Can Your Needles Handle the Pressure?

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Hypodermic needles were put through a series of tests at Iowa State University laboratories to determine how various products ranked in strength, sharpness and detectability.

Needles are an important tool in the pork producers' arsenal against disease. Timely and appropriate vaccinations or treatments keep the United States swine herd healthy and pork products as safe as possible.

Using producer checkoff funds, Iowa State University (ISU) recently completed a two-year study that put needles to the test. Goals were to find out how needles stood up under repeated use, and how well broken needle fragments could be detected in cuts of pork.

Steven Hoff, associate professor in ISU's Department of Agricultural and Biosystems Engineering, in cooperation with the National Pork Board, led this research effort studying standardization procedures and product testing for veterinary-use hypodermic needles.

The collaborative project had three specific objectives: 1) Examining needle strength, 2) Examining the needle sharpness retention of popular gauges and needle types after several uses, and 3) Determining needle detectability by a metal detector like those used in packing plants, as affected by needle fragment size and its position in the cut of pork.

Ultimately, the goal of the research was to provide complete "Consumer Report-type" information on the strength, failure mode, sharpness and detectability for most manufactured veterinary-use needles used in the pork industry today.

Manufacturer Participation

Needle manufacturers were asked if they wanted their products to be included in the analysis. Information presented is only from those companies agreeing to participate. The results are an objective assessment of needles currently on the market or planned for the market in the near future. Producers should apply the information as it fits their specific operation.

Needle Testing Descriptions

Static Test, Maximum Load

The first test was to check needle/hub strength under static (no animal movement) conditions. It used a device that can precisely control the point of pressure on each needle shaft 1 mm. from the hub, as the needle/hub assembly was held in a horizontal position. A highly accurate load cell recorded strength characteristics. The test stand was entirely computer controlled for all strength tests.

This static test was intended to simulate the load that would be applied to a needle if, just after full embedment of the needle, the animal suddenly moved laterally.

Static Test, Failure Load

As the maximum-load static test was being run, the description of the needle/hub assembly failure was recorded. The type of failure ranged from only the hub bending without any bending in the needle shaft, to the needle shaft completely severing, resulting in a naked needle shaft segment with the rest of the needle shaft still attached to the hub.

Dynamic Test, Failure Load

A second test simulated the dynamic loads applied to a needle/hub assembly if the animal moved during the injection process, as often happens in the field. The actual needle injection site consisted of a rigid polystyrene insulation board with two layers of common chamois material, intended to simulate the hide of a typical market pig.

The Animal Movement Simulator (AMS) controlled the simulated animal speed and the point at which animal movement begins relative to the injection process. The description of any needle failure was categorized and recorded.

Sharpness

Sharpness testing was conducted using a test stand in which a needle was held vertically over a 1-in. piece of high-density, rigid insulation board. This stand allowed for consistent injection motion, direction, speed and puncture depth. The needle was allowed to penetrate into the insulation board 1 mm. beyond its furthest cut point. Each needle punctured the material 30 times, always in a new location.

In most cases, this sharpness retention testing showed that repeated use produced a clear trend for increasing necessary puncture force and decreasing sharpness. This decrease leveled off after about 12-14 punctures.

Although this trend was fairly consistent throughout testing, researchers did find a relatively large difference in puncture force between manufacturers. The data tables reflect the force needed to puncture the simulated hide during the first of the 30 injections.

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Needle Performance Evaluation

16 gauge — 1 inch long needles tested

MANUFACTURER/ SUPPLIER	BRAND [a]	HUB [b]	Strength (Max Load, lbs) [c]	Needle/HubTest, Static Failure Mode [d]	Needle/Hub Test, Dynamic Failure Mode [e]	Sharpness [f]	Detectability [g]
Allison Medical		A	red half circle	blue half circle	red full circle	red full circle	blue full circle
		P	blue full circle	open circle	open circle	red half circle	blue full circle
Air Tite		P	blue full circle	red half circle	open circle	red half circle	blue half circle
Jorgensen Laboratories	Harvard Veterinary Needles	SS	open circle	blue half circle	blue half circle	blue half circle	blue full circle
	Henke	SS	open circle	blue half circle	blue half circle	red half circle	blue full circle
	Economy	SS	open circle	blue half circle	blue half circle	blue full circle	blue half circle
PDN		PE	blue full circle	open circle	red half circle	blue half circle	red full circle
SuperVet		SS	open circle	blue half circle	blue half circle	open circle	blue full circle
The Kendall Company	LP/Tyco Healthcare Monoject 200 Needles	A	open circle	blue half circle	blue half circle	red half circle	blue full circle
	Vita Needle	BNC	blue half circle	blue half circle	blue half circle	NR	NR

a *No Brand Name means it is sold under the manufacturer's name.*

b **A = aluminum; P = polypropylene; PA = polypropylene with aluminum insert; PE = polypropylene with an epoxy adhesive; SS = stainless steel; BNC = brass/nickel/chrome plated**

Accept nothing but ZERO . . . Together we can prevent ALL broken needles.

Symbols are representative of classifications of the following needle characteristics. Detailed data can be found on www.porkscience.org.

d Hub/Needle Failure
Static test failure mode – some needles had more than one failure mode, in this case the symbol is conservative and based on the lowest failure mode description

e Dynamic test failure mode – some needles had more than one failure mode, in this case the symbol is based on the failure mode in which the highest percentage of needles failed

Description	Reusable?	Symbol
no visible deformation to the needle or the hub	yes	red full circle
hub deforms without deformation of the needle	*no*	red half circle
hub fractures but remains intact as one assembly	no	red half circle
hub severs leaving the assembly in two pieces	no	open circle
needle permanently deforms with no hub damage	possibly after straightening	blue half circle
needle itself fractures but remains as one	no	blue full circle
needle completely severs	no	blue full circle

c Strength: Based on the static test maximum load in pounds to failure; >80 lbs (red full circle), 60–80 lbs (red half circle), 40–60 lbs (open circle), 20–40 lbs (blue half circle), <20 lbs (blue full circle)

f Sharpness: Based on initial puncture (of 30); pounds of puncture force required; <1.0 (red full circle), 1.0–1.5 (red full circle), 1.5–2.0 (open circle), 2.0–2.5 (blue half circle), >2.5 (blue full circle)

g Detectability: Based on percent of needles detected, all orientations combined; average of all 16 gauge needles=32.9% detected: >90% (red full circle), 75–90% (red full circle), 50–75% (open circle), 25–50% (blue half circle), 0–25% (blue full circle)

ONE is too many[sm]

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Needle Performance Evaluation

18 gauge 1 inch long needles tested

MANUFACTURER/ SUPPLIER	BRAND [a]	HUB [b]	Strength (Max Load, lbs) [c]	Needle/Hub Test, Static Failure Mode [d]	Needle/Hub Test, Dynamic Failure Mode [e]	Sharpness [f]	Detectability [g]
Allison Medical		A	○	◗ blue	● blue	● red	● blue
		P	● blue	◗ red	○	◗ red	● blue
Air Tite		P	● blue	◗ red	○	● red	◗ blue
Jorgensen Laboratories	Harvard Veterinary Needles	SS	○	◗ blue	● red	○	● blue
	Henke	SS	◗ blue	◗ blue	◗ blue	◗ red	● blue
	Economy	SS	◗ blue	◗ blue	● blue	○	◗ blue
PDN*		PE	NR	NR	NR	○	● red
SuperVet		SS	◗ blue	◗ blue	◗ blue	● red	● blue
The Kendall Company	LP/Tyco Healthcare Monoject 200 Needles	A	○	◗ blue	◗ blue	● red	● blue
		PA	● blue	◗ red	○	◗ red	● blue
		PE	● blue	○	○	◗ red	● blue

a *No Brand Name means it is sold under the manufacturer's name.*

b **A = aluminum; P = polypropylene; PA = polypropylene with aluminum insert; PE = polypropylene with an epoxy adhesive; SS = stainless steel; BNC = brass/nickel/chrome plated**

***For sharpness and detectability testing, a 0.75 inch long needle was available for testing**

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d Hub/Needle Failure
Static test failure mode – some needles had more than one failure mode, in this case the symbol is conservative and based on the lowest failure mode description

e Dynamic test failure mode –
some needles had more than one failure mode, in this case the symbol is based on the failure mode in which the highest percentage of needles failed

Description	Reusable?	Symbol
no visible deformation to the needle or the hub	yes	● red
hub deforms without deformation of the needle	*no*	◗ red
hub fractures but remains intact as one assembly	no	◗ red
hub severs leaving the assembly in two pieces	no	○
needle permanently deforms with no hub damage	possibly after straightening	◗ blue
needle itself fractures but remains as one	no	● blue
needle completely severs	no	● blue

c Strength: Based on the static test maximum load in pounds to failure; >80 lbs ● red, 60–80 lbs ◗ red, 40–60 lbs ○, 20–40 lbs ◗ blue, <20 lbs ● blue

f Sharpness: Based on initial puncture (of 30); pounds of puncture force required; <1.0 ● red, 1.0–1.5 ● red, 1.5–2.0 ○, 2.0–2.5 ◗ blue, >2.5 ● blue

g Detectability: Based on percent of needles detected, all orientations combined; average of all 16 gauge needles=32.9% detected: >90% ● red, 75–90% ● red, 50–75% ○, 25–50% ◗ blue, 0–25% ● blue

ONE is too many[sm]

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Detectability

Tests for detectability used a state-of-the-art metal detector commonly used in packing plants. Needle fragments were embedded into an intact 3-lb. picnic roast and passed through the metal detector. Needle fragments of 1/2 in. and 1 in. were tested for 16- and 18-gauge needles. The needles were tested not only by type, but also by the way they were embedded into the pork product.

Researchers tested for detection of fragments horizontally in the back of the meat perpendicular to the detector, fragments horizontally in the side of the meat parallel to the detector and fragments vertically in the center of the meat.

The research found that fragments located horizontally in the back of the product were detected much more easily than the other two needle locations. It also discovered large differences in detecting needles from different manufacturers.

Two of the manufacturers tested, Air-Tite and PDN, had much higher detection levels than the other manufacturers. The average detection level for all predominantly used needles was 14.9%. The results are presented as a rating of the overall detectability, accounting for different lengths of needle fragments.

Results

While needles are efficient and effective aids in protecting pigs from disease, this research revealed that no needle is perfect. Producer responsibility is the key.

With only a few notable exceptions, a needle would not break if it first bent during use. Like any metal that weakens and breaks, straightening a bent needle reduced its strength and increased its chance of breaking the next time it bent.

Besides using a high-quality needle, the single most important prevention of broken needles is to never straighten and re-use a bent needle. Bent needles should always be replaced and properly disposed of.

Posting the operation's policies on needle use and broken-needle procedures will help identify the best way to address this issue in each farm.

Needle selection and use, identification of at-risk pigs if a needle breaks during injection and it is not retrieved, and communication with the packer are important factors to consider in developing a Standard Operating Procedure.

Needle Resources

For more information about needle use, the development of Standard Operating Procedures, and the One Is Too ManySM needle use awareness campaign, look in the Pork Quality Assurance booklet under Good Production Practice #5, Educate All Employees and Family Members on Proper Administration Techniques.

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