流量计受黏度影响变化大，油里有杂质。早期我国用过涡轮流量计，由于当时涡轮流量计的性能不是特别好，所以虽然有标准，用得也比较少。目前只有海上油田在使用，基本也都是从美国引进的项目。

郑琦认为：“从流量仪表的发展趋势来讲，将来应用较多的就是科氏力质量流量计，它的适用面比较宽。此外是超声流量计，超声流量计专门用来贸易计量，它口径很大，里面跟质量流量计一样都是空的。它依据的是发射波，根据声音从这个地方传送到那个地方多长时间，就能算出平均流量。所以，它的前景会非常好。”

## 标准也要与时俱进

张运才指出：“生产流量计的技术一直在发展，流量计本身的技术发展也很快，标准只是在方法上做指导，一些新的技术发展以后，标准如何能够同步、尽快的跟上也是一个需要研究的课题。”



hydrocarbon are the rules to standardize the bill counter. Zheng said, these new standards are of profound influence and significance. Coriolis Mass Flowmeters are mainly used to meter the crude oil in many oil fields.

Zheng said, "Now the standards will play an excellent role in guiding and promoting the petroleum metering industry. The standards on Coriolis Mass Flowmeter metering the liquid hydrocarbon enable the standardization of the processes of operators, installation and identification." He added, "To set up a completed measurement instrumentation system is very important to improve the management in the petrochemical industry."

On behalf of the producers of Coriolis Mass Flowmeters, MicroMotion Emerson's Sales Director in China Zhang Yuncai said, "It is a very good time for China's petrochemical industry. 10 years ago in China, there was no standard to go by, but now we have standards on the Coriolis Mass Flowmeter metering the liquid hydrocarbon, providing users with a good reference."

## Coriolis Mass Flowmeter has a bright future

At present, China makes a reference to international standards on crude oil metering technology. Solvent mass flowmeter and turbine flowmeter are both used in the international trade. From the basic principles, the localization rate of solvent mass flowmeter is higher than the turbine flowmeter, and its users in China have rich experiences.

Zheng said, "According to the development trend of flowmeters, Coriolis Mass Flowmeter will be widely applied in the future. In addition, ultrasonic flowmeter will be of very good prospects as well. With great caliber and empty inside, it calculates the average flow according to the launch wave and the delivery speed of voice. Therefore, the prospects of ultrasonic flowmeter couldn't be rosier."

## Standards should be improved with times

Zhang pointed out that the standards should be improved with the development of flowmeter technology. The study issue in the standards must be synchronized to keep up with the fast growing of

郑琦所长表示，随着产品技术的不断提高与发展，在具体的使用过程中，科氏力流量计测量液态烃标准肯定还需要进一步完善。他举例说，随着油气价格的提高，尤其是成品油、原油价格的提高，原来规定千分之三点五，现在整体水平有可能要提高到千分之二，随着流量计水平的提高，我们可以把整个成品油和原油计量系统提高。在油价更高的情况下，可以更准确、更合理地计量原油和成品油。

据张运才介绍，我们国家有一大批专家在计量上对吸收新的技术和了解国际上的行业标准都非常快，1995年他们在没有质量流量计行业标准和国际标准的情况下，在国内先制定了一个检定规程，参考ISO标准，让客户至少在检定上如何标定质量流量计时有所参考。

“我们的标准必须先实验。”实际上我们国内也能编这个标准，但是国内的基础用户，包括一些专家精力有限。此外在标准制订过程中，我们还缺少一些标准的验证。国内有些自己制定的标准，并没有验证时间，有些只是少量的验证，这样对产品的技术掌握是有缺陷的。另外对国内产品的促进也有影响，一个标准的基础数据是很多的，没有实际的数据不行，我们国家在这方面缺乏积累和重视。

在标准的制定与推广上，郑琦认为，也应包括用户的推进以及生产厂家的支持。生产厂家觉得某个产品应该应用于新的领域，他就应该动手去做。实际上厂家在标准的促进过程中发挥着很大的作用。而作为用户来讲，则非常希望有标准来指导使用，它们两家是相辅相成的。

## 应该更加关注计量

方法标准一般都是推荐性的标准，科氏力质量流量计原理应用于液态烃也并非强制性标准。如今，它已经正式颁布，并将在今年下半年进行宣传推广。

张运才说：“我们国家计量这个行业好象被关注的比较少，至少在媒体上很少听到介绍计量的内容。媒体对自动化有所了解，但是说到计量就不是很清楚。”对此，郑琦分析认为，自动化仪表与装置包括计量仪表和设备，计量虽然跟仪表、系统都有关系，但是从专业角度来说，这个领域还是太窄。尤其是油气计量就更窄，它主要针对石油产品的计量。虽然我们国家有计量测试学会、计量协会等，但计量行业还是没有引起广泛的关注。

最后，郑琦所长强调说：“计量仪表设备或者系统在石化行业很重要，不管是原油产量，还是石化企业的产品数量，都是通过计量设备来实现的。希望《石油与装备》从专业角度更多给予关注。”

the technology as soon as possible.

Zheng said, as the continuous improvement of technology, the standards on Coriolis Mass Flowmeter metering liquid hydrocarbon certainly need to be further improved. For instance, with the growing of the oil prices and the improvement of measurement system, the metering of crude oil and refined products should be more accurate and reasonable.

According to Zhang, there are a large number of experts in the measurement field in China, who can absorb with new technologies and new international standards in the industry. In 1995, without international standards on the mass flowmeters, they made refer to the ISO standards to make rules for customers.

"We must make experiment on our standards." In fact, we can also set the standard ourselves, but it takes up a lot of time and energy. In addition, we can not make any certifications for the standards in the standard-setting process.

Regarding to the standard-setting and promotion process, Zheng thought, the development and promotion of the standards should be supported by the users and manufacturers. Actually the manufacturers play a significant role in the process of the standards promotion. And the users are expected to be guide by the standards. Both of the manufacturers and users supplement and complement each other.

## Greater attention should be focused on measurement

Methodological standards are generally voluntary. The standards on Coriolis Mass Flowmeter the liquid hydrocarbon are not mandatory. Now they have been officially promulgated, and will be promoted in the second half of this year.

Zhang said: "The industry of measurement is paid little attention in China. At least the media seldom introduce the measuring content, and seldom report news about this field." Zheng said that although China has Metrological Measuring Institute and Measurement Association, the measurement sector has not aroused widespread attention.

Finally, Zheng stressed, "Metering equipment or system is very important for the petrochemical industry, either the crude oil output or petrochemical products is measured by the metering equipment. I hope Petroleum & Equipment pay more attention to this field with a professional view." **P+E**