4-2005

Crafting Culture at Fort St. Joseph: An Archaeological Investigation of Labor Organization on the Colonial Frontier

Brock A. Giordano
Western Michigan University

CRAFTING CULTURE AT FORT ST. JOSEPH: AN ARCHAEOLOGICAL INVESTIGATION OF LABOR ORGANIZATION ON THE COLONIAL FRONTIER

by

Brock A. Giordano

A Thesis
Submitted to the
Faculty of The Graduate College
in partial fulfillment of the
requirements for the
Degree of Master of Arts
Department of Anthropology

Western Michigan University
Kalamazoo, Michigan
April 2005

ACKNOWLEDGMENTS

I would like to acknowledge and thank the numerous individuals who have provided advice and support throughout this project. I would like to thank my advisor and chairperson, Dr. Michael S. Nassaney, for his strict guidance and continued support throughout this process. I am truly thankful for the opportunities and involvement that he presented to me throughout this research. Special thanks to Dr. Frederick Smith for his continued positive reinforcement throughout this research process. His many late night words of wisdom helped me keep a positive mindset throughout this research. Thanks to Dr. Lynn Evans for being a valuable member of my thesis committee and providing continuous support. Special thanks to Carol Bainbridge and the Fort St. Joseph Museum for allowing me access to the collection. Kathleen Ehrhardt and Lisa Marie Anselmi receive special thanks for their gracious support. Additionally, I would like to thank many of the graduate students who contributed to my experience along the way, especially Dan Lynch, Tim Bober, the McCarthy family, members of Blue Sofa, and James Tyler. Special thanks to Rory Becker for the many conversations and constant laughs that we shared throughout this research. I would also like to thank all my friends back east in Jersey for their continuous moral support. Finally, I would like to express my deepest gratitude to my entire family for the love and support that they constantly provide me. Their belief in me has made me the person I am today and for this I am truly grateful. I would like to give a special thanks to my father, Philip Giordano, for his dedication to me and my research is truly remarkable. I am proud to say that all interpretations of the data and any shortcomings found in this work remain the sole responsibility of the author.

Brock A. Giordano

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Brock A. Giordano, M.A.

Western Michigan University, 2005

The study of labor organization through the examination of craft production in complex societies has been a topic of intense scholarly interest (Blackman et al. 1993; Costin and Hagstrum 1995; Shafer and Hester 1991). A number of scholars have hypothesized that goods produced in mass quantities by particular specialists can be recognized by their high degree of standardization or homogeneity (Blackman et al. 1993:61; Schiffer and Skibo 1997). As such, this study employs the theoretical framework that in an archaeological context it is possible to differentiate centralized production from noncentralized production by identifying any standardization or variation within the manufacturing techniques used and formal style of the final forms created. This study investigates the way labor was organized in the context of Native American and French populations in the western Great Lakes fur trade at Fort St. Joseph. Specifically, this study examines the degree of standardization or variation in the technological metalworking practices and morphological variation associated with one form of material culture – the tinkling cone.

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CHAPTER I

INTRODUCTION

The study of labor organization through the examination of craft production in complex societies has been a topic of intense scholarly interest (Blackman et al. 1993; Costin and Hagstrum 1995; Shafer and Hester 1991). Measurements of standardization, including formal and technological attributes, are often used as reliable indices for identifying specialized production (Blackman et al. 1993; Brumfiel 1980; Costin and Hagstrum 1995; Shafer and Hester 1991). Archaeological studies of complex societies have long recognized craft specialization as a major characteristic in identifying and examining social, economic, political, and cultural systems (Blackman et al. 1993; Brumfiel and Earle 1987; Kenoyer et al. 1991:44; Rice 1981; Sinopoli 1988:581). Here craft specialization is defined as an adaptive process that reflects the evolving cultural continuum. As such the organization of labor can be studied through the role of craft specialization (Costin and Hagstrum 1995; Kenoyer et al. 1991; Rice 1981; Sinopoli 1988).

The organization of labor has been examined through various forms of material culture such as stone beads (Kenoyer et al. 1991), architecture (McGuire and Schiffer 1983), ceramics (Blackman et al. 1993; Costin and Hagstrum 1995; Schiffer and Skibo 1997; Stark 1991), metal (Wray et al. 1987), and stone tools (Odell 1999; Schaffer and Hester 1991). As expressions of their makers and users identities, artifacts are “rooted in historical and sociocultural conditions and processes” (Jones

1993:182). As such, material culture may serve as a mechanism to examine the organization of labor and shed insight into the changing sociocultural and economic relationships that existed in complex societies. This study investigates the organization of labor through the analysis of cuprous metalworking practices by specifically examining the technological histories of locally produced tinkling cones during the late seventeenth and eighteenth century fur trade.

Tinkling cones, also referred to as tinklers, bangles, dangles, or jingles (Ehrhardt 2002:240; Good 1972; Jelks 1966; Krause 1972; Odell 2001; Walthall and Brown 2001), are conical-shaped decorative objects formed into a cone shape with an open apex by rolling a flat trapezoidal or square metal blank of metal, cut from recycled trade kettles, around a mandrel. Archaeological evidence for the production of tinkling cones is comprised of all the stages of manufacture, from procurement through discard (Ehrhardt 2002:81) in the forms of scrap metal, blanks, rolled rivets, and kettle patches (Anselmi 2004; Bradley 1987; Morand 1994). By identifying any standardization or variation within the manufacturing techniques used in the production of tinkling cones and formal attributes or "style" (Lechtman 1977) of the final forms created, this research investigates any technological signatures that distinguish varied technological practices and ultimately the organization of production that existed during the late seventeenth and eighteenth century in the western Great Lakes fur trade.

The North American fur trade linked people and regions economically and politically through European mercantile expansion (Wallerstein 1976; Wolf 1982). In the western Great Lakes region, or *pays d'en haut,* the fur trade provides an avenue to examine the impact of culture contact and the changing relationships that existed between Native and European populations. One place where changing social, cultural, and economic conditions may be examined is the colonial fur trade outpost known as Fort St. Joseph.

Located in the interior of the Great Lakes region in what is now southwest Michigan, Fort St. Joseph was at the center of commercial, military, and religious activity for local Native populations and European colonial powers from 1691 to 1781 (Nassaney and Cremin 2004). Fort St. Joseph provides an excellent context to examine the role of craft specialization and the organization of labor on the colonial frontier as it is rarely mentioned in historical documents but well represented in the archaeological record. The adoption of shared cultural values and beliefs between two culturally distinct groups (Native and French) can be recognized through the material cultural that has been left behind. Objects such as copper and brass kettles were popular trade and gift items amongst the Natives. Documentary evidence of trade records reveals there was a strong demand for copper kettles (Anderson 1994). However, it is only through the examination of material culture and the archaeological record that the multiple uses of these material objects may be examined. Besides being used for household functions such as cooking, kettles played a major role in craft production (Morand 1994; Turgeon 1997). As they wore down they were cut up and readapted for new uses, such as tinkling cones and projectile points. This notion of reuse and repair seen archaeologically in the form of scrap metal illustrates an alternative method for acquiring goods beyond the boundaries of the fur trade while shedding insight into the socio-economic complexity of the fur trade.

Specifically, the objective of this research is to examine the way production was organized in the context of Native and French populations during the late seventeenth and eighteenth century western Great Lakes fur trade at Fort St. Joseph. To accomplish this goal, this study investigates the role of craft specialization through the analysis of cuprous metalworking practices by examining the technological histories of locally produced tinkling cones. One way to investigate the organization of labor through the examination of material culture is by applying the standardization hypothesis. According to the "standardization hypothesis," specialized production of a particular form or type of material culture may be "observed in the archaeological record through standardization in raw-material and manufacturing techniques, form and dimensions, and surface decoration" (Blackman et al. 1993:61). By analyzing the degree of standardization or variation involved in the sequence of production of tinkling cones and morphological attributes of the final form created, this thesis provides new insight into how labor was organized in and around Fort St. Joseph. This in turn reflects larger economic issues of production, labor, trade, and social stratification throughout the western Great Lakes fur trade.

Archaeologists interested in understanding the organization of specialized craft production have come to recognize the wide range of social, economic, political, and cultural processes that contribute to the development of a particular society in which goods are produced by specialists (Costin and Hagstrum 1995; Blackman et al. 1993; Brumfiel and Earle 1987; Kenoyer et al. 1991:44; Rice 1981; Sinopoli

1988:581). In order to investigate the organization of craft production in complex societies, where most goods are produced by specialists (Sinopoli 1988:581), it is necessary to distinguish between two modes of production. They are centralized production and noncentralized production (Kenoyer et al. 1991; Sinopoli 1988:581).

Centralized production refers to large-scale production in which the demand for an object results in widespread distribution (Sinopoli 1988). In stratified societies where production is strictly controlled, influencing factors such as access to raw materials, new technologies, and external regulations are often seen as indicators of centralized production (Sinopoli 1988). Competition that results in the production and widespread distribution of large quantities of goods is a characteristic of centralized production.

Noncentralized production refers to smaller scale production that takes place in smaller and more dispersed workshops (Sinopoli 1988:582). Noncentralized producers respond to the needs of nearby consumers. Distinguishable variants in production, including the technological and morphological attributes, are seen in their products in response to the needs of their nearby consumers.

In an archaeological context it is possible to differentiate centralized production from noncentralized production by identifying any standardization or variation within the manufacturing techniques used and formal style of the final forms created.

The organization of production in and around Fort St. Joseph can be examined by assessing the degree of standardization in the production of tinkling cones. High degrees of uniformity or standardization exhibited in both the production sequence and the morphological attributes in the finished form are expected to be the result of centralized production. Thus, tinkling cones that exhibit a greater degree of uniformity or standardization are evidence of centralized production. Conversely, variations exhibited in archaeological patterning are expected to indicate a noncentralized mode of craft production. Thus, a lesser degree of uniformity exhibited in the production sequence and final forms, evidences a noncentralized mode of production.

In order to investigate the organization of labor in and around Fort St. Joseph, this research applies the theoretical framework that distinguishable similarities in manufacturing techniques and formal styles of crafted objects are indicative of centralized production (Anselmi 2004:428; Blackman et al. 1993; Wray et al. 1987:250). Conversely, objects that exhibit variation in uniformity are indicative of noncentralized production. Using this theory as my premise, this thesis addresses such questions as, what materials and processes were used in the production of tinkling cones? What were the tools being used and is it possible to identify ethnic variation by examining the manufacturing techniques and formal attributes of tinkling cones? How can technology and technological variation inform on the organization of labor, and as such, what conclusions can be made about the organization of labor through the archaeological record?

To explore these issues, this analysis draws on multiple lines of complimentary data, including a detailed "technometric analysis" (Leader 1988) that includes metric analysis, visual inspection techniques, and scratch testing to determine the base metal, to specifically examine the "technological histories"

(Ehrhardt 2002:81) of a collection of 356 tinkling cones that are curated at the Fort St. Joseph Museum and attributed to the colonial fur trade outpost of Fort St. Joseph. By exploring the degree of standardization or variation in the technological metalworking practices and morphological variation of forms produced, that is, identifying any standardization or variation within the manufacturing techniques and formal styles, specifically in the production of tinkling cones, this study will provide insight into the way labor was organized in the context of Native and French populations during the Middle Historic period in the western Great Lakes fur trade at Fort St. Joseph.

In Chapter 2, I examine how previous researchers from various disciplines (i.e. archaeology, anthropology, and history) have examined issues of labor and the organization of production. I continue with a synopsis of the temporal and spatial distribution of tinkling cones recovered from French and Native American archaeological sites. Chapter 3 presents a historic overview of Fort St. Joseph and describes the formation of the collection of 356 finished tinkling cones under study. Chapter 4 presents the analytical methods, including the archaeometric and visual examination techniques, employed to examine for standardization in the manufacturing of this collection of tinkling cones. Chapter 5 identifies and describes the 11 manufacturing techniques (after Anselmi 2004) that were employed in the production of conical, extended base, and extended seam tinkling cones, the raw material and the two additional visually determinable deformations. It follows with the analysis and the results of the styles, measurements, and manufacturing techniques and detailed comparative analysis of the raw material observed in the collection under study. Finally, Chapter 6 presents the summary and conclusions of this thesis and discusses avenues of future research to which this study can contribute.

CHAPTER II

LITERATURE REVIEW

In this chapter I first address how previous researchers examined standardization and variation in craft specialization to investigate the organization of labor in complex societies. Second, I provide a cultural context of the fur trade and examine theoretical premises for analyzing craft production. Finally, I conclude by providing an analysis of the spatial and temporal dimensions of tinkling cones through the examination of the archaeological record.

Craft Specialization, Standardization, and Variation

Archaeologists, anthropologists, and historians alike have utilized multiple lines of evidence to examine the organization of labor (Blackman et al. 1993; Brumfiel and Earle 1987; Costin and Hagstrum 1995; Kenoyer et al. 1991:44; Rice 1981; Sinopoli 1988:581). Investigating the organization of craft production can give insight into the social and cultural makeup of the colonial frontier (Morand 1994). Archaeological studies have come to recognize the variable range of dimensions that must be addressed in examining the organization of labor (also referred to the organization of production) in complex societies (Blackman et al. 1993; Brumfiel and Earle 1987; Costin and Hagstrum 1995; Kenoyer et al. 1991; Sinopoli 1988). These include social, economic, political, and symbolic or religious systems, as well as certain technological characteristics including the availability of raw materials and the ability to produce objects under specific requirements to fit the demand of the consumer population. Thus, the organization of labor (production) reflects how particular industries or communities were organized to service different demands presented by the consuming population (Costin and Hagstrum 1995:619). In all societies, the need to adapt to changing socioeconomic conditions fosters change, which results in cultural transformations with each society having influence on other (Anderson 1991, 1994; White 1991). The study of post-contact artifacts is significant in evaluating specific cultural transformations that were taking place and how "new cultural traits were adopted, modified, and created to fit within the underlying ideological structure of both non-European and European peoples" (Lightfoot 1995:206).

Archaeological studies that examine the organization of labor have come to recognize craft specialization as a defining characteristic of all complex societies (Costin and Hagstrum 1995; Rice 1981; Sinopoli 1988). A number of scholars have hypothesized that goods produced in mass quantities by particular specialists can be recognized by their high degree of standardization, homogeneity, or uniformity (Blackman et al. 1993:61; Schiffer and Skibo 1997). Following this notion, "standardization" is defined here as the relative degree of homogeneity present in both the technological sequence used to produce the object of material culture and the formal attributes present in the finished form (Blackman et al. 1993:61). Therefore, it is expected that centrally controlled specialized production will produce objects exhibiting greater uniformity or standardization (Sinopoli 1988:582).

Standardization exhibited in the formal attributes in the final object, and the manufacturing sequence used to produce the object, is often used as evidence to measure an artisans skill (Costin and Hagstrum 1995). Skill reflects the ability of an individual to produce a particular form of material culture in repetition throughout the sequence of production (Costin and Hagstrum 1995:623). Therefore, objects manufactured with a greater degree of skill will exhibit similar patterning or uniformity in the formal and technological characteristics in the final crafted product because of the carefully controlled (consciously or unconsciously) repetitive actions of the producer. As such, skill is measured by the degree of repetition in the sequence of production that is observable in the final form. High degrees of standardization, observed through repetitive productions patterns, are expected to result from large-scale or centralized production (Kenoyer el al. 1991; Sinopoli 1988).

To investigate the organization of craft production in South India, Sinopoli (1988) examines the production of textiles and ceramics. Sinopoli (1988) contends that in order to investigate the organization of specialized production we must first identify the various modes of production. Sinopoli (1988) focuses on two modes of production - centralized production and noncentralized production. Simply defined, mode of production is the relationship between humans (labor) and the means of production (tools and raw materials).

Centralized production, as discussed in Chapter I, refers to large-scale production in which the production process is strictly controlled by variable factors such access to raw materials, new technologies, and external regulations (Sinopoli 1988:582). In one analysis of contemporary stone beadmaking in Khambhat, India, Kenoyer et al. (1991:55) find that the organization of production is highly stratified and rigidly controlled by dominant individuals or merchant families. Kenoyer et al.

(1991:56) argue that in the context of bead manufacture the presence of a standardized commodity is a strong indicator of large-scale centralized production.

Conversely, noncentralized production, as discussed in Chapter I, refers to smaller scale production that takes place in more dispersed workshops in order to respond and adapt to the needs of nearby consumers (Sinopoli 1988:582). In her examination of craft production in Vijayanagara, South India, Sinopoli (1988:594) contends that ceramic production appears to have taken place in relatively small-scale and independent workshops. By examining several varieties of vessel forms in conjunction with specific workshops, Sinopoli (1988:590-591) finds that significant variation exists between the workshops in a wide range of variables, including formal attributes identified in the vessel forms, such as maximum diameter, basal diameter, rim thickness, rim height, neck height, maximum body height, basal height, vessel height, and the ratio of vessel height/rim diameter. Sinopoli (1988:593) concludes that "relatively minor but noticeable variations between the products of different workshops" are indicative of noncentralized production. Therefore, in noncentralized production we would expect to see technological and formal variation in similar types of material objects. This is the result of production from more dispersed workshops operating in somewhat different social and technological contexts, and also the varying degrees of skill of the labor force producing such items and the availability of preferred tools and raw material (Sinopoli 1988:593). In a noncentralized mode of production generally accepted forms of an object when defined by local consuming traditions will exhibit considerable variation among similar types.

Costin and Hagstrum (1995) combine the technological attributes of standardization, labor investment, and skill in order to investigate the organization of ceramic production in central Peru. They investigate the ways in which production is organized and how consumer demand influences the technological processes involved in the manufacturing of an object. They conclude that labor, skill, and standardization, i.e. manufacturing technology, attained in finished goods, "is a sensitive indicator of the sociology and economy of craft production and consumption" (Costin and Hagstrum 1995:621). In this context, standardization or homogeneity exhibited in the finished form including material, shape, and/or decoration are all criteria that signify "economic and social constraints within the production system" (Costin and Hagstrum 1995:622). Characteristics such as these are an indication of centralized production.

As a way to explain artifact variability, Schiffer and Skibo (1997:28) present a theoretical framework that incorporates an artifact's observable, often measurable, physical characteristics – formal variability. Schiffer and Skibo (1997:28-31) suggest that "formal variability is caused, in a proximate fashion by artisans executing different sequences of material procurement and manufacture activities, including materials preparation." Therefore, it is important to understand the differences and similarities in an artifact's production sequence, as artifacts produced by different artisans, and thus different manufacturing sequences, are said to differ in design. As such, the technical choices performed by an individual in material procurement and the manufacturing process can be traced in the artifact itself (Schiffer and Skibo 1997:29). This implies that the technical choices visible in the final form are an indication of the artifact's life cycle and thus the artifact's artisan. This in turn enables material culture to shed insight into various aspects of past cultures' beliefs, practices, and ideologies (Nassaney and Johnson 2000).

Jules Prown (1993:1), an art historian, defines material culture as the study of material to understand culture, to discover beliefs – the values, ideas, assumptions, and attitudes – of a particular community or society at any given time. The underlying premise is that human-made objects (artifacts) express (consciously or unconsciously) the beliefs of the individuals who commissioned, fabricated, purchased or used them, and by extension the beliefs of the larger society to which these individuals belonged. In this notion Prown (1993), as with Schiffer and Skibo (1997:28), suggest that the technological choices made in the production of an object are direct reflections in the "activities constituting the life histories of artifacts and people." Thus, greater understanding of an artifact's production sequence will result in greater knowledge of the artisan who produced the artifact. Furthermore, examining the technological history of an object allows us to investigate the various sociocultural conditions that existed during the artifact's life cycle.

In summary, archaeologists who examine the organization of labor have come to recognize craft specialization as a defining characteristic of all complex societies (Costin and Hagstrum 1995; Rice 1981; Sinopoli 1988). Archaeological studies interested in understanding the organization of specialized craft production distinguish between the wide range of social, economic, political, and cultural processes that contribute to the development of a particular society in which goods are produced by specialists (Blackman et al. 1993; Brumfiel and Earle 1987; Costin and Hagstrum 1995; Kenoyer et al. 1991:44; Rice 1981; Sinopoli 1988:581). To examine the organization of craft production in complex societies, it is necessary to distinguish between the modes of production organization. Here I focus on two modes of production. These are termed centralized production and noncentralized production (Kenoyer et al. 1991; Sinopoli 1988:581).

In order to investigate the way production was organized in the context of Native and French populations during the late seventeenth and eighteenth century western Great Lakes fur trade at Fort St. Joseph, this study examines the degree of standardization or variation involved in the sequence of production of tinkling cones and morphological attributes of the final form created. Furthermore this study employs the theoretical framework that distinguishable similarities in manufacturing techniques and formal styles of crafted objects are indicative of centralized production (Anselmi 2004:428; Blackman et al. 1993; Wray et al. 1987:250). Conversely, objects that exhibit variation in uniformity are indicative of noncentralized production.

Craft Production and the Fur Trade

The examination of craft production provides a unique opportunity to shed insight into past cultures' beliefs, practices, and ideologies that have otherwise gone unrecorded. Written accounts of trade records reveal a high demand for kettles however it is only through the archaeological record that we may begin to gain an understanding of how objects took on new meaning as they were transformed to serve new alternative purposes from which they were originally produced. One such avenue to examine the emergence of two culturally distant groups in a culture contact setting is the North American fur trade. In particular, this study examines the 17th and 18th century western Great Lakes fur trade at Fort St. Joseph.

Interpretations of culture contact in the western Great Lakes region have come to recognize the complexities and dynamics of the fur trade. Culture contact within the frontier landscape spawned dramatic changes among the populations in order to survive. Within the context of the western Great Lakes fur trade, it is now argued that culture contact and interaction between the Natives and Europeans (particularly French) were mutual endeavors with particular accommodations taking place in the common interests of both parties (Anderson 1994; Sleeper-Smith 2001; White 1991). Thus, continuous interaction between Native and French individuals resulted in cultural transformations causing identity boundaries to become blurred (White 1991).

The examination of specialized craft production through the material culture that has been left behind can shed insight into the social, cultural, and economic systems that were continuously evolving and being transformed on the colonial frontier. The production of such items like tinkling cones, projectile points, and triangular pendants incorporated and transformed European trade goods into new ornamental, decorative, and symbolic objects (Anselmi 2004; Ehrhardt 2002; Miller and Hamell 1986; Turgeon 1997). For example, objects such as copper and brass kettles were popular trade and gift items amongst the Natives. Besides being used for their intended utilitarian household functions such as cooking and storage, kettles played a major role in craft production (Morand 1994; Turgeon 1997). As kettles became too worn and beyond repair, they were cut up and used as raw material to produce new (mostly decorative vs. utilitarian, see Ehrhardt 2002) items, such as copper and brass tinkling cones, beads, and triangular pendants. Modifications made to European introduced goods to form new material objects are an indication of how Natives were incorporating and transforming European goods into their own cultural identities (Miller and Hamell 1986). This suggests that new material objects were being integrated into existing Native cultural traditions, rather than the Natives adopting new and imposing cultural values and transformations (Miller and Hamell 1986).

Scholars who have studied the fur trade of the western Great Lakes and its impact on Native and European societies have proposed varying interpretations regarding culture contact. Early material culture studies conducted on culture interaction and change within the fur trade have focused on objects of European origin found in Native contexts. The prevailing concept was that European objects were integrated into and transformed Native life (Quimby 1966). Turgeon (1997) conducted a study on the multiple lives of a copper kettle by following its transcultural movement to find how it was used in shaping peoples' identities (Turgeon 1997:9). Turgeon used the copper kettle to identify "the uses made of an object in the culture of origin, to reconstruct its transcultural pathway, and to uncover the new uses to which it was put by the receiving culture" (Turgeon 1997:4). Turgeon (1997) demonstrates that viewing the multiple histories of a copper kettle through time allows for the discovery of the redefinitions and altered meanings that are encoded through this form of material culture.

In the last thirty years there have been many studies of the life of a copper kettle. For example, Martin (1975) looked at the varying functions of a copper pot, such as a container for food, as burial furniture, and as a way of identifying interaction and changing relationships between cultures. More recently, Moreau (1998) examined the "traditions and cultural transformations" that can be exhibited through copper kettles and so-called Jesuit rings from 17th century Native-occupied archaeological sites. Moreau suggests that the contribution of new material goods "testifies more for a process of integration into existing Native cultural tradition, than for transformations of behavior and cultural values" (Moreau 1998:8).

It is important to recognize that European trade goods were valuable, not for their uniqueness or technological benefits, but for their similarity to Native goods (Miller and Hamell 1986). In order to identify how Natives were incorporating European introduced goods into their own culture and customs, Miller and Hamell (1986:315) employed historical, archaeological, and ethnographic materials to conduct a study which reveals that Natives in the sixteenth and seventeenth centuries did not consider European copper as something new, but as an object already familiar to their own traditional ideological systems (Miller and Hamell 1986:315). Therefore, the Natives incorporated European introduced materials into their own culture and customs, creating ceremonial objects that possessed ideological and symbolic meaning (Nassaney and Johnson 2000).

Similarly, Susan Branstner's (1992) study on material and technological change among the Huron suggests that the Native selection process illustrates how European-introduced goods were being used as replacements for previous traditional objects. For example, copper kettles replaced clay pots. Branstner (1992: 191) argues that individual cognizant choices were made to replace traditional objects with European objects that served the same technological function. Branstner argues that the active role of choice in replacing certain objects for others illustrates that there was little change in the Native technological system. For instance, Branstner would argue that although copper kettles virtually replaced clay pots, their primary function remained the same, thus there was little change in the technological system itself (Branstner 1992:191).

Another important technological study that focuses on explaining material culture change is James Bradley's (1987) analysis of the Onondaga. Bradley (1987:5) examines the technological shifts that occurred over time by focusing on material culture and material culture change as a means to indicate change within a cultural system. Bradley (1987:175) emphasizes that the changes in material culture were done in a manner that integrated new materials and forms into an existing set of cultural preferences. Bradley examines material culture change in craft production. He contends that although certain classes of material culture, such as lithic tools, ultimately faded away by the mid-seventeenth century, the craft skills themselves remained. In this case it is suggested that traditional craft skills were incorporated into the changing sociocultural conditions. The result is a new level of "technical proficiency and artistic expression not possible previously" (Bradley 1987:176).

Tinkling Cones and Metalworking Practices

Tinkling cones, as described in chapter I, are conical shaped decorative objects formed into a cone shape with an open apex by rolling a flat trapezoidal or square metal blank, cut from recycled trade kettles, around a mandrel (Figure 1). Archaeological evidence for the production of tinkling cones is comprised of all the stages of manufacture, from procurement through discard (Ehrhardt 2002:81), in the forms of scrap metal, blanks, rolled rivets, and kettle patches (Anselmi 2004; Bradley 1987; Morand 1994). Figure 1 illustrates the recycling and manufacturing process of tinkling cones. The trade kettle (left) is cut into a desired shaped blank (center) and rolled to form the final cone shape.

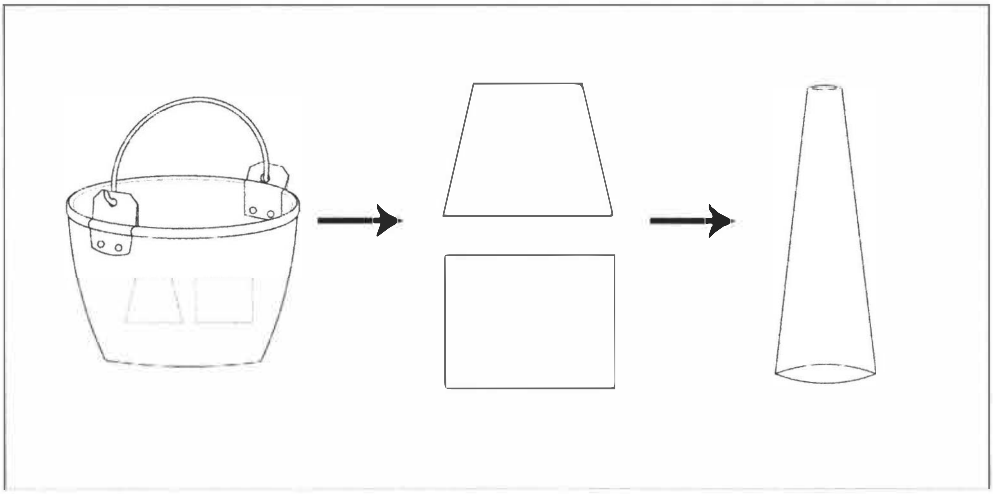

Figure 1. Illustration demonstrating the technological histories of tinkling cones from their initial introduction as copper kettles (left), to being cut into a blank shape (center), and finally being manufactured into a tinkling cone (right).

Tinkling cones are also referred to as tinklers, bangles, dangles, and/or jingles (Ehrhardt 2002:240; Good 1972; Jelks 1966; Krause 1972; Odell 2001; Walthall and

Brown 2001). A thong or some type of hair (often deer or horse) is threaded through the open tip and knotted on the inside for attachment. Tinkling cones are hung onto clothing and accessories such as bags, moccasins, earrings, and purses. The "tinkling" sound comes from individual cones striking one another as they dangle. Perhaps the mystique surrounding tinkling cones comes from the lack of scholarly attention that they have otherwise been given.

The metal (copper and brass) tinkling cone on which this study is based has organic antecedents that stem back to the transitional Early Woodland/Middle Woodland periods. Fitzgerald (1990:503) suggests that the earliest forms of copper-based metal tinkling cones appear in the lower Great Lakes as early as 1580 and were meant to imitate hollowed out deer phalanx bangles, which were common to early Ontario Iroquoian sites. Willoughby (1922:64) notes that "44 hollow cones made of antler tips" were recovered from Altar 4, Mound 4 at the Turner Group in present day Ohio. Additional artifacts recovered from Altar 4, Mound 4 at the Turner Group in association with the cone antler tips, were numerous objects manufactured from Native copper including bracelets, beads, and a series of "copper cones" (Willoughby 1922:66). Although not formally classified as "tinkling cones," their formal attributes are quite similar, exhibiting conical cone shapes with open apexes at their proximal and distal ends. In a similar study, Quimby (1966:43) states that large tinkling cones made of Native copper appear in the Great Lakes region at Late Woodland sites in Michigan and Illinois. Quimby also identifies additional objects manufactured of Native copper including cylindrical hair pipes, finger rings, C-shaped bracelets, and snake effigy pendants (Quimby 1966:39). Today, modern day tinkling cones are often made from tin and can be seen on Native American apparel from bags, moccasins, and pouches to smoking pipes and dream catchers.

Temporal and Spatial Parameters of Tinkling Cones

Tinkling cones have been collected from numerous colonial frontier sites (Morand 1994; Walthall and Brown 2001; Waselkov 1997) and Native contact sites spanning from protohistoric through historic periods. However, little information is often reported on them. Besides preliminary recordings such as length and sometimes metal composition (brass or copper), tinkling cones have almost completely managed to stay clear of in-depth analysis (exception see Ehrhardt 2002).

To begin to gain an understanding of the dispersed locations and the ubiquitous nature of tinkling cones, Figure 2 presents the temporal and spatial distribution of tinkling cones from French colonial sites in the western Great Lakes, Illinois, and Louisiana regions. When visually examining the spatial and temporal dimensions of tinkling cones, it is evident that tinkling cone distribution and the craft of producing tinkling cones was quite common. Their widespread and dispersed locations raise interesting questions of the diffusion of craft industries producing similar goods in similar, but varying, cultural and socioeconomic conditions throughout fur trade.

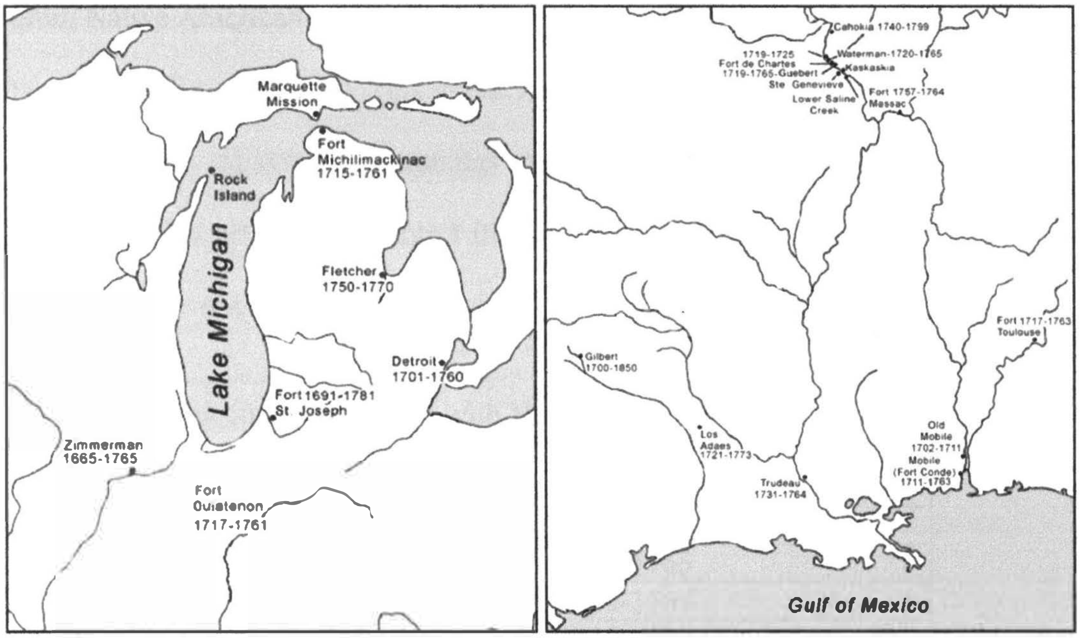

Figure 2. French colonial sites yielding tinkling cones in the western Great Lakes (left), Illinois and Louisiana regions (right).

Tinkling Cones Recovered from Native Contact Sites

Tinkling cones have been recovered from other Native contact sites as well. Among them, the Guebert site which is an 18th century historic Kaskaskia Indian village in Illinois (Good 1972). Although Good (1972:87) does not provide a detailed description or metric comparison, she notes that out of 59 “tinklers” recovered, 48 were brass and 11 copper. Similarly, Brown (1975:31-32) in her study of the Zimmerman site in Kaskaskia reports that there were “13 tinkling cones or tinklers” recovered. They ranged from 17 to 37 mm in length and 3 to 12 mm in base width (1975:32).

Of special interest are the collections of tinkling cones that have been recovered from the graves of Native Americans. Within burial context, funerary objects take on new symbolic meanings as they have been interred at the time of burial. Native Americans believed that funerary objects would accompany the dead to the afterlife (Turgeon 1997). This implies that in many instances tinkling cones were perceived as having symbolic meanings and cultural values that would benefit the individual in life after death. Table 1 illustrates seven different sites that have excavated Native American burials found with tinkling cones.

Table 1. Tinkling cones associated with Native American burials

Settlement	Period of Occupation
Fort de Charles III	1754-1765
The Waterman site	1720-1765
The Guebert site	1719-1765
Starved Rock	1682-1689
River L'Abbe Mission site/Cahokia village	1735-1752
Zimmerman site/"Grand village of Kaskaskia"	1665-1765
The Fletcher site	1750-1770

Tinkling Cone Analysis

As ubiquitous as tinkling cones are there is no inclusive typology for these objects. Besides standard metric analysis (primarily length) tinkling cones have not been subjected to vigorous scrutiny. In his study of a collection of 318 tinkling cones collected from Fort Michilimackinac, Stone (1974:133) used three variables to classify tinkling cones: (1) length, (2) sheet brass thickness, and (3) presence or absence of leather attachment. Stone concluded that metric comparisons between tinkling cones from Michilimackinac and other contact sites indicate a standard size range was common regardless of time or location of manufacture (Stone 1974:134). Stone's (1974:133) sample ranges in length between 11.6 mm and 42.8 mm with a standard deviation that indicates "there is considerable variation in the length of these tinkling cones."

In his analysis of the Onondaga, Bradley (1987:74) states that artifacts of European copper from recycled kettles begin to appear during the latter part of sixteenth century. Bradley (1987:74-75) cites three sources of evidence to illustrate that the Onondaga were locally crafting new objects of material culture. First is the considerable amount of scrap or wastage metal found. Scrap metal is a residual product of the recycling process used in the production of locally produced items of material culture. Additionally, scrap metal can provide information about the technological practices used in the production of such items as tinkling cones (Anselmi 2004; Bradley 1987).

Second, Bradley (1987:75) argues that with few exceptions the final forms produced were reflections of their traditional functions. That is, although the choice of material may have changed (i.e. lithic edge tools vs. metal tools or stone arrow heads vs. metal triangular constructs), there was limited variation in the final form and function of the newly crafted object.

Third, Bradley (1987) attributes the distinguishable variations in forms between various ethnic groups as evidence of local production. Technologically speaking, the manufacturing techniques used in Native metalworking practices have been in existence since the Middle/Late Archaic through Early Woodland periods (Anselmi 2004:294). The three primary manufacturing techniques used are cold-working, hot working, and annealing (Anselmi 2004:294; Bradley 1987:74). Clearly these manufacturing techniques were being employed well before European contact.

Recent researchers follow the work of Bradley to distinguish manufacturing techniques from different temporal and spatial dimensions (Anselmi 2004; Ehrhardt 2002).

In her study of the Wendat and Haudenosaunee, Lisa Marie Anselmi (2004:292) explores evidence for the local manufacture of cuprous artifacts by investigating "the presence of recognizable manufacturing sequences" where visually determinable. To do this, Anselmi (2004:5) examined 14,137 objects from 68 archaeological sites and two amalgamated collections, in order to investigate: (1) the manufacturing techniques used to craft the various objects, (2) the differences in manufacturing techniques used chronologically and ethnically, and (3) the final forms produced. Anselmi (2004:420) determined that with tight chronological and spatial control, it is possible to distinguish the manufacturing techniques used by Native metalworkers verses European metalworkers. This supports her hypothesis that Native individuals were themselves manufacturing locally produced objects of material culture, rather than acquiring them as finished products (Anselmi 2004).

To date no specific metalworking toolkits or manufacturing techniques have been identified for the manufacture of cuprous objects from European introduced trade goods (Anselmi 2004:307). However, both documentary and archaeological evidence from French and English colonial sites, such as Jamestown, Fort Pentagoet (Faulkner 1986), and Fort Michilimackinac, and Native Contact sites, such as Rock Island (Mason 1986) and the Wichita contact settlement (Lasley Vore site) in Oklahoma (Odell 2001), reveal evidence of local manufacture. Anselmi (2004:293) compares the manufacturing techniques between a collection of materials believed to be of Native manufacture (from the *Wendat* Ball Site) and five collections clearly of European manufacture (from the English settlement at Jamestown, the French Jesuit settlement at Ste Marie I and the Dutch settlements of Fort Orange, Van Curler House/Schuyler Flatts and Douw House/Key Corp Site) with a sixth European published account from the French post at Pentagoet. She concludes that manufacturing techniques used to produce Native assemblages are different from those employed by Europeans (Anselmi 2004:299). She relates the difference to the availability of specific tools used in the production of cuprous materials.

For example, Jamestown and Ste. Marie I are two European settlements where a trained metalworker, such as a blacksmith, made and repaired metalwares (Anselmi 2004:302). In these cases manufacturing techniques were dependent upon the tools available. European metalworking tools consisted of jeweler's saws, blacksmithing tools (such as iron clasps and thongs), scissors and knives. At the French site of Pentagoet, which also had a blacksmithing facility, Faulkner (1986:87) concludes that evidence of the local production of crafted items comes from the recycling of copper kettles. As such, items appear to have been crafted by cutting with shears or chiseling (Anselmi 2004:303; Faulkner 1986:87). Faulkner (1986:87) reveals that both utilitarian and ornamental items were crafted, including tinkling cones. Faulkner's (1986) conclusion at Pentagoet, as with Morand's (1994) conclusion at Michilimackinac, indicate that these locally crafted objects of material culture were probably used for trade both with local Native populations and by Europeans themselves.

There are different interpretations as to who was involved in the manufacturing process of locally produced artifacts. Support for the argument that tinkling cones were manufactured by Europeans and then traded to Natives comes in the same forms of scrap metal, kettle patches, and kettle hinges. Waselkov (1992:44) concludes that tinkling cones found *in situ* from the household refuse pit at Fort Toulouse II are evidence that they "were probably produced by the post's garrison and its civilian inhabitants for trade." In her study on *Craft Industries at Fort Michilimackinac*, Morand (1994:27) concludes that no real clusters of tinkling cones were found at Fort Michilimackinac, thus inferring that they were widely used, and likely widely produced. Excavations conducted at Fort St. Joseph in 2002 yielded all the stages of manufacture for tinkling cones.

In their study of an early eighteenth-century outpost in the Illinois Country, Walthall and Brown (2001:102) identify two types of tinkling cones. The first type, conical, refers to the overall final conical shape with an even base plane. The second type, extended base, is more bulbous and has a "triangular basal projection" (Walthall and Brown 2001:102) (see Figure 5). Jelks (1966:92) refers to these same two types recovered from the Gilbert Site (part of the Norteno Focus Site in Northeastern Texas), as "a cone with a point projecting downward from one side of the base, and a cone with a single plane, or approximately so." Walthall and Brown (2001:102) examined fifty-nine conical shaped tinkling cones that range from 16 mm to 51 mm in length and 10 to 22 mm in width. They also examined eighteen expanded base types ranging from 27 to 41 mm in length and 10 to 22 mm in width. Although Jelks distinguishes between types, there was no distinction made when they were metrically examined. Jelks (1966:92) states that "most are between 20 and 40 mm, but the largest one measures 66 mm in length."

Odell (2001:177) discusses the evidence for the local manufacture of tinkling cones at the Lasley Vore site (a Wichita contact settlement) in Oklahoma. Although there is no in depth analysis of tinkling cones presented, 13 tinkling cones are listed in a table of metal artifacts recovered from the Lasley Vore site (Odell 2001:177). Odell (2001) supports his argument that tinkling cones were locally produced by presenting evidence in the form of kettle patches and triangular blanks with rivet holes. Rivet holes were punctured into the body of kettles in an effort to repair them. Tinkling cones were being manufactured from worn out kettles. The remaining cone exhibited a rivet hole that had been punched into the metal for repair. Within the collection for this research, there are twenty-three final cones that exhibited perforated rivet holes (discussed in detail in Chapter 5).

Tinkling cones have not received intensive scrutiny therefore there is limited information about them. Any description beyond metric attributes usually suggests that tinkling cones were made from European kettles and used for adornment. However, using a combination of archaeometric methods, including technometric, microscopic, and metallographic methods, craft metalworking practices and specifically the manufacture of tinkling cones can now be examined more completely. For example, in her analysis of Illinois metalworking practices, Kathleen Ehrhardt (2002) used a combination of laboratory methods, including compositional work (by Proton Induced X-ray Emission (PIXE) and Neutron Activation Analysis (NAA)) and microstructural analysis to investigate the elemental content and manufacturing history for materials, such as tinkling cones, blanks, spirals, and brass beads (Ehrhardt 2002:348). Ehrhardt (2002:34) identifies the processes of annealing, cold working (principally by hammering), and hot working as "primary" manufacturing techniques. These techniques are followed by "secondary" techniques, such as rolling, folding, or bending. In one example, Ehrhardt also examines the cross section of a tinkling cone and identifies pressure indentations on the posterior neck. Ehrhardt (2002:321) finds that "since the inside edge has an annealed structure and shows no similar pattern of grain deformation" the pressure bend was probably hammered or squeezed down after the cone was rolled.

In summary, this chapter addressed how previous researchers examined standardization and variation in craft specialization to investigate the organization of labor in complex societies. I demonstrated the necessity to distinguish between modes of production, namely centralized and noncentralized production in order to examine the organization of craft production. I showed how the examination of specialized craft production provided an opportunity to investigate the way production was organized in the context of Native and French culture contact during the late seventeenth and eighteenth century western Great Lakes fur trade at Fort St. Joseph by examining the degree of standardization or variation involved in the sequence of production of tinkling cones and morphological attributes of the final form created. I also provided a cultural context of the fur trade and examined theoretical premises for analyzing craft production. I examined craft production and the meanings that are attributable to technological histories of tinkling cones. I proceeded with an examination of multiple perspectives for viewing technological and material culture change, as well as the leading arguments for local production. Finally, I concluded by providing an analysis of the spatial and temporal dimensions of tinkling cones through the examination of the archaeological record and the distribution of tinkling cones recovered from French colonial archaeological sites and Native American burial context. Tinkling cones have been recovered from numerous sites throughout North America. Their recovery from widespread and disbursed locations raise numerous questions regarding the diffusion of craft industries producing similar goods.

In the following chapter, I present a brief history of Fort St. Joseph and describe the historical context in which the collection of 356 tinkling cones under study was introduced and formulated. I also highlight pertinent information in regards to the 2002 excavations conducted at Fort St. Joseph.

CHAPTER III

HISTORIC OVERVIEW

In the previous chapter I reviewed how researchers from various disciplines (i.e. archaeologists, anthropologists, and historians) have investigated the organization of labor through the examination of standardization and variation within material culture. This was followed with an examination of the spatial and temporal dimensions of tinkling cones. It concluded with sections dealing with evidence of local production, examining technological change, craft production, and the manufacturing process of tinkling cones. Before presenting a detailed examination of the tinkling cones under study, this chapter describes the historical context into which these tinkling cones were introduced and added to the archaeological record that is Fort St. Joseph.

One area of particular interest where culture contact and interaction is evident is the North American fur trade. The North American fur trade linked people and regions economically and politically through European mercantile expansion (Wallerstein 1976; Wolf 1982). In the western Great Lakes region the fur trade provides an avenue to examine the impact of culture contact and the changing relationships that existed between Native and European populations. Over time as encounters between Native and French individuals became more frequent and trade increased, cultural transformations took place resulting in numerous multi-ethnic identities. Thus, identity boundaries between Native and French individuals became blurred (White 1991).

Fort St. Joseph is located along the St. Joseph River in present day Niles, Michigan. As a mission-garrison-trading post complex, Fort St. Joseph was established by the French in 1691 and controlled by the British for two decades until its abandonment in 1781(Figure 3). In 1679 Robert Cavelier de la LaSalle, arguably the first European explorer to enter the valley, established Fort Miami at the mouth of what was then referred to as the River of the Miamis (Nassaney and Cremin 2002a). LaSalle was part of a contingent of French settlers who sought to establish control of the western trade routes. In 1686 the Jesuits were granted a strip of land along the St. Joseph River to establish a mission in order to strengthen their relationships with the Miami Indians who lived along the river (Nassaney et al. 2004:5).

Figure 3. Map showing location of Fort St. Joseph and surrounding occupied settlements.

Fort St. Joseph was primarily a local trade outpost, similar to Fort Ouiatenon of the Wabash Valley (Tordoff 1983). It was the practice of the French to establish forts in locations where large numbers of Natives lived in adjacent villages. Nearby Fort St. Joseph were Potawatomi and Miami villages. The Miami, who occupied the east side of the river, were permanent residents from the establishment of the fort until 1704. Around that time a Potawatomi village, which was located just across the river (on the west side) was established and remained there throughout the fort's occupation (Ballard 1973; Hulse 1981). Although never a mighty military bastion, Fort St. Joseph was the center of French-Native interaction and served as an important fur trade community on Lake Michigan's southeastern shore (Sleeper-Smith 1998:54). As such, the French generally had good relations with their Native neighbors. Before the end of French and Indian War (1755-1762), the French garrison was withdrawn, leaving only a dozen families behind who supported themselves through trade and interaction with the Natives (Nassaney and Cremin 2002a).

In order to assure alliances and survival, gift giving between the two groups became a fundamental way of life. The diverse population of French and Natives was further complicated by intermarriage of Frenchmen and Native women (Sleeper-Smith 2001). Intermarriage for the fur traders ensured inclusion in an exchange process that was "embedded in an indigenous social context and was defined by friendship and kinship" (Sleeper-Smith 2001:20). In many instances a trader's success depended on the relationship and understanding of the social context that dictated the exchange process.

Previous Archaeological Research and Formation of Collection

Although there is a considerable amount of information regarding the historical context of Fort St. Joseph, there is limited knowledge about the daily lives of the fort's occupants. Only through the study of the material culture left behind can we analyze the daily practices, economic organization, and social identities of *habitants* who once occupied Fort St. Joseph.

The search for Fort St. Joseph has been an ongoing process for over a hundred years. Beginning in the late 19th century, antiquarian treasure hunters unsystematically collected over 100,000 Colonial objects from the vicinity of Fort St. Joseph (Nassaney et al. 2005). Many of these objects are now curated at local museums with the majority residing in the Fort St. Joseph Museum in Niles, Michigan. George Quimby (1939, 1942, 1966) used this extensive collection in Niles for early descriptive and comparative analyses of post-Contact artifact assemblages in the western Great Lakes (Nassaney et al. 2005). Interests were again sparked in the 1970s when the site was recommended for inclusion in the National Register of Historic Places (Ballard 1973). However, it was not until the early 1990s with the formation of Support the Fort, Inc. (STF) that interests and dedication to the identification and preservation of the remains of Fort St. Joseph would create a new movement to locate the precise location of Fort St. Joseph. In 1998 Western Michigan University archaeologists entered into a partnership with STF, the City of Niles, and the Fort St. Joseph Museum to conduct an archaeological survey in search of the material remains of Fort St. Joseph (Giordano and Nassaney 2004). In 2002 further excavations were conducted, which for the first time yielded irrefutable evidence of the precise location of Fort St. Joseph. At last the fort was found (Nassaney and Cremin 2002b).

The 2002 excavations conducted at Fort St. Joseph conclusively demonstrate the presence of intact structural remains, in-ground facilities, and undisturbed concentrations of colonial artifacts, representing French, English, and Native presence at Fort St. Joseph (Nassaney and Cremin 2002a). Interestingly, with few exceptions, the vast majority of materials recovered from the site are consistent in age with a site occupation from 1691-1781. Most of the artifacts collected compare favorably with materials from the 1998 survey, extant collections in the Fort St. Joseph Museum, and artifacts from other French Colonial sites such as Fort Michilimackinac.

Out of a total of 12 excavation units, there were 7 designated cultural features (Nassaney et al. 2005). Two of them (feature 2 and feature 5) have been identified as 18^{th-}century European structures. In association with these features are various examples of 18^{th-}century artifacts, including an engraved bone knife handle, a copper awl, a push pin, numerous glass beads, musket balls, a kettle lug, and various sized fragments of scrap metal. Identifying in-ground facilities and in situ artifact deposits provides evidence for the location of specific activity areas, such as cooking and craft production (Nassaney et al. 2005). These observations provide information about the degree of occupational specialization that existed at Fort St. Joseph.

For example, a large concentration of over 100 gun parts, designated as feature 4, has been interpreted as a gunsmith's repair kit. It clearly represented an intentional caching of materials that would have been useful in the repair of flintlock muskets. However, a blacksmith would have also been capable of repairing muskets, which was one of the services that the French provided for their Native allies in the North American interior (White 1991). Payment records reveal that a gunsmith lived at the fort from 1739 to 1752 (Peyser 1978) and baptismal records show that one resided there as early as 1731 (Faribault-Beauregard 1982:181; cited in Nassaney et al. 2005:14). Among the objects associated with this partly completed excavated gun cache were several other classes of metallic objects. These included a large brass kettle lug, seven musket balls and shot, a push pin, two French military issue brass uniform buttons (Stone 1974:49), a tinkling cone, several sheets of cut out scrap metal, and a unique 30 deniers coin minted in France between 1709-1713 specifically for use in overseas colonies. These materials testify to the production and repair of various metal artifacts at the site (Giordano and Nassaney 2004).

The objective of this research is to examine the way labor and production was organized in the context of Native and French populations during the late seventeenth and eighteenth century western Great Lakes fur trade at Fort St. Joseph. To accomplish this objective, this study employs a technological viewpoint that examines evidence of production activities and finished products, to infer the types of activities that occurred in and around Fort St. Joseph. Specifically, this analysis utilizes a collection of finished tinkling cones (n=356) which are curated at the Fort St. Joseph Museum and until now have received very little attention. These tinkling cones are consistent with the tinkling cones recovered from the 2002 excavations at Fort St. Joseph (n=2).

The collection of tinkling cones upon which this study is based has a long and intricate history. As discussed previously, beginning in the late 19th century, avocational archaeologists collected over 100,000 Colonial objects from the vicinity of Fort St. Joseph (Nassaney and Cremin. 2002b). Within these masses of objects are the 356 tinkling cones selected for analysis in this thesis. Therefore, although these tinkling cones are attributed to the colonial fur trade outpost of Fort St. Joseph, they lack true in situ provenience. As a result intra-site comparisons cannot be made.

In the next chapter I discuss the methodology that I employed to investigate the organization of labor at Fort St. Joseph and present the analytical techniques, including metric analysis and visual inspection, an examination of manufacturing techniques customarily used during the late 17th and 18th century fur trade, and a scratch test to determine the raw material (copper or brass).

CHAPTER IV

METHODOLOGY

In this chapter, I define the analytical methods employed in examining the collection of finished tinkling cones (n=356) curated at the Fort St. Joseph Museum, as a way to investigate the degree of technical and formal variation among the cones. These analytical methods include metric analysis and visual inspection, an examination of manufacturing techniques customarily used during the late 17th and 18th century fur trade, and a scratch test to determine the raw material (copper or brass). By examining each finished tinkling cone for standardization in form, measurement, and manufacturing technique, this research employs the theoretical framework that standardization attained in the finished tinkling cone, both formally and technically, is indicative of centralized production. On the other hand, formal or technical variation, or heterogeneity, is indicative of noncentralized production.

Analytical Methods

This research is based upon a combination of archaeometric (laboratory) and visual examination techniques, including metric analysis and optical examination by the naked eye and low powered magnification. Jonathon Leader (1988:4) refers to the process of recording primary measurements such as length, width, thickness, weight, and observation of surface features as a "technometric analysis." This type of material investigation allows for a typology to be constructed that reflects morphological variation and distinguishes any technological signatures used in the production of cuprous tinkling cones.

For this study to create a working typology and serve as a basis for comparison for future research, an explicit definition for identifying and describing tinkling cones was formulated. Following similar definitions used by previous researchers, such as Ehrhardt (2002:241) and Jelks (1966:92), I define the formal and technical attributes of a tinkling cone as a conical shaped object that was formed by rolling a desired square, rectangular, or trapezoidal shaped blank around a mandrel to form a hollow-shaped object with an open apex. The final conical or cone shape is the essential characteristic that a tinkling cone must possess to separate it from similar looking objects such as brass tube beads and cylindrical hair pipes.

The initial inventory, discussed in Chapter III, of the collection yielded 374 specimens. However, after further examination, 18 objects (catalogue numbers 304, 327, 334, 336, 338, 341, 354, 356, 357, 361, 362, 364, 365, 369, 375, 373, 379, and 382) were removed because they were unidentifiable due to rust, too fragmentary or incomplete, or failed to meet the criteria set forth in the definition. For example, objects such as brass tube beads and cylindrical hair pipes share similar manufacturing techniques with tinkling cones, however they differ in their formal attributes. As such, they were not examined for this study.

For this analysis, I employ standard anatomical nomenclature to characterize each finished tinkling cone under study. This enables me to precisely describe each tinkling cone's general morphology. In addition, precise descriptions allow for comparative information for any future research. For this analysis, I identified the dorsal or posterior side of the object as the seam side (Figure 4). In general, the dorsal side exhibited the most evidence of manufacturing. During the sequence of production, a cut blank would be placed face down and then rolled over a mandrel form. For closure, the two vertical edges met at the midline, creating a seam. The morphological attributes and anatomical nomenclature of a tinkling cone are illustrated in Figure 4.

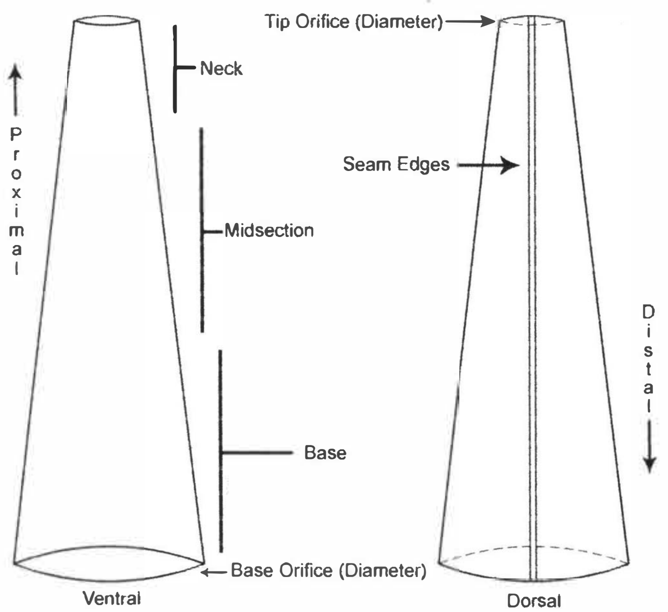

Figure 4. Illustration showing the morphological attributes or anatomy of a tinkling cone.

Metric Analysis

The first stage of material investigation began with recording basic measurements for each complete tinkling cone in the collection. For each artifact, I recorded both the finished dimensions of the final product and the measurements of the blank which was used to form the tinkling cones. In this way I was able to conduct metric comparisons between the blank's size and shape and the finished product. Finished measurements were taken of the length, basal diameter, and tip diameter (Appendix A). Weight and metal thickness were determined for the entire collection (n=356).

Measurements were taken of the final tinkling cones in an effort to reconstruct the original size and shape of the blank that was used to create the final product. To do this I measured and recorded the two horizontal widths (top and bottom) and two vertical lengths (left and right) of each tinkling cone. To measure those hard to reach places and curved surfaces, I used a piece of sticky paper on which I marked the position of the points. I then measured the distance between both points to the nearest millimeter using a digital caliper. This allowed me to record the exact size and shape of the original blank (Appendix A). Lastly, I examined the correlation between the blank shape and the finished shape.

Manufacturing Techniques and Scratch Testing

The second stage of material investigation was the visual examination of all the tinkling cones in the collection. Artifacts were examined for 11 manufacturing techniques (after Anselmi 2004:57, discussed in Chapter V), including hammering and flattening, chiseling, scoring, bending, twisting, folding, cutting, sawing, melting, perforating, and grinding, which were then recorded and entered into a database (Appendix B). Upon further investigation two more fields were added. These included posterior bends and anterior crimp marks.

In addition to recording manufacturing techniques, such as cutting, scoring, bending, and grinding, as well as the variation in base profiles to explore mandrel forms, I performed a simple scratch test that involves the removal of the patina in order to reveal the original color of the metal (Appendix B) (Anselmi 2004; Fitzgerald and Ramsden 1988). With the approval of the Fort St. Joseph Museum, I scratched a small line (1-2 mm) on the distal posterior surface of each tinkling cone. With the surface exposed, I was able to visually determine, both with the naked eye and low powered magnification, the color of the metal. Copper yields a red bodied color when exposed. Brass, sometimes referred to as "yellow copper" yields a yellow tint (Fitzgerald and Ramsden 1988:154).

Fitzgerald and Ramsden (1988) suggest that identifying the raw material is a crucial determinant in identifying the ages of assemblages. Archaeological evidence demonstrates that most pre-1600 kettles were made of copper, while most brass kettles date to post-1600 (van Dongen 1995:125). Van Dongen (1995:125) suggests that brass tended to be easier to work with and cooper kettles had to be lined to protect against some contaminating foodstuffs. Van Dongen (1995:125) also suggests that as the price of copper rose, brass kettles became the more frequent trade item to the New World. During Fort St. Joseph's active period (1691-1781) a wide variety of objects used for various purposes were traded. Copper and brass kettles were among the leading forms of material culture traded (Turgeon 1997). The wide distribution of various reworked metal-based artifacts, including tinkling cones, spirals, and projectile points, along with the wastage or scrap found archaeologically, serve as indisputable evidence for the recycling process of European introduced copper and brass kettles. In keeping with the goal of this thesis, determination of the metal was recorded along with the other formal and metric attributes in order to investigate the technological histories of this collection of tinkling cones.

In this chapter I have defined the analytical methods employed, including metric analysis and visual inspection, along with an examination of manufacturing techniques, and a scratch test to determine the raw material (copper or brass), as a way to investigate the organization of labor. The next chapter identifies and describes the 11 manufacturing techniques (after Anselmi 2004) that were observed in this study and the two additional visually determinable deformations. It follows with the analysis and the results of the styles, measurements, and manufacturing techniques observed in the collection under study. Finally, it concludes with a detailed comparative analysis of the raw material (copper or brass) of each tinkling cone and presents the results of each characteristic.

CHAPTER V

ANALYSIS AND RESULTS

As detailed in Chapter IV, this study employs analytical methods that combine attribute analysis of the forms produced (finished tinkling cones), including metric analysis and visual inspection, along with an examination of manufacturing techniques as a way to investigate the role of craft specialization and the organization of labor.

This chapter first presents the analysis and results of the styles, measurements and manufacturing techniques observed in the examination of a sample of 356 finished tinkling cones. Second, I offer a detailed description of the 11 manufacturing techniques identified (after Anselmi 2004), including hammering, chiseling, scoring, bending, twisting, folding, cutting, sawing, melting, perforating, and grinding, and the two additional visually determinable deformations. Finally, I compare the raw material (copper or brass) of each tinkling cone and present the results of each characteristic.

A Tinkling Cone Typology

This study classifies three distinct types of tinkling cones based on their relative formal attributes from a collection of 356 finished complete tinkling cones: conical (n=334), extended base (n=18) (Walthall and Brown 2001:102), and extended seam (n=4) (Figure 5). The third type, extended seam, captures dimensions of both the conical and extended base, however it is recognized as its own type, and is therefore distinguished from the others. The remainder of this chapter presents the analysis of measurements, manufacturing techniques, and deformation where visible.

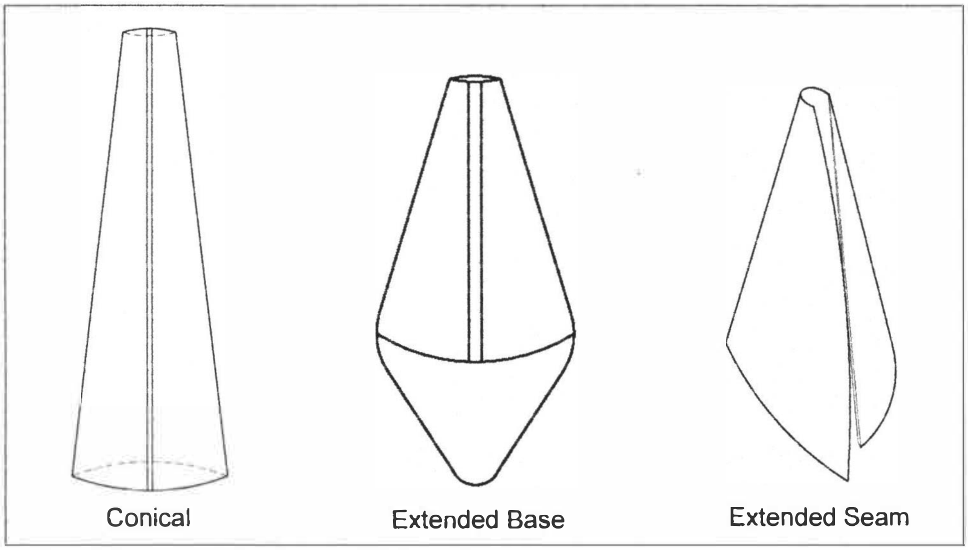

Figure 5. Illustration of the types of tinkling cones identified (left to right): conical, extended base, extended seam. All are showing dorsal surfaces.

The analytical approach employed for this study utilizes multiple lines of evidence in order to achieve a truly holistic interpretation. The interaction of archaeology and statistics enables the archaeologist to incorporate statistical analysis into the archaeological research process. Once data is collected, the archaeologist utilizes statistical analysis and statistical inference to identify patterns in the data. From the data I collected about the 356 finished complete tinkling cones, I have developed quantitative and qualitative information, and I have identified the most common manufacturing techniques employed in the production sequence. I present this information in the tables that follow. Using both statistical analysis and inference, I examine the degree of standardization or variation that may have existed at the time this collection of tinkling cones was manufactured. Specifically, I am going to measure the central tendencies of the collection of finished complete tinkling cones by computing the mean and standard deviation (variance) around the mean of each central tendency (defined as metric measurements of the collection). I am also going to employ statistical inference to determine the primary manufacturing techniques used and the degree of standardization that may have existed in the manufacture of this collection.

In keeping with my goal to identify any distinguishable patterns indicating standardization or variation within the manufacturing techniques and formal styles of finished tinkling cones, it was expected that the objects manufactured with a greater degree of standardization will exhibit similar manufacturing scars in the sequence of production, thereby suggesting centralized production. Conversely, it is expected that if tinkling cones were being manufactured with a lesser degree of standardization, then they would exhibit a greater degree of both formal and technical variation, thus indicating noncentralized production.

It was expected that objects produced under a centralized mode of production would exhibit less variation in total length and overall proportions. Likewise, it was expected that centrally produced tinkling cones would have been manufactured from the same raw material (i.e. copper or brass). To investigate these expectations each type of tinkling cone was compared both formally and technically to identify variation or standardization in formal style, length, diameter, and raw material. Conversely, it was expected that tinkling cones produced in a noncentralized mode of production would exhibit greater variation in formal style, length, diameter, and raw material.

Overall Metric (Total Collection and All Types)

Before classifying the tinkling cones into individual types based on their formal attributes, I first examined the collection as a whole by intricately measuring each specimen. The tinkling cones varied greatly in size and form. In order to maintain consistency in this examination, length measurements were taken from the extreme proximal and distal ends. Tip and base diameters were taken from just inside the rim edges. If a tinkling cone's tip or base was too bent, flattened or compressed, it was noted in the database. Each finished tinkling cone was measured to reconstruct the original blank's metric and formal components. During the sequence of production, a tinkling cone was rolled from a cut blank. Thus a blank is the negative of the tinkling cone before it has been rolled into its final shape. Metal thickness was also recorded for comparative purposes.

The 356 total complete tinkling cones examined, as illustrated in Table 2, range in length from the smallest at 10.1 mm to the largest at 55.6 mm. The average (mean) length of the cones in the collection is 24.9 mm, the mean finished tip diameter of the collection is 2.33 mm, and the mean finished base diameter is 6.7 mm. The average sheet metal thickness is 0.48 mm, ranging from the smallest at 0.2 mm to the largest at 0.92 mm.

The following table (Table 2) summarizes the key descriptive statistics of the whole collection by major measurement feature.

Table 2. Total tinkling cones, metric analysis

Total Tinkling Cones (n=356)	Smallest	Largest	Mean	Standard Deviation
Finished Length	10.10	55.60	24.90	7.20
Finished Tip Diameter	0.61	5.93	2.33	0.85
Finished Base Diameter	2.89	24.25	6.70	3.06
Blank Length 1 – Left	10.85	55.51	23.49	6.74
Blank Length 2 – Right	10.65	55.11	23.35	6.53
Blank Width 1 – Proximal	2.52	35.45	11.23	4.65
Blank Width 2 – Distal	10.34	58.03	21.33	7.53
Metal Thickness	0.20	0.92	0.48	0.15
*all measurements in mm				

Manufacturing Techniques Identified

This research is based on the examination of basic metalworking techniques that have been identified throughout Early and Middle Contact (Native and European) period and archaeological collections (after Anselmi 2004). Manufacturing techniques include chiseling, cutting using snips or scissors, sawing with a jeweler's saw, melting, scoring, folding, bending, twisting, grinding, hammering, perforating, riveting, and use deformation and wear visible to the naked eye (Anselmi 2004:162-176). In the manufacturing sequence of an object any one technique could leave a visible scar. However, certain manufacturing techniques exhibit a clearer signature than others. This may be due to the sequence of production, the tools used, or technique of the craftsman. For example, when a blank is cut to the desired shape and size by chiseling, it will often leave a scar along the edge. However, the scar could be removed by grinding. Therefore, although a particular manufacturing technique was employed in the production of an object, it may no longer be distinguishable because it was obscured by another technique that followed it in the manufacturing sequence. The following section defines the manufacturing techniques and use deformation observed in this collection of finished tinkling cones.

Hammering

Hammering, or literally flattening, refers to the initial process for the reworking of the raw material to form the desired shape blank. In this process a section would be removed from the original source, as in the use of kettles, and hammered flat by repeatedly striking the metal with a heavy tool. Possible tools available during the Middle Historic period that could have been used as hammers included axes, chisels, large stones, and lithic devices. The visible scars of hammering are identified as multiple indentations along the surface (Figure 6a-b).

Chiseling

Chiseling refers to the manufacturing method of breaking apart the raw material into the desired shape and size by applying indirect percussion to the surface using a small chisel. The characteristics displayed from this manufacturing technique are a pattern of breakage marks along the edge of an object (Anselmi 2004:163). Figure 6b-c shows the series of uneven chisel marks along the unground edge.

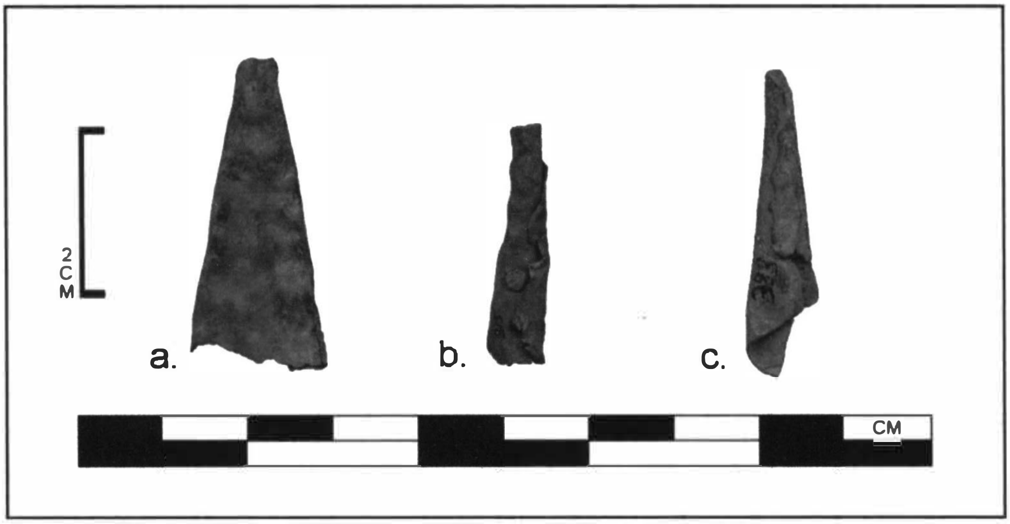

Figure 6. Examples of several manufacturing techniques in conical tinkling cones.
a. Hammering along entire surface.
b. Chiseling along seam edge. Also evidence of hammering and riveting.
c. Chiseling on seam edge.
(Cat. No.366, 315,383)

Scoring

Scoring is the process of inscribing lines into the metal with a sharp object in order to create an outline that may be traced by cutting, chiseling, or repeatedly bending until severed. These score marks would have been placed into the metal to sketch the size and shape of the desired blank. It is likely that if the scoring evenly marked the desired edges, the process of cutting out the object would follow the score marks, thereby removing score marks and eliminating the evidence. Fortunately this is not always the case. Figure 7 illustrates the typical examples of tinkling cones with noticeable scoring marks.

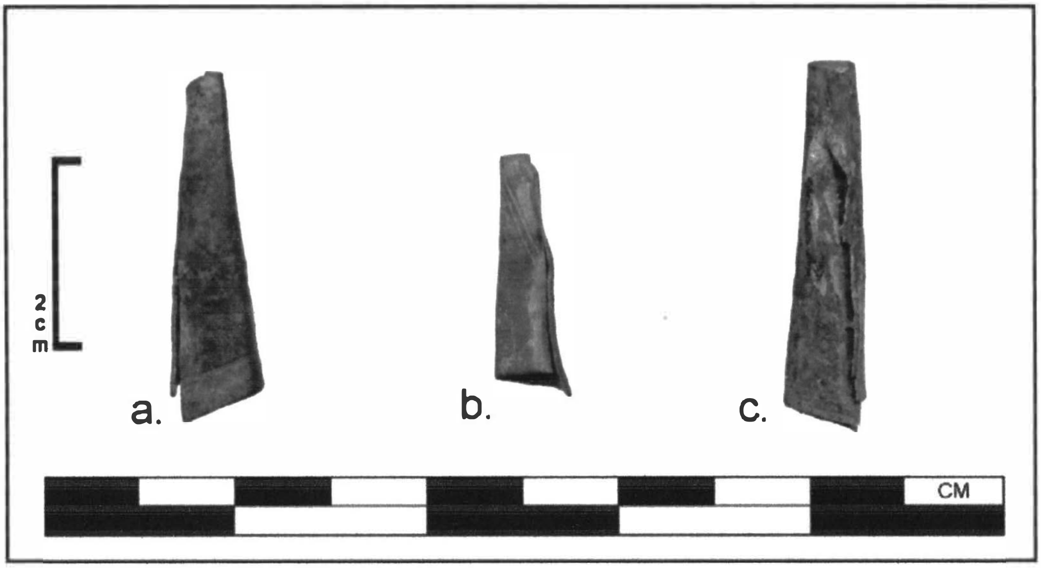

Figure 7. Conical examples illustrating scoring and cutting. Note: All examples are brass.
a. Scoring lines on right dorsal base edge.
b. Diagonal scoring marks from tip through midsection.
c. Score marks on base edge and vertical seam edge. Cutting is also exhibited on seam edge that has not been ground.
(Cat. No. 294,335,295)

Bending

The characteristics that I set forth in this collection to identify bending varies from Anselmi (2004:165). Anselmi (2004:165-166) defines bending as the process of repeatedly applying pressure back and forth along a vertical line until the metal becomes weak and breaks. This process leaves a distinctive upturned edge. As such, I define bending as a technique which was used to alter the symmetry of the finished cone. The result seen here in Figure 8a-d shows that the edge has been bent inward thus altering the final shape. Whether this is the result of post-manufacturing and post depositional processes is unknown.

Twisting

Twisting refers to the process of literally twisting the object around itself or a mandrel to secure it tightly. Anselmi (2004:167) found that compared to other objects, twisting was exhibited most often in closed conical forms. Anselmi (2004:167) suggests that "the overlap of the blank was often twisted at the pointed (proximal) end to reinforce the tip." As seen in Figure 8e the twisting extends the entire length of the finished tinkling cones.

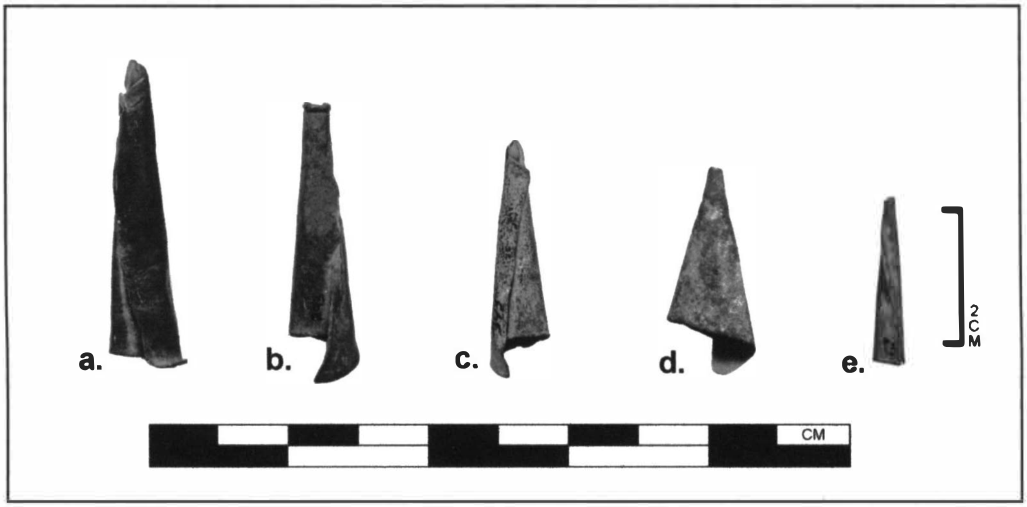

Figure 8. Examples showing bending and twisting.
a. Example shows bending on base edge and is twisted.
b. Example shows bending on right base edge and is also twisted.
c. Slight twisting and bending on left base edge.
d. Ventral view exhibiting left dorsal base bend.
e. Twisting extends around ventral and dorsal surfaces.
(Cat. No. 1,293,343,238,67)

Folding

Folding refers to the process of bending a portion of the object onto itself creating a multi-layered surface (Anselmi 2004:167). This manufacturing technique adds reinforcement and stability. In the manufacture of tinkling cones, a desired shape blank would be rolled into a final cone. In most cases the excess material would be rolled around itself producing seam overlap. For this reason folding would not be necessary. Figure 9a shows one example of a crudely fashioned tinkling cone that was folded over.

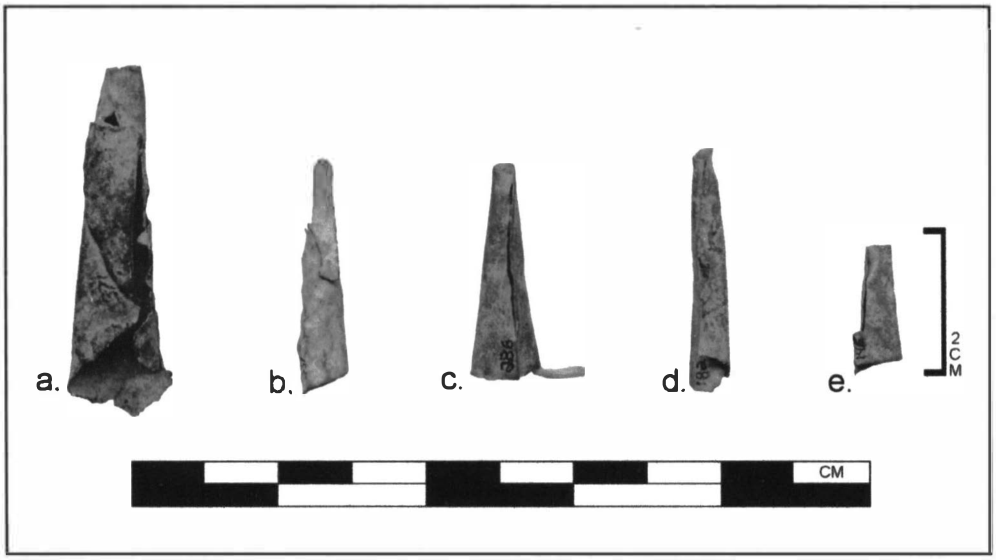

Figure 9. Crude examples illustrating folding, chiseling, and cutting.
a. Folding on left dorsal surface. Also exhibits chiseling on seam edges.
b. Folding on ventral surface from tip edge to the midsection.
c. Seam edges, although ground, reveal evidence of cutting.
d. Cutting exhibited with slight burrs along seam edge.
e. Cutting displayed with irregular seam edge.
(Cat. No. 371, 331, 286, 182, 146)

Cutting

In the production sequence of tinkling cones identified in this study, a desired shape blank was cut out from the raw material of a kettle. Cutting, as defined here, was accomplished using European introduced scissors or snips (Anselmi 2004:168). The availability of scissors is supported with documentary and archaeological evidence. As previously discussed, the 2002 excavations yielded numerous fragments of scrap metal that exhibited burrs from cutting, along with one shear of a scissor. As seen in Figure 9c-e cutting leaves identifiable burrs or snip marks along the edge that has been cut. As suggested in the chiseling category, cutting is not always visible in the final finished tinkling cone as subsequent manufacturing techniques, in this case grinding, have virtually erased any evidence of cutting.

Sawing

Sawing "refers to the use of a jeweler's saw to remove a usually circular blank from a rectangular piece of raw material" (Anselmi 2004:169). Anselmi (2004) found that a circular cut out piece from the English Jamestown site collection was identified as the product of a jeweler's saw. Among the collection of finished tinkling cones examined in this study, there were no examples that revealed evidence of the use of a jeweler's saw. There are two possible reasons for this. First, there were no jeweler's saws available in or around Fort St. Joseph, suggesting the lack of certain tools and equipment. Second, a jeweler's saw would not have been used in the manufacturing of tinkling cones. Anselmi (2004:169) suggests that evidence of the use of a jeweler's saw is typically found when working with circular blanks. However, the blanks used in the manufacture of this collection of tinkling cones are either square or trapezoid, but never circular.

Melting

Melting is defined as the heating of the metal until the edges become rounded in an almost marble form. Anselmi (2004:169) notes that in the example from the

Wendat Le Caron site it is unclear if the melting was the result of intentional manufacture or chance.

Perforating

Perforating refers to the process of punching or piercing a hole in the surface of an object. Anselmi (2004:170) suggests that perforating appears to be a secondary manufacturing technique in the sense that it followed other primary methods that were used to shape and form the final object. Within this collection, I identify two morphologically distinctive methods of perforating. The first method has to do with riveting. As kettles became worn and in need of repair, rivet holes were created to fasten layers together with locally produced rolled rivets. Archaeological evidence from the 2002 excavations at Fort St. Joseph yielded numerous examples that illustrate this scenario (Nassaney et al. 2005). These are represented by scrap metal with rivet holes, locally produced rivets, and fragments of scrap metal that display two sheets of metal that are joined together with the use of rivets. These examples shed insight into the technological history of locally produced tinkling cones. As seen in Figure 10a & d-e, I suggest that the perforated holes were already present in the blank and thus transcribed to the finished product.

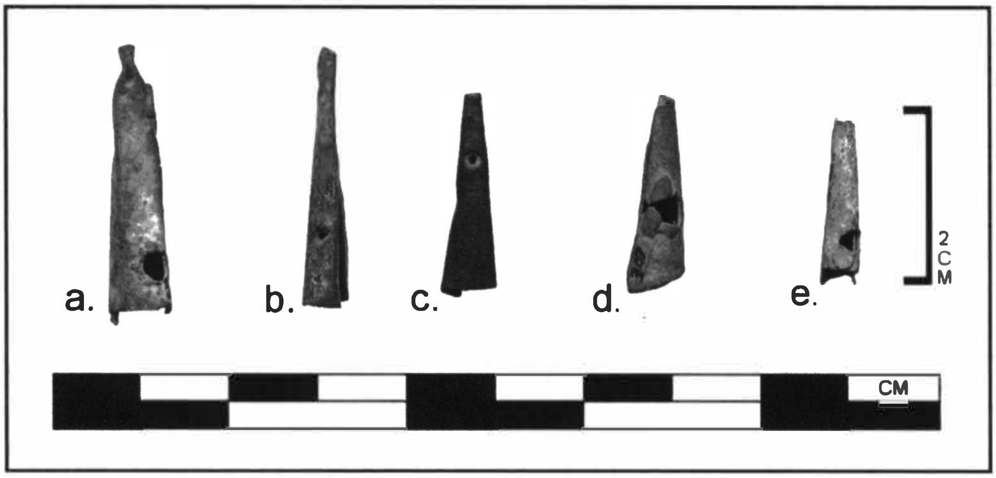

Figure 10. Tinkling cones exhibiting perforations.
a, d-e. Examples of rivet hole.
b-c. Perforated hole by sharply pointed object.
(Cat. No. 306,308,313,307,312)

The second example of perforating varies formally from the riveting example in that the perforated hole is extremely small and circular (Figure 10b-c). This type of perforation was done using a sharply pointed object such as an awl, projectile point, or flint drill. In cases such as this, it appears that the perforations are post-manufacturing techniques. They were added perhaps to embellish the appearance of the tinkling cones. Perforating was employed very differently in the manufacturing processes of each of these examples. In the riveting example perforating was part of the manufacturing process because the perforation was already in the blank, which was the byproduct of the raw material. The second example in which the perforation was likely added to embellish the appearance of the finished product demonstrates the user's personal preference.

Grinding

Grinding refers to the process of repeatedly rubbing two surfaces together until the edges become fine. Possible tools used for grinding are iron files and any type of stone. Anselmi (2004:171) identifies examples of sandstone with clear evidence of grinding. It was expected that there would be a high percentage of tinkling cones in this collection displaying evidence of grinding because grinding was employed at various stages in the production sequence. For example, after the blank was cut the edges were ground until fine. In addition, a finishing touch may have been added to the tinkling cone by grinding the finished seam edge to create a smooth surface plane (Anselmi 2004:171). This process obscures many of the previous manufacturing techniques such as cutting, chiseling, or scoring.

Ventral and Dorsal Markings

In addition to examining for the 11 identified manufacturing techniques described above, this analysis investigated for any deformation wear that was visually identifiable by the naked eye and low powered magnification (Ehrhardt 2002). I identified two attributes that I simply refer to as ventral (anterior) and dorsal (posterior) markings or indentations. Following Ehrhardt's (2002:246) comprehensive analysis of similar deformations in tinkling cones, I suggest two explanations for the existence of ventral and dorsal markings. Either they were caused in the manufacturing process, or they were caused in post-manufacturing, such as when a tinkling cone was attached to a garment (see Figure 17a-b).

Figure 11. Examples of tinkling cones with ventral and dorsal markings.
a – c. Examples of dorsal concave depressions
d. Example of dorsal crimping for attachment.
e. Extended Base tinkling cone with anterior crimp mark for manufacture.
(Cat. No. 283, 339, 253, 71,223)

Ventral (anterior) deformation can be defined as any marking visually identifiable on the ventral surface of the finished cone, thereby altering its appearance. Typically among the examples identified, ventral markings appear to be an indication of variation in the manufacturing process. Although this cannot be proven without advanced metallographic methods, the formal similarities attributable in many examples display small crimp marks. These crimp marks are caused by applying pressure to one area of the surface. Based on their placement and the fact that they are only found on one part of the surface (predominately the ventral distal base) suggests that they were caused by some form of tool, perhaps a tong or clamp, that was used to hold the blank steady while rolling it over the mandrel to form the hollow cone (Figure 11e). Other causes of ventral markings may have been attributable to the attachment of the tinkling cones to leather.

Dorsal deformations can be defined as any marking visually identifiable on the dorsal surface of the finished cone. Like cones with ventral markings, dorsal deformations were either caused in the manufacturing process, or in post-manufacturing. Although these explanations can only be truly delineated using metallographic techniques, the distinguishable formal attributes give insight into their possible roles. For example Figure 17a shows evidence of the post-manufacturing process of attaching tinkling cones. These examples are of cones with the leather still attached.

The evidence for dorsal deformation as a manufacturing technique is indicated by pressure indentations or depressions that run longitudinally along the seam edges. As seen in Figure 11a-c, there are two concave depressions located along the posterior seam edge, most likely caused by a slightly curved tool that was used to close the tinkling cone (Ehrhardt 2002:246).

Manufacturing Techniques, Formal Observations, and Raw Material Analyzed

This study examined 11 manufacturing techniques (previously defined) in the sequence of production of cuprous tinkling cones (after Anselmi 2004) along with visually identifiable formal attributes. Tables 3, 4 and 5 illustrate what I have defined as the qualitative information or results of the data for the entire collection, including: (1) manufacturing techniques observed (Table 3), (2) the base metal used, as determined by the scratch test (Table 5), and (3) the formal attributes including seam overlap and ventral or dorsal markings (Table 4).

Table 3. Total tinkling cones, manufacturing techniques

Manufacturing Techniques (n=356)	Number of Observations	Percent (%) of Sample Assemblage
Hammering	15	4.2
Chiseling	10	3.6
Scoring	80	22.5
Bending	94	26.4
Twisting	29	8.1
Folding	7	2.0
Cutting	86	24.2
Sawing	0	0
Melting	0	0
Perforating	22	6.2
Grinding	351	98.6

As illustrated in Table 3, out of the 356 total finished tinkling cones examined for this study, only 14 show evidence of hammering. Grinding was preformed on 98.6 % of the total collection. As discussed previously, in virtually all cases, before rolling the blank to form the hollow cone, the blank edges were ground down to create smooth edges. The data also clearly shows that sawing and melting were never employed in the manufacturing process of this collection.

Out of the entire collection, only 10 examples show evidence of chiseling. This can be attributed to the availability of scissors to cut the raw material and to the inclusion of grinding in the production sequence, whereby the edges were ground smooth before rolling the blank to form the finished cone. The use of scissors suggests the role of trade and the response to cultural interaction that was taking place during the Middle Historic period at Fort St. Joseph. The 2002 excavations conducted at Fort St. Joseph yielded a shear from a scissor. Furthermore, many of the fragments of scrap metal collected at Fort St. Joseph display evidence of cutting, using scissors or snips.

In this collection there are 80 (22.5%) examples that display scoring lines primarily along the surface edges. However, it is likely that in the process of cutting out other cones, score marks were removed and the evidence eliminated in the production sequence.

Bending, as described by Anselmi (2004), is not often recognizable. However in this collection, the process of bending to alter the morphological appearance is demonstrated in 26.4% (n=94) of the collection.

Twenty-nine examples (8.1%) in the collection demonstrate twisting, and there are only 7 (2.0%) examples of folding among the 356 examined finished tinkling cones. There are 85 examples (23.9%) that display cutting with scissors.

As illustrated below in Table 4, 97 (27.2%) cones exhibited ventral markings and 190 (53.4%) had dorsal indentations. Neither can be attributed conclusively to the production sequence because often such markings were caused in post-manufacturing, such as when a tinkling cone was attached to a garment.

A total of 104 (29.2%) cones exhibited left over right seam overlap, while 120 (33.7%) exhibited right over left seam overlap. More a third of the total collection, 132 (37.1%), of the cones displayed no seam overlap (Table 4).

Table 4. Total tinkling cones, additional formal visual observations

Additional Observations (n=356)	Number of Observations	Percent (%) of Sample Assemblage
Ventral Markings	97	27.2
Dorsal Pressure Markings	190	53.4
Seam Overlap L/R	104	29.2
Seam Overlap R/L	120	33.7
Seam No Overlap	132	37.1

The results of the scratch test to determine the base metal reveal that 198 (56%) of the collection are brass and 158 (44%) are copper (Table 5). A more detailed analysis of the copper and brass follows.

Table 5. Total tinkling cones, raw material

Base Metal Examined (n=356)	Number of Observations	Percent (%) of Sample Assemblage
Copper	158	44.4
Brass	198	55.6

The higher number of brass cones compared to the number of copper cones raises questions about control in the production process and the usage of copper and brass. For example, does the high number of brass cones (n=198) imply that brass was more widely available and thus employed more often than copper? Is copper more difficult to work with? On the other hand, does the high percentage of brass indicate that brass is more malleable and as a result easier to work with? Furthermore, what technological and formal characteristics are attributed to copper and brass? These are all significant distinguishable characteristics that allow this thesis to examine for standardization or variation through multiple formal and technological attributes and shed insight into understanding the organization of labor.

Tinkling Cones Analyzed – Conical, Extended Base, and Extended Seam

The following section of this chapter presents the results of the analyses of the distinguished types of tinkling cones categorized as conical, extended base, and extended seam. First, I present the results of the metric analysis conducted. Second, I present the results of the manufacturing techniques along with the additional visual observations, such as ventral and dorsal markings and seam overlap. Third, I present a detailed analysis of the raw material. As it is the goal of the thesis to identify formal and technical standardization or variation, it was expected that a thorough analysis of the raw material (copper or brass) would be a significant material implication in identifying centralized or noncentralized production. The chapter concludes by highlighting a number of unique in situ specimens including tinkling cones with leather and attachment methods still present and what I termed as "double tinkling cones."

Conical

The conical type is the most well represented of the tinkling cones in the collection. Out of the total 356 tinkling cones in this collection 334 (94%) are conical. Conical tinkling cones were constructed by taking a desired shape blank (trapezoidal (n=332) and square (n=2)), and rolling it over a mandrel to form a hollow conical cone shape leaving an open apex at the tip (proximal) and base (distal) ends. The cones vary from those that are generally symmetrical having constant proportions and uniformity to specimens that exhibit uneven proportions that vary in their formal attributes such as seam overlap and uneven base planes (Figure 12).

Figure 12 shows examples of conical tinkling cones that exhibit symmetrical proportions, such as no seam overlap and even base planes.

Figure 12. Examples of conical tinkling cones with symmetrical proportions exhibiting perfectly abutting seam edges and even base planes.
(Cat. No.91, 139, 94, 96, 114, 282, 257)

Figures 13 and 14 illustrate conical tinkling cones that exhibit varying formal attributes such as seam overlap, ventral and dorsal deformations, and uneven base planes. Figure 13 shows specimens that typically exhibit relatively even proportions, however vary in their manufacturing signatures. Figure 14 illustrates examples that are more crudely fashioned specimens exhibiting significant variation in their manufacturing signatures and formal attributes. The results of the comprehensive metric and technological analysis are discussed in detail below.

Figure 13. Examples of conical tinkling cones with fairly even proportions however vary formally with seam overlap and uneven base planes.
(Cat. No. 112, 183, 189, 38, 199, 108, 197)

Figure 14. Examples of conical tinkling cones exhibiting formal and technical variation with uneven proportions.

Metric Analysis

By analyzing the statistical results of the metric attributes of the 334 conical tinkling cones in this collection, this thesis assesses the degree of variation of the cones in this sample relative one to another. The finished lengths of the 334 conical tinkling cones range from 10.10 mm to 55.6 mm with a mean length of 24.55 mm

(Table 6). The standard deviation around the mean is 7.14 mm. More significantly, the relative variability of the lengths of the cones is a high 29%. This implies that the lengths of the cones in the sample generally vary greatly from one another. Similarly, widespread variation among the cones in the sample is evidenced by the high relative variability in the metrics of the other attributes analyzed.

As seen in Table 6, the finished tip diameters in conical forms range from 0.61 mm to 5.93 mm, with a small standard deviation of 0.85 mm, but a high relative variability of 36%. The relative variability of the finished base diameters is a high 42%. Given the high relative variability of each metric attribute in the sample it appears that there was a greater degree of variation in the production of these cones, which implies noncentralized production.

Table 6. Conical tinkling cones, metric analysis

Conical Tinkling Cones (n=334)	Smallest	Largest	Mean	Standard Deviation	Relative Variability %
Finished Length	10.10	55.60	24.55	7.14	29%
Finished Tip Diameter	0.61	5.93	2.37	0.85	36%
Finished Base Diameter	2.89	24.25	6.37	2.70	42%
Blank Length 1 – Left	10.85	55.51	23.40	6.87	29%
Blank Length 2 – Right	10.65	55.11	23.28	6.67	29%
Blank Width 1 – Proximal	2.52	32.48	10.63	3.78	36%
Blank Width 2 – Distal	10.34	58.03	21.18	7.64	36%
Metal Thickness	0.20	0.92	0.47	0.15	32%
*all measurements in mm					

Manufacturing Techniques

The results of the 9 manufacturing techniques identified in the production of conical tinkling cones are presented in Table 7.

Table 7. Conical tinkling cones, manufacturing techniques

Manufacturing Techniques (n=334)	Number of Observations	Percent (%) of Sample Assemblage
Hammering	15	4.5
Chiseling	9	2.7
Scoring	77	23.1
Bending	84	25.1
Twisting	27	8.1
Folding	7	2.1
Cutting	79	23.7
Perforating	22	6.6
Grinding	330	98.8

The only manufacturing technique common to virtually the entire sample of the 334 conical cones was grinding. 330 or 99% of the conical cones exhibited grinding. Otherwise the manufacturing techniques observed varied widely throughout the sample. 77 (23.1%) were scored, 84 (25.1%) showed evidence of bending and 79 (23.7%) had signs of cutting. Hammering, chiseling, twisting, folding and perforating were evident on only a small percentage of the cones sampled. These observations imply a greater degree of variation in the various technological signatures and the manufacturing techniques employed.

Table 8 presents the results of the additional observed formal attributes including ventral and dorsal markings and seam overlap. Of interest are the 179 (53.6%) specimens that exhibit dorsal pressure markings. In comparison only 92

(27.5%) exhibited ventral markings and the remaining 63 (18.9%) exhibited no surface deformation. Although this may be due to post-manufacturing practices, for example to attach tinkling cones, or as a manufacturing techniques such as seam closure for example, this implies the more common use of a particular slightly curved tool to close the cone. However, it does not imply the standard use of a particular tool.

Also only 37.4% of the sample exhibited no seam overlap, thereby implying a lesser degree of standardization in the production process.

Table 8. Conical tinkling cones, additional visual observations

Additional Observations (n=334)	Number of Observations	Percent (%) of Sample Assemblage
Ventral Markings	92	27.5
Dorsal Pressure Markings	179	53.6
No Overlap	125	37.4

In addition, only 37.4% of the sample exhibited no seam overlap, thereby implying a lesser degree of standardization in the production process.

Raw Material, Copper or Brass

The variable meanings attributed to copper and brass kettles have been described in previous chapters. In addition to their use as cooking vessels and their symbolic connotation in Native practice, cooper and brass kettles were highly valued for their raw material, which served to produce new objects of material culture such as the tinkling cones upon which this study is based. In order to investigate the organization of labor, this study examines a wide range of dimensions, including social, economic, and symbolic or religious systems, as well as the technological characteristics, including the availability of raw materials and the ability to produce objects to fit the demand of the consumer population. As such, this analysis employs the theoretical premise that standardization or variation exhibited within the manufacturing techniques and formal styles of the forms created are indicative of centralized (standardization) or noncentralized (variation) production. Therefore, an examination of the usage of the raw material employed in the production of the tinkling cones under study allows this thesis to infer possible meanings to the uses of copper and brass and to relate these meanings to the formal and technological characteristics under study.

To begin investigating the role of copper and brass and to examine for any standardization or variation within the formal and technological attributes, I first present the results of the analyses of the manufacturing techniques including the additional visual observations, ventral and dorsal markings, and seam overlap. Second, I present the results of the metric analysis where I examined the relative variability of the finished lengths in relation to the raw material.

Illustrated in Table 9 are the results of the analysis of the manufacturing techniques employed in the production of both brass and copper conical tinkling cones.

Table 9. Conical tinkling cones, brass and copper

Conical Cu/BR BR=186 CU=148	Number of observations Brass	Percentage %	Number of observations Copper	Percentage %
Hammering	8	4.3	7	4.7
Chiseling	5	2.7	4	2.7
Scoring	47	25.3	30	20.3
Bending	47	25.3	37	25.0
Twisting	15	8.1	12	8.1
Folding	5	2.7	2	1.4
Cutting	36	19.4	43	29.1
Perforating	11	5.9	11	7.4
Grinding	184	98.9	146	98.6
Ventral Markings	50	26.9	42	28.4
Dorsal Markings	94	50.5	82	55.4
No overlap	82	44.1	43	29.1

It is obvious that brass was more commonly used in the production of conical tinkling cones within this sample. Of the 334 conical types 186 are brass and 148 are copper. More significant is the percentage that each manufacturing technique was employed with either brass or copper. For example, 25.3% of the brass cones exhibited scoring, while 20.3% of the copper cones were scored. Possible explanations for such a difference are that brass is more compliant and easier to work and as a result the process of scoring the object is more effective; a greater availability of brass; or the availability of particular tools. In the initial stages of the production sequence the skin of the kettle would typically be scored leaving scratched or incised striations along the surface. The craft specialist would then cut, presumably on or close to the striated scored lines to form the blank. Of interest are the 36 (19.4%) brass specimens that exhibit cutting, compared to the 43 (29.1%) copper examples that exhibit cutting. Cutting typically leaves a distinguishable upturned or serrated edge. During the production sequence, cutting would be followed by grinding the edges of the finished blank. This is distinguished by the smooth edges present in the final form. The results in Table 9 show that grinding was employed in 184 (98.9%) brass specimens compared to 146 (98.6%) copper specimens. This is significant because there is very little percentage difference in brass and copper cones that exhibit grinding. However, there are significant differences in cutting and scoring each metal, which implies that similar manufacturing techniques were being employed with both copper and brass. However, copper cones exhibit more variation in the manufacturing process as observed in the final forms. Therefore, the high percentage of grinding along with a lesser percentage of cutting and more incidences of scoring among the brass sample may likely be the result of a more proficient craft specialist, the availability of certain tools, and/or access to certain raw materials.

Additionally, 82 (44.1%) brass specimens as compared to 43 (29.1%) copper cones exhibited perfectly abutting seam edges and thus no seam overlap. This implies that brass tinkling cones generally exhibited more symmetrical proportions and as a result less variation with their formal attributes (i.e. length).

In order to fully investigate the degree of variation within the copper and brass samples I conducted a statistical analysis to measure the relative variability in the finished lengths of both the copper and brass conical samples. As illustrated in Table 10, the finished lengths of brass tinkling cones range from 10.10 mm to 43.45 mm with a mean length of 24.08 mm. The standard deviation is 6.36 mm. More significant is the relative variability of 26%. The finished lengths of the copper tinkling cones range from 13.95 mm to 55.60 mm with a mean of 25.14 mm and a standard deviation of 8.01 mm. The relative variability in length of the copper cones is a high 32% as compared to 26% for the brass cones. Therefore, the copper specimens exhibit more variation when comparing them to one another (n=148) as is evident by the standard deviation and the high percentage of relative variability. Furthermore, the comparison of the copper cones to the brass cones shows that the relative variability of the copper cones is greater than the relative variability of the brass cones. This in turn implies that there is greater variation in the production of copper tinkling cones as compared to brass tinkling cones.

Table 10. Conical tinkling cones comparison of finished lengths

Brass n = 186				
Smallest	Largest	Mean	Standard Deviation	Relative Variability%
10.10	43.45	24.08	6.36	26%
*all measurements in mm				

Copper n = 148				
Smallest	Largest	Mean	Standard Deviation	Relative Variability%
13.95	55.60	25.14	8.01	32%
*all measurements in mm				

Extended Base, Total

The second identified category of tinkling cone is classified as extended base (Walthall and Brown 2001:102). Extended base tinkling cones were primarily produced using a square or kite-shaped blank in which the blank was rolled from the two opposite corners across the midline for closure. The size of the square blank would dictate the degree of overlap that was necessary for seam closure in the finished product. Extended base tinkling cones do not exhibit similar base planes as do conical cones. Instead the use of a kite-shaped blank produces a tinkling cone with a wide base and triangular projection facing downward (Figure 15).

Figure 15. Examples of extended base tinkling cones manufactured with square or kite shaped blanks.

Compared to the conical and extended seam types, extended base tinkling cones (Walthall and Brown 2001:102) are more bulbous at the base and overall wider proportionality with a mean finished base diameter of 12.32 mm (Table 11), significantly higher than the conical cones. However the relative variability of the finished base diameters of the extended base cones, while high at 32%, was far lower than the 42% relative variability of the finished bases for the conical cones. This would suggest greater standardization in the production process of the extended base cones as compared to the conical cones. This supposition is reinforced upon analysis of the other metrics.

The finished lengths of the 18 extended base tinkling cones ranged from 23.45 mm to 48.84 mm with a mean length of 30.8 mm and a standard deviation of 6.43 mm (Table 11). However the relative variability of the lengths of these cones was only 21% as compared to the 29% for the conical cones. Again we see less variation among the extended base cones. This conclusion holds true when comparing the other metric attributes of the extended base cones to the conical cones. In all cases the relative variability of the extended base metrics are lower than those of the conical cones and in most cases significantly lower. This suggests that there is a greater degree of standardization in the manufacture of the extended base cones when compared to the conical cones.

Table 11. Extended base tinkling cones, metric analysis

Extended Base (n=18)	Smallest	Largest	Mean	Standard Deviation	Relative Variability %
Finished Length	23.45	48.84	30.8	6.43	21%
Finished Tip Diameter	0.95	3.31	1.84	0.62	34%
Finished Base Diameter	5.90	21.82	12.32	3.92	32%
Blank Length 1 – Left	17.82	35.4	24.44	4.6	19%
Blank Length 2 – Right	18.42	31.2	24.04	4.1	17%
Blank Width 1 – Proximal	15.09	35.45	22.8	4.9	22%
Blank Width 2 – Distal	15.63	31.62	22.6	4.8	21%
Metal Thickness	0.41	0.85	0.62	0.14	23%
*all measurements in mm					

One major difference in the technological history of the extended base category versus the conical category is that the extended base cones were primarily produced using a square or kite-shaped blank. 17 of the 18 extended base cones were manufactured from square or kite-shaped blanks. 332 of the 334 conical cones were produced from trapezoidal blanks as evidenced by the ventral and dorsal crimp marks, severe bending, and poorly-ground edges. Only 2 of the conical cones were manufactured with rectangular cut blanks.

Examination of the manufacturing techniques visually identified in extended base tinkling cones highlights two important characteristics (Table 12). First, none of them exhibit scoring marks. While this can be attributed to the small sample, further examination to compare for this technological signature may reveal variations in the manufacturing processes. One possible scenario is that square blanks may have been easier to cut and shape without the guidance of score incisions. However, if this were the case, it is surprising that there are so few examples in this collection. Future examinations of comparative collections can question the possible variables.

Table 12. Extended base tinkling cones, manufacturing techniques

Manufacturing Techniques (n=18)	Number of Observations	Percent (%) of Total Assemblage
Hammering	0	0
Chiseling	0	0
Scoring	0	0
Bending	9	50.0
Twisting	2	11.1
Folding	0	0
Cutting	6	33.3
Perforating	0	0
Grinding	17	94.4

The second important technological signature is the 5 ventral markings that exhibit what appears to be evidence that a clamp may have been used in the manufacturing process to hold the blank in place (Table 13). This technical attribute, along with the kite shaped blank producing a triangular projection at the base, may indicate craft preference in the production methods for extended base tinkling cones. The extended basal projection prompts questions of technological and social change as new tools and objects of material culture were being integrated into the daily lives of French and Native populations on the colonial frontier.

Table 13. Extended base tinkling cones, additional visual observations

Additional Observations (n=18)	Number of Observations	Percent (%) of Sample Assemblage
Ventral Markings	5	27.8
Dorsal Pressure Markings	9	50.0
Seam Overlap L/R	7	38.9
Seam Overlap R/L	8	44.4
Seam No Overlap	3	16.7

Table 14. Extended base tinkling cones, brass and copper

Extended Base Cu/BR n=18 BR=10 CU=8	Number of observations Brass	Percentage %	Number of observations Copper	Percentage %
Hammering	0	0	0	0
Chiseling	0	0	0	0
Scoring	0	0	0	0
Bending	4	40.0	5	62.5
Twisting	1	10.0	1	12.5
Folding	0	0	0	0
Cutting	5	50.0	1	12.5
Perforating	0	0	0	0
Grinding	9	90.0	8	100.0
Ventral Markings	2	20.0	3	37.5
Dorsal Markings	4	40.0	5	62.5
Seam L/R	3	30.0	4	50.0
Seam R/L	7	70.0	1	12.5
No overlap	0	0	3	37.5

In order to fully investigate the degree of variation within the copper and brass samples I conducted a statistical analysis to measure the relative variability in the finished lengths of both the copper and brass extended base samples. As illustrated in Table 15, the brass tinkling cones range from 24.03 mm to 48.84 mm with a mean length of 31.87 mm. The standard deviation is 7.56 mm. More significant is the relative variability of 24%. The finished lengths of the copper tinkling cones range from 23.45 mm to 36.33 mm with a mean of 29.44 mm and a standard deviation of 4.81 mm. The relative variability in the finished length of the copper extended base cones is a low 16% as compared to 24% for the brass cones. Therefore, the copper specimens exhibit less variation when comparing them to one another (n=8) as is evident by the standard deviation and low percentage of relative variability. This in turn implies that there is greater standardization and thus less variation in the production of copper cones as compared to brass extended base cones. Although the sample size of extended base is far smaller than the conical category, the comparison of relative variability shows that brass, and to a greater extent copper, extended base cones tend to exhibit greater standardization in their metric attributes. This raises interesting questions of chronological implications, perhaps ethnic variation in production, and issues of personal preferences. However, without tight spatial and chronological control in conjunction with in situ structural and contextual and/or comparative data, these issues are out of the scope of this research. Future research comparing these factors can address such questions.

Table 15. Extended base tinkling cones, comparison of finished lengths

Brass n = 10				
Smallest	Largest	Mean	Standard Deviation	Relative Variability
24.03	48.84	31.87	7.56	24%
*all measurements in mm				

Copper n = 8				
Smallest	Largest	Mean	Standard Deviation	Relative Variability
23.45	36.33	29.44	4.81	16%
*all measurements in mm				

Extended Seam

The third category of tinkling cone, termed extended seam, meets the criteria set forth to be identified as tinkling cones, however distinguishes itself formally among the categories because of an extended dorsal surface projecting downward, hence the name extended seam (Figure 16).

Figure 16. Examples of extended seam tinkling cones.

Extended seam tinklers were classified as their own type based two on distinguishable variables: (1) their morphological variation compared to conical and extended base types, and (2) the morphological standardization exhibited in all four examples.

The metric results show that the mean width of the distal blank edge is 28.72 mm with a standard deviation of 2.55 mm. However, the trapezoidal blanks used in the manufacture of the four extended seam tinklers were cut with a much wider distal edge in order to achieve a projecting angle protruding the dorsal surface. This metric comparison is demonstrated in the proportions of the final shape.

Table 16. Extended seam tinkling cones, metric analysis

Extended Seam (n=4)	Smallest	Largest	Mean	Standard Deviation	Relative Variability %
Finished Length	24.2	29.45	27.4	2.32	9%
Finished Tip Diameter	1.29	2.02	1.7	0.32	19%
Finished Base Diameter	8.1	10.12	8.8	0.93	11%
Blank Length 1 – Left	23.36	28.53	26.3	2.2	8%
Blank Length 2 – Right	22.2	27.86	25.8	2.55	10%
Blank Width 1 – Proximal	8.02	10.34	9.23	0.95	10%
Blank Width 2 – Distal	25.4	31.62	28.72	2.55	9%
Metal Thickness	0.42	0.92	0.6	0.23	38%
*all measurements in mm					

Table 17. Extended seam tinkling cones, manufacturing techniques

Manufacturing Techniques (n=4)	Number of Observations	Percent (%) of Total Assemblage
Hammering	0	0
Chiseling	1	25.0
Scoring	3	75.0
Bending	1	25.0
Twisting	0	0
Folding	0	0
Cutting	1	25.0
Perforating	0	0
Grinding	4	100

The second unique attribute that distinguishes extended seam tinkling cones is that they all possess abutting seams with no overlap. Although the sample size is limited to four specimens, the strong correlation between blank shape and size to finished form suggests some standardization in the production process. Three of the four cones in this category exhibit scoring marks, one demonstrates cutting, and another exhibits bending (Table 17). Finally, two are manufactured with copper and the other two are brass (Table 18). Therefore, while their formal attributes appear to be more standardized there is variation in manufacturing techniques and raw material.

Table 18. Extended seam tinkling cones, raw material

Base Metal Examined (n=4)	Number of Observations	Percent (%) of Sample Assemblage
Copper	2	50.0
Brass	2	50.0

Table 19. Extended seam tinkling cones, additional visual observations

Other Observations (n=4)	Number of Observations	Percent (%) of Sample Assemblage
Ventral Markings	0	0
Dorsal Pressure Markings	2	50.0
Seam Overlap L/R	0	0
Seam Overlap R/L	0	0
Seam No Overlap	4	100

Unique Intact Examples

This study combines attribute analysis of the forms produced (finished tinkling cones) with an examination of manufacturing techniques as a way to investigate the organization of labor. While investigating for determined manufacturing techniques, along with visually identifiable formal attributes, this study looked for evidence of post-manufacturing deformation. Although the latter can only be verified using advanced metallographic techniques, which were not employed for this study, I identified crimp marks with tool impressions that were clearly used for attaching tinkling cones to garments and such. In this collection there is clear evidence of this exact scenario as two tinkling cones are still attached to the leather they hung from in the 17th and 18th centuries.

Figure 17. Unique intact examples of tinkling cones.
a. Two attached tinkling cones illustrating multiple methods for attaching tinklers to leather.
b. Example reveals evidence for attachment with crimped dorsal tip and neck.
c. Unique example of applied decoration with black annular band design.

This example (Figure 17) demonstrates two methods of attachment. The top tinkling cone in Figure 17a is attached with a knot on the inside and pulled through the proximal apex. The bottom tinkler is attached to the leather by crimping the posterior and anterior neck surfaces closed. Also intriguing is the variation in manufacturing techniques and formal styles of the two attached cones. The top tinkling cone is an example of a conical cone with perfectly abutting seam edges, finely ground edges, and no pressure bends or tool marks of any kind. The bottom cone suggests more variation in the manufacturing process as it exhibits left over right seam overlap, a bend scar on the base edge, and a rivet hole on the left dorsal neck surface. This example illustrates two styles of tinkling cones that exhibit formal and technical variation, which were used in the same context. Other evidence for the two methods of attachment is also seen in five more examples. Two of them are crimped at the top and two are knotted. The remaining example is barely attached at the distal seam edge and is an example of a double tinkling cone (discussed below). Also visible in two examples is the remaining tufts of animal hair (perhaps deer or horse) that was often attached to the cone for further decoration.

One more notable mention is a tinkling cone that displays an annular black band along its latitudinal base surface (Figure 17c). To date I am not aware of any examples of tinkling cones from the 17th and 18th centuries that exhibit applied decoration. Seen in Figure 17c the annular band is not evenly distributed as some sections are wider than others and the edges are uneven. The annular band appears to have been painted on the surface. The authenticity of the annular band is speculative since this collection was recovered from undisturbed archaeological context.

Another unique dimension to this collection of finished tinkling cones are the nine examples of what I term as double tinkling cones (Figure 18). These examples are literally one tinkling cone engaged in another, hence the name double tinkling cone.

Figure 18. Examples of double tinkling cones.

Examining these unique examples, I suggest that they were combined in one of two ways. First, they were jammed together by taking one tinkling cone and pushing it through the base orifice of another. Or second, they were used as a mandrel to roll a blank into a finished tinkling cone. The latter doesn't seam likely because there is a high degree of variation in the formal attributes for many of the joined tinkling cones. Initially I speculated about the authenticity of the double tinkling cones as many circumstances could have lead to the development of these examples. However, two examples observed are completely rusted, providing additional evidence for their authenticity. These examples shed light as to the multiple ways in which tinkling cones were used.

This chapter presented an analysis and the results of the styles, measurements and manufacturing techniques observed in the examination of a sample of 356 finished tinkling cones. I classified three distinct types of tinkling cones based on their relative formal attributes: conical, extended base (Walthall and Brown 2001:102), and extended seam. I then presented the results of the metric analysis conducted; the results of the analysis of the manufacturing techniques along with the additional visual observations, such as ventral and dorsal markings and seam overlap; and I present a detailed analysis of the raw material. I believe these analyses enabled me to achieve the goal of the thesis that is to identify formal and technical standardization or variation in the production of this collection of finished tinkling cones. An analyses of the all the significant distinguishable characteristics allowed this thesis to examine for standardization or variation through those multiple formal and technological attributes and shed insight into understanding the organization of labor.

The chapter concluded by highlighting a number of unique intact specimens including tinkling cones with leather and attachment methods still present and what I termed as "double tinkling cones."

In summary, I intended to show that high degrees of uniformity or standardization exhibited in both the production sequence and the morphological attributes in the finished forms of the tinkling cones would be the result of centralized production. Conversely, I intended to show that a lesser degree of uniformity exhibited in the production sequence and the final forms of the tinkling cones would be evidence of a noncentralized mode of production.

The next chapter will present a summary of the results of the analyses just completed and offer my conclusions. I will also discuss avenues of future research to which this study can contribute.

CHAPTER IV

RESULTS AND CONCLUSIONS

In order to investigate the organization of labor and the role of craft specialization in and around the Colonial fur trade outpost Fort St. Joseph, this research examined a collection of 356 finished complete tinkling cones. To investigate the organization of labor, I employed the theoretical framework that in an archaeological context it is possible to differentiate centralized production from noncentralized production by identifying any standardization or variation within the manufacturing techniques used and formal style of the final forms created. Therefore, I employed analytical methods that combined attribute analysis of the finished tinkling cones, including metric analysis and visual inspection, along with an examination of manufacturing techniques and raw material as a way to investigate the organization of labor.

This research project began with multiple goals in mind in the examination of craft production. Ultimately I narrowed the objective to the investigation of the organization of labor and the role of craft specialization. I systematically examined the archaeological patterning of tinkling cones and shed insight into the dynamic social, cultural, and economic relationships that existed at the Colonial fur trade outpost Fort St. Joseph. By identifying standardization and variation within the manufacturing techniques used in the production of tinkling cones and formal attributes of the final forms created, this research investigated any technological signatures that would distinguish varied technological practices and ultimately the organization of labor and production that existed during the late eighteenth western Great Lakes fur trade.

Chapter 2 examined how previous researchers from various disciplines (i.e. archaeologists, anthropologists, and historians) have examined issues of labor and the organization of production, including craft specialization, standardization, and variation. I presented a synopsis of the temporal and spatial distribution of tinkling cones recovered from French colonial archaeological sites and Native American burial context. I presented the historical context of craft production, material culture and material culture change, in the cultural context of the fur trade. I also examined multiple perspectives for viewing technological and material culture change, as well as the leading arguments for local production.

In Chapter 3, I presented a brief overview describing the historical context in which the collection of 356 tinkling cones under study were introduced and formulated. This chapter included a history of Fort St. Joseph, in order to provide the socio-cultural and economic setting relevant to my analysis. I then discussed the century-long search for Fort St. Joseph, and the subsequent formation of the collection of tinkling cones under study. I provided pertinent information in regards to the 2002 excavations conducted at Fort St. Joseph, which for the first time, conclusively demonstrated the presence of intact structural remains, in-ground facilities, and undisturbed concentrations of colonial artifacts, thus demonstrating the presence of French, English, and Native peoples at Fort St. Joseph (Nassaney et al. 2005).

Chapter 4 presented the analytical methods employed to examine for standardization or variation in the manufacture of this collection of tinkling cones. I detailed the archaeometric and visual examination techniques, including metric analysis and optical examination of the formal style, including size, seam overlap, base plane, base metal (raw material), and surface features. This detailed analytical approach allowed me to construct a typology that reflected any technical and formal standardization or variation within the collection.

Chapter 5 identified and described the 11 manufacturing techniques (after Anselmi 2004) that were employed in the production of conical, extended base, and extended seam tinkling cones, the raw material and the two additional visually determinable deformations. I then presented the results of the metric analysis conducted; the results of the analysis of the manufacturing techniques along with the additional visual observations, such as ventral and dorsal markings and seam overlap; and a detailed analysis of the raw material. I concluded by illustrating some unique intact examples of tinkling cones in this collection.

By examining the manufacturing techniques of each finished tinkling cone along with form, measurement, and raw material, I was able to assess the degree of variation of the cones in this sample relative one to another. This allowed me to distinguish between centralized and noncentralized production and thus shed insight into the organization of labor. As I clearly demonstrated, the high number and increased percentage of conical tinkling cones that exhibit both formal and technological variation relative to one another infers that the organization of labor in and around Fort St. Joseph was that of noncentralized production. This conclusion is based on the theoretical framework set forth in this analysis that standardization or variation exhibited within the manufacturing techniques and formal styles of the forms created are indicative of centralized (standardization) or noncentralized (variation) production.

Therefore, as a noncentralized mode of production the production of tinkling cones would have taken place in more dispersed workshops and various locations in and around the fort. This implies that the production of tinkling cones was being produced in relatively smaller scale and independent workshops as opportunistic activities to fit the demands of the local nearby consumer, community, relative, or even the individuals themselves. It is probable that these craft specialists produced various other objects as well as tinkling cones, such as metal projectile points and rivets used to repair objects such as kettles.

One of the major contributions of this thesis is that it has provided the ground-work for subsequent analyses. To date, I am not aware of any study that has specifically focused on one collection of tinkling cones by employing a technologically based viewpoint in order to investigate for the role of craft specialization. As such it is the first of its kind.

Future analyses may draw on the multiple issues that I have raised throughout this analysis. For example, I clearly demonstrate that brass was employed more often than copper in the production tinkling cones. Reasons that could be attributed to such a factor include availability of raw material, personal preference, and the malleability of brass. Van Dongen (1995:125) suggests that brass tended to be easier to work with. The results of the comparative data between the brass and copper tinkling cones support this argument. Future examinations of tinkling cones can further test this theorem.

Also of interest are the 18 extended base examples that exhibit relatively far less variation when compared to the conical types. Although the sample size is significantly smaller (n=18) than the conical types (n=334), the extended base sample exhibits less variation when compared to itself as illustrated by the low percentage of relative variability. This raises interesting questions for future avenues of research. For example, perhaps extended base tinkling cones are a chronological indicator for a change in time and as a result express new sets of cultural, social, and economic conditions? Or perhaps extended base tinkling cones are a signature to a specific ethnic group? Without tight spatial and chronological control, which this collection under study lacks, these questions are out of the scope of this research.

One last, but by no means least, point of interest would be to compare the tinkling cones and the scrap metal from in-situ context. As excavations continue at Fort St. Joseph and more structural evidence is presented, distinguishable activity areas will be identified. As such, intra-site analysis will be able to compare the results of this analysis with new and contributing data sets of such items as tinkling cones and scrap metal. The availability of in-situ context also provides the ability to conduct inter-site comparisons, for example with Fort Michilimackinac and/or Rock Island. This in turn will strengthen our understanding of the social, cultural, and economic relationships that existed between the Native and Europeans peoples alike throughout the colonial frontier. Thus, we can begin to appreciate the broader processes that exemplify the fur trade and provide insight into the way labor was organized on the Colonial frontier at Fort St. Joseph.

Appendix A - Tinkling Cones Metric Database

Appendix A - Tinkling Cones Metric Database

Cat No	F/Sp	F/Lgh	F/TD	F/BD	B(T) W1	B(B) W2	B(L) Lg1	B(R)Lg2	Mt Tk	Wt
1	Conical	43.0	3.38	9.87	18.06	35.74	42.86	37	0.67	4.91
2	Conical	53.3	3.46	12.7	14.95	40.71	50.61	51.86	0.49	4.69
3	Conical	55.6	3.29	15.55	9.7	43.15	55.51	55.11	0.79	6.51
4	Conical	55.3	3.86	12.17	17.54	36.45	54.69	51.69	0.53	5.74
5	Conical	16.0	1.56	4.36	2.84	11.5	14.55	15.84	0.48	0.28
6	Conical	20.0	2.48	6.17	7.1	21.91	18.95	19.95	0.32	0.56
7	Conical	16.5	3.22	4.74	8.25	19.2	16.48	16.09	0.35	0.46
8	Conical	25.6	1.99	5.11	7.32	16.1	25.1	25.02	0.3	0.51
9	Conical	13.0	2.48	4.91	8.4	12.94	12.2	12.74	0.39	0.22
10	Conical	15.9	2.76	4.6	8.84	12.71	13.72	14.83	0.36	0.31
11	Conical	19.7	2.42	5.89	9.2	17.65	18.7	19.76	0.36	0.4
12	Conical	24.5	2.3	6.06	7.31	26.56	23.38	23.97	0.48	0.92
13	Conical	15.3	3.27	5.28	18.37	16.66	15.25	14.5	0.62	0.67
14	Conical	20.8	3.51	7.25	11.14	24.14	20.67	20.48	0.43	0.89
15	Conical	21.4	2.93	7.04	14.4	20.11	20.33	21.07	0.32	0.87
16	Conical	19.7	2.89	5.6	9.95	17.1	18.88	19.6	0.33	0.71
17	Conical	20.5	2.56	5.84	9.81	16.79	21.09	19.56	0.38	0.64
18	Conical	21.5	2.28	6.33	9.24	19.7	20.82	20.39	0.39	0.68
19	Conical	21.1	3.29	5.85	12.63	17.77	20.49	20.38	0.43	0.76
20	Conical	26.7	2.63	6.79	9.6	21.55	25.12	26.05	0.49	1.06
21	Conical	18.2	2.85	4.4	10.05	15.22	18.17	18.58	0.44	0.65
22	Conical	23.7	2.08	7.01	10.06	20.42	23.06	23.12	0.54	1.18
23	Conical	21.1	2.96	6.02	8.32	18.32	20.7	20.13	0.21	0.56
24	Conical	28.2	2.83	7.08	10.93	22.02	27.39	27.18	0.36	1.2
25	Conical	22.1	3.72	6.94	14.2	20.26	21.88	21.28	0.6	1.84
26	Conical	29.5	2.38	6.73	10.26	19.03	29.11	29.11	0.46	1.31
27	Conical	21.8	3.58	5.1	15.13	23.93	17.45	18.47	0.22	0.6
28	Conical	23.9	2.81	8.2	9.78	16.59	24.03	24.14	0.46	0.6
29	Conical	30.8	3.82	7.2	11.6	25.77	29.96	29.73	0.44	1.41

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Cat No	F/Sp	F/Lgh	F/TD	F/BD	B(T) W1	B(B) W2	B(L) Lg1	B(R)Lg2	Mt Tk	Wt
30	Conical	21.0	3.15	6.35	10.62	19.37	18.88	19.67	0.4	0.58
31	Conical	19.6	3.69	7.18	13.1	22.7	18.24	18.34	0.92	0.139
32	Conical	18.7	3.05	6.32	12.38	19.16	17.33	17.93	0.53	0.68
33	Conical	17.9	2.86	5.19	8.94	16.21	18.04	17.67	0.28	0.57
34	Conical	15.0	2.58	5.11	7.48	15.63	14.44	14.45	0.37	0.41
35	Conical	20.0	2.75	6.36	8.37	19.4	19.41	18.57	0.27	0.39
36	Conical	23.4	3.68	7.11	14.71	21.23	21.93	20.48	0.53	1.42
37	Conical	18.8	1.58	4.31	7.42	11.77	18.27	18.88	0.33	0.41
38	Conical	24.5	2.99	6.74	10.25	23.21	23.83	23.92	0.36	1.05
39	Conical	21.6	1.81	4.65	8.5	20.53	22.18	21.13	0.36	0.61
40	Conical	18.9	2.19	3.86	7.76	11.7	18.48	18.73	0.36	0.44
41	Conical	16.6	3.05	6.01	8.88	17.76	22.31	21.66	0.46	0.5
42	Conical	22.3	2.57	5.35	11.2	18.26	16.11	15.99	0.37	0.74
43	Conical	22.0	3.47	5.55	16.7	16.7	20.21	21.31	0.48	0.72
44	Conical	19.2	1.94	6.61	7.37	16.82	18.65	18.69	0.44	0.48
45	Conical	19.0	3.72	7.01	14.86	19.22	17.11	17.7	0.38	0.55
46	Conical	11.9	2.56	4.33	9.31	13.03	10.85	10.65	0.46	0.28
47	Conical	16.7	2.89	4.8	9.83	16.42	15.12	16.43	0.39	0.43
48	Conical	16.8	3.5	6.11	12.5	0	16.02	15.95	0.31	0.36
49	Conical	17.5	2.2	4.21	7.77	12.61	16.93	17.3	0.49	0.38
50	Conical	20.2	2.47	4.92	10.6	17.2	19.58	19.8	0.55	0.8
51	Conical	21.8	2.76	6.74	10.91	19.51	20.96	21.06	0.53	0.9
52	Conical	21.4	2.74	7.3	11.5	22	20.31	19.99	0.38	0.73
53	Conical	19.5	2.81	5.31	7.58	13.81	18.96	18.59	0.34	0.42
54	Conical	21.5	2.53	5.69	13.06	17.5	21.64	21.4	0.63	1.01
55	Conical	21.2	2.42	5.76	13.1	18	20.01	20.76	0.38	0.71
56	Conical	24.9	3.27	6.78	11.58	26.62	23.18	23.74	0.8	1.38
57	Conical	22.1	2.61	5.62	10.6	20.84	20.71	21	0.35	0.48
58	Conical	20.9	3.06	6.76	11.22	24.33	20.49	20.5	0.59	1.02
59	Conical	18.9	1.96	5.73	8.46	14.55	17.17	18.81	0.68	0.57
60	Conical	16.9	2.6	4.48	11.3	14.2	17.41	17.06	0.39	0.61
61	Conical	22.0	2.28	4.73	7.56	18.13	21.45	21.14	0.69	0.85

Appendix A - Tinkling Cones Metric Database

Cat No	F/Sp	F/Lgh	F/TD	F/BD	B(T) W1	B(B) W2	B(L) Lg1	B(R)Lg2	Mt Tk	Wt
62	Conical	14	2.92	4.91	11.83	14.84	13.87	13.1	0.7	0.41
63	Conical	14.8	2.26	4.17	8.9	17.8	14.48	14.2	0.35	0.35
64	Conical	22.1	1.44	6.19	12.63	19.79	21.62	20.32	0.44	0.7
65	Conical	16.4	3.18	4.34	11.37	13.4	16.77	16.02	0.52	0.56
66	Conical	16.6	2.71	4.53	10.4	15.18	15.76	16.21	0.4	0.39
67	Conical	23.3	2.01	4.51	6.86	13.12	23.33	23.2	0.36	0.43
68	Conical	18.7	2.44	4.48	9.16	15.1	18.19	18.37	0.38	0.47
69	Conical	16.8	2.26	5.78	8.49	16.71	16.71	16.01	0.59	0.71
70	Conical	15.5	2.5	6.36	7.5	15.54	15.01	15.02	0.68	0.38
71	Conical	23.7	2.35	5.42	9.8	16.06	23.45	23.2	0.32	0.82
72	Conical	17.3	2.4	5.38	9.39	17.22	17.03	16.85	0.52	0.69
73	Conical	22.2	3.61	10.2	10.61	24.77	21.45	22.01	0.46	1.03
74	Conical	23.4	3.38	5.34	10.83	15.25	22.11	22.85	0.59	1
75	Conical	24.3	1.79	5.65	17.79	20.55	22.04	21.63	0.4	1.01
76	Conical	23.7	2.61	4.89	11.23	15.54	21.73	23.06	0.46	0.63
77	Conical	35.6	2.14	4.75	8.25	20.54	35.65	33.5	0.51	1.31
78	Conical	28.1	2.71	7.37	7.6	20.37	27.58	24.4	0.54	1.85
79	Conical	16.5	2.25	4.19	12.44	17.65	16.17	15.93	0.28	0.45
80	Conical	28.7	3.4	7.61	12.3	24.42	28.03	27.67	0.5	1.31
81	Conical	33.9	3.32	7.14	13.03	21.34	33.73	33.93	0.39	1.13
82	Conical	16.9	2.87	4.81	9.33	19.58	16.7	15.74	0.44	0.57
83	Conical	18.4	2.28	5.72	7.72	16.95	17.08	17.68	0.33	0.53
84	Conical	21.7	2.27	3.8	10.18	16.19	21.21	20.38	0.31	0.49
85	Conical	23.7	1.92	5.71	8.7	13.96	23.24	23.29	0.42	0.55
86	Conical	17.8	3.62	6.33	10.76	20.83	16.27	17.12	0.37	0.56
87	Conical	23.1	2.45	5.06	12.39	17.7	22.03	22.11	0.35	0.74
88	Conical	20.7	3.48	5.43	13.1	22.6	20.7	18.58	0.42	1.08
89	Conical	19.5	2.26	4.91	10.82	20.13	19.4	17.34	0.45	0.48
90	Conical	21.8	1.61	6.31	8.55	18.82	21.63	21.54	0.38	0.67
91	Conical	28.0	2.77	8.95	10.31	25.02	27.28	27.28	0.67	2.01
92	Conical	31.5	3.36	7.67	9.28	25.02	31.02	31.03	0.71	2.56
93	Conical	20.1	3.55	5.98	13.36	17.52	19.92	20.29	0.34	0.68

Appendix A - Tinkling Cones Metric Database

Cat No	F/Sp	F/Lgh	F/TD	F/BD	B(T) W1	B(B) W2	B(L) Lg1	B(R)Lg2	Mt Tk	Wt
94	Conical	21.3	2.5	6.33	11.03	20.34	21.08	20.37	0.73	1.39
95	Conical	25.5	0.85	6.82	5.23	21.42	24.89	24.3	0.36	0.74
96	Conical	22.4	2.22	6.08	7.67	18.85	22.17	22.27	0.7	1.28
97	Conical	23.2	3	7.7	11.18	25.98	22.15	22.32	0.34	0.83
98	Conical	23.0	2.06	7.55	8.5	22.14	22.58	21.26	0.44	1.04
99	Conical	35.1	2.63	12.6	18.9	34.32	31.07	33.31	0.57	2.96
100	Conical	23.4	4.22	7.5	16.1	25.49	22.54	22.7	0.48	1.42
101	Conical	29.5	2.93	8.72	17.27	26.7	27.42	27.33	0.58	2.53
102	Conical	26.5	2.55	6.82	11.85	21.89	26.33	26.2	0.41	1.19
103	Conical	26.8	2.61	7.75	12.9	24.29	26.44	26.5	0.32	1.42
104	Conical	29.3	3.19	5.79	11.02	18	28.18	25.38	0.63	1.01
105	Conical	22.4	3.27	5.36	10.06	14.31	21.74	21.74	0.31	0.47
106	Conical	20.3	1.49	6.15	7.12	20.47	20.29	17.68	0.62	0.74
107	Conical	15.7	2.23	5.2	11.66	17.51	14.92	15.24	0.52	0.57
108	Conical	18.5	3.13	6.25	10.45	19.56	17.21	17.49	0.25	0.36
109	Conical	18.7	3.14	6.27	8.17	13.92	18.2	17.12	0.51	0.74
110	Conical	16.8	1.51	5.3	7.25	17.3	16.76	16.53	0.34	0.27
111	Conical	36	4.03	8.6	14.55	27.92	34.81	35.35	0.71	3.4
112	Conical	41.3	2.2	6.2	9.72	25.34	40.45	29.47	0.53	2.39
113	Conical	25	1.69	5.87	6.71	20.34	23.5	24	0.42	0.86
114	Conical	21.8	3.13	6.13	11.18	21.21	21.14	21.21	0.45	0.93
115	Conical	21.7	3.25	4.5	10.91	13.6	21.3	21.76	0.31	0.42
116	Conical	24.8	2.73	5.47	9.75	19.46	24.66	24.41	0.48	1.01
117	Conical	27.7	2.37	5.96	9.91	19.21	26.03	27.94	0.59	1.54
118	Conical	25.1	2.17	4.76	9.79	22.61	23.84	24.38	0.34	0.74
119	Conical	32.4	2.38	9.19	8.49	23.93	31.82	31.74	0.49	1.42
120	Conical	19.2	2.24	6.46	8.42	19.05	17.99	17.02	0.33	0.5
121	Conical	27.5	3.08	8.41	12.57	23.66	27.44	26.23	0.26	0.9
122	Conical	25.0	3.34	6.82	12.11	22.16	24.61	24.51	0.6	1.96
123	Conical	35.3	3.75	15.08	17.8	38.57	32.45	31.72	0.27	1.87
124	Conical	26.8	2.58	5.46	13.32	22.79	26.98	25.32	0.35	0.86
125	Conical	21.0	1.88	4.54	9.46	21.91	20.27	20.1	0.48	0.94

Appendix A - Tinkling Cones Metric Database

Cat No	F/Sp	F/Lgh	F/TD	F/BD	B(T) W1	B(B) W2	B(L) Lg1	B(R)Lg2	Mt Tk	Wt
126	Conical	21.7	0.94	4.85	5.91	22.38	20.59	21.68	0.56	0.82
127	Conical	22.5	2.98	4.24	12.44	18.26	22.23	22.05	0.25	1.08
128	Conical	28.4	2.37	8.07	7.28	25.1	27.56	26.2	0.49	1.17
129	Conical	23.1	3.38	6.18	12.23	24.74	22.16	22.11	0.34	0.88
130	Conical	25.8	1.47	6.01	7.72	27.03	24.89	25.1	0.3	1.02
131	Conical	18.8	0.95	4.84	7.72	14.81	18.39	18.4	0.42	0.6
132	Conical	22.4	1.83	7.68	9.73	21.78	21.7	21.05	0.55	1.14
133	Conical	19.4	3.3	4.46	11.23	18.78	19.78	19.52	0.54	1.22
134	Conical	23.1	1.83	7.31	10.04	30.76	22.17	22	0.33	0
135	Conical	21.5	1.58	4.75	5.5	19.6	20.56	21.1	0.26	0.48
136	Conical	27.4	2.8	8.09	14.44	27.37	26.81	25	0.78	2.22
137	Conical	19.4	1.98	4.72	16.38	18.18	19.01	16.73	0.34	0.89
138	Conical	19.3	0.95	4.66	8.31	17.14	19.04	19.1	0.29	0.5
139	Conical	24.8	2.03	6.35	8.09	22.14	24.13	24.1	0.57	1.27
140	Conical	21.2	1.37	3.91	10.33	23.6	20.58	20.62	0.75	0.76
141	Conical	18.7	2.25	5.49	9.87	18.55	17.79	18.23	0.64	0.8
142	Conical	22.6	2.5	7.37	11.77	22.54	21.3	21.62	0.5	1.08
143	Conical	19.2	3.5	8.05	11.14	19.3	18.74	17.51	0.41	0.71
144	Conical	15.6	2.3	5.28	9.73	22.67	14.94	14.9	0.28	0.38
145	Conical	21.4	1.71	6.26	8.49	20.17	21.13	21.13	0.43	0.86
146	Conical	16.8	2.28	5.3	12.09	17.76	15.91	15.8	0.26	0.34
147	Conical	36.3	2.9	5.79	10.24	20.02	35.13	36.1	0.4	1.58
148	Conical	37.1	4.67	8.75	18.05	28.07	36.42	36	0.41	2.62
149	Conical	20.3	2.13	5.39	12.66	19.06	19.9	20.2	0.53	1.06
150	Conical	17.1	2.71	5.31	8.31	15.81	16.14	16.6	0.47	0.58
151	Conical	17.9	1.35	6.71	5.78	16.96	17.2	16.34	0.3	0.52
152	Conical	27.6	2.05	6.02	11.58	21.54	26.66	26.87	0.61	1.75
153	Conical	17.0	1.85	4.54	8.47	13.44	16.79	16.52	0.45	0.6
154	Conical	22.1	3.35	6.3	12.78	21.62	21.01	21.26	0.44	1.11
155	Conical	21	2	5.12	8.07	18.64	18.72	20.17	0.42	0.81
156	Conical	22.2	1.79	5.62	11.2	18.5	21.51	21.02	0.57	0.78
157	Conical	16.0	2.31	5.37	9.41	16.54	15.5	15.54	0.48	0.47

Appendix A - Tinkling Cones Metric Database

Cat No	F/Sp	F/Lgh	F/TD	F/BD	B(T) W1	B(B) W2	B(L) Lg1	B(R)Lg2	Mt Tk	Wt
158	Conical	20.5	2.19	5.9	9.2	19.38	20.37	20.08	0.52	0.95
159	Conical	21.7	1.12	7.39	7.59	19.39	21.15	21.2	0.63	0.89
160	Conical	22.4	2.28	7.79	12.31	26.96	22.02	20.41	0.29	1.11
161	Conical	16.7	0.87	4.99	7.09	16.01	16.56	15.87	0.48	0.42
162	Conical	19.0	2.2	5.99	9.05	20.91	18.09	19.23	0.3	0.6
163	Conical	20.7	2.52	4.52	9.95	19.03	20.91	20.8	0.44	0.76
164	Conical	19.2	1.36	6.53	8.98	17.97	17.93	18.45	0.48	0.58
165	Conical	17.2	1.37	5.17	8.79	15.49	17.08	18.83	0.44	0.47
166	Conical	27.1	2.14	3.77	10.14	15.66	27.42	26.6	0.57	0.94
167	Conical	22.9	1.31	5.46	8.87	18.71	21.75	22.3	0.58	0.99
168	Conical	21.2	2.55	3.18	5.14	18.21	20.21	20.83	0.22	0.38
169	Conical	36.4	2.21	4.97	9.84	27.22	35.63	35.56	0.47	1.91
170	Conical	33.4	2.55	13.2	10.58	35.1	34.2	33.34	0.6	1.17
171	Conical	24.3	2.75	4.9	13.33	22.84	24.11	24.11	0.5	1.31
172	Conical	23.3	2.31	4.76	10.09	18.43	22.86	22.6	0.2	0.48
173	Conical	15.7	2.98	4.73	12.01	16.52	15.41	14.39	0.38	0.51
174	Conical	36.1	2.15	10.33	10.8	27.26	33.74	34.7	0.65	2.56
175	Conical	26.6	2.43	5.25	11.57	18.73	24.6	26.05	0.33	0.99
176	Conical	34.5	2.55	6.33	9.8	21.32	34.4	34.5	0.49	1.55
177	Conical	27.5	3.13	5.79	11.51	24.48	27.41	27.19	0.68	1.95
178	Conical	29.0	2.69	8.04	11.37	22.94	27.05	27.96	0.5	1.5
179	Conical	19.3	1.66	6.11	9.35	18.32	19.17	18.49	0.58	0.66
180	Conical	19.2	2.19	4.15	11.65	17.6	19.02	18.5	0.72	0.88
181	Conical	21.8	1.86	4.46	9.6	15.88	20.79	21.3	0.75	0.88
182	Conical	32.0	2.48	5.77	12.5	24.54	30.85	27.55	0.34	1.25
183	Conical	34.2	2.9	7.32	9.48	25.57	31.09	34.12	0.3	1.48
184	Conical	22.5	2.31	3.58	8.21	11.2	21.92	22.1	0.45	0.54
185	Conical	24.5	1.45	5.72	8.39	19.7	24.48	24.19	0.42	1.04
186	Conical	30.4	3.12	8.95	11.45	28.8	29.84	29.8	0.34	1.22
187	Conical	18.9	3.46	5.52	12.36	19.09	19.05	18.7	0.54	1.28
188	Conical	15.8	1.72	4.97	7.58	16.16	15.78	15.6	0.55	0.57
189	Conical	29.9	2.95	6.67	12.5	22.7	27.84	28.1	0.49	1.66

Appendix A - Tinkling Cones Metric Database

Cat No	F/Sp	F/Lgh	F/TD	F/BD	B(T) W1	B(B) W2	B(L) Lg1	B(R)Lg2	Mt Tk	Wt
190	Conical	15.2	1.81	4.28	8.31	15.64	14.36	15.26	0.46	0.48
191	Conical	20.7	2.5	5.05	11.32	21.45	20.94	21.11	0.63	1.19
192	Conical	20.0	1.56	5.39	6.72	20.96	18.82	19.56	0.36	0.43
193	Conical	13.9	2.26	3.92	10.26	13.7	12.48	12.27	0.27	0.17
194	Conical	21.0	1.92	5.35	8.96	18.38	20.32	19.05	0.53	0.64
195	Conical	22.2	2.64	5.21	12.84	20.58	22.08	22.04	0.52	1.23
196	Conical	23.9	2.75	4.46	12.33	19.51	23.45	23.59	0.56	1.53
197	Conical	15.4	2.14	4.2	10.1	16.3	14.57	13.77	0.48	0.59
198	Conical	20.5	1.56	5.48	8.49	17.55	20.13	20.1	0.45	0.66
199	Conical	22.1	1.93	4.55	12.42	18.88	20.46	21.1	0.36	0.75
200	Conical	32.1	1.71	9.78	8.61	29.53	31.71	31.54	0.37	1.43
201	Conical	19.9	2.3	5.7	9.34	20.06	19.12	19.12	0.44	0.76
202	Conical	21.4	1.88	4.34	7.47	17.9	19.41	21.12	0.38	0.63
203	Conical	19.1	2.05	3.1	7.12	12.71	18.64	17.01	0.38	0.39
204	Conical	20.0	2.25	3.81	10.77	15.64	18.89	20.2	0.41	0.59
205	Conical	29.6	3.18	6.13	11.22	19.87	26.86	28.81	0.53	1.32
206	Conical	15.1	1.83	4.4	7.26	15.74	15.65	15.65	0.33	0.36
207	Conical	15.0	1.3	3.77	8.59	14.69	15.48	15.35	0.49	0.44
208	Conical	21.6	2.45	5.2	9.83	17.72	21.09	21.13	0.55	0.99
209	Conical	22.2	2.48	6.75	10.15	15.9	21.67	22.26	0.49	0.91
210	Conical	20.0	1.93	3.8	8.55	16.91	19.55	19.42	0.44	0.56
211	Conical	23.9	2.6	6.67	7.73	20.7	23.26	23.25	0.65	1.58
212	Ext Base	48.8	3.31	21.82	35.45	31.62	35.4	31.2	0.49	4.31
213	Ext Base	30.4	1.71	12.77	28.82	25.01	25.01	27.8	0.53	2.17
214	Ext Base	33.3	2.41	9.3	23.22	23.3	25.5	25.9	0.76	1.9
215	Ext Base	38.6	2.31	12.86	25.3	25.23	29.45	26.2	0.54	3.98
216	Ext Base	32.0	2.55	15.09	26.43	21.95	24.7	26.7	0.71	2.81
217	Ext Base	36.3	1.4	15.87	25.38	25.5	28.45	29.6	0.72	3.51
218	Ext Base	33.9	1.61	9.91	23.54	24.8	24.78	23.92	0.47	1.45
219	Ext Base	28.0	1.58	16.7	18.35	30.99	20.1	18.81	0.72	2.91
220	Ext Base	24.0	2.1	9.19	17.99	16.5	17.82	18.42	0.44	0.97
221	Ext Base	27.9	0.95	8.81	20.25	20.6	24.14	24.9	0.85	2.52

Appendix A - Tinkling Cones Metric Database

Cat No	F/Sp	F/Lgh	F/TD	F/BD	B(T) W1	B(B) W2	B(L) Lg1	B(R)Lg2	Mt Tk	Wt
222	Ext Base	31.8	2.21	11.8	24.39	25.1	26.25	26.4	0.78	3.55
223	Ext Base	35.7	1.75	13.82	26.78	26.72	30.4	29.4	0.73	4.44
224	Ext Base	26.7	1.03	9.83	19.45	15.63	21.51	21.48	0.41	0.96
225	Ext Base	27.6	1.75	17.42	21.32	21.6	25.91	21.23	0.57	1.62
226	Ext Base	23.4	1.16	9	15.09	16.5	20.8	19.2	0.58	1.12
227	Conical	24	1.41	8.45	8.34	36.01	22.01	21.55	0.58	1.45
228	Ext Base	26.2	1.14	12	20.17	17.12	18.64	21.8	0.49	1.27
229	Ext Base	24.4	2.49	9.62	17.77	18.2	20.7	20.4	0.79	1.51
230	Ext Base	24.7	1.67	5.9	19.9	20.4	20.32	19.46	0.58	1.27
231	Conical	28.8	2.42	10.54	10.25	31.13	28.74	26.72	0.49	1.71
232	Ext Seam	28.7	2.02	8.1	10.34	31.62	26.29	27.86	0.42	1.6
233	Conical	17.6	1.61	5.18	8.53	20.08	16.27	15.91	0.33	0.5
234	Conical	20.9	1.77	7.12	8.89	21.44	20.38	18.9	0.57	1.08
235	Conical	20.7	1.39	7.97	6.96	22.39	20.54	20.3	0.48	0.9
236	Conical	26.6	2.91	9.25	10.39	29.08	26.68	25.87	0.74	2.51
237	Conical	31.1	3.06	10.34	15.27	32.53	29.62	29.71	0.6	3.22
238	Conical	29.2	1.9	12.37	6.81	39.19	27.58	23.81	0.4	1.22
239	Conical	46.6	2.71	16.91	12.66	48.73	53.42	44.2	0.53	4.85
240	Conical	40.0	2.66	12.7	13.91	41.87	40.4	38.2	0.61	4.13
250	Conical	46.1	2.93	24.25	17.05	58.03	38.52	45.44	0.69	7.77
251	Conical	35.5	1.78	13.97	2.52	41.34	35.41	28.33	0.49	2.7
252	Ext Seam	24.2	1.61	10.12	8.02	28.82	23.36	22.2	0.53	1.26
253	Conical	21.8	1.47	5.51	8.71	19.24	21.48	20.1	0.34	0.57
254	Conical	24.6	2.49	6.67	9.14	26.03	24.05	23.88	0.61	1.41
255	Conical	18.6	1.81	6.35	7.16	20.12	16.94	15.08	0.5	0.97
256	Conical	27.5	1.49	10.89	7.12	22.34	18.47	28.99	0.6	1.61
257	Conical	10.1	1.1	2.89	6.15	14.46	11.18	10.68	0.54	0.28
258	Conical	25.1	2.04	8.19	8.99	25.91	22.94	24.62	0.67	0.93
259	Conical	32.3	3.89	9.54	10.47	27.9	30.14	30.29	0.55	1.59
260	Conical	25.3	2.52	6.8	4.7	20.31	23.29	22.89	0.7	1.53
261	Conical	25.2	2.79	7.92	12.15	30.04	23.4	26.2	0.76	2.1
262	Conical	22.9	1.78	7.12	10.27	21.39	22.47	21.22	0.68	0.121

Appendix A - Tinkling Cones Metric Database

Cat No	F/Sp	F/Lgh	F/TD	F/BD	B(T) W1	B(B) W2	B(L) Lg1	B(R)Lg2	Mt Tk	Wt
263	Conical	22.3	1.91	6	9.32	20.1	22.17	21.6	0.43	0.84
264	Conical	32.6	2.44	9.16	12.3	29.8	31.65	32.15	0.69	3.22
265	Ext Seam	27.1	1.29	8.21	9.31	29.02	26.84	25.65	0.92	2.22
266	Conical	23.0	1.13	8.17	9.11	10.34	20.31	22.5	0.55	1.24
267	Conical	30.2	3.3	11.98	22.13	34.6	29.65	28.77	0.47	1.94
268	Conical	25.1	3.71	9.8	13.8	30.01	22.67	24.04	0.61	1.3
269	Conical	16.1	1.58	4.72	6.9	17.25	15.38	15.67	0.62	0.57
270	Conical	28.8	1.41	9.63	6.73	30.11	28.07	26.79	0.56	1.71
271	Conical	27.4	3.04	8.36	10.2	26.3	27.26	25.38	0.54	1.76
272	Conical	36.1	2.28	8.34	13.76	24.72	35.2	34.06	0.64	3.2
273	Ext Seam	29.4	1.85	8.61	9.23	25.4	28.53	27.3	0.44	2.56
274	Conical	30.2	1.5	10.44	6.92	31.94	30.05	29.96	0.66	2.19
275	Conical	32.0	2.84	9.22	12.19	31.01	30.37	30.9	0.8	2.85
276	Conical	24.1	2.13	6.19	9.3	20.85	22.88	22.4	0.57	1.09
277	Conical	24.7	2.66	7.42	12.46	24.85	23.64	23.91	0.61	1.21
278	Conical	36.2	3.41	9.97	12.26	31.73	33.85	34.8	0.52	2.38
279	Conical	24.8	1.82	7.27	7.33	20.47	23.62	24.25	0.49	0.8
280	Conical	30.1	2.71	10.01	12.71	29.57	29.47	29.12	0.59	0
281	Conical	31.5	1.2	9.24	7.85	31.03	30.82	29.4	0.47	1.79
282	Conical	20.4	1.1	5.22	6.78	18.44	20.38	20.08	0.44	0.58
283	Conical	30.8	2.1	9.27	10.59	28.71	30.02	29.18	0.44	2.18
284	Conical	27.6	1.34	7.69	10.67	23.43	23.13	26.61	0.42	1.21
285	Conical	24.6	2.21	5.27	17.87	20.94	22.79	21.09	0.27	0.71
286	Conical	28.5	2.49	9.01	11.45	23.47	27.04	28.17	0.48	1.52
287	Conical	37.5	2.33	10	14.09	40.87	35.98	35.92	0.91	5.06
288	Conical	22.0	2.5	6.21	16.35	19.64	22.7	22.77	0.55	1.5
289	Conical	32.6	2.5	8.1	15.51	23.1	32.64	31.4	0.61	2.42
290	Conical	35.9	1.1	11.41	10.59	35.17	30.76	28.14	0.43	3.92
291	Conical	25.4	0	5.58	11.1	25.09	24.02	25.2	0.36	1.5
292	Conical	23.5	2.74	6.41	11.26	26.67	21.96	21.95	0.52	1.5
293	Conical	39.1	3.25	9.74	11.66	36.89	32.69	39.26	0.85	4.91
294	Conical	35.5	2.39	9.74	11.91	30.34	32.52	33.58	0.63	2.39

Appendix A - Tinkling Cones Metric Database

Cat No	F/Sp	F/Lgh	F/TD	F/BD	B(T) W1	B(B) W2	B(L) Lg1	B(R)Lg2	Mt Tk	Wt
295	Conical	37.5	4.06	7.41	22.46	28.38	37.11	34.01	0.41	3.28
296	Conical	29.5	3.74	5.32	12.54	20.34	29.3	28.45	0.46	1.94
297	Conical	27.3	1.79	8.11	11.54	25.44	25.84	26.7	0.58	2.03
298	Conical	20.4	2.22	5.01	9.15	18.8	18.65	19.7	0.73	1.1
299	Conical	23.4	2.96	5.1	10.97	17.34	22.45	22.46	0.34	0.88
300	Conical	15.8	2.32	3.51	8.87	12.82	15.59	15.87	0.54	0.5
301	Conical	18.6	1.46	5.63	9.42	17.04	17.46	18.15	0.44	0.63
302	Conical	15.9	1.9	3.77	10.37	16.63	14.24	15.73	0.42	0.53
303	Conical	16.8	1.12	5.01	6.65	18.87	15.96	15.46	0.45	0.46
305	Conical	19.2	1.74	0	7.02	18.65	18	19.05	0.43	0.75
306	Conical	32.2	0	5.98	6.62	30.52	32.21	31.19	0.35	1.45
307	Conical	23.0	2.05	6.29	9.18	21.65	22.49	21.98	0.44	0.86
308	Conical	30.7	0	5.58	5.62	16.37	29.18	29.51	0.37	0.7
309	Conical	19.0	3.09	3.98	14.36	18.79	18.42	16.05	0.49	2.82
310	Conical	28.7	2.5	4.92	10.34	21.05	28.27	28.55	0.43	1.4
311	Conical	19.3	1.33	5.91	9.23	18.34	18.54	18.1	0.68	0.92
312	Conical	19.3	2.78	4.96	11.42	18.25	18.45	18.6	0.35	0.54
313	Conical	23.8	1.36	4.29	7.7	18.29	22.94	23.2	0.56	0.95
314	Conical	32.9	5.93	5.51	32.48	43.85	27.33	23.97	0.92	6.77
315	Conical	27.8	3.79	16.29	21.8	29.33	27.38	26.85	0.36	1.25
316	Conical	23.5	2.29	6.42	11.6	24.61	22.54	23.01	0.45	1.16
317	Conical	28.0	1.77	9.82	9.33	21	26.04	27.91	0.41	1.33
318	Conical	27.7	2.22	6.71	0	0	16.54	17.85	0.31	0.76
319	Conical	21.2	1.23	3.55	0	0	16.59	17.48	0.47	0.95
320	Conical	23.0	2.13	0	0	0	21.21	21.02	0.32	0.83
321	Conical	26.3	2.79	4.71	12.1	0	18.02	16.91	0.32	1.23
322	Conical	26.4	1.81	4.12	9.17	0	22.31	22.1	0.46	2.02
323	Conical	19.3	2.97	7.71	8.77	0	14.78	14.28	0.39	0.89
324	Conical	19.8	0.93	5.24	6.26	0	19.15	19.66	0.36	0.42
325	Conical	21.6	2.87	8.15	7.53	15.76	19.7	21.06	0.42	0.7
326	Conical	25.6	3.39	4.43	12.87	24.4	23.44	24.31	0.51	1.4
328	Conical	12.0	3.02	5.16	31.91	31.8	25.69	25.75	0.47	2.1

Appendix A - Tinkling Cones Metric Database

Cat No	F/Sp	F/Lgh	F/TD	F/BD	B(T) W1	B(B) W2	B(L) Lg1	B(R)Lg2	Mt Tk	Wt
329	Conical	32.7	1.64	2.15	8.01	30.29	31.14	32.01	0.49	1.2
330	Conical	34.5	2.2	9.17	14.17	23.6	30.46	33.55	0.47	2
331	Conical	30.6	0	6.98	4.25	20.9	27.21	28.1	0.62	1.1
332	Conical	28.2	4.01	12.03	13.99	21.43	27.32	26.94	0.36	1
333	Conical	28.2	2.75	5.16	12.39	29.24	26.89	26.01	0.49	1.8
335	Conical	24.7	1.94	8.7	12.63	18.11	22.23	23.54	0.53	1.3
337	Conical	30.6	2.25	0	12.7	24.88	28.69	25.07	0.68	0
339	Conical	28.5	2.13	3.84	9.93	25.26	26.3	27.43	0.53	1.9
340	Conical	16.1	2.51	4.44	11.24	16.39	14.73	14.8	0	0
342	Conical	27.2	1.78	7.56	7.71	16.76	22.46	25.69	0.46	0.9
343	Conical	32.7	1.61	7.53	8.39	27.22	29.12	27.45	0.4	2
344	Conical	21.2	1.95	7.43	11.2	25.56	20.98	21.59	0.47	1
345	Conical	32.2	3.71	9.4	16.37	25.1	25.72	29.51	0.69	2.2
346	Conical	27	2.5	5.43	15.09	31.96	27.02	23.48	0.39	1.5
347	Conical	40.8	1.9	5.33	8.41	36.09	39.14	37.61	0.52	3.3
348	Conical	25.3	0	4.55	20.99	21.2	21.22	18.28	0.46	0.9
349	Conical	29.9	3.58	6.59	16.65	23.21	29.98	28.63	0	1.8
350	Conical	26.9	2.15	0	13.78	23.95	26.97	24.09	0.75	1.3
351	Conical	41.0	2.27	10.21	12.95	25.09	40.25	40.83	0.77	3
352	Conical	36.4	3.13	7.96	15.65	23.21	34.41	34.06	0.76	1.8
353	Conical	31.6	1.84	8.16	9.72	20.62	26.75	25.93	0.6	2.1
355	Conical	23.1	1.31	0	6.72	22.42	21.05	22.1	0.75	1
358	Conical	17.4	1.86	6.22	10.68	16.68	16.51	15.67	0	1.7
359	Conical	26.1	1.71	5.75	8.7	0	17.81	18.22	0	0
360	Conical	25.6	2.34	6.91	9.8	18.44	25.48	25.45	0.45	0.8
363	Conical	19.0	1.64	6.12	13.9	16.49	18.71	18.92	0.55	0.9
366	Conical	36.7	0	4.54	4.88	29.84	31.97	28.64	0.39	1.8
367	Conical	23.5	0	0	5.81	16.91	22.39	22.94	0.36	0.5
368	Conical	19.1	0	5.74	6.7	17.43	18.82	18.49	0.41	0.3
370	Conical	43.4	0.61	0	5.75	33.27	42.9	40.73	0.53	2.2
371	Conical	46.5	3.31	5.07	16.28	27.25	34.2	40.35	0.49	3.2
372	Conical	27.7	0	6.01	27.12	40.28	29.47	26.46	0.55	2.8

Appendix A - Tinkling Cones Metric Database

Cat No	F/Sp	F/Lgh	F/TD	F/BD	B(T) W1	B(B) W2	B(L) Lg1	B(R)Lg2	Mt Tk	Wt
374	Conical	32.1	1.54	5.23	8.03	32.31	31.28	31.06	0.38	1.4
376	Conical	24.1	3.71	5.87	16.02	26.71	22.21	23.09	0.43	1
377	Conical	19.1	2.73	5.18	14.38	25.14	18.26	17.78	0.45	1.7
378	Conical	32.8	2.62	9.61	12.08	0	31.74	32.11	0.81	2.8
380	Conical	37.9	1.04	0	19.17	0	38.23	36.44	0.39	1.8
381	Conical	22.3	3.33	0	9.43	21.71	21.29	20.65	0.26	0.6
383	Conical	35.3	0	0	8.2	15.65	26.03	28.37	0.37	1.4

Key:
Cat No=Catalog Number
F/Sp=Finished Shape
F/TD=Finished Tip Diamter
B(T)W1=Blank Top Width 1
B(B)W2=Blank Bottom Width 2
B(L)Lg1=Blank Left Length 1
B(R)Lg2=Blank Right Length 2
Mt Tk=Metal Thickness
Wt=Weight in grams

Appendix B - Tinkling Cones Manufacturing Techniques

Appendix B - Tinkling Cones Manufacturing Techniques

Cat No	F/Shape	Cu/BR	Ham	Chsg	Sc	Bd	Tw	Fd	Cut	Pf	Gr	V/Cps	D/Imp	SO
1	Conical	Brass	No	No	Yes	Yes	Yes	Yes	No	No	Yes	No	No	R/L
2	Conical	Cu	No	No	No	Yes	No	No	Yes	No	Yes	No	No	No
3	Conical	Cu	No	No	Yes	Yes	No	No	Yes	No	Yes	No	Yes	L/R
4	Conical	Cu	No	No	No	Yes	No	No	Yes	No	Yes	Yes	Yes	L/R
5	Conical	Brass	No	No	No	Yes	No	No	No	No	Yes	Yes	Yes	R/L
6	Conical	Cu	No	No	No	No	No	No	No	No	Yes	No	Yes	L/R
7	Conical	Cu	No	No	No	No	No	No	No	No	Yes	No	No	R/L
8	Conical	Cu	No	No	No	Yes	No	No	No	No	Yes	Yes	Yes	No
9	Conical	Brass	No	No	No	No	No	No	No	No	Yes	No	Yes	No
10	Conical	Cu	No	No	No	No	No	No	Yes	No	Yes	No	No	R/L
11	Conical	Cu	No	No	Yes	No	No	No	No	No	Yes	Yes	No	L/R
12	Conical	Brass	No	No	No	No	Yes	No	No	No	Yes	No	No	R/L
13	Conical	Brass	No	No	No	No	Yes	No	No	No	Yes	No	No	L/R
14	Conical	Brass	No	No	No	No	No	No	No	No	Yes	No	No	L/R
15	Conical	Brass	No	No	No	No	No	No	Yes	No	Yes	No	Yes	R/L
16	Conical	Cu	No	No	No	No	No	No	No	No	Yes	No	Yes	R/L
17	Conical	Cu	No	No	Yes	No	No	No	No	No	Yes	Yes	No	R/L
18	Conical	Brass	No	No	No	No	No	No	No	No	Yes	No	No	No
19	Conical	Brass	No	No	Yes	No	No	No	Yes	No	Yes	No	No	No
20	Conical	Brass	No	No	No	No	No	No	No	No	Yes	No	Yes	L/R
21	Conical	Brass	No	No	No	No	No	No	No	No	Yes	No	Yes	No
22	Conical	Cu	No	No	Yes	No	No	No	No	No	Yes	No	No	No
23	Conical	Cu	No	No	No	No	No	No	No	No	Yes	No	No	R/L
24	Conical	Brass	No	No	No	Yes	No	No	No	No	Yes	No	Yes	R/L
25	Conical	Cu	No	No	Yes	Yes	No	No	Yes	No	Yes	No	Yes	L/R
26	Conical	Brass	No	No	No	No	No	No	No	No	Yes	No	Yes	No
27	Conical	Brass	No	No	Yes	Yes	No	No	Yes	No	Yes	No	No	R/L
28	Conical	Brass	No	No	No	Yes	No	No	No	No	Yes	Yes	No	R/L
29	Conical	Brass	No	No	No	Yes	No	No	No	No	Yes	No	Yes	L/R
30	Conical	Brass	No	No	Yes	No	No	No	No	No	Yes	Yes	Yes	No

Appendix B - Tinkling Cones Manufacturing Techniques

Cat No	F/Shape	Cu/BR	Ham	Chsg	Sc	Bd	Tw	Fd	Cut	Pf	Gr	V/Cps	D/Imp	SO
31	Conical	Brass	No	No	No	No	No	No	No	No	Yes	Yes	No	No
32	Conical	Cu	No	No	Yes	No	No	No	No	No	Yes	No	No	No
33	Conical	Brass	No	No	No	No	No	No	Yes	No	Yes	No	No	L/R
34	Conical	Brass	No	No	Yes	No	No	No	No	No	Yes	No	Yes	R/L
35	Conical	Cu	No	No	Yes	No	No	No	No	No	Yes	Yes	Yes	L/R
36	Conical	Cu	No	No	Yes	No	No	No	No	No	Yes	No	Yes	No
37	Conical	Brass	No	No	No	Yes	No	No	No	No	Yes	No	Yes	R/L
38	Conical	Cu	No	No	No	Yes	No	No	Yes	No	Yes	Yes	No	L/R
39	Conical	Cu	No	No	No	No	No	No	No	No	Yes	Yes	Yes	R/L
40	Conical	Cu	No	No	No	No	No	No	No	No	Yes	No	Yes	R/L
41	Conical	Cu	No	No	No	No	No	No	No	No	Yes	No	Yes	No
42	Conical	Brass	No	No	Yes	No	No	No	Yes	No	Yes	No	No	No
43	Conical	Brass	No	No	Yes	No	No	No	Yes	No	Yes	No	Yes	L/R
44	Conical	Brass	No	No	No	Yes	No	No	No	No	Yes	No	Yes	No
45	Conical	Cu	No	No	No	No	No	No	Yes	No	Yes	No	Yes	L/R
46	Conical	Brass	No	No	Yes	No	No	No	No	No	Yes	No	No	R/L
47	Conical	Brass	No	No	No	No	No	No	No	No	Yes	No	No	R/L
48	Conical	Brass	No	No	No	No	No	No	Yes	No	Yes	No	No	No
49	Conical	Brass	No	No	No	No	Yes	No	No	No	Yes	No	No	No
50	Conical	Brass	No	No	No	No	No	No	No	No	Yes	No	Yes	No
51	Conical	Cu	No	No	No	No	No	No	Yes	No	Yes	No	Yes	L/R
52	Conical	Brass	No	No	No	Yes	No	No	No	No	Yes	Yes	Yes	L/R
53	Conical	Brass	No	No	No	Yes	No	No	No	No	Yes	Yes	Yes	L/R
54	Conical	Cu	No	No	No	No	No	No	No	No	Yes	No	Yes	No
55	Conical	Cu	No	No	Yes	No	No	No	No	No	Yes	No	Yes	No
56	Conical	Cu	No	No	No	No	No	No	No	No	Yes	Yes	No	L/R
57	Conical	Cu	No	No	No	Yes	No	No	Yes	No	Yes	No	No	R/L
58	Conical	Cu	No	No	No	No	No	No	Yes	No	Yes	No	No	R/L
59	Conical	Cu	No	No	No	No	No	No	Yes	Ye	Yes	No	No	No
60	Conical	Cu	No	No	No	No	No	No	No	No	Yes	No	Yes	R/L
61	Conical	Brass	No	No	Yes	No	No	No	Yes	No	Yes	No	No	R/L
62	Conical	Brass	No	No	No	No	No	No	No	No	Yes	No	No	No

Appendix B - Tinkling Cones Manufacturing Techniques

Cat No	F/Shape	Cu/BR	Ham	Chsg	Sc	Bd	Tw	Fd	Cut	Pf	Gr	V/Cps	D/Imp	SO
63	Conical	Cu	No	No	No	Yes	No	No	No	No	Yes	No	No	R/L
64	Conical	Brass	No	No	No	No	Yes	No	No	No	No	No	No	R/L
65	Conical	Brass	No	Ye	Yes	Yes	No	No	No	No	Yes	No	No	No
66	Conical	Cu	No	No	No	No	No	No	No	Ye	Yes	No	Yes	No
67	Conical	Brass	No	No	No	No	Yes	Yes	No	No	Yes	No	Yes	No
68	Conical	Brass	No	No	No	Yes	No	No	No	No	Yes	No	Yes	No
69	Conical	Cu	No	No	No	No	No	No	No	No	Yes	No	No	No
70	Conical	Cu	No	No	Yes	No	No	No	Yes	No	Yes	No	No	No
71	Conical	Brass	No	No	No	Yes	No	No	No	No	Yes	No	No	L/R
72	Conical	Cu	No	No	No	No	No	No	No	No	Yes	No	No	R/L
73	Conical	Brass	No	No	No	Yes	No	No	No	No	Yes	No	No	L/R
74	Conical	Brass	No	No	Yes	No	No	No	No	No	Yes	No	No	No
75	Conical	Cu	No	No	No	No	Yes	No	No	No	Yes	No	No	R/L
76	Conical	Cu	No	No	No	Yes	No	No	Yes	No	Yes	No	No	L/R
77	Conical	Brass	No	No	No	Yes	Yes	No	No	No	Yes	No	Yes	L/R
78	Conical	Cu	No	Ye	No	No	No	No	No	No	Yes	No	No	L/R
79	Conical	Cu	No	No	No	No	No	No	No	No	Yes	Yes	Yes	R/L
80	Conical	Brass	No	No	Yes	No	No	No	No	No	Yes	No	Yes	No
81	Conical	Cu	No	No	No	No	No	No	Yes	No	Yes	Yes	No	R/L
82	Conical	Cu	No	No	No	No	No	No	No	No	Yes	No	Yes	L/R
83	Conical	Cu	No	No	No	No	No	No	No	No	Yes	No	Yes	R/L
84	Conical	Brass	No	No	No	Yes	No	No	No	No	Yes	Yes	Yes	L/R
85	Conical	Brass	No	No	No	No	No	No	No	No	Yes	No	Yes	No
86	Conical	Brass	No	No	No	No	No	No	No	No	Yes	Yes	Yes	R/L
87	Conical	Brass	No	No	No	No	No	No	No	No	Yes	Yes	No	R/L
88	Conical	Cu	No	No	No	No	No	No	No	No	Yes	Yes	No	L/R
89	Conical	Cu	Yes	No	No	No	No	No	No	No	Yes	Yes	No	L/R
90	Conical	Cu	No	No	No	No	No	No	No	No	Yes	No	Yes	L/R
91	Conical	Brass	No	No	No	No	No	No	No	No	Yes	No	No	No
92	Conical	Cu	No	No	Yes	No	No	No	No	No	Yes	No	Yes	No
93	Conical	Brass	No	No	No	Yes	No	No	No	No	Yes	No	No	R/L
94	Conical	Cu	No	No	No	No	No	No	No	No	Yes	No	No	No

Appendix B - Tinkling Cones Manufacturing Techniques

Cat No	F/Shape	Cu/BR	Ham	Chsg	Sc	Bd	Tw	Fd	Cut	Pf	Gr	V/Cps	D/Imp	SO
95	Conical	Cu	No	No	No	No	No	No	Yes	No	Yes	No	No	L/R
96	Conical	Cu	No	No	No	No	No	No	No	No	Yes	No	Yes	No
97	Conical	Cu	No	No	No	Yes	No	No	No	No	Yes	Yes	Yes	R/L
98	Conical	Brass	No	No	Yes	No	Yes	No	No	No	Yes	No	No	No
99	Conical	Cu	No	No	Yes	Yes	No	No	Yes	No	Yes	No	No	R/L
100	Conical	Brass	No	No	No	No	No	No	No	No	Yes	Yes	Yes	L/R
101	Conical	Cu	No	Ye	No	No	No	No	Yes	No	Yes	No	No	L/R
102	Conical	Brass	No	No	Yes	No	No	No	No	No	Yes	No	Yes	No
103	Conical	Brass	No	No	No	No	No	No	No	No	Yes	Yes	Yes	L/R
104	Conical	Brass	No	No	No	Yes	No	No	No	No	Yes	No	No	No
105	Conical	Brass	No	No	No	No	No	No	No	No	Yes	No	No	R/L
106	Conical	Brass	No	No	Yes	No	No	No	No	No	Yes	No	Yes	No
107	Conical	Brass	No	No	Yes	Yes	No	No	No	No	Yes	No	No	No
108	Conical	Brass	No	No	No	No	No	No	No	No	Yes	No	No	L/R
109	Conical	Cu	No	No	No	No	No	No	Yes	No	Yes	No	No	L/R
110	Conical	Brass	No	No	No	No	No	No	No	No	Yes	No	Yes	L/R
111	Conical	Brass	No	No	No	No	No	No	No	No	Yes	No	No	R/L
112	Conical	Brass	No	No	No	No	No	No	No	No	Yes	Yes	Yes	R/L
113	Conical	Cu	No	No	No	Yes	No	No	Yes	No	Yes	No	No	R/L
114	Conical	Brass	No	No	Yes	No	No	No	No	No	Yes	No	Yes	No
115	Conical	Brass	No	No	No	No	No	No	No	No	Yes	Yes	Yes	L/R
116	Conical	Brass	No	No	Yes	No	No	No	No	No	Yes	Yes	No	L/R
117	Conical	Cu	No	No	No	No	No	No	No	No	Yes	No	Yes	L/R
118	Conical	Brass	Yes	No	No	Yes	No	No	No	Ye	Yes	No	No	L/R
119	Conical	Brass	No	No	Yes	Yes	No	No	No	No	Yes	No	Yes	L/R
120	Conical	Brass	No	No	No	No	Yes	No	No	No	Yes	No	No	No
121	Conical	Cu	No	No	No	No	No	No	Yes	No	Yes	No	Yes	R/L
122	Conical	Brass	No	No	No	No	No	No	No	No	Yes	No	Yes	No
123	Conical	Cu	Yes	No	Yes	Yes	No	No	No	No	Yes	Yes	Yes	L/R
124	Conical	Cu	No	No	Yes	No	No	No	No	No	Yes	Yes	Yes	R/L
125	Conical	Brass	No	No	No	No	No	No	No	No	Yes	No	Yes	L/R
126	Conical	Brass	No	No	No	No	No	No	No	No	Yes	No	Yes	R/L

Appendix B - Tinkling Cones Manufacturing Techniques

Cat No	F/Shape	Cu/BR	Ham	Chsg	Sc	Bd	Tw	Fd	Cut	Pf	Gr	V/Cps	D/Imp	SO
127	Conical	Brass	No	No	No	No	No	No	No	No	Yes	No	Yes	R/L
128	Conical	Brass	No	No	No	Yes	No	No	No	No	Yes	No	No	L/R
129	Conical	Brass	No	No	No	No	No	No	No	No	Yes	No	Yes	R/L
130	Conical	Brass	Yes	No	No	Yes	No	No	No	No	Yes	Yes	Yes	L/R
131	Conical	Brass	No	No	No	No	No	No	No	No	Yes	No	Yes	No
132	Conical	Cu	No	No	Yes	No	No	No	No	No	Yes	No	Yes	L/R
133	Conical	Cu	No	No	Yes	No	Yes	No	No	No	Yes	No	No	R/L
134	Conical	Brass	Yes	No	No	Yes	No	No	No	No	Yes	Yes	Yes	L/R
135	Conical	Brass	No	No	No	No	No	No	No	No	Yes	No	Yes	R/L
136	Conical	Cu	No	No	No	Yes	No	No	No	No	Yes	No	No	R/L
137	Conical	Brass	No	Ye	No	No	No	No	Yes	No	Yes	Yes	No	R/L
138	Conical	Cu	No	No	Yes	No	No	No	No	No	Yes	No	Yes	No
139	Conical	Brass	No	No	No	No	No	No	No	No	Yes	No	No	No
140	Conical	Brass	No	No	No	No	No	No	No	No	Yes	No	No	L/R
141	Conical	Brass	No	No	No	No	No	No	No	No	Yes	No	No	L/R
142	Conical	Brass	No	No	No	No	No	No	No	No	Yes	No	Yes	L/R
143	Conical	Brass	No	No	No	No	No	No	Yes	No	Yes	No	Yes	No
144	Conical	Brass	No	No	No	No	No	No	No	Ye	Yes	No	No	No
145	Conical	Brass	No	No	No	No	No	No	No	No	Yes	No	No	L/R
146	Conical	Brass	No	No	No	No	No	No	Yes	No	Yes	No	Yes	L/R
147	Conical	Brass	No	No	No	No	No	No	No	No	Yes	No	Yes	No
148	Conical	Brass	No	No	No	No	No	No	No	No	Yes	Yes	No	L/R
149	Conical	Brass	No	No	No	No	No	No	No	No	Yes	No	No	No
150	Conical	Brass	No	No	Yes	No	No	No	No	No	Yes	No	Yes	R/L
151	Conical	Cu	No	No	No	Yes	No	No	No	No	Yes	No	Yes	No
152	Conical	Cu	No	No	Yes	No	No	No	No	No	Yes	No	Yes	No
153	Conical	Brass	No	No	No	No	Yes	No	No	No	Yes	No	No	No
154	Conical	Brass	No	No	Yes	No	No	No	No	No	Yes	No	No	No
155	Conical	Cu	No	No	No	No	No	No	No	No	Yes	No	Yes	R/L
156	Conical	Brass	No	No	No	No	No	No	No	No	Yes	No	No	L/R
157	Conical	Brass	No	No	No	No	No	No	No	No	Yes	No	Yes	No
158	Conical	Cu	No	No	No	No	No	No	No	No	Yes	No	Yes	R/L

Appendix B - Tinkling Cones Manufacturing Techniques

Cat No	F/Shape	Cu/BR	Ham	Chsg	Sc	Bd	Tw	Fd	Cut	Pf	Gr	V/Cps	D/Imp	SO
159	Conical	Cu	No	No	No	Yes	No	No	No	No	Yes	No	Yes	L/R
160	Conical	Cu	Yes	No	No	Yes	No	No	Yes	No	Yes	No	Yes	R/L
161	Conical	Cu	No	No	No	No	Yes	No	No	No	Yes	No	Yes	No
162	Conical	Cu	No	No	No	No	No	No	No	No	Yes	No	Yes	R/L
163	Conical	Cu	No	No	No	No	No	No	No	No	Yes	Yes	Yes	R/L
164	Conical	Brass	No	No	No	No	No	No	No	No	Yes	No	Yes	No
165	Conical	Cu	No	No	Yes	No	No	No	No	No	Yes	No	Yes	No
166	Conical	Cu	No	No	Yes	No	No	No	No	No	Yes	Yes	No	R/L
167	Conical	Cu	No	No	No	No	No	No	No	No	Yes	Yes	Yes	L/R
168	Conical	Cu	Yes	No	No	No	No	No	Yes	No	Yes	No	Yes	R/L
169	Conical	Cu	No	No	No	No	No	No	Yes	No	Yes	Yes	Yes	R/L
170	Conical	Cu	No	No	No	Yes	No	No	Yes	No	Yes	Yes	No	L/R
171	Conical	Cu	No	No	No	No	No	No	Yes	No	Yes	No	No	R/L
172	Conical	Brass	No	No	No	No	No	No	No	No	Yes	No	Yes	L/R
173	Conical	Cu	No	No	No	No	No	No	No	No	Yes	Yes	Yes	R/L
174	Conical	Cu	No	No	No	No	No	No	No	Ye	Yes	No	Yes	No
175	Conical	Brass	No	No	No	No	No	No	Yes	No	Yes	No	No	L/R
176	Conical	Brass	No	No	Yes	No	No	No	No	No	Yes	No	Yes	R/L
177	Conical	Brass	No	No	No	Yes	No	No	No	No	Yes	No	No	L/R
178	Conical	Brass	No	No	No	No	No	No	No	No	Yes	No	Yes	R/L
179	Conical	Brass	No	No	No	No	No	No	No	No	Yes	No	Yes	No
180	Conical	Brass	No	No	No	Yes	No	No	No	No	Yes	No	No	R/L
181	Conical	Cu	No	No	No	No	No	No	No	No	Yes	No	Yes	No
182	Conical	Brass	No	No	Yes	Yes	No	No	Yes	No	Yes	Yes	Yes	R/L
183	Conical	Cu	No	No	No	No	No	No	No	No	Yes	Yes	No	L/R
184	Conical	Cu	No	No	No	No	Yes	No	Yes	No	Yes	No	No	L/R
185	Conical	Brass	No	No	No	No	No	No	No	No	Yes	Yes	Yes	R/L
186	Conical	Brass	No	No	No	No	No	No	No	No	Yes	Yes	Yes	R/L
187	Conical	Brass	No	No	No	No	No	No	No	No	Yes	Yes	No	R/L
188	Conical	Cu	No	No	No	No	No	No	Yes	No	Yes	No	Yes	No
189	Conical	Brass	No	No	Yes	No	No	No	No	No	Yes	No	Yes	L/R
190	Conical	Brass	No	No	No	No	No	No	No	No	Yes	Yes	No	No

Appendix B - Tinkling Cones Manufacturing Techniques

Cat No	F/Shape	Cu/BR	Ham	Chsg	Sc	Bd	Tw	Fd	Cut	Pf	Gr	V/Cps	D/Imp	SO
191	Conical	Brass	No	Ye	No	No	No	No	Yes	No	Yes	Yes	Yes	No
192	Conical	Cu	No	No	No	No	No	No	No	No	Yes	Yes	Yes	R/L
193	Conical	Cu	No	No	No	Yes	No	No	No	No	Yes	No	No	R/L
194	Conical	Cu	No	No	Yes	No	No	No	No	No	Yes	No	No	No
195	Conical	Brass	No	No	No	No	No	No	No	No	Yes	No	No	No
196	Conical	Cu	No	No	Yes	No	No	No	Yes	No	Yes	No	No	R/L
197	Conical	Cu	No	No	Yes	No	No	No	No	No	Yes	No	Yes	L/R
198	Conical	Brass	No	No	Yes	No	No	No	No	No	Yes	No	No	No
199	Conical	Brass	No	No	No	No	No	No	Yes	No	Yes	Yes	Yes	L/R
200	Conical	Brass	No	No	No	No	No	No	Yes	Ye	Yes	Yes	Yes	R/L
201	Conical	Brass	No	No	Yes	No	No	No	No	No	Yes	No	Yes	No
202	Conical	Brass	No	Ye	Yes	No	No	No	No	No	Yes	Yes	Yes	R/L
203	Conical	Brass	No	No	No	No	No	No	Yes	No	Yes	No	Yes	No
204	Conical	Brass	No	No	No	Yes	No	No	Yes	No	Yes	No	Yes	R/L
205	Conical	Brass	No	No	Yes	No	No	No	No	No	Yes	No	Yes	No
206	Conical	Brass	No	No	No	No	No	No	No	No	Yes	No	Yes	No
207	Conical	Brass	No	No	No	No	No	No	No	No	Yes	No	Yes	No
208	Conical	Cu	No	No	No	No	No	No	No	No	Yes	No	Yes	No
209	Conical	Brass	No	No	No	No	No	No	No	No	Yes	Yes	Yes	No
210	Conical	Cu	No	No	No	Yes	No	No	No	No	Yes	No	No	L/R
211	Conical	Cu	No	No	Yes	No	No	No	No	No	Yes	No	No	L/R
212	Ext Base	Brass	No	No	No	Yes	No	No	No	No	Yes	No	No	R/L
213	Ext Base	Brass	No	No	No	Yes	No	No	No	No	Yes	No	No	R/L
214	Ext Base	Brass	No	No	No	Yes	No	No	No	No	Yes	No	Yes	R/L
215	Ext Base	Brass	No	No	No	No	No	No	No	No	Yes	No	No	R/L
216	Ext Base	Cu	No	No	No	No	No	No	No	No	Yes	No	No	No
217	Ext Base	Cu	No	No	No	Yes	No	No	No	No	Yes	Yes	Yes	L/R
218	Ext Base	Brass	No	No	No	No	No	No	Yes	No	No	Yes	Yes	L/R
219	Ext Base	Cu	No	No	No	Yes	No	No	Yes	No	Yes	Yes	Yes	L/R
220	Ext Base	Brass	No	No	No	Yes	No	No	Yes	No	Yes	No	Yes	L/R
221	Ext Base	Cu	No	No	No	No	Yes	No	No	No	Yes	No	Yes	No
222	Ext Base	Brass	No	No	No	No	No	No	Yes	No	Yes	No	No	L/R

Appendix B - Tinkling Cones Manufacturing Techniques

Cat No	F/Shape	Cu/BR	Ham	Chsg	Sc	Bd	Tw	Fd	Cut	Pf	Gr	V/Cps	D/Imp	SO
223	Ext Base	Cu	No	No	No	Yes	No	No	No	No	Yes	Yes	No	No
224	Ext Base	Brass	No	No	No	No	Yes	No	Yes	No	Yes	No	No	R/L
225	Ext Base	Cu	No	No	No	Yes	No	No	No	No	Yes	No	Yes	L/R
226	Ext Base	Cu	No	No	No	No	No	No	No	No	Yes	No	Yes	L/R
227	Conical	Cu	No	No	No	Yes	Yes	No	No	No	Yes	No	Yes	R/L
228	Ext Base	Brass	No	No	No	No	No	No	No	No	Yes	Yes	Yes	R/L
229	Ext Base	Cu	No	No	No	Yes	No	No	No	No	Yes	No	No	R/L
230	Ext Base	Brass	No	No	No	No	No	No	Yes	No	Yes	No	No	R/L
231	Conical	Brass	No	No	Yes	No	No	No	No	No	Yes	No	Yes	L/R
232	Ext Seam	Brass	No	No	Yes	Yes	No	No	No	No	Yes	No	Yes	No
233	Conical	Brass	No	No	Yes	No	No	No	Yes	No	Yes	No	No	No
234	Conical	Cu	No	No	No	No	No	No	No	No	Yes	Yes	No	No
235	Conical	Brass	No	No	No	No	No	No	No	No	Yes	No	Yes	No
236	Conical	Cu	No	No	No	No	No	No	Yes	No	Yes	No	No	No
237	Conical	Cu	No	No	No	No	No	No	No	No	Yes	No	Yes	R/L
238	Conical	Brass	No	No	No	Yes	No	No	No	No	Yes	No	Yes	L/R
239	Conical	Cu	No	No	No	Yes	No	No	No	No	Yes	Yes	Yes	L/R
240	Conical	Cu	No	No	No	No	No	No	No	No	Yes	No	Yes	R/L
250	Conical	Cu	No	No	No	Yes	No	No	Yes	No	Yes	Yes	Yes	L/R
251	Conical	Cu	No	No	No	Yes	Yes	No	No	No	Yes	Yes	Yes	R/L
252	Ext Seam	Brass	No	No	No	No	No	No	No	No	Yes	No	No	No
253	Conical	Brass	No	No	No	No	No	No	Yes	No	Yes	No	Yes	No
254	Conical	Brass	No	No	No	No	No	No	No	No	Yes	No	No	No
255	Conical	Brass	No	No	No	No	No	No	No	No	Yes	No	No	No
256	Conical	Cu	Yes	No	No	Yes	No	No	No	No	Yes	No	Yes	No
257	Conical	Brass	No	No	No	No	Yes	No	No	No	Yes	No	No	No
258	Conical	Cu	No	No	No	No	No	No	No	No	Yes	No	Yes	L/R
259	Conical	Brass	No	No	No	No	No	No	No	No	Yes	No	Yes	No
260	Conical	Cu	No	No	No	No	Yes	No	Yes	No	Yes	No	No	R/L
261	Conical	Cu	No	No	No	Yes	No	No	Yes	No	Yes	No	Yes	R/L
262	Conical	Cu	No	No	No	No	No	No	Yes	No	Yes	No	Yes	No
263	Conical	Cu	No	No	No	No	No	No	No	No	Yes	Yes	No	L/R

Appendix B - Tinkling Cones Manufacturing Techniques

Cat No	F/Shape	Cu/BR	Ham	Chsg	Sc	Bd	Tw	Fd	Cut	Pf	Gr	V/Cps	D/Imp	SO
264	Conical	Cu	No	No	Yes	No	No	No	No	No	Yes	Yes	No	No
265	Ext Seam	Cu	No	Ye	Yes	No	No	No	Yes	No	Yes	No	No	No
266	Conical	Cu	No	No	No	No	No	No	No	No	Yes	No	Yes	L/R
267	Conical	Brass	No	No	No	Yes	No	No	Yes	No	Yes	Yes	No	R/L
268	Conical	Cu	No	No	Yes	No	No	No	No	No	Yes	No	Yes	R/L
269	Conical	Cu	No	No	No	No	No	No	No	No	Yes	No	Yes	No
270	Conical	Brass	No	No	No	No	No	No	No	No	Yes	No	Yes	No
271	Conical	Brass	No	No	Yes	No	No	No	No	No	Yes	No	No	R/L
272	Conical	Cu	No	No	No	No	No	No	No	No	Yes	No	Yes	L/R
273	Ext Seam	Cu	No	No	Yes	No	No	No	No	No	Yes	No	Yes	No
274	Conical	Brass	No	No	No	No	No	No	No	No	Yes	No	Yes	R/L
275	Conical	Cu	No	No	Yes	No	No	No	No	No	Yes	No	No	No
276	Conical	Brass	No	No	No	No	Yes	No	No	No	Yes	No	No	No
277	Conical	Brass	No	No	No	No	No	No	No	No	Yes	Yes	No	R/L
278	Conical	Brass	Yes	No	Yes	No	No	No	No	No	Yes	No	No	R/L
279	Conical	Brass	No	No	No	No	No	No	No	No	Yes	Yes	No	No
280	Conical	Brass	No	No	Yes	No	No	No	No	No	Yes	Yes	Yes	L/R
281	Conical	Cu	No	No	No	No	No	No	No	No	Yes	Yes	Yes	L/R
282	Conical	Brass	No	No	Yes	No	No	No	No	No	Yes	No	No	No
283	Conical	Cu	No	No	No	No	No	No	No	No	Yes	No	Yes	No
284	Conical	Brass	No	No	No	Yes	No	No	No	Ye	Yes	Yes	Yes	No
285	Conical	Cu	No	No	No	No	Yes	No	No	No	Yes	No	Yes	L/R
286	Conical	Brass	No	Ye	No	No	No	No	Yes	No	Yes	Yes	Yes	L/R
287	Conical	Cu	No	No	No	No	No	No	No	No	No	No	No	No
288	Conical	Brass	No	No	No	No	No	No	No	No	Yes	No	Yes	L/R
289	Conical	Cu	No	No	No	No	No	No	No	No	Yes	Yes	Yes	No
290	Conical	Brass	No	No	No	Yes	No	No	No	No	Yes	No	Yes	L/R
291	Conical	Cu	No	No	No	Yes	No	No	No	Ye	Yes	Yes	Yes	L/R
292	Conical	Cu	No	No	No	No	No	No	No	No	Yes	No	No	No
293	Conical	Cu	No	No	No	Yes	Yes	No	No	No	Yes	No	Yes	R/L
294	Conical	Brass	No	No	Yes	No	Yes	No	No	No	Yes	Yes	Yes	No
295	Conical	Brass	No	No	Yes	No	No	No	Yes	No	Yes	Yes	No	R/L

Appendix B - Tinkling Cones Manufacturing Techniques

Cat No	F/Shape	Cu/BR	Ham	Chsg	Sc	Bd	Tw	Fd	Cut	Pf	Gr	V/Cps	D/Imp	SO
296	Conical	Cu	No	No	No	No	No	No	No	No	Yes	No	Yes	L/R
297	Conical	Brass	No	No	No	Yes	Yes	No	No	Ye	Yes	No	No	No
298	Conical	Cu	No	No	Yes	No	No	No	No	No	Yes	No	Yes	No
299	Conical	Brass	Yes	No	Yes	No	No	No	No	No	Yes	No	Yes	L/R
300	Conical	Brass	No	No	Yes	No	No	No	No	No	Yes	No	Yes	No
301	Conical	Brass	No	No	Yes	No	No	No	No	No	Yes	No	Yes	No
302	Conical	Cu	No	Ye	No	Yes	No	No	Yes	No	Yes	No	No	No
303	Conical	Cu	No	No	Yes	No	Yes	No	No	No	Yes	No	Yes	R/L
305	Conical	Cu	No	No	Yes	No	No	No	No	No	Yes	Yes	No	L/R
306	Conical	Cu	No	No	No	Yes	No	Yes	No	Ye	Yes	Yes	Yes	L/R
307	Conical	Brass	No	No	No	No	No	No	Yes	Ye	Yes	No	No	R/L
308	Conical	Brass	No	No	No	No	No	No	No	Ye	Yes	Yes	Yes	R/L
309	Conical	Cu	No	No	No	Yes	No	No	No	Ye	Yes	No	No	R/L
310	Conical	Cu	No	No	No	No	No	No	Yes	No	Yes	Yes	Yes	No
311	Conical	Cu	No	No	No	No	No	No	No	Ye	Yes	No	No	L/R
312	Conical	Brass	No	No	No	No	No	No	No	Ye	Yes	No	No	L/R
313	Conical	Brass	No	No	No	No	No	No	No	Ye	Yes	No	Yes	No
314	Conical	Cu	No	No	No	No	No	No	Yes	No	Yes	Yes	No	R/L
315	Conical	Cu	Yes	No	No	Yes	No	No	No	Ye	No	No	No	R/L
316	Conical	Cu	No	No	No	No	No	No	No	Ye	Yes	Yes	No	R/L
317	Conical	Brass	No	No	Yes	No	No	No	No	No	Yes	No	No	R/L
318	Conical	Brass	No	No	No	No	No	No	No	No	Yes	No	Yes	R/L
319	Conical	Cu	No	No	No	No	No	No	No	No	Yes	No	Yes	R/L
320	Conical	Cu	No	No	No	No	No	No	No	No	Yes	No	Yes	R/L
321	Conical	Brass	No	No	Yes	No	No	No	No	No	Yes	No	No	L/R
322	Conical	Cu	No	No	No	No	No	No	No	No	Yes	No	Yes	No
323	Conical	Brass	No	No	No	Yes	No	No	No	No	Yes	No	No	No
324	Conical	Brass	No	No	No	No	No	No	No	No	Yes	Yes	Yes	R/L
325	Conical	Brass	No	No	No	No	No	No	No	No	Yes	No	No	No
326	Conical	Brass	No	No	No	Yes	No	No	Yes	No	Yes	No	Yes	R/L
328	Conical	Brass	No	No	No	Yes	No	No	Yes	No	Yes	Yes	No	L/R
329	Conical	Brass	No	No	No	No	No	No	Yes	Ye	Yes	Yes	Yes	L/R

Appendix B - Tinkling Cones Manufacturing Techniques

Cat No	F/Shape	Cu/BR	Ham	Chsg	Sc	Bd	Tw	Fd	Cut	Pf	Gr	V/Cps	D/Imp	SO
330	Conical	Brass	No	No	Yes	Yes	No	No	Yes	No	Yes	Yes	No	R/L
331	Conical	Brass	Yes	No	No	Yes	No	Yes	No	No	No	Yes	Yes	R/L
332	Conical	Brass	No	No	Yes	No	No	No	Yes	No	Yes	Yes	Yes	R/L
333	Conical	Cu	No	No	No	Yes	No	No	No	No	Yes	Yes	No	R/L
335	Conical	Brass	No	No	Yes	Yes	No	No	No	No	Yes	No	No	R/L
337	Conical	Cu	No	No	No	No	Yes	No	Yes	No	Yes	No	No	No
339	Conical	Brass	No	No	No	No	No	No	No	No	Yes	No	Yes	No
340	Conical	Brass	No	No	No	No	No	No	No	No	Yes	Yes	No	No
342	Conical	Brass	No	No	Yes	No	Yes	No	No	No	Yes	No	No	No
343	Conical	Cu	No	No	No	No	Yes	No	Yes	No	Yes	No	Yes	L/R
344	Conical	Brass	No	No	No	Yes	No	No	Yes	No	Yes	Yes	No	R/L
345	Conical	Brass	No	No	No	No	No	No	No	No	Yes	No	No	L/R
346	Conical	Cu	No	No	No	No	No	No	No	Ye	Yes	No	Yes	L/R
347	Conical	Cu	No	No	No	No	No	No	No	No	Yes	Yes	Yes	R/L
348	Conical	Brass	No	No	No	Yes	No	Yes	No	No	Yes	Yes	No	No
349	Conical	Brass	No	No	No	No	No	No	No	Ye	Yes	No	No	No
350	Conical	Brass	No	No	No	No	No	No	Yes	No	Yes	No	No	No
351	Conical	Brass	No	No	No	No	No	No	No	No	Yes	No	No	No
352	Conical	Brass	No	No	No	No	No	No	No	No	Yes	No	No	No
353	Conical	Brass	No	No	No	No	No	No	No	No	Yes	No	No	No
355	Conical	Brass	No	No	No	No	No	No	No	No	Yes	No	No	No
358	Conical	Cu	No	No	No	No	No	No	No	No	Yes	No	No	No
359	Conical	Brass	No	No	No	No	No	No	No	No	Yes	No	No	No
360	Conical	Cu	No	No	No	No	No	No	No	No	Yes	No	No	R/L
363	Conical	Cu	No	No	No	Yes	No	No	No	No	Yes	No	No	R/L
366	Conical	Brass	Yes	No	No	Yes	No	No	Yes	No	Yes	No	No	L/R
367	Conical	Cu	Yes	No	No	No	No	No	Yes	No	Yes	No	No	No
368	Conical	Cu	No	No	No	No	No	No	No	No	Yes	Yes	Yes	L/R
370	Conical	Brass	No	No	No	No	No	No	No	No	Yes	Yes	Yes	R/L
371	Conical	Cu	No	No	No	Yes	No	Yes	Yes	No	Yes	Yes	No	R/L
372	Conical	Brass	Yes	No	Yes	Yes	No	No	Yes	No	Yes	Yes	No	No
374	Conical	Cu	No	No	No	Yes	No	No	Yes	No	Yes	No	Yes	L/R

Appendix B - Tinkling Cones Manufacturing Techniques

Cat No	F/Shape	Cu/BR	Ham	Chsg	Sc	Bd	Tw	Fd	Cut	Pf	Gr	V/Cps	D/Imp	SO
376	Conical	Brass	No	No	No	Yes	No	No	Yes	No	Yes	Yes	Yes	No
377	Conical	Brass	No	No	Yes	Yes	No	No	No	No	Yes	Yes	Yes	L/R
378	Conical	Cu	No	No	No	No	No	No	Yes	Ye	Yes	No	No	R/L
380	Conical	Brass	No	No	No	Yes	No	Yes	Yes	No	Yes	No	No	R/L
381	Conical	Brass	No	No	No	Yes	No	No	Yes	No	Yes	No	No	No
383	Conical	Cu	No	Ye	No	Yes	No	No	Yes	No	Yes	Yes	Yes	R/L

Key:
Cat No=Catalog Number
F/Shape=Finished Shape
Cu/BR=Copper or Brass
Ham=Hammering
Chsg=Chiseling
Sc=Scoring
Bd=Bending
Tw=Twisting
Fd=Folding
Cut=Cutting
Pf=Perforating
Gr=Grinding
V/Cps=Ventral Crimp marks
D/Imp=Dorsal Impressions
SO=Seam Overlap

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