BALL
OFFICIAL RR STANDARD

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BALL
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U.S. Nuclear Regulatory Commission
Office of Nuclear Material Safety and Safeguards
Division of Material Safety, State, Tribal, and Rulemaking Programs
Materials Safety Licensing Branch
Mail Stop: T8E18
Attn: Tomas Herrera
Two White Flint North
11545 Rockville Pike
Rockville, MD 20852-2738

Re: Request for Additional Information
Docket No. 030-36971
License No. 09-23920-01E

Dear Mr. Struckmeyer

The following is a response to your request for additional information. Each response is enumerated per your questions.

A. Information required for review of Sealed Source and Device amendment application.

1. Model NM1092C will have 63 sources with a total of 102.3 mCi (3.79 GBq). Ball will mark timepieces between 100 mCi and 150 mCi with a "T150" on its face. To ensure 150 mCi timepieces can be distributed, this application for amendment was submitted.

2. The only changes will be the quantity and layout of the sources as depicted in Attachment A to this response.

3. The company name is "Hess Fine Arts, Inc. dba Ball Watch USA".

4. Attachments A, B, and C are included.

5. Hess Fine Art intends to add Model NM1092 to the Registration Certificate NR-1265-D-101-E. Please see Attachment A for the source layout and construction drawings of the timepiece.

6. Timepieces containing between 100 mCi and 150 mCi will have "T150" printed on the lower left of the dial face. All other labels will remain the same.

7. The Ball Watch logo is printed on the face of all watches, but depending on the functions presented on the faceplate, the location may be below the 12 o'clock position, below the

center, or the right of the center. Model 1092C will have the Ball Watch logo below the center.

8. The conditions of use for these timepieces will not change.

9. Model NM1092 is constructed using Model NM2090C frame and construction which has already undergone prototype testing. An image of the faceplate and assembly drawing is attached as Attachment D and a report of the results for Model NM2090C prototype testing is attached as Attachment E.

10. The radiation profiles section is not applicable to timepieces containing H-3 because the NuReg 1556, Vol 3, Appendix A checklist contains actions that are not required. The following items are contained in the checklist:

- Survey instruments used (e.g. type, window thickness, sensitivity, calibration dates). Not applicable as H-3 is a weak beta-emitter that is completely shielded by the timepiece itself and there are no survey instruments required to monitor individual timepieces containing H-3.

- Conditions: including environments, scatter (product in bean), and use of guards and shields. Not applicable as there are no guards and shields required for timepieces containing H-3. As weak beta emitters, the watch material is a sufficient shield.

- Distances from sources/surfaces (per ANCI 538-1979, N43.8-2001). Not applicable since the timepieces are worn in contact with the skin and dose assessments have indicated the dose to the individual is nominal.

- Shutter Open and Closed/Source Shielded. Not applicable as there are no shutters.

- Verify that radiation surveys for gamma radiation meet inverse squared law. Not applicable since H-3 is not a gamma emitter.

- Verify that radiation surveys for non-gamma radiation have not been calculated using the inverse squared law. Not applicable since radiation surveys of individual timepieces containing H-3 are not required.

11. Attachment C is provided and Hess Fine Art's Quality Assurance program has not been changed.

B. Information required for review of exempt-distribution license amendment application

1. Please see answer to A.5.

2. Please see answer to A.10.

3. The timepieces are worn by human beings. However, there is no access to the GTLS (gaseous tritium light source) during normal use.

4. The NM1092C has a total activity of 102.3 mCi (3.79 GBq). It is anticipated approximately 20 timepieces will be sold with a total of 2046 mCi (75.8 GBq) distributed annually.

5. Please see answer to A.6. and A.7.

6. Please see answer to A.9.

7. Please see answer to A.10.

8. Please see answer to A.10. and B.2.

9. The H-3 is selaed as GTLS and then again sealed within the watch face by stainless steel backing and crystal cover. To date there have been no reported failures of the stainless steel backing and crystal cover. Therefore, pursuant to §32.23(d) the probabilities are between Low and Negligible.

10. Please see answer to A.11.

11. The appropriate organ for timepieces would be the hands and forearms. According to Column 1 of the Table in §32.24, the dose must remain less than 0.015 rem. Attachment F, Table 1 lists the calculations for skin contact EDE during routine use which indicate an Annual Dose Equivalent to the Hand and Forearm of 2.5×10^{-7} rem for normal use. For disposal, contact is only incidental and would therefore be even lower.

12. According to Column II of the Table in §32.24, the dose must remain less than 0.01 rem to the whole body for units likely to accumulate in one location during marketing, distribution, installation or servicing. Since the timepieces will be in storage, they will not be in contact with the Hands and Forearms for normal use. There will be no dose from exposure since H-3 is a weak beta emitter. The only dose will be derived from inhalation of H-3. Attachment F, Table 2 calculates the inhalation dose from timepieces using an assumption the highest activity GTLS is crushed. The Annual EDE would be 4.4×10^{-7} rem (4.4×10^{-6} mSv). Storage of up to 100 timepieces, each with one crushed GTLS, would create, at most, an Annual EDE of 4.4×10^{-5} rem (4.4×10^{-4} mSv).

13. These timepieces have withstood harsh environments that are beyond normal use and have remained intact. Please refer to the original submission for this amendment for descriptions of the stresses various adventurers have placed on these timepieces.

14. According to Column III of the Table in §32.24, the dose must remain less than 7.5 rem to the whole body for use and disposal of a single unit or likely to accumulate in one location during marketing, distribution, installation or servicing. Since the timepieces will be in storage, they will not be in contact with the Hands and Forearms as for normal

use. There will be no dose from exposure since H-3 is a weak beta emitter. The only dose will be derived from inhalation of H-3. Attachment F, Table 2 calculates the inhalation dose from timepieces using an assumption the highest activity GTLS is crushed. Storage of up to 100 timepieces, each with a crushed GTLS, would create, at most, an Annual EDE of 4.4 X 10^{-5} rem (4.4 X 10^{-4} mSv). The probability is negligible that a person would receive an external dose or dose commitment in excess of the 200 rem limit identified in Column IV of the table in §32.24.

15. From Table 2, column [2], the estimated intake of HTO was 11.84 Bq/day for a timepiece up to 100 mCi. The Dose Conversion Factor is 1.7 X 10^{-11} Sv/Bq which, when combined would create a "daily" EDE to internal organs of 2.0 X 10^{-7} mSv. Multiplying this result by 365 days produced the 7.3 X 10^{-8} Sv Annual EDE. The result should have been 7.3 X 10^{-5} mSv after converting units.

However, our assumptions were incorrect causing two additional errors. The assumption was for tritium paint. The tritium paint is sealed with between the stainless steel case and crystal. Calculations were performed based on leakage from the timepiece. Table 2 has been modified below for tritium paint up to 150 mCi.

The calculations failed to account for the tritium in the current timepieces being encapsulated as a GTLS. All GTLS are sealed and then sealed again between the stainless steel case and crystal. Even though there have no reported ruptures of a GTLS, a worst case scenario would be a ruptured GTLS. In the table below, the highest activity GTLS was assumed to have ruptured and released all its H-3 in the timepiece. The equations creating Table 2 take into account the lower amount of tritium available for leakage out of the timepiece from a ruptured GTLS verses tritium paint. Calculations for Table 2 of the original amendment submission show that Annual EDE to internal organs is four orders of magnitude lower than a similar scenario with Tritium Paint. Table 2 has been modified to show both the original calculations assuming Tritium Paint and also calculations assuming GTLS.

Table 2. Skin Contact EDE During Routine Use

		[1]	[2]	[3]	[4]	[5]	[6]
	GTLS Sources	Leakage	HTO intake	Annual Dose Equivalent of contact area	Average annual dose equivalent to skin of whole body	Annual EDE to skin of whole body	Annual EDE to internal organs
GTLS sources	**GBq**	**Bq/h**	**Bq/day**	**mSv**	**mSv**	**mSv**	**mSv**
	1.37E-1	1.37	4.4E-1	2.9E-2	1.6E-5	1.6E-7	2.7E-6
	mCi	**mCi/h**	**mCi/h**	**rem**	**rem**	**rem**	**rem**
	3.7	1.0E-6	3.2E-7	2.9E-3	1.6E-6	1.6E-8	2.7E-7
H-3	**GBq**	**Bq/h**	**Bq/day**	**mSv**	**mSv**	**mSv**	**mSv**
	5.55	55.5	17.76	1.17	6.5E-4	6.5E-6	1.1E-4

Paint	**mCi**	**mCi/h**	**mCi/h**	**rem**	**rem**	**rem**	**rem**
	150	1500	480	31.54	1.8E-2	1.8E-4	3.0E-3

16. Column [6] of Table 4 was calculated in error. Step [6] used the Intake in Bq/day. The result in Column [6] came by multiplying 365 days to obtain an annual EDE. The result should have been multiplied by 100 watch repairs per year instead and by 1000 for unit conversion. The correct result should be 1.5 X 10^{-5} mSv.

However, for the same reasons mentioned in Questions 15, our assumptions were incorrect. Calculations for Table 4 of the original amendment submission show that Annual EDE to internal organs is five orders of magnitude lower than a similar scenario with Tritium Paint. Table 4 is provided with both the original calculations assuming Tritium Paint and also calculations assuming GTLS.

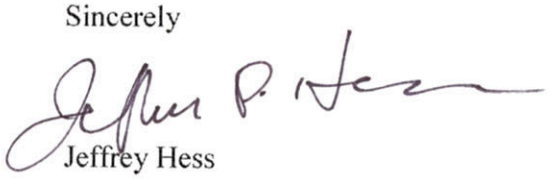
Table 4. Skin Contact EDE During Watch Repair

		[1]	[2]	[3]	[4]	[5]	[6]
	GTLS Sources	Leakage	HTO intake	Annual Dose Equivalent of contact area	Average annual dose equivalent to skin of whole body	Annual EDE to skin of whole body	Annual EDE to internal organs from 100 repairs
GTLS sources	**GBq**	**Bq/h**	**Bq/repair**	**mSv**	**mSv**	**mSv**	**mSv**
	1.37E-1	1.37	2.2E-1	1.3E-02	2.2E-06	2.2E-08	3.7E-10
	mCi	**mCi/h**	**mCi/repair**	**rem**	**rem**	**rem**	**rem**
	3.7	37.03	5.92	1.3E-03	2.2E-07	2.2E-09	3.7E-11
H-3 Paint	**GBq**	**Bq/h**	**Bq/repair**	**mSv**	**mSv**	**mSv**	**mSv**
	5.55	55.5	8.88	0.53	8.9E-05	8.9E-07	1.5E-05
	mCi	**mCi/h**	**mCi/repair**	**rem**	**rem**	**rem**	**rem**
	150	1500	240	5.3E-02	8.9E-06	8.9E-08	1.5E-06

17. The tritium in the GTLS is assumed to be 99% elemental H-3 and only 1% HTO. See NuReg-1717. Appendix A.1. The elemental H-3 can be ignored because it contributes insignificantly to the radiation dose received by the individual (see ICRP 68, Table C.1.). The highest activity GTLS contains 0.137 GBq which would consist of 1.37 MBq (37 uCi) HTO.

As an example of dose-to-source ratios for crushing of glass tubes, NuReg-1717, Table A.1.9. If the highest activity GTLS were crushed in a small watch repair shop, the committed EDE to an individual from inhalation of HTO over the following eight hours would be 6.4 X 10^{-6} rem/uCi time 37 uCi, or approximately 0.24 mrem (0.0024 mSv). This result would be consistent for all timepieces up to 150 mCi as long as the highest activity GTLS were below 0.137 GBq.

Sincerely

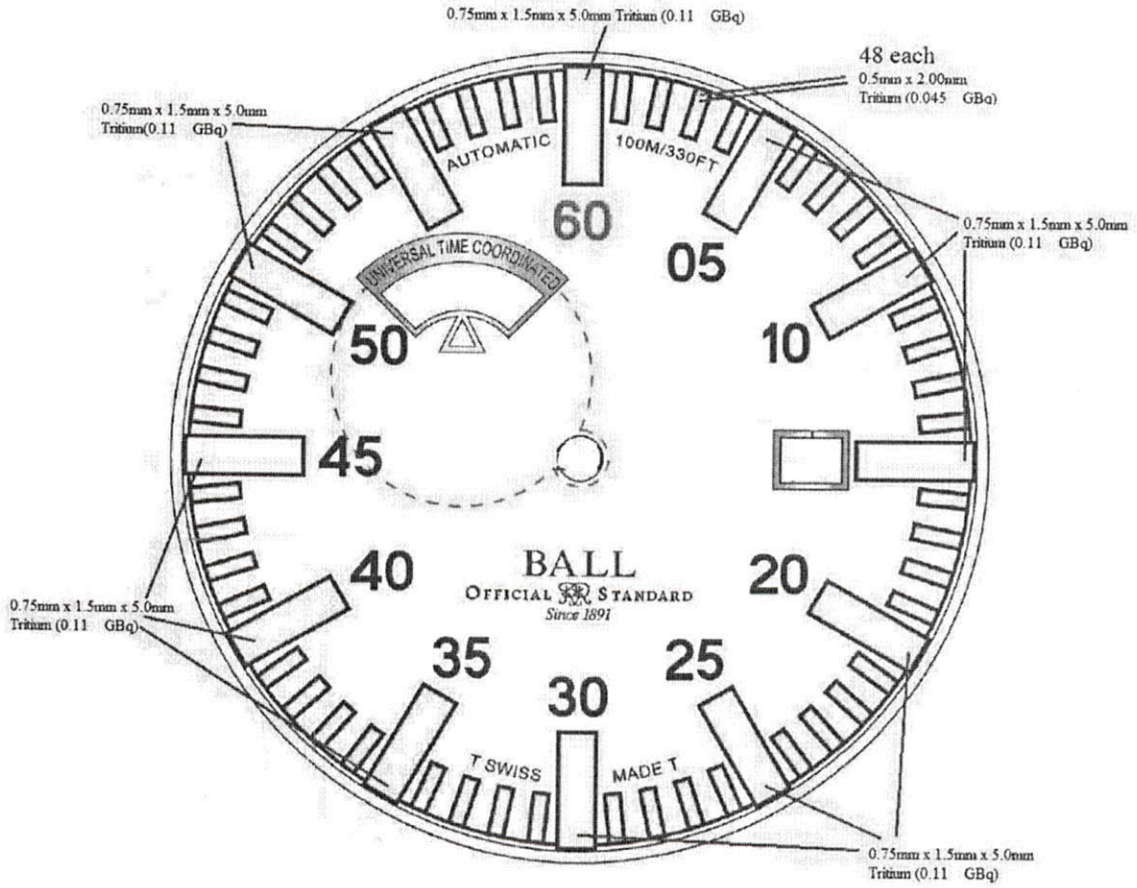


Jeffrey Hess
Hess Fine Art
1131 4th Street North
St. Petersburg, FL 33701

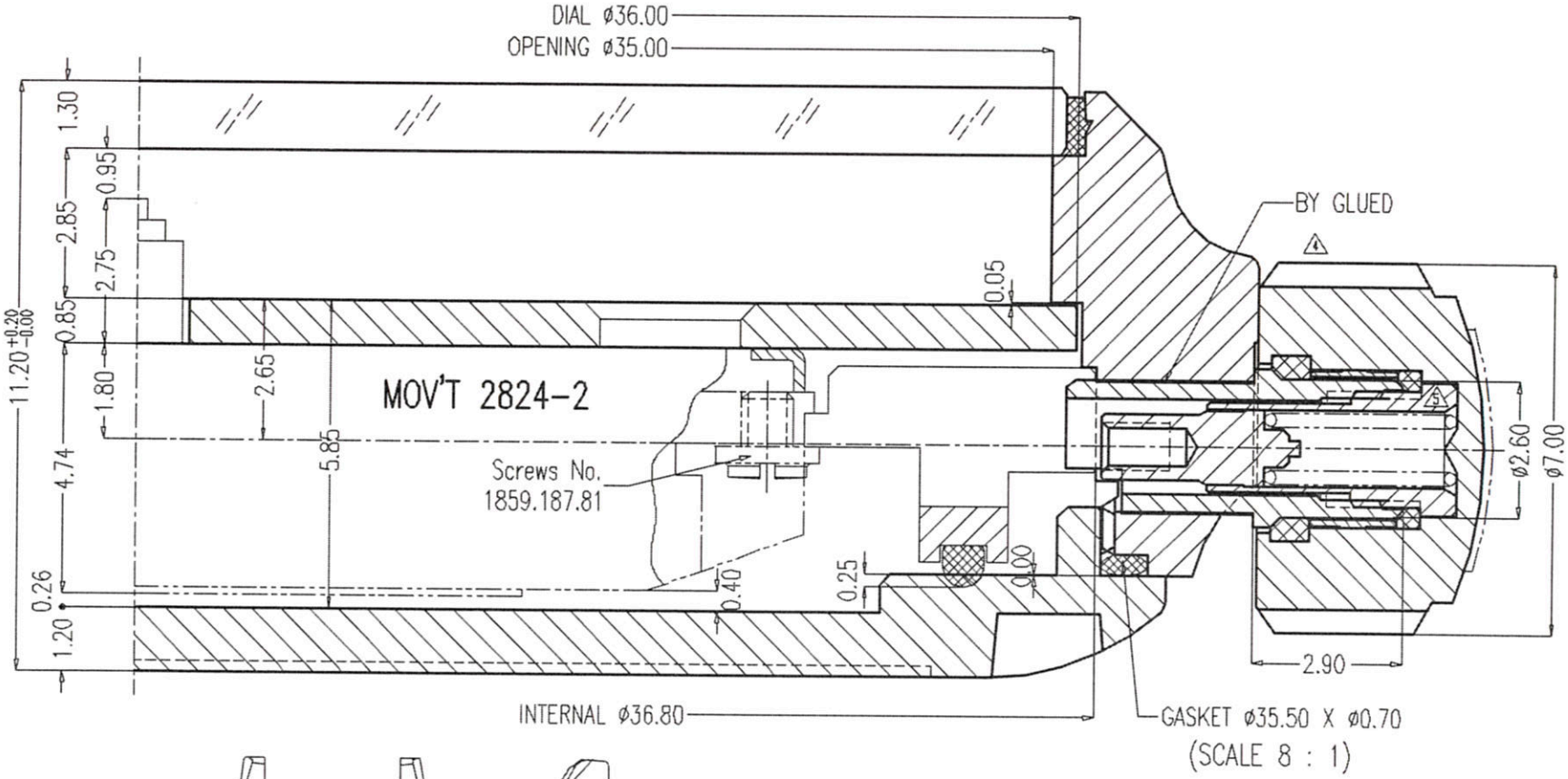
NM1092C
Dial

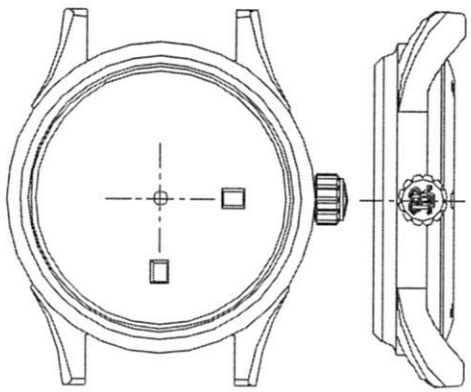
48 each	0.5mm x 2.00mm	(0.045 GBq)	total = 2.16	GBq Dial 1-12h
11 each	0.75mm x 1.5mm x 5.0mm	(0.11 GBq)	total = 1.21	GBq Dial 1-11h
1 each	0.75mm x 1.5mm x 5.0mm	(0.11 GBq)	total = 0.11	GBq Dial 12h

1 each	0.65mm x 4.10mm	(0.134 GBq)	total = 0.134	GBq Hour hand
1 each	0.50mm x 6.50mm	(0.137 GBq)	total = 0.137	GBq Minute hand
1 each	0.50mm x 1.64mm	(0.035 GBq)	total = 0.035	GBq Second hand



ATTACHMENT A

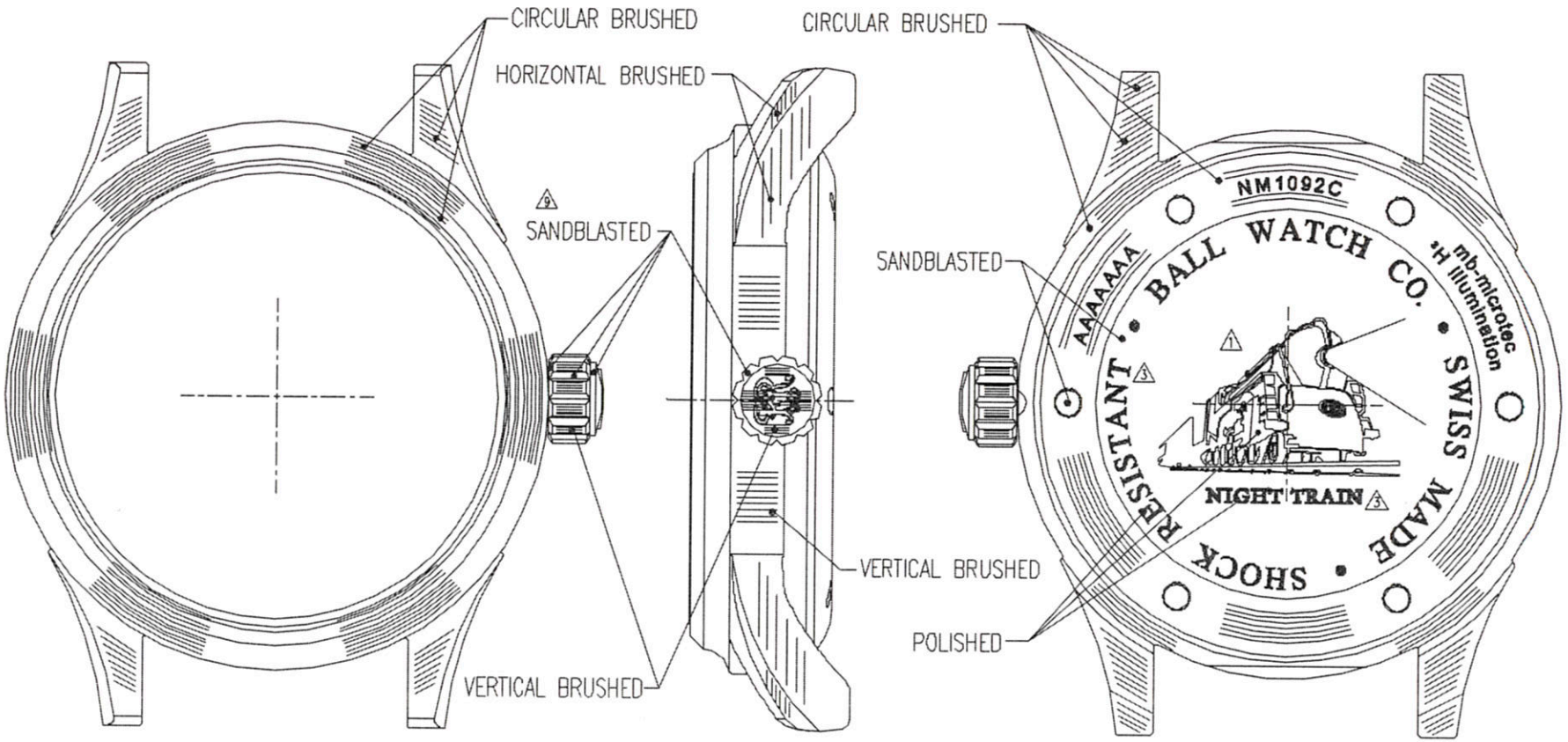


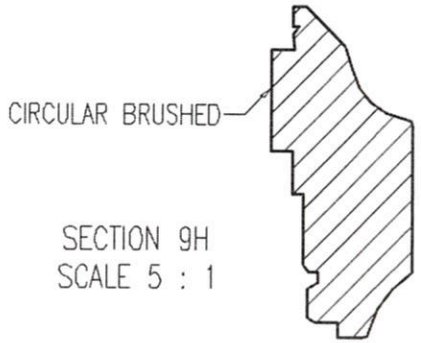


9	2009-04-11
8	2008-10-27
7	2008-07-23
6	2008-06-27
5	2008-04-29
4	2008-04-28
3	2007-06-01
2	2007-05-21
1	2007-05-08

LF LUEN FUNG WATCH CASE FACTORY LIMITED

CUSTOMER:	BALL	MODEL: 3775GS-C		DRAWER: Deng
YOUR MODEL:	NM1092C			DATE: 2007-03-31
MOVEMENT:	2824-2	A T M: 10	13 PAGES	CHECKER:





SECTION 9H
SCALE 5 : 1

9	2009-04-11
5	2007-06-01
1	2007-05-08

2009-04-11 Bin

3775GS-C	NM1092C	2824-2

INCH-POUND
MIL-PRF-46374G
12 November 1999
SUPERSEDING
MIL-W-46374F
14 October 1991

PERFORMANCE SPECIFICATION

WATCH, WRIST: GENERAL PURPOSE

This specification is approved for use by all Departments and Agencies of the Department of Defense.

1. SCOPE

1.1 Scope. This specification covers analog wrist watches intended for general use, that are intended to be continuously read, without any action required on the part of the wearer, for periods in excess of 8 hours in low or no light situations.

1.2 Classification. The watches are of the following types, classes, and colors, as specified (see 6.2).

1.2.1 Types. The types of wrist watches follow:

Type I - Analog, short life (2 years), non-maintainable, antimagnetic, water-resistant
Type II - Analog, long life (5-10 years), maintainable, antimagnetic, water-resistant, high altitude, corrosion-resistant
Type III - Analog, long life (5-10 years), maintainable, antimagnetic, water-resistant, high altitude, corrosion-resistant, with elapsed time ring

1.2.2 Classes. The classes of wrist watches follow:

Class 1 - Electrical movement, battery installed
Class 2 - Electrical movement, battery out of watch but packed with watch
Class 3 - Electrical movement, battery not included with watch
Class 4 - Mechanical movement, battery not required

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be used in improving this document should be addressed to: Defense Supply Center Richmond (DSCR), ATTN: DSCR-VBD, 8000 Jefferson Davis Highway, Richmond, VA 23297-5610 by using the Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

AMSC N/A FSC 6645

ATTACHMENT B

1.2.3 Colors.

Color M - Silvery metallic
Color B - Black

2. APPLICABLE DOCUMENTS

2.1 General. The documents listed in this section are specified in sections 3 and 4 of this specification. This section does not include documents cited in other sections of this specification or recommended for additional information or as examples. While every effort has been made to ensure the completeness of this list, document users are cautioned that they must meet all specified requirements documents cited in sections 3 and 4 of this specification, whether or not they are listed.

2.2 Government documents.

2.2.1 Standard. The following standard forms a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those listed in the issue of the Department of Defense Index of Specifications and Standards (DoDISS) and supplemented thereto, cited in the solicitation (see 6.2).

STANDARD

DEPARTMENT OF DEFENSE

MIL-STD-810E - Environmental Test Methods and Engineering Guidelines

(Unless otherwise indicated, copies of the above standard are available from the Standardization Document Order Desk, 700 Robbins Avenue, Building 4D, Philadelphia, PA 19111-5094.)

2.3 Order of precedence. In the event of a conflict between the text of this document and the references cited herein, the text of this document takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

3. REQUIREMENTS

3.1 Qualification. The watches furnished under this specification shall be products that are authorized by the qualifying activity for listing on the applicable qualified products list (QPL) before contract award (see 4.3 and 6.3).

3.2 Toxic chemicals, hazardous substances, and ozone depleting substances (ODS). The use of toxic chemicals, hazardous substances, or ODS shall be avoided, whenever feasible.

3.2.1 Toxicity. The finished product covered by this specification shall have no adverse effect on the health of personnel when used for its intended purpose.

3.3 Recycled, recovered, or environmentally preferable materials. Recycled, recovered, or environmentally preferable materials should be used to the maximum extent possible provided that the material meets or exceeds the operational and maintenance requirements, and promotes economically advantageous life cycle costs.

3.4 Design. There shall be a stem set movement driving concentrically mounted hour, minute, and second hands around a 12 hour dial. The dial background shall be black; the numbers and graduations shall be white. Arabic numerals 1 through 12 shall be adjacent to and inside the hour marks and arranged in a clockwise direction. Concentric with and adjacent to the numerals 1 through 12, in a smaller font, shall be the Arabic numerals 13 through 24. The 13 shall be adjacent to the 1 o'clock; the 14 shall be adjacent to the 2 o'clock; and continuing until the 24 is adjacent to the 12 o'clock. Manufacturer symbols or identification shall not appear on the dial.

3.4.1. Design approval. At the time of qualification testing, movement and case design shall be reviewed by and subject to the approval of the government. Manufacturer drawings, specifications, sample movements, sample cases, and supporting data, as applicable, shall be submitted for government approval in accordance with 4.6.5.1.

3.4.2 Movement.

3.4.2.1 Class 4 (mechanical).

3.4.2.1.1 Mechanical power. The movement shall be powered by a stem wound and stem set mainspring. When fully wound, the mainspring shall drive the complete movement a minimum of 36 hours without rewinding.

3.4.2.1.2 Jewel bearings, types II and III. The movement shall have 15 or more functional jewel bearings located at bearing points most essential to reduce friction and wear of the train and escapement parts.

3.4.2.2 Classes 1, 2 and 3 (electrical). Classes 1, 2 and 3 watches shall be powered by a self-contained electrical power cell. For type I classes 2 and 3, types II and III classes 1, 2 and 3 watches, the power cell shall be commercially available from a minimum of two manufacturers and shall contain orientation marks which identify the positive (+) side. Internal contacts for the power cell shall be made of, or plated with, material that shall not corrode. The electrically powered watch shall operate a minimum of 2 1/2 years without the necessity to change the battery.

3.4.3 Hand adjustment.

3.4.3.1 Hand setting. The minute hand shall not rotate (jump) at its tip, more than one tip width when the crown is moved from the setting position to the "winding" position after setting the hands.

3.4.3.2 Second hand stop mechanism. Pulling the stem, by means of the crown, to the setting position shall result in stopping the movement. Rotation of the stem, by turning the crown, shall permit the minute and hour hands to be advanced without any movement of the second hand. Depressing the stem, by pushing the crown, shall result in complete operation of the movement and hands. When the stem is pushed in, the watch shall start immediately.

3.4.4 Elapsed time ring, type III. There shall be an elapsed time ring concentric with the axis of the watch. The elapsed time ring shall be designed to assure that the outer edge (shoulder) of the crystal is recessed within the elapsed time ring. The background of the elapsed time ring shall be the same shade of black as the background of the dial. The numbers and graduations shall be the same shade of white as that on the dial. Around the ring there shall be 12 hour marks equally spaced around the dial. Except for the number 12, all the marks shall be numerals starting with 1 and progressing clockwise to 11. The number 12 shall be replaced by a luminous mark. Between the 12 o'clock and 1 o'clock, 1 o'clock and 2 o'clock, 2 o'clock and 3 o'clock, and the 3 o'clock and 4 o'clock marks, there shall be four equally spaced minute marks. The periphery of the elapsed time ring shall be made rough by checkering, knurling, serrating or any method that shall facilitate the turning of the ring. The elapsed time ring shall move only when a torque of 180 ± 40 mNm (26 ± 6 inch-ounces) is applied both in the clockwise and counterclockwise directions. The elapsed time ring shall be capable of withstanding, without damage, two forces, each of 44.5 ± 2 N (10 ± 1/2 pounds), applied to the lower side of the elapsed time ring with the 12 o'clock luminous mark at the 3 o'clock position.

3.4.5 Case bars, types II and III. A watch strap shall be attached to the watch case at both ends by means of integral bars or removable spring bars. A static pull of 67 ± 2 N (15 ± 1/2 pounds) on the watch strap from each end of the case shall cause no damage.

3.4.6 Crystal strength. Crystals, that have been assembled to the case and that have been subjected to the storage environment of table I, shall be visually inspected and tested for strength. When visually inspected, the crystals shall be transparent, uncolored, and free from bubbles, striae, scratches, chips or other imperfections that may interfere with reading the watch. When functionally tested, the crystal shall show no visible damage of cracking or chipping.

3.4.7 Strap. The strap color shall be black.

TABLE I. Operating environment.

Environment	Limits	Duration
Simple harmonic vibration	Amplitude of 0.762 ± 0.127 mm (1.524 ± 0.254 mm total excursion) Amplitude of 0.030 ± 0.005 inch (0.060 ± 0.010 inches total excursion) Frequencies varied uniformly between 30 Hz to 60 Hz to 30 Hz	20 minutes with vibration perpendicular to dial 20 minutes with vibration in plane of dial and in direction from 12 to 6 20 minutes with vibration in plane of dial and in direction from 9 to 3
Shock	Drop from height of 50 cm (19.7 inches), uncontrolled, onto vinyl tile 3 mm (1/8 inch) thick affixed to concrete block	Once
Storage	-45 ℃ ± 1.1 ℃ (-50 ℉ ± 2 ℉) 15.5 ℃ to 32.2 ℃ (60 ℉ to 90 ℉) 60 ℃ ± 1.1 ℃ (140 ℉ ± 2 ℉) and ≥50 percent relative humidity 15.5 ℃ to 32.2 ℃ (60 ℉ to 90 ℉)	24 hours 24 hours 24 hours 24 hours
Water resistance	Complete immersion in distilled water with approximately 1 percent by weight wetting solution under one atmosphere (14.7 psi) and at room temperature Complete immersion in distilled water with approximately 1 percent by weight wetting solution under three atmospheres (44.1 psi) and at room temperature	5 minutes 5 minutes
Water leakage	Submerged in a measured volume of distilled or deionized water, equal to approximately 10 times the volume of the watch, at 23 ℃ ± 1 ℃ (73 ℉ ± 3 ℉)	24 hours
Magnetism, type I	14.5 to 15.5 Gauss magnetic field, stem parallel to direction of field	10 cycles of 3 seconds on - 3 seconds off
Magnetism, types II and III	125 ± 1 Gauss magnetic field, stem parallel to direction of field	10 minutes

TABLE I. Operating environment. - Continued

Environment	Limits	Duration
Altitude, types II and III	Altitude of 10,700 meters (35,000 feet)	60 minutes
Salt fog, types II and III	Salt fog test Method 509.3, MIL-STD-810	48 hours
Human perspiration resistance, types II and III	Immerse watch in a saturated sodium chloride solution containing 5 percent by volume lactic acid (65 strength) at 91 ℃ ±1 ℃ (196 ℉ ±2 ℉) Air dry Store in atmosphere produced by a 50 percent solution of glacial acetic acid	Instantaneous 2 hours 20 hours
Readability in total darkness	After having been stored in total darkness for 8 hours, and without any intervention on the part of the user, watch shall be readable in total darkness	8 hours

3.4.8 Case markings. The back of the case shall be marked with the information shown in table II.

TABLE II. Case markings.

Item	Descriptive title
Title and specification number	WATCH, WRIST: GENERAL PURPOSE, MIL-PRF-46374G
National stock number	NSN
Amount of radioactive material	MILLICURIES
Nuclear Regulatory Commission manufacturer identification number	NRC MFR ID NO.
Contract number	CONT NO.
Date	DATE
Serial number	SERIAL NO.
Manufacturer CAGE code	MFR CAGE CODE

Note: The national stock number, contract number, and date may be applied without the descriptive titles. The amount of radioactive material and the Nuclear Regulatory Commission manufacturer identification number are necessary only if there is radioactive material present. The marking of the month shall be the first three letters of the month and the marking of the year shall be the year in full, e.g. April 2009 would be "APR 2009". For type I class 3, types II and III class 3, and all class 4 watches, the date (month and year) shall be date of award of contract. For all other watches, the date (month and year) shall be date of assembly. Only type I class 3 and all class 4 watches shall be serialized. The serial numbers shall be assigned by the contractor. Serial

numbers of rejected watches shall not be repeated. For class 3 and 4 watches, the manufacturer's name and model or grade number shall be marked on the movement (barrel bridge, train bridge or both).

3.4.9 Case.

3.4.9.1 Battery servicing. For type I classes 2 and 3 and types II and III classes 1, 2, and 3 watches, the power cell shall be replaceable without damaging the watch such that it would not be able to meet all the performance characteristics of 3.5.

3.4.9.2 Finish and color. All visible exterior surfaces of the case assembly, excluding control switches and spring type case bars, shall have a dull non-specular/non-reflective finish. The color shall be silvery metallic or black as specified in the acquisition requirements (see 6.2).

3.5 Performance characteristics.

3.5.1 Vibration. While running, the watch shall not be damaged after being subjected to the vibration environment of table I.

3.5.2 Shock. While running, the watch shall not be damaged after being subjected to the shock environment of table I.

3.5.3 Storage. For class 1 watches, while running, the watch shall not be damaged after being subjected to the storage environment of table I. For class 2 watches, both the watch and its battery (battery not installed) shall be simultaneously subjected to the storage environment of table I. For class 2 watches, at the conclusion of the storage test, the battery shall be installed in the watch and the watch shall run without any evidence of damage. For class 3 watches, the watch shall not be damaged after being subjected to the storage environment of table I. Class 4 watches shall not be run during test.

3.5.4 Water resistance. The watch shall show no evidence of leakage after being subjected to the water resistance environment of table I.

3.5.5 Water leakage. While running, the watch shall not be damaged after being subjected to the water leakage environment of table I. After the watches are removed from the water, if there is any water in the crystal bowl at the completion of the test, it shall constitute a failure of the water resistance test. (This test may be done concurrently with the radiological diffusion test in 3.6.3.)

3.5.6 Synchronization. The hour hand shall indicate the correct time within ±1 dial graduation when the minute hand is at 12. To determine compliance, the setting mechanism shall be activated and readings taken when the minute hand is at 12 and the hour hand is at the 3, 6, 9 and 12 hour positions respectively.

3.5.7 Magnetism. While running, the watch shall not be damaged after being subjected to the magnetic environment of table I.

3.5.8 Dark viewing. After being subjected to the readability in total darkness environment of table I, and without any intervention on the part of the observer, the luminous features of the watch shall be of sufficient brightness so as to be readable in total darkness while holding the watch no closer than 30.5 cm (12 inches) from the eyes of a dark-adapted observer having normal or corrected 20/20 vision.

3.5.9 Isochronism. Watches shall pass the test for isochronism specified in 4.6.5.16, in a dial-up position at 23.9 ℃ ± 1 ℃ (75 ℉ ± 3 ℉).

3.5.9.1 Type I class 4. The watch shall be fully wound and operated for 4 hours. The watch shall again be fully wound. The rate shall be recorded while fully wound and then at the end of the 4th, 20th and 24th hours. The difference in uniformity of rates between 4-hour periods shall not exceed 10 seconds.

3.5.9.2 Types II and III class 4. The variation in rate shall be recorded every 6 hours for a period of 24 hours and shall not exceed 5 seconds from the rate recorded in the previous 6 hour period. The watches shall be fully wound prior to testing and shall not be wound during the test.

3.5.10 Accuracy. After being subjected to all of the environments of table I, the mean daily rates of the watch in each of the two positions of (1) dial-up and (2) crown-down shall not exceed the values at the temperatures specified in table III.

TABLE III. Accuracy.

Temperature	Type I, Class 4	Types II and III, Class 4	Types I, II and III, Classes 1, 2, and 3
	Mean daily rate (Seconds per day)	Mean daily rate (Seconds per day)	Mean daily rate (Seconds per day)
4.4 ℃ ± 1.1 ℃ (40 ℉ ± 2 ℉)	±120	±60	±3
23.9 ℃ ± 1.1 ℃ (75 ℉ ± 2 ℉)	±60	±30	±0.7
51.7 ℃ ± 1.1 ℃ (125 ℉ ± 2 ℉)	±120	±60	±3

3.5.11 Long term accuracy (Qualification only). Accuracy shall be determined during a 90 day period as specified in 4.6.5.24. During the 90 day period of operation, watches shall be subjected to vibration and shock after 30 days and 60 days of operation in accordance with 3.5.1 and 3.5.2, except that duration of vibration shall be for only 5 minutes in each direction. Watches shall meet the criteria of table IV.

3.5.12 Altitude. Types II and III watches shall show no evidence of damage or adverse effect on operation when subjected to the altitude environment of table I.

3.5.13 Salt fog. Types II and III watches shall show no evidence of damage to the crystal, the case, or the watch band or adverse effect upon operation after having been subjected to salt atmosphere in accordance with the salt fog environment of table I.

TABLE IV. Long term accuracy.

Type	Average mean daily rate (Seconds per day)	Mean daily rate (Seconds per day)
Type I, class 4	72	120
Types II and III, class 4	36	60
Types I, II and III, classes 1, 2, and 3	2.4	4

3.5.14 Human perspiration resistance. Types II and III watches and their watch bands shall show no evidence of corrosion, discoloration, or staining after having been subjected to an accelerated lactic acid test in accordance with the human perspiration environment of table I.

3.6 Radiological performance. (NOTE: Section 3.6 is applicable only if nuclear material is present.)

3.6.1 Contamination. Completed watches shall be tested for contamination after having been subjected to all the environments of table I. They shall be wiped with a Metricel GN-6 or equivalent wipe, moistened with deionized or distilled water. Within 1 minute of wiping, the wipe shall be placed in a scintillation counter. Each resulting wipe shall indicate a removable contamination level of not more than 100 disintegrations per minute (dpm).

3.6.2 Long term contamination (Qualification only). Completed watches shall be packaged in accordance with 5.1 for a period of not less than 90 days. They shall then be wiped with a Metricel GN-6 or equivalent wipe moistened with deionized or distilled water. Within 1 minute of wiping, the wipe shall be placed in a scintillation counter and the disintegrations measured. Each resulting wipe shall indicate a removable contamination level of not more than 100 dpm.

3.6.3 Diffusion. Completed watches shall be submerged in a measured volume of distilled or deionized water, equal to approximately 10 times the volume of the watch, for 24 hours at 23 ℃ ± 1 ℃ (73 ℉ ± 3 ℉). The watches shall then be removed from the water and the water measured for radioactive content. The diffusion of contamination into the water shall not exceed 50 nanocuries per 24 hour period (see 3.5.5).

3.7 Workmanship. All parts shall be furnished so the case and crown shall have no sharp edges or corners which could cause skin cuts or abrasions. All lugs from the tip of the lug to the body of the bezel shall have corners rounded to avoid skin abrasion. Rounded edges and corners shall be uniform in appearance.

3.8 Operating instructions. An operating instruction shall be furnished with each watch. This instruction shall describe all the functions of the watch, the durability (i.e., shock and water resistance features), life expectancy, and accuracy that can be expected from the watch, type battery and any precautions that should be observed during the life of the watch.

4. VERIFICATION

4.1 Classification of inspections. The inspection requirements specified herein are classified as qualification inspection (see 4.3) and conformance inspection (see 4.4).

4.2 Inspection conditions. Unless otherwise specified, all inspections shall be performed at 15.6 ℃ (60 ℉) to 32.2 ℃ (90 ℉), at barometric pressure of 710 mm (28 inches) to 790 mm (31 inches) of mercury and maximum relative humidity of 80 percent.

4.3 Qualification inspection. Qualification inspection shall be performed on five complete assemblies when a qualification sample is required (see 3.1). This inspection shall include the examination of 4.5, in accordance with tables V through IX, and the tests of 4.6. (The table IX tests, however, are exclusive to Qualification testing.)

4.3.1 Qualification sample. A quantity of 20 watches shall be submitted for qualification testing (see 6.3). Testing shall be performed at a laboratory facility acceptable to the government. Sample watches submitted for testing shall be derived from normal production and be indicative of normal production equipment and procedures. Ten of the watches shall be packed in accordance with the level of packing specified in the purchase order or contract. The 20 watch samples shall be identified by an attached tag containing the following information:

a. Sample for qualification tests
b. Submitted by (name) (date) for qualification tests in accordance with requirements of MIL-PRF-46374G under authorization of (reference letter authorizing test)
c. Manufacturer's model or part number
d. Name of manufacturer

4.4 Conformance inspection. Conformance inspection shall be performed in accordance with inspection provisions set forth herein. The characteristics shown in tables V, VI, VII and VIII shall constitute minimum inspections to be performed by the supplier prior to government acceptance or rejection by item or lot.

4.5 Examination.

4.5.1 Conformance inspection, mechanical. Inspection shall be in accordance with table V.

TABLE V. Conformance inspection, mechanical.

Characteristic	Requirement	Test
Crystal strength	3.4.6	4.6.1.1
Strap	3.4.7	4.6.2
Battery servicing	3.4.9.1	4.6.3.1
Finish and color	3.4.9.2	4.6.3.2

4.5.2 Conformance inspection, radiological. Inspection, if applicable, shall be in accordance with table VI.

TABLE VI. Conformance inspection, radiological.

Characteristic	Requirement	Test
Contamination	3.6.1	4.6.4.1
Diffusion	3.6.3	4.6.4.2

4.5.3 Conformance inspection, materials and design. Inspection shall be in accordance with table VII.

TABLE VII. Conformance inspection, materials and design.

Characteristic	Requirement				Test
	Type I		Types II and III		
	Classes 1, 2, 3	Class 4	Classes 1, 2, 3	Class 4	
Design	3.4	3.4	3.4	3.4	4.6.5
Design approval	3.4.1	3.4.1	3.4.1	3.4.1	4.6.5.1
Mechanical power	---	3.4.2.1.1	---	3.4.2.1.1	4.6.5.2
Jewel bearings	---	---	---	3.4.2.12	4.6.5.3
Electrical power	3.4.2.2	---	3.4.2.2	---	4.6.5.4
Hand adjustment	3.4.3	3.4.3	3.4.3	3.4.3	4.6.5.5
Hand setting	3.4.3.1	3.4.3.1	3.4.3.1	3.4.3.1	4.6.5.5.1
Second hand stop mechanism	3.4.3.2	3.4.3.2	3.4.3.2	3.4.3.2	4.6.5.5.2
Elapsed time ring (Type III only)	---	---	3.4.4	3.4.4	4.6.5.6
Case bars	---	---	3.4.5	3.4.5	4.6.5.7
Case markings	3.4.8	3.4.8	3.4.8	3.4.8	4.6.5.8

4.5.4 Conformance inspection, performance. Inspection shall be in accordance with table VIII.

TABLE VIII. Conformance inspection, performance.

Characteristic	Requirement				Test
	Type I		Types II and III		
	Classes 1, 2, 3	Class 4	Classes 1, 2, 3	Class 4	
Vibration	3.5.1	3.5.1	3.5.1	3.5.1	4.6.5.9
Shock	3.5.2	3.5.2	3.5.2	3.5.2	4.6.5.10
Storage	3.5.3	3.5.3	3.5.3	3.5.3	4.6.5.11
Water resistance	3.5.4	3.5.4	3.5.4	3.5.4	4.6.5.12
Water leakage	3.5.5	3.5.5	3.5.5	3.5.5	4.6.4.2
Synchronization	3.5.6	3.5.6	3.5.6	3.5.6	4.6.5.13
Magnetism	3.5.7	3.5.7	---	---	4.6.5.14.1
Magnetism	---	---	3.5.7	3.5.7	4.6.5.14.2
Dark viewing	3.5.8	3.5.8	3.5.8	3.5.8	4.6.5.15
Isochronism	---	3.5.9.1	---	---	4.6.5.16.1
Isochronism	---	---	---	3.5.9.2	4.6.5.16.2
Accuracy	3.5.10	3.5.10	3.5.10	3.5.10	4.6.5.17
Altitude	---	---	3.5.12	3.5.12	4.6.5.18
Salt fog	---	---	3.5.13	3.5.13	4.6.5.19
Human perspiration resistance	---	---	3.5.14	3.5.14	4.6.5.20
Workmanship	3.7	3.7	3.7	3.7	4.6.5.21
Operating instructions	3.8	3.8	3.8	3.8	4.6.5.22

4.5.5 Qualification inspection. Inspection shall be in accordance with table IX.

TABLE IX. Qualification inspection.

Characteristic	Requirement - Types I, II and III	Test
Long term contamination	3.6.2	4.6.5.23
Long term accuracy	3.5.11	4.6.5.24

4.5.6 Noncompliance. If a sample fails to pass table VI inspection, the contractor shall immediately notify the cognizant Contracting Activity of such failure and take corrective action on the materials or processes, or both, and on all units produced which can be corrected and which are considered subject to the same failure. Acceptance and shipment of the product shall be discontinued until corrective action, acceptable to the Contracting Activity, has been taken. After the corrective action has been taken, table VIII inspections may be reinstituted; however, final acceptance and shipment shall be withheld until the table VI inspection has shown that the corrective action was successful. In the event of failure after reinspection, information concerning the failure shall be furnished to the cognizant inspection and qualifying activities.

4.6 Test methods.

4.6.1 Crystals. Crystals shall be examined after assembly to the case and after being subjected to the storage environment of table I to determine compliance with 3.4.6.

4.6.1.1 Crystal strength test. The crystals shall be functionally tested as follows: The case assembly, including crystal, shall be placed flat, crystal up, on a rubber sheet 0.5 mm (0.02 inch) thick, placed on a horizontal, rigid nonresilient, metal surface. A solid steel sphere weighing 15.7 ± 1.4 grams (0.55 ± 0.05 ounces) and 1.6 cm (five-eighths of an inch) in diameter shall then be freely dropped so as to fall 30.5 cm (12 inches) before striking the crystal. Any visible damage to the crystal shall be cause for rejection.

4.6.2 Strap. The strap shall be examined for compliance with 3.4.7.

4.6.3 Case.

4.6.3.1 Battery servicing. The case shall be visually inspected to determine the conformance to 3.4.9.1. A physical test shall be applied where case parts are not capable of being removed to determine conformance to 3.4.9.1. The physical test shall consist of applying a force or prying under normal pressure (equivalent to 40.5 ± 4.5 N (9 ± 1 pounds) direct force) in such a manner that no marking or scarring of the case and case finish shall result.

4.6.3.2 Finish and color. The case shall be visually inspected to determine the conformance to 3.4.9.2.

4.6.4 Radiological.

4.6.4.1 Contamination. Completed watches shall be checked for contamination in accordance with 3.6.1. A Metricel GN-6 or equivalent wipe, moistened with deionized or distilled water, shall be used to wipe the watches. All exterior surfaces of the completed watch shall be thoroughly wiped. The wipe shall be placed in the liquid scintillation solution within 1 minute after wiping each watch. The amount of radiological contamination on the wipe shall be determined using a liquid scintillation counting technique. Results indicating removable contamination over the entire watch of more than 100 dpm shall constitute failure of this test.

4.6.4.2 Diffusion and water leakage. Completed watches shall be checked for diffusion in accordance with 3.6.3 and water leakage in accordance with 3.5.5. They shall be submerged in a measured volume of distilled or deionized water, equal to approximately 10 times the volume of the watch, for 24 hours at 23 °C ± 1 °C (73 °F ± 3 °F). Watches shall be removed from the water. This is the test procedure for radiological diffusion, and if the radioactive content of the water exceeds 50 nanocuries per 24 hour period, it shall constitute failure of the test. The watches shall also be examined for water leakage, and if there is water in the crystal bowl at the completion of the test, it shall constitute failure of the water resistance test. Failure of watches in either of these tests shall be cause for refusal by the government to continue acceptance of the

production watches until evidence has been provided by the contractor that corrective action has been taken to eliminate the deficiencies.

4.6.5 Design. The watch shall be visually examined for conformance to 3.4.

4.6.5.1 Design approval. Manufacturing data on movement and case design shall be forwarded to the government activity identified in 6.3 (see 3.4.1).

4.6.5.2 Mechanical power. Movement identity, design and construction (stem mount and stem set) shall be determined prior to qualification testing for compliance with 3.4.2.1.1. With the watch fully wound, it shall be examined for continuous running, without rewinding, for the minimum time specified in 3.4.2.1.1.

4.6.5.3 Jewel bearings. One percent of the watches under contract, but not less than three watches, shall be examined to ensure the watches contain the appropriate number of jewels placed at the most critical friction points, and are in compliance with 3.4.2.1.2.

4.6.5.4 Electrical power. Movement identity, design, construction, availability and marking of the power cell shall be determined prior to qualification testing for compliance with 3.4.2.2. The watch shall be tested to ensure that the current drain allows an operating life as specified in 3.4.2.2. The watch shall be measured with a current meter to determine the timekeeping current drain. To allow sufficient latitude in available power, the capacity of the power cell as measured in milliampere-hours (ma hours) shall be derated by 20 percent to obtain the net power capacity of the power cell. The comparison of power drain from the watch to the power capacity of the derated power cell shall be made to ensure that a minimum life of 30 months can be obtained from the power cell. The internal contacts for the cell shall be inspected for conformance with 3.4.2.2.

4.6.5.5 Hand adjustment. A standard type pull gauge with appropriate adapter shall be used to apply the pull specified in 3.4.3. The crown shall not be damaged or separated from the movement when the pull is applied.

4.6.5.5.1 Hand setting. To ensure compliance with the hour and minute "hand" setting of 3.4.3.1, six settings shall be made in 2-hour increments.

4.6.5.5.2 Second hand stop mechanism. To ensure compliance with the second hand stop mechanism of 3.4.3.2, the second hand setting mechanism shall be activated for at least five different settings, to ensure that a precise stop and start action can be obtained without adverse effect on the hands or movement.

4.6.5.6 Elapsed time ring, type III. The elapsed time ring shall be examined for conformance to 3.4.4. The elapsed time ring shall move only when subjected to a torque applied clockwise and counterclockwise of 180 ± 40.0 mNm (26 ± 6 inch-ounces). With the index at the 3 o'clock position of the dial, a force of 44.5 ± 2 N (10 ± 1/2 pounds) shall be applied to the lower side of the elapsed time ring without the ring being damaged or separated from the case.

4.6.5.7 Case bars, types II and III. Type II and III case bars shall be checked for conformance to 3.4.5. With the watch held in a secured position and the strap held in a position that shall not exert pressure on the buckle or the keeper of the strap, a pulling force of 67 ± 2 N (15 ± 1/2 pounds) shall be applied to each case/spring bar via the strap without the case/spring bar permanently bending, loosening or causing damage to the case/spring bar or case assembly.

4.6.5.8 Case markings. All numbers and lettering shall be visually inspected for correctness, legibility, and application in accordance with 3.4.8. Inspection for permanent marking shall ensure that acceptable processes have been applied, such as: Casting, molding, steel stamp, acid, etching, or engraving.

4.6.5.9 Vibration. The watch shall be vibrated in accordance with 3.5.1.

4.6.5.10 Shock. In compliance with 3.5.2, while running, the watch shall be dropped from a height of 50 cm (19.7 inches), uncontrolled, onto vinyl tile 3 mm (one-eighth of an inch) thick affixed to concrete block. At the conclusion of this test, the watch shall be running and be subjected to a visual and tactile examination in compliance with 3.4.6 for any crystal damage or loose, missing or damaged parts. After passing this examination, the watch shall be subjected to the test in 4.6.5.11.

4.6.5.11 Storage. In compliance with 3.5.3, the watch shall be subjected to storage temperatures for the times and in the order shown in table I. (Unless otherwise specified, the humidity is the ambient humidity.) Temperature changes in the watch may be gradual to avoid thermal shock. All watches shall have the battery in the watch. There shall be no evidence of physical defects, damage on the watch, or imperfections of crystal. After passing this test, the watch shall be subjected to and meet the requirements of 3.5.10. NOTE: The mechanical watches shall not be run during storage tests.

4.6.5.12 Water resistance. The watch shall be examined to determine conformance with 3.5.4. The watch shall be tested by immersing it completely for at least 5 minutes in distilled water containing a wetting agent of approximately 1 percent by weight at room temperature and atmospheric pressure of 1 atmosphere (14.7 pounds per square inch) for 5 minutes. For an additional 5 minutes, the watch shall be immersed under a pressure of 3 atmospheres (44.1 pounds per square inch). The watch interior shall then be inspected for moisture by placing it on a heating element at 40.6 ℃ ± 1 ℃ (105 ℉ ± 2 ℉) for 5 minutes, then placing several drops of 21 ℃ ± 1 ℃ (70 ℉ ± 2 ℉) water on the center of the crystal. Any visible condensed water (fogging) on the inside of the crystal constitutes failure of this test.

4.6.5.13 Synchronization. The watch shall be examined to determine conformance with 3.5.6. The setting mechanism shall be activated and readings taken when the minute hand is at 12 and the hour hand is at the 3, 6, 9 and 12 hour respectively, to determine compliance with 3.5.6.

4.6.5.14 Magnetism. A magnetic field shall be generated electrically using standard test equipment capable of developing the magnetic intensity (in Gauss) within the limits specified in 3.5.7. With the watch running, it shall be placed into the energized field in the manner specified in

4.6.5.14.1 or 4.6.5.14.2 as applicable, with the stem parallel to the direction of the field. Upon completion and removal from the field, the watch shall be rated by a precision type rate recorder to determine compliance with 3.5.7.

4.6.5.14.1 Magnetism - type I. Watches shall be subjected to the field specified in 3.5.7, with the field on for 3 seconds and off for 3 seconds. This cycle shall be repeated 10 times.

4.6.5.14.2 Magnetism - types II and III. Watches shall be subjected to the field specified in 3.5.7, for 10 minutes.

4.6.5.15 Dark viewing. A dark room shall be used to represent total darkness when conducting the visual examination under the conditions and distance specified in 3.5.8 to determine compliance therewith. Watches shall be in the dark room for at least 8 hours prior to conducting examinations. Individual(s) performing the test shall be acclimated to the dark room for a minimum of 20 minutes prior to conducting the test. There shall be no intervention required, for example, by pushing a button, on the part of the individual in order to read the watch. This test shall be performed no sooner than 60 days after assembly of watches.

4.6.5.16 Isochronism (class 4 only). This test shall be conducted concurrently with 4.6.5.17 (see 3.5.9).

4.6.5.16.1 Type I. In the position and at the temperature specified in 3.5.9, the watch shall be fully wound and operated for 4 hours. The watch shall again be fully wound and the rate recorded while fully wound and after 4 hours of operation. The rates shall again be recorded at the 20th and 24th hour. The difference in uniformity of rate between the 4-hour periods shall not exceed 10 seconds.

4.6.5.16.2 Types II and III. This test shall vary from 4.6.5.17 in that the error shall be determined at 6-hour intervals. The difference of error recorded between each 6-hour period shall not exceed 5 seconds.

4.6.5.17 Accuracy. During the conditioning period, the running watches shall be subjected to the test temperatures of table III for at least 4 hours prior to the test. Daily rates shall be recorded for a period of 3 days in each position and the mean daily rate determined therefrom. The watches shall be rejected if the mean daily rate exceeds the requirements of 3.5.10. The mechanical type watches shall be wound at the beginning of each test and each 24 hours thereafter for the duration of the tests (see 4.6.5.16).

4.6.5.18 Altitude - types II and III. Watches shall be subjected to the operating environment specified in 3.5.12.

4.6.5.19 Salt fog - types II and III. Watches shall be subjected to the operating environment specified in 3.5.13. Upon completion of exposure to salt fog, the watches shall be rinsed and allowed to dry for 48 hours prior to examination.

4.6.5.20 Human perspiration resistance types II and III. Watches shall be subjected to the operating environment specified in 3.5.14.

4.6.5.21 Workmanship. Watches shall be inspected by visual and tactile means to ensure that watches are continually produced in accordance with 3.7.

4.6.5.22 Operating instructions. The operating instructions shall be examined for conformance to 3.8.

4.6.5.23 Long term contamination (Qualification only). Ten watches, packaged in accordance with 6.2 and held in storage for a period of not less than 90 days, shall be subjected to the test in 4.6.4.1 and shall pass the requirements in 3.6.2.

4.6.5.24 Long term accuracy (Qualification only). This test shall only be conducted on watches submitted in conformance with 4.3 to determine compliance with 3.5.11. Each watch shall have met all other conformance requirements and tests herein prior to being subjected to the long term accuracy test. The test shall be conducted at 24.0 °C ± 1.7 °C (75 °F ± 3 °F) for a total running time of 90 days, half of which time shall have been in a dial-up and half in a crown-down position, alternated at 7-day intervals. In consideration of the normal work week of testing personnel, testing need not be continuous. The mean daily rate for any "individual" watch shall meet the accuracy specified in 3.5.11.

5. PACKAGING

5.1 Packaging. For acquisition purposes, the packaging requirements shall be as specified in the contract or order (see 6.2). When actual packaging of material is to be performed by DoD personnel, those personnel need to contact the responsible packaging activity to ascertain requisite packaging requirements. Packaging requirements are maintained by the Inventory Control Point's packaging activity within the Military Department or Defense Agency, or within the Military Department's System Command. Packaging data retrieval is available from the managing Military Department's or Defense Agency's automated packaging files, CD-ROM products, or by contacting the responsible packaging activity.

6. NOTES

6.1 Intended use. Three types of watches are covered by this specification. Types I and II are general purpose watches intended for use in low or no light situations. Type III watch is intended for use by bomber pilots and navigators in low or no light situations on prolonged flights. The intended use, available maintenance and storage of the watch will determine which type of watch is required.

6.1.1 Military unique. The watch covered by this specification is military unique. It has the unique military requirement of being able to be read after 8 hours in total darkness without any intervention on the part of the user, for example, by the push of a button. No commercial equivalent exists.

6.1.2 Type selection criteria. The following criteria is a guide for watch type selection to match user requirements:

Type I: Analog, short life (2 years), non-maintainable, antimagnetic, water-resistant
Type II: Analog, long life (5-10 years), maintainable, antimagnetic, water-resistant, high altitude, corrosion-resistant
Type III: Analog, long life (5-10 years), maintainable, antimagnetic, water-resistant, high altitude, corrosion-resistant, with elapsed time ring

6.2 Acquisition requirements. Acquisition documents should specify the following:

a. Title, number, and date of this specification
b. Type, class, and color of watch required (see 1.2)
c. Unit and quantity required
d. Issue of DoDISS to be cited in the solicitation, and if required, the specific issue of individual documents referenced (see 2.2)
e. Case finish and color (see 3.4.9.2)
f. Packaging requirements (see 5.1)

6.3 Qualification. With respect to products requiring qualification, awards will be made only for such products which, at the time of award of contract, have been tested and approved for inclusion on the applicable qualified products list whether or not such products have actually been so listed by that date. The attention of the suppliers is called to this requirement, and manufacturers are urged to arrange to have the products that they propose to offer to the Federal Government tested for qualification in order that they may be eligible to be awarded contracts or orders for the products covered by this specification. The activity responsible for the qualified products list is the U.S. Army Armament Research, Development and Engineering Center, Attn: AMSTA-AR-QAW (B-12), Picatinny Arsenal, New Jersey 07806-5000. Information pertaining to qualification of products may be obtained from that activity (see 3.1, 4.3.1, and 4.6.5.1).

6.4 Definitions.

a. Accuracy error notation. Where algebraic signs are used to denote the direction of timekeeping accuracy error, the plus (+) sign represents "fast" and the minus (-) sign "slow".

b. Daily rate. Rate in a 24 hour period. The term "daily rate" is used synonymously with the terms "daily error" and "daily accuracy".

c. Mean daily rate. The arithmetic average of individual daily rates (daily errors) with proper regard to algebraic signs in the summation. Unless otherwise specified, the mean daily rate will be based on 3 consecutive days operation.

d. Error. Algebraic time difference in seconds between the watch being tested and the master timepiece.

6.5 Cross-reference of classification. Table X is a cross-reference of classification changes from MIL-W-46374F to this specification.

TABLE X. Cross-reference table.

MIL-W-46374F	MIL-PRF-46374G
Type 1	Type II class 4
Type 2	Type I class 4
Type 3	Type I class 1
Type 4	Type I class 2
Type 5	Type I class 3
Type 6	Type III class 1
Type 6	Type III class 2
Type 6	Type III class 3

6.6 Part identification number (PIN). The following part identification numbering procedure is for government purposes and does not constitute a requirement for the contractor. This example describes a part numbering system for specification MIL-PRF-46374G.

MIL-PRF-46374G -X X XXX

- Type I - Analog, short life (2 years), non-maintainable, antimagnetic, water-resistant
  - II - Analog, long life (5-10 years), maintainable, antimagnetic, water-resistant, high altitude, corrosion-resistant
  - III - Analog, long life (5-10 years), maintainable, antimagnetic, water-resistant, high altitude, corrosion-resistant, with elapsed time ring
- Class 1 - Electrical movement, battery installed
  - 2 - Electrical movement, battery out of watch but packed with watch
  - 3 - Electrical movement, battery not included with watch
  - 4 - Mechanical movement, battery not required
- Color M - Silvery metallic
  - B - Black
- Specification number

6.7 Subject term (key word) listing.

Analog
Antimagnetic
Water-resistant
Quartz

6.8 Changes from previous issue. Marginal notations are not used in this revision to identify changes with respect to the previous issue due to the extent of the changes.

Custodians:
Air Force - 82
Army - AR
Navy - SH

Preparing activity:
DLA - GS

(Project 6645-0446)

Reviewer:
Navy - MC

STANDARDIZATION DOCUMENT IMPROVEMENT PROPOSAL

INSTRUCTIONS

1. The preparing activity must complete blocks 1, 2, 3, and 8. In block 1, both the document number and revision letter should be given.
2. The submitter of this form must complete blocks 4, 5, 6, and 7, and send to preparing activity.
3. The preparing activity must provide a reply within 30 days from receipt of the form.

NOTE: This form may not be used to request copies of documents, nor to request waivers, or clarification of requirements on current contracts. Comments submitted on this form do not constitute or imply authorization to waive any portion of the referenced document(s) or to amend contractual requirements.

I RECOMMEND A CHANGE:	1. DOCUMENT NUMBER MIL-PRF-46374G	2. DOCUMENT DATE (YYYYMMDD) 19991112

3. DOCUMENT TITLE **WATCH, WRIST: GENERAL PURPOSE**

4. NATURE OF CHANGE *(Identify paragraph number and include proposed rewrite, if possible. Attach extra sheets as needed.)*

5. REASON FOR RECOMMENDATION

6. SUBMITTER

a. NAME *(Last, First, Middle Initial)*	b. ORGANIZATION	
c. ADDRESS *(Include Zip Code)*	d. TELEPHONE (Include Area Code) (1) Commercial (2) AUTOVON *(if applicable)*	**7.DATE SUBMITTED** (YYYYMMDD)

8. PREPARING ACTIVITY

a. NAME DEFENSE SUPPLY CENTER RICHMOND	b. TELEPHONE *Include Area Code)* (1) Commercial (804) 279-3875 (2) AUTOVON 695-3875
c. ADDRESS *(Include Zip Code)* DEFENSE SUPPLY CENTER RICHMOND, ATTN: DSCR-VBD, 8000 JEFFERSON DAVIS HIGHWAY, RICHMOND, VA 23297-5610	**IF YOU DO NOT RECEIVE A REPLY WITHIN 45 DAYS, CONTACT:** Defense Standardization Program Office (DLSC-LM) 8725 John J. Kingman road, Suite 2533, Ft. Belvoir, VA 22060-2533 Telephone (703) 767-6888 AUTOVON 427-6888

GENERAL QUALITY AND

TECHNICAL REQUIREMENT

BALL
OFFICIAL STANDARD
Since 1891

INTRODUCTION

1.1 Purposed:
We have defined requirement to ensure our suppliers deliver the components up to our quality requirement.

1.2 Responsibility:
Each supplier totally fulfils for the quality of the product deliver our quality requirements.

1.3 Delivery
Component shall be delivered directly to Ball Watch after successful final inspection is made.

1.4 Modification:
All component modification by the supplier must be submitting the approval samples to our engineering department.

1.5 Technical Advice

Since new product launching, new product requirement and inspection standard will be updated to factories by "Technical Advice" which is issued to watch factories whenever necessary.

1.6 Coverage in New Product

When we find out the new developed styles may not suitably covered by this quality manual, please contact our Engineering Department to clarify the standard before submitting "Technical Sample".

COMPONENT SPECIFICATION

SECTION 1 - CASE

COMPETE CASE

Case must pass the following reliability test:

- Artificial Sweat Test
- Drop test, case must be withstand the dropped from 1meter high on to the hard wood in 3 directions; crystal, back, 9 o'clock side. No parts not loose or fall out.
- Water resistant test, refer to order information.

MATERIAL

- 316L
- Titanium Grade 2
- YUS190 component (dial seat plate, movement holder, cassolette) for anti-magnetic watch.

CRYSTAL

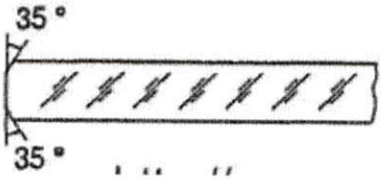
DIMENSION

Steps of 0.5mm must terrace the diameters of the crystals used in all round shaped assemblies. The thickness are standardized:

Water Resistant	Min. Thickness
3 ATM	0.7mm.
10ATM	1.0mm. (ψ <=22mm)
10ATM	1.2mm. (ψ >=22.5mm)
20ATM	1.2mm. (ψ <=22mm)
20ATM	1.5mm. (ψ >=22.5mm)

BEVEL

The bevels of the crystal are 2X35° as figure below:



CRYSTAL HARDNESS

- The hardness of mineral crystal should be a minimum of 500 Vickers
- The hardness of sapphire crystal should be a minimum of 1700 Vickers
- The crystal material used when specified on P.O. and / or specification sheet.

CLEARANCE BETWEEN CRYSTAL AND SECOND HAND

The space between the seconds-hand (gas light tube+0.45mm) and the crystal should be a minimum of 0.50mm.

HOLDING FORCE

The minimum holding force should be 5kg.

UN-EVEN ACCEPTED LEVEL

The crystal setting un-even accepted level 0.05mm

CRYSTAL GASKET

3ATM. Min height 0.6mm
10ATM Min height 0.90mm for ψ <=22mm
10ATM Min height 1.00mm for ψ =22.5mm
20ATM Min height 1.00mm for ψ <=22mm
20ATM Min height 1.30mm for ψ >=22.5mm

MATERIAL

- Hytrel

BEZEL

The bezel should not be moved 1kg/m. The fitting of the bezel should be sufficient to avoid it to be raised.

HOLDING FORCE

The minimum holding force should be 5kg.

CROWN

The screw crown must be screw down or out without problem, Max 0.3kg-cm torsion pull out force for hand setting.

PUSHING FORCE

- The crown pushing force should be 0.9kg+/-0.05kg, when find out the movement may not suitably covered by this standard, please contact Ball Watch Engineering Department to clarify the standard before submitting Sample.
- The screw crown for mechanical movement should be turnabout, for quartz movement should be non-turnabout crown.

CROWN RECESS

Crown recess on case body, minimum 0.30mm > crown diameter.

SETTING

- For all resistant watches, the O-ring of crown must be functionally in contact with tube even when it is pulled outmost position, and the water resistance must be withstand at least 3atm.
- Winding the crown at the rest position should not cause change of calendar or time.
- Screw crown when pressed and screw down should be return to rest position; it should not cause change of calendar or time.

CLEARANCE BETWEEN THE CROWN AND THE CASE

- Maximum 0.05mm

CASE BACK

SCREW BACK

No chips coming from the threading, it will not disturb the functioning to the movement

SECURED BY SCREWS

TECHNICAL REQUIREMENT

Screw out torsion not less than 0.1kg-cm.

GAP BETWEEN THE CASE AND BACK

The gap between the middle case and the back is maximum 0.10mm.

SPRING BARS

- The choice depends on the type of construction.
- Only "Capsa" spring bar or equivalent quality should be used.

HOLDING FORCE

Spring bars and lugs to be able to withstand tensile pull of 10 Kg without deforming or falling.

MATERIAL

- 316L

PUSHER

- The pushers should travel smoothly when pressed and return to rest position when pressure is released.
- All water-resistant pushers should not be activated by specified pressure (i.e. 3ATM,...etc).
- The case should be water-resistant when pusher pressed.
- Pusher activation force from 0.3kg to 0.7kg.

O' RING GASKET

DIAMETER OF GASKET SECTION

3atm	Min. 0.5mm (ladies)
3atm	Min. 0.6mm (gents)
10atm	Min. 0.8mm
20atm	Min.1.0mm

MATERIAL

- NBR

TOLERANCES FOR FUNCTIONAL DIMENSION

Generally the tolerance on functional position is +/-0.03mm are accepted.

- Stem centre

- Spring bar hole location for integrate solid end-piece
- Case inside opening... etc

SECTION 2 – BRACELET

COMPLETE BRACELET

Bracelet must pass the following reliability test:

- Artificial Sweat Test
- Traction and Torsion Test – 5000 cycles, Tension 5Kg, Torsion 6Kg/cm.
- Shaking Test – 5000 cycles.

VISUAL CHECK

- No scratch, dirt, dust can be seen under 30cm distance.
- No pin mark on fixed link of bracelet side.
- No accepted the shape edge or burrs on the bracelet.

MATERIAL

Only following materials are to used in bracelet manufacturing:

- 316L
- Titanium Grade 2
- Others material used when specified on P.O. and / or specification sheet.

ADJUSTABLE LINK

- Only screws for adjustable link.
- Adjustable screw must withstand a torque of 0.10Kg-cm when screw out and pass vibration test. "Loctite 222 accepted for adhesive purposed

- Bracelet should be able to withstand pull force of 10Kg without falling part or deforming.
- Buckle opening force to be 0.6 to 1.5kg and the force should be kept at least after 3,000 times close and open, no attachment not loose or fall out.
- The bracelet which side and centre link are individual, it must be withstand minimum 8Kg side pulling force.

END PIECE FITTING

- Integrated solid end-piece to case, it should not turn from the watch head.

SECTION 3 – DIAL

ROUND

- The total diameter of the dial is equal to the diameter of the opening Min. +0.5mm. The tolerance of the total diameter are –0.02/+0.05mm

SHAPED

- The total size of the dial (3-9H and 6-12H) is equal to the size of the opening + 1mm. The tolerances of the total diameter are –0.02/+0.05mm

THICKNESS

- 0.4mm of thickness is recommended for all watches. The tolerance is +/-0.03mm.
- When find out the dial may not suitably covered by this standard, please contact Ball Watch Engineering Department to clarify the standard before submitting Sample.

FLATNESS

For dials having a diameter or diagonal of:

0.01mm	<20mm
0.02mm	>20mm

DROP TEST

Dial must be withstand the dropped 3 times from 30cm high, No indexes or attachment not loose or come out.

ADHESION TEST

To stick and remove a piece of tape Scotch 810 on the dial surface. No peel off of

printing or sticker.

UV LIGHT TEST

The dial exposure under UV light for 72 hours is approximately equal to exposure under normal sunlight for 6 months.

SECTION 4 – HANDS

- Only "Universo" hands or equivalent should be used.
- Only second hands with counter weights as indicated on the movement manufacturers specification data.
- Hole of hands to be free form burrs.
- Height of Tube used when specified on P.O. and / or specification sheet.

TESTING AND PROCEDURE

BL-001

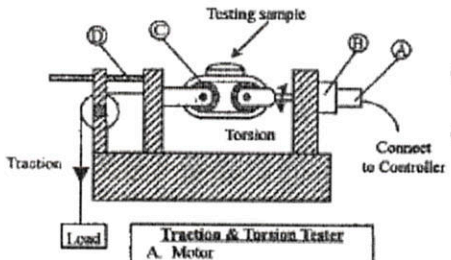
TRACTION AND TORSION TEST

1.0 Purpose
To testify the tensile strength & torsion strength of complete watch under a simulated normal motion.

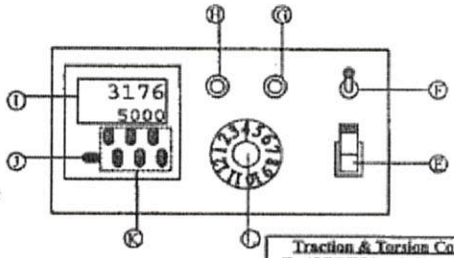
2.0 Scope
It is applicable for testing the longitudinal & latitudinal strength of watch construction.

3.0 Definition

3.1 Traction & Torsion Tester & Controller



Traction & Torsion Tester
A. Motor
B. Torque transducer
C. Watch holder
D. Bracelet breaking detector



Traction & Torsion Controller
E 'POWER' switch
F. 'ALARM ON/OFF' switch
G. 'OFF' switch (red)
H. 'ON' switch (green)
I. Counter display
J. Counter reset
K. Counter setting
L. Speed control

4.0 Procedure

4.1 Sample checking

4.1.1 To check & measure the characteristic of the sample as the following table.

Item	Parts	Checking method	Specification
1	Overall appearance	Visual check	No come-off part, No loosing, cracking or breaking part
2	Screw (if applicable)	Torque meter	Torque ≥ 0.14 Kg·cm
3	Pin (if applicable)	Pull meter	1.5 Kg≤ Pushing Force ≤ 7 Kg
4	Side link (if applicable)	Pull meter	Pulling Force ≥ 7 Kg (Gent) Pulling Force ≥ 5 Kg (Lady)
5	Function, accuracy	Functional check	No malfunction

4.2 Setup

4.2.1 To fasten the sample by fixing the bracelet with the two holders, tighten with the watch holder into bracelet. (as section 3.1)

4.2.2 To adjust the position of bracelet breaking detector within 2mm to 3mm, fasten the screw to prevent movement.

4.2.3 To set the counter setting as follows.

Tension		5 Kg
Torsion		6 Kg.cm
Frequency	**(leather/plastic)**	3000 cycles
	(metallic)	5000 cycles

4.2.4 To adjust the speed controller to the index '4' or above. (i.e. at least 20 cycles/min.).

4.3 Result Evaluation

4.3.1 To check & measure the characteristics of the sample as section 4.1.

4.3.2 If all the above characteristics are still within the specification, the sample passes in the test. Otherwise, the sample fails in the test.

BL-002

DROP TEST

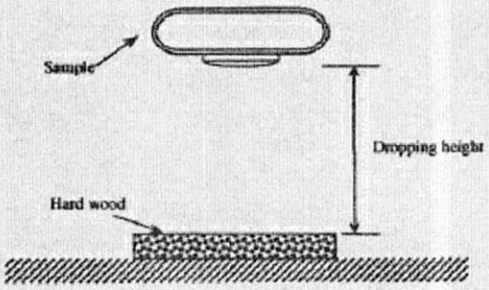
1.0 Purpose

To testify the rigidity of watch with/without packing under the simulated impact in transportation.

2.0 Scope

It is applicable for testing the watch assembly and watch with carton packing.

3.0 Definition



4.0 Procedure

4.1 Sample checking

4.1.1 To visual check the appearance of sample & to ensure no loosing part, no crack & no breakage.

4.1.2 To check the accuracy and functions of sample & to ensure the functions are within the specification.

4.2 Setup

4.2.1 Locate a piece of hard wood on the ground. (The thickness of the wood is at least 25 mm.)

4.2.2 The sample is allowed to free fall on the hard wood surface as the following individual level or combined level.

Plan	Direction		Height	# of drops	Total
I	Watch is vertical to the ground at 9H position		1 m	1	3
	Watch is parallel to the ground with case back facing to the ground		1 m	1	
	Watch is parallel to the ground with crystal facing to the ground		1 m	1	
II	Watch is vertical to the ground at 9H position		0.3 m	1	3
	Watch is parallel to the ground with case back facing to the ground		0.3 m	1	
	Watch is parallel to the ground with crystal facing to the ground		0.3 m	1	
III	Watch with carton packing	Faces	1 m	6	10
		Edges	1 m	3	
		Corners	1 m	1	

Note: Plan I is used for all watches in general. Plan II is only applied to pocket watches only.

4.3 Result Evaluation

4.3.1 To check the above characteristics of the sample as section 4.1.

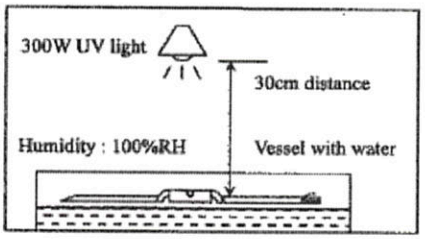
4.3.2 If the characteristics of the sample are still within the specification, the sample passes in the test. Otherwise, the sample fails in the test.

BL-003
UV LIGHT AGING

1.0 Purpose
To testify the ageing resistance of material, dye color, coating under simulated sun light condition.

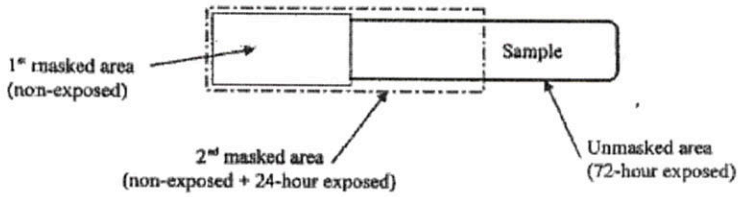
2.0 Scope
It is applicable for testing all components with PU material.

3.0 Definition
3.1 The exposure under 300W UV light from 30 cm distance for 72 hours is approximately equivalent to exposure under normal sunlight in Switzerland for 6 months.
3.2 Facility



4.0 Procedure
4.1 Sample checking
4.1.1 To visual check the initial appearance of sample & to ensure no peeling off, cracking or color changing.

4.2 Setup
4.2.1 Before the test, partially mask around 1/3 testing area of the sample with aluminum foil. (for color comparison between UV exposed and non-exposed area.)
4.2.2 Place the sample under a 300W UV light source with 100% RH for 24 hours.
4.2.3 Partially mask around another 1/3 testing area of the sample with aluminum foil (for color comparison between 24-hour and 72-hour exposed time.). Therefore, totally 2/3 testing area of the sample is masked.



4.2.4 Idle the sample under a 300W UV light for another 48 hours.
4.2.5 Remove all the aluminum foil and compare the color between 3 sections

4.3 Result Evaluation
4.3.1 Check the appearance of sample and to ensure no peeling-off, cracking or brittle part.
4.3.2 Compare the color with the gray scale (ISO 105-A02) as follows.

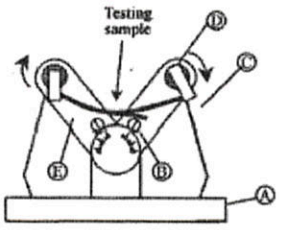
Gray scale	Fossil Specification
3 – 5	Accept
2.5	Conditional Accept
Below 2.5	Reject

BL-004
SHAKING TEST

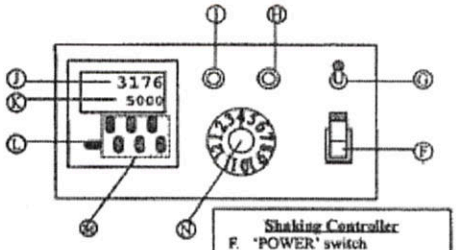
1.0 Purpose
To testify the rigidity of complete watch, bracelet assembly, buckle, fixing pin and clasp under a simulated shaking motion.

2.0 Scope
It is applicable for testing complete watch, bracelet assembly, buckle & clasp.

3.0 Definition
3.1 Shaking Tester & Controller



Shaking Tester
A. Base
B. Level index
C. Guiding pin
D. Driven gear
E. Arm



Shaking Controller
F. 'POWER' switch
G. 'ALARM ON/OFF' switch
H. 'OFF' switch (red)
I. 'ON' switch (green)
J. Counter display
K. Testing cycle
L. Counter reset
M. Counter setting
N. Speed control

4.0 Procedure
4.1 Sample checking
4.1.1 To check the sample as the following table.

Item	Parts	Checking method	Specification
1	Whole sample	Visual check	No come-off part, No loosing, cracking or breaking part
2	Pin	Push gauge	1.5 Kg ≤ Pushing Force ≤ 7 Kg
3	Screw	Torque meter	Torque ≥ 0.14 Kg·cm
4	Clasp	Pull gauge	Pulling force ≥ 1 Kg

4.2 Setup
4.2.1 To adjust the angle of both arms as 70 – 90% total length of the testing sample.
4.2.2 To fasten the bracelet to the arms (as section 3.1)
4.2.3 To set the speed controller to index '4' or above. (i.e. at least 15 cycles/min.).
4.2.4 To set the counter cycle to 50000 times and then start the test.

4.3 Result Evaluation
4.3.1 To check the characteristic of sample mentioned as 4.1.
4.3.2 If all the above characteristics are still within the specification, the sample passes in the test. Otherwise, the sample fails in the test.

BL-005

WATER-RESISTANCE

1.0 Purpose
To testify the ability of water resistance for watch.

2.0 Scope
It is applicable for testing the watch with water resistance construction.

3.0 Definition
3.1 All water-resistant watches (except alloy watches) should pass in both tests as below in general. For alloy watches, the sample should first be tested in air leakage test (test 2), then some of the samples are selected based on MIL-STD-105D Level S-1 to test in "Roxer".
3.2 Test 1 : "Roxer"
a. "PV-8" /or "PV-15" /or "PV-25"
b. "Natator"
3.3 Test 2 : Air leakage test
a. "Hormec" water resistant tester with vacuum and pressure test /or
b. "Witschi" ALC 2000 Electronic water-resistant tester with vacuum and pressure test /or
c. "Sigma" SM8810 Electronic water-resistant tester with vacuum and pressure test.

4.0 Procedure
4.1 Sample checking
4.1.1 To visual check the appearance of sample & to ensure no loosing, cracking or breaking part, no improperly assembled gasket .
4.1.2 To check the moisture inside of the sample according to the Condensation Test Procedure (ENWI-019).

4.2 Test 1(A) : Roxer "PV-8 /or PV-15 /or PV-25"
4.2.1 Place the sample on the tray & immerse the sample in water
4.2.2 Withdraw the air pressure until near vacuum to observe the bubble coming out of the sample.
4.2.3 If large amount of bubble come out, sort out the sample. The sample fails in the test.
(Note : This step is to sort out defective sample with serious leaking. For ease of identification of bubble from the case, remove the turning bezel from case (if possible) before the test begins.)
4.2.4 Increase the air pressure while the sample is immersing in water and hold for adequate time as shown below.

Water-resistance	Duration
≤ 10 ATM	5 min.
> 10 ATM	20 min.

(Note : Water is forced into the sample through weak point, which will be revealed in condensation test. ENWI-019)

4.2.5 Reduce the air pressure (Gent's case : 0.4 bar, Lady's case : 0.2 bar) & hold for 5 min. to make sure the crystal can be held tightly with case.
4.2.6 Release to normal pressure.
4.2.7 Check the moisture inside of sample according to the condensation test (ENWI-019).
4.2.8 If the sample passes in the above tests, the sample passes in the "Roxer" water-resistant test. Otherwise, the sample fails in the test.

4.3 Test 1(B) : Roxer "Natator"
4.3.1 Place the sample into the test vessel
4.3.2 Pour water into the vessel until water flow out.
4.3.3 Close the vessel & lock the knob to ensure no spacing inside the vessel
4.3.4 Increase the air pressure while the sample is immersing in water and hold for adequate time as shown below.

ATER-RESISTANCE (CONTINUE)

Water-resistance	Duration
≤ 10 ATM	5 min.
> 10 ATM	20 min.

(Note : Water is forced into the sample through weak point, which will be revealed in condensation test. ENWI-019)

4.3.5 Release to normal pressure.
4.3.6 Check the moisture inside of sample according to the condensation test (ENWI-019).
4.3.7 If the sample passes in the above tests, the sample passes in the "Roxer" water-resistant test. Otherwise, the sample fails in the test.

4.4 Test 2(A) : "Hormec" Air Leakage Test - Pressure Test
4.4.1 Trial run the tester without sample inside so as to ensure no deviation between containers.
4.4.2 10 pcs. of sample (all should be same model) are placed in each chambers of the pressurizer.
4.4.3 Increase the air pressure as specification and wait for 10 min. to allow the air pressure flow through the sample in case of leakage.
4.4.4 Then, withdraw the air from the chamber until nearly vacuum and hold for 5 min.
4.4.5 If the oil level indicator reduce to 8mm or more, the sample fails in the "Hormec" air leakage test - pressure test.

4.5 Test 2(B) : "Hormec" Air Leakage Test - Vacuum Test
4.5.1 Trial run the tester without sample inside so as to ensure no deviation between containers.
4.5.2 Turn the knob of the tester and allow the liquid to fall to the lower mark and close the knob.
4.5.3 Observe the difference between the liquid level of each column.
4.5.4 The greater level drop of liquid compared with others that indicate serious sealing fault. The sample fails in the "Hormec" air leakage test - vacuum test.

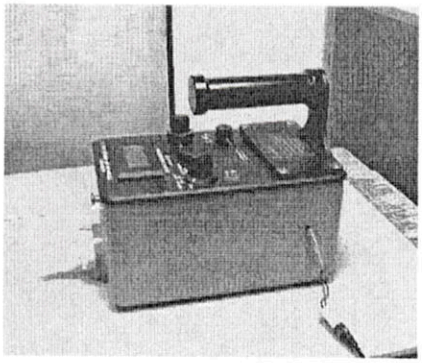
4.6 Result Evaluation
4.6.1 For alloy sample, after the air leakage test, it should be selected according to MIL-STD-105D Level S-1 to carry out the "Roxer" water-resistant test.
4.6.2 If the sample passes in both tests (1 & 2), the samples passes in the water-resistant test.
4.6.3 If the sample passes either test 1 or test 2, the result should be based on the "Roxer" water-resistant test.

BL-006
RADIATION LEAKAGE

1.0 Purpose:
To be confirm the gas light without radiation leakage, during incoming to assembly processing.

2.0 Scope:
It is applicable for monitoring the component, assembly, and complete watches.

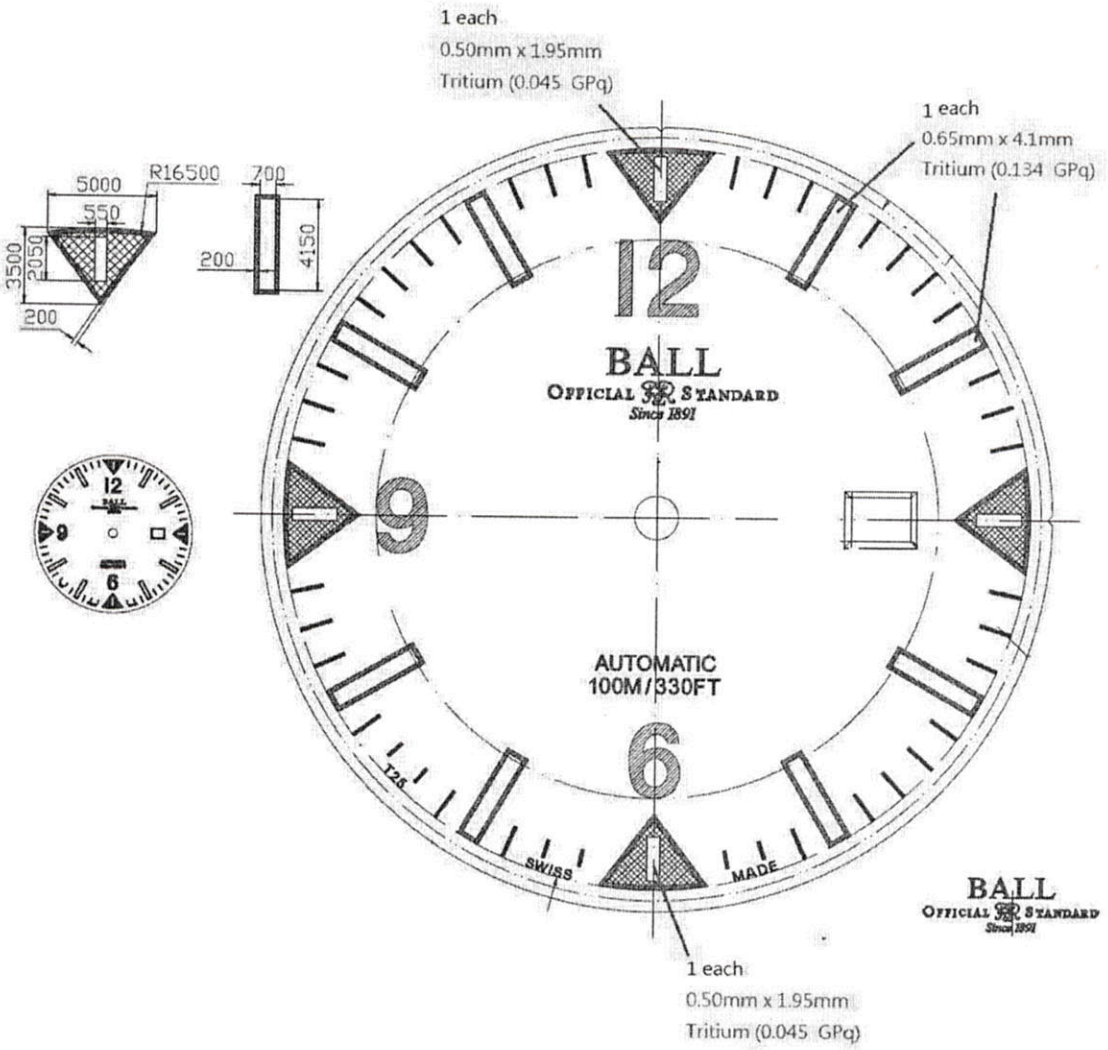
3.0 Definition:
Gas filled detector – SCINTREX TRITIUM-IN-AIR MONITOR MODEL 209J



4.0 PROCEDURE:

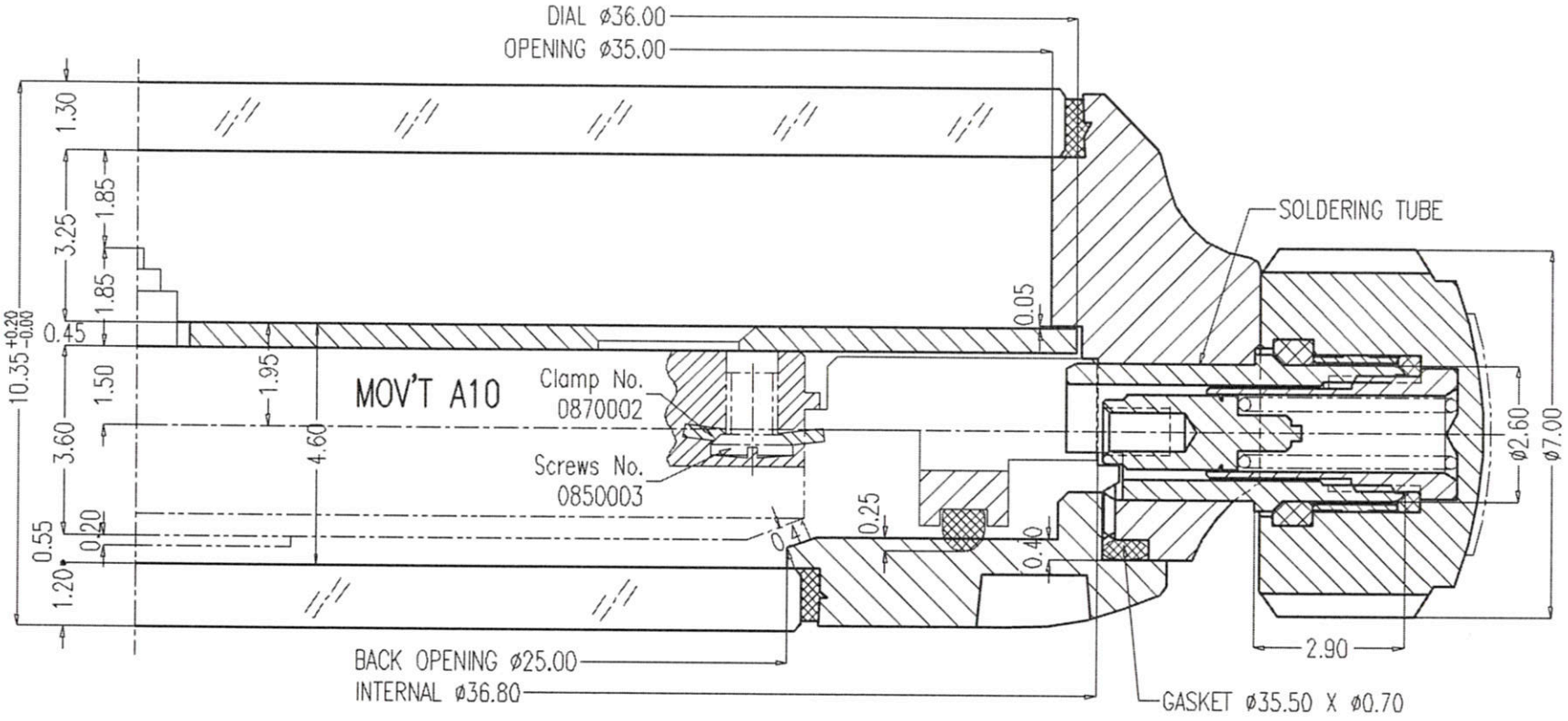
4.1 Turn on the gas filled detector monitoring before start the processing, when the gas light radiation leakage, gas filled detector will be alarm on.

NM2090C



8 each	0.65mm X 4.1mm	(0.134 GBq)	total = 1.072 GBq	Dial at 1.2.4.5.7.8.10.11
3 each	0.50mm X 1.95mm	(0.045 GBq)	total = 0.135 GBq	Dial at 3.6.9
1 each	0.50mm X 1.95mm	(0.045 GBq)	total = 0.045 GBq	Dial at 12
1 each	0.50mm X 3.50mm	(0.056 GBq)	total = 0.056 GBq	Hour hand
1 each	0.50mm X 6.50mm	(0.137 GBq)	total = 0.137 GBq	Minute hand

ATTACHMENT D



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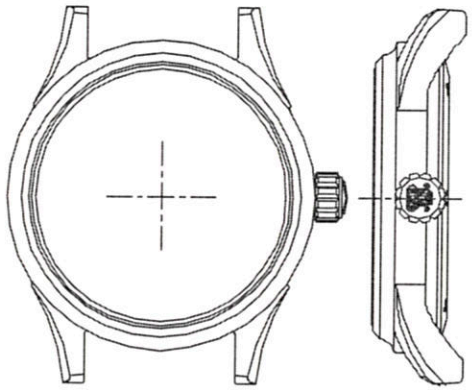

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4	
3	
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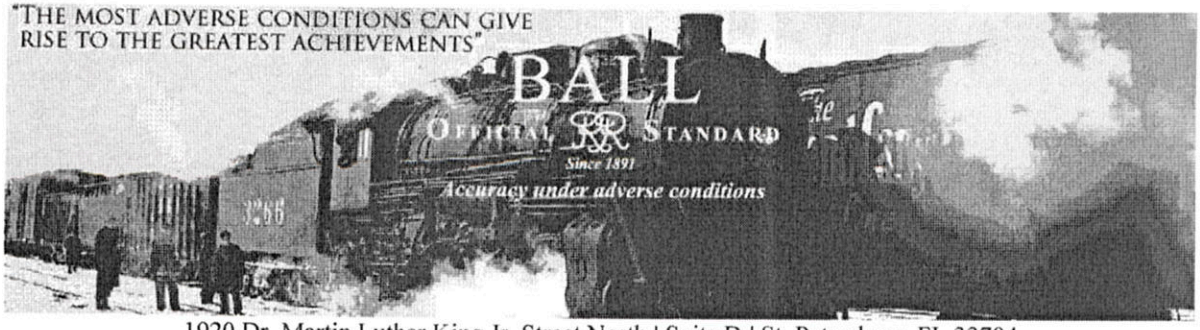
1	

LF LUEN FUNG WATCH CASE FACTORY LIMITED

CUSTOMER: BALL	MODEL: 3775GS-D		DRAWER: He
YOUR MODEL: NM2090C			DATE: 2008-01-02
MOVEMENT: A10	A T M: 10	14 PAGES	CHECKER:



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Tel: 727-896-4278 | Fax: 727-825-0803

PROTOTYPE TESTING RESULT

Model Number: NM2090C Date: 15-12-2016

1.0 DISCOLORATION: Level 1

Evaluation criteria after submitting watch to all tests specified above in proper sequence are:

- No peeling-off, cracking or brittle part.
- No discoloration compare the colour with the grey scale (ISO 105-A02)

Actual prototype testing per above program was performed on five (5) watches.

Results:

- No peeling off or discoloration was observed.

TEMPERTURE: level 2

Evaluation criteria after submitting watch to all tests specified above in proper sequence are:

- To check the appearance & function of the sample and to ensure no tarnish
- Case or strap components should not come apart.
- No substantial color change after test.

Actual prototype testing per above program was performed on five (5) watches.

Results:

- No tarnishing mark, dimension change, cracking, breakage or malfunction was observed.
- No accuracy problem and it are still within the specification.

THERMAL SHOCK: level 2

Evaluation criteria after submitting watch to all tests specified above in proper sequence are:

- No water-resistance problem.
- No parts come out.

ATTACHMENT E

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Actual prototype testing per above program was performed on five (5) watches.

Results:

- No water-resistance defect and no parts come out observed.

REDUCED PRESSURE: level 2

Evaluation criteria after submitting watch to all tests specified above in proper sequence are:

- "Roxer" air leakage test, Vacuum Test prescribes ISO 2281 standard.
- It should be pass –0.4 bar vacuum test to carry out the water-resistant test.

Actual prototype testing per above program was performed on five (5) watches.

Results:
No moisture inside of the watch after vacuum was observed.

IMPACT TESTING

Evaluation criteria after submitting watch to all tests specified above in proper sequence are:

- No loosing part, no crack and no breakage.
- Ensure the accuracy and functions of prototype according to the ISO1413.

Actual prototype testing per above program was performed on five (5) watches.

Results:

- No parts breakage and come out was observed.
- Accuracy of prototype after 2drops residual effect.

Watch 1	+9sec
Watch 2	+ 7sec
Watch 3	+11sec
Watch 4	+8sec
Watch 5	+13sec

VIBRATION: Level 2

Evaluation criteria after submitting watch to all tests specified above in proper sequence are:

- Samples are subjected to a vibration force of 5 g/s for 18 hrs.
- This test simulates low frequency vibration created during transportation.

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- Besides conformance in accuracy and timing, small parts like screw must not come off after the test.

Actual prototype testing per above program was performed on five (5) watches.

Result:
No parts come out, accuracy and accuracy performed without change was observed.

Conclusion: the five (5) watches have passed prototype testing per ANSI N540 for devices with the classification.
T2GC1222222

Routine Use

EDE From Skin Contact

NUREG-1717, Section 2.3.4.2.1 has provided a method for determining the dose from skin contact from routine use of timepieces containing H-3. The method presented in NUREG-1717 was specifically for H-3 paint in timepieces. The H-3 is only capsulated by the timepiece crystal and stainless steel case. The H-3 is first encapsulated in sealed tubes to create the GTLS. These sealed tubes are again encapsulated between the timepiece's crystal and stainless steel case. Leak tests for H-3 sealed sources are not required and there is no historical data on H-3 leakage from GTLS. Assuming a worst case scenario where a tube containing the highest activity of H-3 ruptured, the total H-3 activity that could potentially leak from the timepiece during routine use would be 3.7 mCi (1.37×10^{-1} GBq).

[1] Determine the H-3 leakage from a watch.
Leakage Rate (Bq/hr) = Activity (GBq) X 10 ppb/hr

[2] Determine the intake of tritiated water vapor (HTO) through the skin in contact with the case of the watch.
Intake (Bq/day) = Leakage Rate (Bq/hr) X 16 hr/day X absorbed fraction (0.02)

[3] Determine the annual dose equivalent to the skin in contact with the case.
Annual Dose Equivalent (mSv) = Intake (Bq/day) X 365 days/yr
X dose conversion factor for HTO
(1.8×10^{-3} mSv-cm^2/Bq)
÷ Exposed Skin Area (10 cm^2)

[4] Determine the average annual dose equivalent to the skin of the whole body from the distributed wristwatch source.
Annual Dose Equivalent (mSv) = Annual Dose Equivalent to contact area (mSv)
X 10 cm^2 contact area / 1.8 m^2 whole body area

[5] Determine the contribution of this skin dose equivalent to the annual EDE.
EDE (mSv) = Annual Dose Equivalent to the whole body (mSv)
X organ weighting factor for skin of the whole body (0.01)

[6] Determine the annual EDE to the internal organs of the body from the absorption of HTO through the skin in contact with the case of the watch.
EDE (mSv) = Intake (Bq/day) X Dose Conversion Factor for absorption through the skin or ingestion of H-3 (1.7E-11 Sv/Bq)

Table 1 below provides the estimated annual EDE to the skin and also to the organs. Each step above is enumerated in the table. Combining the doses from H-3 on the skin and absorbed by the internal organs, the EDE for timepieces would be based on the activity of the GTLS and not on the total activity of the timepiece. The EDE would be 2.7×10^{-6} mSv (2.7×10^{-7} rem) regardless of timepiece activity if a single GTLS ruptured.

Table 1. Skin Contact EDE During Routine Use

	[1]	[2]	[3]	[4]	[5]	[6]
GTLS Sources	Leakage	HTO intake	Annual Dose Equivalent of contact area	Average annual dose equivalent to skin of whole body	Annual EDE to skin of whole body	Annual EDE to internal organs
GBq	**Bq/h**	**Bq/day**	**mSv**	**mSv**	**mSv**	**mSv**
1.37E-01	1.37	4.4E-01	2.9E-02	1.6E-05	1.6E-07	2.7E-06
mCi	**mCi/h**	**mCi/h**	**rem**	**rem**	**rem**	**rem**
3.7	1.0×10^{-6}	3.2×10^{-7}	2.9E-03	1.6E-06	1.6E-08	2.7E-07

EDE From Airborne Releases

NUREG-1717, Section 2.3.4.2.2 has provided a method for determining the dose from airborne releases from routine use of timepieces containing H-3. The method presented in NUREG-1717 was specifically for H-3 paint in timepieces. However, the correlation presented above allows these calculations to determine dose from the routine use of Ball Watch timepieces manufactured with GTLS. As above, it is assumed a GTLS ruptured.

[1] Start with the H-3 leakage rate determined above.

[2] Estimate the concentration of H-3 in the air for an enclosed volume of a 450 m^3 (approximately 2,000 ft^2) home with a recirculation rate of 1 volume air change per hour.

[3] Determine the H-3 breathed in for an estimated 12 hour period.

[4] Determine the EDE from inhalation of H-3 using a dose conversion factor of 1.35×10^{-4} mSv/Bq derived from the example contained in NUREG-1717, Section 2.3.4.2.2.

[5] Determine the estimated EDE from inhalation of H-3 for 100 timepieces in storage.

Table 2 provides the annual EDE to the wearer and others in the same facility. The annual EDE for timepieces would be based on the activity of the GTLS and not on the total activity of the timepiece. The EDE would be 4.4×10^{-4} mSv (4.4×10^{-5} rem) regardless of timepiece activity if a single GTLS ruptured.

Table 2. EDE from Airborne Released During Routine Use

	[1]	[2]		[3]	[4]	[5]
GTLS Sources	Leakage	HTO in air	Breathing Rate	HTO breathed	Annual EDE from inhalation	Annual EDE from 100 Timepieces
GBq	**Bq/h**	**Bq/m^3**	**m^3/hr**	**Bq/hr**	**mSv**	**mSv**
1.37E-01	1.37	3.0E-03	0.90	3.3E-02	4.4E-06	4.4E-04
mCi	**mCi/h**	**mCi/m^3**	**m^3/hr**	**mCi/hr**	**rem**	**rem**
3.7	1.0 X 10^{-6}	3.2 X 10^{-7}	9.0E-02	3.3E-03	4.4E-07	4.4E-05

Watch Repair

EDE From Skin Contact

NUREG-1717, Section 2.3.4.2.1 has provided a method for determining the dose from skin contact from routine use of timepieces containing H-3. Section 2.3.4.3 provides some modifications to the equations. The method presented in NUREG-1717 was specifically for H-3 paint in timepieces and the correlation previously presented above was used to adjust these calculations to determine dose from the routine use of Ball Watch timepieces manufactured with GTLS.

[1] Determine the H-3 leakage from a watch.
Leakage Rate (Bq/hr) = Activity (GBq) X 10 ppb/hr

[2] Determine the intake of tritiated water vapor (HTO) through the skin in contact with the case of the watch.
Intake (Bq/day) = Leakage Rate (Bq/hr) X 8 hr/day X absorbed fraction (0.02)

[3] Determine the annual dose equivalent to the skin in contact with the case (assuming 100 repairs per year and only 3 cm^2 of skin touch the timepiece).
Annual Dose Equivalent (mSv) = Intake (Bq/repair) X 100 repairs/yr
X dose conversion factor for HTO
(1.8×10^{-3} mSv-cm^2/Bq)
÷ Exposed Skin Area (3 cm^2)

[4] Determine the average annual dose equivalent to the skin of the whole body from the distributed wristwatch source.
Annual Dose Equivalent (mSv) = Annual Dose Equivalent to contact area (mSv)
X 3 cm^2 contact area / 1.8 m^2 whole body area

[5] Determine the contribution of this skin dose equivalent to the annual EDE.
EDE (mSv) = Annual Dose Equivalent to the whole body (mSv)

X organ weighting factor for skin of the whole body (0.01)

[6] Determine the annual EDE to the internal organs of the body from the absorption of HTO through the skin in contact with the case of the watch.
EDE (mSv) = Intake (Bq/repair) X Dose Conversion Factor for absorption through the skin or ingestion of H-3 (1.7E-11 Sv/Bq)

Table 3 below provides the estimated annual EDE to the skin and also to the organs. Each step above is enumerated in the table. The annual EDE from timepieces would be based on the activity of the GTLS and not on the total activity of the timepiece. The EDE would be 4.4 X 10^{-4} mSv (4.4 X 10^{-5} rem) regardless of timepiece activity if a single GTLS ruptured.

Table 3. Skin Contact EDE During Watch Repair

	[1]	[2]	[3]	[4]	[5]	[6]
GTLS Sources	Leakage	HTO intake	Annual Dose Equivalent of contact area	Average annual dose equivalent to skin of whole body	Annual EDE to skin of whole body	Annual EDE to skin of whole body from 100 repairs
GBq	**Bq/h**	**Bq//repair**	**mSv**	**mSv**	**mSv**	**mSv**
1.37E-01	1.37	2.2E-01	1.3E-02	2.2E-06	2.2E-08	3.7E-10
mCi	**mCi/h**	**mCi/repair**	**rem**	**rem**	**rem**	**Rem**
3.7	37.03	5.92	1.3E-03	2.2E-07	2.2E-09	3.7E-11

		[1]	[2]	[3]	[4]	[5]	[6]
		Leakage (10 ppb/h)	HTO intake	Annual Dose Equivalent of contact area	Average annual dose equivalent to skin of whole body	Annual EDE to skin of whole body	Annual EDE to internal organs
mCi	GBq	Bq/h	Bq//repair	mSv	mSv	mSv	mSv
150	5.6	55.5	8.9	0.58	9.7 X 10^{-5}	9.7 X 10^{-7}	5.5 X 10^{-8}

EDE From Airborne Releases

NUREG-1717, Section 2.3.4.2.2 has provided a method for determining the dose from airborne releases from routine use of timepieces containing H-3. Section 2.3.4.3 provides some modifications to the equations.

[1] Start with the H-3 leakage rate determined above.

[2] Estimate the concentration of H-3 in the air for an enclosed volume of a 34 m^3 repair shop with a recirculation rate of 1 volume air change per hour.

[3] Determine the H-3 breathed in for an estimated 8 hour work day.

[4] Determine the EDE from inhalation of H-3 using a dose conversion factor of 1.35×10^{-4} mSv/Bq derived from the example contained in NUREG-1717, Section 2.3.4.2.2.

Table 4 provides the annual EDE to the wearer and others in the same house. The annual effective dose equivalent for timepieces up to 100 mCi remains less than 1.4×10^{-3} mSv (0.14 mrem).

Table 4. EDE from Airborne Released During Watch Repair

		[1]	[2]		[3]	[4]
		Leakage (10 ppb/h)	HTO in air	Breathing Rate	HTO breathed	Annual EDE from inhalation
mCi	GBq	Bq/h	Bq/m^3	m^3/hr	Bq/hr	mSv
150	5.6	55.5	1.63	1.2	16	2.1×10^{-3}

Disposal

Ball Watch timepieces are expensive items and disposal as waste is remote. Even after the useful life of the GTLS, the timepieces are still state-of-the-art mechanical devices. Each Ball Watch timepiece is registered. To date, all Ball Watch timepieces are accounted for and none have been discarded as refuse. In the event a Ball Watch timepiece is discarded, the dose to the waste collector will not exceed that of the owner of the timepiece previously calculated in Table 1 above. The EDE from incidental contact would be less than 2.5×10^{-6} mSv (1.2×10^{-7} mrem).

Accident and Misuse

NUREG-1717, Section 2.3.4.5 has provided calculations for several scenarios:

For a watch repairman, the individual EDE from crushing a single watch containing 930 MBq (25 mCi) of H-3 could be 0.02 mSv (2 mrem) at a small repair shop or 0.008 mSv (0.8 mrem) at a large repair shop. Extrapolating this to a 100 mCi timepiece would create an EDE of 3.2 to 8 mrem dose.

For a person at home, the individual EDE from crushing a single watch containing 930 MBq (25 mCi) of 3 H could be 5×10^{-4} mSv (0.05 mrem). Extrapolating this to a 100 mCi timepiece would create an EDE of 0.2 mrem dose.

For a worker in a storeroom or cargo-handling area, the individual EDE from crushing 200 watches containing a total of 185 GBq (5 Ci) of 3 H could be 0.05 mSv (5 mrem). This value would remain valid for Hess Fine Arts since no more than 50 timepieces are located in each storage container.

For a child that handles the timepiece for 10 minutes per day and sleeps in a closed bedroom for 12 hours per day, NUREG-1717 calculates the dose equivalent to the skin of a 5-year-old child due to absorption of H-3 from the timepiece at 0.1 mrem for a 25 mCi timepiece. That would be extrapolate to 0.4 mrem for a 100 mCi timepiece. The EDE would be estimated at less than 0.004 mrem due to absorption of the H-3 through the skin in contact with the timepiece and 0.004 mrem from inhalation of the airborne H-3.

In each of the scenarios above, the EDE is well below regulatory limits.
In the article "*Estimated Radiation Dose From Timepieces Containing Tritium*", L.M. McDowell-Boyer, Health and safety Research Division, Oak Ridge National Laboratory, January 1, 1980, testing indicated tritium timepieces of 100 mCi generated a maximum annual dose of 0.02 mrem from use of the wrist watch. Extrapolating this result for 200 mCi wrist timepieces produces a maximum of 0.04 mrem whole-body dose to the wearer. This is below the 1 mrem annual whole body dose requirement pursuant to 10 CFR 32.24.

Dose is linearly related to activity. Therefore if a wrist watch containing 200 mCi of H-3 produces a maximum of 0.04 mrem whole-body dose to the wearer, then a wrist watch with 5,000 mCi would produce a whole-body dose to the wearer of 1 mrem.

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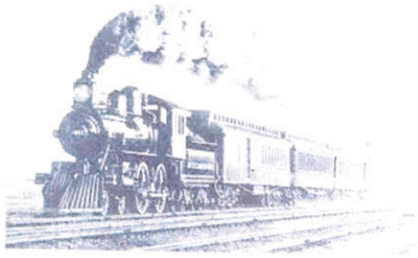

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