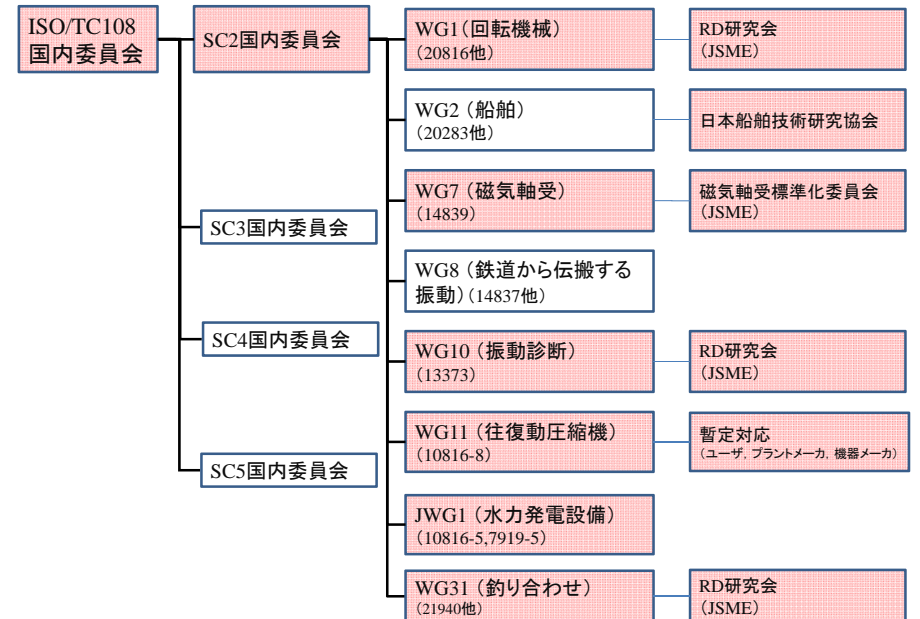
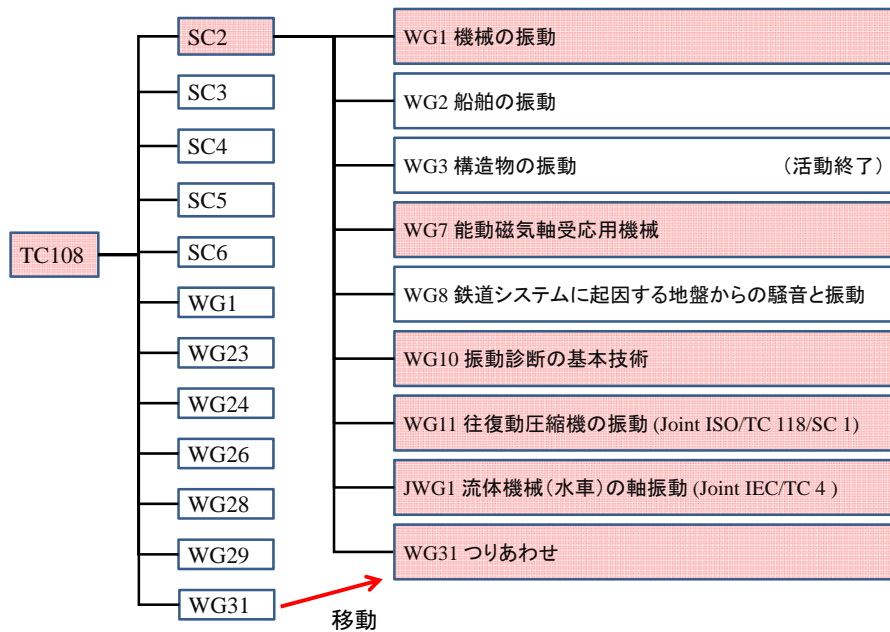
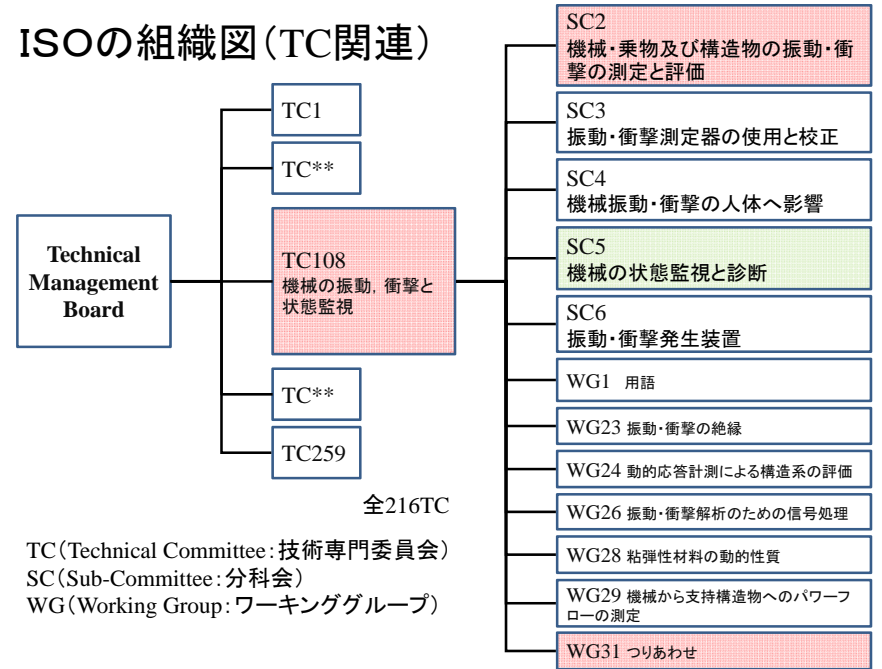


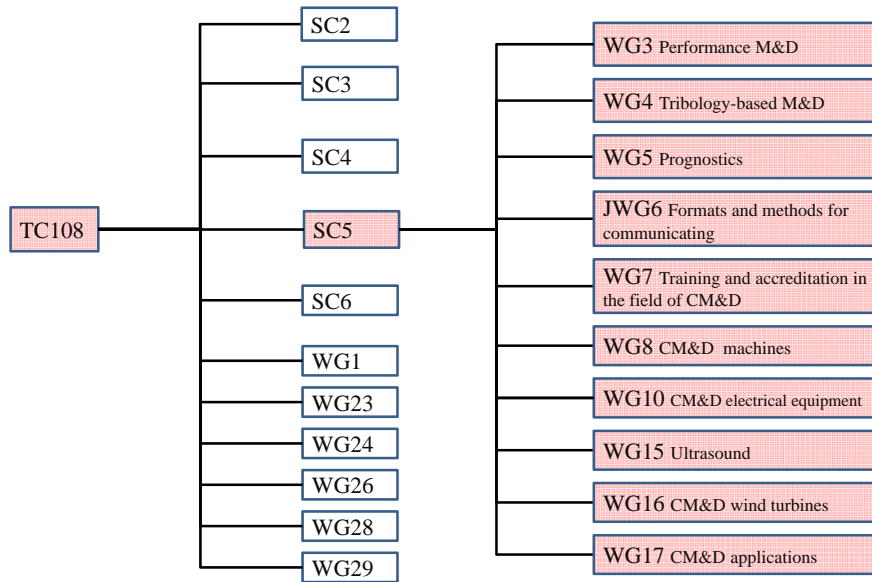
# ISO TC108の変遷と動向 (TC108/SC2を中心に)

ISO TC108/SC2 国内委員会 委員長

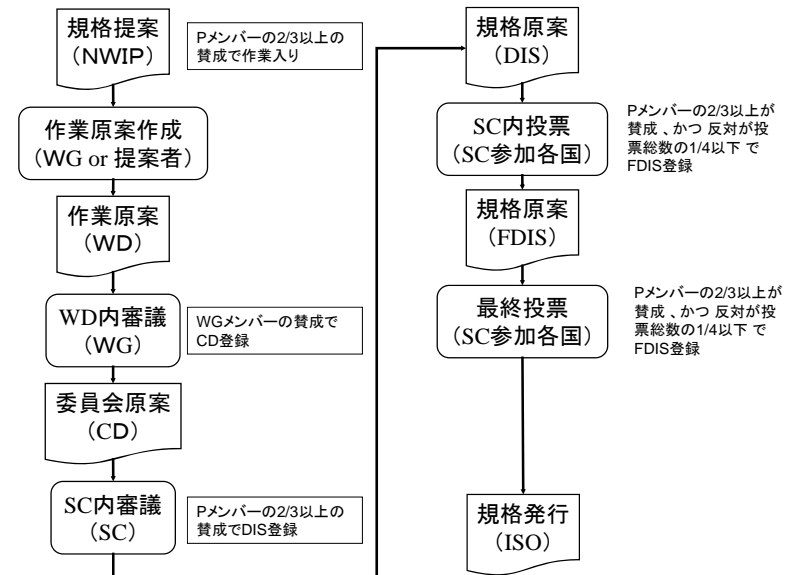
本井久之 (株) IHI 基盤技術研究所

## ISOの組織図(TC関連)





## ISOの規格成立過程



### ISOの立場(決して強要されるものではない)

The specific value is often set by mutual agreement between the supplier and purchaser.

Such specifications shall be subject to agreement between the machine manufacturer and customer.

The following definitions apply in understanding how to implement an ISO International Standard and other normative ISO deliverables (TS, PAS, IWA).

- "shall" indicates a requirement
- "should" indicates a recommendation
- "may" is used to indicate that something is permitted
- "can" is used to indicate that something is possible, for example, that an organization or individual is able to do something

### SC2/WG1 Mechanical vibration

ISO 4863:1984 Resilient shaft couplings -- Information to be supplied by users and manufacturers

ISO 7919 -- Evaluation of machine vibration by measurements on rotating shafts -- Part 1:1996 General guidelines

Part 2:2009 Land-based steam turbines and generators >50 MW, 1500,1800,3000,3600 r/min

Part 3:2009 Industrial machines >15 kW, 120 - 15000 r/min when measured in situ

Part 4:2009 Gas turbine sets with fluid-film bearings

ISO 10816 -- Evaluation of machine vibration by measurements on non-rotating parts

Part 1:1995 General guidelines

Part 2:2009 Land-based steam turbines and generators >50 MW, 1500,1800,3000,3600 r/min

Part 3:2009 Industrial machines >15 kW, 120 - 15000 r/min when measured in situ

Part 4:2009 Gas turbine sets with fluid-film bearings

Part 6:1995 Reciprocating machines with power ratings above 100 kW

Part 7:2009 Rotodynamic pumps for industrial applications, including measurements on rotating shafts

Part 21:2013 Horizontal axis wind turbines with gearbox

ISO/TR 19201:2013 -- Methodology for selecting appropriate machinery vibration standards

ISO 22266 -- Torsional vibration of rotating machinery --

Part 1: Land-based steam and gas turbine generator sets in excess of 50 MW

## SC2/WG1 関係の近年の話題

ISO7919とISO10816の1～5を統合し

ISO20816シリーズとする作業を実施中(以下が発行準備中)

ISO 20816 - Measurement and evaluation of machine vibration –

ISO 7919-1 & ISO 10816-1 ⇒ ISO 20816-1:2016

Part 1: General Guidelines

ISO 7919-2 & ISO 7919-4 & ISO 10816-2 & ISO 10816-4 ⇒ ISO/DIS 20816-2

Part 2: Land-based gas turbines, steam turbines and generators in >40 MW, with fluid-film bearings

ISO 7919-5 & ISO 10816-5 ⇒ ISO/DIS 20816-5

Machine sets in hydraulic power generating and pump-storage plants

part3については未定()

他のパートは7919が無いため、改定はされないが、re-numberingされる可能性はある

## SC2/WG2 Mechanical vibration -- Measurement of vibration on ships

ISO 6954:2000 Guidelines for the measurement, reporting and evaluation of vibration with regard to habitability on passenger and merchant ships

ISO 20283 Measurement of vibration on ships

Part 2: Measurement of structural vibration

Part 3: Pre-installation vibration measurement of shipboard equipment

Part 4: Measurement and evaluation of vibration of the ship propulsion machinery

Part 5: Measurement, evaluation and reporting of vibration with regard to habitability on passenger and merchant ships

## SC2/WG3 Mechanical vibration -- Vibration of fixed structures, buildings, ...

ISO 4866:2010 Vibration of fixed structures -- Guidelines for the measurement of vibrations and evaluation of their effects on structures

ISO 10055:1996 Vibration testing requirements for shipboard equipment and machinery components

ISO/TS 10811 Vibration and shock in buildings with sensitive equipment

Part 1:2000 Measurement and evaluation

Part 2:2000 Classification

ISO 14963:2003 Guidelines for dynamic tests and investigations on bridges and viaducts

ISO 18649:2004 Evaluation of measurement results from dynamic tests and investigations on bridges

## SC2/WG7 Vibration of rotating machinery equipped with active magnetic bearings

ISO 14839 Vibration of rotating machinery equipped with active magnetic bearings

Part 1:2002 Vocabulary (改定作業中)

Part 2:2004 Evaluation of vibration

Part 3:2006 Evaluation of stability margin

Part 4:2012 Technical guidelines

## SC2/WG8 Ground-borne noise and vibration arising from rail systems

ISO 8002:1986 Land vehicles -- Method for reporting measured data

ISO 8608:1995 Road surface profiles -- Reporting of measured data

ISO 10815 Measurement of vibration generated internally in railway tunnels by the passage of trains

ISO 14837 Ground-borne noise and vibration arising from rail systems

Part 1:2005 General guidance

Part 31: Measurement for the evaluation of complaints at residential buildings

Part 32:2015 Measurement of dynamic properties of the ground

## SC2/WG10 Condition monitoring and diagnostics of machines

ISO 13373 Vibration condition monitoring

Part 1:2002 General procedures

Part 2:2016 Processing, analysis and presentation of vibration data

Part 3:2015 Guidelines for vibration diagnosis

Part 4: Diagnostic techniques for steam turbines

Part 5: Diagnostic techniques for fans and blowers

Part 6: Diagnostic techniques for gas turbines

Part 7: Diagnostic techniques for machine sets in hydraulic power generation and pump-storage plants

Part 8: Diagnostic techniques for industrial pumps

Part 9: Diagnostic techniques for electric motors

Part10: Diagnostic techniques for electric generators

Part11: Diagnostic techniques for gears

### 近年の話題

- ・13373シリーズはSC5からSC2へ移管
- ・WGのconvenerはAly El-Shaei
- ・part4以降はようやく審議入り. なかなか前に進まない
- ・内容としては教科書的なもの

## SC2/WG11 Reciprocating compressor systems

ISO 10816-8 Evaluation of machine vibration by measurements on non-rotating parts

Part 8:2014 Reciprocating compressor systems

### 近年の話題

- ・往復動圧縮機に関する振動規格として10816-6(往復動機械)から独立させた
- ・10816-6が主にレシプロエンジン向けだったものに対して, 圧縮機に特化させる.
- ・配管振動を含む
- ・SwRI(USA)が一人勝ち状態であったのに対しNederlandse Organisatie voor Toegepast Natuurwetenschappelijk Onderzoekが自分のシステムでISO化を狙った.
- ・改訂に関するバックデータが不足しているとして日本サイドは反対の立場であった(作業には参加)

## SC2/WG31 Mechanical vibration -- Rotor balancing

(21940シリーズとして再構築中)

ISO 1925:2001 Balancing -- Vocabulary

ISO 1940-1:2003 Balance quality requirements for rotors in a constant (rigid) state -- Part 1: Specification and verification of balance tolerances

ISO 11342:1998 Methods and criteria for the mechanical balancing of flexible rotors

ISO 19499:2007 Balancing -- Guidance on the use and application of balancing standards

ISO 21940 Mechanical vibration -- Rotor balancing

Part 2: Vocabulary

Part 11:2016 Procedures and tolerances for rotors with rigid behaviour

Part 12:2016 Procedures and tolerances for rotors with flexible behaviour

Part 13:2012 Criteria and safeguards for the in-situ balancing of medium and large rotors

Part 14:2012 Procedures for assessing balance errors

Part 21:2012 Description and evaluation of balancing machines

Part 23:2012 Enclosures and other protective measures for the measuring station of balancing machines

Part 31:2013 Susceptibility and sensitivity of machines to unbalance (旧10814(一部変更有(後述)))

Part 32:2012 Shaft and fitment key convention

SC2/JWG1 Machine sets in hydraulic power generating and pumping plants

ISO 7919 Evaluation of machine vibration by measurements on rotating shafts  
Part 5:2005 Machine sets in hydraulic power generating and pumping plants

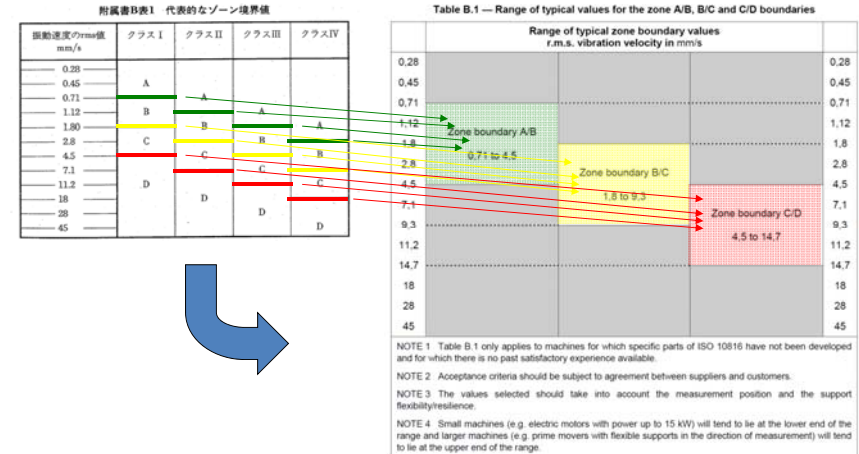
ISO 10816 Evaluation of machine vibration by measurements on non-rotating parts  
Part 5:2000 Machine sets in hydraulic power generating and pumping plants

ISO/DIS 20816 Mechanical vibration -- Measurement and evaluation of machine vibration  
Part 5: Machine sets in hydraulic power generating and pump-storage plants

近年の話題

・ISO7919-5とISO10816-5を統合しISO20816-5とする作業を実施中

トピックス:10816-1 に関する変更点



”〇と〇のゾーンの境界は Δ~Δmm/sRMSの間にあるべきである”  
と表現される。  
⇒-1の表にはほとんど意味は無く、  
-2以降の各規定の表のみに意味がある

トピックス:ISO10814-1 ⇒ ISO 21940-31 に関する変更点

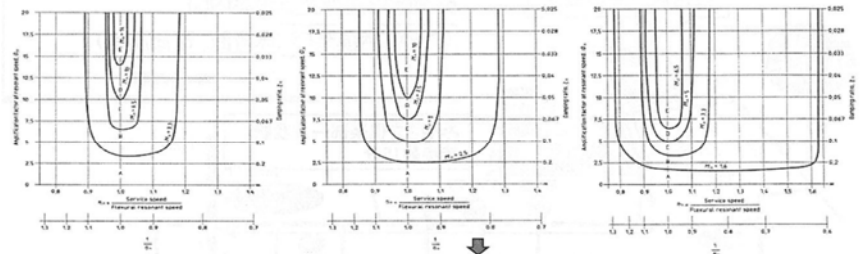
不つり合い振動感度 (ISO21940-31 (ISO10814廃版))

モーダル感度  $M_l = \frac{\eta_l^2}{\sqrt{(1-\eta_l^2)^2 + (2\zeta_l \eta_l)^2}}$   $\eta_l = \Omega / \omega_l$

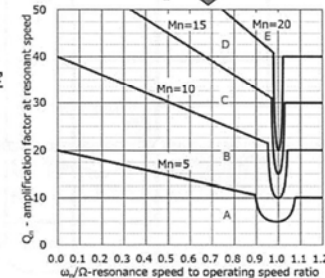
分類	回転機械の種類
Type I : Low Susceptibility	paper machine rolls, high-speed vacuum pumps
Type II : Moderate Susceptibility	pumps, electric armatures, gas and steam turbines, small turbo generators, turbo compressors
Type III: High Susceptibility	Centrifuges, fans, screw conveyors, hammer mills

Modal sensitivity range	運転条件の予想
A: Very low sensitivity	Very smooth resonant speed; difficult to detect
B: Low sensitivity	Smooth, low and stable vibrations
C: Moderate sensitivity	Acceptable, moderate and slightly unsteady vibrations
D: High sensitivity	Sensitive to unbalance; regular field balancing may be required
E: Very high sensitivity	Too sensitive to unbalance; to be avoided

モーダル感度の感度分類



- ・横軸逆数に変更
  - ・境界値2倍に緩和
  - ・回転数変化中のゾーン設定
- y切片4Mn, 傾き-2Mn

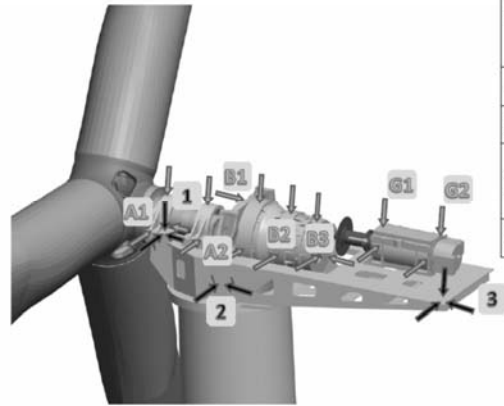


モーダル感度の境界値

Type	I	II	III
A/B	6.7	5.0	3.3
B/C	13.3	10.0	6.7
C/D	20.0	15.0	10.0
D/E	26.7	20.0	13.3

ISO21940-31

1企業または自国のシステムをISO化する動きが強まる傾向にある  
 (10816-21はドイツのコンサルティング会社が自社のシステムでISO化を狙った)

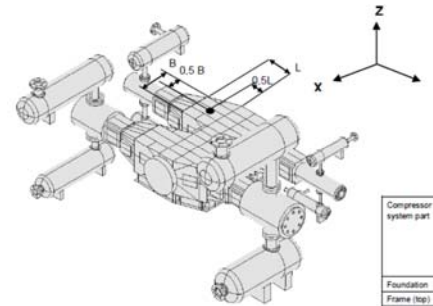


Wind turbine component	Assessment acceleration broad-band r.m.s. value in $m/s^2$ in the frequency band	
	Zone boundary B/C	Zone boundary C/D
Nacelle and tower	0,1 Hz to 10 Hz	
	0,3	0,5
Rotor with rolling element bearings	0,1 Hz to 10 Hz	
	0,3	0,5
Gearbox with rolling element bearings	0,1 Hz to 10 Hz	
	7,5	12
Generator with rolling element bearings	10 Hz to 5 000 Hz	
	10	16

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21

1企業または自国のシステムをISO化する動きが強まる傾向にある  
 (10816-8は国立研究機関(TNO)が自分のシステムでISO化を狙った。  
 (それまでは, SwRI(USA)が一人勝ち状態であった))



Compressor	
Record No.	Inspection date
Date	Measured by
Name of measurement system	
Compressor ID No.	Type/Serial No.
Type gas compressor (value)	Drive type
Number of cylinders (cylinder location)	Capacity (agreement)
Configuration (horizontal/vertical)	Load condition during measurement
Rated speed	Rated power
Rated speed	Rated speed
Mounting (up/down)	Analysis base point
Notes	
Name of test/measuring system	
Instrument make	Instrument model
Measurement unit	FFT or other processing means
Measurement unit location	Attachment
Measurement site condition	Shield condition (value)
Diagram	
Frequency of measurement (min./max.) should be detailed (ping locations of measurement) and the frequency of the test of measurement instrument	
Measurement or approval	

Compressor system part	r.m.s. vibration velocity values for horizontal compressors			r.m.s. vibration velocity values for vertical compressors		
	mm/s			mm/s		
	Evaluation zone boundary A/B	B/C	C/D	Evaluation zone boundary A/B	B/C	C/D
Foundation	2.0	3.0	4.5	2.0	3.0	4.5
Frame (top)	5.3	8.0	12.0	5.3	8.0	12.0
Cylinder (lateral)	8.7	13.0	19.5	10.7	16.0	24.0
Cylinder (rad)	10.7	16.0	24.0	8.7	13.0	19.5
Dampers	12.7	19.0	28.5	12.7	19.0	28.5
Piping	12.7	19.0	28.5	12.7	19.0	28.5

NOTE: For piping values of evaluation zone boundary C/D, see Table 1, Note 3.

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22

## ISO TC108/SC2 の全体的な流れ (個人的感想を含みます)

- ISO全体として商業的な流れにある  
 (議題の最後は"Next Business?")
- 1企業または自国のシステムをISO化する動きが強まる傾向にある  
 e.g. 10816-8, 10816-21, 18436
- 散逸していた旧規格を取りまとめる動きが多い  
 e.g. 7919&10816 -> 20816 1940&etc -> 21940
- 状態監視に踏み込む傾向  
 e.g. 10816