with the recordkeeping requirements in §1633.11;

(iii) Such mattress sets may be used for prototype pooling only if the manufacturer complies with applicable recordkeeping requirements in §1633.11; and

(iv) Such mattress sets may serve as the basis for a subordinate prototype only if the manufacturer has all records required by §1633.11.

§1633.5 Prototype pooling and confirmation testing requirements.

(a) *Prototype pooling.* One or more manufacturers may rely on a qualified prototype produced by another manufacturer or prototype developer provided that:

(1) The prototype meets the requirements of §1633.4;

(2) The mattress sets being produced are the same as the qualified prototype with respect to materials, components, design and methods of assembly; and

(3) The manufacturer producing mattress sets in reliance on a qualified prototype has performed a confirmation test on at least one (1) Specimen of the mattress set it produces in accordance with §1633.7. The tested specimen must meet the criteria under §1633.3(b) before any mattress sets based on the qualified prototype may be sold or introduced into commerce.

(b) *Confirmation test failure.* (1) If the confirmation test specimen fails to meet the criteria of §1633.3(b), the manufacturer thereof shall not sell any mattress set based on the same qualified prototype until that manufacturer takes corrective measures, tests a new specimen, and the new specimen meets the criteria of §1633.3(b).

(2) If a confirmation test specimen fails to meet the criteria of §1633.3(b), the manufacturer thereof must notify the manufacturer of the prototype of the test failure.

§1633.6 Quality assurance requirements.

(a) *Quality assurance.* Each manufacturer shall implement a quality assurance program to ensure that mattress sets manufactured for sale are the same as the qualified and/or confirmed prototype on which they are based with respect to materials, components, design and methods of assembly, except as permitted by §1633.4(b). At a minimum these procedures shall include:

(1) Controls, including incoming inspection procedures, of all mattress set materials, components and methods of assembly to ensure that they are the same as those used in the prototype on which they are based;

(2) Designation of a production lot that is represented by the prototype; and

(3) Inspection of mattress sets produced for sale sufficient to demonstrate that they are the same as the prototype on which they are based with respect to materials, components, design and methods of assembly.

(b) *Production testing.* Manufacturers are encouraged to conduct, as part of the quality assurance program, random testing of mattress sets being produced for sale according to the requirements of §§1633.3 and 1633.7.

(c) *Failure of mattress sets produced for sale to meet flammability standard*—(1) *Sale of mattress sets.* If any test performed for quality assurance yields results which indicate that any mattress set of a production lot does not meet the criteria of §1633.3(b), or if a manufacturer obtains test results or other evidence that a component or material or construction/assembly process used could negatively affect the test performance of the mattress set as set forth in §1633.3(b), the manufacturer shall cease production and distribution in commerce of such mattress sets until corrective action is taken.

(2) *Corrective action.* A manufacturer must take corrective action when any mattress set manufactured or imported for sale fails to meet the flammability test criteria set forth in §1633.3(b).

§1633.7 Mattress test procedure.

(a) *Apparatus and test materials*—(1) *Calorimetry.* The rate of heat release must be measured by means of oxygen consumption calorimetry. The calibration should follow generally accepted practices for calibration. The calorimetry system shall be calibrated at a minimum of two (2) calibration points—at 75 kW and 200 kW.

(2) *Test area.* The test area must have either Test Configuration A or B. The

test area conditions shall be maintained at a temperature greater than 15 °C (59 °F) and less than 27 °C (80.6 °F) and a relative humidity less than 75 percent.

(i) *Test configuration A. (an open calorimeter (or furniture calorimeter))*. In this configuration, the specimen to be tested is placed under the center of an open furniture calorimeter. Figure 1 of this part shows the test assembly atop a bed frame and catch surface. The specimen shall be placed under an open hood which captures the entire smoke plume and is instrumented for heat release rate measurements. The area surrounding the test specimen in an open calorimeter layout shall be sufficiently large that there are no heat re-radiation effects from any nearby materials or objects. The air flow to the test specimen should be symmetrical from all sides. The air flow to the calorimeter hood shall be sufficient to ensure that the entire fire plume is captured, even at peak burning. Skirts may be placed on the hood periphery to help assure this plume capture, if necessary, though they must not be of such an excessive length as to cause the incoming flow to disturb the burning process. Skirts must also not heat up to the point that they contribute significant re-radiation to the test specimen. The air supply to the hood shall be sufficient that the fire is not in any way limited or affected by the available air supply. The fire plume should not enter the hood exhaust duct. Brief (seconds) flickers of flame that occupy only a minor fraction of the hood exhaust duct inlet cross-section are acceptable since they do not signify appreciable suppression of flames.

(ii) *Test configuration B*. The test room shall have dimensions 10 ft. by 12 ft. by 8 ft. (3048 mm × 3658 mm × 2438 mm) high. The specimen is placed within the burn room. All smoke exiting from the room is caught by a hood system instrumented for heat release rate measurements. The room shall have no openings permitting air infiltration other than a doorway opening 38 in ±0.25 in by 80 in ±0.25 in (965 mm ±6.4 mm × 2032 mm ±6.4 mm) located as indicated in Figure 2 of this part and other small openings as necessary to make measurements. The test room shall be constructed of wood or metal studs and shall be lined with fire-rated wallboard or calcium silicate board. An exhaust hood shall be positioned outside of the doorway so as to collect all of the combustion gases. There shall be no obstructions in the air supply to the set-up.

(3) *Location of test specimen*. The location of the test specimen is shown in Figure 2 of this part. The angled placement is intended to minimize the interaction of flames on the side surfaces of the test specimen with the room walls. One corner of the test specimen shall be 13 centimeters (cm) to 17 cm from the wall and the other corner shall be 25 cm to 30 cm from the wall. The test room shall contain no other furnishings or combustible materials except for the test specimen.

(4) *Bed frame*. (i) *Frame dimensions*. The specimen shall be supported around its perimeter by the bed frame with a flat surface and no edges extending up from the surface (i.e., the angle is configured down). For twin size mattresses, the specimen shall be placed on top of a welded bed frame 1.90 m by 0.99 m (75 in by 39 in) made from 40 mm (1.50 in) steel angle. If testing a size other than twin, the test frame shall similarly match the dimensions of the specimen.

(ii) *Frame height*. The frame shall be 115 mm (4.5 in) high, except if adjustments are necessary to accommodate the required burner position in paragraph (h)(2)(ii) of this section. The height of the test frame shall also be adjusted, as necessary, so that the burner is no less than 25mm (1 in) above the supporting surface.

(iii) *Frame crosspieces*. The frame shall be completely open under the foundation except for two crosspieces, 25 mm wide (1 in) at the ⅓ length points, except when sagging of the specimen between the crosspieces exceeds 19 mm (¾ in) below the test frame. Minimal additional crosspieces shall then be added to prevent sagging of the specimen.

(5) *Catch pan*. The bed frame feet shall rest on a surface of either calcium silicate board or fiber cement board, 13 mm (0.5 in) thick, 2.11 m by 1.19 m (83 in by 47 in). The board serves

as a catch surface for any flaming melt/drip material falling from the bed assembly and may be the location of a pool fire that consumes such materials. This surface must be cleaned between tests to avoid build-up of combustible residues. Lining this surface with aluminum foil to facilitate cleaning is not recommended since this might increase fire intensity via reflected radiation.

(6) *Ignition source*—(i) *General.* The ignition source shall consist of two T-shaped burners as shown in Figures 3 and 4 of this part. One burner impinges flames on the top surface of the mattress. The second burner impinges flames on the side of the mattress and on the side of the foundation. Each of the burners shall be constructed from stainless steel tubing (12.7 mm diameter with 0.89 ±0.5 mm wall thickness; 0.50 in diameter with 0.035 ±0.002 in wall). Each burner shall incorporate a stand-off foot to set its distance from the test specimen surface (Figure 5 of this part). Both burners shall be mounted with a mechanical pivot point but the side burner is locked in place to prevent movement about this pivot in normal usage. The top burner, however, is free to rotate about its pivot during a burner exposure and is lightly weighted so as to exert a downward force on the mattress top through its stand-off foot so that the burner follows a receding top surface on the test specimen (Figure 6 of this part). The combination of burner stand-off distance and propane gas flow rate to the burners determines the heat flux they impose on the surface of the test specimen so that both of these parameters are tightly controlled.

(ii) *Top surface burner.* The T head of the top surface burner (horizontal burner, Figure 3 of this part) shall be 305 ±2 mm (12 ±0.08 in) long with gas tight plugs in each end. Each side of the T shall contain 17 holes equally spaced over a 135 mm length (8.5 mm ±0.1 mm apart; 0.333 ±0.005 in). The holes on each side shall begin 8.5 mm (0.33 in) from the centerline of the burner head. The holes shall be 1.45 mm to 1.53 mm (0.058 in to 0.061 in) in diameter (which corresponds to Grade 10 machining practice with a well formed #53 drill bit). The holes shall point 5° out of the plane of the diagram in Figure 3. This broadens the width of the heat flux profile imposed on the surface of the test specimen.

(iii) *Side surface burner.* The T head of the side surface burner (vertical burner) shall be constructed similarly to the top surface burner, as shown in Figure 4 of this part, except that its overall length shall be 254 ±2 mm (10 ±0.08 in). Each side of the burner head shall contain 14 holes spaced evenly over a 110 mm length (8.5 mm ±0.1 mm apart; 0.333 ±0.005 in). The holes shall be 1.45 mm to 1.53 mm (0.058 in to 0.061 in) in diameter (which corresponds to Grade 10 machining practice with a well formed #53 drill bit). The holes shall point 5° out of the plane of the diagram in Figure 4.

(iv) *Burner stand-off.* The burner stand-off on each burner shall consist of a collar fixed by a set screw onto the inlet tube of the burner head (Figure 5 of this part). The collar shall hold a 3 mm diameter stainless steel rod having a 12.7 mm by 51 mm by (2–2.5 mm) thick (0.5 in by 2 in by (0.08–0.10 in) thick) stainless steel pad welded on its end with its face (and long axis) parallel to the T head of the burner. The foot pad shall be displaced about 10 mm to 12 mm from the longitudinal centerline of the burner head so that it does not rest on the test specimen in an area of peak heat flux.

(v) *Burner inlet lines.* A short section (9.5 mm outer diameter (''OD''), about 80 mm long; ⅜ in OD, about 3.2 in long) of copper tubing shall be placed in the inlet gas line just before the burner to facilitate making the burner nominally parallel to the test specimen surface (by a procedure described below). The copper tube on the top surface burner should be protected from excessive heat and surface oxidation by wrapping it with a suitable layer of high temperature insulation to protect the equipment. Both copper tubes are to be bent by hand in the burner alignment process. They must be replaced if they become work-hardened or crimped in any way. The gas inlet lines (12.7 mm OD stainless steel tubing; 0.50 in) serve as arms leading back to the pivot points and beyond, as shown in Figure 6 of this part. The length to the pivot for the top burner shall be approximately 1000 mm (40 in).

(vi) *Burner frame.* Figure 6 of this part shows the frame that holds the burners and their pivots, which are adjustable vertically in height. All adjustments (burner height, burner arm length from the pivot point, counterweight positions along the burner arm) are facilitated by the use of knobs or thumbscrews as the set screws. The three point footprint of the burner frame, with the two forward points on wheels, facilitates burner movement and burner stability when stationary.

(vii) *Arms.* The metal arms attached to the burners shall be attached to a separate gas control console by flexible, reinforced plastic tubing.[1] The gas control console is mounted separately so as to facilitate its safe placement outside of the test room throughout the test procedure. The propane gas lines running between the console and the burner assembly must be anchored on the assembly before running to the burner inlet arms. A 1.5 m ±25 mm (58 in ±1 in) length of flexible, reinforced tubing between the anchor point and the end of each burner inlet allows free movement of the top burner about its pivot point. The top burner arm shall have a pair of moveable cylindrical counterweights that are used, as described below, to adjust the downward force on the stand-off foot.

(viii) *Burner head.* Each burner head shall have a separate pilot light consisting of a 3 mm OD (⅛ in OD) copper tube with an independently-controlled supply of propane gas. The tube terminates within 10 mm of the center of the burner head. Care must be taken to set the pilot flame size small enough so as not to heat the test specimen before the timed burner exposure is begun.

(ix) *Flow control system.* Each burner shall have a flow control system of the type shown in Figure 7 of this part. Propane gas from a source such as a bottle is reduced in pressure to approximately 140 ± 5 kilopascals (''kPa'') (20 ± 1 pounds per square inch gage (''psig'')) and fed to the system shown in Figure 7 of this part. The gas flow to the burner is delivered in a square-wave manner (constant flow with rapid onset and termination) by means of the solenoid valve upstream of the flowmeter. An interval timer (accurate to ±0.2 s) determines the burner flame duration. The pilot light assures that the burner will ignite when the solenoid valve opens.[2] The gas flow shall be set using a rotameter type of flowmeter, with a 150 mm scale, calibrated for propane. When calibrating the flowmeter, take into account that the flow resistance of the burner holes causes a finite pressure increase in the flowmeter above ambient. (If a calibration at one atmosphere is provided by the manufacturer, the flowmeter reading, at the internal pressure existing in the meter, required to get the flow rates listed below must be corrected, typically by the square root of the absolute pressure ratio. This calls for measuring the actual pressure in the flow meters when set near the correct flow values. A value roughly in the range of 1 kPa to 3 kPa—5 in to 15 in of water—can be expected.) See information on calibration in paragraph (b) of this section.

(x) *Gas flow rate.* Use propane gas: The propane shall be minimum 99% pure (often described by suppliers as CP or ''chemically pure'' grade, but this designation should not be relied on since the actual purity may vary by supplier). Each burner has a specific propane gas flow rate set with its respective, calibrated flowmeter. The gas flow rate to the top burner is 12.9 liters per minute (''L/min'') ±0.1 L/min at a pressure of 101 ±5 kPa (standard atmospheric pressure) and a temperature of 22 ±3 °C. The gas flow rate to the side burner is 6.6 ±0.05 L/min at a pressure of 101 ±5 kPa (standard atmospheric pressure) and a temperature of 22 ±3 °C. The total heat release rate of the burners is 27 kW.

(b) *Calibration of Propane Flowmeters*—(1) *Preparation.* Once the assembly of the burner is completed and all the connecting points are checked for gas leakage, the most critical task is ensuring the exact flow rates of propane

[1] Fiber-reinforced plastic tubing (6 mm ID by 9.5 mm OD; 0.25 inch ID by 0.4 inch OD) made of PVC should be used.

[2] If the side burner, or more commonly one half of the side burner, fails to ignite quickly, adjust the position of the igniter, bearing in mind that propane is heavier than air. The best burner behavior test assessment is done against an inert surface (to spread the gas as it would during an actual test).

into the top and side burners, as described in the test protocol. The gas flow rates are specified at 12.9 Liters per minute (LPM) ±0.1 LPM and 6.6 LPM ±0.05 LPM for the top and side burners (Burners 1 and 2), respectively, at a pressure of 101 ±5 kiloPascal (kPa) (standard atmospheric pressure) and a temperature of 22 ±3 °C. The rotameters that are installed in the control box of the burner assembly need to be calibrated for accurate measurement of these flow rates.

(i) The most practical and accurate method of measuring and calibrating the flow rate of gases (including propane) is use of a diaphragm test meter (also called a dry test meter). A diaphragm test meter functions based on positive displacement of a fixed volume of gas per rotation and its reading is therefore independent of the type of the gas being used. The gas pressure and temperature, however, can have significant impact on the measurement of flow rate.

(ii) The gas pressure downstream of the rotameters that are installed in the control box of the burner assembly should be maintained near atmospheric pressure (only a few millimeters of water above atmosphere). Therefore, the best location to place the diaphragm test meter for gas flow calibration is right downstream of the control box. The pressure at the propane tank must be set at 20 ±1 pounds per square inch gage (psig).

(2) *Calibration Procedure.* Install the diaphragm test meter (DTM) downstream of the control box in the line for the top burner. Check all connecting points for gas leakage. Open the main valve on the propane tank and set a pressure of 20 ±0.5 psig. Set the timers in the control box for 999 seconds (or the maximum range possible). Record the barometric pressure. Turn the ''Burner 1'' switch to ON and ignite the top burner. Allow the gas to flow for 2–3 minutes until the DTM is stabilized. Record the pressure and temperature in the DTM. Use a stopwatch to record at least one minute worth of complete rotations while counting the number of rotations.[3] Calculate the propane gas flow rate using the recorded time and number of rotations (total flow in that time). Use the pressure and temperature readings to convert to standard conditions. Repeat this measurement for two additional meter setting to allow for calibrating the flowmeter throughout the range of interest. Plot the flow versus meter reading, fit a best line (possibly quadratic) through these points to find the meter setting for a flow of 12.9 LPM at the above ''standard conditions.'' Repeat this procedure for ''Burner 2'' using three meter readings to find the setting that gives a flow rate of 6.6 LPM at the standard conditions. After completion of the calibration, re-set the timers to 70 and 50 seconds.

(c) *Conditioning.* Remove the specimens from any packaging prior to conditioning. Specimens shall be conditioned in air at a temperature greater than 18 °C (65 °F) and less than 25 °C (77 °F) and a relative humidity less than 55 percent for at least 48 continuous hours prior to test. Specimens shall be supported in a manner to permit free movement of air around them during conditioning.

(d) *Test preparation*—(1) *General.* Horizontal air flow at a distance of 0.5 m (20 in) on all sides of the test specimen at the mattress top height shall be no more than 0.5 m/s. If there is any visual evidence that the burner flames are disturbed by drafts during their exposure durations, the burner regions must be enclosed on two or more sides by at least a triple layer of screen wire. The screens shall be at least 25 cm tall. The screen(s) for the top burner shall sit on the mattress top and shall be wide enough to extend beyond the area of the burner impingement. All screens shall be far enough away (typically 30 cm or more) from the burner tubes so as not to interfere or interact with flame spread during the burner exposure. The screen for the side burner will require a separate support from below. All screens shall be removed at

[3] With a diaphragm test meter well-sized to this application, this should be more than five rotations. A one liter per rotation meter will require 10 to 15 rotations for the flow measurements and greater than the minimum of one minute recording time specified here.

the end of the 70 second exposure interval.

(2) *Specimen.* Remove the test specimen from the conditioning room immediately before it is to be tested. Testing shall begin within 20 minutes after removal from the conditioning area. Be sure the test frame is approximately centered on the catch surface. Carefully center the foundation on top of the test frame to eliminate any gaps between the bottom periphery of the foundation and the inside edges of the test frame. If the mattress is to be tested alone, place it similarly. A mattress tested with its foundation should be centered longitudinally and laterally on the foundation. Carefully center them on the bed frame and on each other. The mattress shall be centered on top of the foundation (see Figure 1 of this part). However, in order to keep the heat flux exposure the same for the sides of the two components, if the mattress is 1 cm to 2 cm narrower than the foundation, the mattress shall be shifted so that the side to be exposed is in the same plane as the foundation. Refer to Figure 8 of this part. A product having an intended sleep surface on only one side shall be tested with the sleeping side up so that the sleeping surface is exposed to the propane burner.

(e) *Burner flow rate/flow timer confirmation.* Just prior to moving the burner adjacent to the test specimen, briefly ignite each burner at the same time, and check that the propane flow to that burner is set at the appropriate level on its flowmeter to provide the flows listed in §1633.7(a)(6)(x). Check that the timers for the burner exposures are set to 70 seconds for the top burner and 50 seconds for the side burner. For a new burner assembly, check the accuracy of the gas flow timers against a stop watch at these standard time settings. Set pilot flows to a level that will not cause them to impinge on sample surfaces.

(f) *Location of the gas burners.* The general layout for the room configuration is shown in Figure 2 of this part. Place the burner heads so that they are within 300 mm (1 ft) of the mid-length of the mattress. If there are unique construction features (e.g., handles, zippers) within the burner placement zone, the burner shall impinge on this feature. For a quilted mattress top the stand-off foot pad must alight on a high, flat area between dimples or quilting thread runs. The same is to be true for the side burner if that surface is quilted. If a specimen design presents a conflict in placement such that both burners cannot be placed between local depressions in the surface, the top burner shall be placed at the highest flat surface.

(g) *Burner set-up.* The burners shall be placed in relation to the mattress and foundation surfaces in the manner shown in Figure 9 of this part, i.e., at the nominal spacings shown there and with the burner tubes nominally parallel[4] to the mattress surfaces on which they impinge. Since the heat flux levels seen by the test specimen surfaces depend on burner spacing, as well as gas flow rate, care must be taken with the set-up process.

(h) *Burner alignment procedure*—(1) *Preparation.* Complete the following before starting the alignment procedure:

(i) Check that the pivot point for the mattress top burner feed tube and the two metal plates around it are clean and well-lubricated so as to allow smooth, free movement.

(ii) Set the two burners such that the 5° out-of-plane angling of the flame jets makes the jets on the two burners point slightly *toward* each other.

(iii) Check the burner stand-off feet for straightness and perpendicularity between foot pad and support rod and to see that they are clean of residue from a previous test.

(iv) Have at hand the following items to assist in burner set-up: The jig, shown in Figure 10 of this part, for setting the stand-off feet at their proper distances from the front of the burner tube; a 3 mm thick piece of flat stock (any material) to assist in checking the parallelness of the burners to the mattress surfaces; and a 24 gage stainless steel sheet metal platen that is 30 mm (12 in) wide, 610 mm (24 in) long and has

[4] The top burner will tend to be tangential to the mattress surface at the burner mid-length; this orientation will not necessarily be parallel to the overall average mattress surface orientation nor will it necessarily be horizontal. This is a result of the shape of the mattress top surface.

a sharp, precise 90° bend 355 mm (14 in) from one 30 mm wide end or another dimension that meets the requirements for a specific sample.

(2) *Alignment.* (i) Place the burner assembly adjacent to the test specimen. Place the sheet metal platen on the mattress with the shorter side on top. The location shall be within 30 cm (1 ft) of the longitudinal center of the mattress. The intended location of the stand-off foot of the top burner shall not be in a dimple or crease caused by the quilting of the mattress top. Press the platen laterally inward from the edge of the mattress so that its side makes contact with either the top and bottom edge or the vertical side of the mattress.[5] Use a sufficient length of duct tape (platen to mattress top) to assure that the platen stays firmly against the surfaces of the mattress.

(ii) With both burner arms horizontal (pinned in this position), fully retract the stand-off feet of both burners and, if necessary, the pilot tubes as well.[6] (Neither is to protrude past the front face of the burner tubes at this point.) Move the burner assembly forward (perpendicular to the mattress) until the vertical burner lightly contacts the sheet metal platen. Adjust the height of the vertical burner on its vertical support column so as to center the tube on the crevice between the mattress and the foundation. (This holds also for pillow top mattress tops, i.e., ignore the crevice between the pillow top and the main body of the mattress.)[7] Adjust the height of the horizontal burner until it sits lightly on top of the sheet metal platen. Its burner arm should then be horizontal.

(iii) Move the horizontal burner in/out (loosen the thumb screw near the pivot point) until the outer end of the burner tube is 13 mm to 19 mm (½ in to ¾ in) from the corner bend in the platen (this is facilitated by putting a pair of lines on the top of the platen 13 mm and 19 mm from the bend and parallel to it). Tighten the thumb screw.

(iv) Make the horizontal burner parallel to the top of the platen (within 3 mm (⅛ inch) over the burner tube length); when properly parallel, it should not be possible to insert the 3 mm flat stock under either burner end by bending the copper tube section appropriately. Note: After the platen is removed (in paragraph (h)(2)(vii) of this section), the burner tube may not be horizontal; this is normal. For mattress/foundation combinations having nominally flat, vertical sides, the similar adjustment for the vertical burner is intended to make that burner parallel to the sides and vertical. Variations in the shape of mattresses and foundations can cause the platen section on the side to be non-flat and/or non-vertical. If the platen is flat and vertical, make the vertical burner parallel to the side of the platen (±3 mm) by bending its copper tube section as needed. If not, make the side burner parallel to the mattress/foundation sides by the best visual estimate after the platen has been removed.

(v) Move the burner assembly perpendicularly back away from the mattress about 30 cm (1 ft). Set the two stand-off feet to their respective distances using the jig designed for this purpose. Install the jig *fully* onto the burner tube (on the *same side* of the tube as the stand-off foot), with its side edges parallel to the burner feed arm,

[5] Mattresses having a convex side are treated separately since the platen cannot be placed in the above manner. Use the platen only to set the top burner parallelness. Set the in/out distance of the top burner to the specification in paragraph (h)(1)(iii). Set the side burner so that it is approximately (visually) parallel to the flat side surface of the foundation below the mattress/foundation crevice once its foot is in contact with the materials in the crevice area. The burner will not be vertical in this case. If the foundation side is also non-flat, set the side burner vertical (±3 mm, as above) using a bubble level as a reference. The side surface convexities will then bring the bowed out sections of the specimen closer to the burner tube than the stand-off foot.

[6] The pilot tubes can normally be left with their ends just behind the plane of the front of the burner tube. This way they will not interfere with positioning of the tube but their flame will readily ignite the burner tubes.

[7] For tests of the mattress alone, set the center of the side burner at the lower edge of the mattress OR the top (upper tip) of the side burner 25 mm (1 in) below the top edge of the mattress, whichever is lower. This prevents inappropriate (excessive) exposure of the top surface of the mattress to the side burner.

at about the position where one end of the foot will be. Loosen the set screw and slide the foot out to the point where it is flush with the bottom end of the jig. Tighten the set screw. Make sure the long axis of the foot is parallel to the burner tube. It is essential to use the correct side of the spacer jig with each burner. Double check this. The jig must be clearly marked.

(vi) Set the downward force of the horizontal burner. Remove the retainer pin near the pivot. While holding the burner feed arm horizontal using a spring scale[8] hooked onto the thumbscrew holding the stand-off foot, move the small and/or large weights on the feed tube appropriately so that the spring scale reads 170 g to 225 g (6 oz to 8 oz).

(vii) Remove the sheet metal platen (and tape holding it).

(viii) Hold the horizontal burner up while sliding the burner assembly forward until the vertical burner stand-off foot just touches the mattress and/or the foundation, then release the horizontal burner. The outer end of the burner tube should extend at least 6 mm to 12 mm (¼ in to ½ in) out beyond the uppermost corner/edge of the mattress so that the burner flames will hit the edge. (For a pillow top mattress, this means the outer edge of the pillow top portion and the distance may then be greater than 6 mm to 12 mm.) If this is not the case, move the burner assembly (perpendicular to the mattress side)—not the horizontal burner alone—until it is.[9] Finally, move the vertical burner tube until its stand-off foot just touches the side of the mattress and/or the foundation. (Use the set screw near the vertical burner pivot.)

(ix) Make sure all thumbscrews are adequately tightened. Care must be taken, once this set-up is achieved, to avoid bumping the burner assembly or disturbing the flexible lines that bring propane to it.

(x) If there is *any* indication of flow disturbances in the test facility which cause the burner flames or pilot flames to move around, place screens around the burners so as to minimize these disturbances.[10] These screens (and any holders) must be far enough away from the burners (about 30 cm or more for the top, less for the side) so that they do not interact with the flames growing on the specimen surfaces. For the top surface burner, at least a triple layer of window screen approximately 30 cm high sitting vertically on the mattress top (Figure 9 of this part) has proved satisfactory. For the side burner at least a triple layer of screen approximately 15 cm wide, formed into a square-bottom U-shape and held from below the burner has proved satisfactory. Individual laboratories will have to experiment with the best arrangement for suppressing flow disturbances in their facility.

(i) *Running the test.* (1) Charge the hose line to be used for fire suppression with water.

(2) *Burner Preparation.* (i) Turn AC power on; set propane pressure to 20 psig at bottle; set timers to 70 s (top burner) and 50 s (side burner); with burner assembly well-removed from test specimen, ignite burners and check that, WHEN BOTH ARE ON AT THE SAME TIME, the flowmeters are set to the values that give the requisite propane gas flow rates to each burner. Turn off burners. Set pilot tubes just behind front surface of burners; set pilot flow valves for approximately 2 cm flames. Turn off pilots.

[8] An acceptable spring scale has a calibrated spring mounted within a holder and hooks on each end.

[9] The foot should depress the surface it first contacts by no more than 1 mm to 2 mm. This is best seen up close, not from the rear of the burner assembly. However, if a protruding edge is the first item contacted, compress it until the foot is in the plane of the mattress/foundation vertical sides. The intent here is that the burner be spaced a fixed distance from the vertical mattress/foundation sides, not from an incidental protrusion. Similarly, if there is a wide crevice in this area which would allow the foot to move inward and thereby place the burners too close to the vertical mattress/foundation sides, it will be necessary to use the spacer jig (rather than the stand-off foot) above or below this crevice to set the proper burner spacing. Compress the mattress/foundation surface 1 mm to 2 mm when using the jig for this purpose.

[10] The goal here is to keep the burner flames impinging on a fixed area of the specimen surface rather than wandering back and forth over a larger area.

(ii) Position burner on test specimen and remove sheet metal platen.

(iii) Place screens around both burners.

(3) *Start pilots.* Open pilot ball valves one at a time and ignite pilots with hand-held flame; adjust flame size if necessary being very careful to avoid a jet flame that could prematurely ignite the test specimen (Note that after a long interval between tests the low pilot flow rate will require a long time to displace air in the line and achieve the steady-state flame size.)

(4) *Start recording systems.* With the calorimetry system fully operational, after instrument zeroes and spans, start the video lights and video camera and data logging systems two minutes before burner ignition (or, if not using video, take a picture of the setup).

(5) *Initiate test.* Start test exposure by simultaneously turning on power to both timers (timers will turn off burners at appropriate times). Also start a 30 minute timer of the test duration. Check/adjust propane flow rates (DO THIS ESSENTIAL TASK IMMEDIATELY. Experience shows the flow will not remain the same from test-to-test in spite of fixed valve positions so adjustment is essential.) If not using video, one photo must be taken within the first 45 seconds of starting the burners.

(6) *End of burner exposure.* When the burners go out (after 70 seconds for the longer exposure), carefully lift the top burner tube away from the specimen surface, producing as little disturbance as possible to the specimen. Turn off power to both timers. Remove all screens. Turn off pilots at their ball valves. Remove the burner assembly from the specimen area to facilitate the video camera view of the full side of the specimen. In the case of the room-based configurations, remove the burner assembly from the room to protect it.

(j) *Video Recording/Photographs.* Place a video or still frame camera so as to have (when the lens is zoomed out) just slightly more than a full-length view of the side of the test specimen being ignited, including a view of the flame impingement area while the burner assembly is present. The view must also include the catch pan so that it is clear whether any melt pool fire in this pan participates significantly in the growth of fire on the test specimen. The camera shall include a measure of elapsed time to the nearest 1 second for video and 1 minute for still frame within its recorded field of view (preferably built into the camera). For the room-based configuration, the required full-length view of the sample may require an appropriately placed window, sealed with heat resistant glass, in one of the room walls. Place the camera at a height just sufficient to give a view of the top of the specimen while remaining under any smoke layer that may develop in the room. The specimen shall be brightly lit so that the image does not lose detail to over-exposed flames. This will require a pair or more of 1 kW photo flood lights illuminating the viewed side of the specimen. The lights may need to shine into the room from the outside via sealed windows.

(k) *Cessation of Test.* (1) The heat release rate shall be recorded and video/photographs taken until either 30 minutes has elapsed since the start of the burner exposure or a fire develops of such size as to require suppression for the safety of the facility.

(2) Note the time and nature of any unusual behavior that is not fully within the view of the video camera. This is most easily done by narration to a camcorder.

(3) Run the heat release rate system and datalogger until the fire has been fully out for several minutes to allow the system zero to be recorded.

(l) *Use of alternate apparatus.* Mattress sets may be tested using test apparatus that differs from that described in this section if the manufacturer obtains and provides to the Commission data demonstrating that tests using the alternate apparatus during the procedures specified in this section yield failing results as often as, or more often than, tests using the apparatus specified in the standard. The manufacturer shall provide the supporting data to the Office of Compliance, Recalls & Compliance Division,

U.S. Consumer Product Safety Commission, 4330 East West Highway, Bethesda, Maryland 20814. Staff will review the data and determine whether the alternate apparatus may be used.

[71 FR 13498, Mar. 15, 2006, as amended at 73 FR 6842, Feb. 6, 2008]

§ 1633.8 Findings.

(a) *General.* In order to issue a flammability standard under the FFA, the FFA requires the Commission to make certain findings and to include these in the regulation, 15 U.S.C. 1193(j)(2). These findings are discussed in this section.

(b) *Voluntary standards.* No findings concerning compliance with and adequacy of a voluntary standard are necessary because no relevant voluntary standard addressing the risk of injury that is addressed by this regulation has been adopted and implemented.

(c) *Relationship of benefits to costs.* The Commission estimates the potential total lifetime benefits of a mattress that complies with this standard to range from $45 to $57 per mattress set (based on a 10 year mattress life and a 3% discount rate). The Commission estimates total resource costs of the standard to range from $8 to $22 per mattress. This yields net benefits of $23 to $50 per mattress set. The Commission estimates that aggregate lifetime benefits associated with all mattresses produced the first year the standard becomes effective range from $1,024 to $1,307 million, and that aggregate resource costs associated with these mattresses range from $175 to $511 million, yielding net benefits of about $514 to $1,132 million. Accordingly, the Commission finds that the benefits from the regulation bear a reasonable relationship to its costs.

(d) *Least burdensome requirement.* The Commission considered the following alternatives: alternative maximum peak heat release rate and test duration, alternative total heat released in the first 10 minutes of the test, mandatory production testing, a longer effective date, taking no action, relying on a voluntary standard, and requiring labeling alone (without any performance requirements). The alternatives of taking no action, relying on a voluntary standard (if one existed), and requiring labeling alone are unlikely to adequately reduce the risk. Requiring a criterion of 25 MJ total heat release during the first 10 minutes of the test instead of 15 MJ would likely reduce the estimated benefits (deaths and injuries reduced) without having much effect on costs. Both options of increasing the duration of the test from 30 minutes to 60 minutes and decreasing the peak rate of heat release from 200 kW to 150 kW would likely increase costs significantly without substantial increase in benefits. Requiring production testing would also likely increase costs. Therefore, the Commission finds that an open flame standard for mattresses with the testing requirements and criteria that are specified in the Commission rule is the least burdensome requirement that would prevent or adequately reduce the risk of injury for which the regulation is being promulgated.

§ 1633.9 Glossary of terms.

(a) *Absorbent pad.* Pad used on top of mattress. Designed to absorb moisture/body fluids thereby reducing skin irritation, can be one time use.

(b) *Basket pad.* Cushion for use in an infant basket.

(c) *Bunk beds.* A tier of beds, usually two or three, in a high frame complete with mattresses (see Figure 11 of this part).

(d) *Car bed.* Portable bed used to carry a baby in an automobile.

(e) *Carriage pad.* Cushion to go into a baby carriage.

(f) *Chaise lounge.* An upholstered couch chair or a couch with a chair back. It has a permanent back rest, no arms, and sleeps one (see Figure 11).

(g) *Convertible sofa.* An upholstered sofa that converts into an adult sized bed. Mattress unfolds out and up from under the seat cushioning (see Figure 11).

(h) *Corner groups.* Two twin size bedding sets on frames, usually slipcovered, and abutted to a corner table. They also usually have loose bolsters slipcovered (see Figure 11).

(i) *Crib bumper.* Padded cushion which goes around three or four sides inside a crib to protect the baby. Can also be used in a playpen.