HONG KONG
ASIAWORLD-EXPO
亞洲國際博覽館

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Hong Kong Experience in Control of Wet Pack through Scientific Approach

Name: Teddy LEE (teddy@hkssma.org)

Affiliation: Vice Chairman, HKSSMA

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- Introduction
- Common Cause of Wet Pack
- Physic of Steam Sterilization
- Wet Load Strategy
- Management Aspects for Wet Pack Prevention

新界西·醫院聯網
New Territories West Cluster

醫院管理局
HOSPITAL AUTHORITY

As at 31 March 2022		Hospital / Institution	Specialist Outpatient Clinic	General Outpatient Clinic
1	Castle Peak Hospital	✓	✓	
2	Pok Oi Hospital ✚	✓	✓	
3	Siu Lam Hospital	✓		
4	Tin Shui Wai Hospital ✚	✓	✓	
5	Tuen Mun Hospital ✚	✓	✓	
6	Tuen Mun Eye Centre		✓	
7	Kam Tin Clinic			✓
8	Madam Yung Fung Shee Health Centre			✓
9	Tin Shui Wai (Tin Yip Road) Community Health Centre			✓
10	Tin Shui Wai Health Centre (Tin Shui Road)			✓
11	Tuen Mun Clinic			✓
12	Tuen Mun Wu Hong Clinic			✓
13	Yan Oi General Out-patient Clinic			✓
14	Yuen Long Jockey Club Health Centre			✓

SSD in Hospital	No of OT	Hospital Bed	Monthly average Instrument Reprocess (per set)	Remarks
Tuen Mun Hospital	22	2100	7100	2 Psy (~1600beds)
Pok Oi Hospital	10	800	4500	
Tin Shui Wai Hospital	4+3	300	2600	3 Remote Theaters + 9 OPDs

A. Introduction

- Wet loads can be defined in different ways depends on where moisture can be found

- If water is present in the load, even if the outer packaging is not wet at the time of inspection, it could contaminate the packaging and render it transparent to microbial penetration

(HTM 01-01, Part C)

- Provide a pathway for microorganism to enter the just sterilized pack (Threat of wet pack)

B. Common Cause of Wet Pack

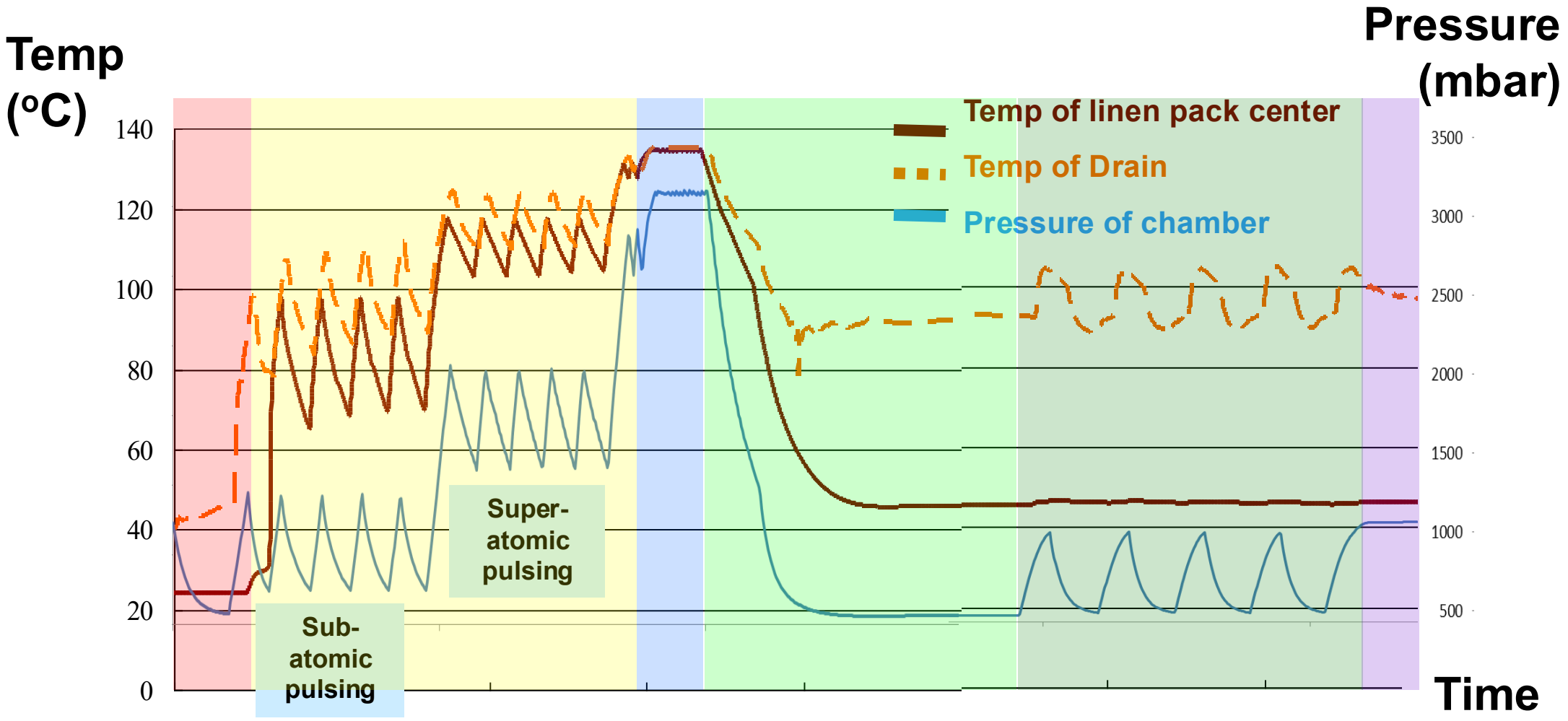
1. Excessive moisture content in steam (Wet steam)
2. Mal-function of vacuum pump
3. Mal-function of steam trap
4. Use correct steam traps located and maintained correctly
5. Inadequate insulation of steam pipes
6. Poor packing configuration
7. Over-weight of sterile pack
8. Over-load of sterile pack

B. Common Cause of Wet Pack

9. Improper loading of sterilization cart – condensate drain to the pack at lower level
10. Improper cooling of sterilized load
11. Mixed load
12. Accumulation of condensate on one location inside the pack
13. Inadequate conservation of heat energy for drying
14. Inadequate drying time
15. The temperature for cooling water used in the vacuum pump exceeding 15 °C as recommended by EN 285

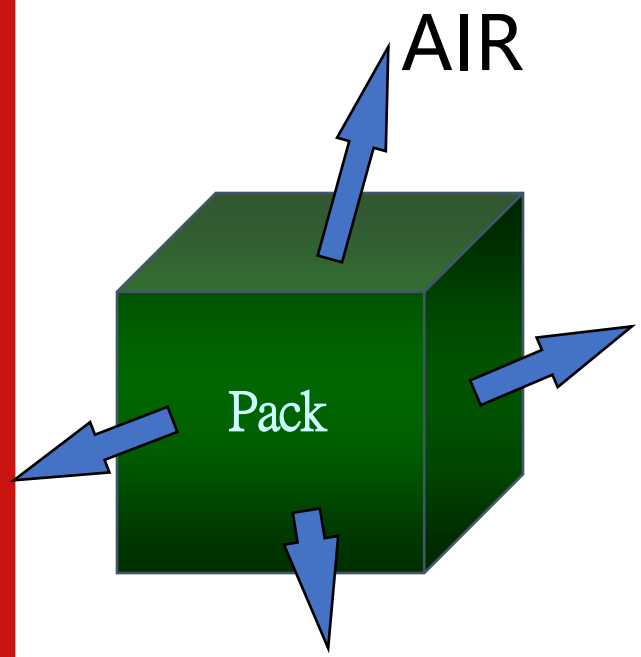
C. Physic of steam sterilization

Sterilization cycle

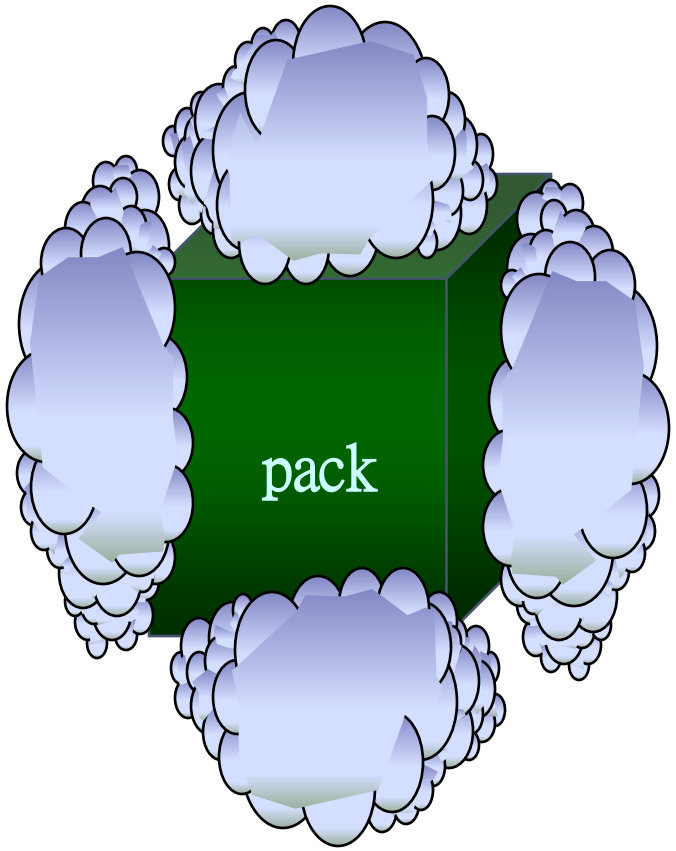


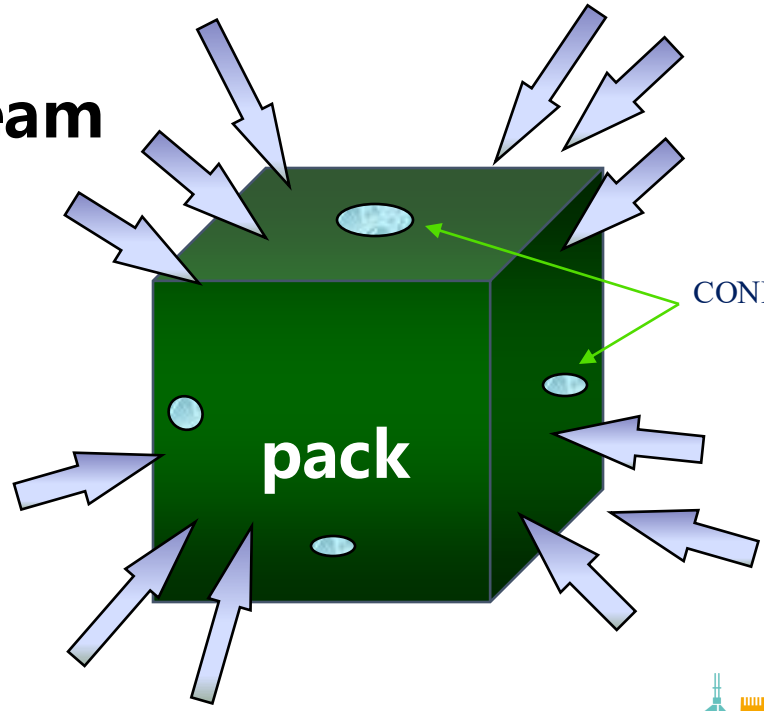
Pulsing Stage

Air Removal

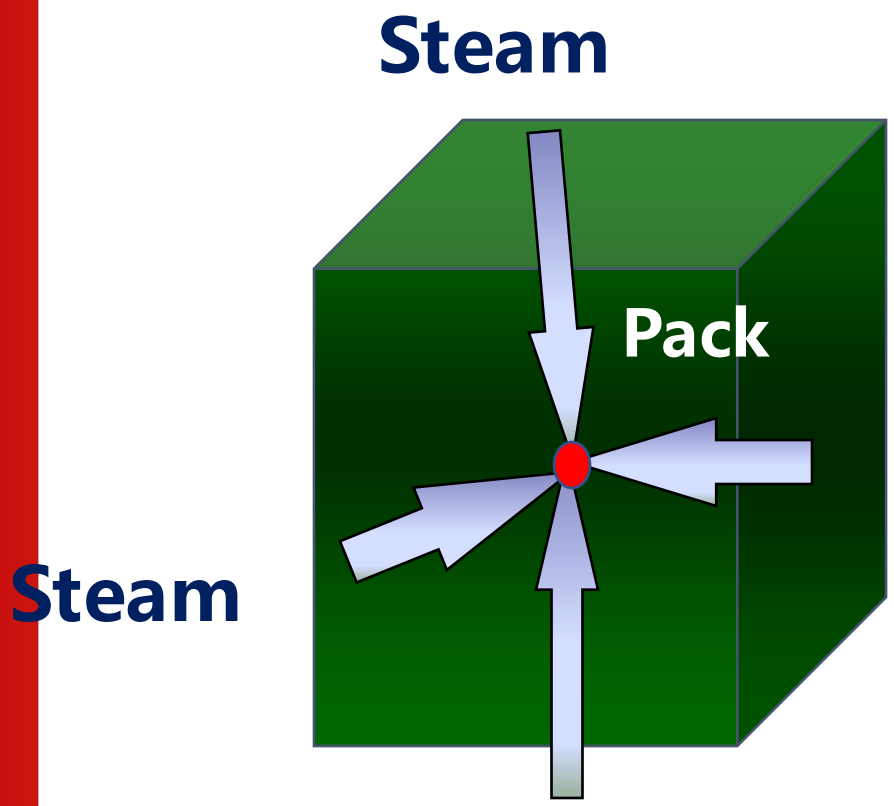


Steam Admission

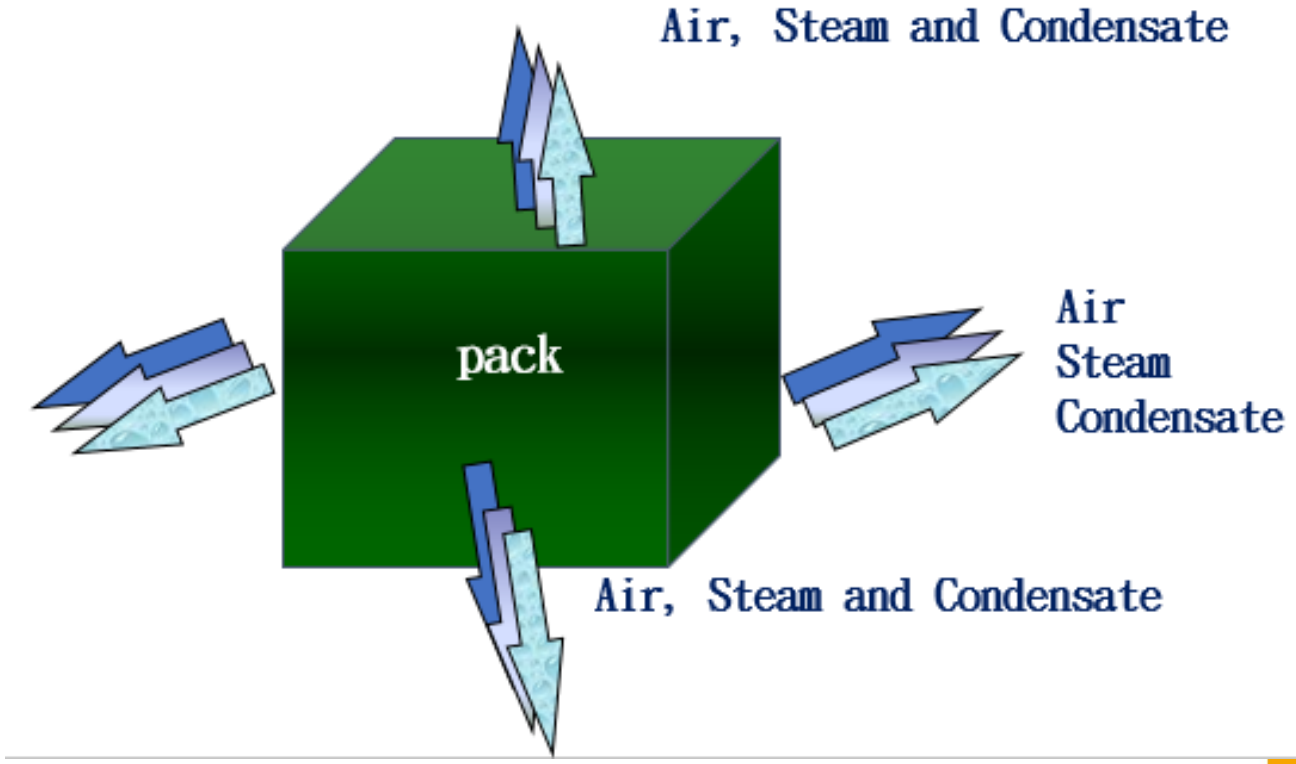




Sterilization



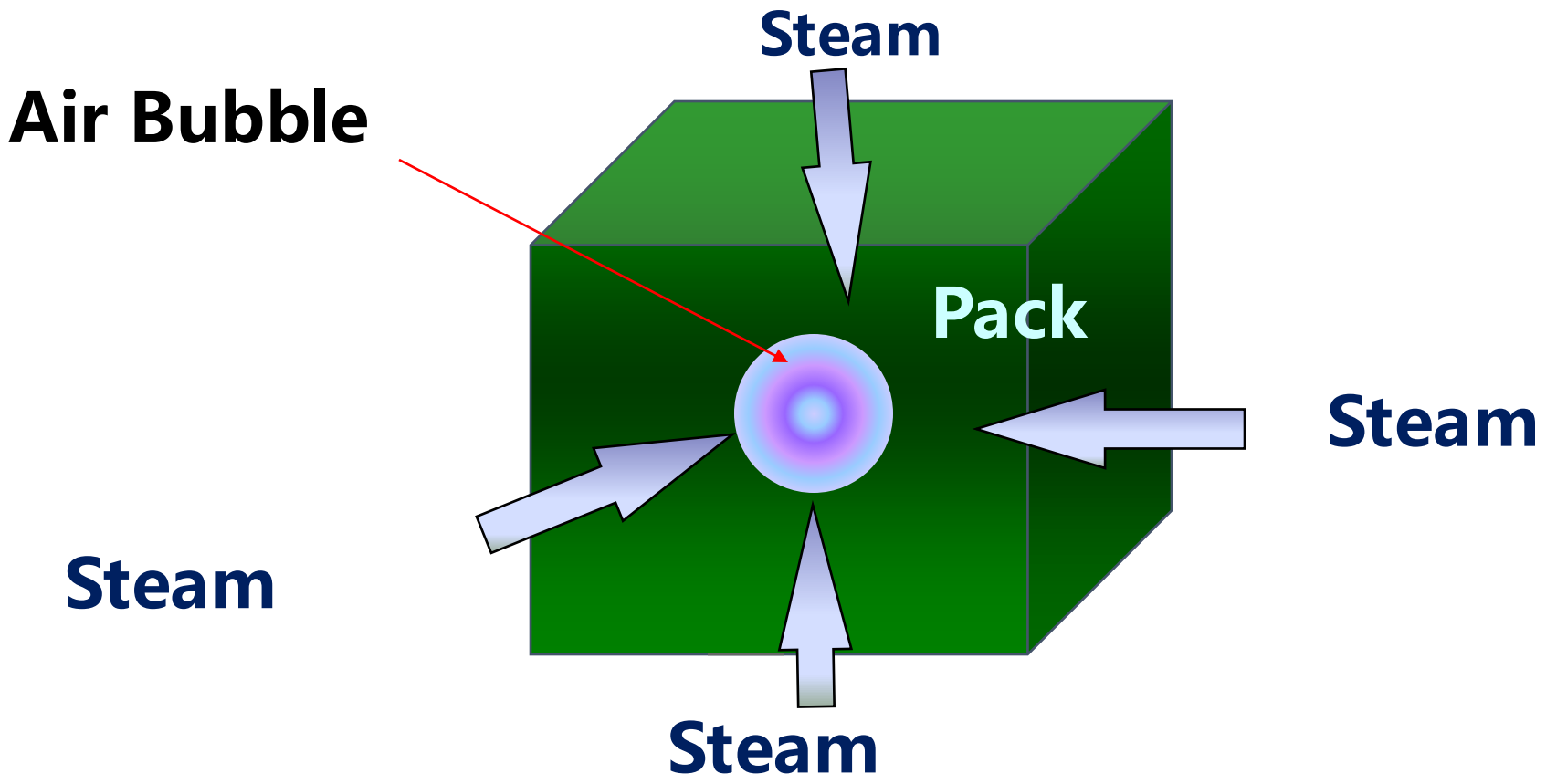
Drying



- Less than 3.5% of air (EN285 2015 13.3.1)

Steam Sterilization Cycle - Failure

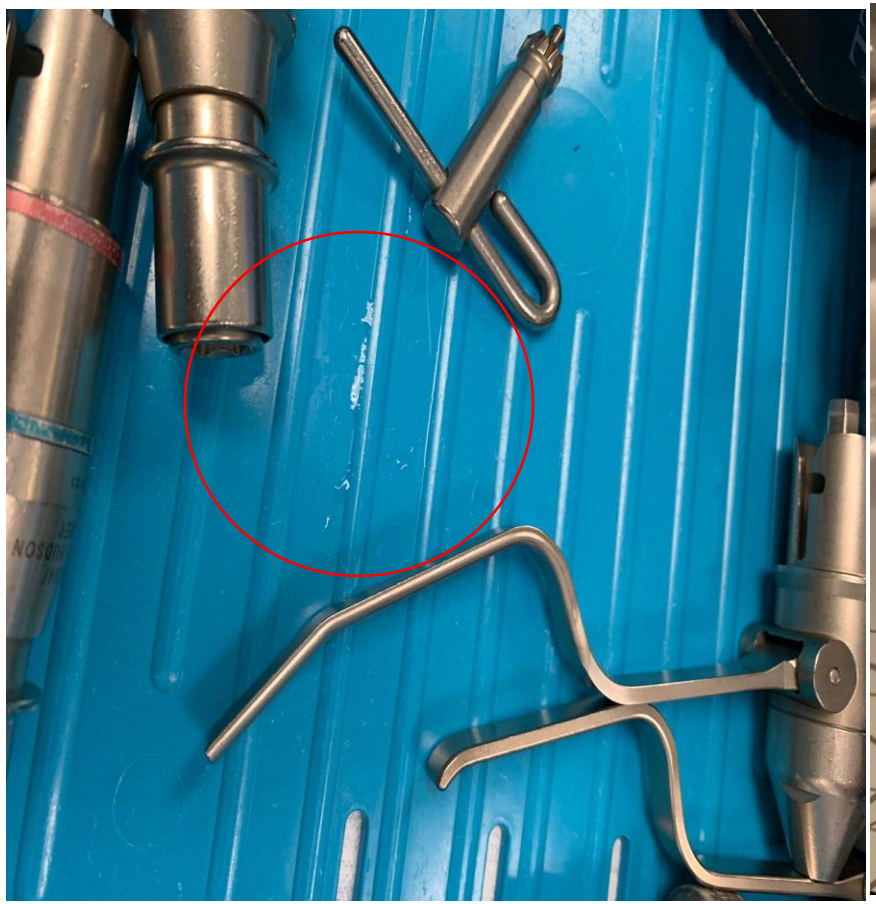
- Poor steam quality or air leakage in the sterilizer causing insufficient air removal
- Air can lurk in the center of the package and hinder sterilization

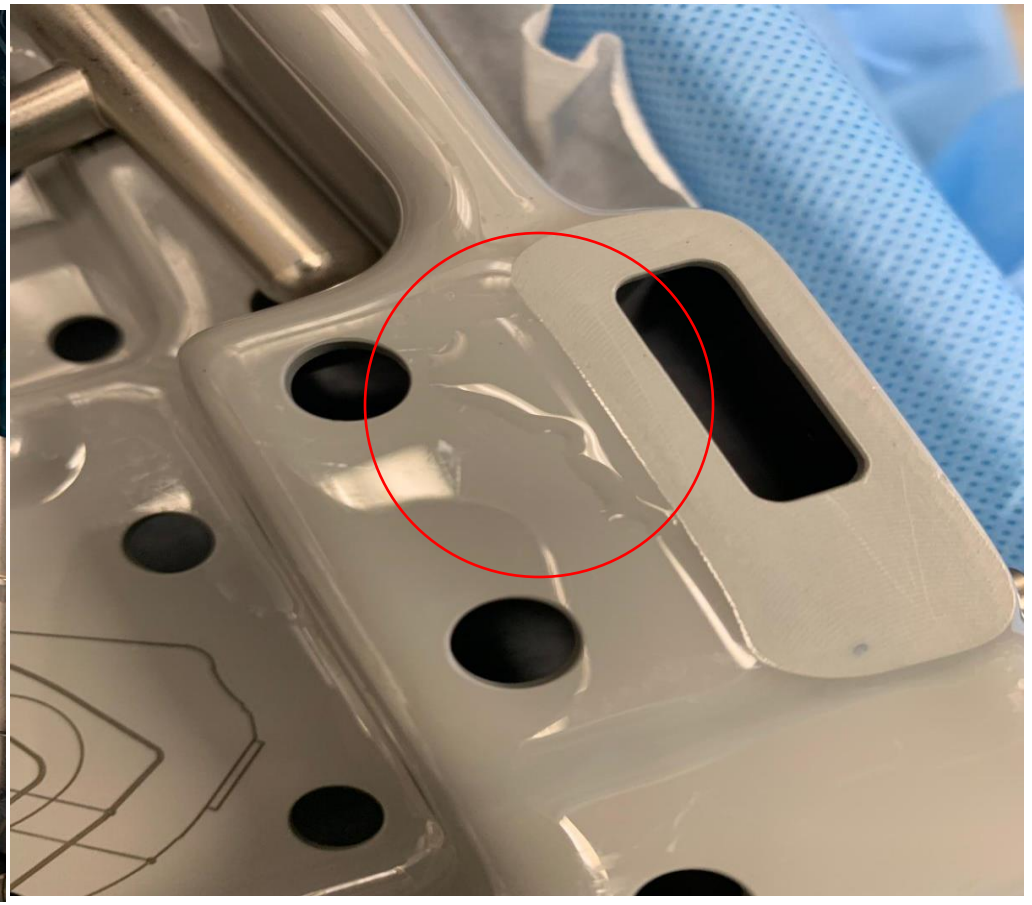


Wet Pack Prevention

Don’t remain sterile items in sterilizer for drying

Conservation of Heat Energy for Drying





Plastic bottom have little heat energy to convert condensate to steam

Conservation of Heat Energy for Drying

- **During drying phase, the condensate accumulated on the hot metal surface will be vaporized to become steam which expanses its volume (1:1694 at 1 bar).**

Steam

Condensate Vaporized and Expanded Out

Smallest size container

- **Size: 254mm x 258mm x 75mm**
- **Volume = 4914.9 cm^3**
- **Condensate change to steam volume ratio is 1:1690 at 1 bar = 100 ^oC**
- **Assume all condensate vaporized. 4914.9 cm^3 /1694 = 2.9 cm^3 condensate**

Physical Properties of Saturated Steam

Absolute pressure	Boiling Point	Specific Volume (steam)	Density (steam)	Specific Enthalpy of Liquid Water(sensible heat)	Specific Enthalpy of Steam(total heat)	Latent heat of Vaporization
(bar)	(°C)	(m^3/kg)	(kg/m^3)	(kJ/kg)	(kJ/kg)	(kJ/kg)
0.02	17.51	67.006	0.015	73.45	2533.64	2460.19
0.1	45.83	14.675	0.068	191.84	2584.78	2392.94
0.2	60.09	7.65	0.131	251.46	2609.86	2358.4
0.3	69.13	5.229	0.191	289.31	2625.43	2336.13
1[1)]	99.63	1.694	0.59	417.51	2675.43	2257.92
2	120.23	0.885	1.129	504.71	2706.29	2201.59
3	133.54	0.606	1.651	561.44	2724.66	2163.22
3.5	138.87	0.524	1.908	584.28	2731.63	2147.35
5	151.85	0.375	2.669	640.12	2747.54	2107.42

1) = 1 bar abs = 0 bar gauge = 100 kPa abs = atmospheric pressure

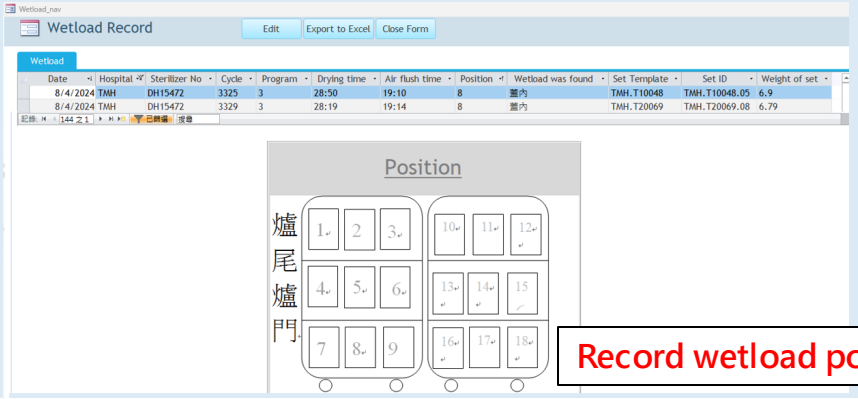
Condensate Vaporized and Expanded Out

- **Condensate change to steam volume ratio is 1:7650 at 60°C**
- **Assume all condensate vaporized. 4914.9 cm^3 /7650 = 0.64 cm^3 condensate**
- **At 100 °C with 2.9 cm3 condensate = 97% - 100% relative humidity**
- **At 60°C with 0.64 cm3 condensate = 0.64 / 2.9 = 22% relative humidity. Consideration should be calculated relative humidity of the filter air for balancing the pressure at the end of the sterilization cycle.**

Smallest size container (shown as image)

D. Wet Load Strategy

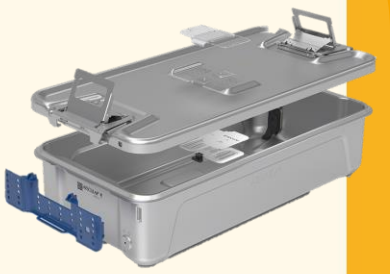
1) Record and analysis (repack if wet)



Record wetload position and parameter

2)Content Organize

A. Change Container



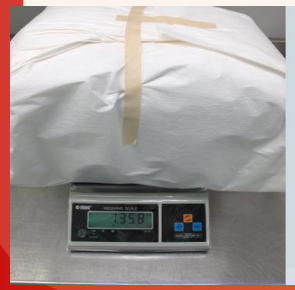
B. Remove low height capacity items

C. Weight Control

≤15KG

D. Minimize graphic tray

3)Load Dryness Test



$$\Delta m = \frac{(m_2 - m_1)}{m_1} \times 100\%$$

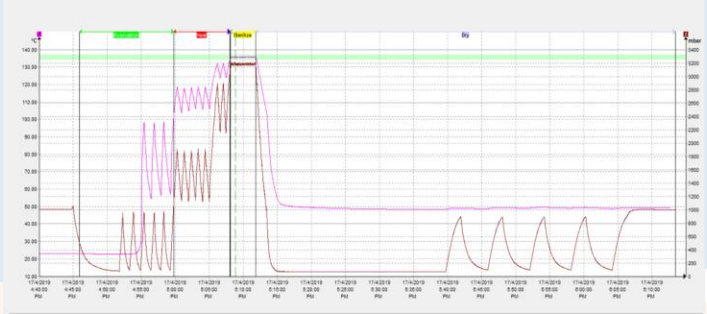
Weight Comparison

EN285

D. Wet Load Strategy

4. Optimal Drying Stage

- Extended drying time (e.g. <20min)
- Air Flush after Normal Sterilization Process

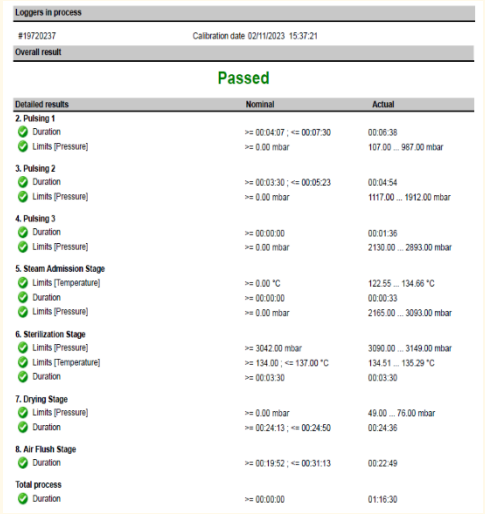


6. Use of absorbent liner

- Increase surface area of the condensate and easy to absorb energy
- Hide the wet pack problems

5. Vacuum Pressure Performance

Compare the vacuum pressure for assuring the efficacy of pump

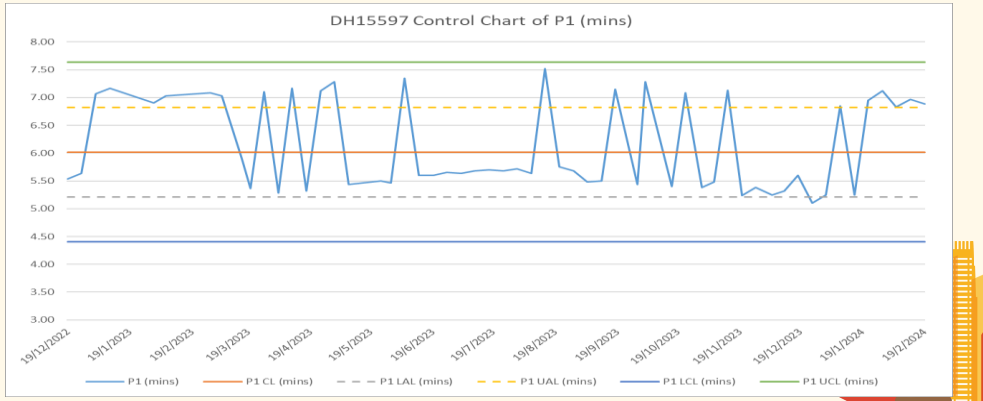


Loggers in process

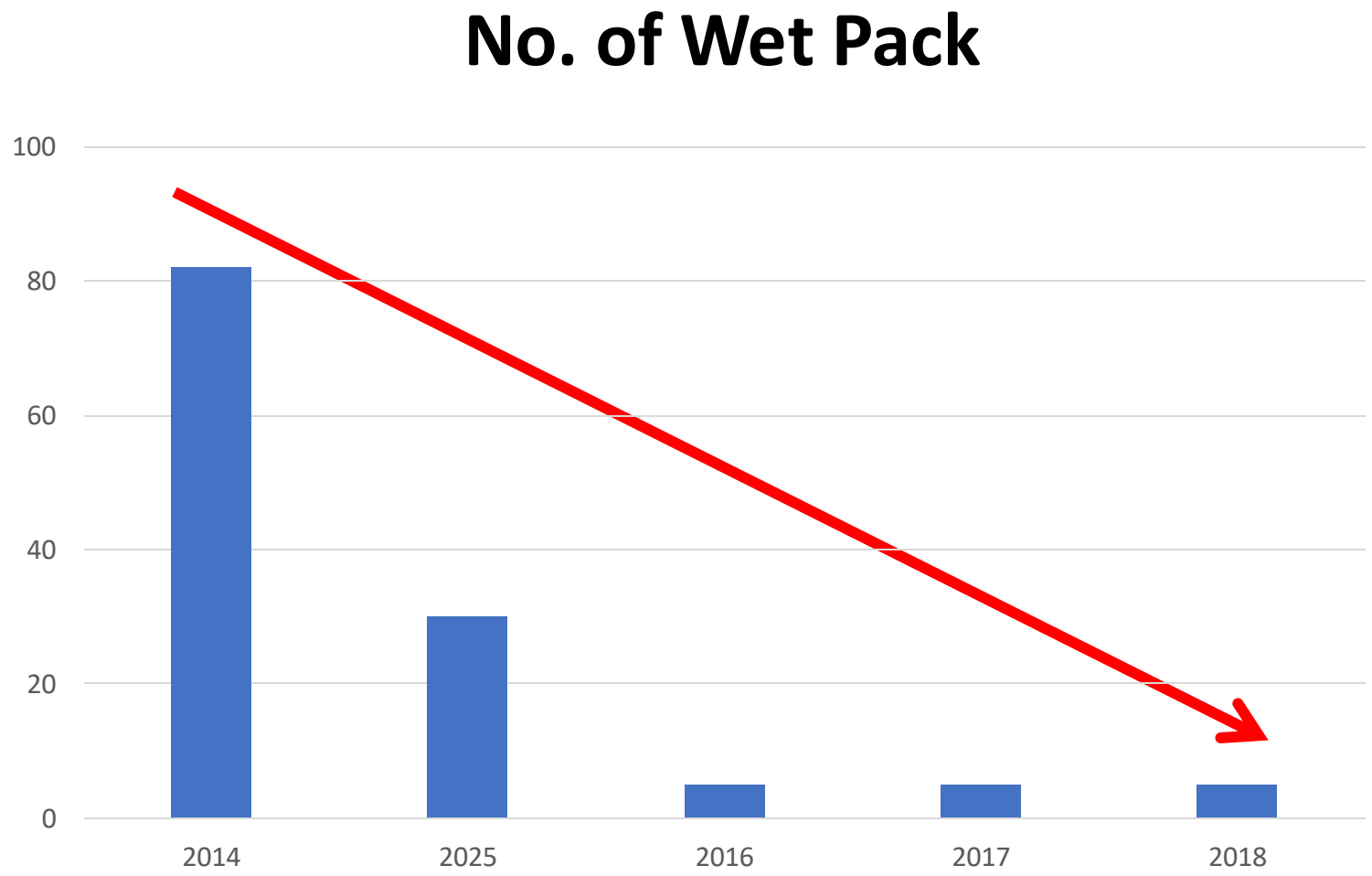
#19720237 Calibration date 02/11/2023 15:37:21

Overall result: **Passed**

Detailed results	Nominal	Actual
2. Pulsing 1		
Duration	>= 00:04:07 ; <= 00:07:30	00:06:38
Limits [Pressure]	>= 0.00 mbar	107.00 ... 987.00 mbar
3. Pulsing 2		
Duration	>= 00:03:30 ; <= 00:05:23	00:04:54
Limits [Pressure]	>= 0.00 mbar	1117.00 ... 1912.00 mbar
4. Pulsing 3		
Duration	>= 00:00:00	00:01:36
Limits [Pressure]	>= 0.00 mbar	2130.00 ... 2893.00 mbar
5. Steam Admission Stage		
Limits [Temperature]	>= 0.00 °C	122.55 ... 134.66 °C
Duration	>= 00:00:00	00:00:33
Limits [Pressure]	>= 0.00 mbar	2165.00 ... 3093.00 mbar
6. Sterilization Stage		
Limits [Pressure]	>= 3042.00 mbar	3090.00 ... 3149.00 mbar
Limits [Temperature]	>= 134.00 ; <= 137.00 °C	134.51 ... 135.29 °C
Duration	>= 00:03:30	00:03:30
7. Drying Stage		
Limits [Pressure]	>= 0.00 mbar	49.00 ... 76.00 mbar
Duration	>= 00:24:13 ; <= 00:24:50	00:24:36
8. Air Flush Stage		
Duration	>= 00:19:52 ; <= 00:31:13	00:22:49
Total process		
Duration	>= 00:00:00	01:16:30



Dramatically Decrease of Wet pack Occurrence



E. Management Strategy – 1) Integrating Continuous Staff Training

- Centralize Training Practice
- Reform the training on job functions
- Transfer the practical experience
- Knowledge oriented and skill transfer
- Team building

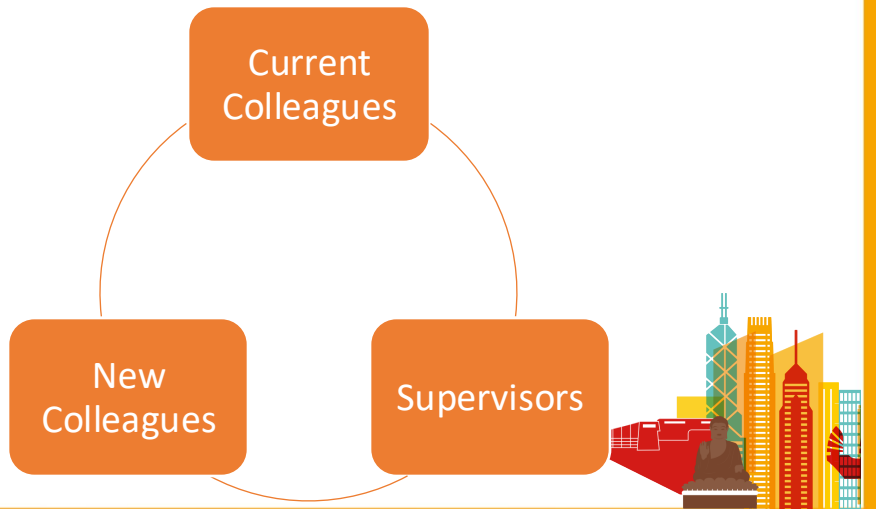
Reform Weekly Training

Autoclave Operator Training

Review Preceptorship Prog **T&T Prog**

Updated Training Contents

Refreshment Training



2) Systematic Incident Documentation

NTWC Sterile Services Department	文件號碼:	NTWCSSD-C-NM-003-V13
	版本:	13
Quality Improvement on Reporting Nearly Missed Case in NTWC SSD	生效日期:	01 – 04 – 2024
	下次修定:	01 – 04 – 2027
	頁數:	頁 1

Quality Improvement on Reporting Nearly Missed Case in NTWC SSD

All Nearly Missed Case should be reported through email within 48 hours.

Severity Grade	→	Nearly Missed belongs to group 3 & 4 should report to DOM verbally in advance
1. Low risk	→	Nearly Missed happens within SSD.
2. Moderate risk	→	Nearly Missed is related to customers and is related to product's non-conformity.
3. Moderate high risk	→	Nearly Missed is related to expensive instruments / potential complaint.
4. High risk	→	Nearly Missed may affect patient safety or clinical service.

Non-conforming product

Hospital Code for reporting & statistics	TMH: T	POH: P	TSWH: W

Follow up action	TMH	POH	TSWH
Internal training	W C LAW & All PCAI		
Staff interview	Cherry CHAN	Martin TANG	Edward YIP
System review	Leo YEUNG	S M KO	S M KO / Ben LAI
Wet load follow up	Ken YIP	Johnson WAN	Ben LAI

Management review	Frequency
Nearly Missed Case Statistics	Monthly
Review in SSD Management meeting	Quarterly
Nearly Missed Case Review Training	Weekly

IOD / OSH Incident

Immediate action	Duty i/c
Follow up action by Department Safety Officer	
TMH DSO	Cherry CHAN
POH DSO	Priscilla LAW
TSWH DSO	Ben LAI

Non-OT Related

Fault of machine or facility
Shortage of supply
Environmental defect

Immediate action	Duty i/c
Follow up action by SSD i/c	
TMH	Leo YEUNG
POH	S M KO
TSWH	S M KO/ Ben LAI

Wet Load

Report by SSD staff:	Record by Wet load form
Report by customers:	Nearly missed report

Author : Chu Yee Man
Rank : EOII
Date : 01/04/2024

Approved by : Ko Shui Mei
Rank : WM
Date : 01/04/2024

Report by SSD

Report by Customers

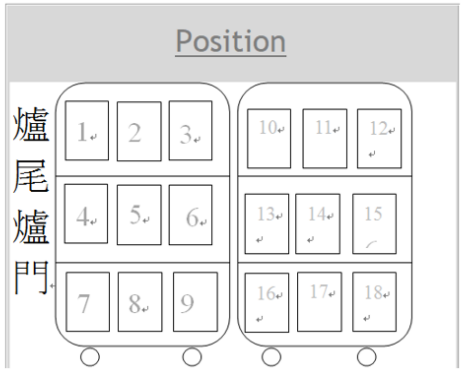
Wetload_nav

Wetload Record Edit | Export to Excel | Close Form

Wetload

Date	Hospital	Sterilizer No	Cycle	Program	Drying time	Air flush time	Position	Wetload was found	Set Template	Set ID	Weight of set
8/4/2024	TMH	DH15472	3325	3	28:50	19:10	8	蓋內	TMH.T10048	TMH.T10048.05	6.9
8/4/2024	TMH	DH15472	3329	3	28:19	19:14	8	蓋內	TMH.T20069	TMH.T20069.08	6.79

記錄: 144 之 1 已篩選 搜尋



Nearly Missed Incident Edit Menu Form Profile GrpWet

Incident Code	240913T00302	Incident Date	13/9/2024 17:35:00	Incident Closed	13/9/2024 11:44:20
Hospital	TMH	Reported by		Follow Up By*	EO I
Category	Non-Conforming product	Latest Update	13/9/2024 11:44:23	Severity*	Moderate risk
Sub-Category	Wet Pack	Updated by		Feedback By*	OT/ TMEC

Feedback to User ☐ For Training ☑ Reported to AIRS ☐ Incident Closed ☑

Incident Heading* Characters Left 61: Wet Load observed in TMH.N20051.01 KNEE PROSTALAC(L)(S.O.4)

Incident Details* Characters Left 1836: On 12/9/2024 17:35 , OT WM inform SSD that water droplet was encountered on one of the L Size of KNEE PROSTALAC inTMH.N20051.01 KNEE PROSTALAC(L)(S.O.4).

Root Cause Characters Left 798: Owing to material of instrument, the absorbed heat capacity was not sufficient to vaporize the condensate after sterilization. The loading configuration could not facilitate the drainage of condensate.

Immediate Action Characters Left 787: SSD I/C was informed. The problematic instrument was not used in operation. OT performed usage area check out on 2024-09-12 21:16 and received by SSD on 2024-09-13 08:25 for operation on 13/9/2024 pm.

Recommendation Characters Left 854: The concerned staff should be alerted the case. Designated loading configuration with slope was recommended to lower the chance of water droplet.

Follow Up(1000) Characters Left 918: Concerned staff was interviewed. To share the case on 20/09/2024 weekly training.

Staff Involve ☐ Uncertain Staf | Staff Role

PCA II Packer
C II Checker

Photos: Add File | Save As

\\pohnas001\pohcssd\CSSDQMS\Frontend_Phot
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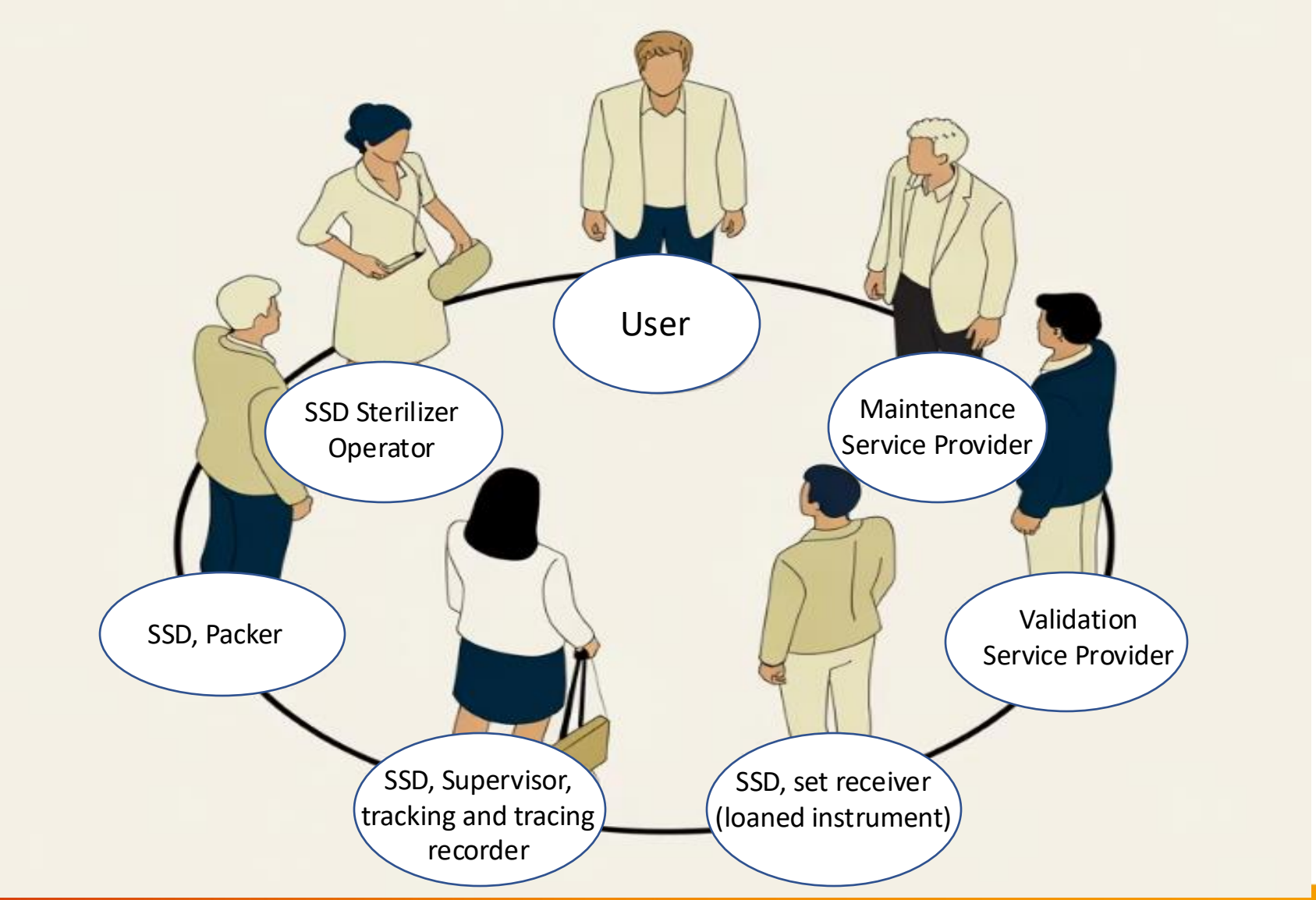
Files

3) Multidisciplinary approach



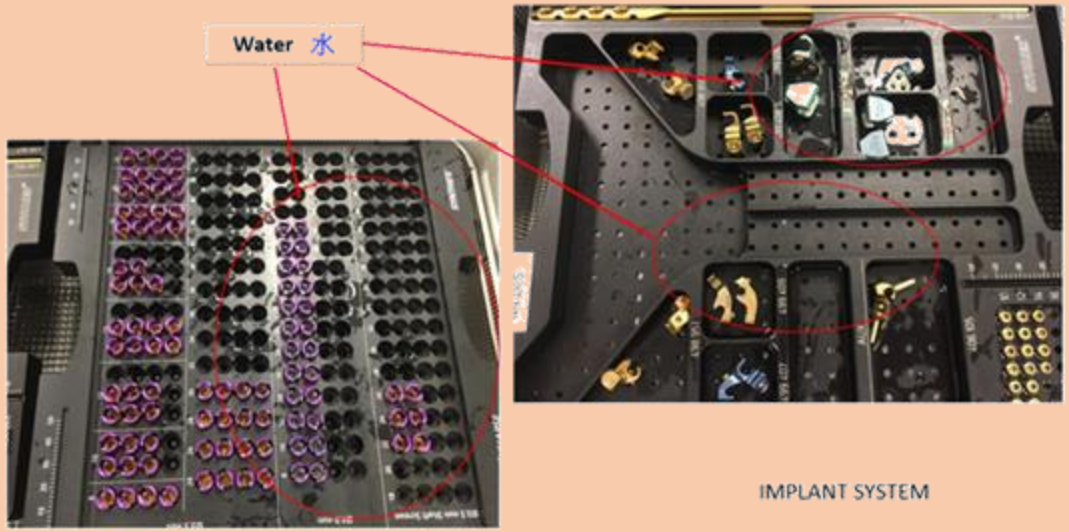
4) Engagement of Frontline Staff

Test performed in CSSD Tuen Mun Hospital

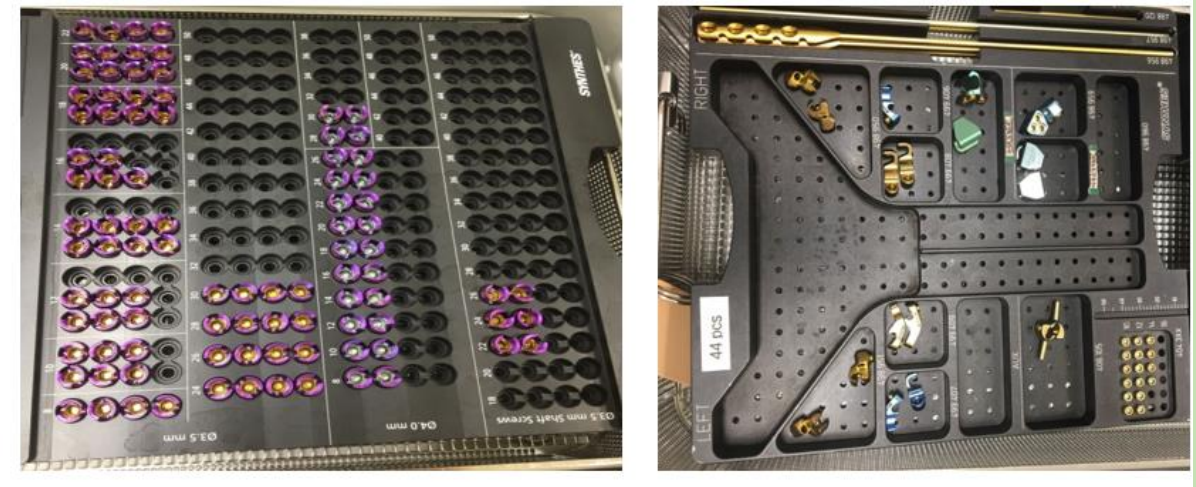
- 1 gallipot of sterile water (less than 50 ml) were randomly poured on to the instrument to simulate an extreme situation / the worst case.

- The tested item sets were undergone normal steam sterilization cycle

➢Before Sterilization



➢After Sterilization



Thank you for your attention