Intel-Recommended Manual Handling/Programming Process for Small Outline Packages

Version 2.4

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1.0 SCOPE

This document describes handling and programming processes and techniques for all Intel TSOP (Thin Small Outline Package), PSOP (Plastic Small Outline Package) and SSOP (Shrink Small Outline Package) packages. It refers to various manufacturers' equipment and techniques that can be immediately implemented to improve outgoing quality.

An instructional video that supplements this process document and reviews all key points is available. This video is a helpful training aid and improves awareness of SOP handling and manual programming issues. For copies of this video, contact Intels' Literature hotline at 1-800-548-4725 within USA/Canada (Outside of USA/Canada contact local Intel office). The video formats and Intel ordering numbers are as follows:

NTSC (USA, standard VHS) - 297684-001
PAL (Europe) - 297689-001
SECAM (Europe) - 297690-001

If there are any questions, concerns, or inputs regarding this process, contact George Mello of Intel Corporation, Folsom, California at 916-356-5069. This report can be obtained by requesting FaxBack* document #2291; FaxBack is accessed by dialing 1-800-628-2283 (USA/Canada), 916-356-3105 (Japan) or +44(0)1793-496646 (Europe).

2.0 INTRODUCTION

Because of SOP small form factors, manual device handling has presented challenges with regards to lead deformation and quality control. The following procedure is a result of best-known handling and lead inspection techniques. While automated handling and inspection remain the preferred method for off-line SOP handling and programming, facilities exist where this equipment may not be cost effective. This document is targeted for that segment.

3.0 APPLICABLE DOCUMENTS

ANSI/IPC-SM-782A	"Surface-mount land patterns"
ANSI/IPC-A610A	"Acceptability of electronic assemblies"
ANSI/IPC-J-STD-001	"Requirements for soldered electrical and electronic assemblies"
ISBN 1-55512-238-8 or Intel literature order # 240800	"Intel packaging reference guide"
Intel literature # 296514-005	"Small Outline Package Guide"
MIL-STD-105D	"Sampling procedures and tables for inspection by attributes"
Various Manufacturer's Publications	See Recommendations section 6.0

4.0 WORK AREA/STATION SETUP

4.1 Always ensure that your work area is clean and that there is enough room to process material. An area which is setup for minimal operator movement and maximum operator comfort will result in better quality and throughput time.

4.2 Process equipment height and location is important. Be sure that equipment is placed in locations which simplify processing.

4.3 Programmers with Angled Socketing Area

4.3.1 Some programmers have socketing areas built at an angle. This makes SOP insertion/removal difficult. Elimination of this angle via table modification, front-end height adjustment or a leveling box is recommended.

5.0 PROGRAMMING PROCESS PROCEDURES

NOTE: Always take adequate ESD precautions: wear wrist ground straps, smocks, ESD footwear, use ESD-protected table top coverings, etc.

5.1 Tray Unstrap

5.1.1 Use a razor blade type cutting tool, rather than scissors or knife, to unstrap incoming trays. This method minimizes risk of bouncing devices from their pockets. The typical razor blade box cutter works well (figure 6).

5.2 Incoming Visual Inspection

NOTE: This inspection checks for gross bent leads that occurred prior to any programming steps. It's intended to catch the majority of lead spacing, coplainarity, terminal dimension and package-body standoff failures. This step can be optimized by viewing units under a wide-angle 3 diaopter magnifier at 1.75x (see recommendations section). Provide adequate lighting.

5.2.1 Inspect packages while still in tray. Hold tray at 45° angle to optimize viewing for coplainarity (figure 1). Start at top row and scan across. Proceed to next row down and scan across in opposite direction. Repeat for entire tray.

5.2.2 Reject packages for lead spacing if any lead is bent more than ½ its original lead spacing distance (figure 2).

5.2.3 Coplainarity failures stand out as leads positioned above or below the plane of corresponding leads. Reject packages having leads exceeding this plane by more than the lead width (figure 3).

NOTE: Standoff and terminal dimension rejects are usually caught as coplainarity failures.

5.2.4 Inspect each package to ensure pin-1 dimple marks are correctly oriented to tray chamfer (corner cutout). See figures 4 and 5 for pictorial explanation.

5.2.5 Record results on quality tracker form (appendix A).

5.3 Tray-to-Programmer Transfer

Using Precision Vacuum Wand (wand with guide pins)

5.3.1 Please refer to appendix B, Precision wand operating instructions.

Using Non-Precision Vacuum Wand

5.3.3 When removing package from tray, carefully raise device in straight-up motion to avoid bumping leads.

5.3.4 Key points to consider when using a non-precision wand and hand-actuated programming socket:

1) When actuating socket, keep fingers away from opening to avoid contact with leads.
2) Push down completely on socket actuator lid to fully open its contact fingers.

5.3.5 Stand whereby you can see directly down into socket cavity. This provides best viewing angle, allowing you to ensure adequate clearance between leads on both ends and cavity walls. With thumb and index finger of one hand, press down on socket actuator lid.

5.3.6 With opposite hand, lower device into socket. Be careful not to brush leads against cavity walls. Release device no higher than 1/8"; this is a good height, decreasing chance of misplacement.

5.3.7 If misplacement occurs, gently lower wand tip to package body surface. Re-applyvacuum and try again. Depending on its skew, it may be better to remove with tweezers. This avoids putting downward pressure on package (and leads).

5.4 Programmer-to-Tray Transfer

Using Precision Vacuum Wand (wand with guide pins)

5.4.1 Please refer to Appendix B, precision wand operating instructions.

Using Non-Precision Vacuum Wand

5.4.3 Key points to consider when using a non-precision wand and hand-actuated programming socket:

1) When actuating socket, keep fingers away from opening to avoid contact with leads.
2) Push down completely on socket actuator lid to fully open its contact fingers.

5.4.4 Stand whereby you can see directly down into socket cavity. This provides best viewing angle, allowing you to ensure adequate clearance between leads on both ends and cavity walls. With thumb and index finger of one hand, press down on socket actuator lid.

5.4.5 With opposite hand, gently lower vacuum wand tip to package body surface. Remove package in straight-up motion to avoid brushing leads against cavity walls.

5.4.6 Gently lower package towards output tray pocket with correct orientation [based on tray cutout (chamfer) and device pin-1 indicator; figures 4 and 5]. Look directly down at pocket, this produces optimal placement.

5.4.7 Release device into pocket from 1/8" above. This is a good height, decreasing chance of misplacement.

5.5 Label Installation

NOTE: Use tweezers to assist label placement.

5.5.1 Use labels of size outlined in recommended materials section, gently centering them onto the package top surface. Use straight downward fingertip pressure to adhere label, being careful to avoid any side-to-side movement.

5.6 Post Visual Inspection

5.6.1 Repeat steps in section 5.2 to check for bent leads and improper orientation.

5.7. Lead Inspection Sampling Size Recommendation

NOTE: Lead inspection systems are a recommended validation tool for questionable visual inspection failures and as a sampling quality assurance process step. Sampling size may be determined by your customers. The following recommendation is based on Military standard specification MIL-STD-105D, “Sampling Procedures and Tables for Inspection by Attributes”.

5.7.1 There are three inspection levels. Level 1 is for less discrimination, level 2 is generally used, and level 3 for greater discrimination. The recommended sampling sizes below are based on a mid-range number and calculated as a percentage for each level. The specific lot size of this example is 120 units. These percentages will vary depending on the size of the lot. Generally, as the size of the lot increases, the sampling percentage decreases and visa-versa.

Level 1= 6.6% of lot size
Level 2= 16.6% of lot size
Level 3= 26.6% of lot size

6.0 TAPE-IN-TUBE PROCEDURE

NOTE: The following procedure outlines Intel's current process procedure. Any variation to this process should be evaluated for shipping reliability.

Please refer to the equipment recommendation table for tape in tube material part numbers and sources.

6.1 Tape-In-Tube Guidelines

6.1.1 Tube quantities per/package:

All TSOP	2	per tube (small tube size)
	10	per tube (large tube size)
56L SSOP	2	per tube (small tube size)
	8	per tube (large tube size)

6.1.2 Empty carrier tape pockets on each side of devices in carrier tape:

For TSOP devices, cut and leave 1½ empty carrier tape pockets on each side of filled pockets prior to slip-on cover installation.

For SSOP devices, cut and leave ½ empty carrier tape pockets on each side of filled pockets prior to slip-on cover installation.

6.2 Tape-In-Tube Packing Procedure

6.2.1 Once devices are loaded into the carrier tape and sealed with cover tape, slide on the clip-on cover, and cut the carrier tape/slip-on cover to appropriate lengths with empty pockets on each side of the tape as mentioned above (6.1.2).

6.2.2 Insert tape/cover into tube (units up) from left side and insert tube stop with pull tab downward.

6.2.3 Insert pull tab into right side of tube (pull tab downward) with pusher device (such as ruler) until the pull down tab just touches the carrier tape. Do not use excessive force so that the carrier tape bows inside the tube.

6.2.4 Install the tape in tube into a JEDEC foam cavity with enough foam pads to protect the tubes from excessive movement during shipment. Complete packing as per according to your companies procedures (i.e., correct desiccant, labels, boxes, HIC's, etc.)

7.0 PACKING GUIDELINES

NOTE: The following items should be considered when packaging Intel SOP devices in trays or tape-in tube. This section outlines basic packaging materials and why they are recommended. Please refer to the Equipment recommendation table for material part numbers and sourcing information.

7.1.1 Tray straps should be approximately ½" in width. This width will minimize tray breakage compared to thinner tray straps (¼" and below).

7.1.2 Tray strap tension should be between 6-11 pounds. These tensions should prevent the trays from breaking and ensure adequate shipping strength.

7.1.3 ESD rubberbands are suggested for internal tray transfers because of the possibility of device contact to the bands during device handling.

8.0 RECOMMENDED MATERIALS

8.1 Label Size

Label adhesive can make packages stick to the cover-tray bottom side. Avoid this by using the following label sizes:

All TSOP	0.25" width x 0.5" length or smaller.
44L PSOP	0.40" width x 0.8" length or smaller.
56L SSOP	0.40" width x 0.6" length or smaller.

8.2 Equipment Recommendation Table 1 (Vacuum Wand Information)

ITEM	DESCRIPTION	VENDOR	PART #
Precision Vacuum Wands and Accessories	Wand and SOP Precision Heads **NOTE: See Appendix C for more Info. (Regards to thin tray precision wand)**		
Refer to note 1			
Prec. pumps only	Vac. Pump w/ 6' cord (0.64CFM@10"Hg)	Grainger, Inc.	5Z348
Venturi Vac pump	See Info. below ESD pencil wands for Venturi vacuum generator Info.		
ESD pencil-type Vacuum Wand Accessories	Order Catalog for more Info. (the items listed below are for a complete ESD pencil wand kit)	H-Square Corp.	
ESD Pencil-type Vacuum Wand	ESD-Protected Pencil-type Vacuum Wand	H-Square Corp.	DPNOAS2LA
Vacuum cup needle	1" in length with 45° bend	H-Square Corp.	SQ21398
Vacuum cup-TSOP	0.25" outside diameter	H-Square Corp.	BNCSD-25
Vacuum cup-PSOP/SSOP	0.38" outside diameter	H-Square Corp.	BNCSD-38
Wand coil tubing	Anti-static, working length 9-36"	H-Square Corp.	CC-4AS1
Wand holder	Wand holder, auto. shut-off, table top	H-Square Corp.	HSUPT
AC-powered pump	For pencil-type wands: 8 Hg. with 6' hose	Mitchell Hughes	1505
Venturi vacuum generator	For pencil or precision wands NOTE: Input to regulator connection is site plumbing specific. It will require an 1/8" male thread connector.	Norcal Inc.	VHH10-6N1
Regulator	1/8 mini regulator with PSI gauge	Norcal Inc.	R08-01-FOGO
Vac hose	6mm OD recoil tube with 3 meter length	H-Square Corp.	CC-9AS2

NOTE 1.

Packages must be in **thick** JEDEC trays only.
TSOPs must use Yamaichi sockets with guide holes.
SSOPs must use Texas Instruments sockets with guide holes.
PSOPs must use Texas Instruments sockets with guide holes.
Minimum vacuum supply of 10" Hg @ 0.50 CFM [Vacuum measurement is non-static (in-line with flow)].

8.3 Equipment Recommendation Table 2 (Miscellaneous Process-Related Equipment)

ITEM	DESCRIPTION	VENDOR	PART #
Lead Inspection Systems/ Accessories			
August Technology PC based system	All Gull-wing/J-lead devices Semi-automatic	August Technology Corp.	LV 9200
Optical Comparator	V12B Profile Projector manual system	Nikon, Inc.	80295
	V12B 10x Projection Lens	Nikon, Inc.	80302
	4" x 4" Stage Assembly with Encoders	Nikon, Inc.	80118
Optical Comparator Accessories	Comparator Baseplate and Inspection Site	Metro Precision	MPM-46-MMT
	Intel 32-ld TSOP Overlay	Empac Design	D032TSOP-01
	Intel 40-ld TSOP Overlay	Empac Design	D040TSOP-01
	Intel 48-ld TSOP Overlay	Empac Design	D048TSOP-01
	Intel 56-ld TSOP Overlay	Empac Design	D056TSOP-01
	Intel 44-ld PSOP Overlay	Empac Design	D044PSOP-01
	Intel 56-ld SSOP Overlay	Empac Design	D056SSOP-01
	10x Eye Piece	Edmund Scientific	G39,107
Magnifier Lamp	Magnifying Lamp with 3 Diopter lens	Dazor Mfg.	8 MR 300
	Solid pedestal stand	Dazor Mfg.	3050R
	Wheel-based caster stand	Dazor Mfg.	1050
Ear Plugs	Expand-o-fit	Vallen Safety	2070100
ESD rubber bands	All sizes (size in video: 4" x ¼")	Malaster Co.	MC-ASRB-7
Tray strappers	Automatic strapping kit	Strapac	
Tray Strap kit	Strap-pac strapping kit with wire buckles	McMaster	1966T3
SOP Pkg. guide	Intel's specific SOP package guide	Intel Corp.	296514-005
Intel Pkg. guide	Intel's general package guide– all of Intel's packages (SOP included)	Intel Corp.	240800

8.4 Equipment Recommendation Table 3 (Tray and Tape-In-Tube Packaging Material)

ITEM	MINIMUM ORDER QTY.	VENDOR	PART #
TRAY BOXES			
Jedec tray boxes large (6/box)	25 Per bundle*	Unisource	36C-7891
Jedec tray boxes small (thin trays or 2 thick trays/box)	25 Per bundle*	Unisource	36C-7905
PKG. ITEMS			
12" pink bubble wrap roll	4 roll bundle	Unisource	33B-5083
JEDEC box deep tray foam cavity	1 case- 180 Ea.	Unisource	36C-7913
JEDEC tray foam lids	1 case- 200 Ea.	Unisource	36C-7948
Tape-in-tube foam sponges	1 case- 2000 Ea.	Unisource	36C-7921
DESICCANT			
Humidity indicator cards	1 can- 125 Ea.	Unisource	33B-5105
Desiccant Gel packs	1 pail- 300 Ea.	Unisource	33B-5091
Desiccant JEDEC tray bags	1 case- 200 Ea.	Unisource	30E-4462
TAPE-IN-TUBE TUBES/STOPS			
10/8 Pc. tape-in-tube (long tube)	10,000 Ea.	ITW Meritex	0-F851204-01
2 Pc. tape-in-tube (short tube)	20,000 Ea.	ITW Meritex	0-F851204-03
Tube end stops	10,000 Ea.	ITW Meritex	EV801118-19
C-Pak division tape-in-tube slide cover	8,000 Ft.	ITW Meritex	KT-3222-000
TAPE/REEL			
32L TSOP carrier tape	None	Advantek	TSOP32-BC90.OP2
40L TSOP carrier tape	None	Advantek	TSOP40-BC90.OP2
48L TSOP carrier tape	None	Advantek	TSOP48-CC99.OP2
56L TSOP carrier tape	None	Advantek	TSOP56-AC95.OP2
44L PSOP carrier tape	None	Advantek	PSOP44-BC57.OP2
56L SSOP carrier tape	None	Advantek	SSOP56-CC83.OP2
Heat seal cover tape– all above packages	None	Advantek	AA25505NP
TRAYS (Thin)	Note: Also refer to tray recycler sources		
32L TSOP	Thin tray only	3M	21002387145
40L TSOP	Thin tray only	3M	21002386145
48L TSOP	Thin tray only	Daewon	1220314
56L TSOP	Thin tray only	3M	21002385145

8.5 Suggested-Vendor Contact Information

Vacuum Wand Information (Table 1):

H-Square Corp.	(408) 734-2543	(Sunnyvale, CA)
Grainger Inc.	1(800) 323-0620	(Illinois)
Mitchell Hughes Co.	(619) 376-4430	(Wofford Heights, CA)
Metro Precision Machining	(408) 727-7905	(Santa Clara, CA)
Norcal Inc.	(408) 727-5756	(Santa Clara, CA)

Miscellaneous Process-Related Equipment (Table 2):

August Technology Corp.	(612) 820-0080	(Edina, MN)
Nikon Inc.	(516) 547-8500	(New York)
Metro Precision Machining	(408) 727-7905	(Santa Clara, CA)
McMaster Co.	(310) 692-5911	
Malaster Co.	(408) 745-0104	(Sunnyvale, CA)
Empac Design	(214) 233-6339	(Dallas, TX)
Edmund Scientific	(609) 573-6280	(New Jersey)
Dazor Manufacturing	1(800) 345-9103	(Missouri)
Strapac Strapper	(217) 431-4000	(Danville, IL)
California Distribution	1(800) 632-8933	(Rocklin, CA)
Vallen Safety	(916) 452-3561	(Sacramento, CA)
Intel Corp. (for copies of video)	(916) 356-5069	(George Mello, Folsom, CA)
Intel Corp. (for package guides)	1(800) 879-4683	(Mt. Prospect, IL)

Tray/Tape-In-Tube Packaging Information (Table 3):

Unisource	1-800-677-3641	(Denice Scalaro) * Requires minimum order of $500.00 per item
ITW Meritex	(817) 649-5777	(Arlington, TX) contact: Ed Gayowski
Advantek	(612) 938-6800	(Minnetonka, MN) contact: Tim Cowen
3M Corp.	1(800) 328-0411	(Austin, TX)
Eco Tech (Tray recycler)	(408) 988-2050	(Santa Clara, CA)
Global Tech (Tray recycler)	(408) 437-1321	(San Jose, CA)

APPENDIX A: INCOMING/OUTGOING QUALITY MONITOR TRACKER

Intended for each manual programming lot, this form serves as a process flow checklist, a traceability record and a data collection tool. As a data collection tool, it ensures that incoming or in-process issues get identified, documented and resolved to achieve continuous improvement. Each site should develop their own failure dispositioning plan.

STEP 1 (INCOMING VISUAL INSPECTION)

LOT NUMBER_____ DATE _____
OPERATOR _____ LOT QUANTITY _____

100% VISUAL INSPECTION:.....PASS/FAIL (CIRCLE ONE)
IF PASSED, GO TO STEP 2.
IF FAILED, VERIFY ON OPTICAL COMPARATOR.....PASS/FAIL (CIRCLE ONE)
IF PASSED, GO TO STEP 2.
IF FAILED, DISPOSITION ACCORDINGLY. QA SIGNOFF_____

COMMENTS:

IF STEP 1 FAILED, HAS THIS LOT BEEN OPENED/SPLIT PRIOR TO THIS STEP?.....YES/NO (CIRCLE ONE)

STEP 2 (POST-PROGRAMMING VISUAL INSPECTION)

AFTER PROGRAMMING/LABELING PROCESS STEP, PERFORM 100% VISUAL INSPECTION

LOT NUMBER_____ DATE _____
OPERATOR _____ LOT QUANTITY _____

100% VISUAL INSPECTION:.....PASS/FAIL (CIRCLE ONE)
IF PASS, AND QUALITY ASSURANCE SAMPLE IS REQUIRED, GO TO STEP 3.
IF PASS, AND QUALITY ASSURANCE SAMPLE IS NOT REQUIRED, YOU ARE DONE.
IF FAIL, VERIFY ON OPTICAL COMPARATOR.....PASS/FAIL (CIRCLE ONE)
IF PASSED, GO TO STEP 3 (IF REQUIRED).
IF FAILED, DISPOSITION ACCORDINGLY. QA SIGNOFF_____

COMMENTS:

STEP 3 (QUALITY ASSURANCE SAMPLE VERIFIED AT OPTICAL COMPARATOR)

LOT NUMBER_____ DATE _____
OPERATOR _____ LOT QUANTITY _____

NUMBER OF UNITS SAMPLED_____

OPTICAL SETUP VERIFIED.....YES/NO (CIRCLE ONE).....DID SAMPLE PASS/FAIL (CIRCLE ONE)
IF PASSED, YOU ARE DONE.
IF FAILED, DISPOSITION ACCORDINGLY. QA SIGNOFF_____

COMMENTS:

APPENDIX B: PRECISION WAND OPERATING INSTRUCTIONS

MANUAL PRECISION WAND
OPERATING INSTRUCTIONS

The precision wand is designed to manually place Intel Flash small outline packages (SOP) into and out of trays and sockets.

Vacuum wand requirements:
Each SOP type, thin small outline package (TSOP), plastic small outline package (PSOP), and shrink small outline package (SSOP) requires a different vacuum wand head. However, the TSOP head is used for all lead count TSOP packages (32,40,48,and 56L).

Each tray type (thick and thin JEDEC trays) will require different vacuum wand heads.

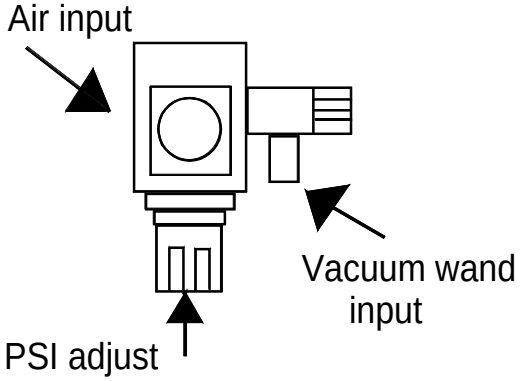
Socket type requirement:
TSOP must use Yamaichi sockets with guide holes.
PSOP must use Texas Instrument sockets with guide holes.
SSOP must use Texas Instrument sockets with guide holes.

Vacuum source requirements:
The precision wand requires a high vacuum source (Approx. 10Hg @ .50 CFM.). An A.C. powered vacuum pump or an Air supplied venturi vacuum generator will work. For ordering information, refer to FaxBack document 2291. You can access Intel's FaxBack by calling USA/Canada: 1-(800)-628-2283, Europe: +44 (0) 1793-496646, or Japan: 916 356-3105 .

If you have in-house supplied compressed air, the air venturi vacuum generator will be an adequate vacuum source.

Venturi vacuum generator hook-up instructions (Refer to figure):
1. Connect in-house supplied air to left side of gauge (Air input).
2. Adjust air pressure to 30-50 PSI.
   NOTE: Alway shut PSI flow off prior to connecting to air source to avoid damage to guage.
3. Connect vacuum hose of precision wand to input connector (Vacuum wand input).

Venturi Vacuum generator



Tray Placement/ pick-up and drop-off: (Figures 1 and 2)
Device pick-up from tray:

1. Lower wand into tray pocket, ensure guide pins are aligned to guide holes.
2. Depress and release valve stem button to pick device up into wand.
3. Raise wand straight up

Device drop-off into tray:

1. Lower wand into tray pocket, ensure guide pins are aligned to guide holes.
2. Depress and hold valve stem button to release device into tray pocket.
3. Raise wand straight up (with valve stem button still depressed).

Socket Placement/ Drop-off and Pick-up: (Figures 3 and 4)
Device drop-off into socket:

NOTE: Ensure socket adapter has been installed into socket (For thin trays only) by guiding adapter pins into socket guide holes.

1. Lower wand into socket (ensure guide pins are aligned to guide holes) and fully compress the socket lid so that the socket contact fingers are fully open.

   NOTE: Before depressing valve stem button (step 2), it is important to ensure the wand is completely lowered into socket and seated correctly. Otherwise device misplacement may occur.

2. Depress and hold valve stem button to release device into socket.
3. Raise wand straight up (with valve stem button still depressed).

Device pick-up from socket:

1. Lower wand into socket, ensure guide pins are aligned to guide holes.
2. Depress and **slowly** release valve stem button to pick device up into wand.
3. Raise wand straight up.

   NOTE: New vacuum cups may require a breakdown period for optimum performance. To accelerate this period, gentle roll the cup with fingers for 30 seconds prior to use.

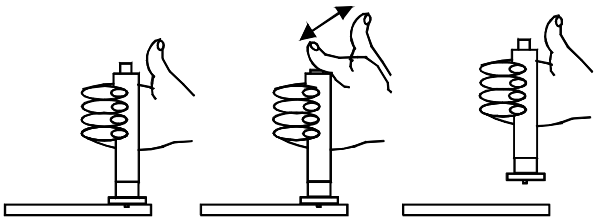


Figure 1
Device pick-up from tray

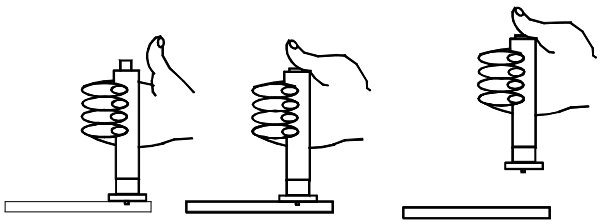


Figure 2
Device drop-off into tray

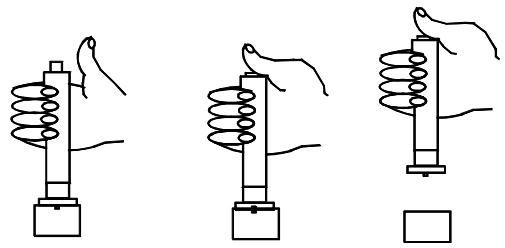


Figure 3
Device drop-off into socket

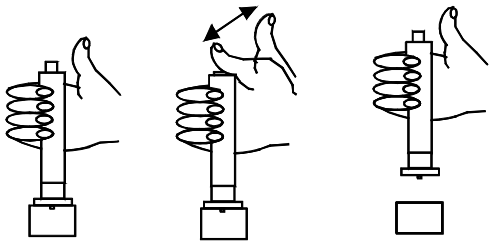


Figure 4
Device pick-up from socket

APPENDIX C: CURRENT PROCESS UPDATE SECTION

NOTE: This section is designed to be a quick update reference which explains any current process changes which relate to this document. The changes will be reflected in this document as well, but for easy referencing, this section has been added to summarize the change and refer you to the location of the actual change within this document.

Updates will be referenced by date of actual change.

Actual Changes to date:

*3/20/96 Precision wand for TSOP Thin trays. The thin tray wand has been designed and is currently in the proto-type stage. Ordering information will be listed on this document as soon as possible. We are in the process of building wand kits and will supply them through Intel. Forecast completion date is May '96. Please contact Jim Malatesta of Intel Corporation at (916) 356-4348 for more information.

FIGURE 1

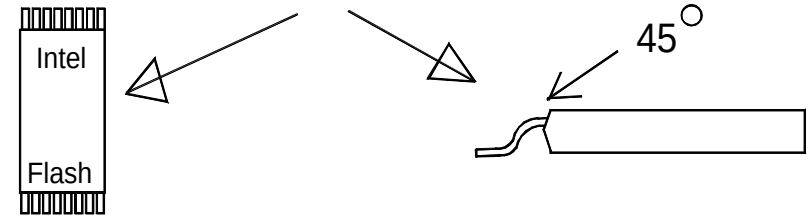


FIGURE 2

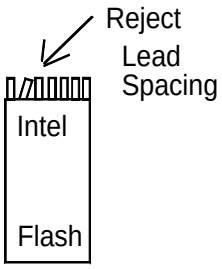


FIGURE 3

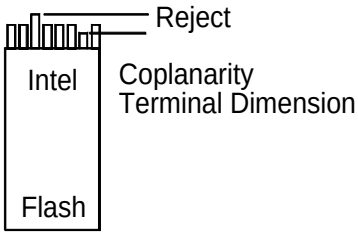


FIGURE 4

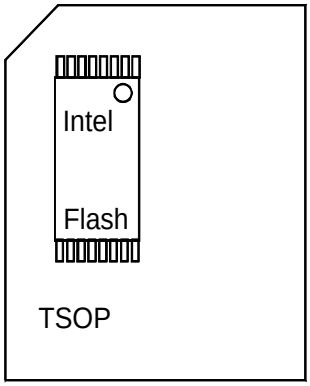


FIGURE 5

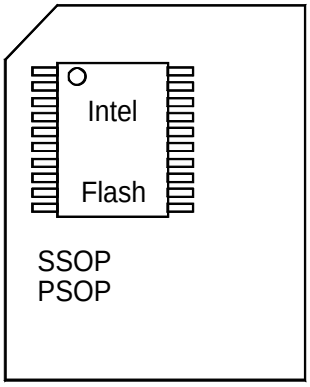


FIGURE 6

Basic razor type box cutter