

ENGINEERING PRACTICE STUDY

TITLE: Propose changes for MIL-PRF-55310

December 18, 2017

STUDY PROJECT 5955-2017-005

Final Report

Study Conducted by DLA Land and Maritime

Prepared by:

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OBJECTIVE: The purpose of this Engineering Practice (EP) study is to obtain feedback from the military services, crystal oscillator manufacturers, and user community concerning updating/adding/removing requirements in MIL-PRF-55310. In addition, request input from the military services, crystal oscillator manufacturers, and user community concerning new types of crystal oscillator usage that are not covered by current slash sheets of MIL-PRF-55310.

BACKGROUND: MIL-PRF-55310 (Oscillator, Crystal Controlled, General Specification For), originated in 1970 by the US Army Communications Electronics Command. Currently there are 20 active slash sheets offering only Type 1 Crystal Oscillators (XO), frequency ranging from 0.1 Hz to 100 MHz that are referenced in 241 weapon systems with 874 NSNs. The specification also offers three technology classes (class 1, class 2, and class 3) with three types of product levels (C, B, and S).

It was brought to the attention of DLA Land and Maritime, by the space community that the status of MIL-PRF-55310 is deteriorating due to lack of coverage of new Space/Military qualified crystal oscillators (i.e. VCXOs, TCVCXOs, MCXOs, RbXOs, OCXOs, and OCVXOs) and obsolete test method references. The space community has been using nonstandard crystal oscillator parts from QPL/non QPL manufacturers with different/better test flow. Therefore DLA has been tasked to unify MIL-PRF-55310.

RESPONSE REQUESTED:

Attached are two tables that displays the comparisons of Screening and Qualification testing of three different specifications MIL-PRF-55310, MIL-PRF-38534, and JPL 10331716. The tables also displays Q-tech 401-0298-001 which was obtained from their website for comparison purpose only:

1. Table I shows the comparison of Screening testing among MIL-PRF-55310, JPL 10331716, Q-tech 401-0298-001, and MIL-PRF-38534. (See attachment 1)
2. Table II shows the comparison of Qualification testing among MIL-PRF-55310, JPL 10331716, Q-tech 401-0298-001, and MIL-PRF-38534. (See attachment 2)

DLA distributed the following questionnaire for review and comments:

1. Please review the attached table I and table II and submit comments:
 - a. Suggest which test requirements in the screening or in the qualification table are obsolete and should be removed or updated from MIL-PRF-55310.
 - b. Suggest if any new requirements should be added to the screening or the qualification table of MIL-PRF-55310 with suitable justifications.
2. Please inform, if new types of Crystal Oscillator that are currently being used or supplied to the requirements of MIL-PRF-55310 or any other specification.

SUMMARY OF RESULTS: All comments received on table I and table II of the EP study are compiled under attachments 1 and 2, with DLA's recommendations. All general comments are placed under attachment 3. DLA will propose minimum changes to product level B (which covers high reliability applications) and propose significant changes to product level S (which covers high reliability space applications). Please see below the list of changes DLA will impose on the next revision of MIL-PRF-55310.

The following changes are DLA's recommendations to the screening table III which will be incorporated under the upcoming revision of MIL-PRF-55310.

- 1.1. **Thermal Shock:** Most of the consensus were received from the customers and manufacturers is to remove "Thermal shock" from screening table of MIL-PRF-55310. Therefore, DLA will propose to remove "Thermal shock" requirement from class 2 product level "B" and "S".
- 1.2. **Temperature cycling:** Update the test from "condition B" to "condition C" (-65 to +150C) of Temperature cycling for product level S. No change to product level B devices.
- 1.3. **Particle impact noise detection (PIND):** Update PIND test condition from "condition B" to "condition A" for class 2 level S product. No change to product level B devices.
- 1.4. **Seal test:** Per MIL-PRF-55310 the fine and gross leak tests are performed in accordance with MIL-STD-883 test method 1014. The fine leak test will remain the same, however the Gross leak test "condition C" will change to condition B2 or B3 for class 2 level S devices only.
- 1.5. **External Visual:** External visual test requirement will be added for both product level B and S in accordance with MIL-STD-883 test method 2009.

The following changes are DLA's recommendations to the qualification table VI which will be incorporated under the upcoming revision of MIL-PRF-55310.

- 1.6. **Physical dimension:** Update the physical dimension requirement per MIL-STD-883 Method 2016 for both class 2 product level B and S.
- 1.7. **Random Vibration:** DLA will remove Random Vibration from screening of class 1 and 3 devices and add this requirement under Class 1, 2 and 3 product level S devices under Qualification requirement and part of periodic inspection.
- 1.8. **Life test:** The Steady-state life test of 1000 hours per MIL-STD-883 Method 1005 will be added for class 2 product level S only. Electricals (end point) will be added also.
- 1.9. **Electrostatic discharge (ESD):** DLA will add ESD test requirement per MIL-STD-883 method 3015 for class 1, 2 and 3 for product level S devices only.
- 1.10. **Thermal shock:** DLA will remove Thermal shock from class 2 product level "B" and "S" under qualification requirement, however the requirement still be applicable for class 1 and class 3 devices.
- 1.11. **Resistance to soldering heat:** Update Resistance to soldering heat requirement for class 2 product level "B" and "S" devices per MIL-STD-883 Method 2036.
- 1.12. **Terminal strength:** MIL-PRF-55310 offers Terminal strength test per package type. MIL-STD-883 method 2004 is applicable for solder pads package type devices, therefore DLA will update the qualification table to reflect which test method is applicable per device type.

DLA will propose the following changes to the appendix B of MIL-PRF-55310 when revised.

- 1.13. **Metal package isolation:** DLA will add Metal package isolation to appendix B for product level S under class 1, 2, 3.

New types of Crystal Oscillator that are currently being used or supplied to the requirements of MIL-PRF-55310 are OCXO, TCXO, and SAW. According to one QPL manufacturer, SAW type of crystal oscillators are most popular. DLA will review those type of device and introduce new slash sheets under the specification MIL-PRF-55310.

CONCLUSIONS: DLA will propose the changes mentioned above under summary of changes during the next revision of MIL-PRF-55310.

Table I. COMPARISON OF CRYSTAL OSCILLATOR SPECIFICATION MIL-PRF-55310, WITH Q TECH 401-0298-001, NASA/JPL 10331716 and MIL-PRF-38534 SCREENING 100%

TEST DESCRIPTION	STANDARD MIL-STD-S883,(S) METHOD (M) and CONDITION													
	MIL-PRF-55310		NASA/JPL		MIL-PRF-38534		Manufacturer A		Manufacturer B		User		Manufacturer C	DLA recommendation MIL-PRF-55310
	Class 2 Level S	Class2 Level B	Class 1	Class 2+	Class K	Class H	Class 2 Level S	Class 2 Level S	Class 2 Level S	Class 2 Level B	Class 2 Level S	Class 2 Level B	Level S	
Pre-seal burn-in	N/A	N/A	N/A	N/A	Optional	Optional	OK AS IS, pre seal burn-in is not applicable to these type of parts.		N/A	N/A	No comment	No comment	N/A	No change
Non destructive bond pull	S883 M2023 with PDA 2%	N/A	S883 M2023	S883 M2023	S883 M2023	Optional	OKAS IS		S 883 M2035 with PDA 2%	N/A	No comment	No comment	S883 M2023 C 2.4 Grams	No change
Internal visual	S883 M2017 and M2032	S883 M2017 and M2032	S883 M2017 Condition S Class K	S883 M2017 Condition S Class K	S883 M2017	S883 M2017	OK AS IS, M2032 is for passive components such as chip resistors and chip caps.		Agree with 55310	Agree With 55310	M2032 is redundant since it is required by M2017	M2032 is redundant since it is required by M2017	S883 M2017 Condition K Class S	No Change
Stabilization bake	S883 M1008 Condition C 48 hours at 150 °C	S883 M1008 Condition C 48 hours at 150 °C	S883 M1008 Condition C 48 hours at 150 °C	S883 M1008 Condition C 48 hours at 150 °C	N/A	N/A	OKAS IS		Agree with 55310 M1008 Condition C 48 hours at 150 °C	Agree with 55310 M1008 Condition C 48 hours at 150 °C	No comment	No comment	S883 M1008 Condition C 48 hours at 150 °C	No change

Table I. COMPARISON OF CRYSTAL OSCILLATOR SPECIFICATION MIL-PRF-55310, WITH Q TECH 401-0298-001, NASA/JPL 10331716 and MIL-PRF-38534 SCREENING 100%

TEST DESCRIPTION	STANDARD MIL-STD-S883,(S) METHOD (M) and CONDITION													
	MIL-PRF-55310		NASA/JPL		MIL-PRF-38534		Manufacturer A		Manufacturer B		User		Manufacturer C	DLA recommendation MIL-PRF-55310
	Class 2 Level S	Class 2 Level B	Class 1	Class 2	Class K	Class H	Class 2 Level S	Class 2 Level S	Class 2 Level S	Class 2 Level B	Class 2 Level S	Class 2 Level B	Level S	
Thermal shock		N/A	N/A	N/A	N/A	N/A	OK AS IS		N/A	N/A	Thermal shock is used in lieu of thermal cycling in MP3098. For hybrid crystal oscillators, since it presents risk to populated substrates. oscillators, and probably Thermal Cycling (M1010) be employed instead, i.e. Condition C, 10 cycles.		N/A	Remove Thermal shock
													S883 M1010 Condition B (-55 to +125)	For Class 2 Level S Change to condition C (-65 to +150) No change to Class 2 Level B
Constant acceleration	S883 M2001 Condition A(5000g's) Y1 direction	S883 M2001 Condition A (5000g's)Y1 direction	S883 M2001 Condition A(5000g's) Y1 direction	S883 M2001 Condition A(5000g's) Y1 direction	S883 M2001 3,000 g's, Y1 direction only	S883 M2001 3,000 g's, Y1 direction only	OKAS IS		Agree with 55310	Agree with 55310	No comment	No comment	S883 M2001 Condition A (5000g's) Y1 direction only	No change
Or Mechanical shock	N/A	N/A	N/A	N/A	S883 M2002 B, (Y1 direction only)	S883 M2002 B, (Y1 direction only)	OKAS IS		N/A	N/A	Add MP38534 requirement.	Add MP38534 requirement.	N/A	No change

Table I. COMPARISON OF CRYSTAL OSCILLATOR SPECIFICATION MIL-PRF-55310, WITH Q TECH 401-0298-001, NASA/JPL 10331716
and MIL-PRF-38534 SCREENING 100%

TEST DESCRIPTION	STANDARD MIL-STD-S883,(S) METHOD (M) and CONDITION													
	MIL-PRF-55310		NASA/JPL		MIL-PRF-38534		Manufacturer A		Manufacturer B		User		Manufacturer C	DLA recommendation MIL-PRF-55310
	Class 2 Level S	Class 2 Level B	Class 1	Class 2	Class K	Class H	Class 2 Level S	Class 2 Level S	Class 2 Level S	Class 2 Level S	Class 2 Level S	Class 2 Level B	Level S	
Particle impact noise detection (PIND)	S883 M2020 Condition B (10 g peak at 60 Hz minimum)	N/A	S883 M2020 Condition A (20 g peak at 40 to 250 Hz.) 5 passes	S883 M2020 Condition A (20 g peak at 40 to 250 Hz.) 5 passes	S883 M2020 Condition A (20 g peak at 40 to 250 Hz.)	Optional	OKAS IS		S883 M2020 Condition A (20 g peak at 40 to 250 Hz)	N/A	Change to M2020 Condition A from Condition B.	Changing to optional using M2020 condition B.	S883 M2020 Condition B (10g Peak at 60Hz minimum) 5 passes	change the condition A from condition B Class 2 Level S
Pre burn-in electrical	Yes	N/A	Yes	Yes	Yes	Optional	No comment		Agree with 55310	N/A per 55310	Yes	Change to optional like MP38534	Yes	No change
Burn-in	240 hours +125°C PDA 2% or one	160 hours +125°C PDA 10% or one	S883 M1015 Condition 125°C 160 hours	S883 M1015 Condition 125°C 160 hours	S883 M1015	S883M1015	Recommend 320 hours for Level S	OK for Level B	240 hours +125°C PDA 2% or one	160 hours +125°C PDA 10% or one	Follow MP38534 Class K burn-in philosophy.		S883 M1015 125 °C for 160 hours	No change
Interim electrical	N/A	N/A	Yes	N/A	N/A	N/A	Ok		Agree N/A	Agree N/A	Yes		Yes	No change
Burn-in	N/A	N/A	S883 M1015 Condition 125°C 160 hours	N/A	N/A	N/A	Ok		N/A	N/A	S883 M1015 125 °C for 160 hours		S883 M1015 125 °C for 160 hours	Under screening already 240 hours burn-in no additional change
Final electrical	Yes	Yes	Yes	Yes	Yes	Yes	Ok		Agree yes	Agree yes	Yes		Yes	No change

Table I. COMPARISON OF CRYSTAL OSCILLATOR SPECIFICATION MIL-PRF-55310, WITH Q TECH 401-0298-001, NASA/JPL 10331716
and MIL-PRF-38534 SCREENIN (100%) continued

TEST DESCRIPTION	MIL-PRF-55310 Class 2 Level S	MIL-PRF-55310 Class 2 Level B	NASA/JPL		M38534		Manufacturer A	Manufacturer B		User		Manufacturer C Level S	DLA recommendation MIL-PRF-55310
			Class 1	Class2+	Class K	Class H		Class 2 Level S	Class 2 Level B	Class 2 Level S	Class 2 Level B		
Seal; Fine leak	S883 M1014 Condition A1, A2 or B A1,A2 (trace Gas (He) B (Radioisotope)	S883 M1014 Condition A1, A2 or B(Radioisotope) A1,A2 (Trace Gas (He)	S883 M1014 (Based on Cavity Volume)	S883 M1014 (Based on Cavity Volume)	S883 M1014	S883 M1014	Per MIL-PRF-55310, Seal testing is done before burn-in. Leak rejects need to be removed from the lot before Burn-in. See Screening table in MIL-PRF-55310	S883 M1014 Condition A1, A2 or B A1,A2 (trace Gas (He) B (Radioisotope) S883 M1014 Condition A1, A2 or B(Radioisotope) A1	S883 M1014 Condition A1, A2 or B(Radioisotope) A1,A2 (Trace Gas (He)	MS883/M1014 pass/fail limit is based on cavity volume by definition.	MS883/M1014 pass/fail limit is based on cavity volume by definition.	S883 M1014 Condition A1	NO change
Seal; Gross leak	S883 M1014 Condition C Perfluorocarbon	S883 M1014 Condition C Perfluorocarbon	S883 M1014	S883 M1014	S883 M1012	S883 M1014	Per MIL-PRF-55310, 0	S883 M1014 Condition B2 or B3(Radioisotope Kr85)	S883 M1014 Condition C Perfluorocarbon	Condition C should be eliminated. Use either radioisotope or OLT for gross leak.	Condition C should be eliminated. Use either radioisotope or OLT for gross leak.	S883 M1014 Condition C Perfluorocarbon	DLA will modify Class 2 Level S with condition B2 or B3. No change to Class 2 Level B.
Radiographic inspection	S883 M 2012	N/A	S883	S883	S883 M 2012	optional	OKAS IS	Agree per 55310	Agree N/A		Make optional like MP38534	N/A	No change
Electrical	100% Group A	Lot size Group A	N/A	N/A	N/A	N/A	OKAS IS	100% Group A	Lot size Group A	No comment	No comment	N/A	No change
Visual and mechanical	100% Group A	Lot size Group A	N/A	N/A	N/A	N/A	OKAS IS	100% Group A	Lot size Group A	No comment	No comment	N/A	No change

Table I. COMPARISON OF CRYSTAL OSCILLATOR SPECIFICATION MIL-PRF-55310, WITH Q TECH 401-0298-001, NASA/JPL 10331716
and MIL-PRF-38534 SCREENIN (100%) continued

TEST DESCRIPTION	MIL-PRF-55310 Class 2 Level S	MIL-PRF-55310 Class 2 Level B	NASA/JPL		M38534		Manufacturer A	Manufacturer B		User		Manufacturer C	DLA recommendation MIL-PRF-55310
			Class 1	Class2+	Class K	Class H		Class 2 Level S	Class 2 Level B	Class 2 Level S	Class 2 Level B		
Solderability	100% Group A Correction Not 100%, it is sample base	Lot size Group A	N/A	N/A	N/A	N/A	100% for Level S is not correct. Solderability test is on a sample basis both for Level B & Level S. See para. 4.7.1.4.5 of MIL-PRF-55310.	5 Pes Group A	Lot size Group A	No comment	No comment	MIL-PRF-55310 70 ± 3 °C 30	Correction Not 100%, it is sample base. No change
Frequency aging	100% group B	Group B Lot size	MIL-PRF-55310	MIL-PRF-55310	N/A	N/A	OKAS IS	Remove PDA = 5%	Lot size Group B	No comment	No comment	N/A	No change
Input power aging test(when specified)	100% group B	Group B Lot size	N/A	N/A	N/A	N/A	OKAS IS	N/A		No comment	No comment	Yes	No change
Frequency/Temp Stability	----	----	---	---	---	---	----	----	----	----	---	Yes	No change
External visual	S883 M2009	S883 M2009	Lot size Group A	S883 M2009	S883 M2009	S883 M2009	OK AS IS It is done as a part of Group A	S883 M2009	N/A	Add external visual per MS883/M2009.		S883 M2009	DLA will add for Class 2 Level S per 883 M2009 under screening

**TABLE II. COMPARISON OF CRYSTAL OSCILLATOR SPECIFICATION MIL-PRF-55310 WITH HYBRID SPECIFICATION MIL-PRF-38534, JPL10331716,
AND Q-Tech 401-0298-001 QUALIFICATION**

REQUIREMENTS														
TEST	MIL-PRF-55310	MIL-PRF-55310	NASA/JPL	MIL-PRF-38534		Manufacturer A		Manufacturer B		Manufacturer C	User		Manufacturer D	DLA recommendation MIL-PRF-55310
	Level B	Level S	Class 2+	Class K	Class H	Level B	Level S	Level S	Level B	Level S	Level B	Level S	Level S	
External Visual	N/A	N/A	X	X	X	Done at Group A				M38535	Add external visual. per M2009	Add external visual. per M2009	X	No change DLA will add for Class 2 Level S per 883 M2009 under screening. Sample units shall have previously passed all the requirements of the screening tests.
								Table II page 6; We are OK with changing MIL-PRF-55310 CLASS B and S, Physical dimensions to comply with MIL-STD-883 M2016	S883	S883	Change to S883.	Change to S883.	X	Class 2 Level B and S, Physical dimensions to comply with MIL-STD-883 M2016
Temperature cycling (S883 M1010)	N/A	Appendix B	X	X	X	Done 100% at Screening (See Note)				X	Add MA & CA per MP38534, Class K QML Group C, for Class II & III	Add MA & CA per MP38534, Class K QML Group C, for Class II & III	X	No change Part of Screening For Class 2 product Level S Change to condition C (-65 to +150)
Mechanical shock and/or Constant acceleration	N/A	Appendix B	X	X	X	Constant Acceleration is done at Screening (See Note)				X	Add MA & CA per MP38534, Class H QML Group C.	Appendix B addresses elements and is not applicable to qualification at the oscillator Level . Add MS &	X	No change Constant Acceleration is performed under screening.

TABLE II. COMPARISON OF CRYSTAL OSCILLATOR SPECIFICATION MIL-PRF-55310 WITH HYBRID SPECIFICATION MIL-PRF-38534, JPL10331716,
AND Q-Tech 401-0298-001 QUALIFICATION continued

REQUIREMENTS														
TEST	MIL-PRF-55310	MIL-PRF-55310	NASA/JPL	MIL-PRF-38534		Manufacturer A		Manufacturer B		Manufacturer C	User		Manufacturer D	DLA recommendation MIL-PRF-55310
	Level B	Level S	Class 2+	Class K	Class H	Level B	Level S	Level S	Level B	Level S	Level B	Level S	Level S	
Random Vibration (S883 M2026)	N/A	N/A	X	X	X	OKAS IS		No comment		Request change to sine vibration M38534	Add RV per MP38534, Class H QML Group C, for Class II & III oscillator S.	No comment	N/A	DLA will remove Random Vibration from screening of Class 1 and 3 devices and add it for Class 1, 2 and 3 devices for product Level S under Qualification requirement and part of periodic inspection.
Seal (fine and gross) (S883 M1014) Appears in Group C and D of NASA and Q-tech doc	X	X	X	X	X	This test is performed during Qualification for example after Shock test, after Storage Temperature test, etc.		No comment		X	The fine leak test limits should be tightened to meet the requirements of MS883/TM1014 for Class K hybrids. In addition, the use of FC for gross leak should be prohibited.	The fine leak test limits should be tightened to meet the requirements of MS883/TM1014 for Class K hybrids. In addition, the use of FC for gross leak should be prohibited.	X	No change

TABLE II. COMPARISON OF CRYSTAL OSCILLATOR SPECIFICATION MIL-PRF-55310 WITH HYBRID SPECIFICATION MIL-PRF-38534, JPL10331716,
AND Q-Tech 401-0298-001 QUALIFICATION continued

REQUIREMENTS														
TEST	MIL-PRF-55310	MIL-PRF-55310	NASA/JPL	MIL-PRF-38534		Manufacturer A		Manufacturer B		Manufacturer C	User		Manufacturer D	DLA recommendation MIL-PRF-55310
	Level B	Level S	Class 2	Class K	Class H	Level B	Level S	Level S	Level B	Level S	Level B	Level S	Level S	
PIND (S883 M2020)	N/A	N/A	X	X	X	Done 100% at Group A (See Note)		No comment		X	Add PIND per MP38534, Class H QML Group C, for Class II & III oscillators.	Add RV per MP38534, Class K QML Group C, for Class II & III oscillators.	X	Correction This test is performed 100% Group A No change
Visual examination (S883 M2010)	X (NOT S883)	X (Not S883)	X	X	X	Done 100% at Group A (See Note)		Table II page 6; should Visual examination (S883 M1010) actually be Visual examination (S883 M2010)?	Class B and S, Visual MIL-STD-883 M2010 Examination in to comply with MIL-STD-883	X S883	MP55310 requirements are relatively general and lack definitive criteria. This requirement needs work	MP55310 requirements are relatively general and lack definitive criteria. This requirement needs work	X (S883 M2009)	DLA will not add any changes to the Qualification since parts are screened where it already requires internal and External Visual examination.
Electricals (end point)	X	X	X	X	X	Consider adding this for Class-S Qualification		No comment		See end of table II	No comment	No comment	X	DLA will add this requirement for Class 2 Level S Qualification
			X	X	X	Consider adding this for Class-S Qualification		No comment		See end of table II	Add LT per MP38534, Class H QML Group C, for Class II & III oscillators.	Appendix B addresses elements and is not applicable to qualification at the oscillator Level . Add LT per MP38534, Class K QML Group C, for Class II & III oscillators.	X	DLA will add Steady state life test total of 1000 hours for Class 2 Level S Qualification.

TABLE II. COMPARISON OF CRYSTAL OSCILLATOR SPECIFICATION MIL-PRF-55310 WITH HYBRID SPECIFICATION MIL-PRF-38534, JPL10331716,
AND Q-Tech 401-0298-001 QUALIFICATION continued

REQUIREMENTS													
TEST	MIL-PRF-55310	MIL-PRF-55310	NASA/JPL	MIL-PRF-38534		Manufacturer A		Manufacturer B	Manufacturer C	User		Manufacturer D	DLA recommendation MIL-PRF-55310
	Level B	Level S	Class 2	Class K	Class H	Level B	Level S	Level S	Level S	Level B	Level S	Level S	
Internal water vapor content (S883 M1018)	X	X	X	X	X	OKAS IS	OKAS IS	No comment	X		X	X	No change
Internal visual and mechanical	Appendix B (Internal Visual)	Appendix B (Internal visual)	X	X	X	Internal Visual is done at Screening External Visual & Mechanical Is done at Group 1 of Qualification Table		No comment	X	Appendix B addresses elements and is not applicable to qualification at the oscillator Level . Add IV per MP38534 QML Group C for Class H	Appendix B addresses elements and is not applicable to qualification at the oscillator Level . Add IV per MP38534 QML Group C for Class K	X	Appendix B is prerequisite for qualification and retention of qualification. The system shall be part of the overall QPL system under MIL-STD-790. NO change
Bond Strength (wire bond)	Appendix B	Appendix B	X	X	X	Is Required as process control in Appendix		No comment	X	Appendix B addresses elements and is not applicable to qualification at the oscillator Level . Add BS per MP38534, QML Group C for Class H	Appendix B addresses elements and is not applicable to qualification at the oscillator Level . Add BS per MP38534, QML Group C for Class K	X	Appendix B is prerequisite for qualification and retention of qualification. The system shall be part of the overall QPL system under MIL-STD-790. NO change

TABLE II. COMPARISON OF CRYSTAL OSCILLATOR SPECIFICATION MIL-PRF-55310 WITH HYBRID SPECIFICATION MIL-PRF-38534, JPL10331716,
AND Q-Tech 401-0298-001 QUALIFICATION continued

	REQUIREMENTS												
TEST	MIL-PRF-55310	MIL-PRF-55310	NASA/JPL	MIL-PRF-38534		Manufacturer A		Manufacturer B	Manufacturer C	User		Manufacturer D	DLA recommendation MIL-PRF-55310
	Level B	Level S	Class 2	Class K	Class H	Level B	Level S	Level S	Level S	Level B	Level S	Level S	
Die sheer strength	N/A	N/A	X			OK as is, 5000 G acceleration in screening is a good substitute for element adhesion test		No comment	X	No comment	No comment	X	No Change
Element Shear	N/A	N/A	N/A	X	X	No comment		No comment	N/A	Add ES per MP38534, Class H QML Group C, for Class II & III oscillators.	Add ES per MP38534, Class H QML Group C, for Class II & III oscillators.	N/A	No change
ESD	N/A	N/A	X	X	X	Parts are Classified as ESO sensitive and are required to be handled with ESD precautions Nothing more is necessary		No comment	N/A	Add ESD per MP38534, Class H QML Group C, for Class I, II & III oscillators.	Add ESD per MP38534, Class H QML Group C, for Class I, II & III oscillators.	X	DLA will add ESD test requirement per MIL-STD-883 method 3015 for Class 1, 2 and 3 for product Level S only.
Frequency aging	X	X	Part of only screening	N/A	N/A	OK AS IS		No comment	N/A	No comment	No comment	N/A	No Change
Input power aging (type 4 and type 6) (when specified)	X		N/A	N/A	N/A	OK AS IS		No comment	N/A	No comment	No comment	N/A	No Change
Conducted interference (when specified)	X	X	N/A	N/A	N/A	OK AS IS		No comment	N/A	No comment	No comment	N/A	No Change
Vibration (MIL-STD-202)	X	X	N/A	N/A	N/A	OK AS IS		No comment	N/A	See Randon Vib above	See Randon Vib above	N/A	No Change
Acoustic noise (when	X	X	N/A	N/A	N/A	OK AS IS		No comment	N/A			N/A	No Change
Shock (MIL-STD-202)	X	X	N/A	N/A	N/A	OK AS IS		No comment	N/A	See Mech Shock above	See Mech Shock above	N/A	No Change
Acceleration (when specified)	X	X	N/A	N/A	N/A	OK AS IS		No comment	N/A	See CA above	See CA above	N/A	No Change
Explosion (when specified)	X	X	N/A	N/A	N/A	OK AS IS		No comment	N/A	No comment	No comment	N/A	No Change

TABLE II. COMPARISON OF CRYSTAL OSCILLATOR SPECIFICATION MIL-PRF-55310 WITH HYBRID SPECIFICATION MIL-PRF-38534 AND JPL10331716

QUALIFICATION continued

REQUIREMENTS													
TEST	MIL-PRF-55310	MIL-PRF-55310	NASA/JPL	MIL-PRF-38534		Manufacturer A		Manufacturer B	Manufacturer C	User		Manufacturer D	DLA recommendation MIL-PRF-55310
	Level B	Level S	Class 2	Class K	Class H	Level B	Level S	Level S	Level S	Level B	Level S	Level S	
Magnetic field (operating) (when specified)	X	X	N/A	N/A	N/A	OK AS IS		No comment	N/A	No comment	No comment	N/A	No Change
Thermal shock	X (MIL-STD-202)	X (MIL-STD-202)	X	X	X	OK AS IS		comply with MIL-STD-883	X MIL-STD-883	Thermal shock is used in lieu of thermal cycling in MP3098. For hybrid crystal oscillators, this test is not recommended since it presents risk to populated substrates. Therefore, it is recommended that Thermal shock be eliminated for Class II oscillators, and probably Class III also and that Thermal Cycling (M1010) be employed instead, i.e. Condition C, 100? cycles.	Thermal shock is not used in MP38534 for qual. It is only used for empty package element evaluation.	X (MIL-STD-883)	Remove Thermal shock. the requirement still be applicable for Class 1 and Class 3 devices.

TABLE II. COMPARISON OF CRYSTAL OSCILLATOR SPECIFICATION MIL-PRF-55310 WITH HYBRID SPECIFICATION MIL-PRF-38534 AND JPL10331716
QUALIFICATION continued

REQUIREMENTS													
TEST	MIL-PRF-55310	MIL-PRF-55310	NASA/JPL	MIL-PRF-38534		Manufacturer A		Manufacturer B	Manufacturer C	User		Manufacturer D	DLA recommendation MIL-PRF-55310
	Level B	Level S	Class 2	Class K	Class H	Level B	Level S	Level S	Level S	Level B	Level S	Level S	
Ambient pressure	X	X	N/A	N/A	N/A	OK AS IS		No comment	N/A	No comment	No comment	N/A	No Change
Storage temperature	X	X	N/A	N/A	N/A	OK AS IS		No comment	N/A	No comment	No comment	N/A	No Change
Radiation hardness (operating) (when specified)	X	X	N/A	N/A	N/A	OK AS IS		No comment	Okay per 55310	Radiation testing should be performed at the element Level .	Radiation testing should be performed at the element Level .	N/A	No Change Since it is required for qualification.
Resistance to soldering heat	X (MIL-STD-202)	X (MIL-STD-202)	N/A	N/A	N/A	OK AS IS		comply with MIL-STD-883.	Okay per 55310	should use MS883	Should use MS883	N/A	For Class 2 product Level B and S devices add per MIL-STD-883 method 2036
Moisture resistance	X	X	N/A	N/A	N/A	OK AS IS		No comment	N/A	No comment	No comment	N/A	No Change
Radiographic inspection	N/A	N/A	N/A	N/A	N/A	Done 100% at Screening for Class-s		No comment	N/A	No comment	No comment	X	No Change
Salt atmosphere	X	X	N/A	N/A	N/A	OKAS IS		No comment	X Done at receiving every 6 month	No comment	No comment	N/A	No Change

TABLE II. COMPARISON OF CRYSTAL OSCILLATOR SPECIFICATION MIL-PRF-55310 WITH HYBRID SPECIFICATION MIL-PRF-38534 AND JPL10331716

QUALIFICATION continued

REQUIREMENTS														
TEST	MIL-PRF-55310	MIL-PRF-55310	NASA/JPL	MIL-PRF-38534			Manufacturer A		Manufacturer B	Manufacturer C	User		Manufacturer D	DLA recommendation MIL-PRF-55310
	Level B	Level S	Class 2	Class K	Class H	Level B	Level S	Level S	Level S	Level B	Level S	Level S		
Terminal strength (lead integrity)	X (MIL-STD-202)	X (MIL-STD-202)	X	N/A	N/A	OK AS IS		comply with MIL-STD-883.	X Done at receiving every 6 month	Class II oscillator packages tend to be similar to those being used in 5962 product. Therefore, recommend using MS883 instead of MS202.	Class II oscillator packages tend to be similar to those being used in 5962 product. Therefore, recommend using MS883 instead of MS202.	X (MIL-STD-883)	MIL-PRF-55310 offers Terminal strength test per the package type. MIL-STD-883 method 2004 is applicable for solder pads package type devices therefore DLA will update the qualification table to reflect the changes per device type.	
Solderability	X	X	X	X	X	OKAS IS		No comment	X Done at receiving every 6 month	No comment	No comment	X	No Change	
Resistance to solvents	X	X	X	N/A	N/A	OKAS IS		No comment	Okay	No comment	No comment	X	No Change	
Fungus	X	X	N/A	N/A	N/A	OKAS IS		No comment	N/A	No Comment	No comment	N/A	No change	
Stabilization Bake (High temperature bake)	N/A	Appendix B	X	X	X	Done 100% at Screening for Class-s & Class		No comment	Class S yes	No comment	No comment	X	No change	
Metal package isolation	N/A	N/A	X	X	X	OK AS IS		No comment	Done at receiving	For Class II, and probably for the other Classes also, metal package isolation should be included as part of the oscillator package element evaluation, per MP38534.	For Class II, and probably for the other Classes also, metal package isolation should be included as part of the oscillator package element evaluation, per MP38534.	N/A	DLA will add MPI under appendix B for "S" Level Class 1, 2, 3.	

PROJECT NUMBER 5955-2017-001		COMPILATION OF COMMENTS		General Comment 1	
Engineering Practice (EP) Study on MIL-PRF-55310		COMMENTOR IND NAME OR CODE:		[X] MFR [] USER [] IND ASSOC	
MIL-PRF-55310 has served as a very good reference for screening, test requirements, and test methods for crystal oscillators. Existing slash sheets have also been used extensively over the past 40 some years. Currently all the slash sheets are for XOs. For various reasons, It has always been impractical to include slash sheets for VCXOs, TCXOs, OCXOs, etc. TCXO Slash sheets /04, /05, /06, /07 were created in 1980s and 1990s but were cancelled in August 1998 because of inactivity. We are currently qualified on most of the MIL-PRF-55310 slash sheets for Level B parts. The market for Level S has been much smaller for us to justify the cost of initial qualification and retention of qualification for Level S. To address many of the points you have brought up in your letter, a face to face coordination meeting is needed to thoroughly discuss and arrive at the most significant changes/updates needed to improve MIL-PRF-55310.					
DoD USE ONLY	DEPARTMENT :	☐ A ☐ N ☐ AF ☒ DLA ☐ NSA ☐ CNDN ☐ NASA		☐ ESSENTIAL ☒ SUGGESTED	
RECOMMENDED DISPOSITION OF COMMENT: ☐ ACCEPTANCE ☐ NON-ACCEPTANCE (see reason) ☐ WITHDRAW ☐ MODIFY ☒ DISCUSS Thank you for your comments. DLA will propose a coordination meeting once an initial draft of the document MIL-PRF-55310 is coordinated.					
FINAL DISPOSITION OF COMMENT: ☒ ACCEPTANCE ☐ NON-ACCEPTANCE ☐ WITHDRAW ☐ MODIFY					

PROJECT NUMBER 5955-2017-001		COMPILATION OF COMMENTS		General Comment 2	
Engineering Practice (EP) Study on MIL-PRF-55310		COMMENTOR IND NAME OR CODE:		[] MFR [X] USER [] IND ASSOC	
Maybe some construction updates like no Cu-wire at least for the time being. I don't know any crystal people doing it yet but in case. I have not looked at in a while but if they build with packaged elements instead of chip and wire does it require the use of JSTD001 Class 3? I know they are suppose to be using 883 on chip and wire but it seems like in the past there have been questions on if they really need to meet the RGA periodically, may want to look into that.					
DoD USE ONLY	DEPARTMENT :	[] A [] N [] AF [X] DLA [] NSA [] CNDN [] NASA	[] ESSENTIAL [X] SUGGESTED		
RECOMMENDED DISPOSITION OF COMMENT: [] ACCEPTANCE [] NON-ACCEPTANCE (see reason) [] WITHDRAW [] MODIFY [X] DISCUSS All compound bonds shall be 100 percent nondestructive pull tested in accordance with MIL-STD-883, method 2023. Only allows AL and AU wire. No Cu-wire is used in MIL-PRF-55310 devices.					
FINAL DISPOSITION OF COMMENT: [X] ACCEPTANCE [] NON-ACCEPTANCE [] WITHDRAW [] MODIFY					

PROJECT NUMBER 5955-2017-001		COMPILATION OF COMMENTS		General Comment 3	
Engineering Practice (EP) Study on MIL-PRF-55310		COMMENTOR IND NAME OR CODE:		[] MFR [X] USER [] IND ASSOC	
On Radiation Hardness Assurance. I believe that MIL-PRF-55310 Para. 3.6.47 addresses Total Dose and neutron-induced effects. However, I believe that certain types of oscillators need to use linear devices like operational amplifiers or voltage references inside the packaged component as well; in those cases, the effects of Single Event Transients may need to be understood for space applications. I understand that this is perhaps too much to ask in some way, and certainly cannot be something to screen for. However, this sort of internal design assurance often needs to be established as well. Similarly, as another Classical element of design assurance, add-on parts de-rating is often as well something one might want to know more about for a complex oscillator type? Perhaps something along these lines could be added one day under the element evaluation requirements in Appendix B for microcircuits? In addition to that, I have tried to compare your screening and qualification tables with our (European) ESCC3503 specification, which only aimed at addressing Class 1 and Class 2 oscillators. There are several (fine detail) differences which I cannot really elaborate on; I have however noticed that we have specified Random Vibration for Class 1 oscillators during screening (instead of constant acceleration, which we specify for Class 2 only). And we have specified as well Random Vibration both for Class 1 and Class 2 at the time of Qualification. I see that your specs do not really require such test mandatorily. I wonder if the relevance of random vibration as a meaningful test, which European users and agencies seem to agree to, might be something that could be considered or discussed in your study? Another difference that I have noted is that Steady state life is specified in our spec for 2000h. Finally, even when we have limited experience so far with the implementation of this ESCC3503 in procurement and qualification, I think that we may have encountered some unexpected issues with the accumulation of stress (environmental + mechanical). As I see that Group III in 55310 Table IV requires separate SG1 and SG2, I wonder if an evolution of the spec could include as well a combination of both, in addition, in order to perhaps bring additional assurance on quality of workmanship, robustness of the assembly (perhaps this is more relevant for Class 1).					
DoD USE ONLY		DEPARTMENT :	[] A [] N [] AF [X] DLA [] NSA [] CNDN [] NASA	[] ESSENTIAL [X] SUGGESTED	
RECOMMENDED DISPOSITION OF COMMENT: [] ACCEPTANCE [] NON-ACCEPTANCE (see reason) [] WITHDRAW [] MODIFY [X] DISCUSS Thank you for your comments. The element design is unique to the individual Manufacturer and the specification does not control the design, moreover the specification only controls the performance requirement of the device. DLA will add Random Vibration option for class 1, 2 and 3 device Level "S" only.					
FINAL DISPOSITION OF COMMENT: [] ACCEPTANCE [] NON-ACCEPTANCE [] WITHDRAW [X] MODIFY					

PROJECT NUMBER 5955-2017-001		COMPILATION OF COMMENTS		General Comment 4	
Engineering Practice (EP) Study on MIL-PRF-55310		COMMENTOR IND NAME OR CODE:		[X] MFR [] USER [] IND ASSOC	
The life and post life testing requirements of 38534 and 55310 are instructive in determining how to test and what to test. There is no 1000 hour steady state life test in 55310, but <i>we perform</i> that test due to 38534 because we used chip and wire bond construction. The parameter most tested after life test in 38534 is DC current and a change in current of an IC is extremely important and an indicator of a problem. Change in current is also very important for a crystal oscillator. We also generally check output Level and rise time and fall time and duty cycle after life test. We do not recommend testing frequency shift after life test. This is not an indication of the health of the oscillator for reasons described below: 1) Burn in at higher temperature does not simulate the lifetime of the crystal under service conditions. 2) Burn in at higher temperatures also does not accelerate aging. It only subjects the device to conditions and chemical processes that would never be seen under normal operating conditions. It is not a valid aging test. 3) We prefer to test for startup time as an increase in startup time might indicate degradation of the metallization on the crystal and a higher series resistance.					
DoD USE ONLY	DEPARTMENT :	[] A [] N [] AF [X] DLA [] NSA [] CNDN [] NASA	[] ESSENTIAL [X] SUGGESTED		
RECOMMENDED DISPOSITION OF COMMENT: [] ACCEPTANCE [] NON-ACCEPTANCE (see reason) [] WITHDRAW [] MODIFY [X] DISCUSS DLA will recommend adding 1000 hour steady state life test for S Level devices Class 2.					
FINAL DISPOSITION OF COMMENT: [] ACCEPTANCE [] NON-ACCEPTANCE [] WITHDRAW [X] MODIFY					