Optical Particle Counting
光学颗粒计数
Fluid Power & Hydraulics
液压及水力学

Agenda
议程

- What is Particle Counting and why is it important to the Industrial marketplace (fluid power, hydraulics, lubrication, etc.)
  何谓“颗粒计数”及其重要性（液压、水力学、润滑等）
- What methodologies currently exist that allow customers to monitor their particle levels
  目前监测颗粒水平所采用的方法有哪些？
- Why are Optical Particle Counters the best technology and what is the operating theory
  为什么光学颗粒计数器是最佳技术，它的操作原理是什么？
- What are the governing standards that allow for reporting and decision making
  报告及决策的决定性标准是什么？
- How can HachUltra Analytics ’ help you with your particle counting needs
  哈希超纯分析怎样满足您的颗粒计数需求？

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What is a Liquid Particle Counter?

A device or system which *discretely* measures particulate contaminants suspended in a liquid.

什么是液体颗粒计数器？

它是测量液体内颗粒污染的设备或系统

Particulate Contamination
微粒污染

Why Count Particles?
为什么要进行颗粒计数？

- 80% of hydraulic failures are due to contamination
  80%的液压故障由污染引起
- Particle contamination is destructive to lubricants and equipment
  颗粒污染会降低油液质量并损坏仪器
- “Microscopic wrecking crews” “极微小的破坏集群”
- Hard Particles (wear particles) 硬粒子（磨粒）
- Soft Particles; water and air 软粒子，即水和气泡

Particles are *the* leading indicator of wear & contamination
颗粒是机械工况的预警标志

Contamination in Hydraulics & Lubrication
液压及润滑系统的污染

Contamination Control isindispensable.... without it, few if any systems could ever achieve their intended purpose, let alone their expected service lives.

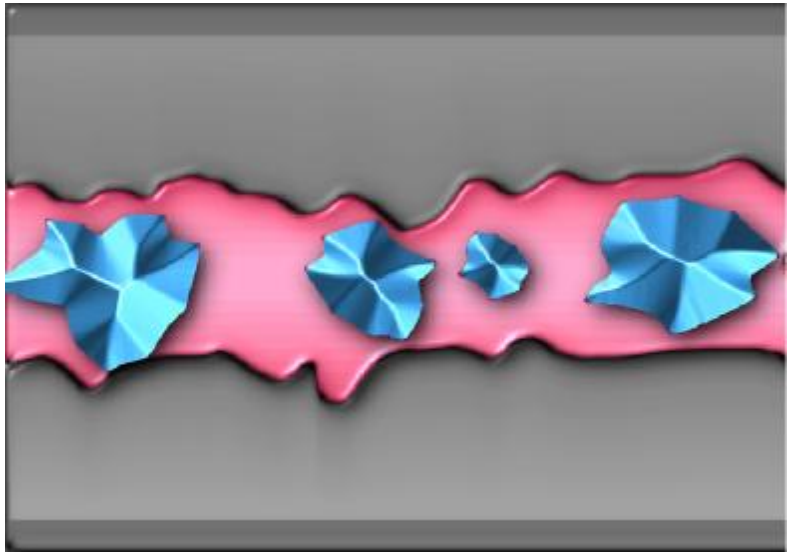
污染控制是必不可少的.....没有污染控制，仪器就不能正常工作，更别说达到预期的使用寿命了。

--E.C. Fitch

Sources of Contamination污染源

- Addition of new Contaminated Oil新的污染性油液的加入
- Ingression from Operating Environment工作环境污染
- Built-in Contamination内部污染
- Repairs using Contaminated Components使用污染的元件进行维修
- Internally Generated Wear Particles内部产生的磨粒

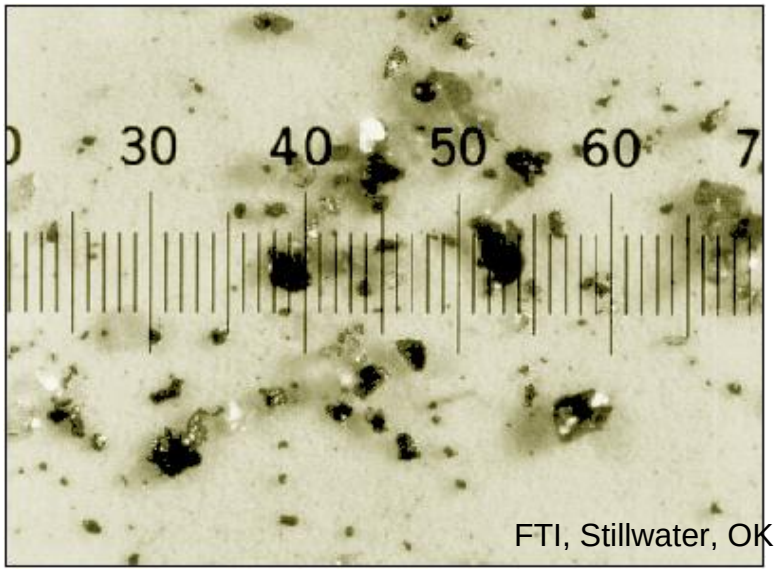
Generation of Wear Particles
磨粒的产生



- Abrasive Wear研磨性磨损
  - Particles the same size or slightly smaller than part clearance will cause wear尺寸与管道相同或稍小于管道的颗粒产生的磨损
- CavitationWear 气穴性磨损
- Fatigue Wear疲劳性磨损
- Erosive Wear腐蚀性磨损
- Adhesive Wear粘性磨损
- Each particle material can have unique characteristics每个颗粒材料具有不同特性
  - Dominant opticalproperties 主要光学特性
  - Dominant size range主要尺寸范围

Types of Damage
破坏类型

- Bearing fatigue 轴承疲劳
- Worn Seals失去密封
- Loss of lubrication失去润滑
- Accelerated wear加速磨损
- Increase in temperatures温度升高



Reult of Contamination Damage
污染的破坏作用

- Power Lo$$ 能量损失
- Lo$$ of $urfaceLubrication 表面失去润滑
- Degradation of Operation 操作性能下降
- Intermittent Operation 操作中断
- Cata$trophicFailure 灾难性故障
- Co$tlyRepair$ 昂贵的维修费用
- Co$tlyDowntime 昂贵的停工时间
- Co$tlyRework 昂贵的返工费用

Fluid Power Market Analysis
液压市场分析

Customers客户
Off road equipment maintenance大型仪器维护
On-road maintenance小型仪器维护
Military fluid power 军用液压
Aerospace – ground support 航空-地面支持
Laboratory Analysis 实验室分析
Industrial equipment工业仪器 manufacturing 制造

Customer Motivations 客户动机
Ease of use /installation 使用安装方便
Simplicity 简单
Sampling speed (interval) 采样（间隔）速度
Repeatability/reproducibility 重复性/重现性
Return on investment (justification to use OPCs) 收益（使用OPC的理由）
Applicability to fluid needs 液体适用性
Responsive service (time / knowledge) 响应服务（时间/经验）

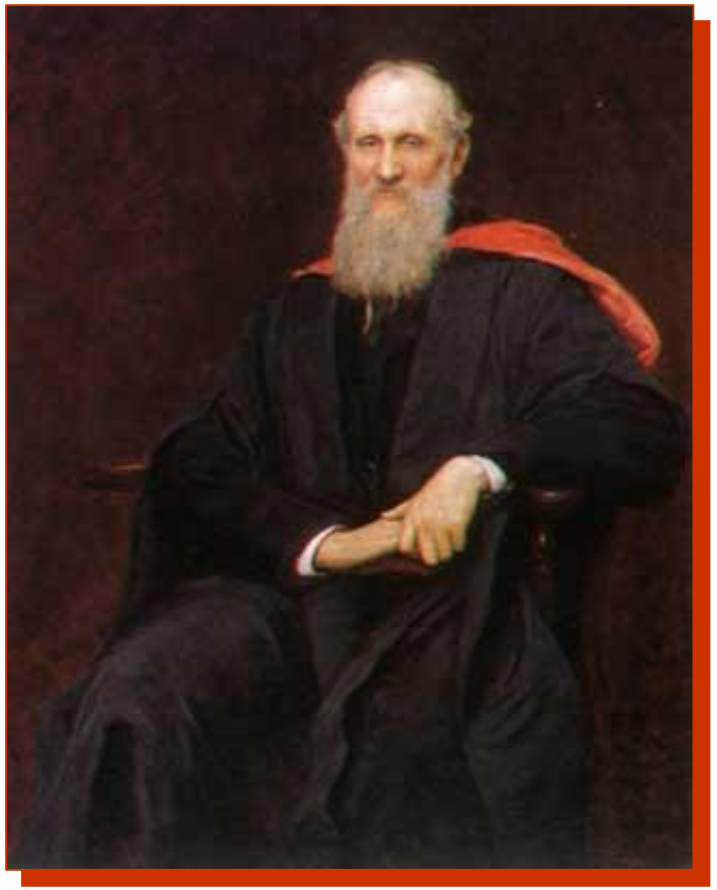
Driving Force 动力
Machine/equipment uptime 机械/仪器正常运行时间
Prevention of premature failures防止过早破坏
Adherence to international standards符合国际标准
Consistent performance 性能稳定
Product quality and reliability 产品质量与可靠性
Increase energy efficiency 提高能量效率
Environmental -cost of fluid disposal 环保 - 液体处理成本

Why Should I use a Particle Counter?
为什么我使用颗粒计数器

"If you can measure that of which you speak and can express it by a number, you know something of the subject; but if you cannot measure it, your knowledge is meager and unsatisfactory."

如果你可以测量所提到的物体并用数字来表示它，你对这个物体就有一定的了解。但是如果你不能测量这个物体，那么你对这你物体的了解就是混杂而不令人信服的。

--Lord Kelvin
English Physicist
英国物理学家开尔文



Are Your Contamination Levels...
你的污染水平…

- Trivial?微量？
- Treatable?可处理的？
- Or Terminal?或者是已达到极限？

How can you be sure?你怎样来确认？

Particle Counting Methods
颗粒计数方法

Methods of Particle Counting
颗粒计数方法

Light Obscuration遮光法（光阻法）

Light Scattering 光散射法

Microscope Method显微镜法

Pore Blockage塞阻法

Particle Sizers粒径法

Particle Scanners颗粒扫描仪

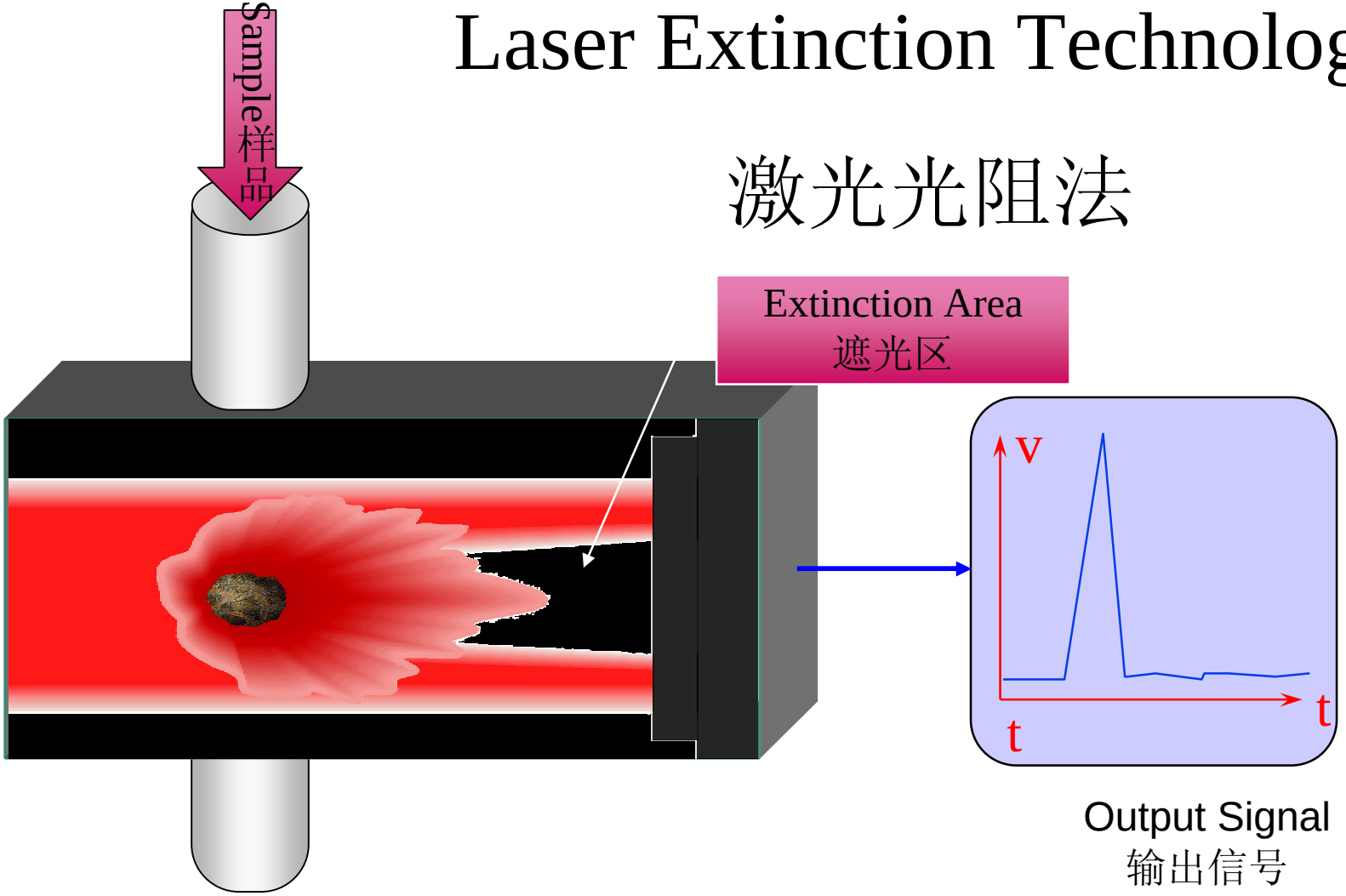
Patch Test斑片法

Note: These instruments do NOT count particles! Therefore they are NOT “Particle Counters.”

注：这些仪器并不进行颗粒计数，因此它们不是颗粒计数器。

Laser Extinction Technology

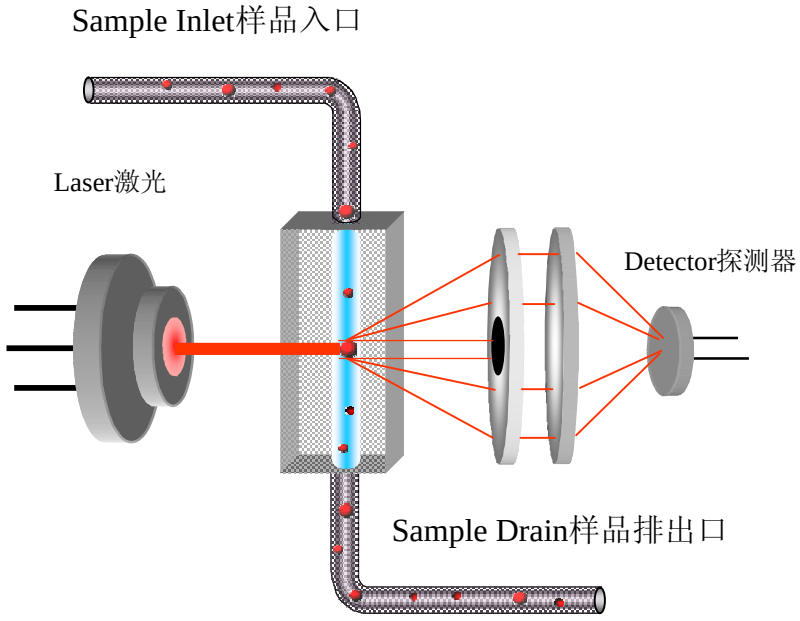
激光光阻法



Output Signal
输出信号

Light Scatter Sensors
光散射传感器

- Detect the Laser light “Scattered” off particles探测粒子散射的激光
- Used for very small, sub-micron particles 用于探测极小的亚微米粒子
- Calibration is upset by particle’s material properties; Eg: Carbon 校准受颗粒表面特性的影响，如碳
- Used in Semi-conductor facilities monitoring super cleanDI water or process fluids用于半导体行业，检测超纯去离子水或清洗液



- NOT recommended for oil samples不建议用于油液试样

Microscope Method
显微镜方法

- **A specified volume of fluid is filtered through a membrane filter of known pore size. All particulate matter in excess of an "average size," determined by the membrane characteristics, is left on the membrane surface**

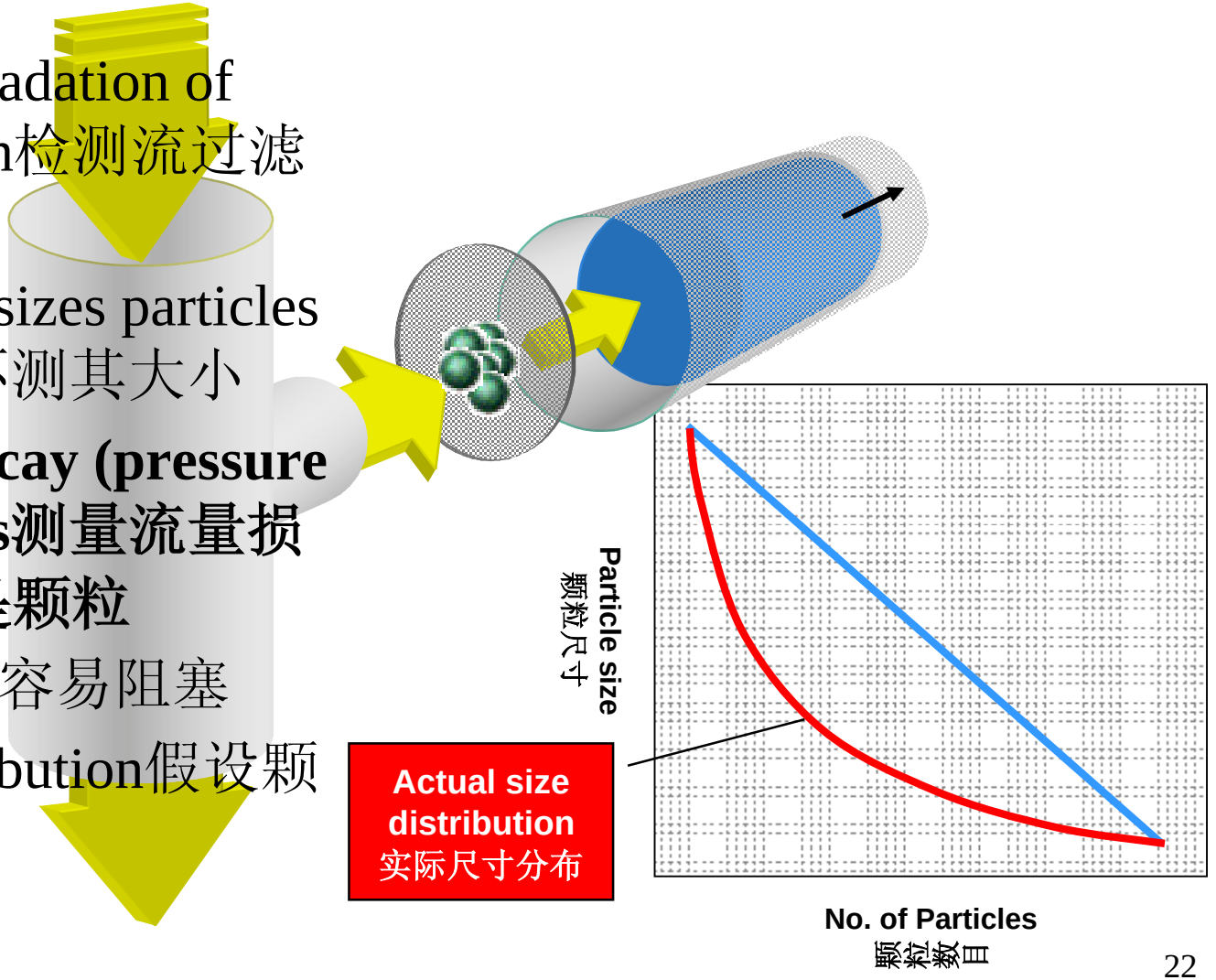
  使一定体积的被测液体流过已知孔目大小的滤膜，所有大于滤膜"平均尺寸"的粒子将被挡在滤膜表面。

- **This membrane is then examined under a microscope, and the particles are visually sized and counted to establish the cleanliness level of the hydraulic system**

  将此滤膜放在显微镜下即可检查出留在上面的颗粒的大小与数目，从而判定液压系统的洁净度等级。

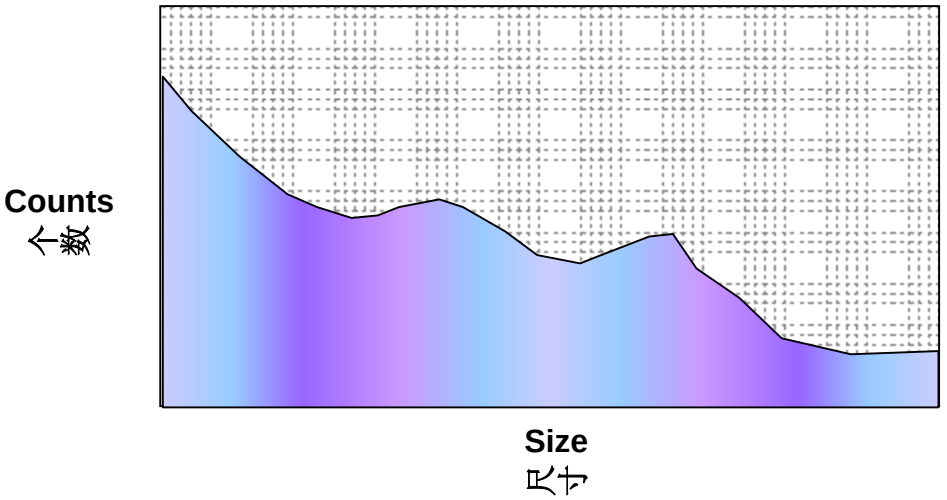
Flow Decay (pressure drop)
流量损失（阻塞）

- Monitors flow degradation of fluid through screen检测流过滤网的流量差
- Neither counts nor sizes particles既不计数颗粒也不测其大小
- **Measures Flow decay (pressure drop) not Particles测量流量损失（压差）而不是颗粒**
- Subject to clogging容易阻塞
- Assumes size distribution假设颗粒分布形式



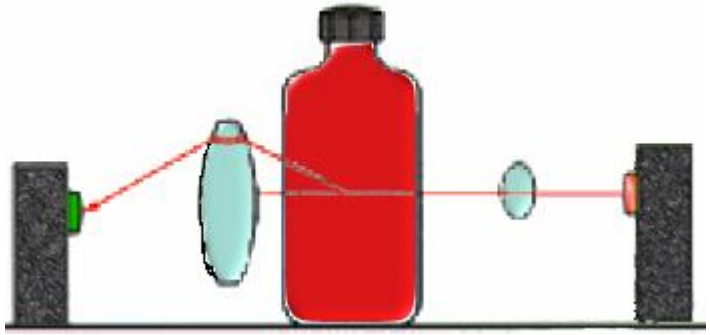
Particle Sizers
粒径仪

- Give relative size distribution of particles, inferred by indirect measurement　给出颗粒的相对粒径分布，由间接测量推算
- Mass Detection, not individual counting as required　群体测量，而不是按要求单个计数
- Not typical used nor seen
  不常用也不常见
- Assumes “normal” distribution
  假定是常态分布
- No individual counting
  不是单个计数
- Multi-size Histogram
  多粒径的直方图



Scanning type particle “counters”
“扫描”式颗粒计数器

- Laser beam moves up and down through fixed volume of fluid
  激光束对一定体积的液体上下扫描
- **Does not individually count particles**-relies on calculations to derive count
  不是单个计数—依靠计算得出计数结果
- Mass Detection, not individual counting as required
  群体测量，不是单个计数



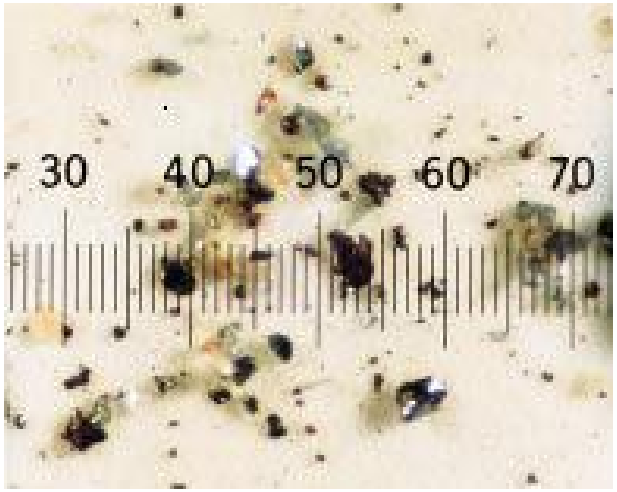
Com Par/Patch Test
比较法

A specified volume of fluid is filtered through a membrane filter of known pore size. All particulate matter in excess of an "average size," determined by the membrane characteristics, is left on the membrane surface.

使一定体积的被测液体流过已知孔目大小的滤膜，所有大于滤膜“平均尺寸”的粒子将被挡在滤膜表面。

The test filter is visually compared with standard patches of known contamination levels to determine the cleanliness level of the fluid system.

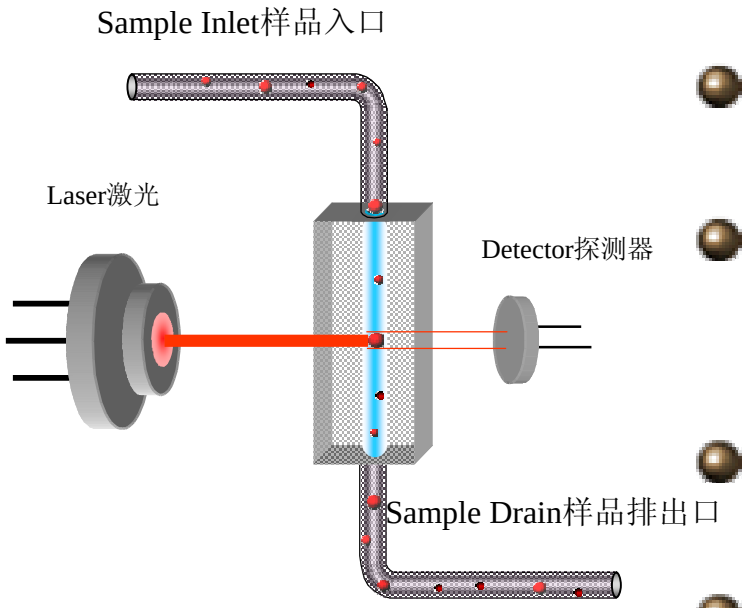
将取样后的滤膜与标准样板对比，判定洁净度等级。



Optical Particle Counting
光学颗粒计数

Theory of Operation

操作原理



Light Blocking Sensors
光阻传感器

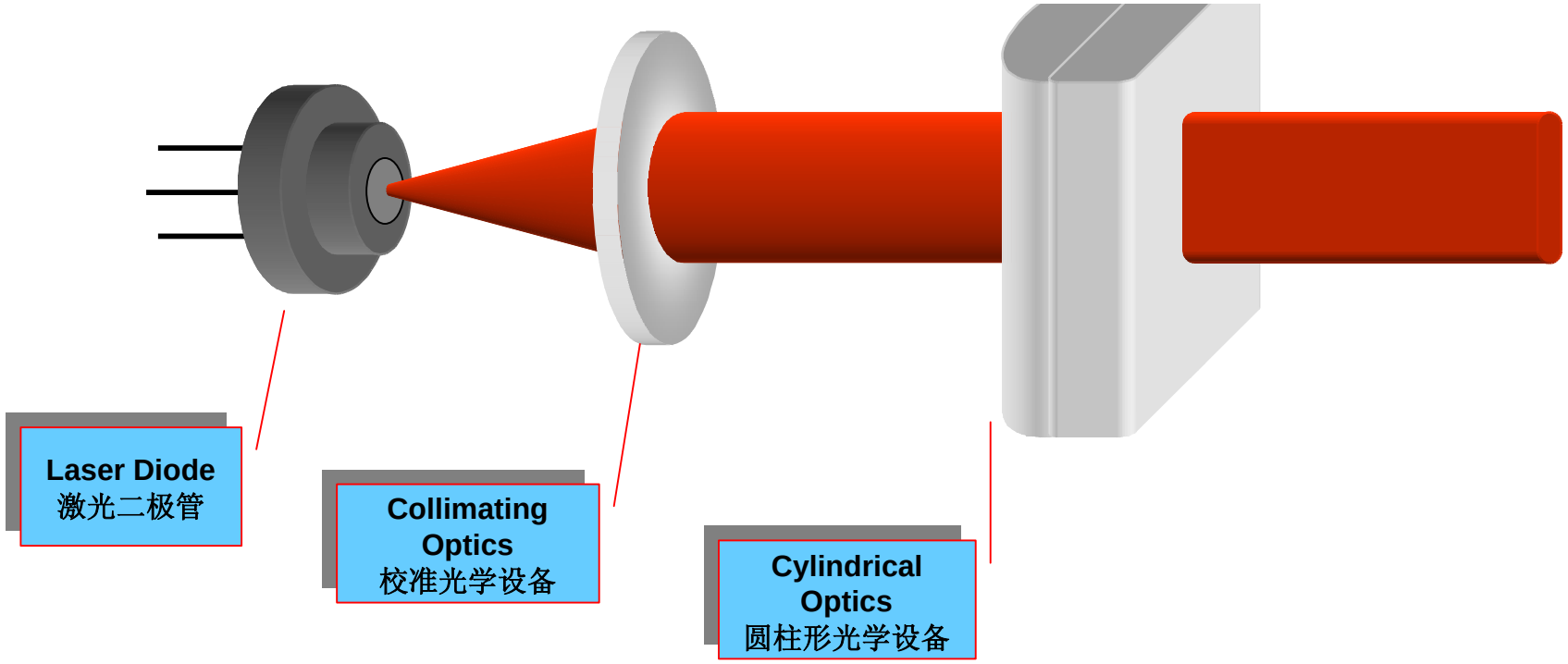
- Approved by National and International Standards 国家及国际标准认可
- Detects particles that fail to scatter light 探测不散射光的颗粒
- Simpler rugged design, ideal for field and heavy shop use 取样器设计坚固耐用，使用范围广
- Required technology in Laboratory Instruments 实验室设备要求技术
- Designed into all HachUltra products for the fluid power industry. 设计用于哈希超纯为液压工业设计的产品中

Particle Counter Theory
颗粒计数原理

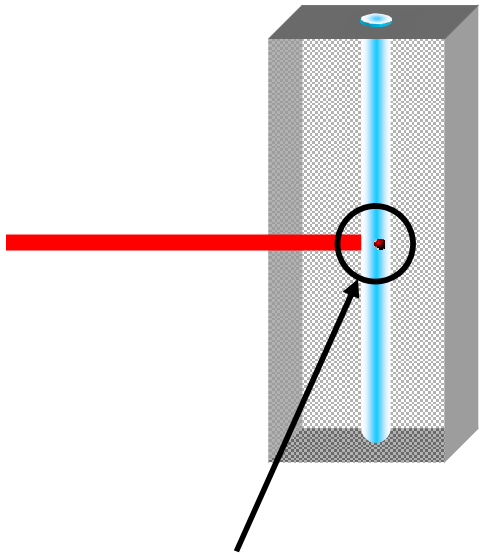
Particle Sensor 颗粒传感器
Counting Electronics 计数电子信号
Performance Characteristics性能特点
Calibration: Purpose and Efficiency
校准：目的与效率

Laser Beam Propagation
激光束的传播

The Laser beam is profiled for optimal illumination and responsiveness.激光束用于照明及作出响应



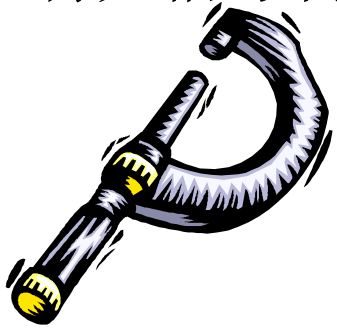
What Is the View Volume?
何谓“观测体积”?

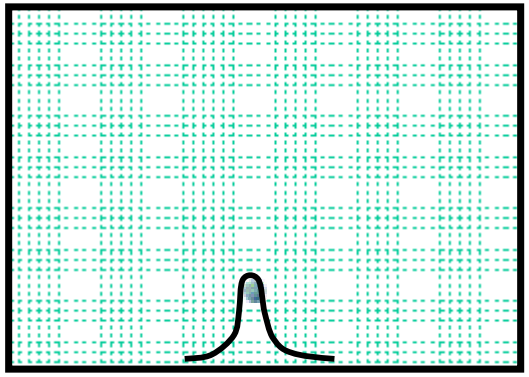


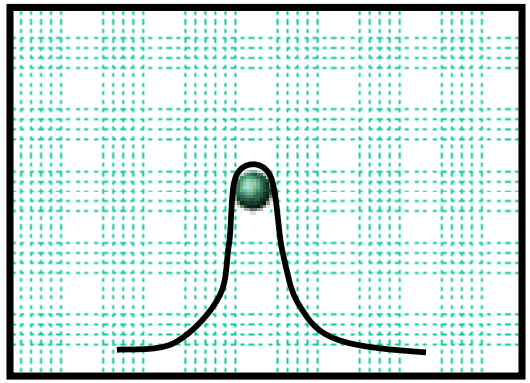
- The area within the sample cell where the laser beam intersects with the sample path.
  激光束与颗粒通道交汇的区域。

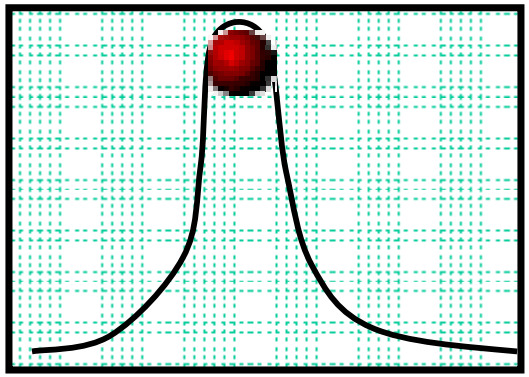
Counting Electronics, Particle Sizing
计数电路、粒径测量

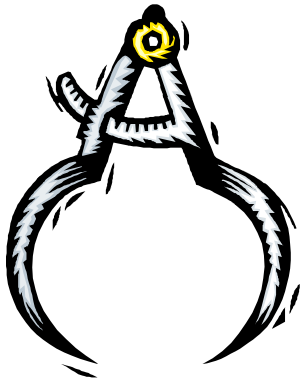
- Converting an optical event to an electronic signal.将光信号转为电信号





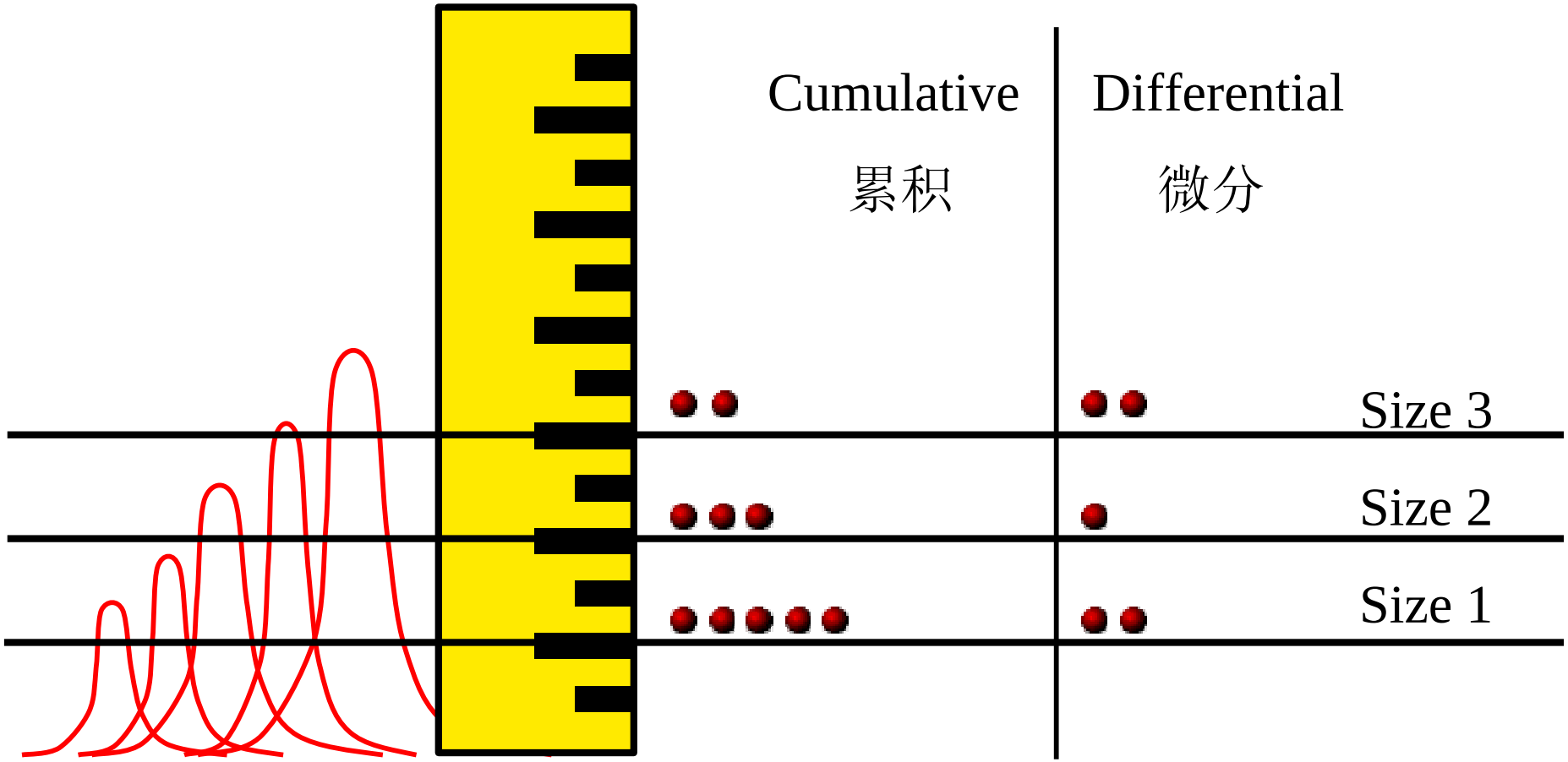




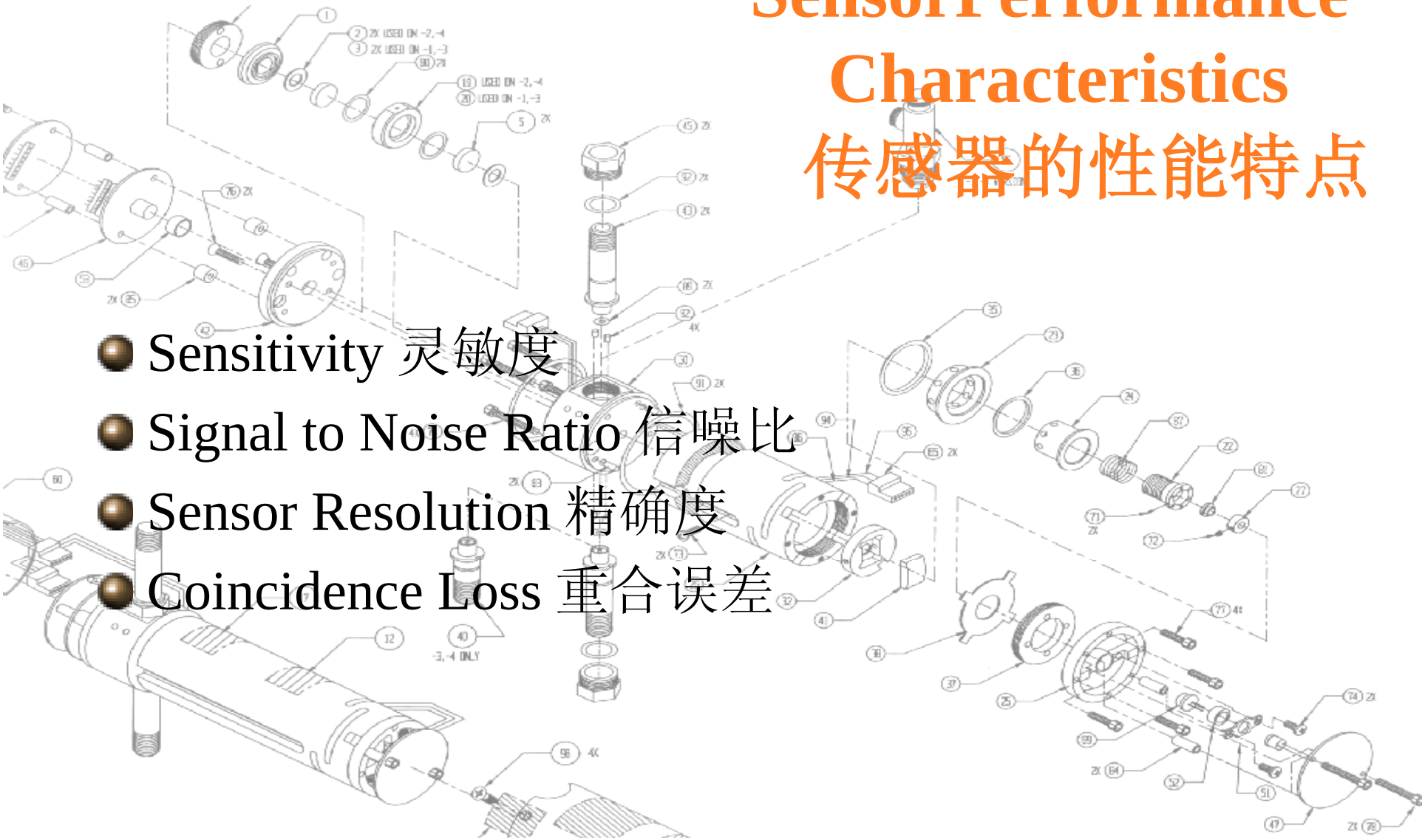


Counting Modes
计数方法

- How would you like your particles?怎样进行计数？



SensorPerformance Characteristics
传感器的性能特点



- Sensitivity 灵敏度
- Signal to Noise Ratio 信噪比
- Sensor Resolution 精确度
- Coincidence Loss 重合误差

Sensitivity灵敏度

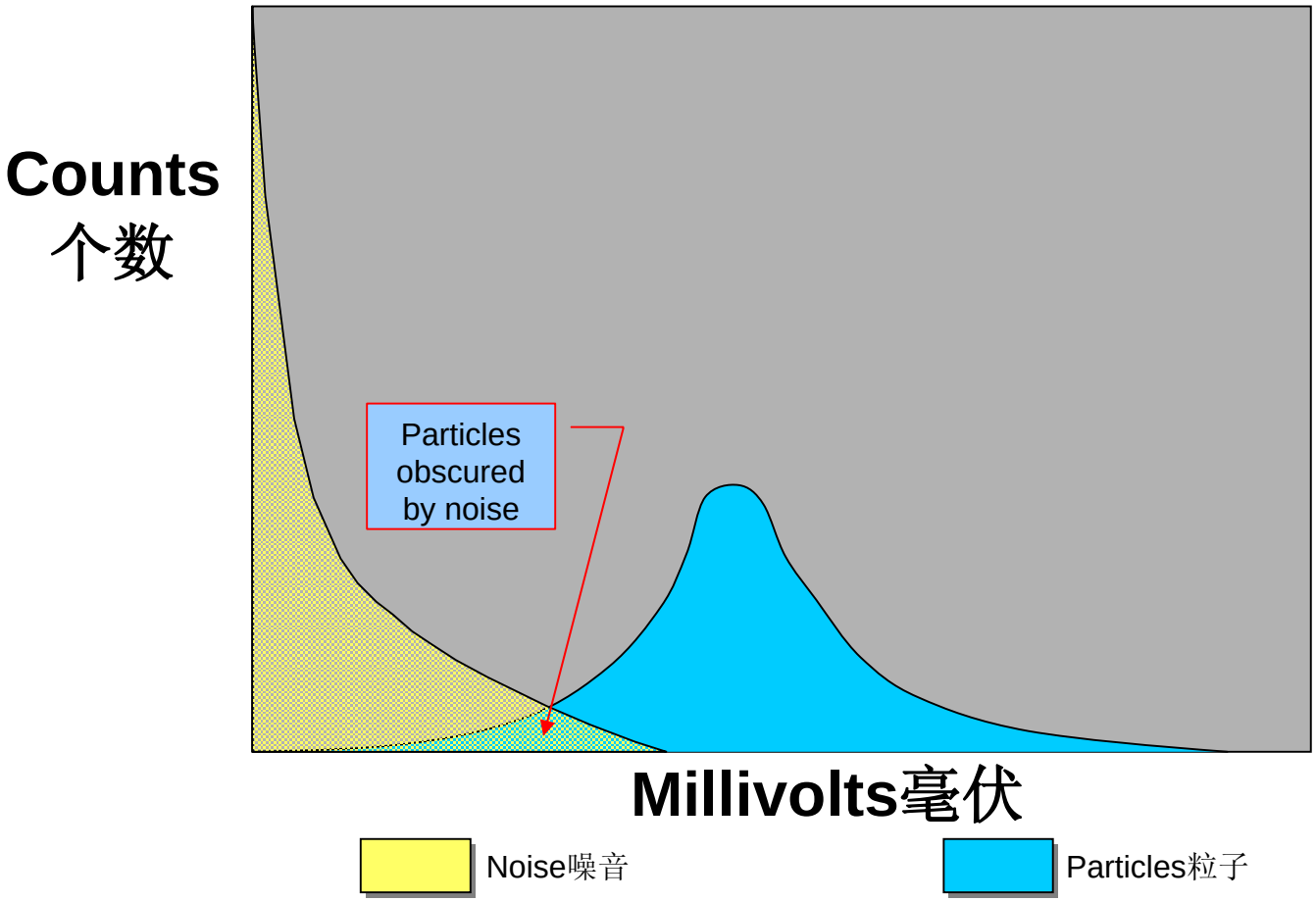
- The smallest size particle that the particle counter can measure. For Hydraulics, 4µm(c) sensitivity meets or exceeds all requirements

  计数器可以测量的最小粒子的尺寸。对于液压系统来计，4微米(c)的灵敏度可以满足或超过所有的标准要求。

  - Lower sensitivities are available for specialized applications: research, membrane filtration, etc.

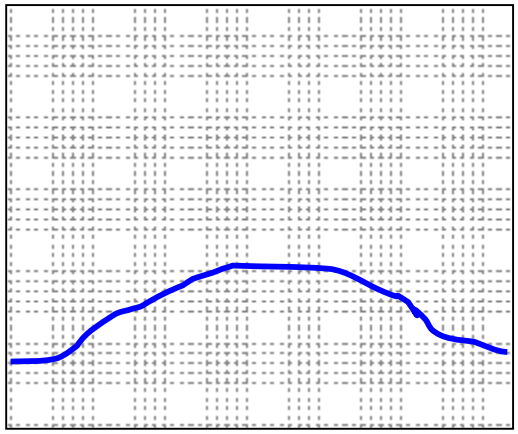
    对于一些特殊的应用来讲，如科研、滤膜过滤等，还可提供更低灵敏度的仪器

Signal to Noise Ratio
信噪比

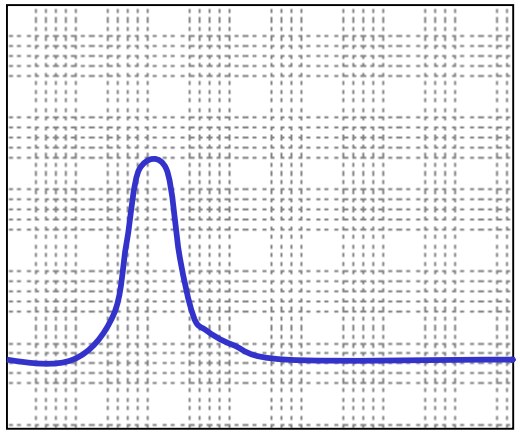


Sensor Resolution
传感器灵敏度

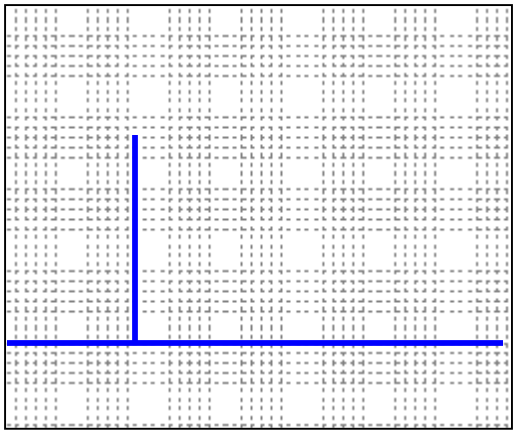
- The accuracy of particle sizing. 颗粒尺寸精确度
- The ability of the instrument to discern between different sized particles. 仪器辨别不同尺寸粒子的能力
- Resolution can vary between instruments, but should be about 5 to 10%. 不同仪器的灵敏度不同，但误差应小于5-10%。



Poor resolution
灵敏度差



Good resolution
灵敏度好

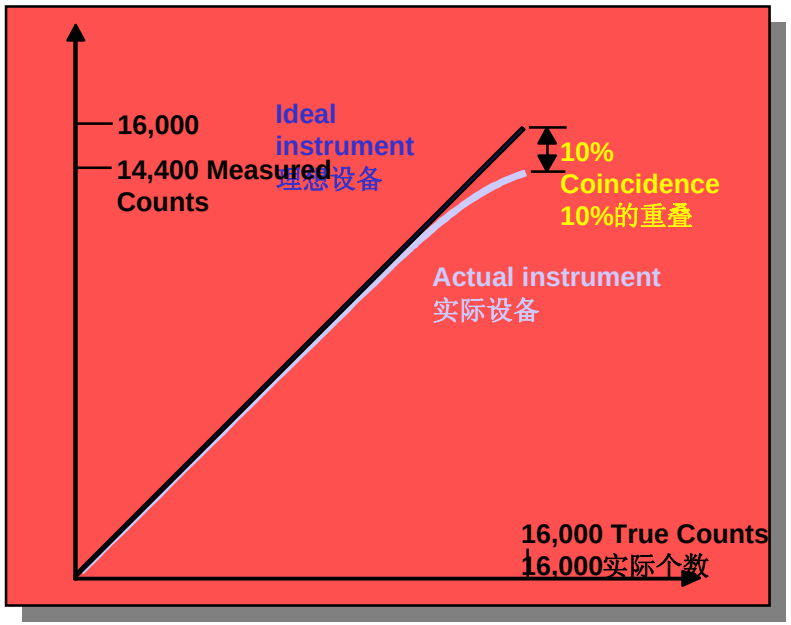


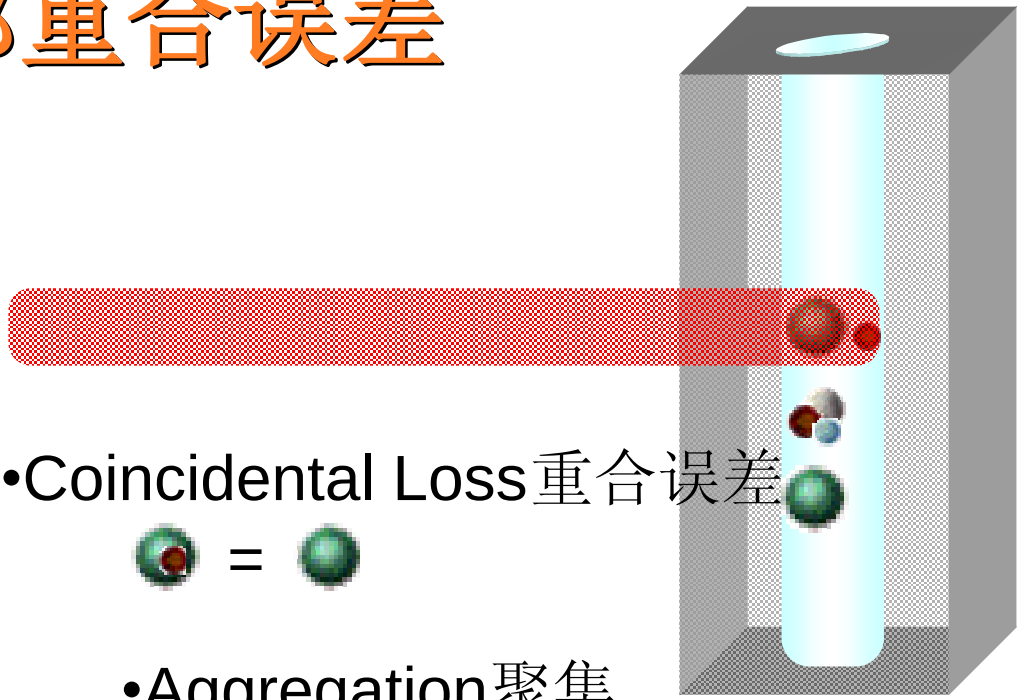
Perfect resolution
灵敏度极好

Sensor Resolution (cont.) 传感器灵敏度（续）

- Response curves are for mono-disperse solution (e.g., 10 μm)响应曲线为单一直径溶液（如10微米）
- Can the instrument accurately count the particles?!仪器能否精确进行颗粒计数？！
  - Poor Resolution: No. Too much uncertainty. Can't discern between 8 and 12 μm, e.g.精确度低：否。很多不确定因素，如不能分辨8微米与12微米。
  - Good Resolution: Yes. Good range of mV values that coincide with 10 μm. Allows for natural tolerances and variations and still provides accurate and precise results.精确度高：是。毫伏值范围与10微米一致。允许自然偏差与变化，并提供精确的结果。
  - Perfect Resolution: No. The response curve is much too tight to appreciate the natural variances in the real world. Particles will be missed and improperly counted. Perfect resolution is not desired.
    精确度极佳：否。反应曲线太紧，不能反应实际使用时的自然偏差。不需要极佳的精确度。

Coincidence Loss Inside a Sensor
传感器内部重合误差





- Coincidental Loss重合误差

- Aggregation聚集

- Single Particle单个颗粒

Standards
标准

Common Industry Standards
通用行业标准

- Standards vary from reporting methodologies …
  标准因报告方法而异
  - ISO 4406
  - NAS 1638
  - SAE AS4059

- … to calibration methodologies
  标准因校准方法而异
  - ISO 4402
  - ISO 11171

Standards标准

ACFTD Calibration
ACFTD校准

"Old" ISO Code"旧"ISO码

- ISO 4402-91 Calibration ACFTD @ 5mg/L
- ISO 4406-87 Report Methodology 2/5/15µ
- NAS 1638-92 Report Methodology

"New" ISO Code"新"ISO码

MTD Calibration MTD校准

- ISO 11171-99 Calibration MTD @ 2.8mg/L
- ISO 4406-99 Report Methodology 4/6/14µm(c)
- AS 4059 Report Methodology 4/6/14/21/38/70 µm(c)

NAS 1638 Replacement
替代NAS 1638

Calibration Methods
校准方法

- PSL spheres in DI water 脱离子水中的PSL球
  - “Size Calibration” NIST traceable. “尺寸校准”NIST标准
- ACFTD in Mil-H-5606
  - “Count Calibration” ISO4402 “计数校准”ISO4402
- ISO-MTD
  - “Count Calibration” NIST Traceable. “计数校准”NIST
  - Based upon ISO 11171 基于ISO11171
- ISO 11171
  - “Count and Size Calibration” NIST traceable .“计数与尺寸”校准NIST

Our methods are in full accordance with ISO 11171.

我们采用的方法完全符合ISO 11171标准

Report Methodologies
报告方法

- ISO 4406 – 99
- SAE AS4059
- NAS 1639
- MIL-STD 1246C
- NAVAIR 01-1A-17
- ISO 11218
- DEF STAN 05-42/2

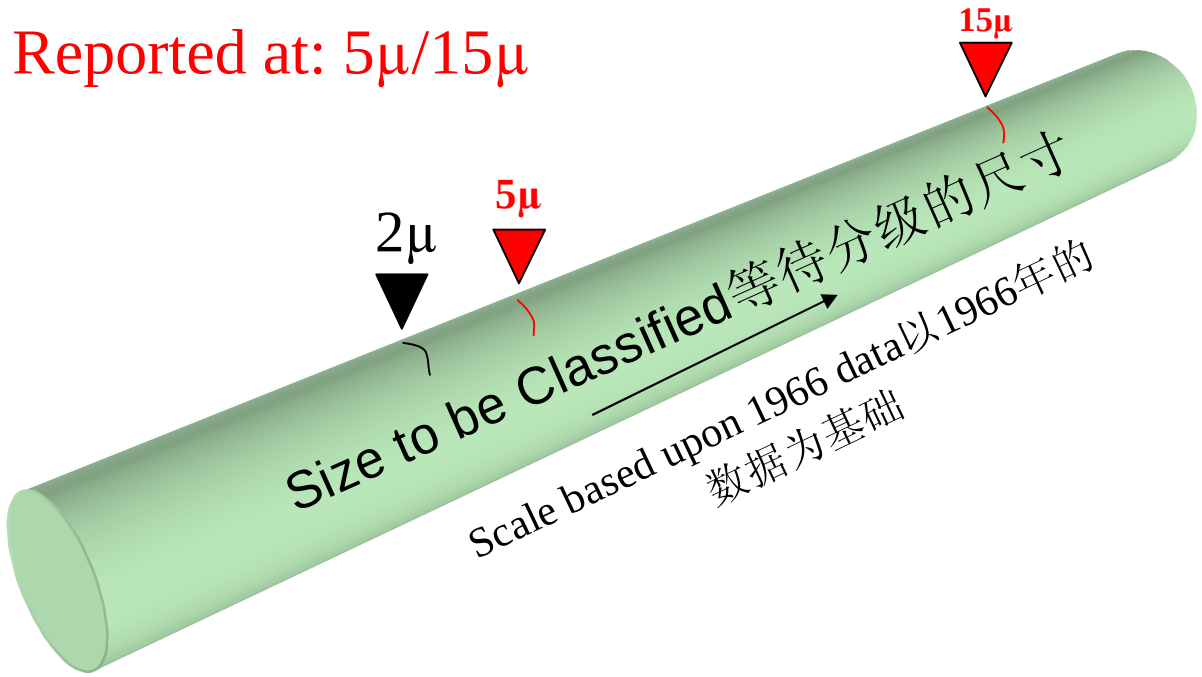
ISO Code
ISO码

- “Old” ISO 4406-1987 “旧”ISO 4406-1987
- Counts/ml 个数/毫升
- Data sorted into classes数据分级
- 2/5/15µ

ISO Code
ISO码

ISO 4406-1987

Reported at: 5μ/15μ



ISO 4406

- “New” ISO Code“新”ISO码
- Counts/ml个数/毫升
- Data sorted into same classes分为同一等级的数据
- 4/6/14µm(c)

When is a Micron not a Micron?
当微米不一致时？

- A: When it's a certified micron – **mm(c)**

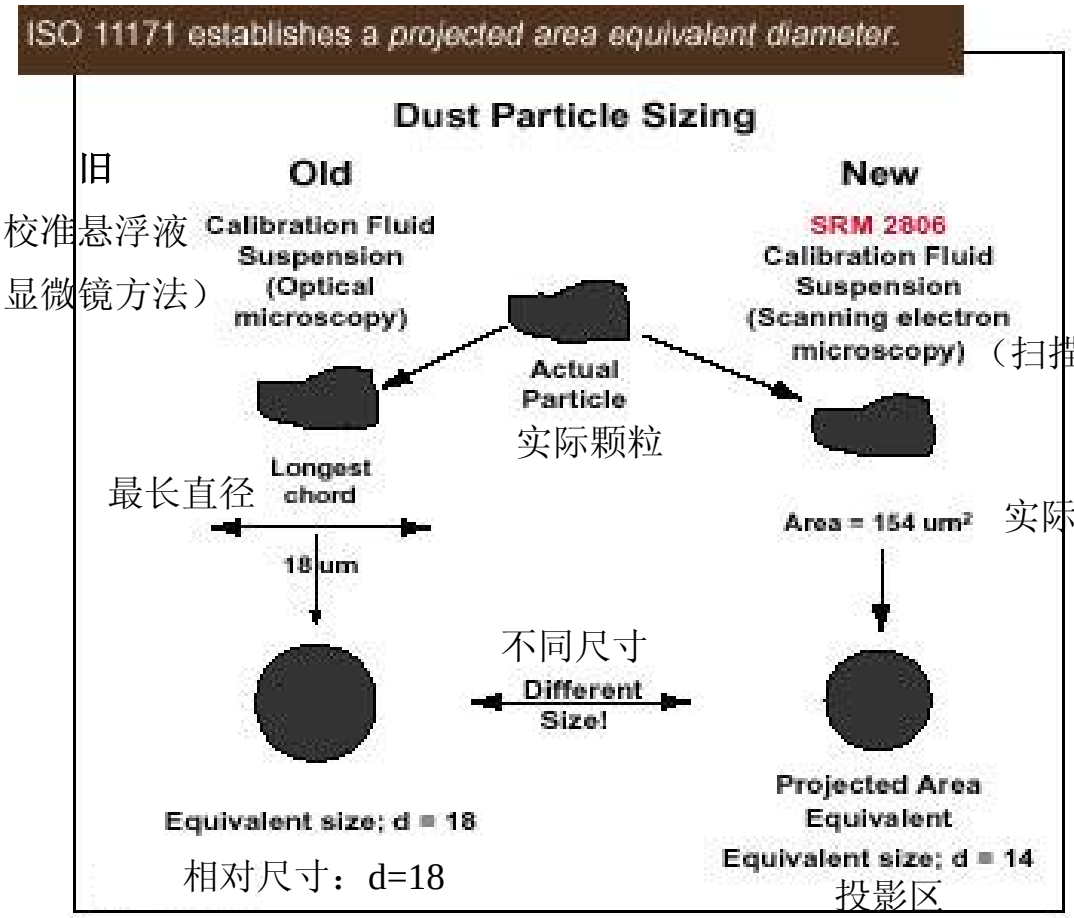
  A：何时为被鉴定的微米- **mm(c)**
- ACFTD used longest chord; MTD uses projected area equivalent diameter

  ACFTD采用颗粒的最长直径；MTD采用相同面积的圆的直径。

- Because NIST (MTD) measures the same particle differently than ISO 4402 (ACFTD), a new size standard had to be created

  因为NIST（MTD）测量粒子的方法与ISO 4402(ACFTD)的方法不同，所以必须建立新的尺寸标准。

Same Particle – Different Sizes
相同的粒子-不同的尺寸



旧

校准悬浮液

（显微镜方法）

新

SRM 2806

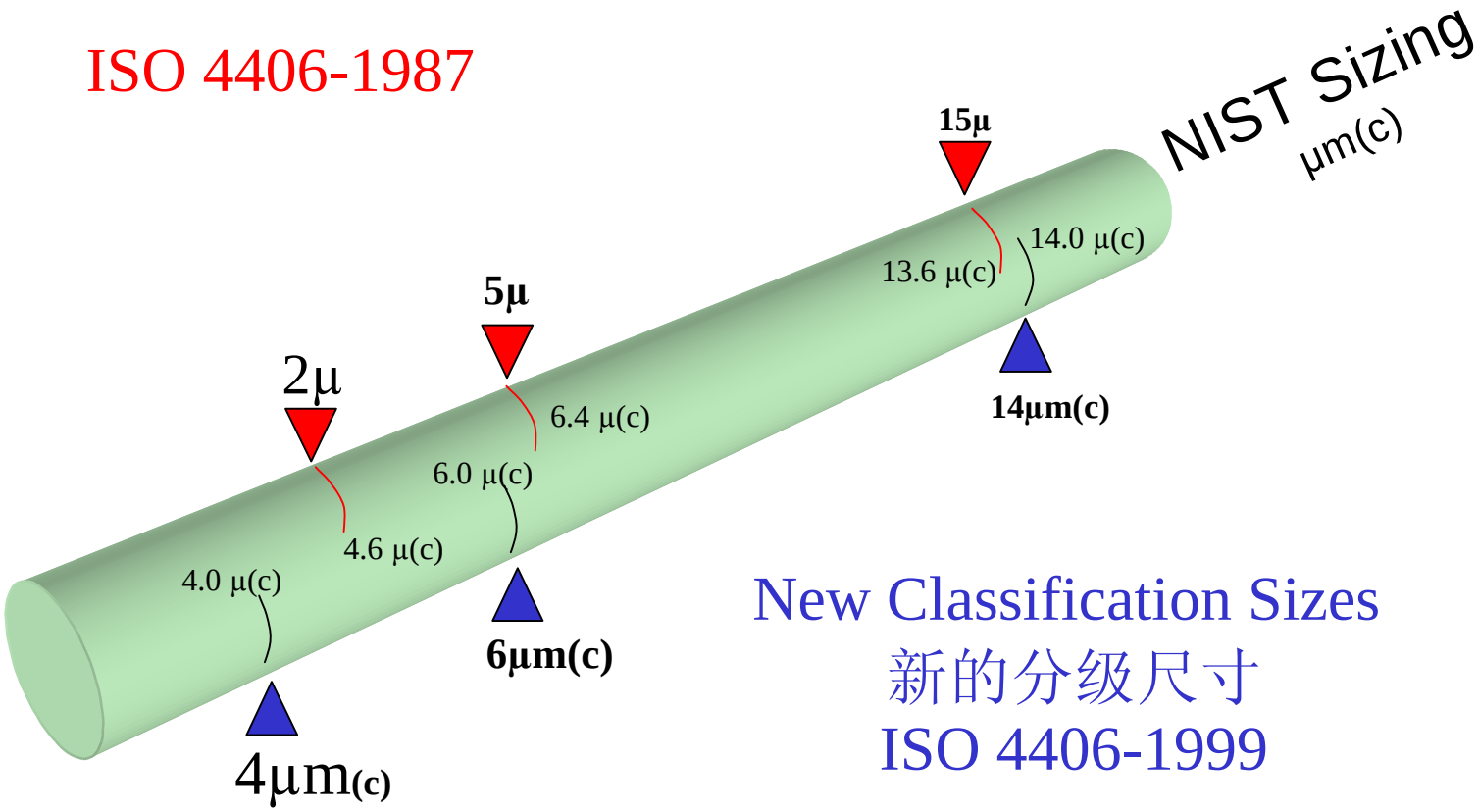
校准悬浮液

（扫描电子显微镜方法）

实际面积=154um^2

ISO 4406

ISO 4406-1987



New Classification Sizes
新的分级尺寸
ISO 4406-1999

How Does This Affect My Codes?
它怎样影响用户的编码？

- ISO 4406, the standard used to create *ISO Codes*, was updated in 1999 to specify 4, 6, and 14 µm(c) as the sizes of interest

  用于建立ISO编码的ISO 4406于1999年更新，它规定的颗粒尺寸为4、6及14微米。

- Old sizes were 2, 5, and 15 µm and many people/companies had SOPs written around these parameters

  旧尺寸为2、5及15微米，很多用户/公司已将这些参数写到标准操作程序中。

NAS 1638

- National Aeronautical Standard 国家航空标准
- Counts/100ml 个数/100毫升
- Data sorted into 5 classes 数据分为5等级
- Data reported in differential format 以不同的形式报告数据
- 5-15, 15-25, 25-50, 50-100, 100+ micron

Extract from minutes
会议记录摘要

- The following has been extracted from the minutes of an NASC meeting heldin **1999: 以下内容摘自1999年的NASC会议：**
- "*The National Committee, decided that a note should be added to NAS1638 stating: 'This standard should not be used with automatic particle counters.' Additionally, 'Inactive for New Design, after xx/xx/xx. See SAE AS4059C.' should also be added to the document.*

国家委员会决定在NAS1638中加入以下内容："此标准不再适用于自动颗粒计数器"。此外，"自某年某月某日起，不在新设计中采用，请参考SAE AS 4059C"。

SAE AS 4059

- Replacement for NAS 1638　替代NAS 1638
- Counts/100ml 个数/100毫升
- Data sorted into 6 classes 数据分为6个等级
- Data classification includes size code 数据分级包括尺寸编码
- 4, 6, 14, 21, 38 and 70 µm(c)
- Allows OPCsto be calibrated with ACFTD (ISO 4402:1987)
  允许OPC使用ACFTD（ISO 4402：1987）校准
- Data reported in cumulative format 以累积形式报告数据

SAE and NAS Comparisons
SAE与NAS的比较

SAE						Class	NAS 1638				
0	1	3	14	76	195	**000**	-	-	-	-	-
0	1	5	27	152	390	**00**	125	22	4	1	0
0	2	10	54	304	780	**0**	250	44	8	2	0
1	4	20	109	609	1560	**1**	500	89	16	3	1
1	7	39	217	1220	3120	**2**	1000	178	32	6	1
2	13	76	432	2430	6250	**3**	2000	356	63	11	2
4	26	152	864	4860	12500	**4**	4000	712	126	22	4
8	53	306	1730	9730	25000	**5**	8000	1425	253	45	8
16	106	612	3460	19500	50000	**6**	16000	2850	506	90	16
32	212	1220	6920	38900	100000	**7**	32000	5700	1012	180	32
64	424	2450	13900	77900	200000	**8**	64000	11400	2025	360	64
128	848	4900	27700	156000	400000	**9**	128000	22800	4050	720	128
256	1700	9800	55400	311000	800000	**10**	256000	45600	8100	1440	256
512	3390	19600	111000	623000	1600000	**11**	512000	91200	16200	2880	512
1020	6780	39200	222000	1250000	3200000	**12**	1024000	182400	32400	5760	1024
>70m **m (c)**	>38m **m (c)**	>21m **m (c)**	>14m **m (c)**	>6m **m (c)**	>4m **m (c)**	ISO 4406 Calibration	(6–14µm(c))	(14–21µm(c))	(21–38µm(c))	(38–70µm(c))	(>70µm(c))
>100m **m**	>50m **m**	>25m **m**	>15m **m**	>5m **m**	>1m **m**	ISO 4402 Calibration	5-15m **m**	15-25m **m**	25-50m **m**	50-100m **m**	>100m **m**
F	E	D	C	B	A	SAE Size Code					
Cumulative							**Differential**				

累积 微分

ISO 11171

ACFTD is Obsolete
ACFTD已过时

- In 1992, AC Rochester discontinued its manufacture of ACFTD
  1992年，AC罗彻斯特停止了ACFTD的生产

- ACFTD no longer a viable test dust
  ACFTD不再是可行的测试方法

- SAE and ISO Technical Committee TC22 formed to find a substitute
  SAE与ISO成立了TC22技术委员会以制定新的替代方法

The Community Acts
社团行动

- Due to obsolescence & accuracy, ACFTD is abandoned
  由于过时与精确度问题，ACFTD已废弃
- PSL is ruled out due to unit-to-unit variations
  PSL因单位变化问题被排除
- NIST becomes involved
  NIST加入
- ISO, SAE, NFPA, ANSI all become involved
  ISO，SAE，NFPA，ANSI加入
- ISO MTD created and approved
  ISO MTD建立并通过
- NIST Standard Reference Material SRM 2806
  NIST标准参考材料SRM 2806

Is That All? No!
这是全部吗？不！

- The attention to detail and accuracy drove the committee to create an entirely new calibration standard
  细节与精度要求使委员会建立了新世的校准标准。
- ISO 4402 is out
  ISO 4402停止使用
- ISO 11171 is in – many changes, but …
  ISO 11171正在使用——很多修改，但是…
- ISO MTD and NIST counts have the largest impact!
  ISO MTD与NIST计数的影响最大！

ISO 11171

Specifically *requires multiple tests to determine accuracy and calibration*

特别要求多项测试以保证精度和校准

- System Noise 系统噪音
- Coincidental error 重叠错误
- Volumetric accuracy 体积精度
- Coefficient of Variance 变化系数
- Flow rate dependency tests 流速测试
- Resolution (sizing accuracy) 粒径精确度（尺寸精确度）
- Count Accuracy (distributional dependencies) 计数精确度（由分布决定）
- Calibration (threshold determination using NIST traceable poly and mono dispersed particles) 校准（可溯源NIST标准的多个及单一直径门槛电压）

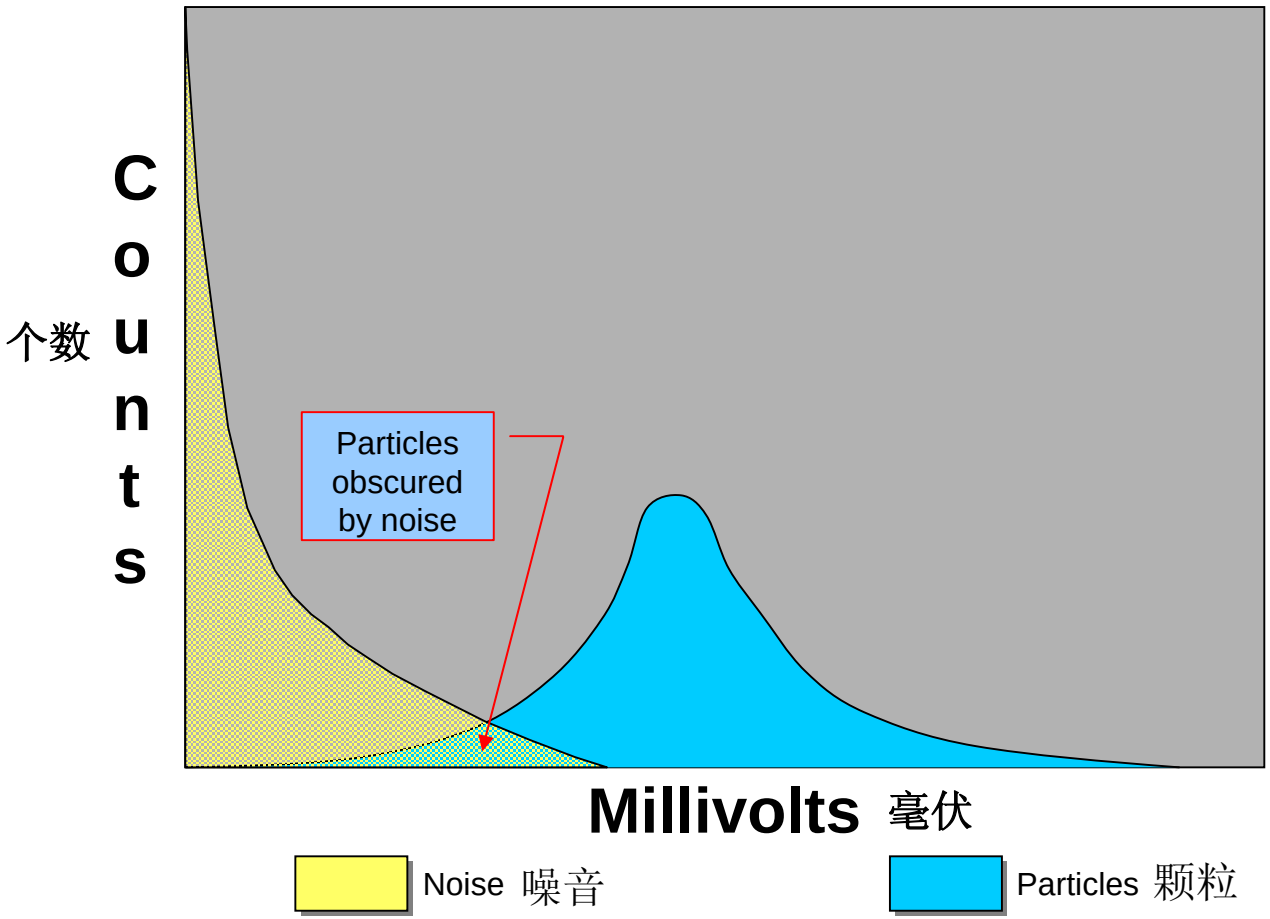
Why 11171?
为什么使用11171？

- Consistency一致性
- Repeatability重复性
- Reproducibility重现性
- Traceability可溯源性
- Universal Accuracy全面准确性

Volume Accuracy
体积精度

- Ensures that the volume sampled by the particle counter is accurate and repeatable.
  保证颗粒计数器取样体积准确且重复性好。

Signal to Noise Ratio信噪比



Coefficient of Variation
变化系数

- Repeatability重复性
  - Does the sensor count the same from run to run?
    每次测量的结果都相同吗？

- 3% maximum COV allowed
  允许的最大重复性误差为3%

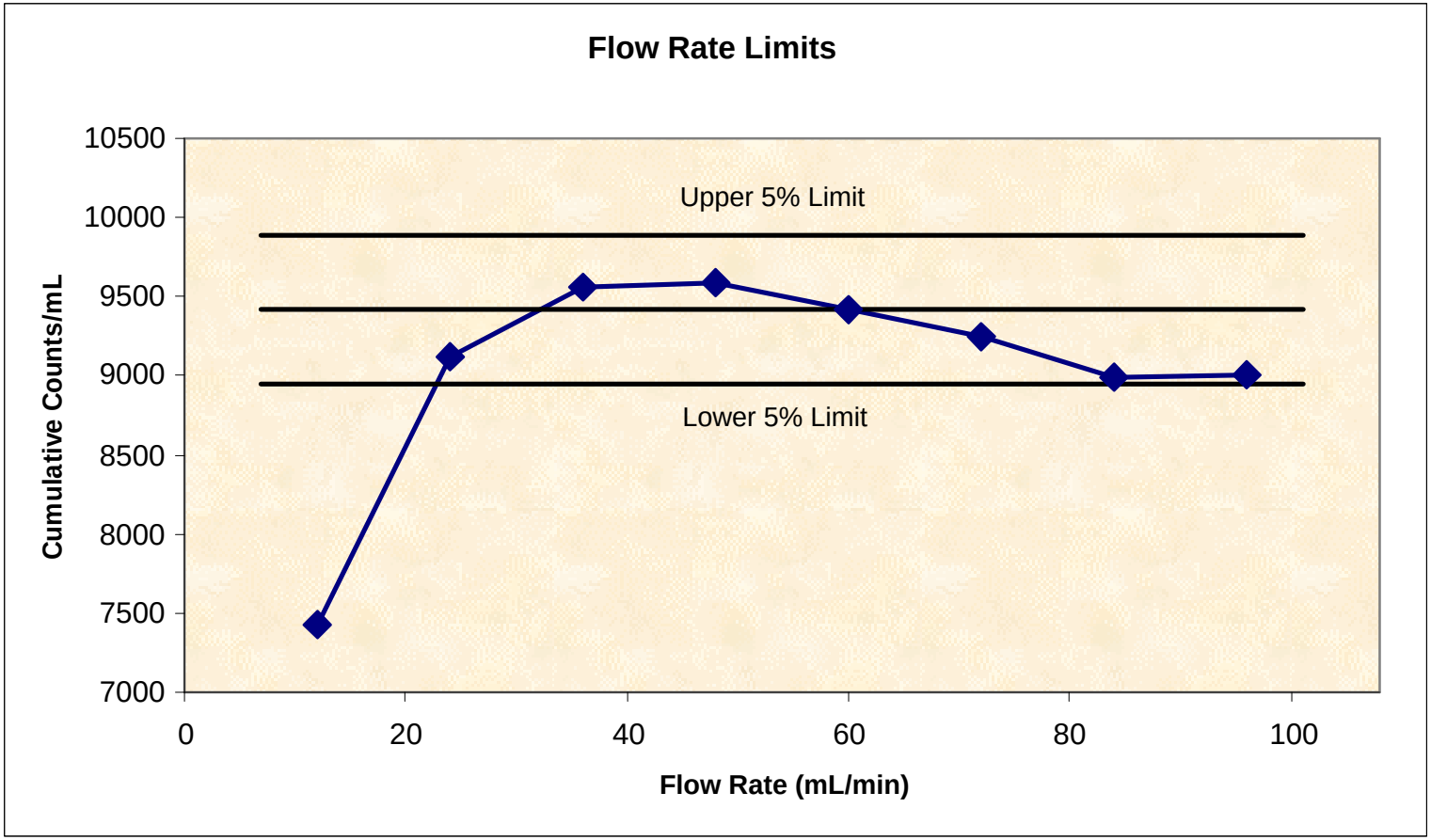
Flow Rate Limits
流速极根

- What is the operability range of your sensor?
  什么是传感器的操作范围？
- Compare counts between baseline flow rate and various other flow rates
  比较基线流速与其它流速
- Automatic flow rate calculator
  自动流速计数器

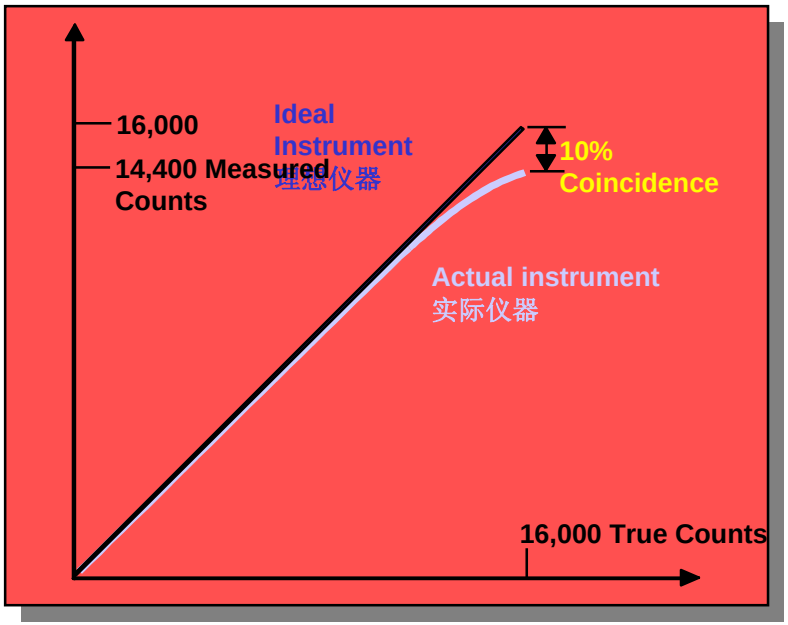
Flow Rate Limits
流速极限

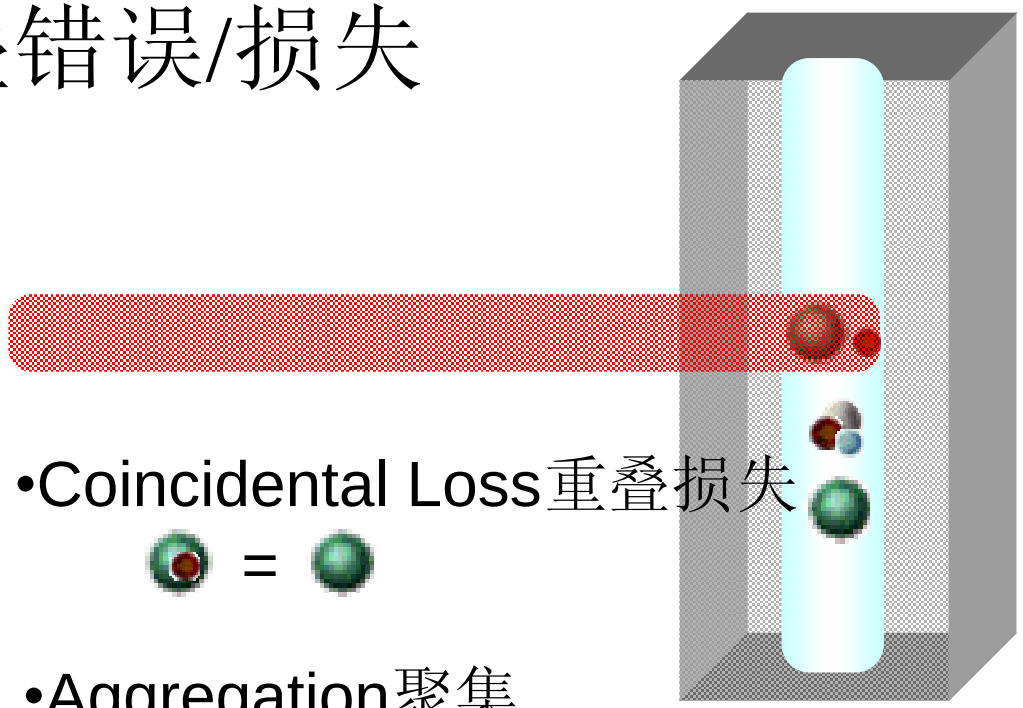
	Cumulative Counts/mL							
n	1	2	3	4	5	6	7	8
Flow Rate	12	24	36	48	60	72	84	96
Run Time	50.0	25.0	16.7	12.5	10.0	8.3	7.1	6.3
Run 1	7378	9135.1	9555.9	9581.5	9409	9320.8	8989.7	9034.4
Run 2	7414.3	9184.1	9594.4	9588.5	9395.8	9240.1	9038	8987.4
Run 3	7460.2	9083.7	9583.8	9576.6	9421.5	9271.9	8982.5	8987.5
Run 4	7507.3	9116.5	9488.7	9601.8	9428.9	9196.8	8982.1	8981.6
Run 5	7349.8	9090.8	9572.1	9590.9	9425	9224	8960	9005.4
Average	7421.9	9122.0	9559.0	9587.9	9416.0	9250.7	8990.5	8999.3
D_Q	2.1%	1.1%	1.1%	0.3%	0.4%	1.3%	0.9%	0.6%
Test	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS

Flow Rate Limits
流速极限



Coincidence Error/Loss
重叠错误/损失



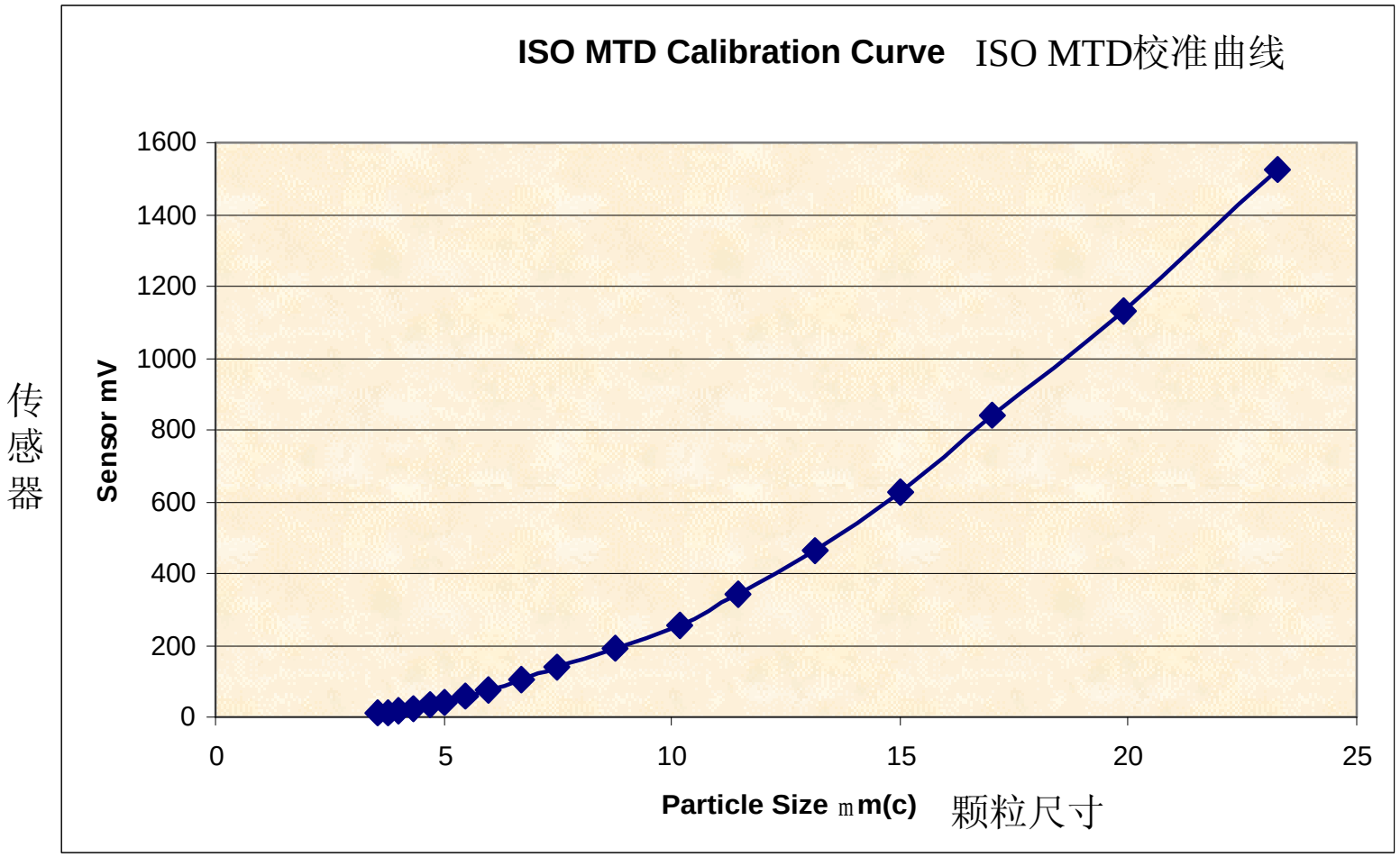


•Coincidental Loss重叠损失

•Aggregation聚集

•Single Particle单个颗粒

Calibration – MTD
校准—MTD



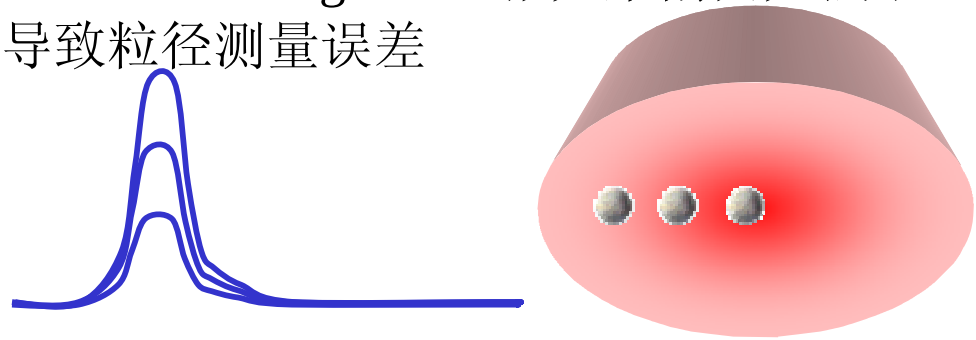
Sizing Calibration – MTD
尺寸校准—MTD

- 18-point calibration
  18点校准
- 4 – 30 µm(c) is the desired range
  理想范围为4-30µm(c)
- Polystyrene spheres in oil
  油液中的聚苯乙烯球
- 50 & 100 µm(c)

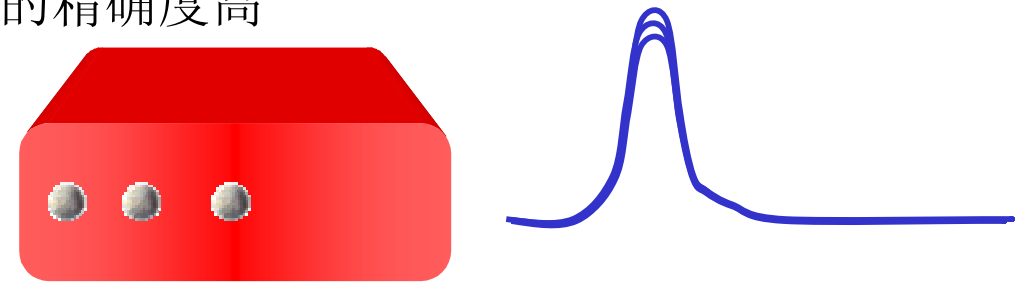
- Moving windows in 8000A
  8000A的移动窗

Beam Profile Impact On Resolution
光束剖面对精确度的影响

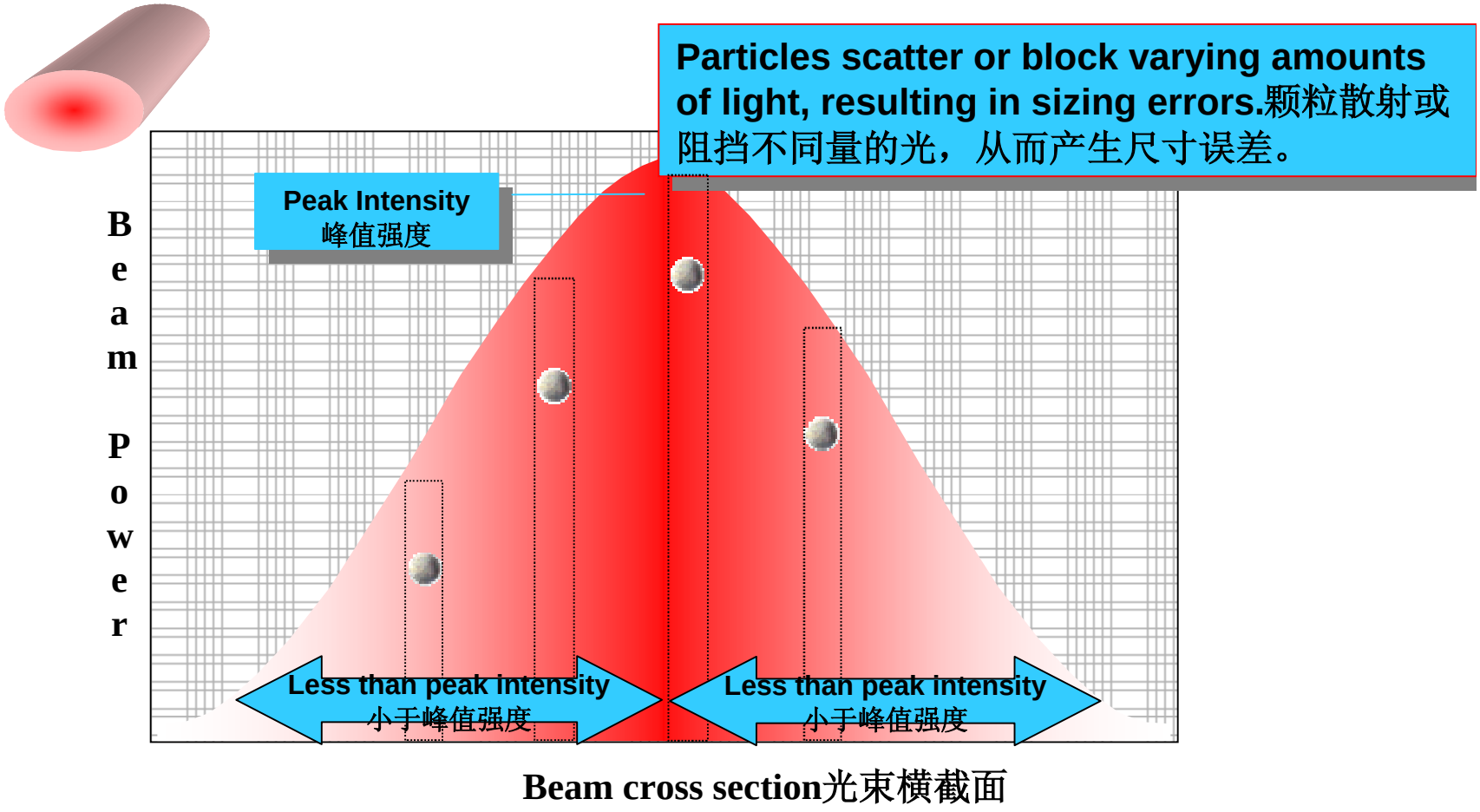
•Inconsistent laser intensity in the beam profile can cause sizing errors.激光束剖面光强不一致导致粒径测量误差



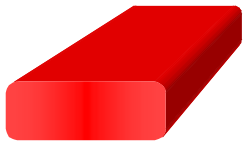
• Illuminating the view volume with a beam of uniform intensity will produce better resolution.
光强一致性好的光束测得粒径的精确度高



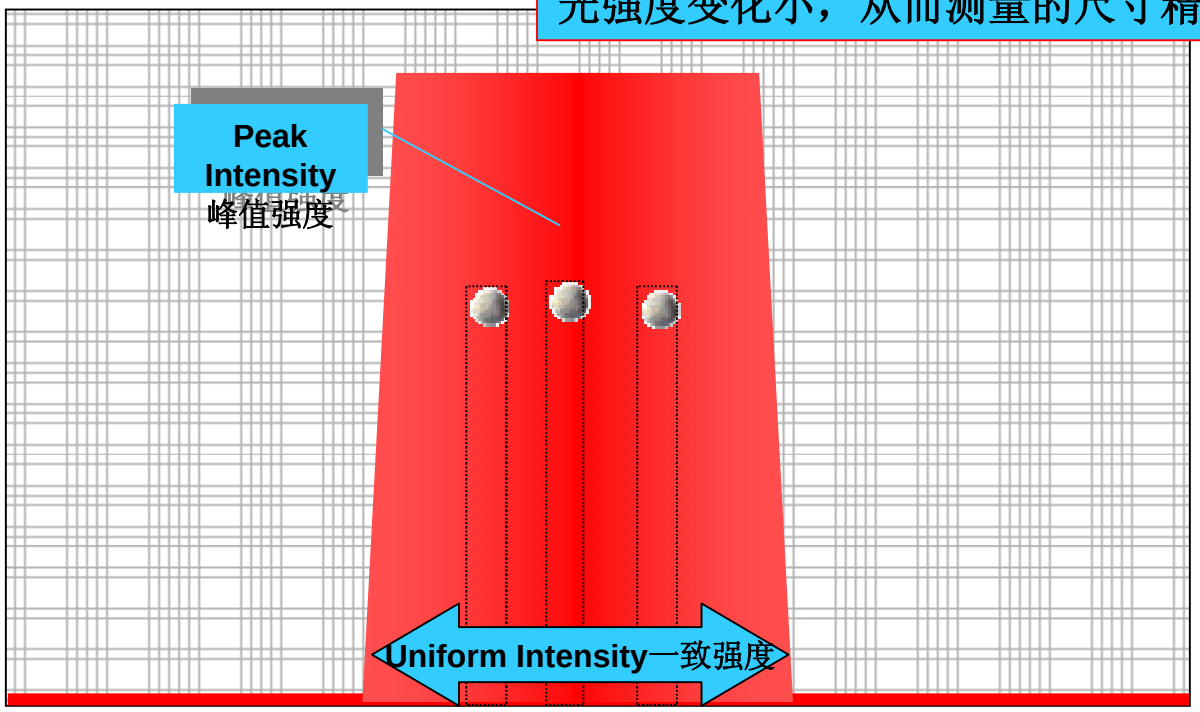
Poor Beam Profile
差的光束剖面



Uniform Beam Profile
一致的光束剖面



Variations in light intensity are minimal, resulting in accurate sizing (highresolution).
光强度变化小，从而测量的尺寸精确（高精度）

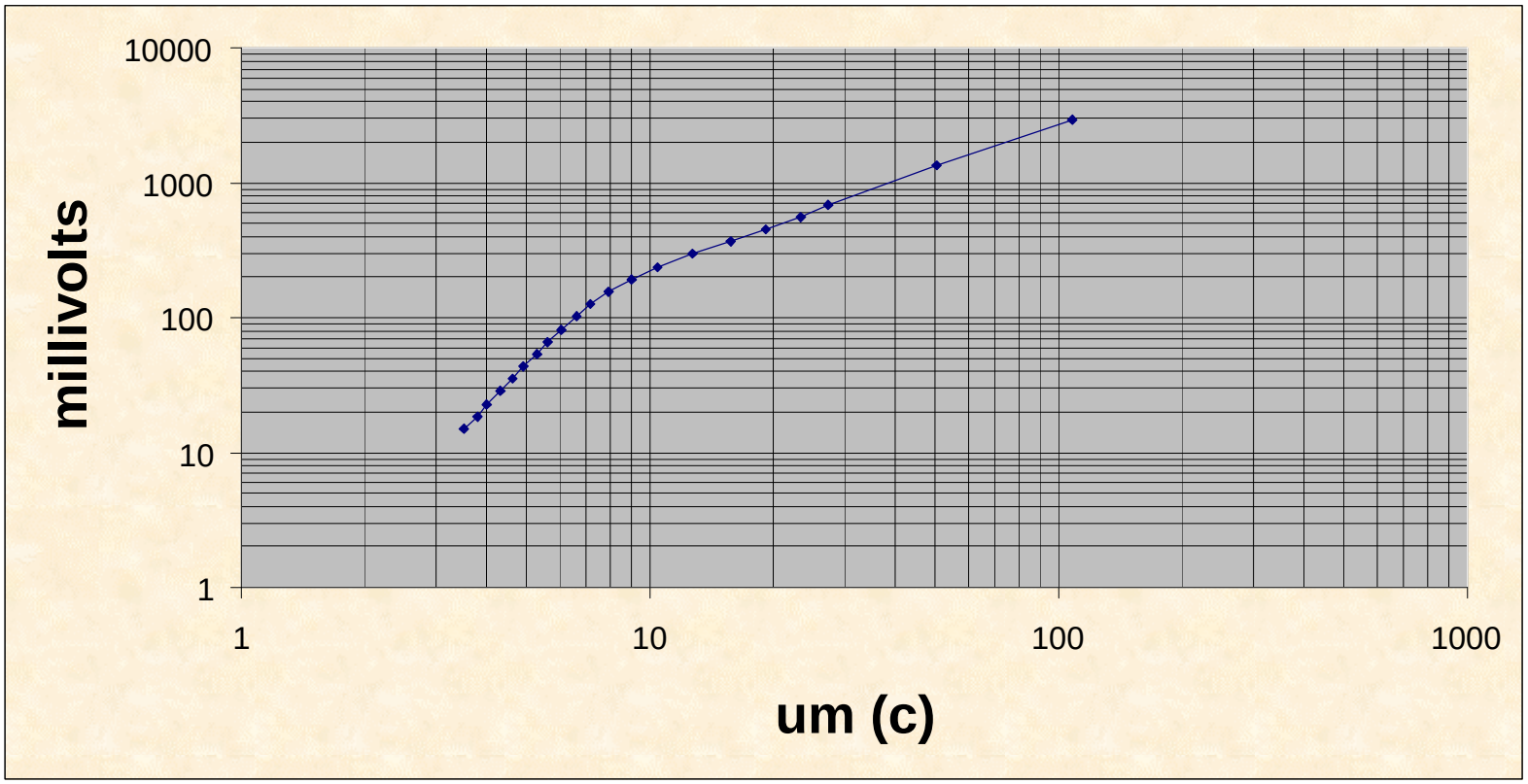


Beam cross section光束横截面

Accuracy
精确度

- Count accuracy计数精确度
- Enter the calibration curve 输入校准曲线
- Check against UFTD 再次检查UFTD

NIST CountsNIST 计数
Converted to Calibration Curve转化为校准曲线



Particle Counting Options
颗粒计数器的选择

Laboratory OPCs
实验室光学颗粒计数器

- Allow particle counting in various fluids including water based.
  可以计数不同液体（包括水溶液）内的颗粒
- Give instant results 立即得到结果
- Have degassing facility so remove errors caused by air 除气功能以除去气泡引起的误差
- Parts per billion accuracy 高精度
- Extremely flexible (sample size, number of runs, etc.) 高度灵活性（试样尺寸、测试次数等）

Portable OPCs
便携式自动颗粒子计数器

- Online sampling at the “point of use.” 测试点在线取样
- High and low pressure sampling capabilities高低压两种采样模式
- Limits need for laboratory analysis results now not tomorrow. 立即得到实验室分析结果
- Allows system trending and auditing系统变化或检查时也可使用
- A valuable proactive maintenance tool超值的维护工具
- PODS – Feature rich, high value PODS-超值多功能仪器
- PC4000 – basic system, low cost PC4000-低成本基本系统

PODS Brief Description
PODS简介

- Offers flexibility in sampling with an online or lab/bottle modefor multi-variant analysis of particle counts, viscosity and temperature

  在线或采样瓶采样，方式灵活；颗粒计数、粘度与温度等多个变量分析。
- Capable of calibration to full ISO 11171 standards, the PODS performs in harsh environments, accurately monitoring hydraulic and lubricating fluids

  完全符合ISO 11171标准，PODS可以恶劣环境下使用，精确监测液压及润滑液体。

PODS Features
PODS的特点

- 8-channel display 8通道显示
- **Bottle and online sampling 采样瓶或在线采样**
- **Viscosity & temperature measurement 粘度与温度测量**
- 500 sample memory 记录500个试样
- High speed thermal printer buffer 高速热敏打印机缓冲器
- Flash programmable 固件或升级
- Aluminum alloy sheet metal casing 铝合金金属外壳
- **Built-in bottle sampler pressure chamber 内置采样瓶压力箱**
- Compact power supply 小型电源
- Refillable CO2 bottle or shop air operation 充气式二氧化碳瓶或商用气体操作
- Multiple language capabilities 多种语言
- **Full ISO 11171 calibration capability 完全符合ISO 11171标准**

Performance
性能

- Fluid Compatibility: Phosphate ester based fluids AND petroleum and synthetic based fluids
  液体兼容性：磷酸脂溶液、石油溶液及合成溶液
- Online sampling at pressures of 7 to 420 bar (9 to 6000 psi)
  在线采样压力为7-420巴（9-6000psi）
- Maximum fluid viscosity of 434 cSt
  最大液体粘度为434cSt
- Concentration limit: 90,000 particles/mL@10%
  浓度极限90,000 个/毫升@10%
- Sample fluid temperature: Up to 90°C (194°F)
  最高采样温度可达90°C (194°F)

Online Particle Monitors
在线颗粒监测

- Allow 24/7 contamination monitoring.
  24/7污染监测
- Reduces the need for, and cost of, laboratory samples – only analyze when necessary
  减少实验室采样的要求与成本，只有必要时进行分析
- Particle contamination is **the** leading indicator of machine condition – particle count will increase ***before*** damage occurs
  颗粒污染是机械工况的预警标志，仪器损坏前颗粒数目会增加
- Simple to operate – less to go wrong
  易于操作-不易出错
- Wide installation capabilities
  易于安装
- Easy integration into existing facility monitoring packages
  便于与已有的监测系统集成
- Low cost
  成本低

Agenda议程

- What is Particle Counting and why is it important to the Industrial marketplace (fluid power, hydraulics, lubrication, etc.)何谓“颗粒计数”及其重要性（液压、水力、润滑等）
- What methodologies currently exist that allow customers to monitor their particle levels目前监测颗粒水平所采用的方法有哪些？
- Why are Optical Particle Counters the best technology and what is the operating theory为什么光学颗粒计数器是最佳技术，它的操作原理是什么？
- What are the governing standards that allow for reporting and decision making报告及决策的决定性标准是什么？
- How can HachUltra Analytics ’ help you with your particle counting needs哈希超纯分析怎样满足您的颗粒计数需求？

Questions & Answers
欢迎提问

Thank you for listening

谢谢参与

上海罗湾实业有限公司

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