



United States

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Processed  
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Branch

# Grading Manual for Tomato Catsup

Effective February 1992

This manual is designed for Processed Products Branch personnel of the U.S. Department of Agriculture. Its purpose is to give background information and guidelines to assist in the uniform application and interpretation of U.S. grade standards, other similar specifications, and special procedures.

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## SAMPLING PROCEDURES

Follow: Regulations (109-A-1)  
Sampling Procedures (120-A-1)  
Time Sampling (120-A-4)  
In-Plant Inspection (160-A-1; 160-A-5)  
Condition of Container (125-A-1)  
Foreign Material (172-A-1)  
Technical Inspection, Mold Count (135-A-8)

## NONQUALITY PROCEDURES

Follow: Time Sampling (120-A-5)  
Vacuum (128-A-20)  
Net Weight (128-A-10)  
Inspection by Variables (140-A-1)

## METHODS OF ANALYSES

In addition to using this manual and the U.S. grade standards for catsup, refer to the following Branch instructions:

Determination of Consistency - Methods of Analyses for Tomato Products

Solids Content Determinations - Methods of Analyses for Tomato Products

Mold Count - Methods of Analyses for Tomato Products

Technical Inspection Procedures for Foreign Material in Canned Tomatoes and Tomato Products (135-A-6)

Sand and Inorganic Residue - Methods of Analyses for Tomato Products

### **SALT**

The amount of salt found in catsup is a matter of preference. It usually ranges from 1.5 percent to 3.0 percent by weight. Neither the lack of salt in a catsup especially prepared as "low sodium" nor the addition of salt in a catsup labeled "added salt" should cause the score for the product to be lowered. These products should be graded to reflect the intended style or type of product marketed.

### **SPICES**

Spices make up a substantial part of the flavor sensation of tomato catsup. The most commonly used spices are cinnamon, cassia, cloves, allspice, pepper, cayenne pepper, ginger, mustard, and paprika. Onion and garlic may also be used. Some packers manufacture a "hot" or "hot style" catsup which contains an excessive amount of cayenne pepper. Spices are discussed further in the Suggested Order of Grading under the topic of "flavor".

### **VINEGAR**

Vinegar is the principal preserving agent in catsup. About one-half of the total acid in catsup comes from the vinegar. Most catsups have a total acidity ranging from 1.5 to 2.0 percent (expressed as acetic acid) which inhibits the growth of most yeast and bacteria. At these levels of acidity, sugar is added to maintain a proper sugar/acid ratio. The total acidity of the catsup should be over one percent, before considered effective as a preservative.

### **TOTAL SOLIDS**

In the U.S. Standards for Grades of Catsup, the definition for "total solids" means, "the refractometric sucrose value of the International Scale of Refractive Indices of Sucrose Solutions to which is added 1 percent." To clarify this statement further, "total solids" is represented by the values in the Scale cited above, to which is added one percentage **point**. For example, a sucrose value of 32 percent would become 33 percent after one percentage point is added. Table III in the "Methods of Analyses for Tomato Products -Solids Content Determinations" is a table derived especially for tomato catsup which already includes the one percent added to the refractive index. This table is included in the APPENDIX of these instructions.

### **GOOD FINISH**

"Good finish", as described in the U.S. grade standards means the product has a uniform, smooth texture. Most catsup packed under good commercial practice has a good finish. To be graded Substandard account finish would mean the product was quite lumpy, contained larger pieces of vegetable flavoring ingredients (such as onion), or contained an unsatisfactory amount of seed and/or peel, or a combination of the above.



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SUGGESTED ORDER OF GRADING A SAMPLE UNIT

1. After the nonquality factors (codes, net weights, vacuum, headspace, etc.) have been recorded, **evaluate and grade** the sample units on a container-by-container basis.
2. **Remove** some catsup from the container and prepare to smooth out a layer of product on a smooth white surface (shallow grading tray) by drawing a scraper with a clearance of 3/32 inch by 7 inches rapidly through the sample in two horizontal planes so as to form an approximate square or use the USDA Grading Plate and follow the instructions provided in the APPENDIX. The prepared sample is evaluated for defects in accordance with the following table:

QUALITY FACTOR	COLOR, KIND, TYPE OR SIZE	CLASSIFICATION		
		Minor	Major	Severe
DEFECTS	Light brown specks or seed particles 1/32 to 1/16 inch	X		
	More than 1/16 inch but not more than 1/8 inch		X	
	More than 1/8 inch			X
	Dark brown or black specks: 1/32 inch or less	X		
	More than 1/32 inch but not more than 1/16 inch		X	
	More than 1/16 inch			X
Peel:	More than 1/8 inch but not more than 3/16 inch	X		
	Over 3/16 inch		X	

Rejection numbers for various defects classifications

Grade	Defect Classification						
A/B	Severe		Major		Total		Seeds
	AC 2	RE 3	AC 6	RE 7	AC 12	RE 13	Not more than 1 seed/100 oz
C	5	6	15	16	30	31	Not more than 5 seeds/100 oz

Remember to use the above chart as a guide. In the U.S. grade standards, any combination of defects present that does not affect the appearance or eating quality more than slightly is U.S. Grade A. Any defects present that affect the appearance or eating quality more than slightly but not seriously is U.S. Grade C.

The following is a guide which may be used in regulating score points with relation to the number and type of defects found in the sample unit.

Severe	Major	Minor/Total	Points
0	0	0 - 2	25
0	1 - 2	3 - 5	24
0	3 - 4	6 - 8	23
1	5	9 - 10	22
2	6	11 - 12	21
3	7 - 9	13 - 18	20
4	10 - 12	19 - 24	19
5	13 - 15	25 - 30	18

The most severe defect(s) limits the score.

Examples: 1 severe and 3 minor = 22 points  
2 major and 4 minor = 23 points

3. **Place** a tablespoon of catsup on a flat transparent plastic plate located over a sheet of graph paper (1/16 inch graduations) and determine the amount of "weeping" after two minutes. This test for serum separation is a supplement to the test for consistency to help determine a score point value. Record the amount of separation on the scoresheet.
4. **Determine** the consistency using the Bostwick Consistometer or other equipment which gives equivalent results. Consistency is determined as the product comes from the container, before it is stirred to any great extent, and should precede determination of the total solids (when stirring is required).

Have the consistometer clean and dry for each determination.

Place on a steady support and level by means of the leveling screws.

Close the gate and fill the reservoir behind the gate with catsup. The temperature of the product in the consistometer should be as close as practicable to 20 degrees Celsius (68 °F).

Holding the instrument steady with one hand, trip the gate and start timing the instant the gate opens. A watch with a second hand or a stop watch is necessary.

After 30 seconds, observe the position of the front edge of the flow with respect to the lines on the bottom of the consistometer. These lines are one centimeter increments from the gate outward. The number of centimeters the catsup has flowed is the consistometer reading.

5. **Use** the score point guide and assign the score for consistency and separation of free liquid (determined earlier).

### Tomato Catsup

#### Bostwick Consistometer Chart (in centimeters, cm)

Score points:

Grade A&B

25 points

3.0 - 5.0

24 points

5.1 - 5.7

23 points

5.8 - 6.5

22 points

6.6 - 7.0

Grade C

21 points

2.8 - 2.9

7.1 - 8.0

20 points

2.6 - 2.7

8.1 - 9.0

19 points

2.4 - 2.5

9.1 - 9.5

18 points

2.0 - 2.3

9.6 - 10.0

Substandard

17 points

< 2.0

> 10.0

or less

Free liquor:

U.S. Grades  
A&B:

1/8th inch or less

U.S. Grade C:

1/4th inch or less

6. **Refer** to the color score guide found under the section for color of the U.S. grade standards for catsup to evaluate color.

**Determine** the color score using the Macbeth-Munsell Disks Colorimeter--Type 1 (or comparable equipment approved by the Branch). See the APPENDIX for selected approved colorimeters with equations.

**Classify** good color by assigning a score of 21 to 25 points if the color of the tomato catsup is as red as the prescribed combinations of the spinning Munsell disks described in the U.S. grade standards. While it is possible for badly scorched or oxidized catsup to meet the color requirement, the catsup would fail because it is not typical of properly processed catsup (See definition for good color--U.S. Standards for Grades of Catsup). If there is discoloration in the neck or any other area of the bottle, lower the score to 20 points or lower. If the discoloration seriously affects the appearance, lower the score to 16 points or lower.

**Classify** fairly good color by assigning a score of 17 to 20 points if the tomato catsup meets or exceeds the requirements for U.S. Grade C of the U.S. grade standards but fails to meet "good color".

7. **Determine** the flavor score by either assigning a score of 21 to 25 points for good flavor if the tomato catsup possesses a good, distinct flavor characteristic of good quality ingredients or by assigning a score of 17 to 20 points for fairly good flavor if the tomato catsup possesses a flavor characteristic in which there may be slight traces of undesirable flavor such as scorched, bitter, or astringent, but is free from objectionable or off flavor of any kind. Catsup with bright color and a pungent, pleasing odor will have a good acceptable flavor. No "off flavor or odor" is permitted in good flavor. In fairly good flavor, there may be slight trace of undesirable flavor but the catsup must be free from objectionable or off flavor of any kind. Tomato catsup can be formulated differently by adjusting the amount of spices, sugar, and acid, and tomato pulp. Evaluate flavor quickly. First impressions often are the best impressions. Repeated taste testing for flavor may not be as reliable as the initial impression. Catsup may vary in saltiness, acidity, and spice flavoring and still possess "good flavor". However, neither an extremely acid or an exceptionally bland catsup would be considered "good flavor".

Regular tomato catsup which contains an excessive amount of spices or salt which is objectionable, is assigned a lower score.

Note: Excessively spiced catsup labeled or declared to be "hot" or "hot style" or similarly labeled to denote an excess of spices, should be graded for its intended style and the body of the certificate should state: "Flavor - highly spiced."

8. **Determine** the total solids content using one of the methods found in the "Methods of Analyses for Tomato Products - Solids Content Determinations". Many processors have chosen to determine the total solids by centrifuging the product for 2 minutes in a Clay-Adams Centrifuge (or equivalent) and taking a reading of the filtrate (clear serum) on an Abbe, Bausch & Lomb, or Zeiss refractometer. There are several alternative methods that are also permitted for analyses.

**Refer** to the U.S. grade standards and methods of analyses for solids determination for instructions on centrifuging the product, applying the proper temperature corrections, and determining the total solids for tomato catsup (Table III in the instructions; Also see APPENDIX). Also remember, to correctly determine the total solids for catsup, one percentage point must be added to the International Scale of Refractive Indices of Sucrose Solutions OR use the values assigned in Table III for tomato catsup. The values in this table have been adjusted to include the addition of one percentage point. **Record** the total solids for the sample unit.

9. **Total** the score points for defects, consistency, color, and flavor for each sample unit.

10. **Find** the average of the total solids for the lot. A lot of tomato catsup is considered as meeting a grade with respect to total solids content if:

- (1) The sample average (average of all sample units) meet the applicable (or declared) concentration:
- (2) The number of sample units which fail the intended (or declared) average concentration does not exceed the applicable acceptance number specified in the single sampling plan contained in the regulations (7 CFR 52.1 - 52.83); and
- (3) No sample unit may fall more than one percent (1%) below the appropriate requirement. For example, if the grade requirement is 33% total solids, no sample unit may be less than 32% total solids.

11. **Assign** the grade for the lot as a whole.

APPENDIX



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### INSPECTION EQUIPMENT

1. Scale, preferably graduated to 0.1 ounces.
2. Vacuum gauge.
3. Headspace gauge.
4. Can opener.
5. Flat white grading tray (at least 7" x 7") and metal scraper with prescribed clearance or approved USDA Grading Plate. Also, see USDA Grading Plate Instructions in this APPENDIX.
6. Approved light source for grading.
7. Refractometer and filter paper.
8. Bostwick consistometer, thermometer, and stop watch.
9. Mold counting equipment (See Methods of Analyses for Tomato Products, Mold Count).
10. Ruler.
11. Instructions for Inspection of Canned Tomato Catsup; U.S. Standards for Grades of Catsup; Solids Content Determination, Methods of Analyses; and Any supplemental instructions or methods that achieve equivalent results when compared to these instructions.
12. Contract specifications; Applicant information; and Score sheets and work sheets for preparing certificates.
13. Other equipment not specifically listed.

### **USDA GRADING PLATE INSTRUCTIONS**

A comparable but more precise method to evaluate tomato catsup for defects is provided by the use of the Official USDA Grading Plate. This device consists of a flat plastic sheet, 9-1/2 inches square, to which two circular rings are cemented -- the rings being 7-3/4 inches in diameter. On one side of the plate the ring forms a shallow cylinder having a depth of 3/32 inch and on the other side a similar shallow cylinder having a depth of 1/4 inch. A plastic scraper is furnished with each plate.

The cylinder on the grading plate with the 3/32 inch depth provides very nearly the same volume of product at the same depth as the method prescribed in the U.S. grade standards.

#### **Instructions for using the USDA Grading Plate are as follows:**

1. Use the cylinder with the 3/32 inch depth;
2. Transfer a sufficient amount of the thoroughly mixed product into a cylinder to provide a slight excess of material;
3. Tilt the grading plate in a circular motion allowing the product to run evenly to the walls of the cylinder;
4. While holding the plate level, scrape the excess product off with the plastic scraper so that the material remaining is even with the top edge of the cylinder; and
5. Place the grading plate over a white surface and view the sample in such a manner as to eliminate surface glare. Do not pick the plate up and view from the underside.

The prepared sample is evaluated for defects in accordance with the classifications and allowances for defects (See Step 2, suggested order of grading).

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TABLE III  
REFRACTIVE INDEX/TOTAL SOLIDS FOR TOMATO CATSUP  
20° Celsius (68° F)

R.I.	% Total Solids	R.I.	% Total Solids	R.I.	% Total Solids	R.I.	% Total Solids
1.3389	18.0	1.3682	23.6	1.3778	29.2	1.3879	34.8
1.3592	18.2	1.3685	23.8	1.3782	29.4	1.3883	35.0
1.3595	18.4	1.3688	24.0	1.3785	29.6	1.3887	35.2
1.3598	18.6	1.3692	24.2	1.3789	29.8	1.3891	35.4
1.3602	18.8	1.3695	24.4	1.3792	30.0	1.3894	35.6
1.3605	19.0	1.3699	24.6	1.3796	30.2	1.3898	35.8
1.3608	19.2	1.3702	24.8	1.3800	30.4	1.3902	36.0
1.3612	19.4	1.3706	25.0	1.3803	30.6	1.3906	36.2
1.3615	19.6	1.3709	25.2	1.3807	30.8	1.3909	36.4
1.3618	19.8	1.3712	25.4	1.3810	31.0	1.3913	36.6
1.3621	20.0	1.3716	25.6	1.3814	31.2	1.3916	36.8
1.3625	20.2	1.3719	25.8	1.3818	31.4	1.3920	37.0
1.3628	20.4	1.3723	26.0	1.3821	31.6	1.3924	37.2
1.3631	20.6	1.3726	26.2	1.3825	31.8	1.3928	37.4
1.3635	20.8	1.3729	26.4	1.3829	32.0	1.3931	37.6
1.3638	21.0	1.3733	26.6	1.3832	32.2	1.3935	37.8
1.3641	21.2	1.3736	26.8	1.3836	32.4	1.3939	38.0
1.3645	21.4	1.3740	27.0	1.3839	32.6	1.3943	38.2
1.3648	21.6	1.3743	27.2	1.3843	32.8	1.3947	38.4
1.3651	21.8	1.3747	27.4	1.3847	33.0	1.3950	38.6
1.3655	22.0	1.3750	27.6	1.3850	33.2	1.3954	38.8
1.3658	22.0	1.3753	27.8	1.3854	33.4	1.3958	39.0
1.3661	22.4	1.3757	28.0	1.3858	33.6	1.3962	39.2
1.3665	22.6	1.3761	28.2	1.3861	33.8	1.3966	39.4
1.3668	22.8	1.3764	28.4	1.3865	34.0	1.3970	39.6
1.3672	23.0	1.3768	28.6	1.3869	34.2	1.3974	39.8
1.3675	23.2	1.3771	28.8	1.3872	34.4	1.3978	40.0
1.3678	23.4	1.3775	29.0	1.3876	34.6	1.3982	40.2

Table based on Sucrose value plus one percentage point  
Table III - Methods of Analyses, Solids Content Determination

TABLE IV  
CORRECTIONS FOR REFRACTIVE INDEX READINGS  
WHEN DETERMINED AT TEMPERATURES OTHER THAN 68N F (20N C)

<u>Temperature</u>		<u>Refractive index reading</u>					
<u>NC</u>	<u>NF</u>	<u>1.3400</u>	<u>1.3500</u>	<u>1.3600</u>	<u>1.3700</u>	<u>1.3800</u>	<u>1.3900</u>
<u>To be subtracted from reading:</u>							
15	59.0	.0004	.0005	.0005	.0006	.0006	.0007
16	60.8	.0004	.0004	.0004	.0005	.0005	.0005
17	62.6	.0003	.0003	.0003	.0003	.0004	.0004
18	64.4	.0002	.0002	.0002	.0002	.0002	.0003
19	66.2	.0001	.0001	.0001	.0001	.0001	.0001
<u>To be added to reading:</u>							
21	69.8	.0001	.0001	.0001	.0001	.0001	.0001
22	71.6	.0002	.0002	.0002	.0002	.0003	.0003
23	73.4	.0003	.0003	.0003	.0004	.0004	.0004
24	75.2	.0004	.0004	.0005	.0005	.0005	.0005
25	77.0	.0005	.0005	.0006	.0006	.0007	.0007
26	78.8	.0006	.0006	.0007	.0008	.0008	.0008
27	80.6	.0007	.0008	.0008	.0009	.0010	.0010
28	82.4	.0008	.0009	.0010	.0010	.0011	.0011
29	84.2	.0010	.0010	.0011	.0012	.0012	.0013
30	86.0	.0011	.0012	.0012	.0013	.0014	.0014

Table IV - Solids Content Determination, Methods of Analyses

## SCORING TOMATO CATSUP COLOR OBJECTIVELY

Other selective electronic color meters may be used as an alternate means of determining color in tomato catsup (in addition to the use of the Macbeth-Munsell colorimeter). Such meters shall be calibrated to indicate that the color of the product is as red or more red than that produced by spinning the Munsell color disks in the combination as set out in the U.S. grade standards.

### Methods

**Tomato Catsup.** Color of tomato catsup is measured as it comes from the container. No dilution is necessary. If the tomato catsup is in a can, the product must be thoroughly mixed prior to measuring color. If the sample is in a **bottle**, the **entire contents** of the bottle must be emptied into a beaker so the sample can be thoroughly mixed prior to sampling or color measuring. During stirring, care should be taken to avoid incorporation of air bubbles into the product.

### Colorimeters - Operation, Standardization and Color Score Calculation

#### Hunter Colorimeters:

**Instrument.** Use Hunterlab **D25-D2** series with type A optical head.

**Selection and Use of Sample Cups.** On request, U. C. Davis will supply several six-ounce cans of the standard (see page 22 for address).

#### Color Score Point Conversions - Hunter Colorimeter

The following equation is used for calculation of tomato catsup color score:

$$\text{Score} = -74.937 + 7.5172(a_L) - 0.1278(a_L)^2 - 0.8051(b_L)$$

#### Agtron Colorimeters:

**Agtron M400 and M500.** Use black and red discs to set zero on scale.

**Selection and Use of Sample Cups.** (Agtron M400 and M500 Models). Use only pre-selected cups. On request, U. C. Davis will supply several six-ounce cans of the standard (see page 22 for address).

### **Color Score Point Conversions - Agtron Colorimeters**

The following equation is used for calculation of tomato catsup color score:

#### **Agtron M400 and M500 Colorimeters**

$$\text{Score} = -5.3411 + 1.0309(R) - 0.00745(R^2) - 0.15663(G)$$

#### **Gardner Colorimeters:**

**Instrument.** Use Gardner models XL20 or XL23 series, XL-805 and Colorgard 2000/05 models.

**Selection and Use of Sample Cups.** Use only pre-selected cups. On request, U. C. Davis will supply several six-ounce cans of the standard (see below for address).

#### **Color Score Point Conversions - Gardner Colorimeters**

The following equation is used for calculation of tomato catsup color score:

$$\text{Score} = -40.511 + 4.7767(a_L) - 0.07791 (a_L^2) - 0.56986(b_L)$$

#### **Information and Assistance**

Assistance in colorimeter standardization and operation may be obtained by contacting your supervisor at the local area field office.

For further information about obtaining cans of tomato color standards to use to standardize these colorimeters, please contact:

Teri Wolcott  
Department of Food Science and Technology  
Crues Hall  
University of California  
Davis, California 95616  
(916) 752-8079