

## **MFER NWIP 22077-2 -3**

**Masato Tanaka 1)  
Satoshi Kobayashi 2)**

*MFER Committee  
1) Nihon Kohden Corp.  
2) Fukuda Denshi Co.,Ltd.*

*Oct.23 2013  
ISO/TC215 Health Informatics in Sydney*



### **Agenda**

- **ISO/TS 11073-92001 Health informatics –  
Medical waveform format -- Part 1: Encoding rules  
-> Renumber ISO/DIS 22077-1**
- **ISO/NP TS 22077-2 Health informatics –  
Medical waveform format Part 2  
Electrocardiography**
- **ISO/NP TS 22077-3 Health informatics –  
Medical waveform format Part 3 Long term  
electrocardiography**



## 22077-1 Supports Waveform

### ECG

- 12-lead Electrocardiography (included extended leads) **22077-2**
- Electrocardiography for a long time (Ambulatory ECG) **22077-3**
- **Stress electrocardiography (Stress ECG)**
- Late potential Electrocardiography
- Vector cardiography (VCG)
- Deriving inducement electrocardiography
- Intracardiac electrocardiogram and His bundle electrography
- Surface mapping ECG (Mapping ECG)

### EEG/EP/EMG

- Electroencephalograph (EEG)
- Sleep electroencephalogram (Sleep EEG)
- Electroencephalographs for declaration of brain death
- Evoked Potential/Electromyograph (EP/EMG)

### Monitoring

- Electrocardiography (ECG)
- ST Segment Electrocardiogram
- Continuous Blood pressure
- Pulse wave
- Respiration
- Impedance respiration
- Thermistor respiration
- Anesthetic and respiration gas
- SpO<sub>2</sub>,IBP,NIBP
- CO,CO<sub>2</sub>
- Temperature

### Other

- Spirometry
- Heart sound
- EOG
- Fetal heart sound
- Fetal electrocardiogram
- + others



**Medical waveform view.**



## Background

- **Medical waveform data such as an ECG or an EEG are widely utilized in physiological examinations, physiological research, electronic medical records (EMR), healthcare information and other areas in the clinical field.**
- **Medical waveform data can be used for many medical and research purposes if digital signal processing technology is applied to standardize the data in a digital format.**

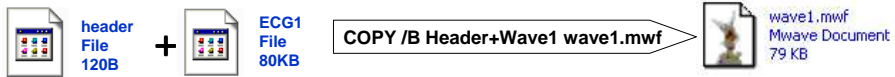
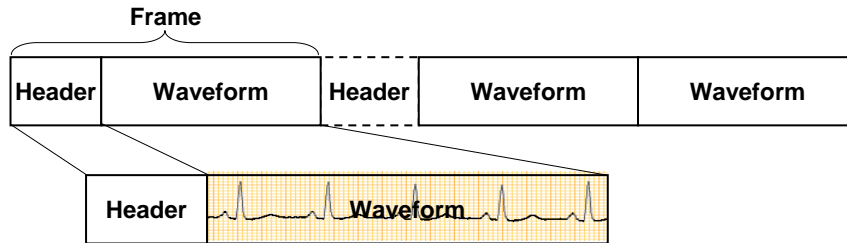


## Concept MFER

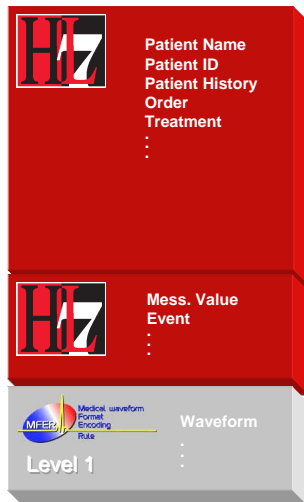
- **Simple and Easy Implementation**
- **Harmonization with Other Standards**
- **Separation of Waveform Data between Application and Provider**



## Simple and Easy MFER



## Harmonization with HL7



MSH|^~\&||LAB||Kohden|20050525||ORU^R01|mn256|T|2.4|||||~ISO IR87|JP|ISO 2022-1994 <cr>

PID||OPC-001|PID001||KOHDEN^TARO^L^A-KOHDEN^TARO^L^A^P||19500523|M <cr>

OBX||TX|9A100&IMP^ECG^JC10||Atrial fibrillation||AA||F| <cr>

OBX||RP|9A100IECG^JC10||../ecgdb.nk/H020923/01234.mwf||AA ||F|...<cr>

Level 2

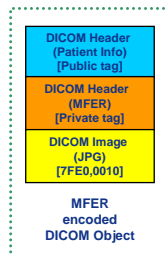
Level 1

Report information uses standards, such as HL7 CDA.

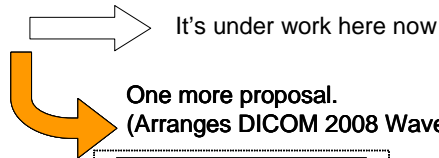


## Harmonization with DICOM

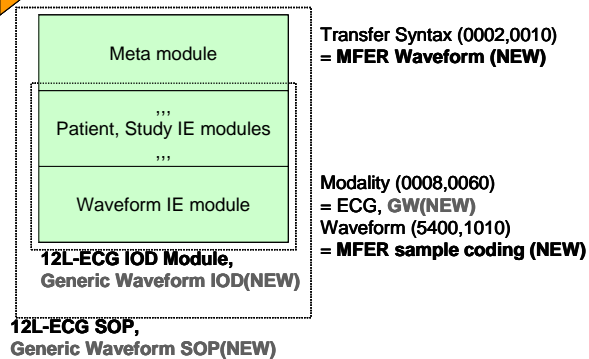
A present image of corresponding to MFER.



Japanese Market Example

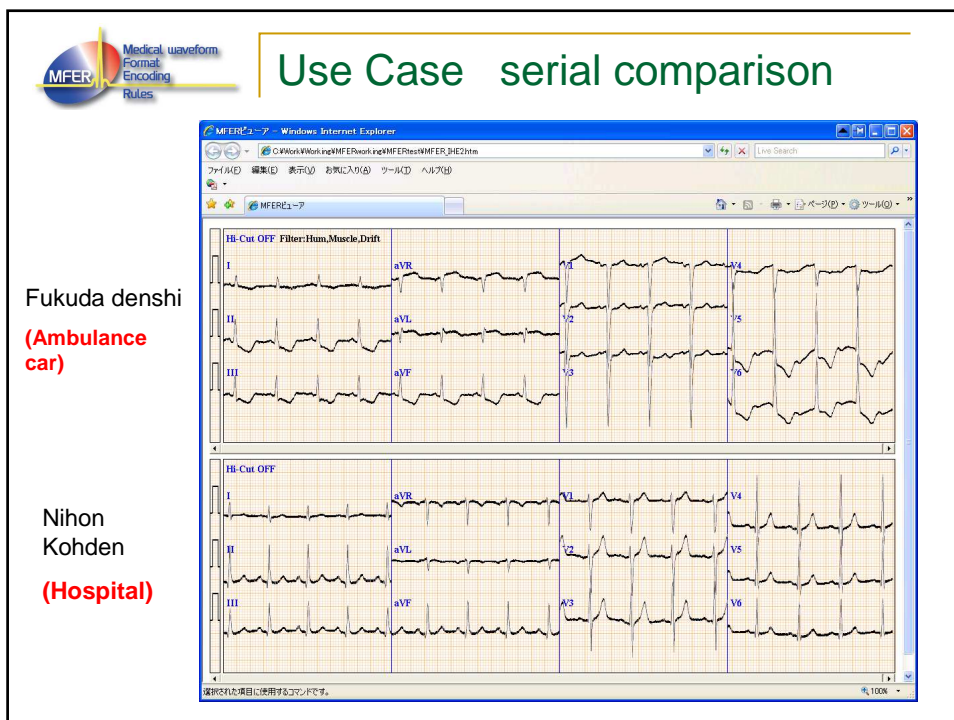
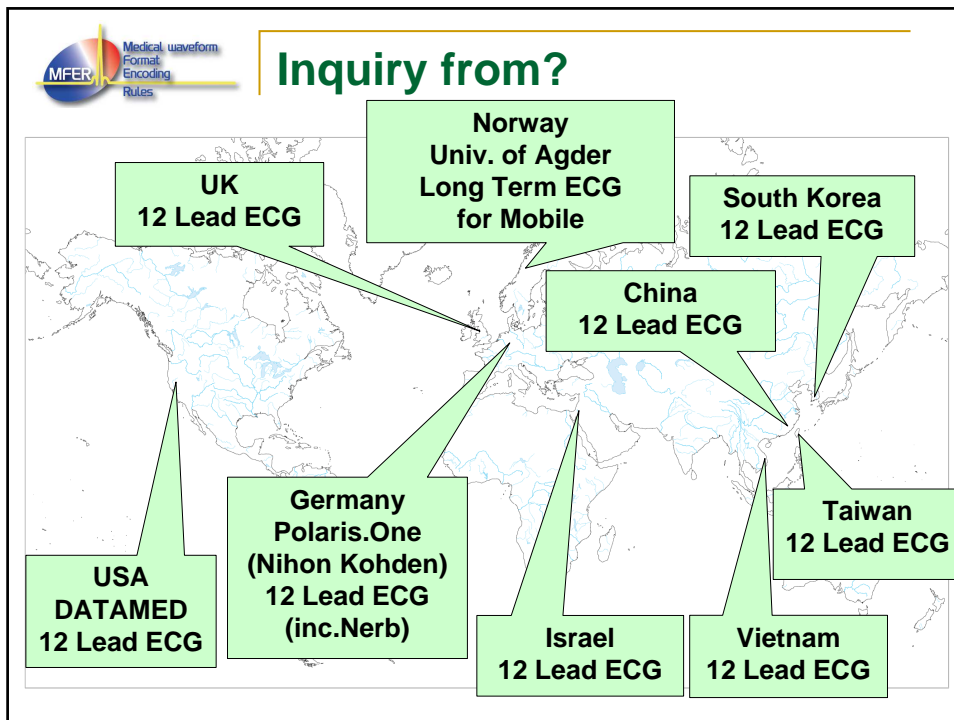


One more proposal.  
(Arranges DICOM 2008 Waveform for MFER)



## Current situation

- Japanese Ministry of Health, Labor and Welfare adopted MFER as recommended standard
- Japanese Society of Electrocardiography adopted MFER as standard of electrocardiogram
- MFER committee receives many inquiry about adoption of MFER from around the world.





## **ISO/NP TS 22077-2**

---

### **Medical waveform format Part 2**

### **Electrocardiography**



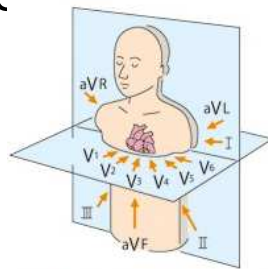
### **Many estimated ECG**

- **It was estimated that more than 12 million was recorded in 2010 year in the clinic and the hospital in Japan.**
- **In 1993, it was estimated that more than 100 million standard ECGs are recorded yearly in the European Community.**

**(ISO 11073-91064:2009)**

## Scope of Electrocardiography

- Electrocardiography such as 12-lead, 15-lead, 18-lead, Cabrera lead, Nehb lead, Frank lead, XYZ lead



ISO/TS NP 22077-2

## Overview of the rules

- **ECG Waveform Encoding**
- **Non-ECG waveform data**
  - **Measuring conditions** (ex. Filter characteristic)
  - **Measurement value** (ex. HR, QT Interval)

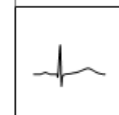
ISO/TS NP 22077-2





## Waveform Encoding

- Standard 12-lead ECG is shown by MWF\_WFM waveform class.
- Waveform class is specified as follows:
  - ECG\_STD12 Standard 12-lead ECG  
Standard 12-lead ECG including general ECG in short term recording.
  - Extracted waveform
    - ECG\_BEAT QRS beat  
In general, one heart beat waveform extracted from standard
    - ECG\_DRV Derived lead  
Derived ECG from Frank vector leads, EASI lead, etc



ISO/TS NP 22077-2



## Other Informatics

- Filter Information
  - Tag : MWF\_FLT
  - Value: "HPF=0.05" (High freq. pass filter, cutoff =0.05Hz)  
"BEF=50^HumFilter" (50Hz Hum filter)
- Measurement Value
  - Tag : MWF\_VAL
  - Value code : MWF\_ECG\_HEART\_RATE
  - Time point : sampling number from waveform start point .
  - String : "60^bpm"  
( Heart rate = 60bpm )

ISO/TS NP 22077-2



## ISO TS NP 22077-3

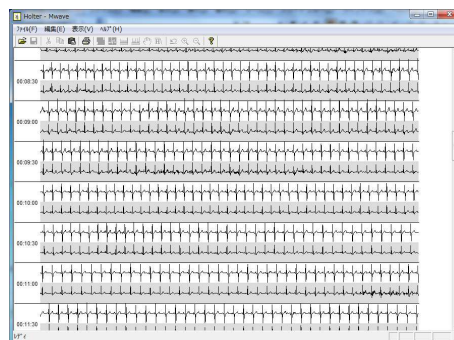
### Medical waveform format Part 3 Long term electrocardiography

ISO/TS NP 22077-3



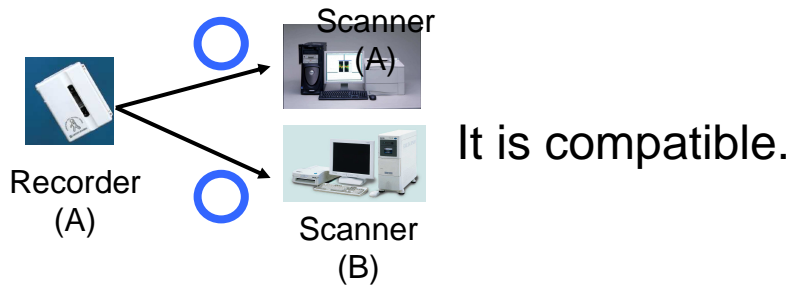
## Scope of Long term ECG

Electrocardiography such as bipolar 2, 3-lead, 12-lead that are measured by medical equipment such as ambulatory ECG examination and patient physiological monitors.

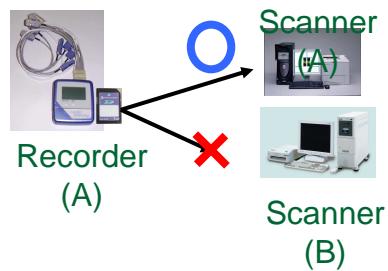


ISO/TS NP 22077-3

## Tape Holter Recorder ECG



Vender depend



ISO/TS NP 22077-3

## Why use MFER for Holter ECG

	Analog	Digital
Media	Cassette Tape	IC memory (SD, MMC card etc.)
Dimension	200 ~ 300 g	35 ~ 100 g
Weight	270 ~ 320 cm <sup>3</sup>	30 ~ 100 cm <sup>3</sup>
Disposible	Tape, mechanical parts	No
Frequency	0.2 ~ 35 Hz	0.05 ~ 40 Hz
Future extension	NO more	More
Compatibility	Direct recording with sync. (32 Hz)	No compatibility
Quality Equability	Poor quality (wow and flutter) (Irregular speed, Polluted head)	Good quality
Archiving	Cassette tape	Easy archiving



## When MFER was used

- Users can use the combination of the favorite recorder and the scanner.
- Pacemaker spike and patient event can be dealt with except for ECG.

ISO/TS NP 22077-3



## More information

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
0	0	0	0	0	1	0	1	0	0	0	0	0	1	0	1

Body position    Event    monitoring    Pacing

bit 0 : Pacing

bit 2 : Ventricular pacing

bit 3 : Atrial pacing

bit 5 : Cheng Battery

bit 6 : Electrode confirmation

bit 7 : Radio field strength

bit 8~9 : Patient event 1,2

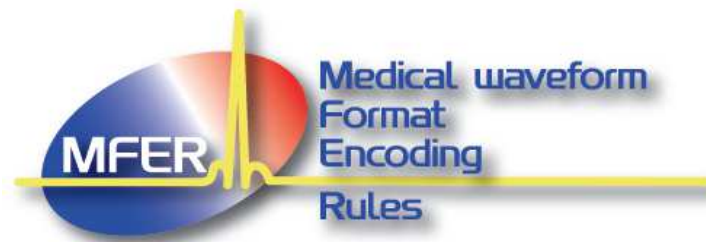
bit 10~12 : Body position

bit 1, 4, 13,14,15 : Reserved

For telemetry monitoring

000: none  
 001: Standing/ Seating  
 010: Supine  
 011: Right lateral decubitus  
 100: Left lateral decubitus  
 101: Prone  
 110: Reserved  
 111: Reserved

ISO/TS NP 22077-3



## Information

### Stress Test Electrocardiography



## Scope of Stress Test ECG

- A scope is about the electrocardiography in stress testing by exercise or using medicine.





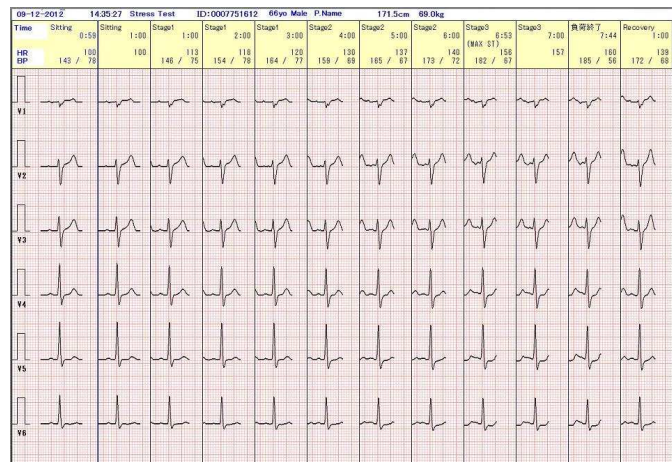
## The feature of Stress Test ECG

- In a stress test, a time series compares change of each ECG the time of before applying load, having applied load, and having recovered.
- By applying load to the heart, an ischemic disease and the arrhythmia which appears at the time of exercise can be found.



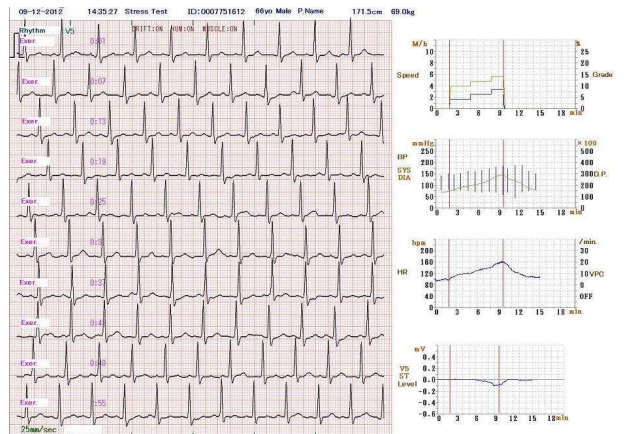
## Report of STRESS TEST

- Average wave for ECG changes



## Report of STRESS TEST

- Full-disclosure wave
- Load information, etc.



## Interoperability

- After the treatment of cardiac disease, in order to evaluate the recovery condition of cardiac function, it is required to refer former ECG data.
- The present system has too strong the originality of each vendor, and it has obstructed interoperability.
- The standard of waveform and load information in stress test is required.



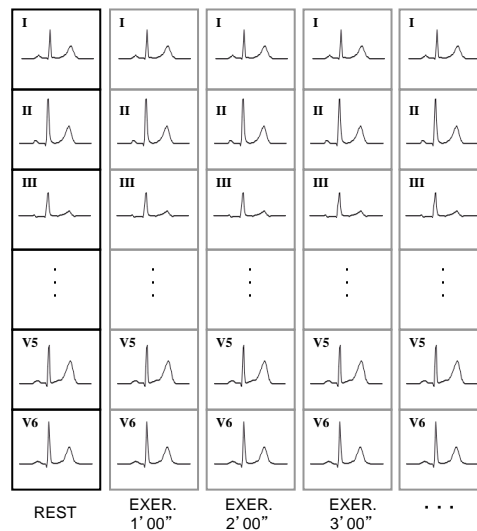
## MFER for stress test

- Extracted beat waveform
- Full disclosure waveform
- Intermittent record waveform
- Event record waveform
- Execution information on load
- Other biological information (Blood pressure, SpO2, etc...)



## Extracted beat waveform

- In order to diagnose ischemia, a serial comparison of ST segment of extraction ECG waveform is referred.







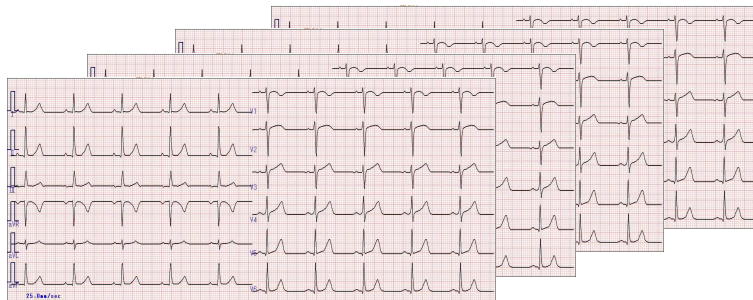
## Full disclosure waveform

- The full disclosure waveform under stress test is recorded.
- This description method is the same as the long term ECG (TS22077-3).



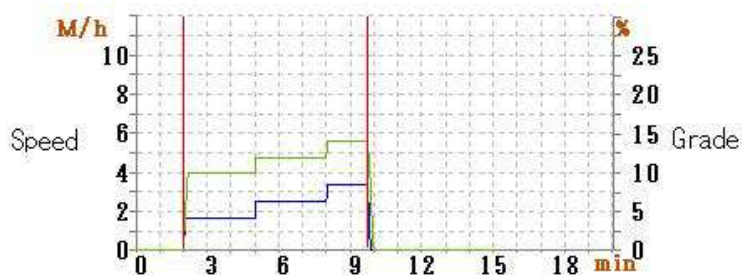
## Intermittent record waveform

- For example, 12 lead ECG is recorded every other minute during an examination.
- This description method is the same as the electrocardiography (TS22077-2).



## Execution information on load

- The speed and grade of a treadmill, the watt and rotations of a bicycle ergometer, etc. are described as waveform data.



## Conclusion

- MFER can describe **all medical waveforms**.
- MFER is very simple and guarantees **interoperability**.
- MFER can be used for **multi purpose** such as EMR, research, database and so on.
- Suitable for other waveform description  
(introduces Stress Test)
- ISO/TS NP 22077-2 Electrocardiography
- ISO/TS NP 22077-3 Long term electrocardiography

**ISO/TS NP 22077-2 -3 Need Expert!**  
**Please entry Participation.**



## Basic policy of MFER

- **MFER does not disturb good features of each product by according with MFER specification.**
- **MFER should easily translate stored past data on databases to new data in MFER, current data including future new waveforms will be still described in MFER.**
- **MFER does not exclude other rules.**



## Medical waveform rules

- **HL7** (Health Level Seven)
  - **Text String**
- **DICOM** (Digital Imaging and COmmunications in Medicine)
  - **Catheterization waveform**
- **SCP-ECG**  
(Standard Communication Protocol computer assisted electrocardiography)
  - **Standard 12-Lead ECG**
- **ISHNE** (International Society for Holter and Noninvasive Electrocardiology)
  - **Holter ECG**
- **EDF, EDF+** (European Data Format)
  - **EEG, Medical waveform**
- **X73 (IEEE1073,IS11073)**
  - **Monitoring waveform ( ex.ICU,CCU)**
- **ASTM E1467-94**  
(Standard Specification for Transferring Digital Neurophysiological Data Between Independent Computer System)
  - **EEG**