

## **Checking Voice Coil Position at the Production Line**

線上直接檢驗音圈定位和其他影響良率的原因

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## **Objectives in end-line-testing:**

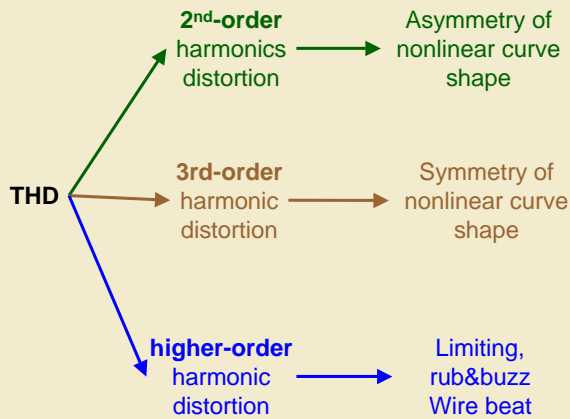
線上檢驗的目的:

1. Basic Goal: 基本目的: Separate defect units from delivered goods 篩選良品出貨/挑出客訴不良品  
→ simple PASS/FAIL decision using limits
2. Ultimate Goal: 最終目的: Avoid manufacturing of defect units 避免不良品的產生  
→ use diagnostics to get meaningful characteristics used as feedback in controlling the production process



# Exploiting Information from Components

## 找出造成不良問題的部件或組裝的問題癥結



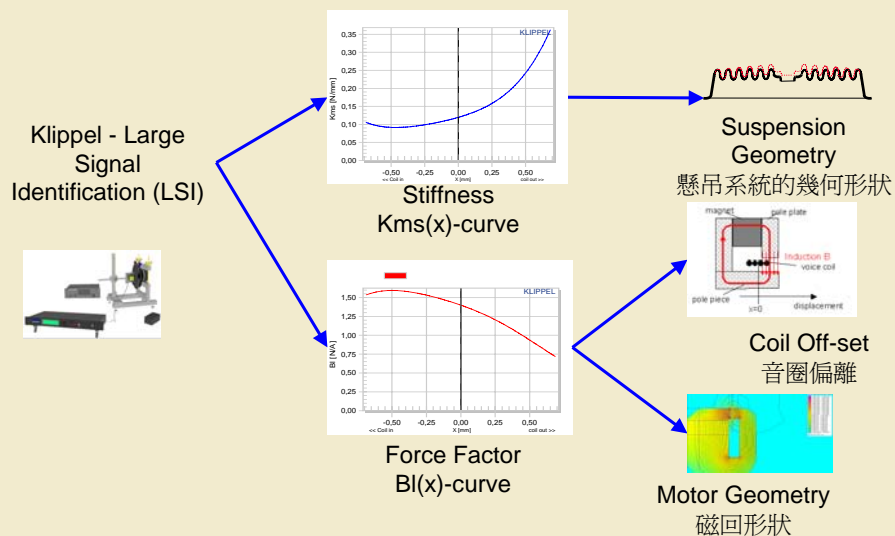
### Open Questions:

A defective part or an assembling problem ?

How to fix the problem ?

# Diagnostics based on Nonlinear Parameters

## 如何利用大信號參數找到出問題的原因



## Are nonlinear curves good for end-of-line testing ? 線上檢測非線性BL, Cms特性曲線好不好??

PRO:

- Curves provide all relevant information

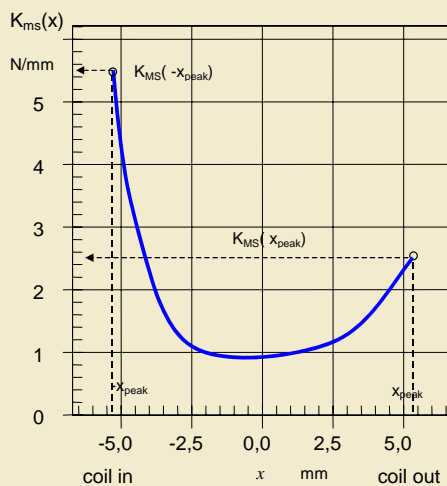
Cons:

- Full identification requires more time
- Complexity makes interpretation difficult
- Curves reveals multiple physical causes
- Cpk and Ppk can not be applied

single-value characteristics are preferable for QC  
線上最好用單純不複雜的單一數值參數管理.



## Stiffness asymmetry $A_K(x_{peak})$



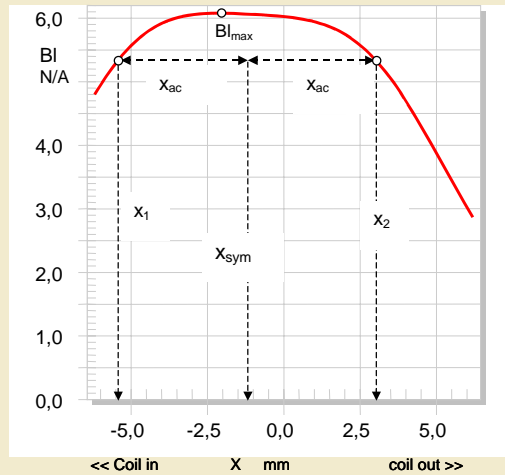
Considering stiffness at positive and negative peak displacement:

$$A_K(x_{peak}) = \frac{\text{Difference value}}{\text{Mean value}}$$

$$A_K(x_{peak}) = \frac{2(K_{MS}(-x_{peak}) - K_{MS}(x_{peak}))}{K_{MS}(-x_{peak}) + K_{MS}(x_{peak})} 100\%$$



## Definition of Coil Offset $X_{offset}$



Coil offset is the centre point between two points having the same Bl value.

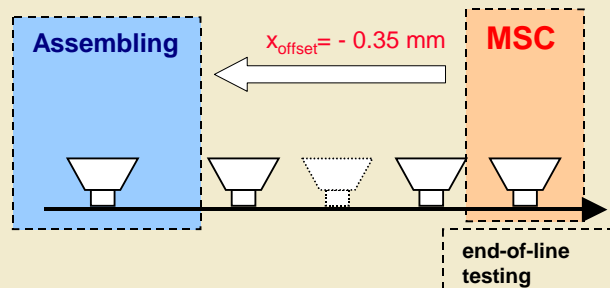
$$Bl(X_{offset} - x_{ac}) = Bl(x_{offset} + x_{ac})$$

Condition:

$$X_{ac} > X_{Bl}$$

## Controlling the Production Process

### 測參數來控制製程

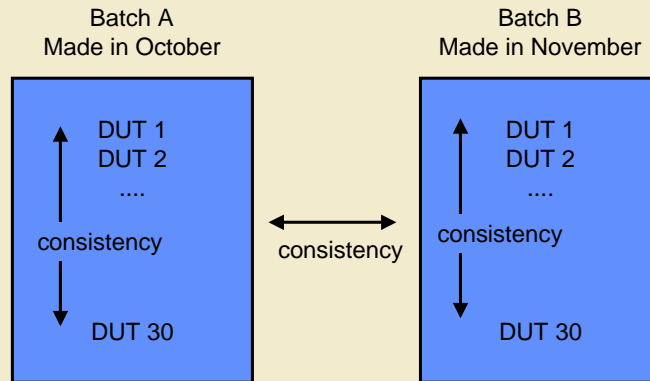


- Diagnostics can be integrated in end-of-line testing
- MSC parameters correspond with production process parameter
- Adjustment accomplished in shortest time
- Predictive Control by trend calculation
- Process stability (Ppk and Cpk)

→ Minimal Rate of Rejection 把不良率降到最低

# Study on Headphone Drivers

## 耳機驅動器的解決實例



- Failures (statistics, properties) ?
- Causes of failures
- Parameter variation
- Process stability.



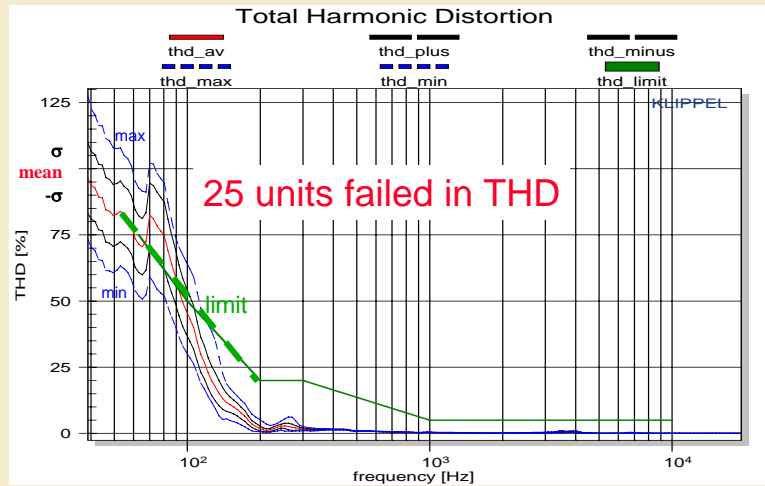
# Measurement Conditions

## 測量治具



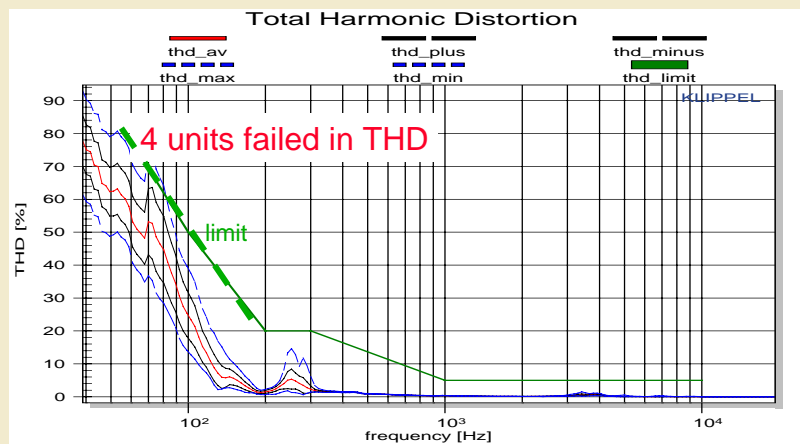
# Total Harmonic Distortion

batch A (30 DUTs) A批次總失真: 25不良/30

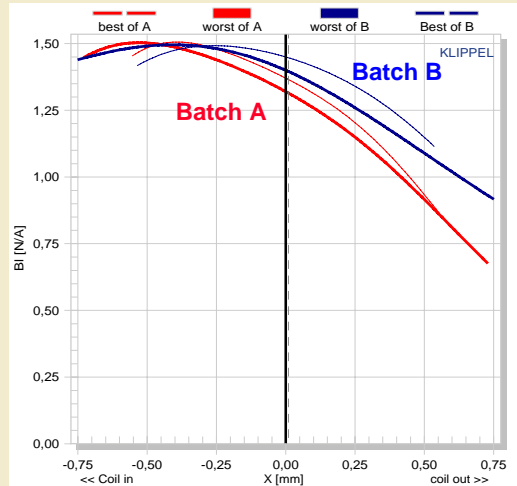


# Total Harmonic Distortion

batch B (30 Duts) B批次總失真 4/30不良



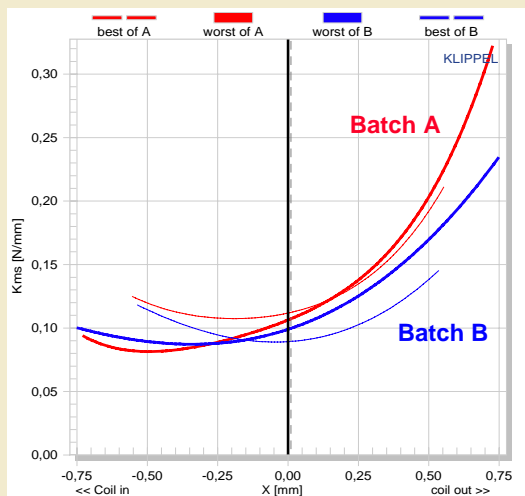
# Force Factor Curve BI(x)



Curve measured by using Large signal Identification (LSI)  
 測大信號曲線 需10分鐘  
 Measurement time: 10 min



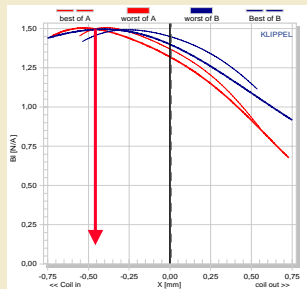
# Stiffness Curve Kms(x)



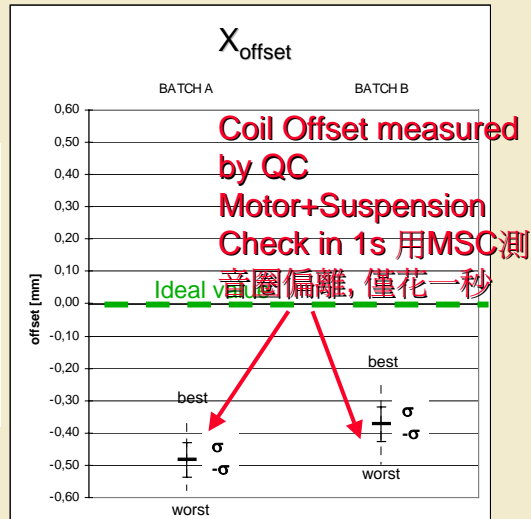
Curve measured by using Large signal Identification (LSI)測大信號曲線 需10分鐘  
 Measurement time: 10 min



## Voice coil offset $X_{\text{offset}}$ of the headphone



$X_{\text{offset}}$  in mm



$X_{\text{offset}}$

BATCH A BATCH B

Coil Offset measured by QC

Motor+Suspension

Check in 1s 用MSC測

音圈偏離, 僅花一秒

Ideal v

best

best

σ

σ

worst

worst

## Characteristics measured by QC system

Klippel QC可測項目:

Characteristics required by manufacturer:

- SPL, impedance, THD, polarity, fs

Additional Characteristics:

- rub/buzz + meta-hearing
- 2<sup>nd</sup>-5<sup>th</sup> harmonic distortion
- Voice coil offset  $X_{\text{offset}}$  in mm
- Stiffness asymmetry  $A_K$  in %



## 联系方式

## Contact

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Many thanks !很多謝謝!~

