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The Equipment and Facilities Specifications Newsletter

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WELCOME TO NEW SUBSCRIBERS

This Newsletter is a semi-annual educational tool for Implement Inspectors, Technical Managers, interested Throws Officials, and certification chairs. Input and suggestions are always welcome. This copy is being sent to about **900** officials around the world. We welcome our new subscribers with this issue:

Last Name	First Name	Association
Powers	Mike	Illinois
Weir	Doug	Michigan

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CHAIRMAN'S CORNER

I have been working on my annual summary of implement disqualifications. I received more indoor reports than last year and about the same number of outdoor reports. I would love to get more so that the summary has more validity. All implement inspectors are encouraged to submit a report following a meet.

What I keep track of are the total number of each implement, how many are repaired and how many are disqualified. I keep separate numbers for men's and women's implements. I also am interested in why implements were not allowed.

The vast majority of reports are from collegiate meets so my form is set up for that. What that means is that age group meets (both Youth and Masters) have a problem. I don't keep each individual weight that might be used. I keep to the men's and women's category.

One area where I don't get many reports is high school meets. I would really love to have more in this area so that trends can be spotted.

I like seeing the details, but sometimes it is difficult to get the math right. Give me all the detail you wish, but make sure I can see the three numbers I am looking for: The number of implements for each type, the number of repairs and the number rejected. Then go ahead and tell me how many were fixed in which way and the number rejected for each reason.

RULE CHANGES AFFECTING EQUIPMENT OR FACILITIES

This year is an L&L year for USATF, but a number of rules changes are pending, either from last year or conformance with recent IAAF rules changes. The following **USATF** rules change proposals, as regards equipment & facilities specifications, will be considered during the annual meeting in Columbus, OH:

Item 28, Rule 148.1, Measurements and Weights section: Added facility survey requirements. [for IAAF conformity]

Items 29-30, Rule 149, Validity of Performance: Added facility survey requirements. [for IAAF conformity]

Item 32, Rule 161, Starting Blocks: Rewrite of section 1. [for IAAF conformity]

Item 54, Rule 181.11, Vertical jumps crossbar: Added requirement for the crossbar to be colored so that it is visible. [for IAAF conformity]

Item 55, Rule 181.19, Vertical jumps landing area: Amended the dimensions of the landing areas. [for IAAF conformity]

Item 59, Rule 188.3, Shot put: The surface smoothness specification is removed from the general requirements and made into an information note to manufacturers. The requirement for the surface to be smooth still remains. [for IAAF conformity]

Item 60, Rule 190, Throwing cages:: Adds new Note 3, establishing a 53° danger sector in the hammer throw. [for IAAF conformity]

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Item 76, Correction/Editorial Changes:

- Amendment to Rule 193.11: Adds reference to new Figure 17. Adds Figure 17 which contains an illustration of most of the dimensional specifications for the Aero Javelin.

- Amendment to Rule 195.5: (1) Adds definitive wording that a hammer handle is not allowed in the weight throw event, (2) Adds a reference to Figure 15 which was accidentally deleted in a previous change, and (3) Revises some of the Figure 15 wording to make Figure 15 match the text of Rule 195.5

EQUIPMENT CORNER

If you have any information on equipment that you have purchased or built to help with your weight and measures or technical managers' activities, please pass along the information. One of our goals is to disseminate this type of information.

Measuring & inspection equipment

With the indoor season just around the corner, it is time to give your inspection equipment a tune-up. Scales and calipers should be calibrated. Measurement templates, such as for the shot, should be measured to ensure that they are not excessively worn. The length gauge for the throwing weight should be checked that it is set to 41.00 cm for all categories of competition.

Summary of implement reports.

Bob Springer has compiled the implement inspection reports that have been sent to him during the 2017 season. His summary follows. The data table is on the last page of this newsletter.

There were more problems with shots than other implements. The problems were surface roughness and finger holds. I'm not sure what has caused this. It could be that care is not being taken in the storage of shots leading to corrosion or inspectors being more critical or older shots being presented. There are probably other causes as well.

The high school implements once again have a very high failure rate. In most states, there is little inspection done during the season and so the problems are found late in the season. There is also little care taken with the implements and so some get corroded. This needs to be addressed with the high schools.

The number of repairs is probably smaller than what actually happened. Some meets did not report the number of repairs and so were listed as not having any. In some cases that was due to time constraints on the inspector. It is more important to get the implement repaired and into competition than in keeping track of how many were repaired. In many meets, there were more repairs than rejects. I did not include tightening of screws on the weight. This is such a minor, but important repair, that many of them are not reported. I really have no idea why the men's indoor shot is repaired at a higher rate than the women's indoor shot.

We did see a few eight pound shots being presented as four kilogram shots, but that was down from last year. This will continue to be a problem as they have the same dimensions.

The high school statistics are not really good for comparison as the number of reports is very small. More reports are needed in that area. Most of what shows here are from meets in one area of the country and so probably have the same implement reported several times.

THE TRAINING CENTER

This is a regular feature of this newsletter, where we discuss the method of measuring an implement, venue or a track facility. Your comments or areas of interest are welcome. It is through this kind of dialogue that we learn from each other and improve our skills. Send the editor your stories and questions.

Thermal imaging of the indoor weight throw

Anyone who has marked the indoor weight throw knows it can be a daunting task. Due to the designs of both the floor and the weight's head, impressions at the landing spot can be quite small or nonexistent. Sometimes discoloration of the ground is the only tell-tale.

Some work-arounds are available, such as coating the head with chalk or covering the ground with corn starch. But they have drawbacks as well. The chalk method requires the whole head, not just the bottom to be covered; otherwise the white mark on the ground might not indicate all of the contact area on the landing site. The corn starch method does not work on surfaces such as Field Turf very well, and probably wouldn't be allowed by the host institution. When used, these methods require constant monitoring so that all landings are recorded equally. Is there another way?

A possible alternative is the use of a thermal imaging camera. These cameras have been in use for many years in both commercial and military applications. Examples include easy detection of a hot circuit breaker in a power panel, an overheating motor bearing, or inadequate insulation in a home or office building. But are these cameras sensitive enough to detect small variations in heat, such as the point on the ground where a weight just landed?

Before continuing with this subject, a couple of notes must be made:

First, this method is not for everyone – an adequate camera is not cheap and requires practice for proficiency at its use.

Second, the concept of using a thermal imaging camera for this purpose is not new. We are aware of a paper written on the subject over a decade ago by two scientists who used an imager to evaluate the accuracy of traditional marking methods by several officials vs. marking with a thermal imager. The resulting data should be of interest to anyone who works the weight throw:

http://www.botanysurveys.com/publications_files/49-54.pdf

Now, what is thermal imaging? It is the measurement of heat by detection of the electromagnetic energy that emanates from an object due to its temperature.

Our eyes detect a narrow band of electromagnetic energy which we call visible light. The wavelength of that band is about 390 to 700 nanometers (nm), with violet being at 390 nm and red being at 700 nm. Light that has a wavelength longer than 700 nm is called infrared.

The infrared range is quite broad, but we're interested in a small part of it that has a wavelength of about 7.5 to 14 micrometers (μm). This is sometimes called *thermal infrared* because heat is radiated from objects in this frequency range due to the object's temperature.

Why is this of interest in the weight throw? When the head of a weight hits the ground, it deposits a small amount of energy, in the form of heat, due to skidding and the inelastic bounce off the ground. This heat is confined to the area where the head contacted the ground. Therefore, if that heat can be detected, it should be possible to confirm the proper marking of that throw.

What follows is one association's experience in trying to adapt thermal imagers to the weight throw. We welcome commentary of any other officials group that uses or has used this method.

When selecting a thermal imager, there are two specifications that are prominently advertised by the manufacturers. In this application, one of these specifications is of little importance; the other is the key to solving the problem. The two specifications are ***spectral response*** and ***sensitivity***, respectively.

Spectral response refers to the frequency range of the infrared radiation that the thermal imager can detect. What complicates the matter is that the earth's atmosphere (with water vapor being the primary culprit) absorbs many frequencies of infrared radiation. However, this leaves certain gaps in the infrared spectrum that readily transmit the infrared, making it detectable by the imagers.

Some imagers are advertised with a spectral response of 6.5 μm to 14μm, others with 7.5 μm to 14 μm, and still others with 8 μm to 14 μm. Whether your imager's low end is 6.5 or 8 μm is fairly irrelevant in our application. That area butts up against a large absorption spike in the atmosphere making it a moot point.

The ***sensitivity*** of an imager is another matter. This specification refers to the smallest difference in temperature that the imager can detect. While these devices are adjusted and calibrated in the factory, and the higher-end models can calibrate themselves, we don't really care about the actual temperature of the ground or the impact zone. We want to see the temperature difference on the ground where the weight landed.

Therefore, how sensitive must an imager be in order to be of use to us? The answer to this question was not obvious when the Pacific Northwest Officials began experimenting with thermal imagers. For reference, the PNTFO officiate the University of Washington indoor meets where the weight throw is performed on Field Turf.

The first attempt at imaging the weight throw was with a Fluke model VT02. This model is no longer made, but a surplus unit was purchased at a very reasonable cost. The advertised sensitivity of the VT02 is 250 mK, which is the same thing as 0.25 °C. That is, it should detect a temperature difference of a quarter degree Celsius on a typical surface.

During weight throw warm-ups at the next track meet, it became quickly obvious that the VT02 is not adequate. It did not detect a single impact of a weight against the ground.

The next attempt was with a FLIR model C2. It is a more expensive unit but is still aimed at the general consumer market. Its advertised sensitivity is given as <0.10 °C, which would be about 2.5 times better than the VT02. This unit was a personally-owned imager that was loaned to the officials group.

During weight throw warm-ups at the next track meet, the C2 imager detected most of the weight landings (about 75-80%), but not all. While this was a notable improvement, it is not good enough because all marks and measurements must be treated equally. 100% detection is required.

At this point the editor approached the marketing group at his employer (Fluke Electronics), explained the situation and asked if an appropriate demo model could be borrowed. Fortunately, a Fluke Ti32 was at hand and made available. This is a higher-end model, with self-calibration, and has a sensitivity specification of ≤ 0.045 °C.

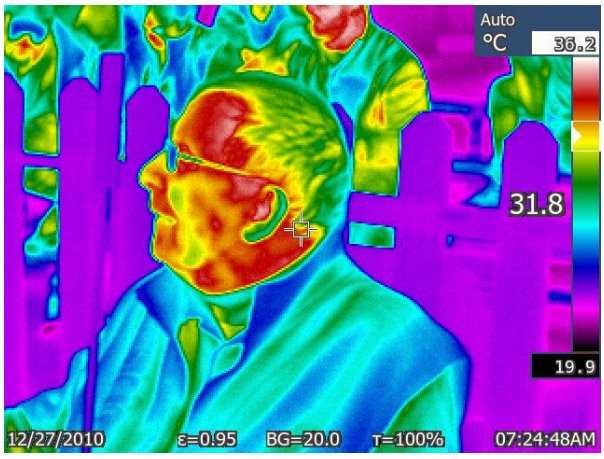
At the next meet, The Husky Classic, the Ti32 detected every landing that was imaged during warm-ups. It was then successfully employed at that meet, and later on at the Mountain Pacific Indoor Championships and a D-II last chance meet. The detection rate of weight landings was 100% at all the mentioned meets, and no complaints or protests were received regarding the marking of all the weight throw events.

Clearly the Ti32's sensitivity of ≤ 0.045 °C was good enough. No testing of other models was performed; therefore, a minimum sensitivity value can not be suggested. This means that anyone interested in using a thermal imager for the weight throw should first try to get a loaner unit and determine if it is good enough. Be advised, also, that the method of determining sensitivity specifications may vary between manufacturers, and their resulting specs may not be directly comparable.

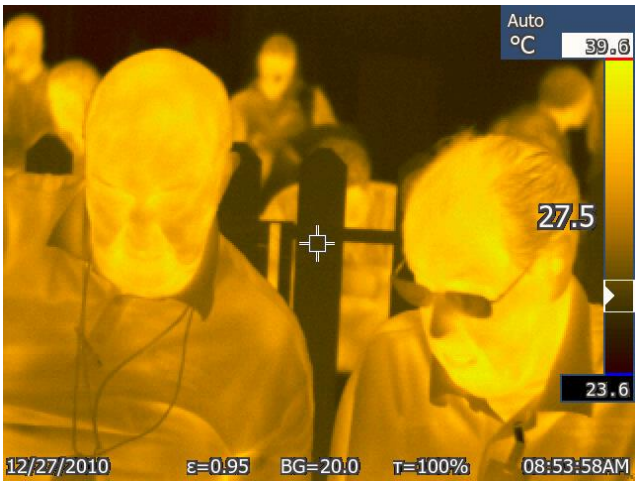
How does one use a thermal imager? The Ti32, and many other models, operate like slow-speed video cameras. The image refreshes 9-10 times per second, which is adequate for our use. Others are faster; however, the image rate is not as important as the sensitivity.

As was mentioned previously, these imagers detect infrared radiation. But since we can not see this infrared radiation with our eyes, how is the detected infrared displayed? This is done by use of *false color palettes*. Colors are arbitrarily assigned to different temperatures. Red is frequently used for high temperatures and dark blue or black is used for low temperatures. There are different false color palettes available, depending on what the user wishes to achieve.

A commonly-used color palette is called Blue-Red, High Contrast or similar names. It uses the full spectrum of colors to represent temperatures. An example of this is seen in the following thermal picture of an official:



In cases where great detail in temperature differences is desired, this palette can be very useful. However, in the case of imaging the landing spot of a weight, this palette can contain too much information. We found the Amber palette to represent temperature differences well, but to also provide a crisper cutoff at the edge of a "hot area." Pictured here are two other officials in Amber palette:



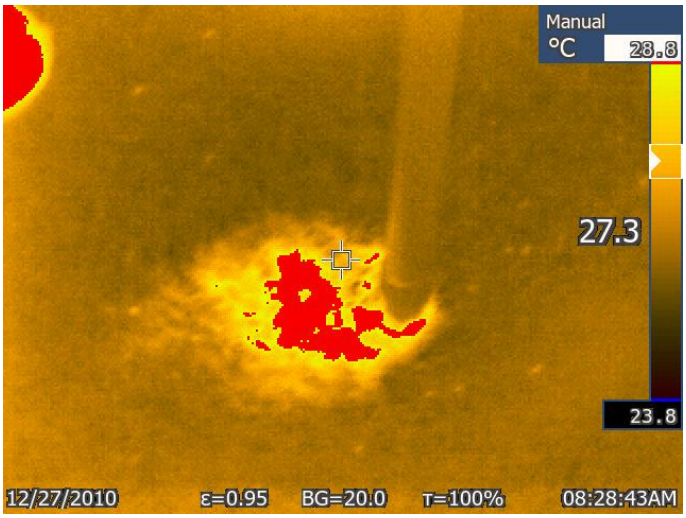
Once the color palette had been selected, then it was a matter of learning to "photograph" the landings. The Ti32 has a manually-focused lens. This requires some time be spent learning the distance at which the operator will be from each landing, and prefocusing the lens at that distance. [Some imager models use an internal laser for auto-focusing, but the Ti32 does not have that feature.]

The next issue is to whether let the imager select the temperature range for each shot, or to manually preset that. This will be a matter of personal preference. The editor preferred auto-ranging.

And now, the arguably most important aspect of imaging the weight throw: How do you communicate an error in marking?

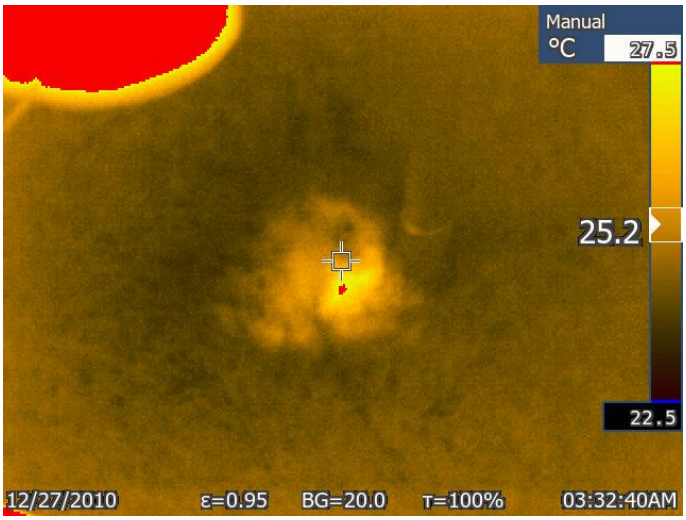
The weight throw will typically be marked by use of a measuring cane, if a tape measure is used, or a reflector pole if a laser is used. Ideally, the marking pole (or cane) will be placed at the nearest edge of the landing imprint to the throws circle.

In the following image, the landing impact is displayed as light yellow and red by the thermal imager, with the red being the "highest" temperature of this impact location. A reflector pole can be seen at the right, but it is not on the very edge of the imprint.



We found that verbally telling the marker where and how much to move the pole was slow and inexact. Instead we used a smaller pole to indicate the spot to be measured. The person performing the imaging would hold the camera in one hand and the small pole in the other. If the marker was correctly placed, then no correction would be needed. If the marker was off, then the official with the imager would slide the smaller pole, while viewing the thermal image, to the correct location. The marker would then reposition the main pole to the correct location.

In the following image the pole is properly placed at the edge of the thermal imprint (the solid red in the upper left is the shoe of the person holding the reflector pole):



The act of correcting the marking requires some coordination and practice. But once that is achieved, the general confidence is high that the marking is accurate.

One other thing that can be done is to demonstrate the operation and sensitivity of the imager to the coaches at a meet. Rub your shoe once on the ground and show the thermal imprint on the imager. This convinces most people of the viability of the instrument.

Tim Edwards uses two FLIR units and provides the following information about his experiences:

"I have two Flir E6 thermal imaging cameras and you are correct, they are expensive. I paid $2,500 for each one. (they are now down to $1999) We used these in Albuquerque last year at the Masters Indoor Nationals. The only problem we had was one official forgot to open the lens cover and thought the unit had failed.

I came into contact with these devices at the Air Force Academy where they have been used for all of their indoor meets for a number of years. (I have found that thermal imaging cameras don't work well outdoor on grass)

When marking, these units are far superior to eye sight or chalk. One thing I found to be helpful was to hold the tip of the marking cane between markings and transferring some of my body heat to the marking cane. This makes it easier to see the point of the cane and establish the mark.

At the AFA they have had some of the coaches and athletics suggest that we were off with where we were marking the implement landing. Once they explained and demonstrated how the units work the observations evaporated.

I tried the Flirs outside and you can't see anything. What makes it really hard is the way the sun hits the grass and the effect it has on the units."

Tim's observation about using the imager outdoors is quite correct. First, the heat load from the sun will overwhelm the imager's sensor. Also, a further complication occurs when using on grass: The water in the grass has a high heat capacity, which means that relatively more heat is required to raise water's temperature (as opposed to Field Turf or other hard surface), and that reduces the imager's usefulness.

Once again, if anyone else is using this technique for marking, please submit your experiences, learnings and recommendations.

DOCUMENT LINKS

The **2017** revision of the **Implement Inspector's Handbook,** along with the implement spec sheet, are available at:
http://www.usatf.org/Resources-for---/-groups-officials-/Officiating-Resources/Implement-Inspection.aspx

EFSS newsletters are located at:
http://pacificnorthwest.usatf.org/Officials/Resources.aspx

Summary of Reports

		College, Open & Masters					High School							
		Total	Repairs	Reject	Per Cent	% Rep.	Total	Repairs	Reject	Per Cent	% Rep.			
Indoor Shot	Men	356	33	15	4.21%	9.27%								
	Women	454	19	22	4.85%	4.19%								
Outdoor Shot	Men	545	14	54	9.91%	2.57%	234	12	43	18.38%	5.13%			
	Women	568	10	27	4.75%	1.76%	213	17	43	20.19%	7.98%	HS Rubber Discus		
												Total	Rejected	Per Cent
Discus	Men	1137	60	44	3.87%	5.28%	353	8	31	8.78%	2.27%	5	3	60.00%
	Women	1340	60	33	2.46%	4.48%	466	18	16	3.43%	3.86%	21	20	95.24%
Javelin	Men	627	3	54	8.61%	0.48%	254	11	16	6.30%	4.33%			
	Women	795	12	32	4.03%	1.51%	247	12	17	6.88%	4.86%			
Hammer	Men	541	14	47	8.69%	2.59%								
	Women	672	24	64	9.52%	3.57%								
Weight	Men	236	31	8	3.39%	13.14%								
	Women	336	19	12	3.57%	5.65%								
Total		7607	299	412	5.42%	3.93%	1767	78	166	9.39%	4.41%			

Combined Events

		Total		Reject	% Reject	% Rep.
Indoor Shot	Men	70	7	4	5.71%	10.00%
	Women	104	5	5	4.81%	4.81%
Outdoor Shot	Men	46	15	5	10.87%	32.61%
	Women	59	17	6	10.17%	28.81%
Javelin	Men	83	19	5	6.02%	22.89%
	Women	87	19	5	5.75%	21.84%
Discus	Men	87	19	5	5.75%	21.84%
Total		536	101	35	6.53%	18.84%