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Development
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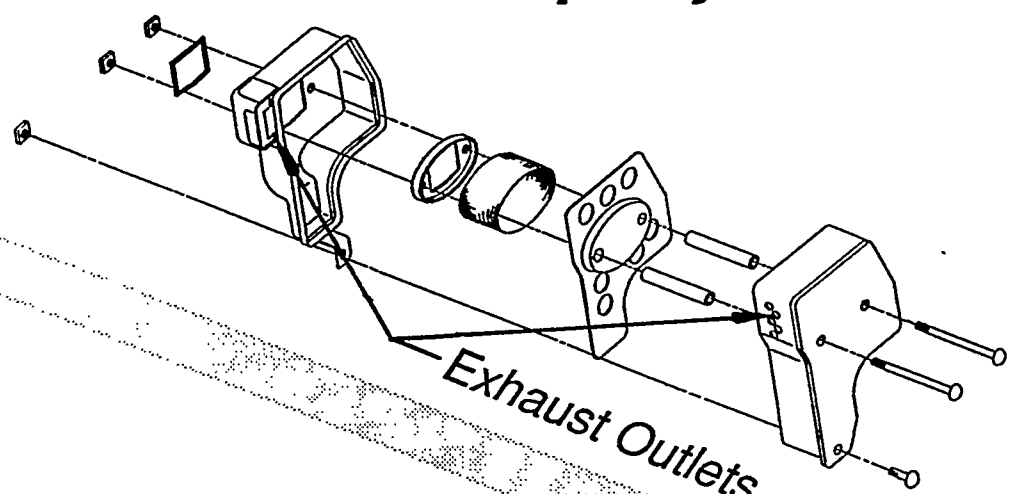
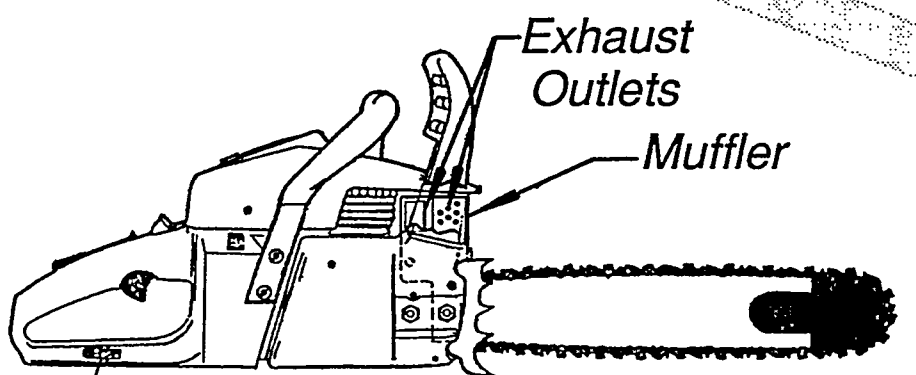
# Standard Test Procedure for Chain Saw Spark Arrester Exhaust Systems

## *Model: Sparky ABC-123*




*Model No./Serial No. Label*

# Standard Test Procedure for Chain Saw Spark Arrester Exhaust Systems

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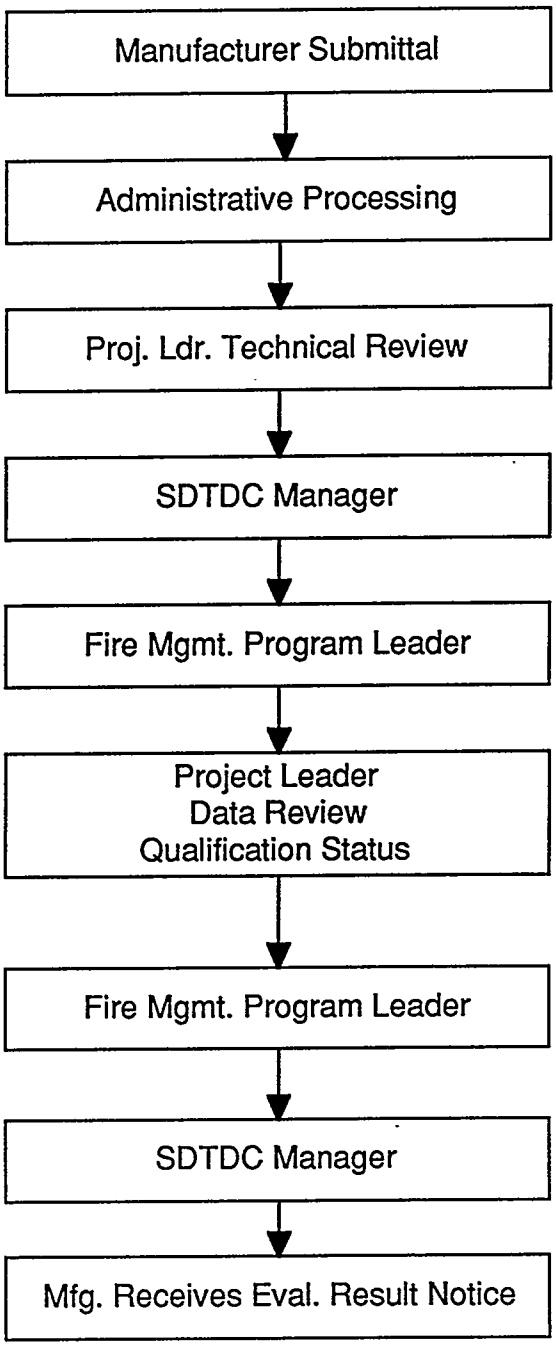


## 1.0 *Purpose and Scope*

**1.1 Purpose** - This standard test procedure defines a method of testing to evaluate the fire ignition potential of exhaust systems on hand-held, gasoline-powered chain saws. Qualification requirements include the provisions that exhaust system exposed surfaces shall not exceed 550 °F, and the gas exhaust temperatures shall not exceed 475 °F as measured along a predetermined contact plane specific for each chain saw. An additional provision requires that screen-type arresters shall allow 100 percent of the exhaust gases to pass through a screen with openings of 0.0232 in, or smaller.

**1.2 Scope** - This test procedure applies only to spark arrester exhaust systems used on gas-powered chain saws which are multipositional and come into close proximity to grass, brush, lumber, and similar cellulose materials. This procedure is designed to determine if a particular chain saw exhaust system meets the requirements of Society of Automotive Engineers (SAE) Recommended Practice J335, "Multiposition Small Engine Exhaust System Fire Ignition Suppression."

## 2.0 *Applicable Documents*

**2.1** SAE Recommended Practice J335—"Multiposition Small Engine Exhaust System Fire Ignition Suppression."

**2.2** SAE Recommended Practice J1349—"Engine Power Test Code—Spark Ignition and Diesel."

## 3.0 *Definitions*

**3.1 Ambient Temperature**—The temperature of the medium surrounding the power unit on the test stand.

**3.2 Spark Arrester**—An exhaust system used on an internal combustion system having the ability to control the amount and size of particulate carbon or metal particles emitted into the atmosphere.

**3.3 Power Unit**—Chain saw exclusive of removable extensions such as chain saw bar and chain; also called test unit, or sample test unit.

**3.4 Contact Plane**—An imaginary flat surface defined by at least three points of contact on the exterior surfaces of a power unit.

**3.5 Exposed Surfaces Temperature Test**—A test that measures exhaust system temperatures at the points where the engine exhaust system comes in contact with the contact plane surfaces of a power unit.

**3.6 Exhaust Gas Temperature Test**—A test that measures the maximum temperature of the engine exhaust gas stream as it flows through a predetermined contact plane.

**3.7 Best Power**—Power at maximum torque achievable by a given test power unit at the maximum, continuous, corrected net brake power speed, as defined by SAE J1349.

**3.8 Shall**—Indicates a mandatory requirement.

**3.9 Should**—Indicates an advisory condition.

**3.10 May**—Indicates a permissive condition.

## 4.0 *Instrumentation*

**4.1 Wire Plug Gage**—A round wire gage with a specific diameter. The wire gage shall have precision-ground squared ends, which shall periodically be examined with a 40X optical magnifier for any rounding of the corners. The gage shall be replaced if any rounding is noted.

**4.2 Thermocouple**—A temperature measuring device consisting of a standard K-type thermocouple wire with a welded tip in a grounded, shielded surface probe.

**4.3 Tachometer**—A device for determining the rotational speed of a chain saw power unit. It shall be integrated with the calibrated loading device to provide direct measurement and recording of engine angular velocity in rpm.

**4.4 Calibrated Loading Device**—Dynamometer - An apparatus designed to test a chain saw power unit, at given loads and speeds, that displays torque or power and is compatible with a multipoint recorder or data logging device.

**4.5 Multichannel Recorder/Datalogger**—An instrument directly connected to the thermocouples to record temperatures while testing a power unit. The instrument shall have a visual display and also record on a hard-copy data sheet individual test points at a specific time.

**4.6 Loading Device Adapter**—An assembly designed to align and couple the test power unit shaft with the calibrated loading device—dynamometer.

**4.7 Graduated Cylinders**—Calibrated containers to measure fuel and lubricant volumes used to obtain a fuel/lubricant mix accuracy of ±2 percent.

**4.8 Photographic Equipment**—Cameras and adequate lighting appropriate for the creation of

a photographic record of the test power unit, the spark arrester screen assembly, and the test stand setup.

**4.9 Tack Welding Instrument**—An instrument used to tack weld the thermocouple wires for proper positioning in measuring the power unit head temperature or the exhaust surface temperatures.

## 5.0 Laboratory Pretest

**5.1** The Project Leader shall give the following completed paperwork in the form of a test folder to the test technician to initiate testing:

**5.1.1** A completed Project Services Request, form SDTDC 7120-1 (10/89).

**5.1.2** A completed Chain Saw Pretest Information Form for Qualification Testing by the USDA Forest Service, form SDTDC 7100-07 (5/90).

**5.1.3** A parts list for the power unit.

**5.1.4** An operator's manual for the power unit.

**5.1.5** A three-quarters, exploded, isometric view drawing that shows internal/external construction details of the exhaust system submitted for testing.

**5.1.6** A three-quarters isometric or side view drawing of the power unit with all appurtenances. The type view will be of the exhaust system as installed on the power unit.

**5.2** The manufacturer shall run each new power unit for a suitable break-in period, which shall be a minimum of one tank of fuel or 2 hr of running time, whichever is longer.

**5.3** The manufacturer shall send the following hardware:

**5.3.1** A test power unit with chain bar spacers installed.

**5.3.2** Any special tools required to remove the chain brake drum to allow installation of the dynamometer adapter.

**5.3.3** A dynamometer adapter fabricated from drawings on file at SDTDC.

**5.3.4** A spark plug of the type specified in form SDTDC 7100-07, the parts list, and the operator's manual.

**5.3.5** A container of oil, for the fuel/oil mix, of the type specified in form SDTDC 7100-07 and the operator's manual.

**5.3.6** Any spikes, bumper bars, additional handlebar wraps, or other special attachments the manufacturer wants to have as required equipment on a qualified power unit.

**5.3.7** Any special tools that may be required to complete testing.

## 6.0 Visual Exam

**6.1** Complete the Chain Saw Data Sheet, form SDTDC 7100-29 (5/90), by transfering data from form SDTDC 7100-07 and by obtaining information from the supplied test power unit. The form SDTDC 7100-29 will be located in the test folder given to the test technician by the Project Leader.

**6.2** Make an outline drawing of all spikes or bumper bars and, if possible, identify each drawing with a part number. Place the drawings in the test folder.

> ***NOTE:*** Make sure that all papers added to the test folder by the technician are identified with both the name and model number of the power unit and the exhaust system; the Collection Agreement number and date; and the name of the technician.

**6.3** Assemble the power unit according to the operator's manual and/or manufacturer-supplied instructions. Do not add fuel or oil at this time.

**6.4** If the manufacturer has not included spacer(s) between the crankshaft cover and the chain saw body, it is necessary to insert the spacer(s) now. Spacer(s) are plastic or metal washers having the same thickness as the chain saw bar. The spacer(s) fit on the bolts designed for attaching the chain saw bar to the power unit. The spacer(s) shall not protrude beyond the body of the power unit.

**6.5** On a 3- x 5-in piece of paper print the manufacturer's name and the model numbers of the power unit and exhaust system, the Collection Agreement number, the date, and the initials of the technician/photographer. Place the power unit on a well-lighted, white-background table. Place a straight-edged scaled ruler in front of the power unit. Place the paper with the power unit description next to the power unit. Photograph the power unit from the front, both sides, and the back. Take any other photographs that may be descriptive. Poloroid photographs are recommended. If the manufacturer submitted spikes and/or bumper bars, photograph the power unit with all attachments.

6.6 Copy the submitted "Spark Arrester Guide" (SAG) quality drawing and write in the basic dimensions to describe the exhaust system and power unit.

7.0 *Screen Exam*

7.1 If necessary, remove the power unit exhaust guard to make the exhaust system accessible.

7.2 With the screen exhaust cover plate still installed, probe its periphery with a 0.024-in wire plug gage to determine if there are any gaps between the cover plate and its mounting structure. Position the wire plug gage as necessary to probe the periphery, but do not rotate the wire plug gage while probing. Probing force shall not exceed the weight of the wire plug gage holder of 2 oz. *Any penetration around the periphery shall be defined as a screen test failure.*

7.3 Carefully remove the screen exhaust cover plate.

7.4 Probe the screen a minimum of 20 times with a 0.024-in wire plug gage. Pay special attention to any bends, molding, or edges of the screen. Position the wire plug gage perpendicular to the surface to be probed and do not rotate during probing. Do not exceed the force of the weight of the wire plug gage holder of 2 oz. On the Chain Saw Data Sheet, form SDTDC 7100-29 (5/90), record the number of screen penetrations in the "Go" column, and the number of nonpenetrations in the "No-Go" column. *Any screen penetration using the 0.024-in wire plug gage shall be defined as a screen test failure.*

7.5 In the event of a *screen test failure*, place the qualification testing on "hold," and call the Project Leader for direction.

7.6 If the screen passes the test with the 0.024-in wire plug gage, repeat the probing process described in section 7.4 by decreasing the wire plug gage size by 0.001 in, with each set of 20 attempted penetrations. Find the largest diameter wire plug gage that will penetrate the screen. Record the result on the Chain Saw Data Sheet as the "Maximum Gage Size to Penetrate Screen." Then add 0.001 in to the "Maximum Gage Size to Penetrate the Screen," and record the result as the "No-Go wire gage size for screen openings."

7.7 Place the disassembled screen exhaust system on the table in front of the power unit, and follow the procedures in section 6.5 to photograph.

7.8 Reassemble the exhaust system, and follow the procedures in section 7.2 to probe the periphery of the exhaust screen cover plate again. If there are any penetrations with the 0.024-in wire plug gage, examine whether you have installed the screen correctly. If you can not easily eliminate the gaps around the periphery, the unit has a serviceability problem that requires correction. *The unit fails the screen test.*

7.9 Replace the exhaust guard, if required.

8.0 ***Contact Plane Determination Preparation***

8.1 Make sure that the spacer(s) are in place as outlined in section 6.4.

8.2 If spikes and/or bumper bars are supplied and required by the manufacturer, test the chain saw power unit with spikes or bumper bars in position. Use the attachment that creates the closest contact plane to the exhaust system. Bumper bars may not be substituted for spikes, even if the critical root base depth is the same.

8.3 Place the chain brake in the "off," or disengaged, position and deflect the hand guard *by the weight of the saw* into its most rearward position. Use reinforced tape to secure the hand guard in this position.

9.0 ***Contact Plane Determination***

9.1 Position the power unit on a suitable flat surface, such as the prep table, so that the exhaust system is facing the flat table surface.

9.2 Slowly rotate the power unit around the exhaust system area. When at least three points on the power unit are in contact with the flat table surface, a contact plane has been determined. Mark these points on the power unit with white liquid marker. Continue to rotate the power unit until the contact planes around the exhaust system have been determined. If a straight edge on the power unit is in contact with the flat table surface, along with another contact point somewhere else, a contact plane has been determined. The entire straight edge should be marked with white liquid marker. When locating contact points, pay close attention to points directly on the exhaust system that contact the flat table surface. These contact points will have thermocouple wires welded to them prior to testing.

***NOTE:*** Sometimes when the power unit is to be tested with spikes in place, the spikes will not allow the power unit to be rotated properly around the exhaust system. It is then necessary to place the spikes into the spike support bracket located on the edge of the flat-surface prep table. Place a 1/16-in diameter rod; e.g., Allen wrench or welding rod; between the spike teeth at the root. With the spikes supported by the 1/16-in rod and the power unit body resting on the table, any three-point contact will establish a contact plane. The contact point on the spikes should be marked with white liquid marker at the exact point on the spike root where the spikes rest on the 1/16-in rod.

**9.3** Using 1/8- to 1/4-in colored chart tape, connect the points in each contact plane.

**9.4** Follow the procedure in section 6.5 for photographs of the contact planes as established by the tape for ease of reconstruction later.

**10.0** ***Standard Temperature/Humidity Test Environment***

Ambient Air Temperature: 70 °F ±2 °F (21 °C ±1 °C).

Relative humidity: 90% or less.

If the actual test environment deviates from these standards for temperature and humidity, the Project Leader shall be notified and a note will be made by the test technician on the Chain Saw Temperature Test Record, form SDTDC 7100-28.

**11.0** ***Test Stand Preparation***

**11.1** Review the operator's manual instructions for carburetor adjustment to determine the location of the high- and low-speed mixture jet adjustment screws. Determine the manufacturer's setting of the high- and low-speed adjustment screws using the following procedure:

**11.1.1** Insert a carburetor adjustment screwdriver into the slot on the high-speed adjustment screw.

**11.1.2** Place a dot on the power unit housing with white liquid marker to identify the starting position of the screwdriver pointer.

**11.1.3** Turn screwdriver clockwise and count the number of turns needed to close the adjustment screw. *Do not close the screw tight, as damage may result.*

**11.1.4** Enter the number of turns to the nearest 1/16-in on the Chain Saw Data Sheet.

**11.1.5** Turn the adjustment screw counter-clockwise to its original setting.

**11.1.6** Follow steps 11.1.1 through 11.1.5 for the low-speed adjustment screw.

**11.2** Remove the spark plug and verify that the spark plug type and its gap are as specified in the operator's manual and on the form SDTDC 7100-07. Do not reinstall the spark plug into the power unit at this time.

**11.3** If the power unit has a chain brake, it will be necessary to remove the chain brake drum from the crankshaft by using the following procedure:

**11.3.1** Remove the power unit crankshaft cover.

**11.3.2** Stop the piston movement by inserting a length of knotted cord into the cylinder via the spark plug opening, or install an appropriate piston stop.

**11.3.3** Place a properly sized wrench over the nut holding the chain brake drum on the crankshaft, and turn the nut in a clockwise direction.

**11.3.4** Mark a plastic bag with the name of the power unit, and place the chain brake drum in the bag. Store this bag in the cabinet in room No. 30. Place other items removed from the power unit, into the plastic bag. These items will be returned to the manufacturer at the completion of testing.

**11.4** Determine which dynamometer will be used for testing. SDTDC has two dynamometers with differing physical limitations as follows:

Quick Dynamometer—Torque range: 0.25 to 6.0 ft-lb; max. rpm: 10,000.

Schenck Dynamometer—Torque range: 0.9 to 24.0 ft-lb; max. rpm: 11,500.

If a power unit is not compatible with the dynamometer specifications given above, the power unit shall be tested at the manufacturer's facility with a representative of the Forest Service present to witness the testing and certify the test results. Any additional expense incurred by the Forest Service and/or the manufacturer to perform testing at the manufacturer's facility shall be the responsibility of the manufacturer.

**11.5** Take the manufacturer-supplied dynamometer adapter and attach it to the SDTDC splined coupling adapter.

**11.6** If the manufacturer has not modified the crankshaft cover, it will be necessary to drill an access hole having a diameter as large as possible to allow ease of connection between the dynamometer adapter and the power unit crankshaft. Modifications are not to affect the exhaust system, exhaust flow characteristics, or contact points.

**11.7** Verify that the dynamometer adapter will fit through the hole in the crankshaft cover, and attach to the power unit crankshaft. Remove the dynamometer adapter for later installation on the test stand. Remove the chain bar spacer(s), which are no longer needed.

**11.8** Remove the power unit housing cover to expose the on/off switch area. Take the two wires from the on/off switch and, if necessary, attach solderless connectors that will fit the specific wiring of the dynamometer used. The on/off wires will later connect to the test stand electrical cutoff (kill) switch system. If there is only one wire connected to the on/off switch, it is then necessary to connect a grounding wire from one of the metal screws that attaches to metal on the power unit.

**11.9** Carefully refit the power unit housing cover and determine if it interferes with or pinches the kill switch wiring. Modify the housing cover by drilling a hole or filing a notch that will be large enough to provide unobstructed wiring access through the housing cover, if necessary.

**11.10** Remove the fuel tank cap. If possible, pull the fuel line tubing to extend outside of the tank. Remove the fuel filter, if present. If the fuel line tubing is not long enough to extend out of the tank, a hole must be drilled where the fuel line can be accessed.

> **NOTE:** Make sure there is no fuel in the tank before drilling.

With the fuel line tubing extending outside the fuel tank, snugly install a plastic fuel line adapter to the end of the tubing. Check the fuel line adapter for cracks before and after installation.

## 12.0 *Test Stand Setup*

**12.1** Place the power unit on the test stand table with the power unit crankshaft facing the dynamometer.

**12.2** Remove the crankshaft cover and lift the power unit. Place the crankshaft cover bolts through the slot in the mounting fixture support bracket of the test stand.

**12.3** Verify that the power unit will fit flush against the support bracket.

> **NOTE:** Sometimes the chain bar *adjustment pin* needs to be removed from the adjustment screw. DO NOT remove the *adjustment screw* if it is a contact point on a contact plane.

**12.4** Check for any vertical movement of the crankshaft cover bolts within the slot on the support bracket. If there is too much vertical movement, change the support bracket or wedge a shim between the bolts and the edge of the slot to restrict the vertical movement of the power unit.

**12.5** Thread the dynamometer adapter onto the power unit crankshaft, but *do not tighten.*

**12.6** Slide the mounting fixture toward the dynamometer until the adapter almost touches the dynamometer. Position the power unit on the support bracket so that it will require only minor horizontal and vertical alignment adjustment later.

**12.7** Slide the mounting fixture away from the dynamometer and remove the adapter from the power unit.

**12.8** Install the crankshaft cover and tighten the nuts to hold the power unit in place.

**12.9** Stop the piston movement by inserting a length of knotted cord into the cylinder via the spark plug opening, or install an appropriate piston stop.

**12.10** Wipe the threads on the power unit crankshaft (output shaft) to remove any excess dirt or oil and then apply "Lok-Tite" or an equivalent solution to the threads.

**12.11** Mate the dynamometer adapter to the power unit output shaft with left-hand turns until it is hand tight. While standing on the side of the test stand which is closest to the control room, tighten the adapter with a strap wrench to the acceptable tightening torque recommended by the manufacturer on the Chain Saw Pretest Information Form, SDTDC 7100-07.

**12.12** Remove the knotted cord or other piston stop used previously to stop piston cylinder movement.

**12.13** Obtain the spark plug that was removed from the power unit in section 11.2. Spot weld the two wires of a type "K" thermocouple duplex-wire to the spark plug head just above the threads or to the spark plug washer. Make sure that thermocouple wires establish a point contact as close to the wire ends as possible.

**12.13.1** Tack Welding of Spark Plug Probe

**12.13.1.1** The "Hot Spot" welding instrument has two cables extending from the welding unit. The first cable is connected to a rectangular-shaped, magnetized-steel grounding plate. The second cable has a pair of welding pliers with insulated hand grips. The magnetized steel is used to "ground" the item the wire(s) will be welded to. Place the spark plug head, or spark plug washer when provided, onto the rectangular surface attached to the first cable.

**12.13.1.2** Weld the thermocouple duplex wire to the spark plug metal head above the threads by twisting the ends of the two wires together or by welding one wire at a time to the spark plug head. It is important to make sure that the two wires create a point contact to each other at the weld surface.

**12.13.1.3** Locate a dial with unit markings around its circumference on the front panel of the Hot Spot welding instrument. If the thermocouple duplex wires are twisted together, set the dial at approximately 50 units. If the wires will be welded one at a time, set the dial at approximately 35 to 40 units. After the dial has been set, the welding instrument will emit a steady tone when it has enough power to weld.

**NOTE:** All personal in the area will wear tinted safety glasses.

**12.13.1.4** Hold the thermocouple wire(s) against either the spark plug metal head above the threads or the spark plug washer, with the welding pliers.

**CAUTION:** Do not touch the metal on the welding pliers or around the area being welded.

**12.13.1.5** When the welding instrument has full power, press the button located above the dial. Full power is determined when the tack welding unit begins to emit a steady tone.

**12.13.1.6** Check the weld to ensure a strong connection. If the weld is weak or did not "take", adjust the dial as necessary and repeat.

**12.13.1.7** Carefully reinstall the spark plug with the thermocouple attached. Tighten the spark plug to the torque value provided by the power unit manufacturer. Check the thermocouple temperature readout with a hand-held thermocouple thermometer to verify that the welded connection did not break during installation of the spark plug into the power unit.

**12.14** Carefully install the housing cover over the spark plug and thermocouple wire. If the housing cover will interfere with the thermocouple wire, modify the housing cover by drilling a hole, or cutting a notch that will allow the wire unrestricted movement. Modifications are not to affect the exhaust system or exhaust flow characteristics.

## 13.0 *Power Unit/Dynamometer Alignment and Coupling*

**13.1** Loosen the bolts holding the mounting fixture to the test stand. Slide the mounting fixture toward the dynamometer until the adapter on the power unit is almost touching the dynamometer.

**13.2** Locate the vertical fine adjustment knob and the three lock screws on the mounting fixture.

**13.3** Loosen the vertical lock screws to allow slight vertical movement.

**13.4** Adjust the vertical alignment of the adapter to the dynamometer with the fine adjustment knob and check with the 1/2- x 1-1/2- x 3-in precision alignment bar. The alignment shall be ±1/16-in. Tighten the vertical alignment lock screws. Recheck the vertical alignment, as overshoot may occur when tightening the lock screws.

**13.5** Locate the horizontal fine adjustment knob and one lock screw on the mounting fixture.

**13.6** Loosen the horizontal lock screw just enough to allow movement horizontally.

**13.7** Adjust the horizontal alignment of the adapter to the dynamometer with the fine adjustment knob and check with the 1/2- x 1-1/2- x 3-in precision alignment bar. The alignment shall be ±1/16-in. Tighten the horizontal alignment lock screw. Recheck the horizontal alignment, as overshoot may occur when tightening the lock screw.

**13.8** Do not apply vertical or horizontal pressure to the power unit or the support bracket once

the adapter has been aligned with the dynamometer.

**13.9** Slide the mounting fixture approximately 6-in away from the dynamometer.

**13.10** A flexible coupling sleeve is required to connect the adapter on the power unit to the dynamometer. This coupling sleeve is located in the storage cabinet in room No. 30. The flexible coupling sleeve may be used for several test operations, depending upon wear. Check the splines on the inside of the sleeve for wear. New flexible coupling sleeves (54SU sleeves, 4-cm length x 2.45-in diameter) may be purchased from:

Guardian Industries
1215 East Second Street
Michigan City, IN 46360

Local Distributor: Power Products Co.
6237 Maywood Avenue
Huntington Park, CA 90255
213/583-6011.

Flexible coupling sleeves with equal performance characteristics may be purchased from other sources.

**13.11** Lubricate the coupling sleeve splines with a thin coating of high-temperature and long-term grease for rolling and plain bearings. The following (or an equivalent) grease is approved:

STABURAGS N4, manufactured by
Kluber Lubrication

**13.12** Install the flexible coupling sleeve onto the splines of the dynamometer adapter which is attached to the power unit output shaft.

**13.13** Slide the mounting fixture toward the dynamometer power shaft. Carefully align the flexible coupling sleeve with the splines on the dynamometer power shaft. Continue to slide the mounting fixture toward the dynamometer until the flexible coupling sleeve fits snugly between the dynamometer power shaft and the chain saw dynamometer adapter.

**13.14** In order to allow for flexibility of the coupling, it is necessary to slide the mounting fixture approximately 1/8-in away from the dynamometer.

**13.15** Tighten the test stand base tee bolts, securing the mounting fixture to the test stand. It is important that there is a washer under each bolt head.

**13.16** For safety, it is necessary to place a guard over the dynamometer adapter and coupling assembly. The guard shall be fabricated from 10-gage, or thicker, cold-rolled steel plate. It shall be fitted to assure that all rotating parts of the coupling assembly are shielded from inadvertent access. It shall be designed to protect test personnel and instruments from high velocity fragments of the coupling assembly in case it should break or disconnect during testing. The guard shall be securely attached to the test stand with a sufficient number of tee bolts to ensure its integrity.

## 14.0 *Thermocouple Placement*

**14.1** It is necessary to tack weld thermocouple wires to any points on the power unit exhaust system surface that were marked as being points on a contact plane. (See section 9.0).

**14.1.1** Tack Welding of Surface Probes

**14.1.1.1** Set up the Hot Spot welding instrument on the test stand table. Scrape the white liquid marking off of the point where the thermocouple wires will be welded. Place the rectangular-shaped magnetized steel onto the exhaust system surface.

**14.1.1.2** The thermocouple duplex wire may be welded to the exhaust system surface by twisting the ends of the two wires together or by welding one wire at a time to the exhaust system. It is important that the two wires create a point contact to each other at the weld surface.

**14.1.1.3** Locate a dial with unit markings around its circumference on the front panel of the Hot Spot welding instrument. If the thermocouple duplex wires are twisted together, set the dial at approximately 50 units. If the wires will be welded one at a time, set the dial at approximately 35 to 40 units. After the dial has been set, the welding instrument will emit a steady tone when it has enough power to weld.

**NOTE:** All personnel in the area will wear tinted safety glasses when welding.

**14.1.1.4** Hold the thermocouple wire(s) against the exhaust system surface with the welding pliers.

> **CAUTION:** Do not touch the metal on the welding pliers or around the area being welded.

**14.1.1.5** When the welding instrument has full power, press the button located above the dial. Full power is determined when the tack welding unit begins to emit a steady tone.

**14.1.1.6** Check the weld to ensure a strong connection. If the weld is weak or did not "take," adjust the dial as necessary and repeat.

**14.2** Re-establish the contact planes with 1/8-in tape by connecting the white marks placed on the power unit, and by referencing the photographs taken in section 9.4.

**14.3** By viewing the angle of the exhaust outlet on the power unit, estimate the location where the hottest exhaust gases will intersect the contact planes.

**14.4** On the test stand table, in positions located around the power unit exhaust system, place two to four magnetic stands holding the thermocouple probes.

**14.5** Position the thermocouple probes so that the temperature sensing end is located at a point on the imaginary contact plane. Place the probes in the area where the hottest exhaust gases are expected to intersect the contact plane. Final positioning of the thermocouple probes will be completed after the power unit is started.

**14.6** Connect all of the thermocouple wires to the plug-in panel on the side of the test stand nearest the control room. Channel 1 is for the ambient air temperature and channel 2 is for the spark plug or head temperature. If there are surface contact points on the exhaust system, connect them into the panel starting at channel 3. Connect the thermocouples measuring exhaust gas temperatures in subsequent order.

## 15.0 *Final Test Stand Setup*

**15.1** Connect the throttle control cable to a leather strap attached to a 1/8- x 2-1/4- x 3-in metal plate. Position the metal plate on top of the hand-hold of the power unit. The metal plate is held in position by a "U"-shaped bolt which slides around the hand-hold from underneath and then through two holes in the metal plate. Secure with washers and nuts. Position the leather strap so that it hangs under the metal plate and around the throttle trigger in the power unit's hand-hold. The fit of the leather strap can be adjusted by changing the number of washers between the strap and the metal plate. The strap should be adjusted so that there is no pressure on the throttle trigger when the throttle cable is all the way out. When the throttle cable is pulled in, the leather strap should push the throttle trigger to the wide-open position.

> **NOTE:** The control for the throttle cable is located in the control room. (See section 17.2.)

**15.2** Connect the kill switch circuit wiring from the power unit to the kill switch circuit wiring from the dynamometer.

**15.3** Check the level of the "oil mister" for the dynamometer. This mister is located on the side of the dynamometer away from the control room. Use Chevron "OC turbine oil 46" or an equivalent.

**15.4** The 88-octane regular gasoline is stored in the fuel storage compartment located to the south of the SDTDC warehouse. If the proper fuel mix is not available in this compartment with a dated label of less than 30 days, obtain an empty fuel container from the bottom shelf of the far-right cabinet in room No. 30.

**15.5** At the fuel storage compartment, mix 1500 to 2200 ml of proper fuel mix according to the information supplied on the Chain Saw Pretest Information form. Locate a funnel inside the compartment and also locate a 1000-ml graduated cylinder for measuring gasoline and a 50-ml graduated cylinder for measuring the two-cycle oil supplied by the manufacturer. It is important that these cylinders are clean.

**15.6** The fuel mix shall have an accuracy of ±2 percent:

| *Fuel:Oil Ratio* | *ml of Oil per 1000 ml of Gasoline* |
|---|---|
| 16:1 | 62.5 ml |
| 24:1 | 41.7 ml |
| 32:1 | 31.3 ml |
| 35:1 | 28.5 ml |
| 40:1 | 25.0 ml |
| 50:1 | 20.0 ml |

Any other fuel:oil ratios will need to be calculated.

**15.7** Measure 1000 ml of 88-octane regular gasoline and pour into the fuel container. Measure the two-cycle oil required for the *total* fuel-mix quantity being prepared, and pour it into the fuel container.

**15.8** In the 1000-ml container, measure the remaining quantity of the 88-octane regular gasoline required to complete the fuel mix.

**15.9** Pour a small amount of the measured gasoline into the 50-ml cylinder used to measure the two-cycle oil. Then pour the contents of the 50-ml cylinder into the fuel container. Repeat this process until the oil has been cleared from the walls of the 50-ml cylinder. Pour the remainder of the measured 88-octane regular gasoline into the fuel container. Shake the fuel mix gently for a minimum of 1 min.

**15.10** In the test stand stand room, remove the cap on the fuel container and replace with the test stand fuel line siphoning apparatus. Place the fuel container in the fuel supply holder on the test stand.

**15.11** Evacuate the air from the fuel container siphoning fuel line, using a suction bulb. Clamp the end of the siphoning fuel line with a hemostat instrument and connect it to the fuel line adapter already inserted in the power unit's fuel line. Remove the hemostat clamp.

**15.12** Prime the power unit carburetor by moving the choke to the fully closed position. Slowly pull the starter rope for two complete rope extensions. Move the choke back to the fully open position.

**15.13** Double check the tightness of all test stand fixture bolts.

## 16.0 *Recorder/Data Logger Setup and Programming*

**16.1** A Molytek recorder/data logger is located in the control room. Open the door on the front of the unit and slide the control panel out by pulling on the handle at the bottom of the unit.

**16.2** At the top of the unit, note the two windows with a display up to 16 digital characters each. These windows will display the information needed to follow programming procedures.

**16.3** The operating instruction manual for the recorder/datalogger is located on top of the unit.

**16.4** See p. 43 of the manual for "How the Recorder Keyboard Operates."

**16.5** Identify each of the thermocouple wire connections on the test stand on the recorder by a "channel tag." The ambient air reading on channel 1 is called "Air 1" and the spark plug reading is called "Head 2." If there are surface contact points, they should be labeled "Surf 3," "Surf 4," etc. The exhaust gas readings should be labeled "Exha 5," 'Exha 6," etc.

To change the channel tags, follow these steps:

**16.5.1** Press the G key to access the "user tags" sequence, which will show in the upper left screen; the upper right screen will read "make new."

**16.5.2** Press the "next" key until the right screen reads "change old." The "user tags" can have a maximum of six characters.

**16.5.3** After creating the "tag" names required, press the "end" key and then the "enter" key. For additional help, see operating instructions, p. 73.

**16.6** To program the channels in the recorder, follow these steps:

**16.6.1** Press the "prog" key, and the left screen will read "program channel."

**16.6.2** To program channel 1, press the "1" key. To program only channel 4, press the "4" key; etc. The left screen will then read "through.'

**16.6.3** Press the "enter" key. (Refer to p. 99-107 of the operating instructions for further direction.)

> **NOTE:** To scroll through all of the options available in each "prog" step, it is necessary to press the "next" key until the appropriate option is displayed on the right screen. Then press "enter," and the recorder will automatically move to the next "prog" step. With an incorrect entry, it is necessary to complete all of the steps and then start programming that channel again.

**16.7** Prior to the start of a test, the technician will enter specific test information to the printed chart. Press the "Z" key, and the left screen will read "message to chart." A maximum of 109 characters per line of information may be printed on the chart. After each line of information

has been typed, it is necessary to press the "enter" key. The following information should be printed on the chart before the start of a test:

**16.7.1** Press "Z," and type the name of the safety person; press "enter."

**16.7.2** Press "Z," and type the following words: "safety person;" press "enter." Then press "paper advan" to leave some space on the paper before the next entry.

**16.7.3** Press "Z," and type the name of test technician; press "enter."

**16.7.4** Press "Z," and type the following words: "test technician; press "enter." Now press "paper advan" to leave some space.

**16.7.5** Press "Z," and enter the name and number of the exhaust system; press "enter."

**16.7.6** Press "Z," and enter the following words:"exhaust system;" press "enter." Now press "paper advan" to leave some space.

**16.7.7** Press "Z," and enter the name and number of the power unit; press "enter." Now press "paper advan" to leave some space.

**16.7.8** Repeat the above steps for other information you feel needs to be recorded on the chart.

**16.8** Consult the operating instructions for further information regarding the Molytek recorder/datalogger.

**17.0 Prestart Procedure**

**17.1** Request the presence of a safety person to assist during the test.

**17.2** The chrome-colored throttle control handle is located just below the table top in the center of the instrument table. Turn the handle a 1/2 turn counter-clockwise to unlock it, pull it outward into its fully open position; then push it inward to 1/2 the fully open distance to achieve a *1/2 throttle setting.* Now turn the throttle control handle clockwise to lock it into position.

**17.3** When facing the control instruments in the control room, the switch that determines which of the two dynamometers will be operational (see section 11.4) is located on the wall to the right side of the safety window.

**17.3.1** Startup procedure for the Quick dynamometer:

**17.3.1.1** Engage the Quick dynamometer, using the switch to the right of the safety window; the switch lever will point down.

**17.3.1.2** The tachometer is placed above the unit controlling the load of the "Schenck" dynamometer. The tachometer has two readout window screens; the left one marked "torque;" the right marked "rpm." Turn the tachometer power on by moving the switch between the screens to the "up" position.

**17.3.1.3** The unit controlling the load is located in the center of the instrument table. The upper left face of the control panel displays "Borghi & Saveri." The switch on the left side of the control panel should be positioned for an "Internal Load." The bottom left of the panel contains a white on-off button. Press this button to turn on the load instrument. Set the dial at the bottom center of the control panel to a load of 5.0. Press the red button to the right of the load dial to test the kill switch; the light will go out. The light will illuminate after the button is released. There are three dials on the right side of the control panel. Set the top dial to n = constant, and the center and bottom dials to 10.

**17.3.1.4** Proceed into the test stand room.

**17.3.1.4.1** Check the pressure gage in the water line at the south end of the test stand. The gage should read between 21 and 25 $lb/in^2$ (psi) water pressure.

**17.3.1.4.2** Check the motor switch on the southeast corner of the test stand. The switch lever should be pointed away from the control room to operate the Quick dynamometer.

**17.3.1.4.3** Check the dynamometer's oil mister, with a minimum feed rate of four oil drops per min. The feed rate is currently set for about 20 oil drops per min for maximum dynamometer bearing lubrication.

**17.3.1.4.4** Check the setting of the clutch switch at the center of the west side of the test stand. The switch should be in the down position to operate the Quick dynamometer.

**17.3.1.4.5** Locate the clutch switch on the west wall, on the right side of the safety window. Turn the clutch switch to the "on" position. The switch lever will point to the left.

**17.3.1.4.6** Turn on the respirator air using the switch located on the north wall to the left of the door. Check the flow of air in the hood.

Check for twisting and kinks in the hood air line/ hood interface for adequate air flow.

**17.3.1.4.7** Open the doors to the outside to allow exhaust gases to escape the building.

**17.3.1.4.8** Re-enter the control room and close both doors to the test stand room.

**17.3.2** Startup Procedure for the Schenck dynamometer:

**17.3.2.1** Engage the Schenck dynamometer, using the switch to the right of the safety window; the switch lever will point up.

**17.3.2.2** The tachometer is placed above the unit that controls the load of the Schenck dynamometer. The tachometer has two readout window screens; the left one marked "torque;" the right marked "rpm." Turn the tachometer power on by moving the switch between the screens to the up position.

**17.3.2.3** The unit controlling the load is located to the right of the instrument table. The upper left face of the control panel displays "Schenck." The switch at the bottom center of the control panel will point down. Set the load dial at the center of the control panel to a load of 5.0. Set the dial to the right of the load dial to n = constant. Set the small knob between the lights at the top of the panel with the line pointing up. Press the red button at the top right of the panel to test the kill switch; the light will go out. The light will illuminate again after the button is released. Set the dial below the kill switch to 6. The black twist-handle at the bottom right of the panel should point up when the unit is first turned on; this will light the green light above the load dial to verify that water is circulating through the dynamometer. When water circulation has been verified by the green light, the black twist-handle will be pointing to the right.

**17.3.2.4** Proceed into the test stand room.

**17.3.2.4.1** Check the pressure gage in the water line at the north end of the test stand. The gage should read between 21 and 25 $lb/in^2$ (psi) water pressure.

**17.3.2.4.2** Check the motor switch on the southeast corner of the test stand. The switch lever should be pointed toward the control room to operate the Schenck dynamometer.

**17.3.2.4.3** Check the dynamometer's oil mister, a minimum feed rate of four oil drops per min. The feed rate is currently set for about 20 oil drops per min for maximum dynamometer bearing lubrication.

**17.3.2.4.4** Check the setting of the clutch switch at the center of the west side of the test stand. The switch should be in the up positon to operate the Schenck dynamometer.

**17.3.2.4.5** Locate the clutch switch on the west wall, on the right side of the safety window. Turn the clutch switch to the "on" position. The switch lever will point to the left.

**17.3.2.4.6** Turn on the respirator air using the switch located on the north wall to the left of the door. The switch will point up. Check the flow of air.

**17.3.2.4.7** Open the doors to the outside to allow exhaust gases to escape the building.

**17.3.2.4.8** Re-enter the control room and close both doors to the test stand room.

**17.4** ***Continuation of Prestart Procedure for Both Dynamometers.*** Turn on the blower in the control room by pressing the "on" button to the left side of the safety window.

> **NOTE:** The switch marked "fan" is not connected and will not be used.

**17.5** Review with the safety person the following safety items/rules:

**17.5.1** Location of all fire extinguishers, including the magnesium extinguisher specific for chain saw power heads.

**17.5.2** The safety person will be in the control room at all times when the chain saw power unit is operational and immediately before and after the running of a chain saw.

**17.5.3** No smoking at any time in the prep, test, or control rooms.

**17.6** An emergency shutdown procedure will take place in event of a dynamometer/coupling failure, or if the maximum head temperature is exceeded, or for any safety action at the request of the test technician or the safety person. Review with the safety person the following emergency shut-down procedure.

**17.6.1** Use the electrical cutout (kill) switch in the control room to stop the engine. Depress the switch until engine stops. At the same time close the throttle with the throttle control.

**17.6.2** Pull the black knob next to the throttle control handle. This will stop the siphoning of fuel from the fuel container. There will still be enough fuel in the fuel line to operate the power unit for 30 to 50 sec.

**17.6.3** Decrease the load on the power unit by switching the load away from internal load.

**17.6.4** The test technician can halt the procedure from the test room by pulling the choke out to the full position—this cuts the air supply and floods the carburetor—or by clamping the fuel line with a laboratory hemostat clamp.

**18.0** ***Power Unit Engine Startup***

**18.1** The test technician and safety person shall wear hearing protection.

**18.2** Immediately to the left of the switch that controls which dynamometer is in use, there is an electrical cable connection. This cable extends to a red button attached to a wooden handle, which is usually located on top of the Quick dynamometer loading unit. Press the red button to engage the clutch connecting the startup motor to the dynamometer.

**18.3** Visually check the clutch gear meshing to ensure engagement. It may be necessary to have the safety person engage the clutch while the test technician goes into the test stand room to visually inspect the meshing of the gears.

**18.4** Continue to press the red button, and turn on the starter motor with the switch located to the left of the safety window. The power unit engine will usually start in 30 to 45 sec. Watch the movement of the power unit and listen for the sound of the engine. If the power unit engine does not start within 3 min, release the red button and stop the starter motor. Proceed to section 18.9.

**18.5** When the power unit engine has started, disengage the clutch by releasing the red button.

**18.6** Stop the starter motor with the switch located to the left of the safety window.

> **NOTE:** If the power unit has not started with the release of the red button, DO NOT attempt to remesh the gears again until the dynamometer has stopped rotating completely.

**18.7** If the power unit did not start on the first attempt, go through steps in sections 18.2 to 18.6 again.

**18.8** If the power unit engine does not start up after three attempts, set the power unit choke at approximately 1/4-full and attempt to restart by again going through sections 18.2 to 18.6.

**18.9** If power unit engine still will not start:

**18.9.1** Examine the fuel line for a possible kink or crack in the fuel line adapter.

**18.9.2** Check the placement of the throttle cable leather strap installation.

**18.9.3** Read the power unit operator's manual to determine if all of the power unit settings are correct.

**18.9.4** Remove the spark plug from the power unit and visually examine the electrode for excess fuel dampness. If the electrode appears to be wet, dry it with a clean cloth, and wait 15 min for further drying by evaporation. Before re-installing the spark plug, check to be sure the connection is producing a spark. This is done by inserting the top of the spark plug into its electrical cable connector and positioning the spark plug thread end to the metal cylinder head of the power unit. While pulling on the starter rope, look at the bottom of the spark plug to see if a spark is created between the gap of the spark plug and the metal cylinder head. If there is no spark, replace the spark plug with another plug of the same type as called for in the operator's manual. Re-install the spark plug in the power unit.

**18.9.5** If the power unit engine will still not start, request further direction from the Project Leader.

**18.10** Once the power unit engine has started, look at the rpm readout on the tachometer, and adjust the load dial number value until the rpm are at an idle speed of 2,500 to 3,000 rpm. To increase rpm, turn load dial clockwise (an increase in the load dial number value). To decrease the rpm, turn load dial counter-clockwise (a decrease in the load dial number value).

> **NOTE:** An increase in the load dial number value does not indicate an increase in the dynamometer resistive load, and vice versa.

Allow the engine to run at this setting for at least a 3-min warm-up period.

**18.11** To have a complete record of time and temperature during the test run, the safety person shall sit in front of the recorder/datalogger and operate the recorder *continuously* from the start

of the power unit engine until the engine is shut down. This will be done as follows:

**18.11.1** Press the "oper" key on the recorder keyboard. The left screen should read "operation mode." The right screen will read either "standby" or "operate/auto."

**18.11.2** If the right screen reads "standby," press the "next" key until the screen reads "operate/auto." Press the "enter" key.

**18.11.3** The recorder will print the most recent data that have been collected from the thermocouples. When the printer has completed printing data for all of the channels, the safety person must press the "oper" key and then the "enter" key in order to print new data. This must be done after every printing cycle.

**18.12** The safety person shall also monitor the head temperature (channel 2) of the power unit to make sure that it does not exceed the manufacturer's maximum recommended temperature. Look on the test data sheet from the test folder to verify the manufacturer's maximum recommended head temperature. The safety person will notify the test technician if the head temperature gets within 30 °F of the maximum recommended. If the maximum is exceeded, immediately proceed with the emergency shutdown procedure in section 17.6.

## 19.0 Final Adjustment of Thermocouple Placement

**19.1** While the safety person continues to monitor the head temperature and record data, the test technician shall enter the test stand room to adjust the placement of the thermocouple probes.

> **NOTE:** The power unit engine is currently idling.

**19.2** Upon entering the room, the test technician shall wear the respirator and hearing protection.

**19.3** The test technician shall carefully move a bare hand around the power unit exhaust area to roughly determine the hot spots and where the thermocouple probes need to be located.

**19.4** Using a hand-held thermocouple thermometer, slowly crisscross the probe over the contact planes to find the location of the hottest exhaust gases. There may be more than one area that has hot exhaust gases. Locate the test stand thermocouple probes at the points where the hottest exhaust gases impinge a contact plane. Two or three probes in one general area should be sufficient to get adequate data, but remember that there can be large temperature differences within a millimeter. Remove the tape marking the contact planes and return to the control room.

> **NOTE:** If the tape marking the contact planes will not stay in position because of the movement of the exhaust gases, it may be necessary to setup the contact planes by use of 1/16-in diameter welding rods. This is done by holding the welding rods so that they are in contact with the marked points on the power unit. Assistance may be required to position the welding rods and the thermocouple probes. Get someone other than the safety person to assist in the test stand room. Remember, the tip of the probe needs to be located on the contact plane. The final probe position will not penetrate the contact plane or be farther away from the exhaust system than the contact plane.

## 20.0 Collection of Test Data

**20.1** Look at the chain saw data sheet from the test folder for the rpm at best power, as specified by the manufacturer.

**20.2** Look in the operator's manual to determine if the carburetor is adjustable. If it is, look for the location of the high/low jet adjustment screws.

**20.3** Gradually increase the power unit engine speed by pulling the throttle control outward to full throttle. As the throttle is increased, watch the rpm readout on the tachometer. Do not increase the engine speed by more than 500 rpm increments every 10 sec. To keep the rpm from exceeding the manufacturer's rated rpm, it may be necessary to decrease the load dial number value by turning the load dial counter-clockwise. If the power unit engine should start to "run away," push the throttle control in to slow the engine down. If that is not effective, use the emergency shut-down procedures in section 17.6.

**20.4** *With the throttle at full open*, continue to adjust the load dial number value until the rpm readout on the tachometer is at the manufacturer's specified rated rpm. To increase the rpm, turn the load dial clockwise (an increase in load dial number value.) To decrease the rpm, turn the load dial counter-clockwise (a decrease in load dial number value).

> **NOTE:** An increase in the load dial number value does not indicate an increase in the dynamometer resistive load, and vice versa.

**20.5** The test technician then re-enters the test stand room and puts on the respirator. The test technician will adjust the high-speed mixture jet on the power unit by 1/16 increments to determine maximum indicated torque at best power. The technician shall allow 15 sec for each 1/16 turn of the high-speed mixture jet to provide time for the dynamometer to automatically reset back to the manufacturer's specified best-power rpm. Do NOT adjust the load dial number value at this time. Adjustment of the high-speed mixture jet will be reflected in a change in the indicated dynamometer torque. The test technician will adjust the high-speed mixture jet on the power unit until the safety person indicates that the torque has peaked and then decreased. The test technician will then back the high-speed mixture jet screw off slightly by turning the screw 1/16-turn counter-clockwise from the peak torque position. This will achieve proper engine lubrication.

**20.6** The test technician then re-enters the control room. The power unit is now running at best power speed.

**20.7** The safety person shall mark the best-power speed rpm in the margin of the recorder chart next to the data entry when that rpm speed is achieved. Example: "Begin best-power speed 8,150 rpm" shall be written in the chart margin next to the time printout.

**20.8** Run the engine at best-power speed for at least 3 min. Record the torque, load, and rpm referenced to a time from the printed chart. If the head temperature continues to rise after 3 min, repeat the steps in sections 20.4 to 20.6.

**NOTE:** If at any time during the test, the head temperature reaches the manufacturer's maximum recommended head temperature, immediately begin to decrease the engine speed by 500 rpm every 10 sec until idle speed (2,500 to 3,000 rpm) is reached. Allow the engine to idle for 5 min, and then go to zero throttle and press the kill switch to stop the engine. Inform the Project Leader of the high head temperature. Do not restart testing without further direction from the Project Leader.

**CAUTION:** If the power unit engine seizes during the test, a mechanical failure will follow. Proceed with the emergency shutdown procedure in section 17.6. Continue to run the dynamometer water cooling system for 10 min before placing the dynamometer control switch, located on the right side of the safety window, in the "off" (center) position.

**20.9** When the engine has run 3 min at best-power rpm, and the engine head temperature has stabilized, record the load, torque, rpm, and time on the torque/load/rpm record form, SDTDC 7100-30 (5/90). Use the printed time from the recorder chart. In the margin of the recorder chart mark "End-Best Power Speed: ____ rpm."

**20.10** Increase the load until the power unit engine speed is 1,000 rpm above the best-power speed. In the margin of the recorder chart mark "Start ____ rpm". Allow a stabilization time of at least 3 min, and record load, torque, rpm, and time as above. In the margin of the recorder chart mark "End ____ rpm."

**20.11** Decrease the load, in steps of 500 rpm, until the power unit engine speed is 1,000 rpm below the best-power speed. Record the load, torque, and rpm at each step level. When the total 2,000 rpm speed reduction has been reached, run the power unit engine at that level for at least 3 min to stabilize the head temperature. In the margin of the recorder chart mark the start and end of this rpm test. At the end of the test time, record the load, torque, rpm, and time as above.

**20.12** To determine the repeatability of the test, increase the load dial number value until the power unit engine speed is back to the best-power speed. Record information as in previous tests.

**20.13** If the chain saw power unit fails by recorded temperature, initiate the shutdown procedure in section 21.0. After the power unit has stopped, a second person will recheck the contact planes and thermocouple placement with the test technician and a note will be written on the data sheet.

## 21.0 Shut-Down Procedure

**21.1** After all of the required test data have been collected, slowly decrease the power unit engine speed by a combination of closing the throttle and decreasing the load dial number value. Reduce the speed by 500 rpm every 10 sec until engine is at idle speed. Maintain idle speed for 5 min. Completely close the throttle, and press the kill switch until the engine stops.

**21.2** In the *test stand room*: Turn off the clutch switch located on the west wall, which is to the right side of the safety window. The switch lever will point to the right. Turn off the respirator air with the switch located on the north wall to the left of the door. The switch will point down.

**21.3** In the *control room*: Turn off the tachometer by moving the switch to the center position. Turn

off the load instrument by pressing the white on/off button.

**21.4** Allow the dynamometer water-cooling system to run for 10 min before placing the control switch, located to the right side of the safety window, in the "off" (center) position. Allow the blower to run as long as necessary to help clear the exhaust gases from the test stand room. Turn off the blower by pressing the off button located to the left of the safety window.

## 22.0 *Documentation of Thermocouple Placement*

**22.1** Take photographs to show (A) the general test setup, (B) thermocouple and probe locations with respect to the body of the test power unit, and (C) thermocouple and probe locations with respect to the contact planes and the exhaust system.

**22.2** Select an easily identifiable reference point *on* the power unit (near or on the exhaust system) which will be used for documentation of thermocouple positions. Note the reference point as "0,0,0" and measure the X, Y, and Z distances for each thermocouple and record in table form. Use millimeters as a unit of measure. Each thermocouple measurement should be labeled by the recorder channel number that it was connected to during the test.

**22.2.1** The "X" distance is measured horizontally. This is *parallel* with the exhaust system face of the power unit and *parallel* with the test stand table.

**22.2.2** The "Y" distance is measured vertically. This is *parallel* with the exhaust system face of the power unit and *perpendicular* to the test stand table.

**22.2.3** The "Z" distance is measured horizontally and is *perpendicular* to the exhaust system face of the power unit and *parallel* with the test stand table.

**22.3** Obtain the manufacturer-supplied drawing of the power unit and/or exhaust system from the test folder. Place the drawing on a "light table" and trace a copy of the drawing onto a sheet of graph paper, being careful to place the location of the "0,0,0" reference point at a cross-junction on the graph paper. The following information needs to be included on the graph paper (see example; first item within appendixes):

A. Title: "Documentation of Thermocouple Placement."
B. Name and model number of the power unit and the exhaust system.
C. Date, collection agreement number, and the signature of the test technician.
D. Description of where the reference point is located on the power unit.
E. Plot the thermocouple locations on the graph.
F. Table format showing the thermocouple channel numbers and "X, Y, and Z" locations.
G. Statement indicating that the power unit and/or exhaust system drawing is not to scale.
H. Thermocouple placement scale: One block equals one "mm."
I. Place a note stating: The power unit crankshaft is parallel to the "X" axis.

## 23.0 *Qualification Notice*

**23.1** Log on to a DG terminal and follow these steps:

A. At "main menu," select No. 5, "filing".
B. At "filing functions", select No. 1. "drawers," then select No. 1, "personal."
C. At "drawers" select "No. 2 F&AM Qual. Prgm, CS-MSE."
D. Within drawer No. 2, select "No. 4. !Forms for MSE & CS."
E. At the bottom of the next DG screen, select No. 9, "move/duplicate/archive."
F. The folder to be duplicated is either: Document "No. 4, CS Failure to Qualify" or document "No. 5, CS Qualified Form," whichever is applicable.
G. On the next screen, select No. 3, "duplicate."
H. The duplicated document will go in:
1. Drawer: "F&AM Qual Prgm, CS-MSE"
2. Folder: Type in the name of the test power unit manufacturer.
3. Document: Type in the name of the test power unit. (The duplicated blank form will now be located in this drawer and folder under this document name.)

**23.2** Locate the blank form, document, that was just created, and bring it onto the DG screen in the "edit" mode. The following applies to pg. 1:

A. In parenthesis above the date/location, enter the collection agreement No.
B. Enter the date.
C. Enter the manufacturer's name and address.
D. Enter the collection agreement number.
E. At the first hyphen, enter the exhaust system name and number and highlight (bold).
F. At the second hyphen, enter the power unit name and number and highlight (bold).
G. If this power unit is being qualified; at the third hyphen, enter the applicable equipment required for this qualified unit (i.e., chain brake, hand guard, spikes or bumper bars, 1/2 wrap handlebar, etc.).

If the power unit is not qualified, this does not apply.

The following applies to pg. 3 and 4: Using the manufacturer's form SDTDC 7100-07 (5/90), Chain Saw Pretest Information, and information from the test, fill in the requested information (as necessary).

**23.3** When the form has been completed, cancel/exit out of the document and via the DG system, mail the document to "!Typing Staff."

**23.4** Via the DG system, send a short message to the Project Leader, stating: "The qualification notice (or failure to qualify notice) for the test power unit _____ is located in "!Typing Staff" for your review."

**23.5** Return the power unit test folder with all applicable data to the Project Leader. After the notice has been reviewed by the required staff, it will be returned to the test technician for a signature before it is mailed to the manufacturer.

**24.0** ***Removal of Power Unit from Test Stand***

**24.1** Disconnect kill switch wires and throttle control cable from the power unit.

**24.2** Clamp the fuel line with the hemostat and disconnect from the power unit.

**24.3** Remove the guard that is covering the dynamometer adapter and coupling.

**24.4** Remove the spark plug from the power unit and disconnect the welded thermocouple wires.

**24.5** Loosen the T-bolts holding the mounting fixture in place, and slide the mounting fixture away from the dynamometer. Remove the flexible coupling sleeve.

**24.6** Use a knotted cord or a piston stop to stop piston movement.

**24.7** Stand on the side of the test stand that is away from the control room, and use a strap wrench to remove the dynamometer adapter.

**24.8** Remove the power unit from the mounting fixture. Re-assemble power unit with spark plug, crank shaft cover, etc.

**24.9** Determine the final setting of the carburetors high- and low-speed adjustment screws as follows:

**24.9.1** Insert a carburetor adjustment screwdriver into the slot on the high-speed adjustment screw.

**24.9.2** Place a dot on the power unit housing with white liquid marker to identify the starting position of the screwdriver pointer.

**24.9.3** Turn screwdriver clockwise and count the number of turns needed to close the adjustment screw. Do not close the screw tight or damage may result.

**24.9.4** Enter the number of turns to the nearest 1/16-in on the Chain Saw Temperature Test Record, form SDTDC 7100-28.

**24.9.5** Turn the adjustment screw counterclockwise to its original setting.

**24.9.6** Repeat the steps in 24.9 for the low-speed adjustment screw.

**24.10** Place the Power Unit in the storage cabinet in room No. 30.

**24.11** Remove the manufacturer's dynamometer adapter from the SDTDC splined adapter, and place it in room No. 30 storage cabinet with the power unit.

**24.12** The fuel container with remaining fuel mix shall be capped, and labeled with date, fuel mix ratio, and oil brand type. This container shall be placed in the fuel storage compartment.

**25.0** ***Disposal of Hardware***

**25.1** After approval of the test results by the Project Leader; pack the tested power unit and all other equipment furnished by the manufacturer into their original shipping containers. Check the manufacturers original shipping list to verify that all items originally shipped are accounted for or are being returned.

> **NOTE:** The dynamometer adapter shall be returned to the manufacturer unless otherwise indicated by the Project Leader.

**25.2** Return all of these hardware items to the manufacturer in accordance with the established Forest Service shipping procedures. Send package(s) to the attention of the individual named as the manufacturer's technical contact at the address supplied by the Project Leader.

## PROJECT SERVICES REQUEST

Project Leader: _____ Date: _____

Management code(s): Salary _____ Other: _____

Due date: _____ Revised due date: _____

Completion date: _____

Description of work: _____

A copy of specification & data sheets, if required: _____

Remarks: _____

SDTDC 7120-1 (10/89)

## CHAIN SAW PRETEST INFORMATION FORM
## for Qualification Testing by USDA Forest Service

1. Power unit model number or name:_____
2. Power unit serial number:_____
3. Exhaust system model number or name:_____
4. Engine displacement (cc):_____
5. Best power rated speed (rpm):_____
6. Best power (hp):_____
7. Torque limit on power shaft (ft-lb):_____
8. Torque limit on crank shaft cover stud bolt/nut(s) (in-lb):_____
9. Torque limit on spark plug (in-lb):_____
10. Maximum allowable head temperature (°F):_____
11. Proper spark plug:_____
12. Proper spark plug gap:_____
13. Proper fuel mix ratio with 88 octane gasoline:_____
14. Type of two-cycle oil supplied for testing:_____
15. Total time power unit has been run in (2 hr, min.)_____
16. Shank on clutch side of engine is left hand, and any special tool required to remove the clutch is included:_____
17. Spark arrester screen material is fabricated from (incl. the stainless steel designation):_____
18. Diameter (thickness) of screen material:_____mm (_____in)
19. Size of screen openings:_____mm (_____in)
20. How and where is exhaust system make and model number marked to identify the exhaust system?_____

-Continued on reverse side-

SDTDC 7100-07 (5/90)

21. A dynamometer adapter has been fabricated from one of two SDTDC supplied drawings and is being transmitted with power unit: _____Yes _____No

22. The following will be sent to SDTDC by surface mail:

    a. Power unit's operator's manual

    b. Power unit's parts list

    c. A Spark Arrester Guide quality 3/4 isometric exploded view drawing of exhaust system showing internal and external construction details.

    d. A Spark Arrester Guide quality 3/4 isometric view drawing of exhaust system as assembled on power unit.

    e. A completed Chain Saw Pretest Information Form, SDTDC 7100-07 (5/90).

    f. A completed MSE Collection Agreement Form, with an original signature, SDTDC 7100-17 (9/88).

    g. If this exact spark arrester exhaust system will be used on any other power units that are not previously qualified, a waiver request may be submitted as outlined in the Waiver Request Procedure of the Manufacturer Submittal Procedure.

***Note:*** If chain saw exhaust system does not have a screen-type spark arrester, additional testing as specified in section 3 of Society of Automotive Engineers (SAE) J335b, "Multiposition Small Engine Exhaust System Fire Ignition Suppression," will be required. Subsequently, additional fees may be required.

## CHAIN SAW TEMPERATURE TEST

Power unit: _____ C/A No.: _____

Exhaust system: _____ Test date: _____

Speed at best power as specified by the manufacturer: _____rpm Test Technician signature: _____

Maximum recommended head temperature: _____ °F Test Technician printed name: _____

Standard test conditions: Wide open throttle
Temperature: 70 °F ± 2 °F; 21 °C ± 1 °C
Relative humidity: 90% or less
Safety Person signature: _____
Safety Person printed name: _____

| Load Dial Number Value | Torque ft-lb | Speed rpm | Power hp | CHAIN SAW THERMOCOUPLE TEST DATA Retrieved from the Data Logger Recorder (°F) # 1. | # 2. | # 3. | # 4. | # 5. | # 6. | # 7. | # 8 | Running time to stabilize 3 minute minimum Minutes: _____ Seconds: _____ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | at Best Power | | Ambient | Head | | | | | | | Minutes: _____ Seconds: _____ |
| | | + 1,000 | | | | | | | | | | Minutes: _____ Seconds: _____ |
| | | - 1,000 | | | | | | | | | | Minutes: _____ Seconds: _____ |
| | | at Best Power | | | | | | | | | | Minutes: _____ Seconds: _____ |

Channel # 1: Ambient Air Thermocouple Probe
Channel # 2: Head -Spark Plug- Surface Thermocouple Probe

CIRCLE THE CORRECT TYPE THERMOCOUPLE PROBE:

Channel # 3: Surface / Exhaust Probe

Channel # 4: Surface / Exhaust Probe

Channel # 5: Surface / Exhaust Probe

Channel # 6: Surface / Exhaust Probe

Channel # 7: Surface / Exhaust Probe

Channel # 8: Surface / Exhaust Probe

Carburetor Settings After Temperature Test Completion:

High: _____turns

Low: _____turns

<2 Percent Error in Qualification Test System

For Qualification: Exposed surface temp: <550 °F
Exhaust gas temp: <475 °F

SDTDC 7100-28 (5/90)

## CHAIN SAW DATA SHEET

C/A number:_____

Power unit:_____

Exhaust system:_____

88 octane gasoline with a oil/fuel ratio of 1:_____

Two-cycle oil brand (manufacturer supplied):_____

Spark plug specified on pretest (type):_____

Spark plug with power unit:_____ In operator's manual:_____

Spark plug gap measured: 0.0_____(in)

Spark plug gap specified and tested at: 0.0_____(in)

Serial number of chain saw (if present):_____

RPM at best power as specified by the manufacturer:_____(rpm)/Power:_____(hp)

Torque limits as supplied by the manufacturer, power shaft:_____(ft-lb)

Crank shaft cover stud bolt/nut(s):_____(in-lb) Spark plug:_____(in-lb)

Screen exam/probing of periphery exhaust area: With a 0.024-inch wire gage:

0.024 inch No Go = ____Pass 0.024 inch Go = ____Fail Probed:_____times

Screen exam/probing of exhaust screen: Starting with a 0.024-inch wire gage and probing 20 times each.

| | | | | |
|---|---|---|---|---|
| 0.024 inch: | No Go X_____Probes | Go X_____Probes | Pass:_____ | Fail:____ |
| 0.023 inch: | No Go X ____ Probes | Go X ____ Probes | Pass | |
| 0.022 inch: | No Go X ____ Probes | Go X ____ Probes | Pass | |
| 0.021 inch: | No Go X ____ Probes | Go X ____ Probes | Pass | |
| 0.020 inch: | No Go X ____ Probes | Go X ____ Probes | Pass | |
| 0.019 inch: | No Go X ____ Probes | Go X ____ Probes | Pass | |
| 0.018 inch: | No Go X ____ Probes | Go X ____ Probes | Pass | |

Maximum Gage Size To Penetrate Screen: 0.0_____(in)
Adding 0.001 inch equals:

No-Go Wire Gage Size For Screen Openings: 0.0_____(in)

SDTDC 7100-29 (5/90)

Recheck of Periphery Probe

Screen exam/probing of periphery exhaust area: With a 0.024-inch wire gage:

0.024 inch No Go = ____Pass 0.024 inch Go = ____Fail Probed:_____times

Screen exam test date:_____

Screen exam test technician:_____

Carburetor settings as received from the manufacturer:

High:_____ turns Low:_____ turns

Handle bar wrap: 1/2_____ 3/4_____ Full_____

Chain brake present: Yes:_____ No:_____

Is chain brake a point on any contact plane? Yes:_____ No:_____

Hand guard present: Yes:_____ No:_____

Is hand guard a point on any contact plane? Yes:_____ No:_____

Bumper spikes: Small:_____Medium:_____Large:_____Inside:_____Outside:_____

Bumper spikes serial number, if present:_____

Bumper bar(s): Small:_____Medium:_____Large:_____Inside:_____Outside:_____

Bumper bar(s) serial number, if present:_____

Photograph date:_____

Comments:_____

_____

_____

_____

_____

_____

# TORQUE/LOAD/RPM RECORD

*for use in Chain Saw Temperature Testing*

**Power unit:** _____ **C/A:** _____

**Exhaust system:** _____ **Test Technician** _____

| RPM | Load Dial number value | Torque (ft-lb) | Time (min:sec) |
|---|---|---|---|
| Best power | | | |
| Best power | | | |
| Best power + 1,000 | | | |
| Best power + 1,000 | | | |
| Best power + 500 | | | |
| Best power | | | |
| Best power - 500 | | | |
| Best power - 1,000 | | | |
| Best power - 1,000 | | | |
| Best power | | | |

**Comments:** _____

_____

_____

_____

SDTDC 7100-30 (5/90)

# MULTIPOSITION SMALL ENGINE OTHER THAN CHAIN SAW PRETEST INFORMATION FORM

***for Qualification Testing by USDA Forest Service***

1. Power unit model number or name:_____
2. Power unit serial number:_____
3. Exhaust system model number or name:_____
4. Engine displacement (cc):_____
5. Best power rated speed (rpm):_____
6. Best power (hp):_____
7. Torque limit on power shaft (ft-lb):_____
8. Torque limit on spark plug (in-lb):_____
9. Maximum allowable head temperature (°F):_____
10. Proper spark plug:_____
11. Proper spark plug gap:_____
12. Proper fuel mix ratio with 88 octane gasoline:_____
13. Type of two-cycle oil supplied for testing:_____
14. Total time power unit has been run in (2 hr, min.):_____
15. Spark arrester screen material is fabricated from (incl. the stainless steel designation):_____
16. Diameter (thickness) of screen material:_____mm (_____in)
17. Size of screen openings:_____mm (_____in)
18. How and where is exhaust system make and model number marked to identify exhaust system?_____

*-Continued on reverse side-*

19. The following will be sent to SDTDC by surface mail:

a. Power unit's operator's manual

b. Power unit's parts list

c. A *Spark Arrester Guide* quality 3/4 isometric exploded view drawing of exhaust system showing internal and external construction details.

d. A *Spark Arrester Guide* quality 3/4 isometric view drawing of exhaust system as assembled on Power Unit.

e. A completed Chain Saw Pretest Information Form, SDTDC 7100-07 (5/90).

f. A completed MSE Collection Agreement Form, with an original signature, SDTDC 7100-17 (9/88).

g. If this exact spark arrester exhaust system will be used on any other power units that are not previously qualified, a waiver request may be submitted as outlined in the Waiver Request Procedure of the Manufacturer Submittal Procedure.

**NOTE:** If the multiposition small engine exhaust system does not have a screen-type spark arrester, additional testing as specified in section 3 of Society of Automotive Engineers (SAE) J335b, "Multiposition Small Engine Exhaust System Fire Ignition Suppression," will be required. Subsequently, additional fees may be required.

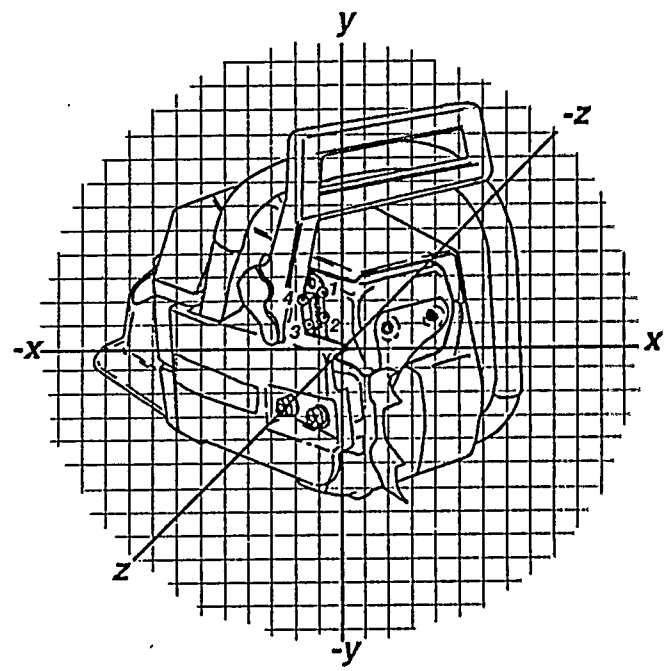
# THERMOCOUPLE LOCATION DOCUMENTATION

1. Make and model of the exhaust system tested: _____

2. Make and model of the test power head: _____

3. The exact location of the thermocouple tips during the temperature test will be graphed. Thermocouple locations shall be identified by X,Y, and Z coordinates. Each axis will be defined on the drawing and 2 of the 3 axis will be defined in text. Each thermocouple tip coordinate will be indicated on the drawing and in a data table. See the example below.

| Thermocouple Number | Coordinates X | Units in mm Y | Z |
|---|---|---|---|
| 1 | -6 | 4 | -3 |
| 2 | -4 | 3 | -1 |
| 3 | -5 | 3 | -1 |
| 4 | -5 | 4 | -2 |




The Z axis is parrallel to the engine crank shaft and the X axis is parallel to the chain bar.

*The power unit is not to scale.*

*Thermocouple location scale: 1 block equals 3 mm.*

Test Technician:

_____
(Name)

_____
(Title)

_____
(Date)

SDTDC 7100-41 (9/91)

United States Department of Agriculture

Forest Service

Technology & Development Center
444 East Bonita Avenue
San Dimas, California 91773
714/599-1267

Reply to: 7120

Date:

Gentlemen:

Reference Collection Agreement No. xx .

Testing has been completed on the xx chain saw exhaust system on the xx test chain saw submitted under Collection Agreement No. xx .

The chain saw exhaust system was tested in accordance with the Society of Automotive Engineers (SAE) Recommended Practice J335b, "Multiposition Small Engine Exhaust System Fire Ignition Suppression" and is qualified with a xx wrap handle bar, chain brake, handle bar and xx spikes as meeting minimum recommended performance levels outlined in the appendix of the above Recommended Practice.
A summary of the test results is attached. The xx exhaust system will be listed in the Spark Arrester Guide (SAG) as indicated in the table below.

The xx chain saw exhaust system is qualified additionally by waiver for use on the chain saw models listed in the following table. This listing will also be incorporated into the SAG. See the attached Multiposition Small Engine Waiver Request Criteria.

| Chain Saw | Arrester | Mfgr. | Handlebar | Spike | CB/HG | Filter | Remarks |
|---|---|---|---|---|---|---|---|
| | | | | | | | |

Qualification of the above identified product indicates only that the unit of product submitted meets SAE Recommended Practice J335b. It does not imply endorsement of the product or approval of any other unit of the product by the Department of Agriculture. The stated identification is that of the unit of product which was submitted. The Department of Agriculture assumes no responsibility for infringement of patent or copyright, for misuse of manufacturer's name, or for other misrepresentation in connection with any use made of this qualification.

Sincerely,

LEON R. SILBERBERGER
*Manager*

# SUMMARY OF TEST RESULTS

## NOTICE OF QUALIFICATION

**MULTIPOSITION SMALL ENGINE EXHAUST SYSTEM TEST WAS PERFORMED IN ACCORDANCE WITH SAE RECOMMENDED PRACTICE J335b, "Multiposition Small Engine Exhaust System Fire Ignition Suppression"**

1. Make and model exhaust system tested: xx

2. Make and model test chain saw power head: xx

   a. Displacement: xx

   b. Serial number: xx

3. Type spark arrester:

   Screen with maximum opening of 0.023 inch (0.59 mm).

   a. Screen material used: xx Stainless Steel. (Information supplied by the manufacturer)

   b. Wire diameter: 0.0 xx inch. (Information supplied by manufacturer)

   c. No-go wire gage size for screen openings: 0.0 xx inch.

4. Tested at maximum power and rated speed of xx rpm.

5. Ambient air temperature during the test xx °F.

6. Gasoline use was 88 octane regular.

7. Gasoline/oil mix xx :1; Type: xx .

8. Submitted for qualification testing equipped as follows:

   a. Chain brake/handguard: Yes ___ No ___

   b. Handlebar: 1/2 ___ 3/4 ___ Full ___

   c. Spike requirement:

   d. Other special equipment required:

9. Test Results:

| | | Required | Actual | Pass | Fail |
|---|---|---|---|---|---|
| a. | Exposed surface Temperature | 550 °F (228 °C) Max* | NR | ____ | ____ |
| b. | Exhaust gas Temperature | 475 °F (246 °C) Max* | °F | X | ____ |
| c. | Carbon particle retention or destruct - Screen, 100 percent; other, 90 percent (min.) | | 100% | X | ____ |
| d. | Debris accumulation | None | NONE | X | ____ |
| e. | Serviceability | | Not Measured | | |
| f. | Durability | | Not Measured | | |

* = 2 percent deviation accepted
N.R. = Not required to qualify

10. This unit is qualified when equipped as described above. Addition or removal of accessories will nullify qualification.

Comments: _____

_____

_____

Name _____

Title _____

Date _____

# MULTIPOSITION SMALL ENGINE

## *WAIVER REQUEST CRITERIA*

Most manufacturers develop several lines of chain saws, trimmers, brush cutters and blowers to meet widely differing applications. With each line there may be several models employing the same exhaust system and which differ only slightly from each other. These differences may have little or no effect on the exhaust system. Where such a condition exists, it may only be necessary to test the exhaust system on one chain saw and qualify it for use on all, or part of all, the models in that line. The unit selected for test should be the one representing the most severe application, with the largest engine displacement for the group of applications being considered. Qualification by waiver is determined by USDA Forest Service, San Dimas Technology and Development Center.

Listed below are some of the reasons for waiving of test requirements for additional models:

Item:

A. The model, including the exhaust system, is identical to the test unit except the engine displacement is reduced.

B. The rated speed at maximum power does not differ by more than ±1,000 rpm.

C. Variations in design do not significantly affect the exhaust system, exhaust flow pattern, and do not allow hot muffler surfaces or exhaust gases to have closer proximity with flammable materials than would occur with the original test unit.

D. Variations in the ignition system are limited to a breaker point versus electronic ignition system that will not affect rpm.

E. Changes in the air intake filter that do not significantly affect the originally qualified test unit measurements.

F. The model, including the exhaust system and housing, is identical to the test unit except for color and/or label or miscellaneous appearance changes.

United States Department of Agriculture

Forest Service

Technology & Development Center
444 East Bonita Avenue
San Dimas, California 91773
*714/599-1267*

Reply To: 7120

Date:

Gentlemen:

Reference Collection Agreement No. xx .

Testing has been completed on the xx chain saw exhaust system on the xx test xx submitted under Collection Agreement No. xx .

The xx exhaust system was tested in accordance with the Society of Automotive Engineers (SAE) Recommended Practice J335b, "Multiposition Small Engine Exhaust System Fire Ignition Suppression" and is **not qualified** with xx wrap handle bar, chain brake, hand guard and xx spikes(s) as meeting minimum recommended performance levels outlined in the appendix of the above Recommended Practice. A summary of the test results is attached.

Sincerely,

**LEON R. SILBERBERGER**
*Manager*

# SUMMARY OF TEST RESULTS

## *NOTICE OF FAILURE TO QUALIFY*

**MULTIPOSITION SMALL ENGINE EXHAUST SYSTEM TEST WAS PERFORMED IN ACCORDANCE WITH THE SAE RECOMMENDED PRACTICE J335b, "Multiposition Small Engine Exhaust System Fire Ignition Suppression"**

1. Make and model exhaust system tested: xx

2. Make and model test chain saw power head: xx

   a. Displacement: xx

   b. Serial number: xx

3. Type spark arrester:

   Screen with maximum opening of 0.023 inch (0.59 mm).

   a. Screen material used: xx Stainless Steel. (Information supplied by the manufacturer)

   b. Wire diameter: 0.0 xx inch. (Information supplied by manufacturer)

   c. No-go wire gage size for screen openings: 0.0 xx inch.

4. Tested at maximum power and rated speed of xx rpm.

5. Ambient air temperature during the test xx °F.

6. Gasoline use was 88 octane regular.

7. Gasoline/oil mix xx :1; Type: xx .

8. Submitted for qualification testing equipped as follows:

   a. Chain brake/handguard: Yes ___ No ____

   b. Handlebar: 1/2 ___ 3/4 ___ Full ____

   c. Spike requirement:

   d. Other special equipment required:

9. Test Results:

| | Required | Actual | Pass | Fail |
|---|---|---|---|---|
| a. Exposed surface Temperature | 550 °F (228 °C) Max* | NR | ____ | ____ |
| b. Exhaust gas Temperature | 475 °F (246 °C) Max* | °F | ____ | X |
| c. Carbon particle retention or destruct - Screen, 100 percent; other, 90 percent (min.) | 100% | X | ____ | ____ |
| d. Debris accumulation | None None | X | ____ | ____ |
| e. Serviceability | Not Measured | | | |
| f. Durability | Not Measured | | | |

* = 2 percent deviation accepted
N.R. = Not required to qualify

10. Failure of this test unit to qualify nullifies any request for waiver of an originally qualified unit under this collection agreement.

Comments: _____

_____

_____

_____

_____

Name _____

Title _____

Date _____