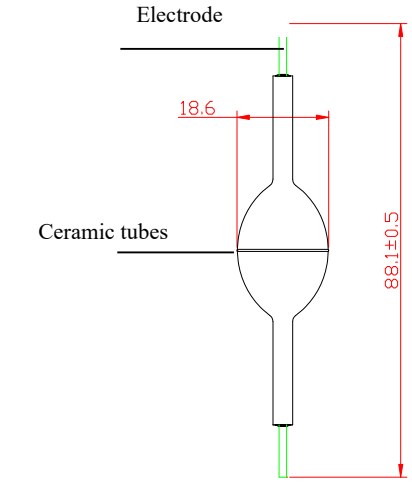
Item#2：Construction and Design

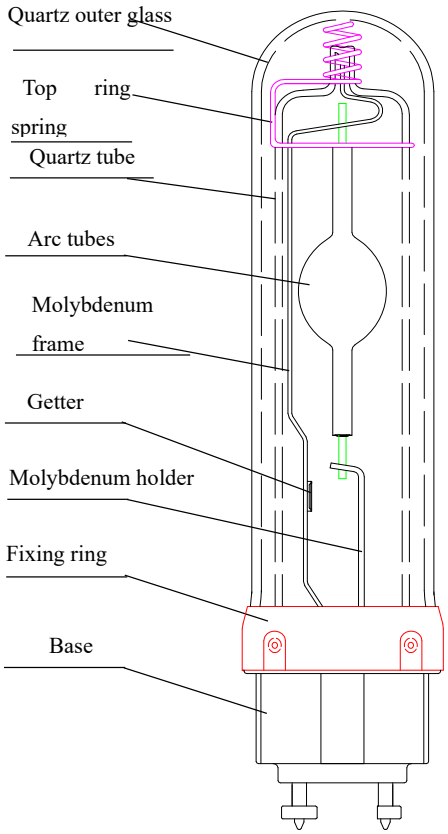
1. CMH315T38/PGZX18

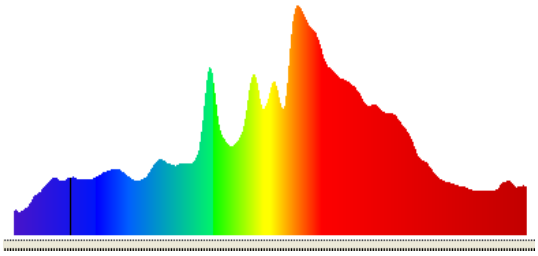
PERFORMANCE DATA		
Initial lumens	31000	Lm
Rated average life	10% failure @12000hrs	
Max. Warm up time	3	Min
Max. Hot Re-Strike time	10	Min
Correlated color temperature	3000/4000	K
Color rendering index	90+	
Operating Position	U	

ELECTRICAL CHARACTERISTICS		
Nominal lamp wattage	315	W
Nominal lamp voltage	100	V
Nominal lamp current	3.15	A

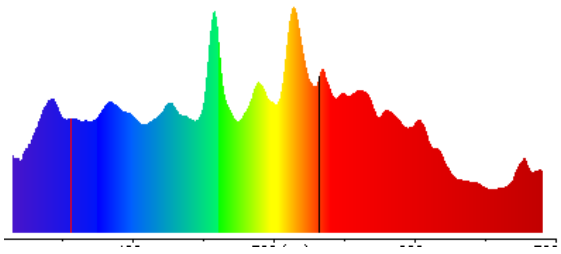
PHYSICAL DESCRIPTION		
Maximum overall length	193	mm
Light center length	88	mm
Bulb diameter	39	mm
Max. Base Temperature	250	℃
Max. Bulb Temperature	350	℃
Outer Bulb designation	T38	
Bulb material	UV block quartz	
Arc tube material	PCA	
Outer Bulb material	Quartz	
Base designation	PGZX18	







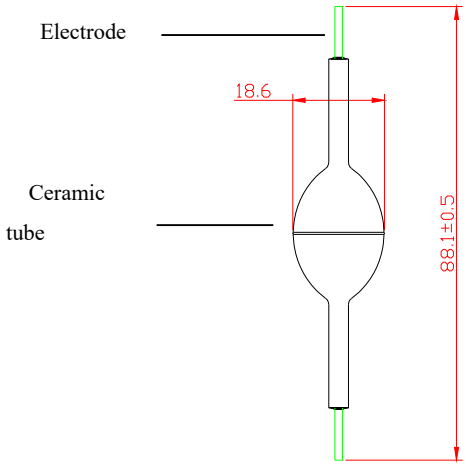
3000K

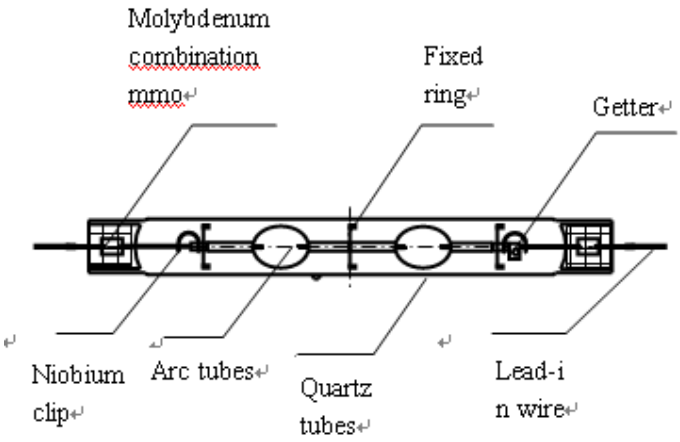


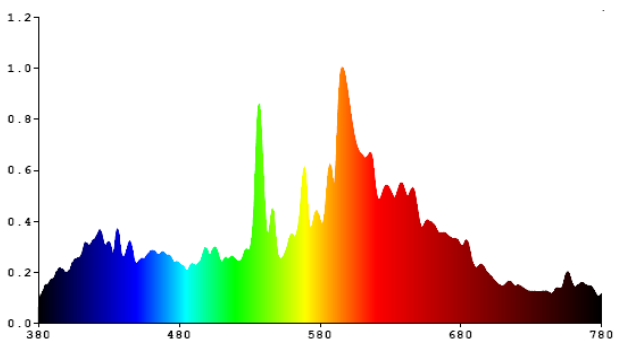
4000K

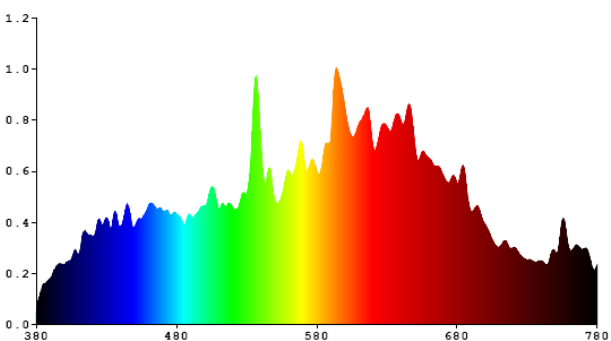
2. CMH630T32.5

PERFORMANCE DATA		
Initial lumens at rated watts after 100 hours operation	63000	lm
Rated average life	10000	Hours
Correlated color temperature	3000/4000	K
Color rendering index	90+	
Operating Position	HOR	
ELECTRICAL CHARACTERISTICS		
Nominal lamp wattage	630	W
Nominal lamp voltage	195	V
Nominal lamp current	3.2	A
PHYSICAL DESCRIPTION		
Maximum overall length	394	mm
Light center length	/	mm
Bulb diameter	33	mm
Bulb designation	T32.5	
Bulb material	UV block quartz	
Arc tube material	PCA	
Bulb finish	Clear	
Base designation	Double ended	



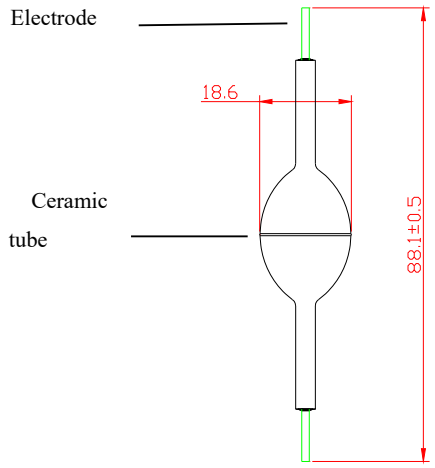


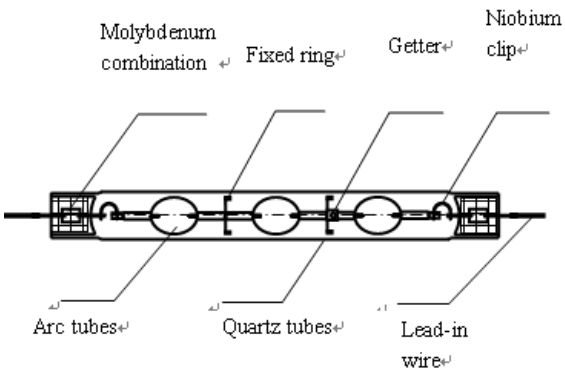


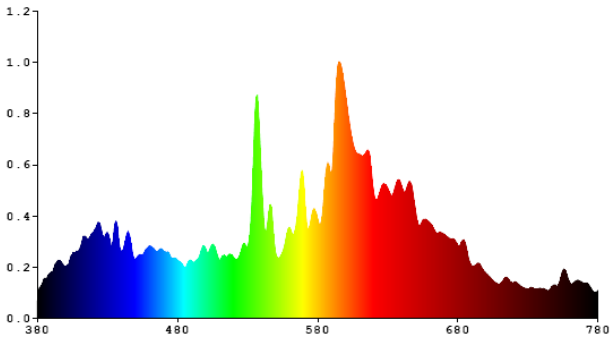


3. CMH945T32.5

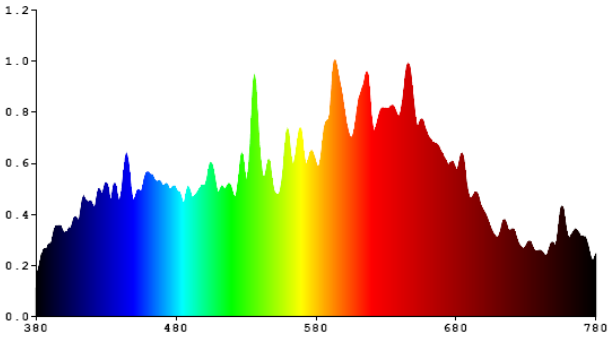
PERFORMANCE DATA		
Initial lumens at rated watts after 100 hours operation	100000	lm
Rated average life	10000	Hours
Correlated color temperature	3000/4000	K
Color rendering index	90+	
Operating Position	HOR	
ELECTRICAL CHARACTERISTICS		
Nominal lamp wattage	945	W
Nominal lamp voltage	235	V
Nominal lamp current	4.1	A
PHYSICAL DESCRIPTION		
Maximum overall length	394	mm
Light center length	/	mm
Bulb diameter	33	mm
Bulb designation	T32.5	
Bulb material	UV block quartz	
Arc tube material	PCA	
Bulb finish	Clear	
Base designation	Double ended	







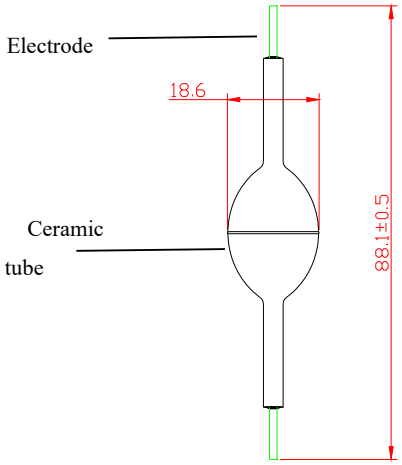
3000K

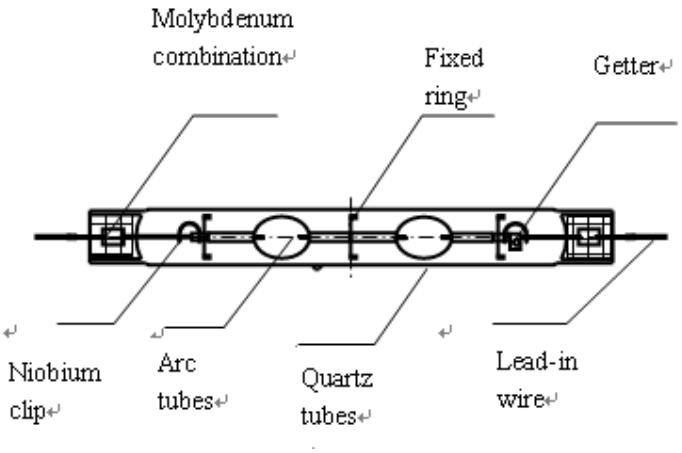


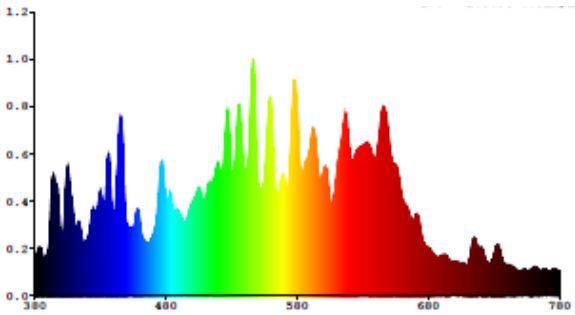
4000K

4. CMH1000T32.5

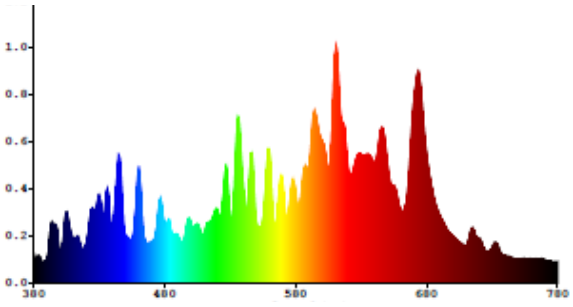
PERFORMANCE DATA		
Initial lumens at rated watts after 100 hours operation	100000	lm
Rated average life	10000	Hours
Correlated color temperature	3000/4000	K
Color rendering index	90+	
Operating Position	HOR	
ELECTRICAL CHARACTERISTICS		
Nominal lamp wattage	1000	W
Nominal lamp voltage	235	V
Nominal lamp current	5.2	A
PHYSICAL DESCRIPTION		
Maximum overall length	394	mm
Light center length	/	mm
Bulb diameter	33	mm
Bulb designation	T32.5	
Bulb material	UV block quartz	
Arc tube material	PCA	
Bulb finish	Clear	
Base designation	Double ended	







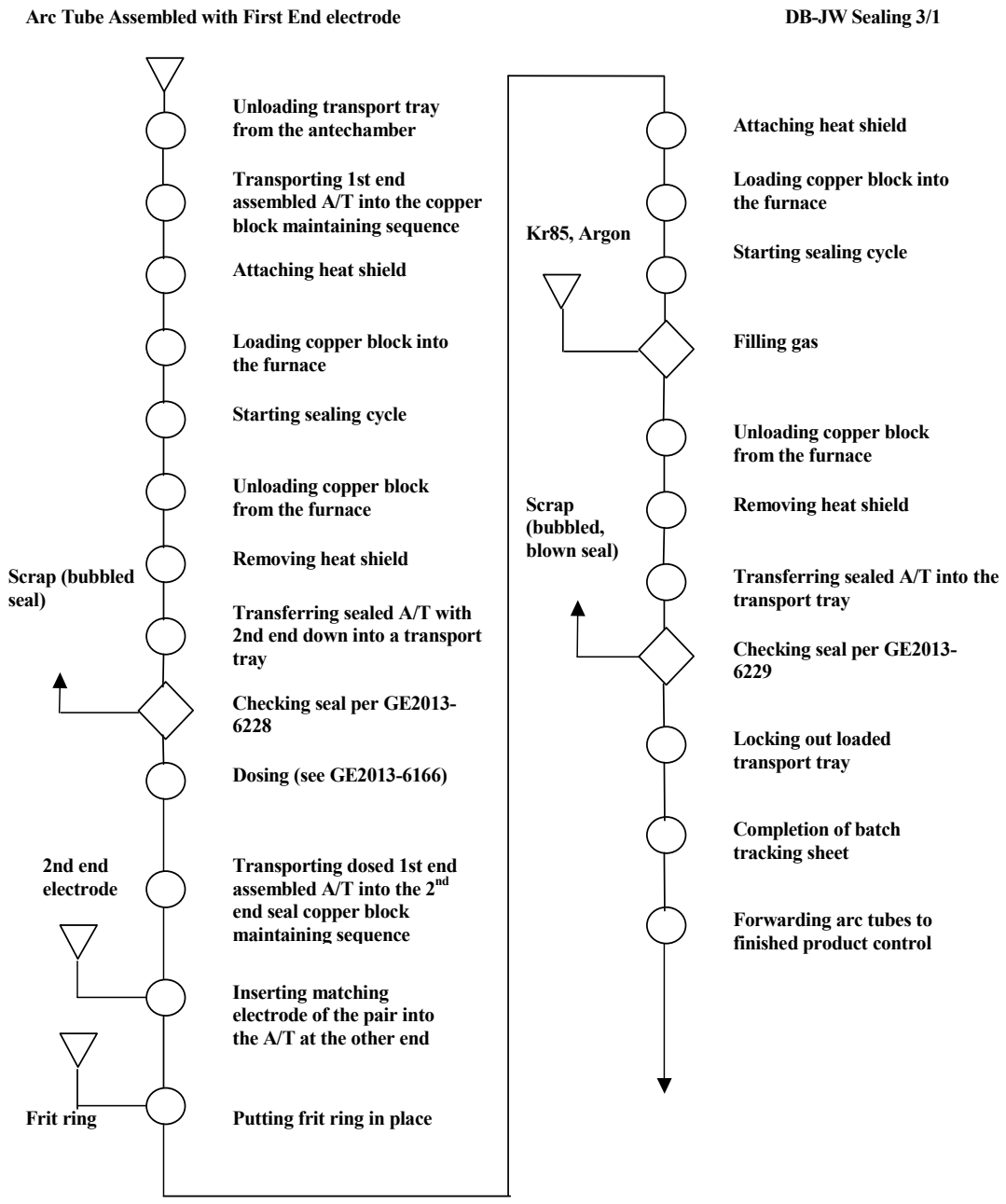
4000K



3000K

Item #2 Construction and Design/ Method of Containment

1. CMH 1st & 2nd end-sealing Manufacturing Process Flowchart



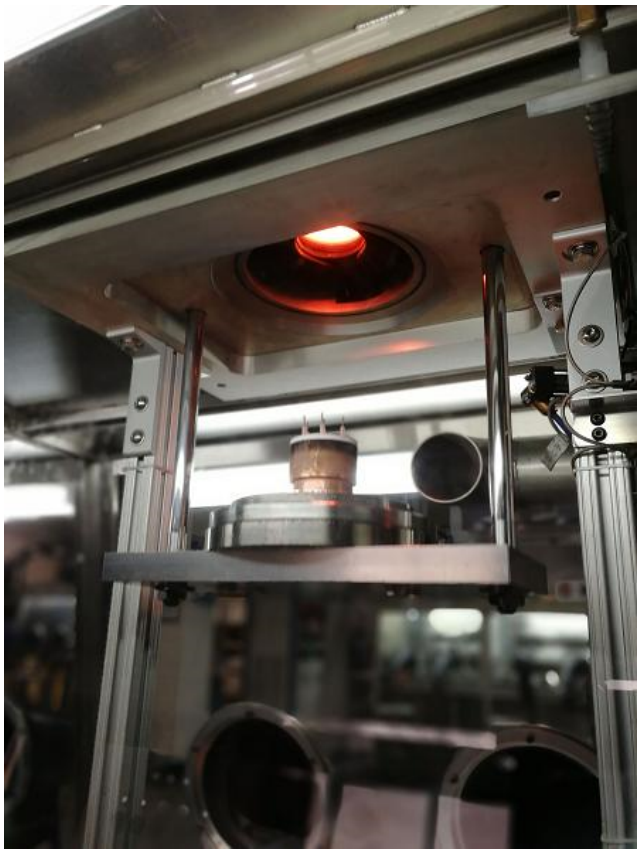
Description:

1.Put electrode, PCA, frit ring, metal halide pill materials into operation box which filled with Ar.

Load one electrode into PCA, put a frit ring above it, then put them into the furnace, heating until frit ring melt, 1st end of A/T sealing finished.

2.Invert the one end sealed PCA, dose metal halide pill into PCA, load one electrode into the other side of PCA, put a frit ring above it, then put them into the furnace, filling gas Ar+Kr85(Kr85 about three in a million) through

pipeline, heating until frit ring melt and seal. Completion of whole A/T sealing.

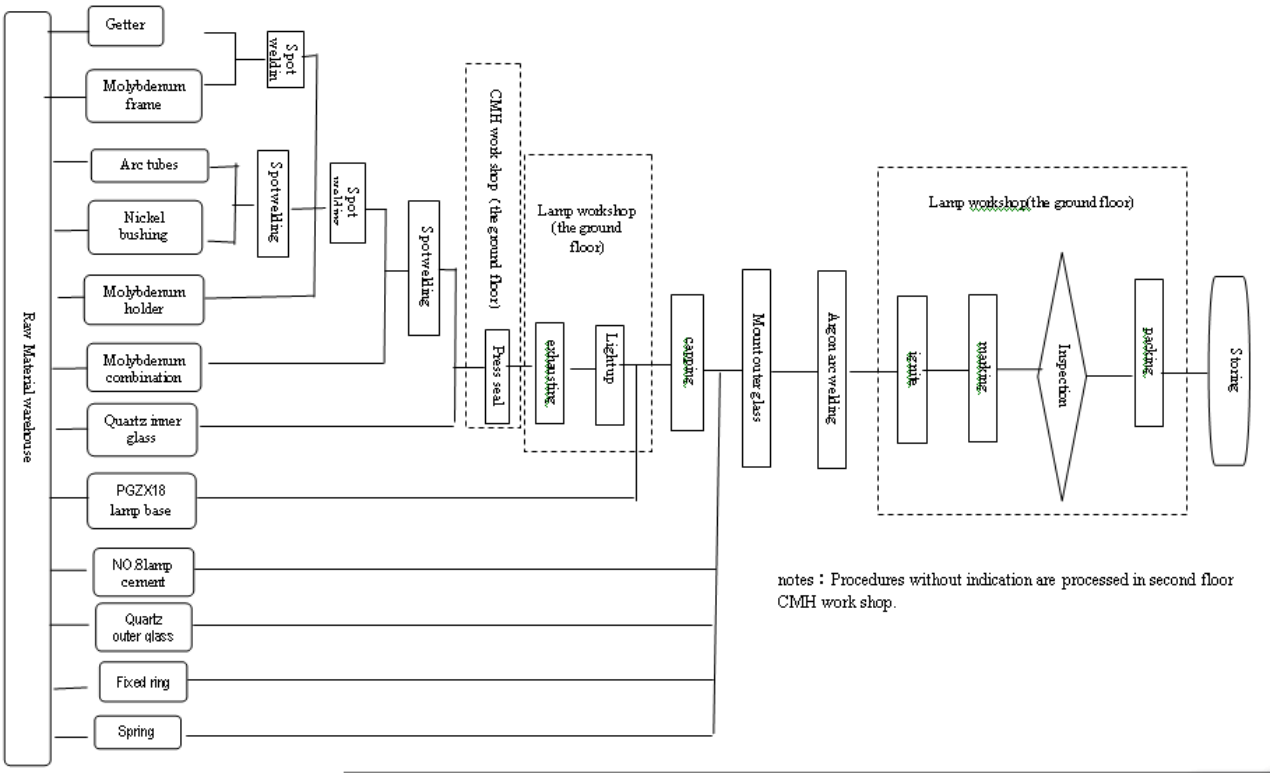


Sealing machine：used for sealing by Melting the arc tube frit ring.

First put the electrode into PCA, then also put a frit ring into PCA, Secondly, Put the whole PCA into the sealing machine, Automatic heating the electrode, frit ring, and the PCA together. thirdly, put the metal halide pill , electrode and frit ring on the other end of PCA, then put the whole PCA into the sealing machine again, automatic heating and fill the mixture of Ar+Kr85. Finally the gas will be enclosed in the arc tube.

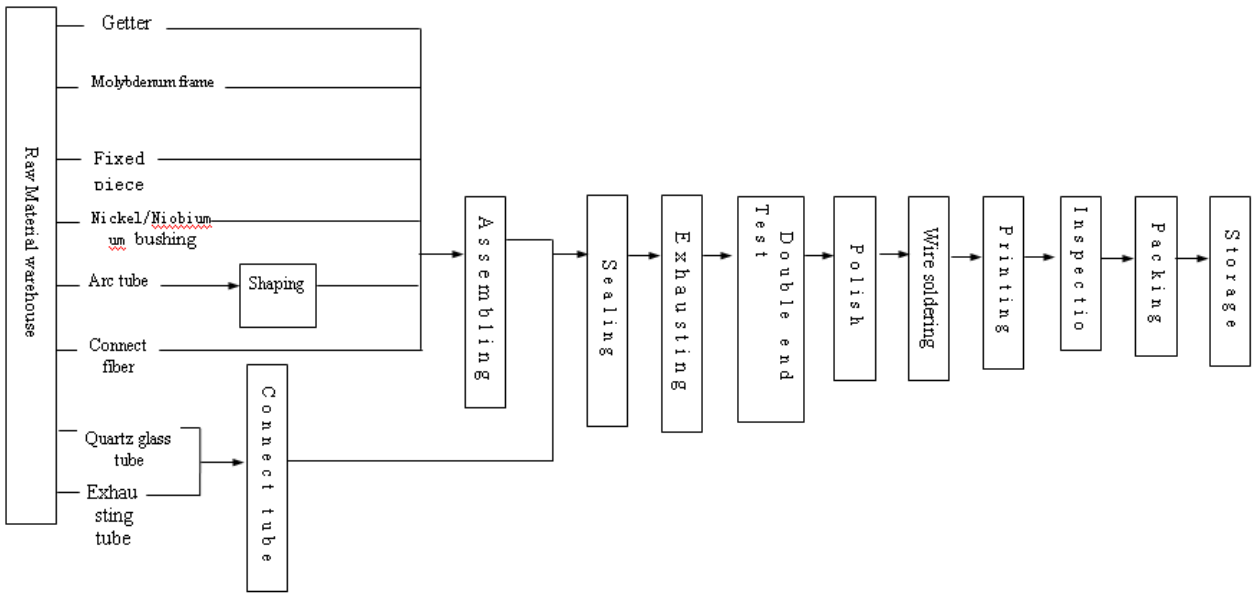
2. Process Flow Diagram

2.1 CMH315W



1) Firstly, assemble the arc tube and the metal parts such as the holder, the getter together, Then sealed the whole assembly parts into a quartz tube.
2) Empty the air in the tube by an exhaust machine, Sealed the arc tube inside the quartz tube with a fire vent.
3) Finally, install the explosion-proof casing and bulb.

2.2 CMH630W/CMH945W/CMH1000W DE

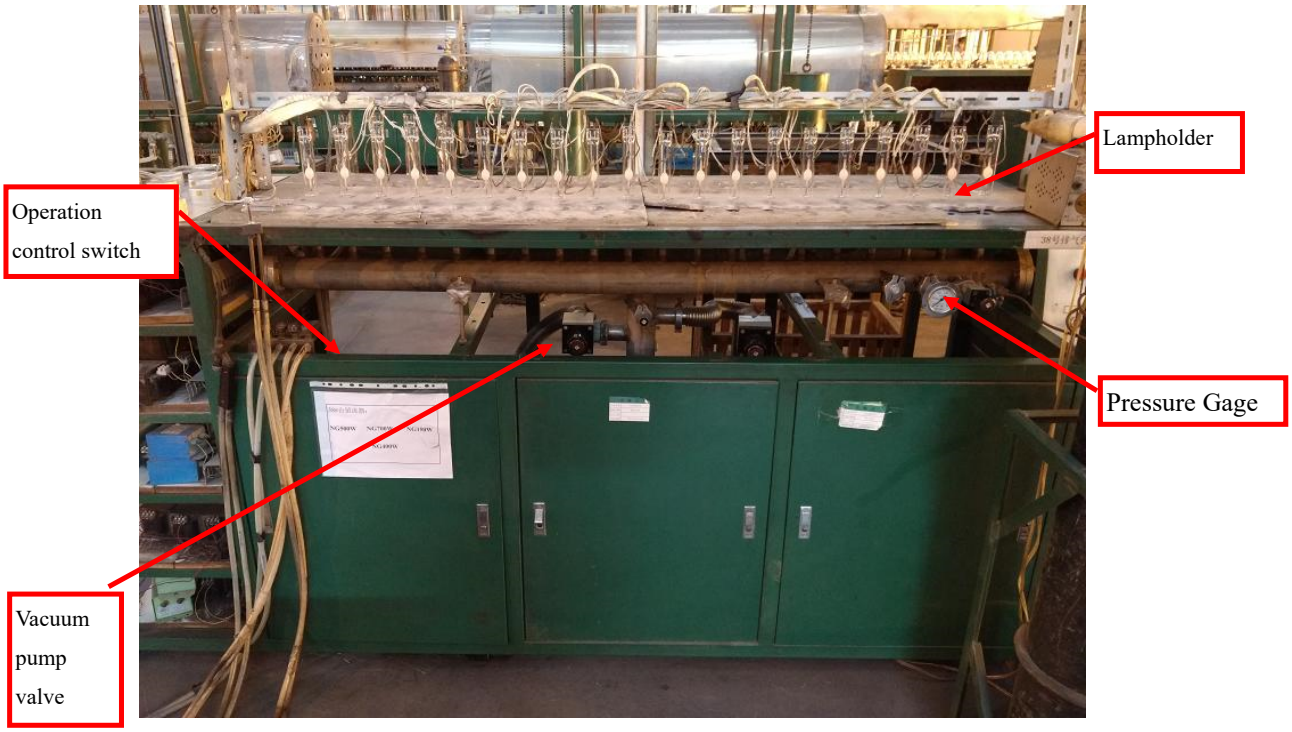


1） Assemble two or three arc tubes with the metal parts such as getter, molybdenum stents together, then put the whole assembled piece into the quartz tube.

2） Empty the air in the quartz tube by an exhaust machine, fill in proper nitrogen, sealed the arc tube inside the quartz tube with a fire vent.

3） Finally, welding a piece of lead wire at each end of the quartz tube.

2.3 Exhausting Machine



Assembled the exhaust tube of semi-finished lamp into the machine, then empty the air within arc tube and outer bulb. Finally, melting the exhaust pipe with the fire to prevent the air from entering the bulb.

Item #3 Method of Labeling

The arc tube is too small to label, so we have placed the designation of Kr-85 on the next smallest item which is the box that houses each lamp.

Marked at the bottom of box, see below pics. Website (where to buy) is: optilume-lighting.com

Item #4 Radiation Levels and Method of Measurement

Use Kr85 Mixture Standard

1. **MATERIAL:** Argon + Krypton^{85}

* 2. **CHEMICAL COMPOSITION:**

- Krypton85 Kr^{85} activity = 6.2 MBq per litre at NTP# equivalent to approx. 2.9 vpm
- Argon Ar 99.9995%
- Carbon dioxide CO2 <1 vpm
- Hydrogen H2 <1 vpm
- Nitrogen N2 <3 vpm
- Oxygen O2 <1 vpm
- Water H2O <1 vpm
- Total hydrocarbons CnHm <1 vpm

*

*

Note: NTP refers to temperature = 0ºC (273 K) and pressure = 1 atmosphere (101325 Pa)

3. **PHYSICAL PROPERTIES:** Colourless, odourless gas, chemically inert

4. **HAZARDS:**

Asphixiant
Radiation hazard – Krypton^{85} is a *beta* emitter
Radiation hazard – X-rays are emitted from cylinders containing Krypton^{85}
Gas cylinders are filled to high pressure

5. PRECAUTIONS:

Normal precautions for handling high pressure cylinders should be observed
Detailed safety precautions are described in Process Specification GE0158-7127
Consult supplier's safety instructions
Avoid exposure to gas cylinders - follow guidelines in GE0158-7127
Exposure to ionising radiation – follow guidelines in GE0158-7127
Ensure that procedures and local rules comply with The Ionising Radiations Regulations 1985.

6. QUALITY PERFORMANCE REQUIREMENTS:

The supplier shall provide a gas analysis certificate with each cylinder delivered to Jingwei Lighting, Leicester. The supplier shall show evidence of compliance on all Critical To Quality parameters (CTQ's). The supplier shall advise Jingwei Lighting, Leicester on amendments and modifications to processes in the preparation of the gas mixture.

7. CERTIFICATE OF CONFORMITY:

This is to be supplied with each cylinder received and must include the following information: -

Supplier's name
GEL specification number
GEL SAP number
GEL order number
Product description and supplier's product reference
Quantity
Date code/Batch identification
Gas analysis certificate showing concentrations of the substances listed in section 2

* **8. CYLINDER DESCRIPTION:**

Type B10
Dimensions: 140 x 1000 mm (diameter x length)
Contents: 1500 litres of gas at NTP
Maximum pressure: 138 atmospheres (140 bar)
* Connection: Din 10

9. LABELLING:

Each cylinder shall be clearly labelled to display the following information.

Supplier's name
* Product description and supplier's product reference
Date code/Batch identification
Radiation hazard information label showing total activity (9.3 GBq)

* **10. PACKAGING:**

The packaging shall be such as to preserve the quality of the product during transit and storage.

*

11. SUPPLIERS:

Air Liquide,
Department Gaz Rares,
BP no. 313-57, Avenue Carnot,
94503 Champigny-sur-Marne Cedex,
France.

12. RADIATION ASSESSMENT:

Transport, handling, storage, labelling and use must comply with The Ionising Radiations Regulations 1985 and The Radioactive Substances Act 1960.

NOVA GAS

February 6, 2018

TES Solutions Co., Ltd.
Acct: 20040704

PO Number LM-K85-1706-CN
Invoice Number 625996

CERTIFICATE OF ANALYSIS

Cylinder Number	Size	Contents (liters)	Gas Description	Concentration (mol/mol)
4249039 4657976 4657995 4791903	11	1400	Krypton-85 Argon	0.17 mCi/L 100%

Per Cylinder
Surface Reading: 14 mr/h
Transport Index: 0.3 mr/h

Certified by: *Joanne Pazyniak*

NGT Representative

Nova Gas Technologies, Inc.
2781 Three Lakes Road, North Charleston, South Carolina, 29418 USA

10^{-5}

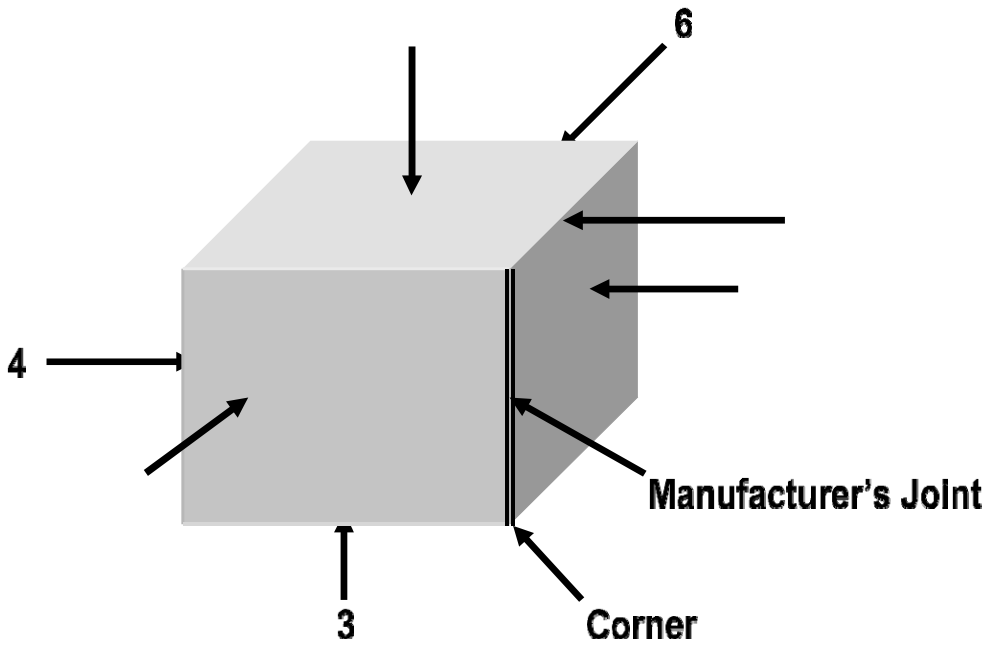
Model	PCA Cubage（ml）	Gas Pressure（torr）	Kr85 Concentration（MBq/L）	Activity of Kr85 Per lamp（Bq）	Activity of Kr85 per hour at 1 centimeter（millirad）
CMH315	3.21	80	6.2	2095	1.676×10^{-6}
CMH630	6.42	80	6.2	4190	3.352×10^{-6}
CMH945	9.63	80	6.2	6285	5.028×10^{-6}
CMH1000	9.916	80	6.2	6471	5.1768×10^{-6}

Item #5 Byproduct Material Containment

1. Each carton is dropped 10 times following the below sequence:

Sequence #	Orientation	Specific face, edge or corner
1	Corner	most frag ile face-3 corner, if not known, test 2-3-5
2	Edge	shortest edge radiating from the corner tested
3	Edge	next longest edge radiating from the corner tested
4	Edge	longest edge radiating from the corner tested
5	Face	one of the smallest faces
6	Face	opposite small face
7	Face	one of the medium faces
8	Face	opposite medium face
9	Face	one of the largest faces
10	Face	opposite large face

Identify faces according to the diagram below.



Packaged-Product Weight				Drop Height			Impact Velocity	
Equal to or greater than		But Less than		Free Fall			Incline or Horizontal	
lb	kg	lb	kg	In.	mm		ft/s	m/s
0	0	21	10	38	970			1.4
21	10	41	19	32	810		13	4.0
41	19	61	28	26	660			3
61	28	100	45	20	510		10	3.2
100	45	150	68	12	310		8	2.5

Sealing Machine

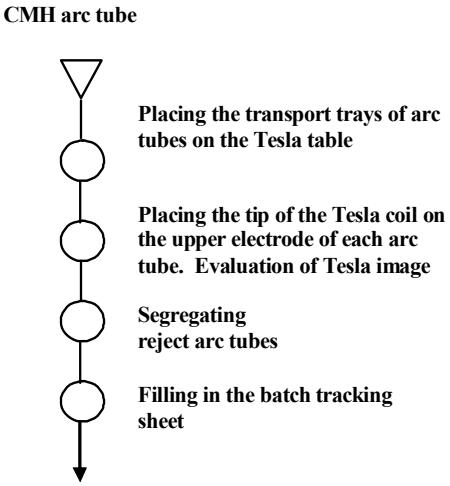
Unsealed Arc tube

A drop test on 3 cartons whatever the order size is.

No damage is allowed at all on the products after a drop test so a single broken bulb will fail the result.

2. Air Leakage Inspection Process

Tesla Image Inspection of CMH Arc Tubes



Process Execution

1. Check that the appropriate arc tubes complying with the batch tracking sheet are available.
2. Collect all the transport trays of the batch including any scrap.
3. Place the reject arc tubes - considered as hazardous waste - from the drybox into the container for hazardous waste.
4. Place the transport trays of arc tubes on the Tesla table.
5. Hold up the tip of the Tesla coil in the air and switch on the Tesla instrument. Tip of the activated Tesla coil can cause severe electric shock, therefore it is not only forbidden to touch but also to bring it near to a human body. (Fig. 2)
6. Touch the electrode tip of each arc tube with the tip of the 3.8 MHz Tesla coil and observe the glow in the arc tube. **Do not touch ceramic body/leg with tesla coil.**
7. In case of a voluminous, pale blue glow, the arc tube is good. No glow or purple glow indicates a reject arc tube.
   Important!
   The intensity of glow does not qualify the arc tube. A pale or too intense Tesla image does not mean a defect.
8. Collect the reject arc tubes, place them into the container for hazardous waste and fill in the batch-tracking sheet. Leave the good arc tubes on the transport tray.

Fig. 1


BUCKLEYS (UVRAL) LTD
UVRAL
OUTPUT
TMF SPARK TESTER MK.3
Knob to adjust spark
On/Off Switch

Fig. 2

Checking the Pressure Drop

The purpose of this process is to detect any possible leakage before higher amount of gas could escape. Observe the pressure drop of the closed system.

1. At weekend shutdown, close the valve of the cylinder in the reductor line, but leave the valve open in the furnace line.
2. Record the high-pressure side and low-pressure side pressure values in the cylinder replacement log book.
3. On start-up, also record the pressure values.
4. The pressure drop during 48 hours must not be higher than 5 bars, assuming that the secondary pressure has not changed.
5. A larger pressure drop accompanied by a 3-4 bars increase in the secondary pressure does not refer to a leakage, but a gas flow into pipe section after the reductor.
6. There must not be any pressure drop on the secondary side.
7. In case of pressure drop, find the location of the leakage and stop it.

Regular Measurement of Radiation

The radiation level (dosage rate) of the area has to be measured after every cylinder replacement and every day at the following points:

Measuring point 1: 1 m from the cylinder storing (Fig. 3)

Measuring point 2: in the middle of the space between the box and its control cabinet (Fig. 4)

Measuring point 3: on the aisle in front of the box room with closed doors. This measuring point is useful to determine the background radiation (see Fig. 5). The photo is taken with the door open to help you identify the room.

Type of the gauge used for this measurement: SM 2000 X Miniray Radiometer

Radiation Level Measurement

1. Take the radiometer from the closed cabinet.
2. Verify that the calibration is still valid.
3. Go to measuring point 1 and then press and hold the red button on the radiometer.
4. Wait until the radiometer reaches the highest displayed value and record it.
5. Wait until the radiometer shows decreasing values. Record the lowest displayed value and release the red button.
6. Calculate the average of the two extremes (dosage level exhibits statistical fluctuations).
7. Record this average value in the measurement logbook.
8. Complete steps 3-7 at measuring point 2.
9. Complete steps 3-7 at measuring point 3.
10. If the dosage level exceeds acceptable limit at any of the measurement points, follow the instructions in Chapter “Ventilation in case of high radiation level”.

11. Fill in the measurement log book.
12. Replace the radiometer.

Measurement data have to be recorded in the dosage rate measurement logbook for every measurement.

Allowed dosage rate:

Measuring point 1 – 0.8 µSv/hour

Measuring point 2 – 0.4 µSv/hour

Measuring point 3 – 0.4 µSv/hour

Ventilation in case of High Radiation Level

1. If dosage rate exceeds allowed level, operators have to leave the room immediately.
2. The group leader has to be notified.
3. The assigned person has to close the cylinder and ventilate the room by opening the doors and windows.
4. After the ventilation, radiation level has to be measured again.
5. Ventilation should be continued until the dosage level drops below the acceptable value.
6. Afterwards, evacuating capability of the Kr85 cylinder and the piping has to be checked and root cause of the leakage has to be clarified.
7. The leakage must be stopped.
8. Leakage, time of ventilations, cause of the leakage, and radiation level on restarting the work has to be recorded in the logbook.

Figure 3

Figure 4

Figure 5

Storage and Shipping

Only one Kr85 spare cylinder may be stored in the production area. Always put the back-up cylinder and the cylinder used into the lead sheathed storage vessel. Bring full cylinder only when cylinder replacement is required. Immediately return the empty cylinder to the gas-mixing facility in Building 75.

Cylinders can only be transported on cart.

The cylinder must be secured against falling down.

Safety Precautions

Safety Requirements and Checking

Process steps can only be performed by operators who passed the cylinder handling examination, trained for the cylinder replacement and qualified in process and safety instructions.

The cylinder and the spare cylinder must be placed into the lead sheath storage vessel.

Prior to starting daily work, operators and the supervisor have to verify conditions for safe work.

It is prohibited to operate the equipment with any noticeable damage or deficiency to the safety guarding or other protective function of the equipment. Notify the group leader in case of abnormal operation of the machine. The group leader is responsible for taking the required troubleshooting actions.

Work can only be done in clean and ordered area. Only the minimum amount of material required for the work may be stored in the working area.

No smoking, eating or drinking in the working area!

Report any accident to the group leader or supervisor immediately.

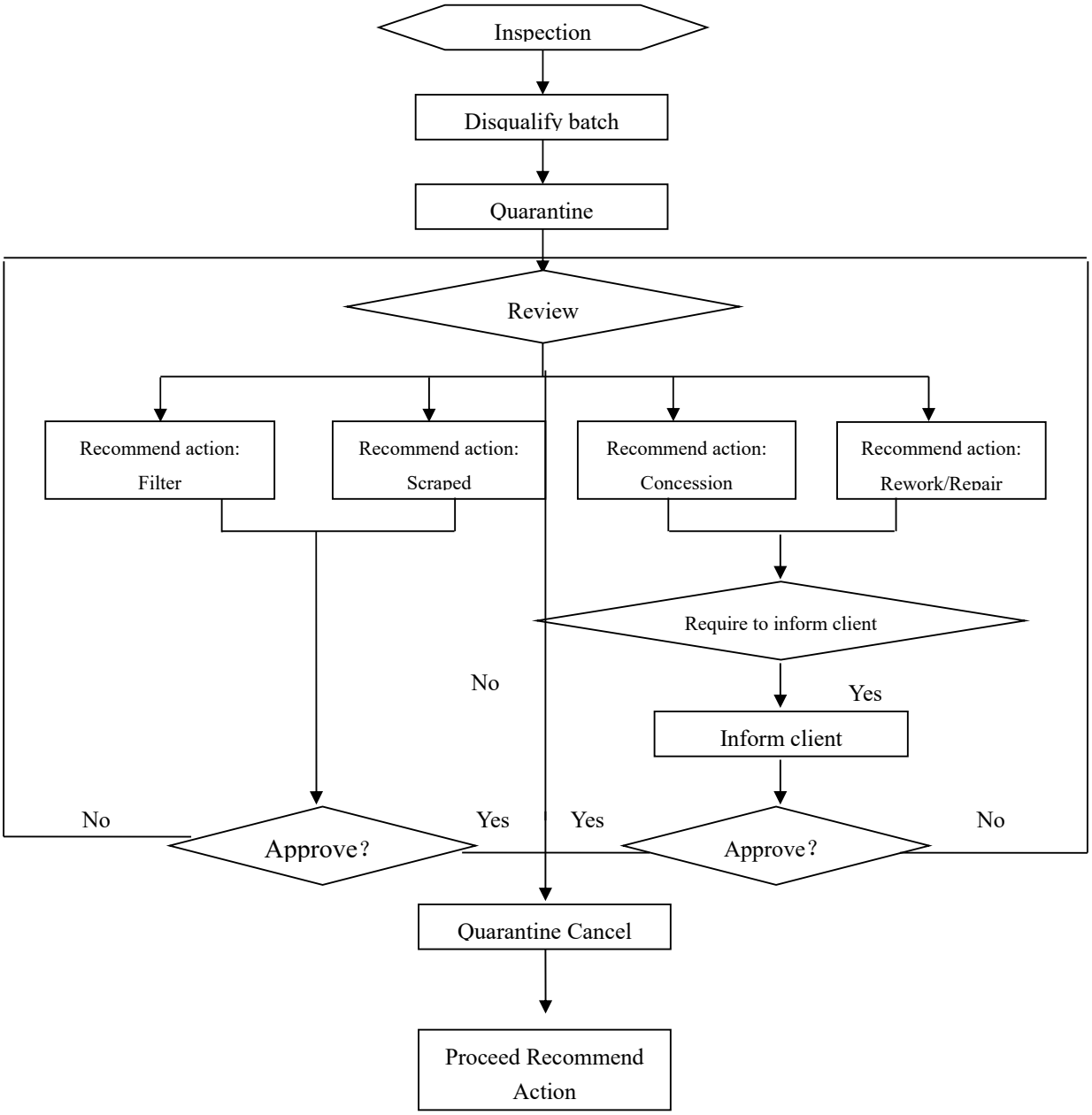
Environmental Protection Instructions

Amount of emitted radioactive gas specified in the EHS requirements must not be exceeded.

During process executions, always comply with the EHS requirements.

Q7

Disqualify control procedure during manufacture



Description:

1 Concession:

1.1 Concession request by the sector that disqualify occurred, applicator must provide sufficient backups (such as: test report and risk report etc.) also quantity and time-table that helps making decision.

1.2 Concession application must signed by sector supervisor, then proceed to quality control department, review by QC manager and relative people who in charge, if in the occasion that people in charge cannot make the decision, the named representative will perform the duty.

1.3 If the concession affects the products performance during client usage (such as product life, lumen output, and color render etc.) the client must be informed and send written permission. The QC manager and superior department must be informed before send to client.

2 Scraped and Return:

2.1 When disqualified products cannot be repair or re-work, if the disqualify is about the complete products, then they will be scraped, if it is about raw material, then purchasing sector need to inform and make agreement with supplier, whether to scarp or return the raw material.

2.2 Products are quarantined before scarp or turn.

2.3 Raw material scrap is recorded in <Scrap memo>hold and manages by purchasing sector; half complete or complete disqualified products are recorded by responsive sector. <Scarp memo> is copied and saved by QC department.

3 Re-work, repair and filter:

3.1 Re-work, repair and filter need to ensure the quality.

3.2 Re-work, repair and filter are hold by responsive sector.

3.3 Responsive sectors need to make agreement on certain standard, all the detail need to recorded in <Disqualification action memo> and approved by QC manager and superior leader.

3.4 Personal, equipment, material and place will managed by production sector.。

3.5 Operation instruction book and operators' training is managed by technical department

3.6 Client will be informed if needed; certain re-work, repair and filter require client permission.