|  |  |  |
| --- | --- | --- |
| **Requirement** | **Description** | **Notes** |
| 1065.510(b)(4) | Set operator demand to maximum and control engine speed at (95 ±1) % of its warm idle speed determined above for at least 15 seconds. For engines with reference duty cycles whose lowest speed is greater than warm idle speed, you may start the map at (95 ±1) % of the lowest reference speed. | Specifies the starting conditions for the map.  **Verify that the map start point satisfies these conditions.** |
| 1065.510(b)(5)(ii) | For any variable-speed engine, you may perform an engine map by using a continuous sweep of speed by continuing to record the mean feedback speed and torque at 1 Hz or more frequently and increasing speed at a constant rate such that it takes (4 to 6) min to sweep from 95% of warm idle speed to the check point speed as described in paragraph (b)(5)(iii) of this section. Use good engineering judgment to determine when to stop recording data to ensure that the sweep is complete. In most cases, this means that you can stop the sweep at any point after the power falls to 50% of the maximum value. From the series of mean speed and maximum torque values, use linear interpolation to determine intermediate values. Use this series of speeds and torques to generate the power map as described in paragraph (e) of this section.  See also 1065.510(b)(5)(iii) and 1065.510(e) | Specifies the frequency of the engine map, data collection, duration, start and end point.  **Verify**   1. **Mean feedback speed and torque were recorded at 1 Hz or more** 2. **Speed is increasing at a constant rate\* over the interval from from 95% of warm idle speed to the check point speed speed {see 1065.510(b)(5)(iii)}** 3. **The time to sweep from 95% of warm idle speed to the check point speed\*\* was between 4 and 6 minutes inclusive**   **\*\* Note: Per 1065.510(b)(5)(iii): “For continuous mapping, if the engine cannot be mapped to the check point speed, verify that the sweep time from 95% of warm idle to the maximum mapped speed is (4 to 6) min.”**  Note: \*Strictly speaking, speed is highly unlikely to be increasing at a constant rate as the raw data will fluctuate a bit. The graph of the data should (generally) fall on a straight line, which might be the extent of the verification check.  \*\* How do we want to deal with this “requirement” given that it isn’t always applicable? {see 1065.510(b)(5)(iii)}  Finally, although I doubt it will be an issue, we have to be careful here if we’re going to allow data that isn’t equally-spaced (e.g., data collected at 1 Hz with assorted intervals collected at 10 Hz) as that could quite clearly skew later analysis (for instance, the mean). The software can, of course, check to make sure that all data points are being collected at a constant frequency and report the input file as invalid if the check fails. |
| 1065.510(b)(5)(iii) | The check point speed of the map is the highest speed above maximum power at which 50% of maximum power occurs. If this speed is unsafe or unachievable (*e.g.,* for ungoverned engines or engines that do not operate at that point), use good engineering judgment to map up to the maximum safe speed or maximum achievable speed. For discrete mapping, if the engine cannot be mapped to the check point speed, make sure the map includes at least 20 points from 95% of warm idle to the maximum mapped speed. For continuous mapping, if the engine cannot be mapped to the check point speed, verify that the sweep time from 95% of warm idle to the maximum mapped speed is (4 to 6) min. | Specifies the “check point” or end point for the map and steps to perform if the engine cannot be mapped to the check point speed.  Note: We can probably estimate this since we aren’t explicitly told how to determine when the power is 50% of maximum power. Since it is probably unlikely that power is ever **precisely** 50% of maximum power, we can interpolate between two adjacent points but that would correspond to a non-existent time so that using such a time as an endpoint doesn’t really make sense (moreover, it introduces the issue I referred to earlier about un-equally spaced points). |
| 1065.510(b)(5)(iv) | Note that under §1065.10(c)(1) we may allow you to disregard portions of the map when selecting maximum test speed if the specified procedure would result in a duty cycle that does not represent in-use operation.  See also 1065.10(c)(1) | Specifies the portion of the CFR providing the criteria when it is acceptable to disregard portions of the map.  Note: This would seem to be an issue best dealt with by the engineer producing the file used by CycleMaster. The software can report issues that are then explained by the engineer in such cases. |
| 1065.510(b)(6)(i) | Use one of the following methods to determine warm high-idle speed for engines with a high-speed governor if they are subject to transient testing with a duty cycle that includes reference speed values above 100%:  You may use a manufacturer-declared warm high-idle speed if the engine is electronically governed. For engines with a high-speed governor that shuts off torque output at a manufacturer-specified speed and reactivates at a lower manufacturer-specified speed (such as engines that use ignition cut-off for governing), declare the middle of the specified speed range as the warm high-idle speed. | Note: This is really a test requirement. The software requirement is probably that the warm high-idle speed can be manually input. |
| 1065.510(b)(6)(ii)(A) | Measure the warm high-idle speed using the following procedure:  Set operator demand to maximum and use the dynamometer to target zero torque on the engine's primary output shaft. If the mean feedback torque is within ±1% of *T*max mapped, you may use the observed mean feedback speed at that point as the measured warm high-idle speed. | Describes ways to measure the warm high-idle speed. In this case, if the mean feedback torque is within ±1% of *T*max mapped, we may use the observed mean feedback speed at that point as the measured warm high-idle speed.  Note: Parts (A) through (D) are probably best dealt with by allowing the warm high-idle speed to be calculated separately and manually entered. That said, we could probably calculate them in the software if desired. We’d need to make sure the algorithms for doing so were well-defined.  In the case of (A), I am a little unclear here. I assume that if the mean feedback torque is within ±1% of Tmax mapped over its range, we can used the feedback speed at Tmax mapped as the measured warm high-idle speed. The use of the term “**mean** feedback speed” makes me wonder if we are referring to a set of points, though, since the mean of a single value doesn’t seem to make a lot of sense. I suspect I am confused by the terminology here. |
| 1065.510(b)(6)(ii)(B) | Measure the warm high-idle speed using the following procedure:  If the engine is unstable as a result of in-use production components (such as engines that use ignition cut-off for governing, as opposed to unstable dynamometer operation), you must use the mean feedback speed from paragraph (b)(6)(ii)(A) of this section as the measured warm high-idle speed. The engine is considered unstable if any of the 1 Hz speed feedback values are not within ±2% of the calculated mean feedback speed. We recommend that you determine the mean as the value representing the midpoint between the observed maximum and minimum recorded feedback speed.  See also 1065.510(b)(6)(ii)(A) | This provides the criteria for determining engine instability which, in turn, implies that the warm high-idle speed must be calculated as provided detailed in 1065.510(b)(6)(ii)(A).  Note: Also note that the calculation of mean feedback speed is provided, here, too (as only a recommendation and not a requirement). |
| 1065.510(b)(6)(ii)(C) | If your dynamometer is not capable of achieving a mean feedback torque within ±1% of *T*max mapped, operate the engine at a second point with operator demand set to maximum with the dynamometer set to target a torque equal to the recorded mean feedback torque on the previous point plus 20% of *T*max mapped. Use this data point and the data point from paragraph (b)(6)(ii)(A) of this section to extrapolate the engine speed where torque is equal to zero.  See also 1065.510(b)(6)(ii)(A) | See above |
| 1065.510(b)(6)(ii)(D) | You may use a manufacturer-declared *T*max instead of the measured *T*max mapped. If you do this, or if you are able to determine mean feedback speed as described in paragraphs (b)(6)(ii)(A) and (B) of this section, you may measure the warm high-idle speed before running the speed sweep specified in paragraph (b)(5) of this section.  See also 1065.510(b)(6)(ii)(A), 1065.510(b)(6)(ii)(B) and 1065.510(b)(5) | See above |
| 1065.510(b)(7) | For engines with a low-speed governor, if a nonzero idle torque is representative of in-use operation, operate the engine at warm idle with the manufacturer-declared idle torque. Set the operator demand to minimum, use the dynamometer to target the declared idle torque, and allow the engine to govern the speed. Measure this speed and use it as the warm idle speed for cycle generation in §1065.512. We recommend recording at least 30 values of speed and using the mean of those values. If you identify multiple warm idle torques under paragraph (f)(4)(i) of this section, measure the warm idle speed at each torque. You may map the idle governor at multiple load levels and use this map to determine the measured warm idle speed at the declared idle torque(s).  See also 1065.512 and 1065.510(f)(4)(i) | This is really a test requirement; however, the use of at least 30 values to determine the mean warm idle speed is suggested. |
| 1065.510(c)(1) | *Negative torque mapping.* If your engine is subject to a reference duty cycle that specifies negative torque values (*i.e.*, engine motoring), generate a motoring map by any of the following procedures:  Multiply the positive torques from your map by −40%. Use linear interpolation to determine intermediate values. | Describes how the negative torque mapping can be created from the positive torques.  **Handled in software by automatically generating the friction curve as described here.** |
| 1065.510(c)(2) | *Negative torque mapping.* If your engine is subject to a reference duty cycle that specifies negative torque values (*i.e.*, engine motoring), generate a motoring map by any of the following procedures:  Map the amount of negative torque required to motor the engine by repeating paragraph (b) of this section with minimum operator demand. You may start the negative torque map at either the minimum or maximum speed from paragraph (b) of this section.  See also 1065.510(b) | **The software allows users to specify a friction curve to be applied.** |
| 1065.510(c)(3)(i)  1065.510(c)(3)(ii) | *Negative torque mapping.* If your engine is subject to a reference duty cycle that specifies negative torque values (*i.e.*, engine motoring), generate a motoring map by any of the following procedures:  Determine the amount of negative torque required to motor the engine at the following two points near the ends of the engine's speed range. Operate the engine at these two points at minimum operator demand. Use linear interpolation to determine intermediate values.  (i) *Low-speed point.* For engines without a low-speed governor, determine the amount of negative torque at warm idle speed. For engines with a low-speed governor, motor the engine above warm idle speed so the governor is inactive and determine the amount of negative torque at that speed.  (ii) *High-speed point.* For engines without a high-speed governor, determine the amount of negative torque at the maximum safe speed or the maximum representative speed. For engines with a high-speed governor, determine the amount of negative torque at a speed at or above *n*hi per §1065.610(c)(2).  See also 1065.610(c)(2) | **The software allows users to specify a friction curve to be applied.** |
| 1065.510(c)(4) | *Negative torque mapping.* If your engine is subject to a reference duty cycle that specifies negative torque values (*i.e.*, engine motoring), generate a motoring map by any of the following procedures:  For engines with an electric hybrid system, you may create a negative torque map that would include the full negative torque of the electric hybrid system, so operator demand will be at a minimum when the reference duty cycle specifies negative torque values. | **The software allows users to specify a friction curve to be applied.** |
| 1065.510(d) | *Mapping constant-speed engines.* For constant-speed engines, generate a map as follows: | **The software currently does not generate a map for constant-speed engines.** |
| 1065.510(e) | *Power mapping.* For all engines, create a power-versus-speed map by transforming torque and speed values to corresponding power values. Use the mean values from the recorded map data. Do not use any interpolated values. Multiply each torque by its corresponding speed and apply the appropriate conversion factors to arrive at units of power (kW). Interpolate intermediate power values between these power values, which were calculated from the recorded map data. | **The software currently creates a power-versus-speed map by by transforming torque and speed values to corresponding power values. This calculation will be moved into a utility function.**  % Calculate power(kW) from speed(rpm) and torque(Nm)  handles.PowerCurvePower = handles.PowerCurveSpeed.\*handles.PowerCurveTorque\*pi/30000; |
| 1065.510(f) | *Measured and declared test speeds and torques.* You must select test speeds and torques for cycle generation as required in this paragraph (f). “Measured” values are either directly measured during the engine mapping process or they are determined from the engine map. “Declared” values are specified by the manufacturer. When both measured and declared values are available, you may use declared test speeds and torques instead of measured speeds and torques if they meet the criteria in this paragraph (f). Otherwise, you must use measured speeds and torques derived from the engine map. | **All measured values can be manually overwritten. It will be up to the user to determine when they are appropriate.** |
| 1065.510(f)(1)(i)  1065.510(f)(1)(ii)  1065.510(f)(1)(iii)  1065.510(f)(1)(iv) | *Measured speeds and torques.* Determine the applicable speeds and torques for the duty cycles you will run:   1. Measured maximum test speed for variable-speed engines according to §1065.610. 2. Measured maximum test torque for constant-speed engines according to §1065.610. 3. Measured “A”, “B”, and “C” speeds for variable-speed engines according to §1065.610. 4. Measured intermediate speed for variable-speed engines according to §1065.610.   See also 1065.610 | **Many of the equations described here are incorporated in the current version of CycleMaster. However, they will be moved to the Common Tools or perhaps the Engine Tools directories. The reason for this is twofold:**   1. **To improve traceability from CFR requirements to code and allow for validation testing of these same requirements.** 2. **To allow these calculations to be performed outside of CycleMaster for “manual” data analysis using “validated” scripts.**   **For an example, refer to the findMaxTestSpeed.m that implements 1065.510(c)(1)(i) 🡪 1065.610(a) included as Attachment 1 to this document.** |
| 1065.510(f)(1)(v) | *Measured speeds and torques.* Determine the applicable speeds and torques for the duty cycles you will run:  For variable-speed engines with a low-speed governor, measure warm idle speed according to §1065.510(b) and use this speed for cycle generation in §1065.512. For engines with no low-speed governor, instead use the manufacturer-declared warm idle speed.  See also 1065.510(b) and 1065.512 | Note: As noted before, this is probably best dealt with by allowing the warm high-idle speed to be calculated separately and manually entered. |
| 1065.510(f)(2) | *Required declared speeds.* You must declare the lowest engine speed possible with minimum load (i.e., manufacturer-declared warm idle speed). This is applicable only to variable-speed engines with no low-speed governor. For engines with no low-speed governor, the declared warm idle speed is used for cycle generation in §1065.512. Declare this speed in a way that is representative of in-use operation. For example, if your engine is typically connected to an automatic transmission or a hydrostatic transmission, declare this speed at the idle speed at which your engine operates when the transmission is engaged.  See also 1065.512 | Note: I’m assuming that the lowest engine speed possible with minimum load is the idle speed (?) so this is handled by allowing for the warm idle speed to be calculated separately and manually entered. |
| 1065.510(f)(3)(i)  1065.510(f)(3)(ii)  1065.510(f)(3)(iii) | *Optional declared speeds.* You may use declared speeds instead of measured speeds as follows:   1. You may use a declared value for maximum test speed for variable-speed engines if it is within (97.5 to 102.5) % of the corresponding measured value. You may use a higher declared speed if the length of the “vector” at the declared speed is within 2% of the length of the “vector” at the measured value. The term vector refers to the square root of the sum of normalized engine speed squared and the normalized full-load power (at that speed) squared, consistent with the calculations in §1065.610. 2. You may use a declared value for intermediate, “A”, “B”, or “C” speeds for steady-state tests if the declared value is within (97.5 to 102.5)% of the corresponding measured value. 3. For electronically governed engines, you may use a declared warm high-idle speed for calculating the alternate maximum test speed as specified in §1065.610. | **The software allows for manual override of the measured quantities. It might be a good idea to check these declared speeds against the criteria listed here and, at the very least, provide the user with an alert. These values could also be flagged in the reports.** |
| 1065.510(f)(4)(i)  1065.510(f)(4)(ii) | *Required declared torques.*If a nonzero idle or minimum torque is representative of in-use operation, you must declare the appropriate torque as follows:   1. For variable-speed engines, declare a warm idle torque that is representative of in-use operation. For example, if your engine is typically connected to an automatic transmission or a hydrostatic transmission, declare the torque that occurs at the idle speed at which your engine operates when the transmission is engaged. Use this value for cycle generation. You may use multiple warm idle torques and associated idle speeds in cycle generation for representative testing. For example, for cycles that start the engine and begin with idle, you may start a cycle in idle with the transmission in neutral with zero torque and later switch to a different idle with the transmission in drive with the Curb-Idle Transmission Torque (CITT). For variable-speed engines intended primarily for propulsion of a vehicle with an automatic transmission where that engine is subject to a transient duty cycle with idle operation, you must declare a CITT. You must specify a CITT based on typical applications at the mean of the range of idle speeds you specify at stabilized temperature conditions. 2. For constant-speed engines, declare a warm minimum torque that is representative of in-use operation. For example, if your engine is typically connected to a machine that does not operate below a certain minimum torque, declare this torque and use it for cycle generation. | **CITT can be entered by the user.** |
| 1065.510(f)(5)(i)  1065.510(f)(5)(ii) | *Optional declared torques.*   1. For variable-speed engines you may declare a maximum torque over the engine operating range. You may use the declared value for measuring warm high-idle speed as specified in this section. 2. For constant-speed engines you may declare a maximum test torque. You may use the declared value for cycle generation if it is within (95 to 100) % of the measured value. | Note: Is this a test requirement only? While maximum torque is calculated I’m not aware of it being used or any way the user can enter a maximum torque. |
| 1065.510(g) | *Mapping variable-speed engines with an electric hybrid system.*Map variable-speed engines that include electric hybrid systems as described in this paragraph (g). You may ask to apply these provisions to other types of hybrid engines, consistent with good engineering judgment. However, do not use this procedure for engines used in hybrid vehicles where the hybrid system is certified as part of the vehicle rather than the engine. Follow the steps for mapping a variable-speed engine as given in paragraph (b)(5) of this section except as noted in this paragraph (g). You must generate one engine map with the hybrid system inactive as described in paragraph (g)(1) of this section, and a separate map with the hybrid system active as described in paragraph (g)(2) of this section. See the standard-setting part to determine how to use these maps. The map with the system inactive is typically used to generate steady-state duty cycles, but may also be used to generate transient cycles, such as those that do not involve engine motoring. This hybrid-inactive map is also used for generating the hybrid-active map. The hybrid-active map is typically used to generate transient duty cycles that involve engine motoring. | Note: These would seem to be test requirements only. |
| 1065.512(a) | Generate duty cycles according to this section if the standard-setting part requires engine mapping to generate a duty cycle for your engine configuration. The standard-setting part generally defines applicable duty cycles in a normalized format. A normalized duty cycle consists of a sequence of paired values for speed and torque or for speed and power. | **Implemented in software.** |
| 1065.512(b)(1) | (b) Transform normalized values of speed, torque, and power using the following conventions:  Engine speed for variable-speed engines. For variable-speed engines, normalized speed may be expressed as a percentage between warm idle speed, fnidle, and maximum test speed, fntest, or speed may be expressed by referring to a defined speed by name, such as “warm idle,” “intermediate speed,” or “A,” “B,” or “C” speed. Section 1065.610 describes how to transform these normalized values into a sequence of reference speeds, fnref. Running duty cycles with negative or small normalized speed values near warm idle speed may cause low-speed idle governors to activate and the engine torque to exceed the reference torque even though the operator demand is at a minimum. In such cases, we recommend controlling the dynamometer so it gives priority to follow the reference torque instead of the reference speed and let the engine govern the speed. Note that the cycle-validation criteria in §1065.514 allow an engine to govern itself. This allowance permits you to test engines with enhanced-idle devices and to simulate the effects of transmissions such as automatic transmissions. For example, an enhanced-idle device might be an idle speed value that is normally commanded only under cold-start conditions to quickly warm up the engine and aftertreatment devices. In this case, negative and very low normalized speeds will generate reference speeds below this higher enhanced idle speed and we recommend controlling the dynamometer so it gives priority to follow the reference torque, controlling the operator demand so it gives priority to follow reference speed and let the engine govern the speed when the operator demand is at minimum.  See also 1065.610 and 1065.514 |  |
| 1065.512(b)(2) | Engine torque for variable-speed engines. For variable-speed engines, normalized torque is expressed as a percentage of the mapped torque at the corresponding reference speed. Section 1065.610 describes how to transform normalized torques into a sequence of reference torques, Tref. Section 1065.610 also describes special requirements for modifying transient duty cycles for variable-speed engines intended primarily for propulsion of a vehicle with an automatic transmission. Section 1065.610 also describes under what conditions you may command Tref greater than the reference torque you calculated from a normalized duty cycle. This provision permits you to command Tref values that are limited by a declared minimum torque. For any negative torque commands, command minimum operator demand and use the dynamometer to control engine speed to the reference speed, but if reference speed is so low that the idle governor activates, we recommend using the dynamometer to control torque to zero, CITT, or a declared minimum torque as appropriate. Note that you may omit power and torque points during motoring from the cycle-validation criteria in §1065.514. Also, use the maximum mapped torque at the minimum mapped speed as the maximum torque for any reference speed at or below the minimum mapped speed. |  |
| 1065.512(b)(3) | Engine torque for constant-speed engines. For constant-speed engines, normalized torque is expressed as a percentage of maximum test torque, Ttest. Section 1065.610 describes how to transform normalized torques into a sequence of reference torques, Tref. Section 1065.610 also describes under what conditions you may command Trefgreater than the reference torque you calculated from the normalized duty cycle. This provision permits you to commandTref values that are limited by a declared minimum torque. | Note: Not implemented in the current Cycle Master software. |
| 1065.512(b)(4) | Engine power. For all engines, normalized power is expressed as a percentage of mapped power at maximum test speed, fntest, unless otherwise specified by the standard-setting part. Section 1065.610 describes how to transform these normalized values into a sequence of reference powers, Pref. Convert these reference powers to corresponding torques for operator demand and dynamometer control. Use the reference speed associated with each reference power point for this conversion. As with cycles specified with % torque, issue torque commands more frequently and linearly interpolate between these reference torque values generated from cycles with % power. |  |
| 1065.512(b)(5) | Ramped-modal cycles. For ramped-modal cycles, generate reference speed and torque values at 1 Hz and use this sequence of points to run the cycle and validate it in the same manner as with a transient cycle. During the transition between modes, linearly ramp the denormalized reference speed and torque values between modes to generate reference points at 1 Hz. Do not linearly ramp the normalized reference torque values between modes and then denormalize them. Do not linearly ramp normalized or denormalized reference power points. These cases will produce nonlinear torque ramps in the denormalized reference torques. If the speed and torque ramp runs through a point above the engine's torque curve, continue to command the reference torques and allow the operator demand to go to maximum. Note that you may omit power and either torque or speed points from the cycle-validation criteria under these conditions as specified in §1065.514. |  |
| 1065.512(c) | For variable-speed engines, command reference speeds and torques sequentially to perform a duty cycle. Issue speed and torque commands at a frequency of at least 5 Hz for transient cycles and at least 1 Hz for steady-state cycles (*i.e.*, discrete-mode and ramped-modal). Linearly interpolate between the 1 Hz reference values specified in the standard-setting part to determine more frequently issued reference speeds and torques. During an emission test, record the feedback speeds and torques at a frequency of at least 5 Hz for transient cycles and at least 1 Hz for steady-state cycles. For transient cycles, you may record the feedback speeds and torques at lower frequencies (as low as 1 Hz) if you record the average value over the time interval between recorded values. Calculate the average values based on feedback values updated at a frequency of at least 5 Hz. Use these recorded values to calculate cycle-validation statistics and total work. |  |
| 1065.512(d) | For constant-speed engines, operate the engine with the same production governor you used to map the engine in §1065.510 or simulate the in-use operation of a governor the same way you simulated it to map the engine in §1065.510. Command reference torque values sequentially to perform a duty cycle. Issue torque commands at a frequency of at least 5 Hz for transient cycles and at least 1 Hz for steady-state cycles (*i.e.*, discrete-mode, ramped-modal). Linearly interpolate between the 1 Hz reference values specified in the standard-setting part to determine more frequently issued reference torque values. During an emission test, record the feedback speeds and torques at a frequency of at least 5 Hz for transient cycles and at least 1 Hz for steady-state cycles. For transient cycles, you may record the feedback speeds and torques at lower frequencies (as low as 1 Hz) if you record the average value over the time interval between recorded values. Calculate the average values based on feedback values updated at a frequency of at least 5 Hz. Use these recorded values to calculate cycle-validation statistics and total work. |  |
| 1065.512(e) | You may perform practice duty cycles with the test engine to optimize operator demand and dynamometer controls to meet the cycle-validation criteria specified in §1065.514. | Not a software requirement. |

Attachment 1

findMaxTestSpeed.m

function fntest = findMaxTestSpeed(P,f)

% Determines the maximum test speed for variable speed engines

%

% Syntax:

% fntest = findMaxTestSpeed(P,f)

%

% Inputs:

% P - (dbl) An n-by-1 vector of powers (kW)

% f - (dbl) An n-by-1 vector of speeds (rpm)

%

% Outputs:

% fntest - (dbl) Maximum test speed

%

% CFR Requirement(s) Implemented:

% 1065.610(a)

%

% Example:

% fntest = findMaxTestSpeed(P,f)

%

% Other m-files required:

% None

%

% Subfunctions:

% findMaxPower

% abscissaInterp

%

% MAT-files required:

% None

%

% See also: http://www.ecfr.gov/cgi-bin/text-idx?SID=a1aacb2cd749e173bcfcd47709132422&node=pt40.33.1065&rgn=div5#se40.33.1065\_1610

% Author: Eric Simon

% File Version: 1.0

% Revision History:

% 1.0 09/23/2014 Original file.

% =========================================================================

% 1065.610(a)(1)(i)

Pmax = findMaxPower(P,f);

Pmax98 = Pmax \* 0.98;

% 1065.610(a)(1)(ii)

fPmax98 = abscissaInterp(f,P,Pmax98);

fPmax98\_lo = min(fPmax98);

fPmax98\_hi = max(fPmax98);

% 1065.610(a)(1)(iii)

fnPmax = mean([fPmax98\_lo fPmax98\_hi]);

% 1065.610(a)(1)(iv)

Pnorm = P ./ Pmax;

fnorm = f ./ fnPmax;

SS = fnorm.^2 + Pnorm.^2;

% 1065.610(a)(1)(v)

SSmax98 = max(SS) \* 0.98;

% 1065.610(a)(1)(vi)

fSSmax98 = abscissaInterp(f,SS,SSmax98);

fSSmax98\_lo = min(fSSmax98);

fSSmax98\_hi = max(fSSmax98);

% 1065.610(a)(1)(vii)

fntest = mean([fSSmax98\_lo fSSmax98\_hi]);