



Draft Requirements for VeraSol Certification of Refrigerators

Stakeholder Feedback

October 2022

Context

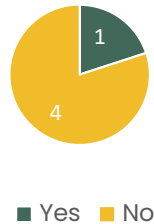
VeraSol is in the process of launching a certification program for off- and weak-grid appropriate refrigerators. In March 2022, VeraSol published the proposed draft quality standards, [Requirements for VeraSol Certification of Refrigerators](#), which address four core elements of product quality: truth in advertising, health and safety, durability, and consumer protection. These requirements apply to refrigerators intended for use on or compatible with off-grid energy systems, either included with a VeraSol-certified SHS kit or as a standalone appliance.

The VeraSol team sought stakeholder feedback on the proposed framework and requirements prior to offering certification services for refrigerators. The team received responses from five stakeholders via an online form and one stakeholder via a phone interview. The summary of stakeholders' responses, comments, and questions, as well as VeraSol's responses to these comments, are outlined below.

Based on the feedback, VeraSol is working on updating the quality standards and expects to launch the certification program in 2023. In addition, the initial proposed standards did not include solar direct-drive (SDD) refrigerators. We are researching and adapting the standards to include SDD refrigerators in the certification scope. If you have any questions about this document or would like to provide further comments on the draft standards, please contact info@verasol.org.

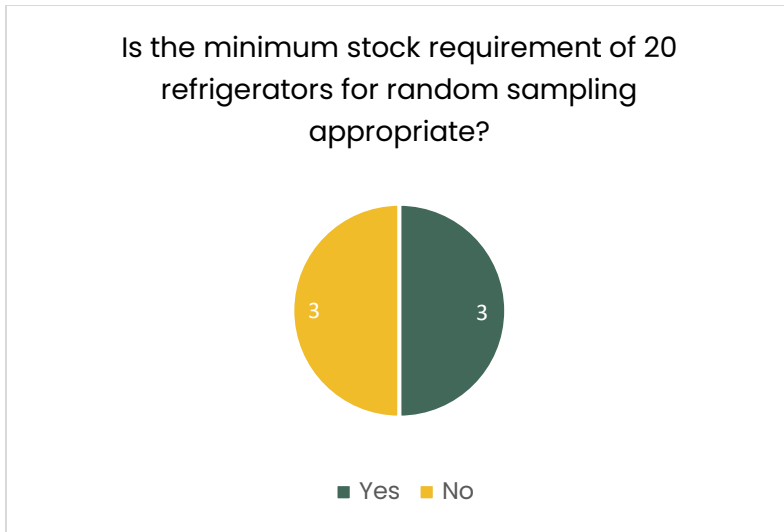
Certification Scope

Two pathways are proposed for certifying refrigerators: (1) refrigerators included in an SHS kit and (2) as standalone appliances. Should another pathway be added?



Stakeholder comment	VeraSol response
<p>Fridges without other accessories – vaccine fridges aren't typically provided with solar lighting but are typically offered with solar+battery. However, this might be considered a "SHS kit".</p>	<p>At this time, vaccine storage refrigerators are not considered in the scope of VeraSol certification. We encourage stakeholders to reference the World Health Organization (WHO) Performance, Quality and Safety (PQS) framework for requirements related to vaccine refrigerators.</p> <p>For refrigerators powered by solar and a battery, companies can have their refrigerator certified as an SHS kit where the only appliance in the kit is the refrigerator or as a standalone refrigerator, where the battery, solar module, and associated run-time performance are not assessed.</p> <p>Additionally, based on feedback, we are identifying ways to enable a third certification pathway for solar direct drive (SDD) refrigerators, which typically use a phase change material to store energy instead of a battery.</p>

Minimum stock requirement



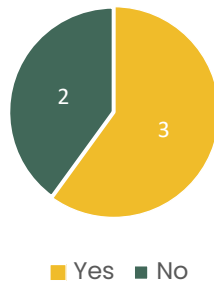
Stakeholder comment	VeraSol response
Three samples should be selected in line with IEC 62552-1/2/3: 2015	IEC 62552-1/2/3: 2015 does not define a random sampling requirement. We recommend that companies use a random sampling procedure when submitting products for those tests, but we will not enforce any random sampling requirements for IEC 60335, IEC 60335-2-24, IEC 60335-2-75, or IEC 60335-2-89. However, for VeraSol's refrigerator testing process, we implement random sampling to ensure that the products selected are representative of a production run. To ensure that testing is timely and cost-effective, only one sample is used for testing, but two are selected in case there is damage to the first during shipment or testing. VeraSol requires the two samples are selected from a minimum stock of 20 units.

Stakeholder comment	VeraSol response
<p>The minimum stock requirement should be 15, which is >5% of our current minimum order quantity (MOQ)</p>	<p>According to our data, based on refrigerators submitted through VeraSol testing (n=4), the average MOQ is roughly 200 units, which seems consistent with this feedback. VeraSol aims to randomly select from a stock that is representative of a production run. Based on our understanding, each production run should at least produce the same number of units as the MOQ. Given this, we still think that 20 units are reasonable and appropriate as a minimum stock size.</p>

Health and Safety

Global warming potential (GWP)

Should we include a global warming potential (GWP) limit for refrigerants and foam blowing agents to encourage climate-friendly refrigerants?



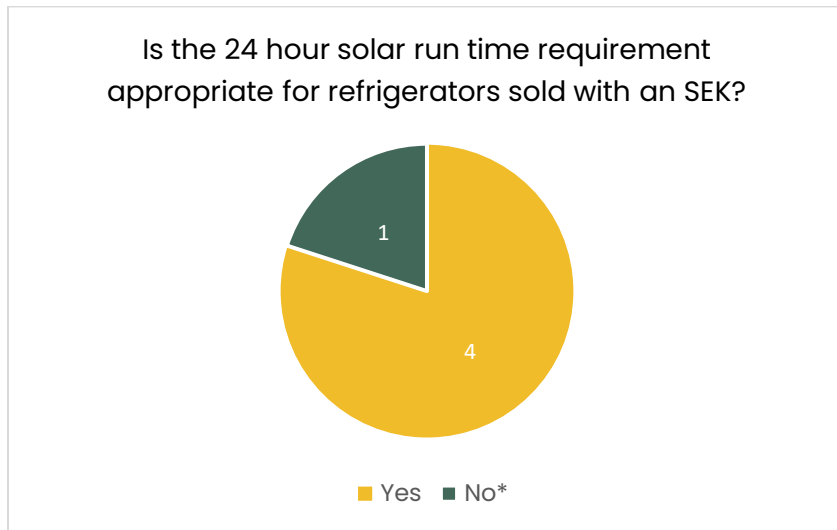
Stakeholder comment	VeraSol response
<p>Need to do a benefit analysis as there are higher efficiency "non-climate-friendly" refrigerants which might actually have a positive net benefit?</p>	<p>In recent research, Efficiency for Access analyzed the GWP of refrigerants used in DC refrigerators in off-grid settings. The study identified that the HC systems (i.e., R600a or R290) offer higher energy efficiency levels than conventional HFC systems. One of the manufacturers reported that using thicker insulation materials in HC systems provides the best levels of energy efficiency. However, the off-grid refrigerator market is dominated by the use of R134a and R600a. 40% of the analyzed refrigerator models use R600a, and 47% of models use hydrocarbons (R600a or R290). More than 50% of manufacturers are still using the HFC R134a.</p> <p>Refrigerators using R134a refrigerants had a GWP value of 1430, compared to 3 for natural refrigerants (R600a or R290). While VeraSol would encourage the use of low GWP refrigerants, we are concerned a stringent GWP requirement could negatively impact consumers' choice and accessibility to refrigerators. We are proposing to allow R134a and to set a limit that excludes refrigerants with a GWP higher than 1430, with the ambition to tighten the GWP requirement over time.</p>
<p>Although important, it should be an aspirational 'additional requirement' that is required and can be selected for eligibility. There is currently insufficient infrastructure and local capacity in the majority of developing countries to support this.</p>	<p>This is noted. Research from Efficiency for Access found that all surveyed off-grid refrigerators (n=30) used refrigerants R134a, R290, or R600a. The GWP limit we are considering setting would still allow all these refrigerant types but would limit the worst refrigerants in the market. Any refrigerant with a GWP higher than 1430 would not be permitted. Based on this research, this would be inclusive of most off-grid refrigerators already available in the market.</p>

Other comments

Stakeholder comment	VeraSol response
<p>These should cover aspects that affect food safety as well as physical use of the appliance.</p>	<p>The physical safety is evaluated via the Global LEAP Test Methods as well as IEC 60335-1 and one of the following:</p> <ul style="list-style-type: none"> • IEC 60335-2-24 • IEC 60335-2-75 • IEC 60335-2-89 <p>To address food safety, VeraSol requires that any compartment to store fresh food (i.e., spoilable food items) should maintain 4C or lower. If it does not, it must state that it is "Not intended for long-term storage of temperature-sensitive foods".</p>
<p>Any AC-DC power supply included with a refrigerator carries a recognized consumer electronics safety certification as specified in IEC TS 62257-9-8. Is the same is valid for a DC-AC power supply as well?</p>	<p>If the refrigerator is certified as a standalone product and comes packaged with a DC-AC power supply or inverter, this power supply is tested with the system as part of the Global LEAP Off-Grid Refrigerator Test Method. We are looking into whether any additional requirements need to be specified and will likely require that the company provide documentation that the inverter meets one of the following:</p> <ul style="list-style-type: none"> • IEC 62109-1 / UL 62109-1: Safety of Power Converters for Use in Photovoltaic Power Systems – Part 1: General Requirements AND IEC 62109-2: Safety of Power Converters for Use in Photovoltaic Power Systems – Part 2: Particular Requirements for Inverters • UL 1741: Inverters, Converters, Controllers and Interconnection System Equipment for Use with Distributed Energy Resources • IEC 62368-1: Audio/video, information and communication technology equipment – Part 1: Safety requirements

Stakeholder comment	VeraSol response
	<ul style="list-style-type: none"> • UL 458: Power Converters/Inverters and Power Converter/Inverter Systems for Land Vehicles and Marine Crafts <p>These requirements would apply to inverters that are packaged with but separate from a refrigerator and those that are built into a refrigerator.</p> <p>For refrigerators being certified as part of an SHS kit, DC-AC (inverters) are not permitted to be included with the kit because AC appliances are not currently within the scope of the VeraSol solar energy kit certification program. We hope to expand the certification to incorporate AC appliances in the next few years.</p>

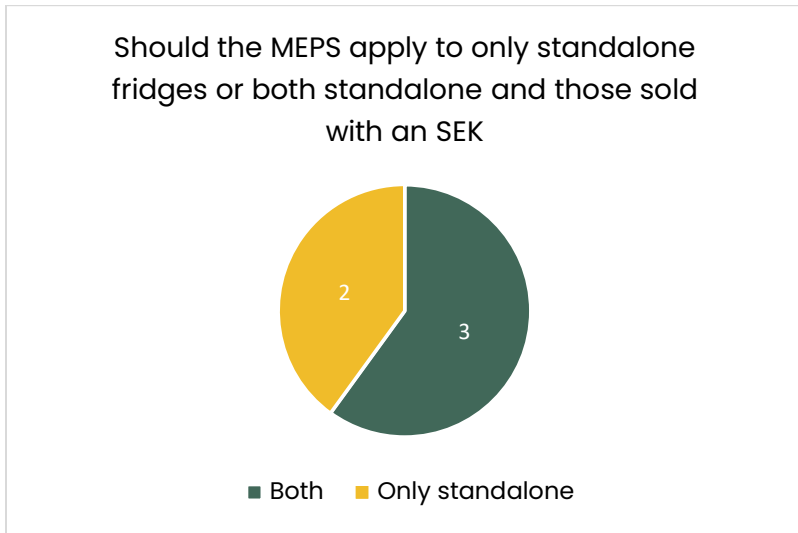
Run-time requirement



* The one person who answered no stated this because it would not be appropriate for vaccine refrigerators. We will rethink this requirement for SDD refrigerators as we include them in the certification scope.

Minimum Energy Performance Standards (MEPS)

Scope



Stakeholder comment	VeraSol response
Voted for MEPS for standalone refrigerators only	
<p>MEPS targets the refrigerator performance, which directly affects the SHS battery and panel sizing. When a refrigerator has low performance, it will need a bigger battery (high cost) and bigger solar panel (high cost); therefore, MEPS directly related to the total cost of ownership (TCO) of the whole refrigeration solution. Once a refrigerator meets a defined target (MEPS), you can set to the market fair TCO - resulting in a better proposition for the end-user. That said, the MEPS works as a tool to address the market's needs for the refrigerator manufacturer/supplier. On the other hand, defining a</p>	<p>We reviewed the responses and determined that it makes the most sense for MEPS to apply to standalone products only. Our testing will ensure that refrigerators sold with an SEK are efficient enough to run with their provided power system. Refrigerators sold with an SEK will also be required to advertise the refrigerator's performance with the SEK, giving customers the choice of which product best meets their needs between metrics such as price, performance, and system size.</p>

<p>MEPS for an SHS kit seems is pointless once the SHS kit supplier is responsible for the whole kit sizing and price selling. They don't need any target (MEPS) to address the markets needs as they are already facing the market pressure to deliver a viable refrigeration solution and a good price point.</p>	
<p>If the supplier chooses to increase the solar system size to suit a slightly less efficient fridge but still meets run time, that should be their commercial decision? Much like the choice of a supplier to choose a lower efficiency LED and increase solar+battery for commercial reasons, there is no minimum lumen efficiency required for SHS kits etc.</p>	
<p>Voted for MEPS for both standalone refrigerators and those sold with an SHS kit</p>	
<p>This guarantees efficiency of the off-grid refrigerators</p>	<p>As highlighted above, we determined that specifying MEPS for refrigerators sold with an SHS kit is redundant, given that efficiency is factored into the design of the SHS as well as VeraSol's SHS runtime requirement.</p>
<p>The energy performance will show the quality of the product, energy efficiency and performances. Hence the need for MEPs for all energy-consuming appliances</p>	
<p>I cannot see any good reason for why they would NOT apply. As appliance performance MEPS should be independent of power source or bundling.</p>	

AECmax Requirements

To comply with MEPS, the Maximum Annual Energy Consumption (AECmax) formulas are defined in Annex 2. Are these requirements appropriate for each refrigerator category?



Stakeholder comment	VeraSol response										
Consider requirements in IEC 622552-1/2/3: 2015	There is no maximum annual energy requirement in IEC 62252 series. IEC 62252 only defines how energy consumption should be measured for refrigerating appliances.										
Should there be an inclusion of efficiency to volume to be able to compare relative performance of refrigerators of different sizes? AEC/AV = some kind of 'energy star' rating kWh/L? Perhaps thermodynamically it becomes more complex as fridges become larger providing a bias to smaller fridges, I have not thought as far on it.	<p>The current MEPS requirement does factor in volume. Table 3 below shows the maximum annual energy consumption allowance, where AV is adjusted volume.</p> <p>Table 3. Maximum Annual Energy Consumption (AECmax) adjusted by Volume</p> <table border="1" data-bbox="789 1187 1793 1377"> <thead> <tr> <th>Reference Temperature</th> <th>Product Category</th> <th>AECmax (kWh/year)</th> </tr> </thead> <tbody> <tr> <td rowspan="3">32°C</td> <td>Refrigerators</td> <td>$0.220 \times AV + 137 + A_R$</td> </tr> <tr> <td>Refrigerator-Freezers</td> <td>$0.288 \times AV + 210 + A_{RF}$</td> </tr> <tr> <td>Freezers</td> <td>$0.268 \times AV + 247 + A_F$</td> </tr> </tbody> </table> <p>These equations are not wholly dependent on volume, resulting in an efficiency requirement line that is relatively flat. However, from our understanding,</p>	Reference Temperature	Product Category	AECmax (kWh/year)	32°C	Refrigerators	$0.220 \times AV + 137 + A_R$	Refrigerator-Freezers	$0.288 \times AV + 210 + A_{RF}$	Freezers	$0.268 \times AV + 247 + A_F$
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	<p>manufacturers often use the same size of the compressor if refrigerator capacities are similar (for example, 50L and 100L). So, the energy consumption between the two-liter sizes isn't significantly different.</p> <p>Note we are planning to update values in these equations to better align with the upcoming United for Energy (U4E) guidance, and results from recent testing. However, the structure of the equations will not change and will still be partially dependent on the volume of the refrigerator.</p>
<p>How is the energy consumption measured? Is this including a pulldown energy consumption or a steady state? Is this including opening/closing the fridge several times?</p>	<p>Energy consumption is measured in a steady state over 24 hours. The energy consumption tests do not include any door openings or closings. Data from the field indicated that opening and closing doors have a minimal impact on energy consumption and is hard to replicate in the lab.</p>
<p>Rather than giving a max. energy consumption per day/year I think it would be better to rate the energy class, like A, A+ (like the European standard)</p>	<p>Given the current state of the off-grid refrigerator market, we believe MEPS are the more appropriate market intervention. MEPS and energy class ratings have different (complementary) goals. Where MEPS remove the least efficient products from the market, labels encourage consumers to buy more efficient products by differentiating them. Historically, VeraSol has used the certification process to define the baseline, and minimum quality for products and then allowed products to differentiate through publicly shared performance information. On the VeraSol Product Database, we report the energy consumption in kWh/day for every tested refrigerator, which can easily be compared on the website or by downloading the .csv file at the top right of the screen.</p>

Temperature Classifications

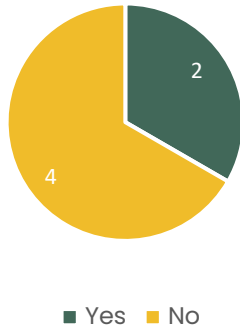
Stakeholder comment	VeraSol response
Very good that this is defined!	N/A
All refrigerators shall maintain a temperature of 12C at an ambient temperature of 43C, is 12C average or peak?	The refrigerator must hold this temperature throughout the specific test.
Why are the temperature class/use class advertisements assessed based on the ability of the refrigerator to maintain the advertised temperature class at an ambient temperature of 43C? And, in case the climatic class of the country is qualified as subtropical, why does the appliance need to meet a tropical 43C?	Our field testing found that consumers are using refrigerators whether or not it is suitable for their climate. Further, refrigerator placement is often in direct sunlight, significantly impacting performance. Therefore, to ensure that all refrigerators are still functioning well in the most extreme conditions, we test at 43°C.

Other Performance Requirements

Stakeholder comment	VeraSol response
<p>9.2h pulldown time might be too short if the fridge includes any kind of thermal storage (e.g., ice battery). If this kind of storage is included, I suggest extending this time.</p>	<p>The initial quality standards did not include refrigerators with an ice battery/thermal storage (i.e., SDD refrigerators) in the certification scope. However, based on feedback, we are currently adjusting the requirements to include SDD refrigerators.</p>
<p>Testing must identify and incorporate real-life use cases for a variety of suitable domestic and productive use applications.</p>	<p>The quality requirements aim to be general enough to incorporate a variety of use cases, mainly domestic food storage and for small businesses (e.g., storage of cold drinks, produce, etc.). The compartment classifications are also based on the use-case, and if a refrigerator cannot meet 4°C, it must include a statement that it's not intended for food storage.</p>
<p>Determine a variety of set metrics that represent a range of potential use cases and test against these. This should include performance in the typically hot climates, measurement against multiple door openings, measurement of ability to chill set volumes of standardized mass to represent liquid and food stuffs.</p>	<p>The Global LEAP Off-Grid Refrigerator Test Methods define performance in hot climates (e.g., with certain tests measured at 43°C ambient) and ability to chill standardized masses (e.g., freezing capacity).</p>

Truth-in-Advertising

Is a 15% tolerance between rated and tested values appropriate?



Stakeholder comment	VeraSol response
It should be up to 5%	Energy star allows a 10% deviation between tested and rated values, while the VeraSol standards for solar energy kits (IEC TS 62257-9-8) allow a 15% deviation. We will continue to discuss this tolerance internally and align with one of these.
It should be 10%	
Not sure, 10% max but I do not know the specifics of refrigerators to determine this. Suggest aligning with energy star or equivalent tolerances	
I just answered no, because it takes time for fridges to stabilize thermodynamically, therefore if it hasn't been, there should be some kind of indication as to how long the fridge will be run prior to testing being undertaken. This will affect tolerance.	We reference stability criteria in IEC 62252 for the energy consumption and storage test. In case stability cannot be achieved, it is assumed that the refrigerator is not stable enough. For the pull-down test, we typically wait 24 hours before testing. For the autonomy test, we ensure at least a few compressor cycles, if present, before cutting power.

Quality and Durability

Stakeholder comment	VeraSol response
<p>This is subjective and hard to assess without inclusion of physical tests such as hinge durability.</p>	<p>The quality and durability inspections are subjective but aim to be as objective as possible, following a standardized set of criteria. The design and durability evaluation does evaluate the robustness of the door hinge.</p>

Other General Feedback/Questions

Stakeholder comment	VeraSol response
<p>Kenya adopted IEC 62252-1/2/3: 2015 for household refrigerators. The refrigerators are tested using the test methods for MEPS and labelled using KS 2464-2:2020. We have noticed that some of the test metrics proposed are different from those in the IEC standards. For instance, the guideline provides for pull-down time of 8 hours (tolerance 15%) against the requirements of IEC standards provided. Similarly, the test is based on 32C while the standards use 16 and 32C. While we note the progress for the off-grid refrigerators, it is our submission that we should seek to harmonize the above requirements among others in the IEC standard. This is important to guarantee efficiency and allow for energy</p>	<p>IEC 62252-1/2/3: 2015 only applies to AC refrigerators intended to be used with grid connections. The VeraSol standards aim to align with IEC 62252-1/2/3: 2015 as much as possible while adding requirements to address the quality of refrigerators intended for use in off- and weak-grid settings. The Global LEAP Off-Grid Refrigerator Test Method references many of the tests in IEC 62252-1/2/3: 2015. We will investigate the discrepancies between the two test methods and consider whether aligning would be appropriate.</p>

<p>performance labelling in countries such as Kenya and Ghana that have already adopted MEPS. A lot of messaging has been done to educate end-users on the importance of labelling and hence the need for harmonization. Further, off-grid refrigerators imported as standalone have both AC and DC input, thus making it difficult to distinguish.</p>	
<p>Recommend including one label on the refrigerator's power cord indicating the type of power input that the refrigerator can operate on.</p>	<p>This is a good suggestion and could help minimize accidental misuse. We may propose adding this as a requirement but will solicit additional feedback from companies and other stakeholders before finalizing.</p>
<p>Is there any way to apply for a the VeraSol lab network? Is there any plan to include Intertek or SGS (or others) in the network?</p>	<p>VeraSol is not seeking any new solar energy kit or refrigerator labs. However, please reach out to us at info@verasol.org with your inquiry. Intertek Hong Kong is currently part of the solar energy kit test lab network, but for now, RegenT in the Netherlands is the only VeraSol lab qualified to test refrigerators.</p>
<p>Appliances that do not meet all requirements for certification will have one month to correct issues, but one month may be too short depending on the issues found. If the requirements are not met and there is no feasible time to correct them, will it be possible to not post the data in the VeraSol website?</p>	<p>Companies must correct all issues related to consumer-facing information (e.g., packaging or user manual) and submit digital updates within one month. If the updates are not made, the product will still be posted on the VeraSol website but will be marked as 'tested' only. Companies can still submit the required materials after one month, and the product's status will be changed to 'certified'. If a product fails to meet the standards and no updates are made, the company can choose not to have its refrigerator posted on the VeraSol Product Database.</p>
<p>When the certification expires, besides the documentation update, will it be necessary to pay a fee to renew the certification?</p>	<p>Yes, companies will be required to pay a fee to renew their refrigerator. This will cover the cost of document review and updates, the database listing, and market surveillance.</p>