IMPLEMENT INSPECTOR'S HANDBOOK

PREPARED BY THE EQUIPMENT AND FACILITIES SPECIFICATIONS SUBCOMMITTEE OF THE NATIONAL OFFICIALS COMMITTEE OF USA TRACK AND FIELD

Author and Editor: George Kleeman

Proof Read by Ivars Ikstrums and George Adams

June, 2009-0-2

PRICE $5.00

This manual is part of the USATF National Officials Monograph Series on how to officiate. Each monograph covers the various techniques for each officiating assignment. These monographs are intended for more in depth understanding of each job. They are intended for both the novice and seasoned official. They cover the real details of the job and how it should be preformed. They summarize various techniques to accomplish the job. These monographs can be copied and used for officials training only.

INDEX

Dedication:

This manual is dedicated to Dr. James Sabatelle of the Metropolitan Association, Carl Strombom and Norm Morrison of the Pacific Association, and Red Meade of the Southern California Association. Jim and Carl were original members of the committee and Norm was one of the original W&M people along with Red Meade on the West Coast. Red was the original manufacturer of the Trackmaster system. Jim was a contributor to the original version of this manual. All were dedicated to helping improve the proficiency of the Implement Inspector in the United States.

INTRODUCTION:

This manual was prepared for Implement Inspectors by the Equipment and Facilities Specifications Subcommittee of the Officials Committee of USA Track and Field for the use, education and training of Inspectors of Implements. As such, it is copyrighted for the use of USATF members. It is predominately slated to the use of the Trackmaster® and similar measuring equipment although the techniques and procedures are general. Additional copies are available by downloading them directly from http://www.usatfofficials.com/training/Monograph-WeightsandMeasures2009pdf. Comments and recommendations are welcome and can be sent to George Kleeman 5104 Alhambra Valley Rd., Martinez, CA 94553-9773 or via E-mail at george_kleeman@comcast.net. It is the first known publication of how to do the job of an Implement Inspector. In addition to this manual there is available a free newsletter for Implement Inspectors across the country, published by the subcommittee in January and September. To get on the mailing list write to the same address or e-mail your request. The only other one that I am aware of is "Prontuario Di Verifica Attrezzature E Attrezzi" published by the Federazione Italiana Athletica Leggera in 2007 for the WMA World Championships at Riccione, Italy.

This manual is intended as a “how to” book for the novice Inspector of Implements as well as a guide to the seasoned veteran. It is an attempt to get more uniformity in the methods used to certify implements and in the measurement techniques being used throughout the United States.

Although the specifications for implements are published in the various rule books of the various governing bodies for track and field, the method of weighing and measuring implements is not specified in any of them. The Inspector of Implements should be able to say that any implement passes because it met every requirement of the rules governing the meet. Simply weighing an implement does not approve it for use in competition. It must meet all the measurement standards.

HOW TO BECOME A CERTIFIED OFFICIAL:

At the present time, USA Track & Field is the major certifier of officials for track and field. As the national governing body for Athletics in the United States, which includes the sports of Track and Field, Race Walking, Cross Country and Long Distance Running, it is affiliated with the IAAF or the International Association of Athletic Federations which governs the sport worldwide. It is likewise the representative for track and field, race walking and the marathon to the United States Olympic Committee.

There are three levels of USATF officials - Association, National and Master. Each has its own qualification requirements. You begin at the Association level after you have attended an officiating clinic and taken the association level test on the USATF rulebook. Each association sets the requirements for their local area. Some associations require officiating at a certain number of meets as a trainee before you can join. Others only require that you complete a test on the rules. Contact your local association to obtain their requirements. You can get their address from the USATF Website at www.USATF.org or by writing the author at the address shown above. At the present time USATF is the only organization which is certifying W&M officials for USATF, NCAA, IAAF, WMA (World Masters Athletics) and high schools in the U.S.

PREMEET REQUIREMENTS:

FACILITIES:

A room at least 10 feet by 10 feet and with a 9 foot ceiling if you are handling javelins and preferably twice that size with a lock and key and limited access is recommended. You will need good lighting, preferably over the measurement area. If you have a room smaller than this you will have problems checking the javelin, and storing implements until competition time. This is particularly true for meets greater than two days. It should be located near the field and preferably near the athlete entry gate. Make sure there are adequate signs and announcements about its location. If you do the measurements on the field or outside, make sure that the wind doesn't interfere with your weight measurements. In a meet where you expect a record you

consider an additional location near that event. Then you can quickly recheck an implement during the competition and return it to the athlete before the next throw. You may also want a writing area. To keep athletes and other people away from the measurement area set up the room so that the implements are dropped off at the door. See Appendix Fig. 1

EQUIPMENT:

The most common implement inspection equipment include the Trackmaster(TM), UCS Implement Certification unit and the Gill Implement Certification Kit. However, some meets may find the cost prohibitive as these now retail from about $1200 for a high school unit without scale or javelin gauges to $3700. Currently there are a few specialty tools to measure some implements like the javelin or hammer. This manual will describe several that are available. You also can make some of your own if you have access to shop facilities. The TRACKMASTER(TM) equipment it is manufactured by DAKTRONICS, INC., 331 32nd Avenue, P.O. Box 5128, Brookings, SD 57006 (phone number (888) 325-8766, fax (605) 697-4700, web page daktronics.com, e-mail sales@daktronics.com). Their scale is now electronic and with a maximum capacity of 20 kg (44 lbs). The gauges and scale (between $1200 and $2500) were reengineered when they took over from the previous manufacture as a result of suggestions from the Equipment and Facilities Subcommittee of USATF. The Gill Implement Certification Kit can be purchased from Gill Athletics, 201 Courtesy Rd., Urbana, IL 61801-2727(phone 800- 637-3090 or 217-367-8438, fax (217) 367-8440, and web page www.gillathletics.com). This kit is available for order online and comes in three versions- high school without javelin gauge for about $1400, high school with javelin gauge for $1700 and full kit for IAAF, NCAA, USATF, WMA and high school for $2500. Implement scales for 10 kg and 20 kg can be purchased separately. Gill also sells 5 and 10 kg calibration weights. The UCS kit is new and is more expensive but also more robust. It is sold by UCS Spirit, 511 Hoffman Road, Lincolnton, NC 28092, (phone 800-256-4856, fax 888-810-4070 and web site www.ucsspirit.com). Since some of the manufactures change their sources for scales, it is not possible to specify the accuracy or the tolerance for them.

Measuring equipment must be handled with care, maintained, calibrated and properly stored in order to do the best job. The misuse of equipment is usually the biggest problem and is the result of lack of knowledge or training. Misuse leads to damage which results in inaccuracies even when a competent person is using it.

NOTE: All measurement equipment should be checked at least annually against a known standard. The standard should be traceable to a National Institute of Standards and Technology (NIST) standard. This is true for scales, weights and measurement devices, i.e., tapes and calipers. This applies also to the TRACKMASTER(TM), UCS, or Gill templates. When you first get a kit, make sure that all implement measuring devices are measured and marked correctly. Each year check that the gauges have not been damaged through use or enlarged. Standards should not be used for routine checks. Any standard must be handled with care and protected so it is not damaged. Equipment templates should be checked periodically with calipers. Never force implements into the templates as you will wear the sides making them less accurate. You will find some of your templates will undersized and some oversized for the measurement they are intended. Take this into account and allow for it if you have a close measurement. For a fee, DAKTRONICS, Inc. will recalibrate your scale if you ship it to them. Likewise your local scale store, accredited calibration laboratory (like Davis-Inotek or Simco) or your county Weights and Measures unit may be able to do it. Any standard must be handled with care and protected so it is not damaged.

The following is a list of needed equipment for setting up your Weigh-in room:

Recommended Personal Equipment:

Steel Measuring Tapes: Normally carry a 3 m tape for implement measuring.

Marking Pens: It is preferable to use paint, particularly on the shot where markings are easily worn off. Mark all implements the same way with the same color, same location and same mark. If it is more than a one day meet, change the color and the mark each day. Make it distinctive. Paint sticks are easier to use and are available in your local hardware store, stationery store or hobby shop. Spray paint can also be used but usually takes longer to dry and is not as easy to use. Fluorescent colors stand out more. Broad Line Deco Color Opaque Waterproof Markers or nail polish also works well. You can also use colored dots or square labels on the javelin or discus. However, these markers wear off easily on the hammer or the shot. Colored tape may be used on the hammer wires particularly in wet conditions and can be more durable than paint. Sharpie pens work well in many cases, and are available in several colors; as a minimum, use a black and silver Sharpie as the latter

stands out well on dark implements. Sharpies are also available in retracting/self-sealing pens which can be easily deployed with one hand.

Adhesive Tape: For labeling equipment and laying out javelin measuring tape.

Masking Tape: For erecting signs and schedules.

Implement Labels and Form Sheets: Use computer labels to indicate event and name of the implement owner. This helps in tracking implements through the weigh-in process. When used with the implement forms in the Appendix implements can be monitored easily.

Men Decathlon Shot	Women Open Shot
Name _____	Name _____

Using a form with carbon paper lets the event judge know exactly how many implements were checked in and which implements did not pass. The labels are particularly useful when you have multiple events or flights in the same event such as in Masters and Youth Meets. Samples are found in the appendix. An alternative is to use the DYMO® electronic tape type device to label each implement. Be forewarned, though, the label adheres poorly to the shot, particularly if the landing area is rock or gravel.

Stencil: The more distinctive the better. You can buy a plastic geometric or engineering symbol guide at your local stationery store. Alternately you can make your own stencils out of plastic, metal or wood.

Square: Used to test the overall hammer length.

Paperwork: Have a current meet schedule so you know which implements to do first and when to take implements out to the field.

Implement Inspection Signs: Paper signs to indicate location of Weigh-Ins in a plastic cover.

Implement Spec Tables: Complete tables of specifications for all implements from this manual in plastic covers for ready reference. Tables are in the appendix.

Implement and Impoundment Forms: (see example in Appendix)

Poster/Sign Marking Pens: Some Marks-A-Lots should be available in your kit for emergencies but these aren't the best marking devices unless you're making signs.

Level: Used to level scale location.

Calculator: For use in calculating percentages for javelin measurements.

Caliper: Used to measure the hammer wire diameter and the various points on the javelin. Consider an electronic one, and keep an extra battery in the box. If it has at least 3 ½ inch jaws, it can be used to measure the discus, weight and shot as well as the javelin profile. Harbor Freight sells an aluminum manual caliper with 3 ½inch jaws for just $9.

Handbook: Keep a copy of this handbook in a folder. Note: included in back are the implement specification tables for all implements in case the individual sheets get misplaced.

Straight Edge: at least 50 centimeters long as a fast check of the javelin taper or to measure the taper when used with feeler gauges.

Javelin Measuring Gauge: You can make your own out of wood or even tape on the edge of the table. See Figures 21 and 22 in the Appendix for examples of ones that were made in three pieces so they could be easily transported. Both are color coded so that the javelin can be easily measured. The one in Figure 21 allows you to do multiple javelins at once for everything but the balance. The dimensions are:

Overall Length:	9 ft. / 2.73 m
Overall Width:	6" 18 cm for all 5
Each Piece:	3 ft. / 0.91 m

I used 3 -3' pieces of 1"x6" lumber with pieces of shelf hanger as sides so the javelins don't roll off. All marks were engraved into the wood before it was painted for accuracy. The three boards can be held together by hinges or pins to assure constant length.. Alternatively, the javelin board can be laid out on a paper or cloth template that can be rolled up and taped to a table or the floor. Finally, use a hinge or other sharp edge to place at the balance point. My original one shown in Fig. 22 in the Appendix was only set up for the only three javelins at that time. You also can mount rulers along the board to do the overall and midpoint measurement for the contour or simply use a string or wire to get their approximate location by measuring to the center of gravity from either end and then halving the measurement by folding the string back on itself.

Other Miscellaneous Equipment:

Wet and Dry Towels for Cleaning Implements

Implement Cart, Wheelbarrow, wagon or grocery cart for transporting implements

Boxes for segregating unmeasured, approved and impounded implements. You will need a minimum of one per implement type per sex and preferably four for larger meets, i.e. two for check-in and two for measured implements of each type or age group. In addition you will need at least one and possibly two boxes for impounded implements of all types.

Soft drink plastic trays work well for storing javelins lying down.

Signs for Location of Implement Inspection Room.

Tool bag for repairing implements:

- coarse and fine files for deburring a discus rim or a shot
- adjustable pliers, needle-nose pliers and Vise-Grips for removing/installing hammer wires, and disassembling/reassembling indoor weights (for length adjustment)
- adjustable spanner wrenches of several sizes to remove/replace the plugs on shots and hammers (also will need small hex keys for the set screw – see next item)
- Several sizes of slotted screw drivers, Phillips drivers (thru #4) and hex wrenches (English & metric) to disassemble a discus. Fold-up sets offer the best range of sizes for the cost. Two of each set is best, as some discus hubs freeze up over time and require the same size tool on both sides to break the fasteners free of the hub. The #4 Phillips is a common size for discus fasteners, but is not typically found in fold-up tool sets – a good alternative is a 3/8" drive #4 Phillips bit with a 3/8" drive stubby handle.
- chain grip for holding shot or hammer while removing plug (Vise Grip model 20R works well)
- dead-blow hammer or rubber mallet for tapping stubborn discus plates together
- Small pick or awl set for cleaning out the fasteners on discuses, hammers and shots, prior to implement disassembly or plug removal.
- Polanik key wrench for removing Polanik hammer plugs.
- Shot / hammer wrenches to tighten or remove plugs to add weight.
- Some WD-40 or liquid wrench to help loosen stubborn bolts

Notebook: To do any needed calculations and to record calibration procedure. Also record the following information on any implement that is impounded. Owner/Athlete, School, type, brand, failing parameter, condition of implement, i.e., Is failure due to wear or damage or is it a new implement. See Appendix for a sample Inspector of Implements form.

Rulebooks: Always have a current rulebook for the type and level of meet you are officiating. The specifications are slightly different in some cases, particularly in the high school rulebook. However, now all rulebooks refer to and use IAAF specifications. They can be purchased from the following institutions:

(1) National Federation of State High School Associations
P.O. Box 361246
Indianapolis, IN 46236-5324
800-776-3462
www.nfhs.com

Published in 3 volumes at $6.95 each, for Rules, Officials and Case Book. Rulebook and case book are annual and the Officials book is published every two years plus 7.95 shipping charges. Rule book and Case book are annual while the Official's Manual is published once every two years. You can order by fax or e-mail with a credit card.

(2) National Collegiate Athletic Association
P.O. Box 6222
Indianapolis, Indiana 42606-6222
317-917-6222
www.ncaa.org

Cost is $7.20 plus a $5.95 shipping charge. You can order by e-mail. The rule book is published once every two years and is also available as a download at the following web site: http://www.ncaapublications.com/Uploads/PDF/mw_trackandfield_rulese88cb2a4-3dac-4a6d-b6c2-c0fe5a66ffe7.pdf. The case book (updated February 2009) is available on line at http://www.ncaa.org/wps/ncaa?ContentID=563. Click on "Case Book."

(3) USA Track and Field
USATF Book Order Department
132 E. Washington St.
Indianapolis, In 46204-3723
317-261-0500, Fax 317-261-0514
www.usatf.org

Cost is $15.00 ($13.50 for USATF members) annually plus a $5.95 shipping charge. You can order by e-mail, or it is available for download at http://www.usatf.org/about/rules/2009/.

(4) International Amateur Athletic Federation
17, rue Princesse Florestine
BP 359 - MC 98007
Monaco Cedex
(377) 93 10 88 88
Fax (337) 93 15 95 15
www.iaaf.org

Cost is $10 from IAAF and is published every two years. You can order by e-mail. Cost includes mailing. Also available for download at http://www.iaaf.org.

(5) World Masters Athletics is available for download at: http://www.world-masters-athletics.org.

Equipment provided by the Meet Site:

Table: Three to four tables which are at least 6 feet in length.. One would be used for your scale and measuring instruments, one for the hammer and/or javelin measurements and one for implement check in. Make sure you have plenty of room particularly if you are doing the javelin. A solid table is preferable to a folding table. A couple of chairs are always useful.

Scale: Preferably a double pan balance or electronic scale capable of measuring to at least one part in 3000. The desired tolerance is one part in 10,000 (10 mg per 1000 g or per kg) to meet the National Institute of Standards and Technology Class

Field Standards for weights (NIST Class F) over 700 grams which covers all but two javelin weights. At 600 g the tolerance is 70 mg while at 400 g, it is 45 mg. See tables below for full spectrum of weights of interest for field events implements. (Note: in this discussion and throughout this manual, I am going to use "tolerance" and "accuracy" interchangeably although scientifically these terms have slightly different meanings.) However, a tolerance of one part in 10,000 is quite expensive, usually costing in excess of $1000 for an electronic scale with this accuracy. The recommended tolerance is about 3 parts in 10,000 although one part in 2000, the previous standard, is typical for older TRACKMASTER(TM) units. The Equipment and Facilities Specifications Subcommittee recommends use of a scale with at least a tolerance of one part in 1000 or 1 g in 1 kg. But the use of any scale is better than the use of none. The following table may be of use as you look for a scale. There is no intent to endorse any of the scales shown, only to show the relative cost in 1997 for the various tolerances. Note the wider the range desired, the lower the relative tolerance. A scale rated to cover more than about 20 lb will generally have half the tolerance of the comparable scale for the range less than 20 lbs.

Any newly-purchased scale, particularly a sensitive one, should be calibrated/adjusted in the general geographic area of where it will be used. Do not rely on the factory adjustment – latitude, altitude and even the makeup of the earth in your location affect the local gravity. For example, one of the editors had a recent occasion to calibrate a newly-purchased 30 kg scale, with claimed accuracy of 2 g. At full scale, it initially indicated 11 g too high (a result of its factory adjustment in a different part of the world). However, after adjustment, it produced results closer to ±1 g (about half of the claimed accuracy).

Columns 1 and 2 contain the manufacturer's name and model number. The next column is the maximum capacity of the scale. The fourth column indicates the smallest increment that can be read. Note the differences when there are two ranges. The comments column contains any special considerations listed by the manufacturer in the literature. The next column is the percentage accuracy expected. Note rows 1 through 3 are the NIST requirements at those weights for comparison purposes. This accuracy is shown as error in part per parts measured in the last column labeled accuracy, i.e. 1 part in 10,000 means that the error will be only 1 g in 10 kg. The next column contains where that scale may have been used in 1996 when the data was collected. The eighth column contains the 1996 costs. The next to last column is quantification of whether the particular scale is better than, equal to, or less than the NIST Standard. The final column is the accuracy claimed by the manufacturer.

SCALE COMPARISION SUMMARY

MFG	Model	Capacity	Increment	Comments	%	Where Used	Cost	NBS F	Accuracy
NBS Class F		50 lb.			0.01	Standard		Standard	1/10000
NBS Class F		20 lb.			0.01	Standard		Standard	1/10000
NBS Class F		2 lb.			0.01	Standard		Standard	1/10000
Toledo	SM 15000	33 lb.	0.1g	Build in calib.	0.00066			Better	1/150000
Toledo	BP3260	70 lb./14 lb.	1g/0.1g	ISO 9000	0.003/0.0016	Olympics	$4500	Better	1/64000 &1/32100
Toledo	BP1630	7 lb./35 lb.	0.1g/1g		0.006/0.003			Better	1/32000 &1/16100
Ishida	QB-12KE	26 lb.	1g		0.008			Better	1/12000
Pennsylvania	7000	25 lb.	0.005 lb.(2g)		0.02	Houston	$650	_	1/5000
Pennsylvania		50 lb.	0.01 lb.(4.5g)		0.02			1/2f	1/5000
Pennsylvania		100 lb.	0.02 lb.(9g)		0.02			1/2f	1/5000
Doran	8020	20 lb.	1g		0.01	LA	$1100	Meets	1/10000
New Trackmaster	Toledo	40 lb.	1g					Standard	1/10000
Doran	8030	30 lb	5		0.037			_	1/2700
Doran	8060	60 lb.	0.01 kg(10g)		0.037			_	1/2700
Old Trackmaster		16 lb.	0.05lb			Older		1/5	1/2000
CCI	TLEC-10	10 lb.	5g		0.1	Ohio	$230	1/10	1/1000
CCI	TLEC-20	20 lb.	10g		0.1		$255	1/10	1/1000
CCI	TLEC-50	50 lb.	20g		0.1		$285	1/10	1/1000
Pelouze	4010	125 lb.	0.1kg(100g)			Penn	$150	1/17	1/600

Cen-Tech	95364	5kg	1g	Sold by Harbor Freight			$15	-	1/5000
Cen-Tech	95069	70 lb/32 kg	5g	Sold by Harbor Freight			$58	-	
Bathroom		300 lb.	1 lb.		0.1677				1/40
Minimum									1/1000
Suggested					0.03			1/3 or better	3/10000

Note: The following provide good coverage from the javelins thru the Superweight (see Figures 41& 42):

MFG	Model	Capacity	Increment	Comments	%	Where Used	Cost	NBS F	Accuracy
Ohaus	RD30LS	30 kg	1 g		0.007	PNW	$830	Better	1/15000
Sartorius	CPA34000	34 kg	1 g	internal cal	0.004	PNW	$2572	Better	1/23000

Class F Tolerances for Field Standard Weights

NIST Handbook 105-1

lb.	kg	g	1/10000 Value (down to 1.5 lb.)	NBS Class F Tolerance	Implement Weights in that range
50	22.679	22679.3	2.268 g	2.3	56 lb
30	13.608	13607.6	1.361 g	1.4	35 lb
20	9.072	9071.7	0.907 g	0.91	20 lb
10	4.536	4535.9	0.454 g	0.45	16 lb/12 lb/4 kg
5	2.268	2267.9	0.227 g	0.227	2 kg/1.6 kg
2	0.907	907.2	0.091 g	0.091	800 g/600 g
1	0.454	453.6	0.045 g	0.070	400 g

Tolerances for Implements

Based on full use of Class F Standards

Implement Weight lb	kg	g	Tolerance 1/10000	NIST F Table	Tolerance g (1/10000)	Tolerance mg (1/10000)	Recommended Tolerance g (1/3000)	Recommended Tolerance mg (1/3000)	Implement Name
56	25.40	25400.8	2.540	2.3	2.54		**7.62**		56lb Weight
35	15.88	15875.5	1.588	1.4	1.59		**4.76**		35lb Weight
25	11.34	11339.6	1.134	0.91	1.13		**3.40**		25lb Weight
20	9.07	9071.7	0.907	0.91	0.91		**2.72**		20lb Weight
16	7.26	7257.4	0.726	0.45	0.73		**2.18**		16lb Shot/Ham./Wt.
	6.00	6000.0	0.600	0.45	0.60		**1.80**		6k Shot/Ham./Wt.
12	5.44	5443.0	0.544	0.136	0.54		**1.63**		12lb Shot/Ham./Weight
	5.00	5000.0	0.500	0.45	0.50		**1.50**		5k Shot/Hammer
	4.00	4000.0	0.400	0.227	0.40		**1.20**		4k Shot/Hammer
8	3.63	3628.7	0.363	0.227	0.36		**1.09**		8 lb Jr. High shot
	3.00	3000.0	0.300	0.227	0.30		**0.90**		3k Shot/Hammer
6	2.72	2721.5	0.272	0.227	0.27		**0.82**		6lb Shot
	2.00	2000.0	0.200	0.136	0.20	200	0.60	**600**	2k Discus
	1.60	1600.0	0.160	0.136	0.16	160	0.48	**480**	1.6k Discus
	1.50	1500.0	0.150	0.136	0.15	150	0.45	**450**	1.5k Discus
	1.00	1000.0	0.100	0.091	0.10	100	0.30	**300**	1k Discus
		800.0	0.080	0.070	0.080	80	0.24	**240**	800g Javelin
		600.0	0.060	0.070	0.070	70	0.21	**210**	600g Javelin

400.0	0.040	0.045	0.045	45	0.14	**135**	400g Javelin

When using a double pan balance, place the weights on the left and implements on the right. Test this by moving the ounce slide to the 1 ounce position and see which way the balance moves, i.e. it takes one ounce of weight on the side containing the implements to rebalance the scale to zero. Note some scales have a plus and minus designation to indicate overweight and underweight respectively.

Remember every measurement has some level of error or uncertainty. For a scale that degree of uncertainty is called tolerance. Every scale, even an electronic scale, has a degree of uncertainty. However, because many scales use a digital readout, some people believe all the significant places displayed. The scale is no more accurate than its tolerance. Or put another way, one cannot tell the difference between the following two implements: one that weighs exactly at the measured weight minus the tolerance and one that weighs the measured weight plus the tolerance. Thus a scale that can measure to plus or minus 1 gram in a kilogram cannot display the difference between a 1 kg discus weighing 999 g and 1001 g or 0.999 kg and 1.001 kg. Both could read 1.000 kg on the scale. Similarly if a discus showed 0.999 kg it could weigh 1.000 kg or 0.998 kg. Thus one would have to accept as legal a discus that weighed 0.999 kg on this scale but not one that weighed 0.998 kg. This is statistical reality. Obviously if you have a more accurate scale with a lower tolerance then you might be able to distinguish between the discuses. Remember that there is a tolerance for any scale but particularly the electronic scale.

With regard to selecting an electronic scale, there's one other consideration to take into account. Earlier in this section we discussed the concept of the accuracy-to-range tolerance. For example, a scale with an accuracy of 1 g and a range of 10 kg (10,000 g) would have a tolerance of 1:10,000, which matches the NIST Class F tolerance used widely in commerce. This would be ideal for all measurements used in Weights and Measures, but scales with this tolerance come at a price, and many organizations will settle for a lesser tolerance to fit their budget.

However, there is a pitfall in only using the accuracy-to-range tolerance as the sole criteria for selecting a scale. Virtually all electronic scales contain a load cell at their core, calibrated to display pounds of force. Most load cell manufacturers specify their load cell accuracies in percent of full scale load. For example, let's take a 30 kg load cell which is given an accuracy of ±0.02% of full scale by the manufacturer. That translates to ±6 g *at all points of measurement.* In other words, the manufacturer is declaring an accuracy of 6 g, regardless whether you're weighing a Superweight or a 400 g javelin. The accuracy value does not scale down as you decrease the weight of the measured implement. At full load, the tolerance is 6:30,000 or 1:5,000, which is respectable. However, when considering the 400 g javelin, the tolerance is *effectively* 6:400 or 1:67, which is not as respectable. At this point the buyer should also consider the actual value of the accuracy as a criteria: is ±6 g tolerable when weighing a 400 g javelin? Or would you rather prefer ±2 g or less, although the latter will cost more? Another possibility is to buy two scales, each one selected for a particular range of weights. Now the hypothetical scale used in this example may possibly have better performance to 400 g than assumed here. But you won't know that until you have a chance to calibrate it properly; until then, you only have the factory specs to go on.

To close out the above discussion, it should be noted the scale manufacturers do not specify their products' accuracies in percent of full scale load. Some will actually declare a total accuracy value in ounces or grams, but a great many others will not. The latter will frequently specify linearity error, reproducibility error, and sometimes other error components. With only that to go on, it is customary to add up the individual given errors and use that as a starting point.

Weights: Unless you are using an electronic scale, you will need the following weights depending on the competition. This can be accomplished with the following sets of weights: a) 1, 2, 5, 10, 20 lb, b) 1, two 2, 5 kg and c) 50, 100, 300, 400, 600, 800 g. This allows you to weigh all implements up to the 35 lb weight.

	Men's Open	**Women's Open**
Shot and Hammer	16 lb	4 kg
Javelin:	800 g	600 g
Discus:	2 kg	1 kg
Weight	56 lb, 35 lb	20 lb

	Junior Men	Junior Women
Shot and Hammer:	6 kg	4 kg
Javelin:	800 g	600 g
Discus:	1.75 kg	1 kg

	Collegiate Men	Collegiate Women
Shot and Hammer:	16 lb	4 kg
Javelin:	800 kg	600 g
Discus:	2 kg	1 kg
Weight:	35 lb.	20 lb.

	Men's Masters	Women's Masters
Hammer:	3 kg, 4 kg, 5 kg, 6 kg, 16 lb	3 kg, 4 kg
Shot:	3 kg, 4 kg, 5 kg, 6 kg, 16 lb	3 kg, 4 kg
Javelin:	400 g, 500 g, 600 g, 700 g, 800 g	400 g, 500 g, 600 g
Discus:	1 kg, 1.5 kg, 2 kg	0.75 kg, 1 kg
Weight/Superweight:	12 lb, 16 lb, 20 lb, 25 lb, 35 lb, 44 lb, 56 lb	12 lb, 16 lb, 20 lb
Ultraweight	35 lb, 44 lb, 56 lb, 98 lb ,200 lb ,300 lb	35 lb, 44 lb, 56 lb, 98 lb, 200 lb

	High School Boys	High School Girls
Shot:	12 lb	4 kg
Javelin:	800 g	600 g
Discus:	1.6 kg	1 kg

	Jr. High School Boys	Jr. High School Girls
Shot:	8 lb, 4 kg	6 lb

	Youth Boys	Youth Girls
Shot:	6 lb, 12 lb, 4 kg	6 lb, 4 kg
Javelin:	800 g	600 g
Discus:	1kg, 1.6 kg	1 kg

	IAAF Boys	IAAF Girls
Shot and Hammer:	5 kg	4 kg
Javelin:	700 g	600 g
Discus:	1.5 kg	1 kg

Athletics for the Disabled:

	Javelin	Discus	Shot
Cerebral Palsy	600 g 800 g	1 kg, 1.5 kg	4 lb, 6 lb, 3 kg, 4 kg, 5 kg
Wheelchair	600 g 800 g	1 kg, 1.5 kg	2 kg, 3 kg, 4 kg, 5 kg 4 lb, 6 lb, 8 lb
Blind	400 g, 600 g, 800 g	1kg, 1.5 kg, 2.0 kg	3 kg , 4 kg, 5 kg, 7.26 kg
Ambulatory	600 g, 800 g	1 kg, 1.5 kg	4 kg, 5 kg, 6.25 kg
Special Olympics			3 lb, 4 lb, 6 lb, 4 kg

Hearing Impaired 800 g 2.0 kg 7.26 kg

Weights should be handled with care so as not to damage them so they either gain weight, less likely or lose weight by being dropped.

Ultraweights: (updated 2009**;** See Rules 195.8 & 9 for further specifications and 203 for updates for this table) Also see Ultraweights Supplement: 98, 200 and 300 lb Implement Specifications and Throwing Rules Manual.)

Age Group	Weight, lb	Super-Weight ,lb	35lb	44lb	56lb	98lb	200lb	300lb
	MEN							
Open-49	35	56				x	x	x
50-59	25	56				x	x	x
60-69	20	44			x	x	x	
70-79	16	35		x	x	x		
80+	12	25	x	x	x			
	WOMEN							
Age Group	Weight, lb	Super-Weight, lb	25lb	35lb	44lb	56lb	98lb	200lb
Open-49	20	35			x	x	x	
50-59	16	25		x	x	X		
60-69	12	25		x	x	x		
70+	12	20	x	x	x			

The accepted conversions (though not exact) for pound to kilogram for the ultraweights are the following:

lb	kg	lb	kg
12	5.443	25	11.340
16	7.260	35	15.880
20	9.080	56	25.400

Note: There are 16 oz per lb, 453.5924 g per lb, 28.349527 g per oz, and 2.20462 lb per kg. Only the 6 and 12 lb shots, because they are a youth and a high school implement respectively, are still weighed in pounds. The other weights have been accepted internationally and have taken on the metric weight equivalent shown***. NOTE: For NCAA meets accept weight implements weighing 20 lb and 35 lb via discussions with Bob Podkaminer and NCAA Rules Committee in February, 2006. Note the same is true for high school implements that are specified in pounds.***

DAY OF THE MEET:

1. Arrive early at the site to make sure equipment being supplied by meet management is present and in good working order. Normally this should be at least two hours before the first throwing event. If possible, do it before the day of the meet.

2. Inform the appropriate Event Heads and the Field Referee the type, color and location of the mark to be used on the implements that particular day. If the possibility of breaking a national or world record exists, let the judge and the referee know your location. Try to have a location near the venue where an implement could be rechecked during the competition in such a case.

3. While returning to the Implement Inspection room, you should make sure that there are adequate signs to direct athletes to your location from where they will normally enter the track. Post the times for weigh-ins. Make sure you have a copy of the event schedule and post it nearby to avoid having to answer questions regarding starting times.

4. Set up the Weigh-In room. Set aside an area for receiving and marking implements with the athlete's name or school. This should be near the door to keep athletes away from the measurement area. In addition, set aside separate areas for storing competition-ready implements, impounded implements and unchecked implements. It is important that each of these areas is segregated to avoid problems. See drawing in the appendix.

5. Set up your measuring equipment. Pay particular attention to having your scale level. Place the scale on the table carefully, so that flexing of the table under load won't tilt the scale. Put the scale in an area with plenty of space to avoid moving it to weigh all the different size implements. The scale should not be in direct sunlight, as heating it may alter its adjustment. The scale should be turned on about 45 minutes before any calibration check to allow for adequate warm-up time. Cross check your scale versus a second scale or standard. Two calibration weights may be needed , one at the low end and one at the high end, i.e. 400g or 600 g and 8 kg respectively. Layout your javelin measuring tape. Try to have separate areas for each implement and its measurement. If there is more than one person working, make sure there is enough room to move around, particularly with the javelin. It becomes more difficult if the ceiling is not at least 9 feet to allow the javelin to be turned vertically.

6. Set up an implement check-in sheet. Have room to record the name of the individual, school and manufacturer for all implements measured and/or impounded. The Equipment and Facilities Specification Sub-committee (E&FSS) would like information on impounded new implements in order to work with the manufacturers on improving equipment and gathering statistics on common explanations for implement impoundment. This information will help us suggest to the manufacturers improved specifications for the various implements as well as suggesting changes in the order of doing the measurements.. Send the information to the chair, George Kleeman, 5104 Alhambra Valley Rd., Martinez, CA 94553-9773 or fax to 925-229-2940 or e-mail to george_kleeman@comcast.net.

7. Prepare to make the first measurement at least an hour to an hour and a half before the first throwing event. If the inspector is to bring the implements to the competition venue, then take them out 10 minutes prior to the start of the warm-up period for the scheduled event. Typically this is so they arrive about 30 to 35 minutes before the event starts. Make sure to turn them over to an event official and not just leave them on the field.

CHECKING OF EQUIPMENT:

The following sections are ordered in such a manner so the most common implement defects are listed first in order to minimize time spent on equipment that eventually will not pass. The order was generated from a consensus of the most experienced implement inspectors in the country. The order may be varied at the implement inspector's discretion, but be consistent and don't leave out a measurement.

RECOMMENDED ACCURACY IN MEASUREMENTS:

1. As discussed in the scales section on equipment, NIST recommends an accuracy of 0.01% or 1 part in 10,000. This is equivalent to 0.1 g per kg for weight or 10 mm (1 cm) per 100 meters for length measurements. However, because of cost and the continued use of older scales,, the E&FSS committee recommends a weight tolerance minimum of 0.03%.

2. Based on the accuracy for measuring record lengths by steel tape and the impact of temperature, plus the recommended procedures for certifying electronic measurements, the accuracy varies from 0.04% to 0.17% for sector lines in the long throws. The E&FSS Committee recommends a minimum standard of 0.1% or 0.1 mm for every 100 mm in diameter for a shot. This means gauges used for implement measurement should be accurate to 1 part in 1000. If properly manufactured, the gauges would be accurate to ± 0.005 inch (0.127 mm) or 7 parts in 10000 versus our recommendation of 10 parts in 10000. However, the proper care and handling is mandatory in order to maintain its accuracy. Remember any standard has some error in it. Note a temperature change of 36°F (20°C) with some linear measuring devices can alter the reading by as much as 0.24 mm per m. This may be additive to the tolerance limit. Thus if you have an implement just missing the spec and there is a large temperature difference between the measuring device and the implement or the measuring device and the

temperature at which the device was calibrated, pass the implement. This illustrates why it is good practice not to have the implement or the measuring equipment in the sun.

Basis for Accuracy Measurements

Type of Measurement	Expected Accuracy	Measurement	%	Parts/ 1000
Pole Vault Electronic	± 2 mm	5 m	0.04	0.4
High Jump Electronic	± 2 mm	2 m	0.01	1
Discus/Hammer Sector	±164 mm	100 m	0.164	1.64
Javelin Sector	± 169 mm	100 m	0.169	1.69
Temperature Correction at 10°C difference	± 12 mm	100 m	0.012	12
Weight , NIST Class F	± 0.07 g	700 g	0.01	0.1

GENERAL PROCEDURE FOR ALL IMPLEMENTS:

1. Have an implement check-in sheet for each athlete to signs and indicate the number and type of implement(s) he or she is leaving. Have tape or labels and pens available so the athletes can put their name and their school name, if appropriate, on the implement.

2. Have a separate box or container for the implements to be inspected to avoid mixing with previously certified implements.

3. Check each implement for internal movement (including the javelin should this be a requirement) or loose connections when you first pick it up.

4. Check the general appearance. Is this a homemade implement or a modified implement? Are all the original pieces there? Does it have the expected shape? There should be no significant nicks, gouges, and logos, decals or movable implement weights or parts that would give an advantage for a better grip or better aerodynamics.

5. Does the implement have previous weigh-in markings?

6. Does the implement have a name or school identification, in case you have to impound it, so it can be identified for picked up later?

7. Is the implement clean or dirty or with excess tape or other removable debris which might affect its weight or center of gravity? Note a single piece of tape or label will not make enough difference in weight or balance such that it needs to be removed. Your equipment is not accurate enough to detect that small an increment.

8. Weighing is first because it is the most common reason for implement failure. Constant use and damage tend to reduce the weight of an otherwise legal implement. When checking the weight of the implement, do it carefully. There are three common types of scales used. Any scale which can or has been certified by your local or state authority or an accredited calibration lab is acceptable. The three types of scales are electronic, balance and lever or beam. Be aware that there have been two different types of the beam scales used in the Trackmaster™ kits over the years. The older versions of the TRACKMASTER(TM) made by Red Meade or Jack Balko used a beam scale. Red Meade manufactured units with serial numbers below 180. Make sure to know the steps in calibrating the scale. Normally put the calibration weights on and then set the balance point. To pass, an implement must be at or above the balance point. The new version by Daktronics uses an electronic scale. Because even these scales can't be exact, err on being fair to the athlete. If an implement fails on one scale but passes on another, let it go unless there is a significant difference in calibration or tolerance between the two scales. If it is that close to weight, it really will not have any impact on the competition or a record. (See previous section on scales for

discussion of accuracy and tolerance.)

NOTE: When using any scale, treat it carefully. When removing implements or weights from the scale, do it gently to avoid damaging the knife edges or bearings. This is particularly true for a single pan balance such as that used in the TRACKMASTER(TM). Hold the bar when removing weights or implements so the bar doesn't damage the knife edges or bearings. With care, the scale will last a long time. Without care, damage can occur very quickly. Remember, with normal use, scales and weights need to be calibrated at least bi-annually if not annually. When moving the scales, immobilize the scale to protect the knife edges or bearings. Use foam rubber under the arm and/or on top of it for protection. Calibrate the scale before use each day or each time you move it. For the double pan variety, try weighing two identical weights switching them to make sure the weights are balanced and level enough. Keep the scale out of the wind and sun because both can impact even an electronic scale.

Before putting any weight on the scale, test the movement of the pan(s) to make sure it moves easily and isn't bound by anything. When putting an implement on the pan make sure it is well balanced. For hammers, shots and weights, use a washer on each pan (so balanced) to prevent the implement from rolling. Make sure the scale balances before weighting the implements since the two holding devices may vary in weight. On an electronic scale with one pan you can tare the weight out. For the hammer put the ball in the handle loop. Be careful with new wires that may spring out. Make sure the wire isn't in contact with any other surface while weighing the hammer. For the javelin, the center of gravity is near the front of the handle so place the javelin with the front of the handle near the center of the pan. In general place the weights and the implements as near to the center of the pan as possible (see also discussion of tolerance/accuracy under the equipment section on scales).

9. Continue on with the other implement specific tests.

10. If the implement passes all the tests, then mark it. Label it in a place where the marking is less likely to come off - like at the weight mark, the hex screw, near the swivel or just in front of the grip. Some inspectors mark javelins on the tip, but I find it can come off more easily there. Do not put the mark behind the grip where the javelin thrower may grip the javelin. Some use symbols, some use lines, some use initials and even dates. Make sure the mark is dry and then place it with the other approved implements for the day. This is the recommended procedure. Short on help? Then return it to the athlete to transport to the competition site.

11. If you are impounding an implement, let the athlete know the reason and the time to pick up the implement after the event. Record the reasons for impounding any implement in your notebook, on the check-in sheet and place a piece of tape or label on the implement. This will save time if there is a protest or the coach or referee becomes involved. This way the implement in question can be located quickly and the reason for disqualification easily given.

12. If possible, take the implements out to the competition area either 35 minutes before the scheduled start or ten minutes before warm-ups or have an event official pick them up. If possible, always turn over the marked implements to an event official insuring the chain of custody and making sure no implements are lost.

The following sections detail how to certify each of the implements. Because there are subtle differences between the wordings in each rulebook, it is always a good idea to review the rulebook the night before the meet. This is particularly true for a meet with a different set of rules than have been used recently. Use the rulebook as the ultimate authority, unless there has been in intervening change. The E&FSS committee keeps implement inspectors apprised of changes throughout the year. Send an e-mail to george_kleeman@comcast.net so notification can be done in a timely fashion. These sections try to point out the similarities and the differences between the various rulebooks.

When demonstrating to athletes or coaches how much their implement is light, use the following table for coins as an indication. Thanks to Shirley Crowe and Emmitt Griggs:

Coin	Weight, in kg	Weight, in g

Dime	0.0020	2
Penny	0.0025	2.5
Nickel	0.0050	5
Quarter	0.0055	5.5

SHOT:

1. Note: internal movement by sound or feel is no longer a reason to impound a shot. Make sure that the weight stamp or the plug cannot be used as a finger hold. Some screw the plug in beyond being even with the surface. This was an emphasis point in the 1998 HS rules. If the shot has a removable plug for weight adjustment, either 1) seal it with bath tub sealer or Elmer's glue if it appears loose to prevent tampering or 2) make a mark across one side of the plug to indicate the location of the plug when it was checked. Elmer's glue can be bought in colors so it can't be easily replaced, but the use of glue has the disadvantage that it takes longer to dry. Unless someone has recently opened it, most plugs are hard to remove. A mark across the plug is often adequate.

2. The shot should be smooth. In fact, the IAAF and USATF require a maximum roughness of N7. Check for finger holds, cracks or dents. Look for out of roundness by sight or feel. It should be essentially spherical with no significant flat spots that might help gripping. Assume it is spherical if the shot passes the diameter in step 4 using a minimum of three out of four planes including the plane containing the flat spot. If there is a significant flat spot (i.e., a several millimeter gap between the ball and gauge), then impound it. Some practice shots and overweight shots turn up at meets. These shots are usually cast iron and have such a large imprint of the weight. These are legal. If using this implement gives a thrower an advantage or compromises the safety of the event, then impound the implement. The shot may be rolled to check if the center of gravity is significantly from the center. However, there is no specification for this eccentricity, and thus should not be used to disqualify an implement.

3. Weigh the shot. Make sure the shot is clean of any foreign substance that might significantly affect the weight. If just at weight, recheck it to make sure it is clean, and that removal of any debris doesn't cause it to drop below the minimum. Normally the tolerance of your scale won't be sufficient to measure such small differences. Note if you are using a double pan scale place an equal size washer on each pan to keep the shot from rolling off the pan, and place the weight on one pan and the shot on the washer on the other one. The men's shot weighs 7.260 kg and the women's 4.000 kg. For other weights see the previous chart or the tables in the Appendix. In areas where junior high or middle school boys throw the 8 lb shot, be alert for 8 lb shots masquerading as high school girls 4 kg shots – this is a common problem. If you are using the older TRACKMASTER(TM) use weights #1, 4 and 8 for the men's shot, weight 7 for women's shot, weights 5 and 6 for the Junior men's and weight 6 for the Junior women's shot. Remember that there is a tolerance for any scale but particularly the electronic scale. Because there is a digital display, people tend to believe all of the numbers. If the reading is within the tolerance limit, then one cannot tell if the value is less or more than the displayed weight (for further details, see the section on scales under equipment).

4. Check the minimum and maximum diameter using three locations with the appropriate diameter gauge. For the men's shot the respective diameters are 110 mm and 130 mm while for the women's shot, 95 mm and 110 mm. For other dimensions see the tables in the appendix. If all three diameters clear, pass the implement. If one or more fail, check at least two more locations. If you can't get at least three acceptable measurements, impound the implement. For indoor competitions, each rulebook is slightly different. The acceptable maximum diameters are slightly larger for synthetically covered implements in USATF and IAAF meets, 145 and 130 mm respectively. As dictated by the facilities and the Games committee, outdoor metal shots, synthetic shots with rubber or plastic covers or metal-filled ones may be used provided these implements meet weight. For Masters implements the USATF generalized the diameter rule. The diameter for a synthetic covered indoor shot can be a maximum of 15 mm larger than the corresponding outdoor men's shot and 20 mm larger for the corresponding outdoor women's shot. In 2001 USATF and IAAF specified that only indoor or outdoor implements can be used in the same competition, not both.

NOTE: 1) Some new stainless steel shots have not been making the minimum diameter.

5. If it meets all of the requirements, mark it and put it with the other approved implements for that event. If not then see step 11 above in the general procedures section.
See Table 3 and Figure 8 in Appendix.

DISCUS:

1. Check the rim and nearby surfaces for dents, cracks, or roughness that would aid the grip. All discuses must have metal rims with the exception of high school where the use of the rubber discus is allowed. Check the implement for any loose parts. If there are any significant areas that can be gripped easily, impound it. Normal wear or minimum damage is acceptable. Some athletes have immerse discuses with wooden centers in water in order to make weight. On a hot, sunny day a wet implement dries quickly and is underweight during the competition. Impound any wet discus. Be sure the profiles of both sides are the same. Place a straight edge on each side. The discus contour should be in contact along the entire length of the straight edge for a legal implement. That is, the taper should not be concave or convex in nature . Dents are acceptable as long as they aren't along the edge, too big or cause the edge not to fit the ring. A bent rim is usually the cause of the last problem. A discus is held at the edge so indentions closer to the center should not give a thrower an advantage. A broken or cracked metal ring is reason enough to impound a discus. Safety should be a major concern. However, because the discus is held at the rim, allow small dents and cracks on the side of the discus because these flaws don't aid in holding the discus, unless its structural integrity is compromised.
NOTE: 1) In 1993 USATF and IAAF rule changes limited the degree of roughness allowable on the edge of the discus. Manufactured grooves in the metal rim or elsewhere are not allowed.

2) The PACER Gold Plus was declared illegal for USATF and IAAF competition because it was weighted more on side than the other. Although the NCAA did not declare it illegal, their rules read the same as the USATF and IAAF on discus conformity which in my opinion makes it illegal. The high school rule is less clear and therefore is probably legal since there is no mention that both sides be symmetrical. This discus was weighted on one side more than the other as part of the manufacturing process.

2. Weigh the discus. The Men's discus is 2 kg while the women's is 1 kg. The high school boy's discus is 1.6 kg. Masters women have added a 750 g discus. See appendix for other weights. With the older version TRACKMASTER(TM) use the following weights: Men's 1 and 4, Women's 2 and Junior Men's 3. The Junior Men's discus is 1.75 kg. The Masters have a 1.5 kg discus.

3. Gauge the diameter (219-221 mm for men and 180-182 mm for women; see Rule 189 or the appendix for others), center diameter (50-57 mm), and center (44-46 mm for men and 37-39 mm for women) and the minimum edge (12 mm) thickness. Check at least three points for each dimension to insure adequate roundness and thickness. Note the minimum thickness of the edge should be measured at a point 6 mm from the edge. The center plate of the discus, if there is one, should be flush with the mating surface. For dimensions of other discuses see the Appendix. Note that the flat surfaces must meet only the dimension requirement and do not necessarily have to made of metal. Indeed, some discuses have metal plates smaller than the whole flat surface (Early Denfi discuses ~ 1995). Both are OK. In measuring the edge thickness of the discus, place the measuring tool perpendicular to the sides. The first edge thickness measuring devices included in the 1997 and early 1998 Trackmaster™ kits from Daktronics were themselves too thin. If not held properly, these early gauges will indicate a valid thickness when in actuality the discus edge thickness is too thin. This gauge should itself be a minimum 1/4" thick to limit this problem. Below this minimum, it is difficult to place the gauge perpendicular to the sides. This gauge must be very accurate to measure the edge thickness. The discus should be at least 6 mm thick at 12 mm from the periphery. The easiest and most accurate way to measure this parameter is using a gauge. The edge of a discus is a semicircle with a 12 mm minimum and a 13 mm maximum in diameter. Thus one gauge should be a 12 mm diameter semicircle and the other 13 mm. If the discus edge fits the 12 mm gauge without rattling, the implement meets the minimum thickness. If the semicircle doesn't fit into the 13mm gauge then the discus is too thick. This is particularly true for the Denfi discuses. Gauges are available from VS Athletics, but verify the measurement with a good caliper when you get them.

4. Check the taper of the sides by laying a straight edge from the center plates to the rim on both sides. It should be in contact along the contour to the metal edge.

5. If the implement passes, mark it and place it with the other approved implements. Mark the top of the discus rather than the bottom. The two sides can be distinguished from one another - the label is placed on top while the scratches are found on the bottom. If the discus does not pass, note the reason for failure as listed in section 11 of the general procedure section.

6. If the discus rattles, then the plate is loose or something is in the void space. If the surfaces are tight against the rim or the discus is too thick, disassemble the discus with an Allen wrench, screw or Phillips screwdriver and cleanout the edges. If it is a wood discus place some tissue in the center to keep the clay ring or ball from rattling potentially correcting the problem. Often the plates get tightened too much so that the edges of the flat surface have been bent upward so that the discus is too thick. Remove the flat plates and level them with a hammer or bend them using pliers or Vise-Grips. The plates usually straighten out and fit back in the groove. Other times the plates are not distorted, but the plate fasteners simply need to be snugged to get the discus within the thickness limits. When you dismantle a discus, make sure you know which side which plate go together. This is particularly true for discuses that may be out of round or the rims are bent and thus may only fit back together one way. Mark the plates, the sides and the rim before taking the implement apart. See Table 4 and Figures 9-12 in Appendix.

HAMMER:

1. Check the hammer head for internal movement, dents, cracks and a plug for adjusting the weight. Internal movement is a reason for not certifying a hammer. If there is a plug then seal it if it looks like it has been recently opened, otherwise mark it as described in the shot section. Make sure the head is reasonably spherical and made of iron or other metal not softer than brass. (See discussion for the shot and the diameter below.) Check to see that the swivel is free to move.

2. Check both the minimum and maximum length of the hammer. The 7.260 kg, 6 kg and 12 lb implements must be at least 117.5 cm and not more than 121.5 cm from the inside of the grip to the end of the head. IAAF has modified the 5 kg length to 116.5 cm to 120.0 cm. For 4 kg and 3 kg implements, the measurements are 116 cm and 119.5 cm, respectively. When measuring length, make sure the wire is straight but not stretched nor curled. The weight of the hammer itself is usually not enough to straighten the wire, particularly if the wire has been curled from normal use or for transport. Applying additional tension may be necessary. Be careful not to apply too much tension so as to stretch the wire, the wire loops, or handle. With a hammer stretcher, be careful to make sure the handle and ball are properly placed so neither will come loose as the tension is increased. Tighten until the wire is reasonably taut but not enough to bend the handle. When taut, use the gauge to check the maximum and minimum lengths. Be careful in doing this measurement. If you are using the TRACKMASTER(TM) or Gill hammer stand, we recommend you use a "C" clamp to hold it firmly to the table surface.

3. Check the weight. This is most easily done by placing the handle on the scale and then putting the head in the handle so it doesn't roll. Make sure the wire does not contact anything in the process. The open men's hammer weight is 7.260 kg (nominally 16 lb) and the women's is 4 kg If you are using the TRACKMASTER(TM) the weights are 1, 4, and 8 for Men's and 7 for Women's hammer. See appendix or rule books for other weights.

4. Check the hammer head diameter and roundness. The hammer should be essentially spherical. It must pass in at least three different planes. If it doesn't pass, impound it. It must be at least 110 mm and not more than 130 mm in diameter. For the 4 kg hammer the diameter measurements are 95 and 110 mm. Note for other weight hammers check the shot dimensions because they are the same.

Note: 1: *There is currently no quantitative check for out of roundness or sphericity, a flat spot etc. What is round may differ from one implement inspector to the next. The spherical nature of the hammer is less important than for the shot because the hammer is not grasped by the head. Likewise, do an eccentricity test as in item 2 for the shot.*

5. Check the center of gravity by placing the hammer head sideways on a 12 mm diameter horizontal sharp edge orifice; that is, the swivel should be oriented horizontally, which isolates the measurement to the most critical axis for the hammer. It passes if it doesn't fall off.

6. Check the wire diameter in at least three places. If it is close or there appears to be a significant amount of wire draw then impound the implement unless the athlete can change the wire and resubmit the implement. The wire should be a single

unbroken length of spring wire at least 3 mm in diameter. The most likely places for breaks are where the wire is wound around itself to form the loops at both ends. Likewise any sharp kinks are potential problem areas. The wire is connected to the head by a swivel while the grip is connected to the wire via a loop but not a swivel..

7. Check the size of the loops at both ends of the wire. Neither can be bigger than 1.95 cm in diameter for USATF sanctioned meets. If the loop is too wide, *carefully* squeeze the loop with *padded* pliers until it meets the 1.95 cm maximum. This dimension is not specified by other rulebooks.

NOTE: Why check the loop? Some competitors will come with a big loop and during warm ups it will straighten out making the hammer too long. This has been a parameter in the USATF rulebook for a number of years, but it is not covered in the others. Also check that the wire loop is tight so it won't unraveled when throwing. If appropriate, add adhesive tape or plastic electrical tape over the ends to keep it from unraveling or so the wire ends don't get caught in the cage netting. This is a safety concern rather than an implement weight concern.

8. Check the dimensions of the handle. The handle can be any width. The maximum perpendicular length between the bottom of the handle to lowest edge of loop for connecting the wire is 110 mm. There is no specification of the sides any longer. The handle may be straight or curved. USATF and IAAF require that under a 3.8 kN tension load the handle will not deform more than 3 mm and a minimum breaking strength of at least 8 kN. These force parameters cannot be tested by any of the implement inspection kits. Unless the handle looks very old or significantly bent, pass it, provide it meets the 110 mm length requirement and looks like it can withstand repeated throws without breaking.

9. If the implement passes then mark it by painting or taping both the loops at the connection points and the handle so that neither the handle nor the wire can be changed. Mark the swivel plug so that it can't be unscrewed to lengthen the hammer. Alternatively wrap the loops and connection points with colored tape. This is especially useful on days when the landing area is wet. Tape adheres better to both loops and handle than paint which tends to come off through use. If there is a lot of tape or it looks like a weight has been added in the tape, remove it. It takes a lot of tape to add any appreciable weight to a hammer. See Table 1 and Figures 13 to 16 in the Appendix.

WEIGHT:

1. For safety check the weight head and handle for dents or cracks that might cause them to break during competition. Be sure the plug for adjusting the weight is tight. If there is a plug nut, then seal or mark it per shot instructions. Make sure the head is essentially spherical and made of iron or other metal not softer than brass. Check the embedded forged steel eye used for attachment. In some indoor competitions a weight bag or synthetically covered weight may be used. Typically a synthetically cover sphere (which can have internal movement) is contained in a canvas bag or nylon straps which is attached to a handle (See NCAA Rule 10-9 for a picture). Note outdoor or metal weights cannot have internal movement.

2. Check the weight. This is most easily done by placing the handle on the scale and putting the head in the handle so it doesn't roll. The weights for this event are measured in kilograms (kgs). If you are using the older TRACKMASTER(TM), you can use weights 6, 7, 8 and 9 for the 35 lb weight. The number 9 weight is optional. The men's weight is 35 lb (15.880 kg) and the women's is 20 lb (9.080 kg). Do not allow wet implement bags.

For indoor weights with canvas bags or nylon straps, some athletes will tape quarters or large washers onto the head to help them make weight. As the head rotates within the bag during successive throws, the quarters will rip free and detach. The implement inspector should be aware of this type of hobby-shop repair. A more proper repair is adding washers to the center link clevis pin.

3. Check the maximum length of the weight. It must be no more than 406.4 mm from the inside of the longest leg of the grip to the end of the head. This is true for both the metal weight and the weight bag. Make sure the links are straight and not curled. Be careful in doing this measurement. If you are using the TRACKMASTER(TM) hammer stand, we recommend you use at least a "C" clamp to hold it to the table surface so it doesn't tip. We also recommend a slight alteration to remove the

center extension and add a calibration to the upper leg for ease of measurement. Note: For USATF Masters and WMA competitions the overall maximum length can be 410.0 mm. Indoor weights that fail the maximum length measurement due to stretched nylon straps are a common problem. These are corrected by disassembling the center link and twisting one or more straps, effectively shortening them. Also be aware of synthetic indoor weights that are not round. These have been deliberately flattened to ensure they meet the length specification. This is not allowed; the weight itself must be round, and the straps must be shortened to meet the overall length specification. Always remember to check the tightness of the center (or yoke) pin, with your fingers, regardless if you worked to tighten the straps to make length or not.

4. Check the triangular shape of the handle. Also inspect the diameter at a minimum of three places. It should be at least 12.7 mm in diameter and not more than 184.1 mm along each side inside the handle. If the handle does not meet these requirements, impound the implement unless the athlete can change the handle and resubmit the implement. The handle should not stretch appreciably under the weight of the implement. The NCAA now specifies that a hammer handle cannot be used, and if the grip can swivel at its connection point to the ball or bag, it shall be an equilateral triangle with no side more than 190 mm (7.5 in) or less than 100 mm (4 in). If the grip cannot turn, it only needs to be a triangle with the same maximum and minimum dimension requirement.

5. Check that the maximum diameter of the welded steel links making up the connector is no more than 9.5 mm. Note there is currently some wording difference between the NCAA and the USATF rule book but there is no intent that the rules be different. The NCAA also allows the grip to be connected to the ball by means of a steel line.

6. The 35 lb implement has a minimum diameter of 145 mm and a maximum diameter of 165 mm. The 20 lb implement has a 130 mm minimum and a 150 mm maximum. If they are synthetically covered spherical implements, they can be no greater than 15 mm larger in diameter than the corresponding metal implement. Weight bags have no diameter requirement. See Tables in appendix for other implements.

7. Beginning in 1999, there is now a center of gravity measurement for the metal weight for USATF. If a filling is used, it must be inserted in such a manner that it is immovable and the center of gravity shall be not more than 6 mm from the center of the sphere. This can be checked when the head is not in a bag, do it in a manner similar to the hammer, using a 12 mm diameter sharp-edge orifice. For balls in a bag, the manufacture will specify that it meets the requirement since no measurement can be easily done. (Rule change 2009 in Rule 195.4.)

8. If the implement passes, then mark it by painting or taping both the loops at the connection points and the handle so that neither the handle nor the connectors can be changed. See Table 2 and Figures 17 to 20 in Appendix..

JAVELIN:

NOTE: The javelin has the most required measurements so it is very important that the inspection be done in the order listed to limit the measurements on an implement that won't pass. The most common reasons for failure are listed first.

1. Hold the javelin vertically, first tip down then rotate so the tip is up and shake. Listen for any internal movement. Tap the javelin on the floor to make sure there aren't any moveable parts. Internal movement might impact the center of gravity and therefore its flight characteristics. Loose internal parts may also be an indication of imminent failure of the javelin – usually snapping in half during the throw or landing.

2. Check the javelin whipcord (grip) to see if it is damp which might help it make weight. If the grip is damp, impound the javelin..

3. Check the overall length, the length of the head and the length of the grip. Make a folding device to measure the overall length and the incremental distances as shown in the equipment section. Alternately mark a retractable steel tape or adhesive tape on the edge of a table with the necessary dimensions. This allows you to quickly lay the javelin on the tape and check the overall length, the length of the point, and length of the grip. Mark the 150 mm tip and tail marks used later for contour

measurements. See Table 5 in the Appendix for all the appropriate dimensions for each of the currently legal javelins.

4. Check the center of gravity by performing the balance test. Most javelins balance at about the second cord on the handle. That is not a specification, just a fact. The javelin should just balance or just drop down at the point. This is the most common reason for why a javelin fails. Mark the center of gravity on the grip (this is where a silver Sharpie pen is very useful if the cord is black). Measure the distance to the tip. See Table 5 for dimensions in Appendix. Check for indentations, rings, roughness, flutes or other aerodynamic improvements, i.e. non-smooth finish. Normal wear is acceptable as long as the groves aren't symmetric. There should be no tape or decals on the javelin that might improve the aerodynamics during flight. If the balance is very close, make sure that there isn't any paint or solder on the tip that might come off during the competition thus altering the balance point. Use nail polish remover if you need to remove the paint and then retest the javelin.

5. Check the weight. With the old TRACKMASTER(TM) use the number 1 weight for the men's javelin and no weight for the women's javelin. There is no weight for the 400 g javelin. A 200 g weight can be added to the pan using the balance (200 g + 400 g Javelin = 600 g to verify the weight. For other javelins use other weights.

6. Check the tip for the forty-degree taper maximum taper using the tip guide. This can also be done with a plastic protractor and several pieces of tape.

The remaining checks should be made whenever possibly but generally don't change with use, i.e. they are characteristic of the javelin manufacturing process. Thus if these have been previously checked as signified by the mark of the day or one you recognize then with limited time skip them. The first time a javelin is inspected each year you check these items. Then use a special mark to indicate that these have inspected. These points can then be overlooked for the rest of the season.

7. Check the diameter just in front of the grip or handle. The diameter behind the handle should be no smaller than the diameter in front of the handle less 0.25 mm. Note it is not uncommon for the diameter to be slightly larger behind the grip The most accurate way to do this is with the calipers. When using the calipers don't push too hard. Just snug it up and move it around to determine the maximum and then the minimum dimension at that point. Record those measurement. . The cross section is suppose to be circular but there is a 2% allowance between the largest and smallest diameters at a cross section. The mean of these two measurements will be used for checking the specifications. That means the if the mean diameter is 29 mm then the measured diameter at a cross section could vary as much as from 28.71. to 29.29mm. Check the diameter of the tail, which must be greater than 3.5 mm for all javelins. Check the diameter of the grip. The difference between the diameter of the grip and the diameter of the shaft at the point at the front of the grip should be no more than 8 mm. There can be no abrupt alterations along the shaft. Note if you have one of the older TRACKMASTER(TM) ring sets, cannot measure the new javelins properly. Make sure to order a new measurement device from TRACKMASTER(TM)(Cost is about $95). See bottom picture in Fig. 36 in Appendix under javelin gauges.. In the interest of time, some of these measurements may be excluded if a visual check does not show a gross or obvious problem. Some people have started to use semi circular or square gauges to measure diameter as well as the maximum and minimum contour points. See Figures 28 and 29 in Appendix.

8. Mark the 150 mm point from the tip and the tail (substitute 125 mm for the 400 g javelin in all cases). Mark the mid-points between the tip and the center of gravity, and the tail and the center of gravity. Make the necessary measurements using either the TRACKMASTER (TM) gauge or a caliper. The percent of the total diameter for both the Men's and Women's javelin are the same. The diameter at the 150 mm point from the tip must be less than or equal to 80% of the maximum diameter. The diameter at the 150 mm point from the tail must be greater than 40% of the maximum diameter. The diameter at the mid-point between the tip and the center of gravity must be less than or equal to 90 percent of the total diameter. The equivalent point half way to the tail must be greater than or equal to 90% of the maximum diameter, Thus the measurement on the tip end are maximums so measuring device should go beyond the indicated marks and the tail measurements are minimums so the measuring device should not go beyond the marks.

9. Either use a 50 cm long straight edge to check for uniform tapering or use a calipers to measure each point and calculate

the percentage at each point if there seems to be a question about the tapering.

10. If the javelin passes all the tests, mark it on tip end near the whip cord or just above the metal head. Do not mark it behind the grip because it may impact an athlete's grip.

Because of the many changes in specifications in javelins over the last 20 years the following table of older javelin specifications is included. You may continue to see some of these implements at meets for the next few years. This table will help you verify what they are. All the dimensions shown are in millimeters. Note: Although there have been several changes to the Masters' 400 g javelin over the last ten years to make it more aerodynamic and easier to manufacture there has not been the formal demarcation date for the specs changes which occurred with the open 800 and 600 g javelins.

HISTORICAL JAVELIN SPECIFICATIONS

Measurement/Group		High School Pre 2002	IAAF Pre 1992	IAAF Pre 1999	High School Pre 2002	IAAF Pre 1986
Users		Girls	Open	Open	Boys	Open
Weight, g		600	600	600	800	800
Length of Javelin	Min.	2200	2200	2200	2600	2600
	Max.	2300	2300	2300	2700	2700
Length of Head	Min.	250	250	250	250	250
	Max.	350*	330	330	350*	330
Length of Rubber Tip	Min.	35			35	
	Max.	77			77	
Diam. of Front of Rubber Tip	Min.	14			14	
	Max.	35			35	
Thickness at Front of Rubber Tip	Min.	5			5	
Length of Grip	Min.	140	140	140	150	150
	Max.	150	150	150	160	160
Length from Tip to	Min.	800	800	800	900	900
	Max.	950	950	950	1100	1100
Diameter of Shaft (D)	Min.	20	20	20	25	25
	Max.	25	25	25	30	30
Diam. Reduction Front to Back of Grip	Max.	-	0.25	0.25		0.25
Diam. Reduction behind Head	Max.	-	2.5	2.5	-	2.5
Diam. at mid point CG to Tip	Max.	-	0.9D	0.9D	-	0.9D
Diam. at mid point CG to Tail	Min.	-	0.7D	0.9D	-	0.9D
Diam. 150 mm from Tip	Max.	-	0.8D	0.8D	-	0.8D
Diam. 150 mm from Tail	Min.	-	0.3D	0.4D	-	0.8D
Diam. 125 mm from Tip	Max.					
Diam. 125 mm from Tail	Min.					
Diam. of Tail	Min.	-	3.5	3.5	-	3.5
Diam. of Grip	Max.		D+8mm	D+8mm		D+8mm
Circumference of Grip over Diam.	Max.	D+1 in			D+I in	
Diam. at mid point fm front of grip to Tip	Max.					
Diam. at mid point fm front of grip to Tail	Max.					
Angle of Tip	Max.		40º	40º		40º

*When a rubber tip is used, the metal point shall be 70 mm shorter than the normal point, and shall end (before affixing the rubber tie) in a slightly rounded button shape 18-21 mm in diameter for the boy's 800 g and 16-18 mm in diameter for the girl's 600 g. The length and center of gravity with the rubber tip in place may be less than the standard javelin with a metal point but will still fall within the nominal specifications. See Table 5 and Figures 21 to 29 in Appendix

Mini Javelin:
In 2000 the Youth Committee adopted the 300 gram mini javelin for use with the younger age groups. Other than weight, all three sizes have the same specifications. The shaft, grip and fins will be made out of plastic; the tip shall be made of soft rubber with a blunt, rounded tip. The fins must be smooth.

Name	300 g	400 g	500 g
Nominal Wt. g	300	400	500
Minimum Record Wt. g	300	400	500

The following specifications are common to all mini javelins:

MINI JAVELIN (All Weights)	
Overall Length min. mm	685
Overall Length max. mm	705
Length of Head min. mm	84
Length of Head max. mm	94
Tip Diameter at largest point, min. mm	37
Tip Diameter at largest point, max. mm	43
Distance from tip to CG min. mm	365
Distance from tip to CG max. mm	380
Diameter of Shaft forward of grip min. mm	30
Diameter of Shaft forward of grip max. mm	38
Diameter of Shaft behind grip min. mm	24
Diameter of Shaft behind grip max. mm	30
Diameter of Shaft at grip min. mm	34
Diameter of Shaft at grip max. mm	40
Width of grip min. mm	99
Width of grip max. mm	109
Location of front of grip from tip of tail min. mm	322
Location of front of grip from tip of tail max. mm	332
Number of Fins	4
Fin Length min. mm	162
Fin Length max. mm	168
Fin diameter (peak to peak opposing fins) min. mm	95
Fin diameter (peak to peak opposing fins) max. mm	105

Note: Currently the TurboJav ™ is the only javelin that meets these specifications although other manufactures will begin making them. The current version is the TurboJav VII.

1. You need to check each dimension. Because of the fins finding the center of gravity requires a much higher balance point. Most dimensions are easily measured with a 15 or 30 cm (6-12 inch) straight edge and the diameters with a caliper. The only other specifications are weight and center of gravity. Alternately you can mark your javelin board with the required dimensions and get a larger fulcrum to determine the center of gravity. See Table 6 and Figure 30 in Appendix.

USE OF THE TRACKMASTER(TM) or OTHER CERTIFICATION KITS:

The following section is included as an introduction the TRACKMASTER(TM), UCS, or Gill Implement Certification equipment. See Figures 32 to 37 in Appendix.) It is the most commonly used weights and measure system in the United States. However, the TRACKMASTER(TM) does not perform all the indicated tests listed in the measurement section. You may have to construct or buy some additional devices to do the measurements. Most are reasonably straight forward. If you have access to either a wood shop or a metal shop you can make your own. Use a caliper and make sure it is accurate, to at least 0.1%.

Generally the TRACKMASTER(TM), UCS, and Gill kit are set up on the principle of pass or fail. It doesn't give you the actual

measurement but indicates that you are above the minimum or below the maximum. The TRACKMASTER(TM) is the most widely used system with over 350 units throughout the United States before Daktronics began manufacturing the newer version in 1997. Before that, there were four models sold by Red Meade (original Inventor) of Southern California until the mid 80's and then Jack Benko out of Texas who was the inventor of the Accutrack(TM) timing system until the late 90's. Mark I for Men, Mark II for Women, Mark III for Men, Women and Junior, and Mark IV for High School. Now there are just three: High School with and without Javelin, and NCAA, IAAF & WMA. Gill began sales in 2000. UCS started in 2007. Instructions come with each system but the following is a more detailed description of the tests and how they should be performed and interpreted.

Some of the most common complaints about this equipment are:

1. Initial Cost is high ($1250 to $3700 depending on implements to be measured)
2. Cost of Maintenance is high
3. Old models have not all been updated with improvements
4. Instructions are not current with rule changes
5. Owners Neglect leads to inaccurate measurements
    a> Equipment gets wet and isn't properly dried, and cleaned.
    b> Instructions get lost.
    c> Equipment gets lost.
    d> Equipment gets damaged.
    e> Scale not accurate, or impossible to calibrate
    f> Every scale responds differently with different accuracy.
    g> Scale cannot be calibrated for the "heavy end" of weights.

USE OF OTHER METHODS:

If you know of other methods that should be discussed please pass them along to the editor at 5104 Alhambra Valley Road, Martinez, Ca. 94553-9775, 510-229-2927 or e-mail george_kleeman@comcast.net.

IMPORTANT IMPLEMENT SPECIFICATION DIFFERENCES BETWEEN THE VARIOUS RULEBOOKS AND DIVISIONS:

Tables 1 -4 in the appendix summarizes all of specifications for all implements. Some data is still needed for the handicap implements. This table was compiled as convenient way to have all the data in one place. In case of a question always refer to the rulebook itself in the event that a table has an incorrect entry.

Weight: There are still some slight difference between the NCAA and USATF concerning the Weight specifications. There is also a length difference between NCAA/USATF and WMA.

Javelin: There are no longer any differences between the rulebooks for the javelin specifications. All refer to the IAAF specifications.

Hammer: There are no longer any specification differences for the NCAA,USATF, IAAF, and WMA for the hammer. However, only USATF has specs for the size of the wire loop at each end.

APPENDIX

W&M ROOM LAYOUT

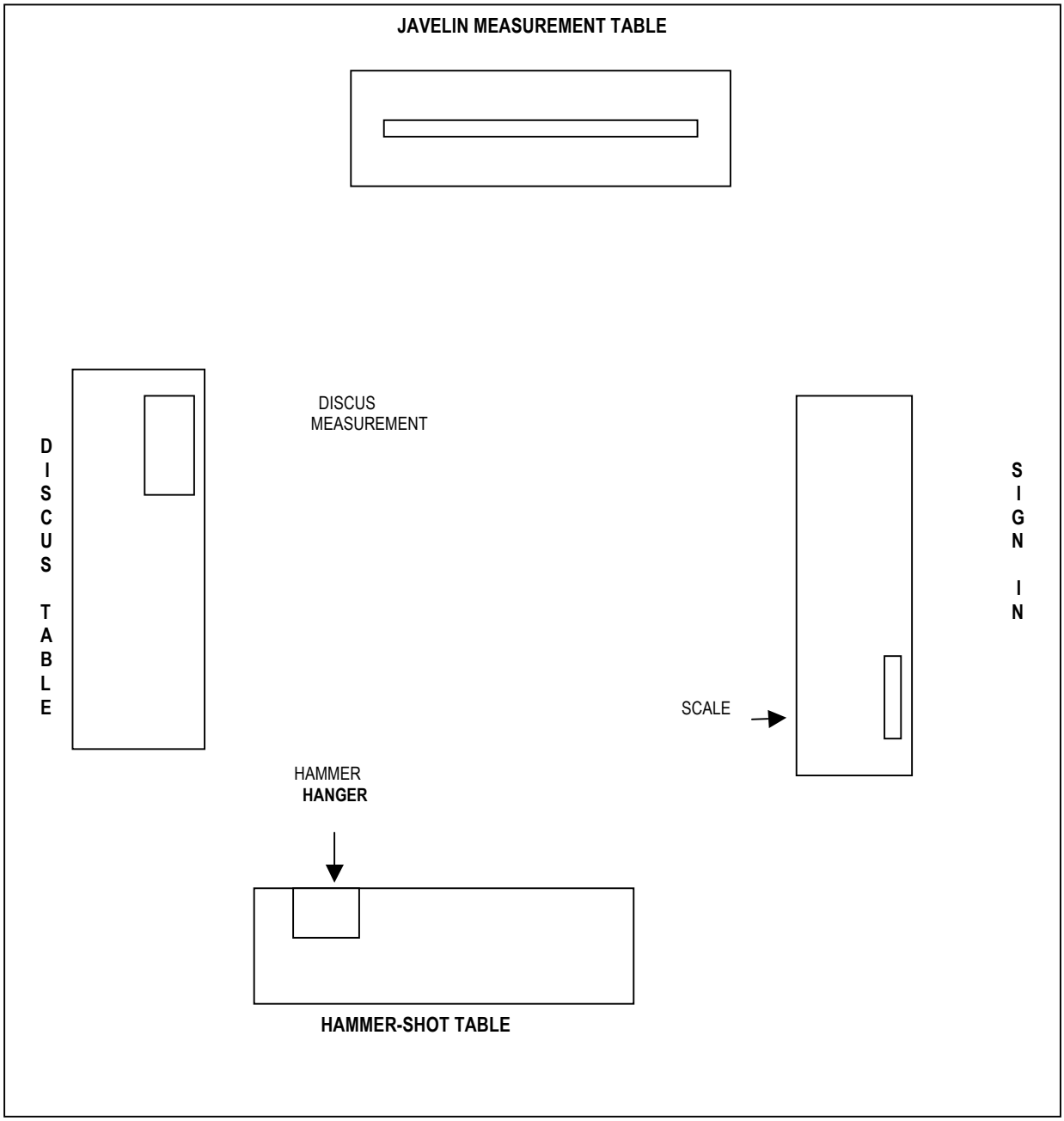

Fig. 1

Fig. 2 Beijing Implement Storage

Fig. 3 Layout at Des Moines NCAA Division I