KEYWORD
SUBJECT **Peak Accelerations From Package Impacts**

The purpose of this TWR is to document the work performed at the request of Dr. David Manko (REO) concerning peak accelerations resulting from Waste Package to Waste Package and Waste Package to Pallet impacts. The methodology for determining peak accelerations, the computer code used, and finally the results will all be given herein.

The calculations requested by Dr. Manko were for the peak accelerations resulting from simulations where, from vibratory ground motion, Waste Packages impacted 1) other Waste Packages (EI, for end impact), and 2) the Pallets (PI, for pallet impact). In total, peak accelerations were calculated for 68 simulations for both the PI and EI cases, resulting from 17 (1-17) scenarios of 4 cases (v040, v105, v244, and v407).

The PI data (contained in the "PI_Summary" files) resulting from the simulations listed the peak force, angle, and location of each package to pallet impact with over 134,000 lbs of force. For each impact, an impact velocity was determined by interpolating (using angle, impact location and peak force) between tables 6-10, 6-11, 6-12, 6-13, and 6-14 (along with instruction from Chapter 6, pages 99-100, since the format of the tables by themselves is ambiguous at best) from YMP document MDL-WIS-AC-000001, "Mechanical Assessment of Degraded Waste Packages and Drip Shields Subject to Vibratory Ground Motion", September 2007. Then using Appendix F, Table F-3, a peak acceleration was obtained by interpolating the table based on impact velocity, impact location, and angle. For each of the 68 events, only the maximum peak acceleration was recorded. For convenience, the tables used are pasted below.

Upon inspection of tables 6-10 – 6-14, it is immediately clear that table 6-10 has a different format than the rest. However, using the instructions of Chapter 6 page 100, it can be expanded to take the same form as the other tables and thus allow for easy interpolation. This explanation is included below for convenience. Also note that in some of the tables, two values may appear in one block. In such cases, the maximum value is used.

For Table F-3, impact velocities are given only for 7 and 10 m/s. For less than 7, interpolations are done with 0, and if above 10 m/s, velocities are rounded down to 10 m/s (per Chapter 6 – with the reasoning that it would be rare and statistically insignificant, and so will not make a difference if rounded down). Also note that value 27.4 does not really fit. This was brought to the attention of Dr. Manko, who replied that he agreed, but these tables are "taken as gospel".

PAGES COVERED 1 THRU 17 LG Rebholz 2/13/08 COGNIZANT MATHEMATICIAN DATE	DEPTH OF CHECK AND RESULTS HAVE BEEN RECORDED ON PAGES(S) ____ PAGES COVERED 1 THRU 17 DJ Manko 2/13/08 REVIEWER DATE	PAGES COVERED ____ THRU ____ C Jeffrey SUPERVISOR DATE

KEYWORD
SUBJECT **Peak Accelerations From Package Impacts**

The waste package-to-pallet damage lookup table analyses with a 0 degree impact angle are only performed with impact velocities up to 2.00 m/s. For the lookup tables above 2.00 m/s, the damaged areas from the analyses at +/–0.25 degrees are assumed for the 0-degree impacts. Below 2.00 m/s, the damaged areas from the +/–0.25-degree impacts are still assumed at the 0-, 1/2-, and 1-point locations, and the lookup tables analyses at 0 degrees provide the damaged area for the 1/8-, 1/4-, 3/4-, and 7/8-point locations at 0 degrees. The damaged area associated with the "< 1/2" location (see Section 6.3.2.2.7) is prescribed for the 1/8- and 1/4-point locations, and the damaged area associated with the "> 1/2" location is prescribed for the 3/4- and 7/8-point locations.

Table 6-10. Waste Package-to-Pallet Impact Forces (lbs) for the Kinematic Model of the TAD-Bearing Waste Package for an Impact Angle of 0 Degrees

Impact Velocity (m/s)	Location	
	< 1/2	> 1/2
0.20	134,000	141,000
0.25	167,000	176,000
0.30	200,000	211,000
0.35	233,000	245,000
0.40	265,000	280,000
0.50	330,000	348,000
1.00	659,000	692,000
2.00	1,650,000	1,770,000

Output DTN: LL0704PA048SPC.023, file *NavalLong_TAD_WPP_kinematic_analyses_force.xls*, sheet "0 degrees."

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Table 6-11. Waste Package-to-Pallet Impact Forces (lbs) for the Kinematic Model of the TAD-Bearing Waste Package for an Impact Angle of +0.25 Degrees

Impact Velocity (m/s)	Location						
	0	1/8	1/4	1/2	3/4	7/8	1
0.20	144,000	*82,000* 172,000	*133,000* 204,000	277,000	204,000	172,000	152,000
0.25	184,000	*103,000* 214,000	*166,000* 256,000	347,000	256,000	214,000	190,000
0.30	222,000	*123,000* 257,000	*198,000* 307,000	416,000	307,000	257,000	227,000
0.35	263,000	*143,000* 299,000	*231,000* 357,000	485,000	357,000	299,000	266,000
0.40	304,000	*163,000* 341,000	*263,000* 408,000	555,000	409,000	341,000	304,000
0.50	384,000	*206,000* 425,000	*332,000* 510,000	693,000	510,000	425,000	380,000
1.00	770,000	792,000	*664,000* 1,010,000	1,390,000	1,010,000	837,000	758,000
2.00	1,530,000	2,230,000	2,500,000	3,200,000	2,460,000	1,600,000	1,500,000
3.00	2,380,000	3,570,000	4,510,000	4,320,000	3,790,000	2,640,000	2,220,000
5.00	3,640,000	6,940,000	8,190,000	9,440,000	7,100,000	5,120,000	3,290,000
7.00	6,580,000	9,630,000	11,200,000	12,400,000	9,980,000	7,380,000	5,220,000
10.00	10,300,000	12,600,000	15,100,000	17,400,000	13,700,000	11,300,000	8,560,000

Output DTN: LL0704PA048SPC.023, file *NavalLong_TAD_WPP_kinematic_analyses_force.xls*, sheets "+0.25 degrees" and "+0.25 degrees (original)."

NOTE: Original values in *italics*, and corrected values given below original values.

PAGES COVERED ____ THRU ____ LG Rebholz COGNIZANT MATHEMATICIAN DATE	DEPTH OF CHECK AND RESULTS HAVE BEEN RECORDED ON PAGES(S) _____ PAGES COVERED _____ THRU_____ DJ Manko REVIEWER DATE	PAGES COVERED _____ THRU _____ C Jeffrey SUPERVISOR DATE

Table 6-12. Waste Package-to-Pallet Impact Forces (lbs) for the Kinematic Model of the TAD-Bearing Waste Package for an Impact Angle of −0.25 Degrees

Impact Velocity (m/s)	Location						
	0	1/8	1/4	1/2	3/4	7/8	1
0.20	141,000	136,000	193,000	278,000	*141,000* 193,000	*87,000* 136,000	151,000
0.25	177,000	170,000	242,000	347,000	*176,000* 242,000	*108,000* 170,000	189,000
0.30	212,000	204,000	290,000	417,000	*210,000* 290,000	*130,000* 204,000	226,000
0.35	247,000	237,000	337,000	486,000	*244,000* 337,000	*151,000* 237,000	264,000
0.40	283,000	271,000	386,000	555,000	*280,000* 386,000	*173,000* 271,000	302,000
0.50	353,000	336,000	483,000	693,000	*350,000* 483,000	*216,000* 336,000	377,000
1.00	707,000	662,000	958,000	1,390,000	*774,000* 958,000	914,000	753,000
2.00	1,410,000	1,570,000	2,270,000	3,170,000	2,670,000	2,390,000	1,580,000
3.00	2,070,000	2,550,000	3,600,000	4,300,000	4,900,000	3,970,000	2,680,000
5.00	3,290,000	4,560,000	6,550,000	9,320,000	8,740,000	7,390,000	4,220,000
7.00	3,900,000	7,390,000	9,320,000	12,300,000	11,800,000	10,100,000	7,740,000
10.00	5,100,000	10,600,000	12,900,000	17,000,000	15,900,000	13,300,000	11,800,000

Output DTN: LL0704PA048SPC.023, file *NavalLong_TAD_WPP_kinematic_analyses_force.xls*, sheets "−0.25 degrees" and "−0.25 degrees (original)."

NOTE: Original values in *italics*, and corrected values given below original values.

Table 6-13. Waste Package-to-Pallet Impact Forces (lbs) for the Kinematic Model of the TAD-Bearing Waste Package for an Impact Angle of +6 Degrees

Impact Velocity (m/s)	Location						
	0	1/8	1/4	1/2	3/4	7/8	1
0.20	148,000	186,000	222,000	281,000	225,000	164,000	148,000
0.25	186,000	232,000	278,000	351,000	281,000	205,000	185,000
0.30	223,000	278,000	334,000	422,000	338,000	245,000	222,000
0.35	259,000	325,000	389,000	492,000	394,000	285,000	258,000
0.40	297,000	371,000	444,000	562,000	451,000	326,000	295,000
0.50	371,000	464,000	565,000	702,000	562,000	405,000	369,000
1.00	740,000	927,000	1,140,000	1,400,000	1,100,000	796,000	736,000
2.00	1,480,000	1,690,000	2,180,000	2,690,000	2,250,000	1,500,000	1,470,000
3.00	2,170,000	2,860,000	3,540,000	4,130,000	3,770,000	2,270,000	2,180,000
5.00	3,620,000	5,030,000	5,210,000	6,250,000	6,590,000	4,240,000	3,460,000
7.00	5,540,000	6,520,000	6,700,000	8,010,000	8,800,000	5,700,000	4,600,000
10.00	7,580,000	8,210,000	11,500,000	14,900,000	12,000,000	7,880,000	5,810,000

Output DTN: LL0704PA048SPC.023, file *NavalLong_TAD_WPP_kinematic_analyses_force.xls*, sheet "+6 degrees."

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Table 6-14. Waste Package-to-Pallet Impact Forces (lbs) for the Kinematic Model of the TAD-Bearing Waste Package for an Impact Angle of −6 Degrees

Impact Velocity (m/s)	Location						
	0	1/8	1/4	1/2	3/4	7/8	1
0.20	137,000	176,000	212,000	279,000	236,000	191,000	159,000
0.25	172,000	220,000	265,000	349,000	294,000	239,000	199,000
0.30	206,000	264,000	318,000	419,000	353,000	287,000	239,000
0.35	241,000	308,000	370,000	489,000	411,000	335,000	279,000
0.40	275,000	352,000	424,000	559,000	471,000	383,000	318,000
0.50	344,000	440,000	529,000	698,000	599,000	478,000	398,000
1.00	686,000	879,000	1,040,000	1,390,000	1,190,000	949,000	796,000
2.00	1,370,000	1,590,000	2,070,000	2,670,000	2,380,000	1,810,000	1,580,000
3.00	2,030,000	2,720,000	3,510,000	4,110,000	3,760,000	3,080,000	2,330,000
5.00	3,240,000	5,040,000	6,170,000	6,240,000	5,510,000	5,190,000	3,880,000
7.00	4,350,000	7,100,000	8,340,000	8,010,000	6,980,000	6,570,000	5,810,000
10.00	5,550,000	9,760,000	11,600,000	14,500,000	12,800,000	8,530,000	7,810,000

Output DTN: LL0704PA048SPC.023, file *NavalLong_TAD_WPP_kinematic_analyses_force.xls*, sheet "−6 degrees."

Table F-3. Peak Acceleration (g) of TAD-Bearing Waste Package Internals Determined by Waste Package-to-Pallet Detailed Impact Analyses

Impact Velocity (m/s)	Angle	Location		
		1/8	1/4	1/2
7.00	+0.25 degrees	22.5	29.0	33.0
	+6 degrees	23.5	25.6	28.5
10.00	+0.25 degrees	31.4	33.9	40.5
	+6 degrees	30.6	27.4	37.9

Output DTN: LL0708MG004SPC.001, file *Catalog_analyses_accel.xls*, sheet NavalLongTAD WPP.

The code to calculate the peak accelerations has a main file, "CalculateGfromPIandEI", which essentially loops through the 68 events, and for each event, calls the program "process_PI_file", which inputs a file name and outputs the maximum acceleration for the file. These programs are given below. The reference to "get_PI_Data_Tables" is simply a call that returns a 3d array containing the data in the tables given above.

```
function maxGforce = process_PI_file(filename)
% function maxGforce = process_PI_file(filename)
% This function will take a PI summary file and determine that max G force
% that can result from the impact data the file contains.
%
% First, from the angle/force/location, a velocity is determined for each impact in the file
% Then the velocity, angle and location determine a G force for each impact
% Finally the max of the G forces is taken


  % ImpactData will hold impactnum,time,force,angle,location for each
  % impact
  ImpactData = [];

  % Open the file and process it to create ImpactData
  fid = fopen(filename);
  if (fid == -1)
     error(['ERROR: process_PI_file: cannot open file ',filename])
  end
  % From the data files, the way I know I have a line of data (vs. extraneous info) is when I
  % have the sequence:
  % Interface n ...
  %  ImpactNum ...
  %      1
  %      etc.
  %       ...
  %            min ...
  filenotdone=1;
  while filenotdone
     % read the next line
     newline = fgetl(fid);
     if ~ischar(newline)
        % end of file
        filenotdone=0;
     else
        % continue processing
        if(size(newline,2)>8)
           if strcmp(newline(1:9),'Interface')
              % Found an interface, next look for ' ImpactNum'
              newline = fgetl(fid);
              if ~ischar(newline)
                 error('ERROR: looking from string ImpactNum after Interface string found')
              end
              if strcmp(newline(1:10),' ImpactNum')
                 % The next line could be data or say that 0 impacts
                 % are found.  A data line has many more characters,
                 % so we can distinguish that way.
                 newline = fgetl(fid);
                 if(size(newline,2)>75)
                    % This line is data, and so may be the next,
```

```
                newline = fgetl(fid);
                if(size(newline,2)>75)
                   % This line is data, and so may be the next,
                   % until line has "min"
                   while( strcmp(newline(14:16),'min')==0 )
                      dataline = sscanf(newline,'%f');
                      ImpactData(end+1,:) = dataline(1:5)';
                      newline = fgetl(fid);
                      if ~ischar(newline)
                         error('ERROR: end of file while looking for more data')
                      end
                   end

                end
             end
          end
       end
    end
 end
 fclose(fid);

 % I now have the impact data in matrix form as ImpactData where each
 % row corresponds to an impact
 %
 % For each row we need to calculate a velocity.
 %
 % Create the force/angle/location/velocity conversion table constants

 % It is possible that there were no significant impacts.
 if (size(ImpactData,1)<1)
    % no significant impacts!
    maxGforce=0;
 else


    DATA = get_PI_Data_Tables(0);
    for row=1:size(ImpactData,1)
       ImpactData(row,6)=getPIvelocity(ImpactData(row,3),ImpactData(row,4),ImpactData(row,5),DATA);
    end

    % The table for Gforces.  index1 is velocity (7 and 10), index2 is
    % angle (0.25 and 6) and index 3 is location (0,1/8,1/4,1/2,3/4,7/8,1)
    % This data table comes from Table F3 + info on last par of 6-99
    Gdata(1,1,:) = [22.5, 22.5, 29.0, 33.0, 29.0, 22.5, 22.5];
    Gdata(1,2,:) = [23.5, 23.5, 25.6, 28.5, 25.6, 23.5, 23.5];
    Gdata(2,1,:) = [31.4, 31.4, 33.9, 40.5, 33.9, 31.4, 31.4];
    Gdata(2,2,:) = [30.6, 30.6, 27.4, 37.9, 27.4, 30.6, 30.6];

    % Next we interpolate our data to get the associated Gforce.
    for row=1:size(ImpactData,1)
```

```
    ang = ImpactData(row,4);
    ang = abs(ang);
    if (ang<0.25)
       ang=0.25;
    end
    loc = ImpactData(row,5);

    if (vel>10)
       error('ERROR: process_PI_file: a velocity is > 10 !!!')
    elseif (vel >= 7 & vel<=10 )
       alpha = ( 10 - vel )/3;
       GdataRed1 = squeeze( alpha*Gdata(1,:,:) + (1-alpha)*Gdata(2,:,:));
    elseif (vel <7 & vel>0)
       % 0 vel -> 0 g, so interpolate with 0.
       alpha = vel / 7;
       GdataRed1 = squeeze( alpha*Gdata(1,:,:));
    else
       display(['The velocity is', num2str(vel)])
       error('ERROR: process_PI_file: velocity is not what is expected... <0?')
    end
    % GdataRed1 has now been interpolated for this velocity.  Next
    % interpolate it for this angle.
    if (ang>6 | ang<0.25)
       error('There is an angle >6 or <0.25!!!')
    else
       alpha = (6 - ang) / (6 - 0.25);
       GdataRed2 = squeeze(alpha*GdataRed1(1,:) + (1-alpha)*GdataRed1(2,:) );
    end
    % GdataRed2 is now a vector, so we interpolate for location
    refLoc = [0, 1/8, 1/4, 1/2, 3/4, 7/8, 1];
    indexLoc=1;
    if (loc<0 | loc>1)
       error('location does not make sense')
    end
    for i=1:6
       if( loc>=refLoc(i) & loc<=refLoc(i+1) )
          indexLoc=i;
       end
    end
    %  So now interpolate between indexLoc and indexLoc+1
    alpha = (refLoc(indexLoc+1) - loc) / (refLoc(indexLoc+1) - refLoc(indexLoc) );
    if (alpha<0 | alpha>1)
       error('Alpha is not a legal value')
    end
    Gforce = alpha*GdataRed2(indexLoc) + (1-alpha)*GdataRed2(indexLoc+1) ;
    % Put the Gforce back into the matrix
    ImpactData(row,7)=Gforce;

 end
 % Once here, ImpactData holds, for each impact,
 % force/angle/loc/vel/Gforce
```

```
    %ImpactData(:,3:end)
    %max(ImpactData(:,6))
    % Find the maximum Gforce
    maxGforce = max(ImpactData(:,7));
  end

end
```

The second task, as described on page 1, was to determine peak accelerations from Package to Package (EI) impacts. The data from each event was held in EI_Summary files. To calculate the accelerations for each impact, the location, angle, and velocity are interpolated using Tables F-1 and F-2, given below. Once interpolated, the max from either the case in Table F-1 and the WP2 case of Table F-2 is taken as the acceleration for a particular impact. For each event, only the maximum acceleration was of interest.

Table F-1. Peak Acceleration (g) of TAD-Bearing Waste Package Internals Determined by Waste Package-to-Waste Package Detailed Impact Analyses

Impact Velocity (m/s)	Waste Package	Location				
		-0.30	-0.15	0.00	0.15	0.30
2.00	WP1	25.8	26.7	18.4	23.8	30.2
	WP2	25.1	23.7	13.6	18.5	25.2
4.00	WP1	47.7	48.7	49.7	49.5	46.7
	WP2	36.0	41.8	44.2	43.1	41.9
6.00	WP1	52.3	59.1	61.5	61.4	52.0
	WP2	42.5	50.9	57.4	51.0	43.1
9.00	WP1	66.6	64.9	72.0	69.1	64.2
	WP2	56.2	67.8	64.6	55.2	56.5

Output DTN: LL0708MG004SPC.001, file *Catalog_analyses_accel.xls*, sheet NavalLongTAD WPWP.

NOTE: WP = waste package.

Table F-2. Peak Acceleration (g) of Codisposal and TAD-Bearing Waste Package Internals Determined by Waste Package-to-Waste Package Detailed Impact Analyses

Impact Velocity (m/s)	Waste Package	Location				
		−0.30	−0.15	0.00	0.15	0.30
2.00	WP1 (CDSP)	14.1	7.8	6.6	8.0	8.3
	WP2 (TAD-bearing)	25.0	24.9	11.5	16.0	22.7
4.00	WP1 (CDSP)	23.6	75.0	32.8	56.0	35.5
	WP2 (TAD-bearing)	40.4	41.9	30.1	39.6	43.5
6.00	WP1 (CDSP)	88.4	107.7	101.9	110.9	90.7
	WP2 (TAD-bearing)	50.2	75.4	70.0	66.4	56.0
9.00	WP1 (CDSP)	145.3	146.7	163.8	162.9	149.3
	WP2 (TAD-bearing)	72.5	79.5	86.3	88.4	71.3
10.00	WP1 (CDSP)	151.3	156.0	174.9	173.8	167.9
	WP2 (TAD-bearing)	76.3	77.1	85.3	88.5	87.9

Output DTN: LL0706MG004SPC.001, file *Catalog_analyses_accel.xls*, sheet CDSP WPWP.

NOTE: CDSP = codisposal; TAD = transportation, aging, and disposal (canister); WP = waste package.

The program used to calculate the max acceleration for each event's EI_Summary file is called "process_PI_file", given below:

```
function maxGforce = process_EI_file(filename)
% function maxGforce = process_EI_file(filename)
% This function will take a EI summary file and determine that max G force
% that can result from the impact data the file contains.
%


  % EImpactData will hold end(0==left,1==right), velocity, location, angle
  EImpactData = [];

  % Open the file and process it to create ImpactData
  fid = fopen(filename);
  if (fid == -1)
     error(['ERROR: process_EI_file: cannot open file ',filename])
  end
  % A line of data starts with either ' I ', ' J ', or ' K '
  filenotdone=1;
  while filenotdone
     % read the next line
     newline = fgetl(fid);
     if ~ischar(newline)
        % end of file
        filenotdone=0;
```

```
    else
      % continue processing
      if(size(newline,2)>100)
        if( strcmp(newline(1:3),' I ') | strcmp(newline(1:3),' J ') | strcmp(newline(1:3),' K ') )
          impactEnd=-1;
          if( strcmp(newline(18),'L'))
            impactEnd=0;
          elseif( strcmp(newline(18),'R') )
            impactEnd=1;
          end

          if(impactEnd > -1)
            % If the line has more than 100 chars, happens to have
            % an L or R in the correct location, and begins with '
            % I', ' J ' or ' K ', I am ready to say it is
            % definitely a data line, so lets process it

            % after a line says right or left, all numbers are left
            rowdata = sscanf(newline(25:end),'%f');
            % EImpactData = [ End, velocity, location, angle]
            EImpactData(end+1,1:4) = [impactEnd, rowdata(2), rowdata(3), rowdata(4)];
            size(EImpactData);
          end
        end
      end
    end
  end
  fclose(fid);

  % So the file has now been completely read in, and each line of data
  % has been processed so that its end, vel, loc, and angle are stored in
  % a row in the matrix EImpactData

  % We need the conversion data.  Data(1,:,:) is for Table F1, WP1
  Data(1,:,:) = [
        0.0  0.0  0.0  0.0  0.0
       25.8 26.7 16.4 23.8 30.2
       47.7 48.7 49.7 49.5 48.7
       52.3 59.1 61.5 61.4 52.0
       66.6 64.9 72.0 69.1 64.2
        0.0  0.0  0.0  0.0  0.0
       ];
  % Table F1, WP2
  Data(2,:,:) = [
        0.0  0.0  0.0  0.0  0.0
       25.1 23.7 13.6 18.5 25.2
       36.0 41.8 44.2 43.1 41.9
       42.5 50.9 57.4 51.0 43.1
       56.2 67.8 64.6 55.2 58.5
        0.0  0.0  0.0  0.0  0.0
       ];
```

```
% Table F2, WP2 TAD-bearing
Data(3,:,:) = [
        0.0  0.0  0.0  0.0  0.0
       25.0 24.9 11.5 16.0 22.7
       40.4 41.9 30.1 39.6 43.5
       50.2 75.4 70.0 66.4 56.0
       72.5 79.5 86.3 88.4 71.3
       76.3 77.1 85.3 88.5 87.9
       ];

% Per Dave Manko, what we need for conversion to G force is the max
% value at each vel/loc pair.
Gvelloc = squeeze(max(Data));

% Make sure file is not empty

if(size(EImpactData,1)<1)
   maxGforce=0;
else
   for row=1:size(EImpactData,1)
      % For each impact (i.e. row), calculate the G force and place
      % it as the 5th element of the row in EImpactData matrix
      vel = EImpactData(row,2);
      loc = EImpactData(row,3);

      % Make sure loc and vel are in bounds
      if (loc<-0.3 | loc>=0.3 | vel>10)
         error('ERROR:location is outside specified range')
      end
      % Interpolate for location
      locbin = floor((loc+0.3) / 0.15) + 1;
      alpha = rem( loc+0.3, 0.15) / 0.15;
      Gvel = squeeze((1-alpha)*Gvelloc(:,locbin) + alpha*Gvelloc(:,locbin+1));
      % Interpolate for velocity
      if vel<=2
         velbin=1;
         alpha= vel/2;
      elseif (vel>2 & vel<=4)
         velbin=2;
         alpha = (vel-2)/2;
      elseif (vel>4 & vel<=6)
         velbin=3;
         alpha = (vel-4)/2;
      elseif (vel>6 & vel<=9)
         velbin=4;
         alpha = (vel-6)/3;
      else % vel>9 and vel<=10
         velbin=5;
         alpha = (vel-9);
      end
      if(alpha>1 | alpha<0)
```

```
            error('alpha is not correct!!!')
        end
        maxGforce_thisrow = (1-alpha)*Gvel(velbin) + alpha*Gvel(velbin+1);
        EImpactData(row,5) = maxGforce_thisrow;
    end
    maxGforce = max( EImpactData(:,5) );
end
```

Finally, we give the results of the programs:

Calculating G Forces for Pallet and End Impacts
Calculations done using the (strange) instructions of Ch. 6 from
Mech. Assessment of Degraded Waste Packages and Drip Shields Subject ...

From script CalculateGfromPlandEI.m
Written by Leo Rebholz
January, 2008

Peak Acceleration (g) resulting from Package to Pallet Impact
Impact data from *_PI_Summary files
A maximum G = 0 corresponds to no impacts showing in PI_summary file

Velocity is calculated using Tables 6-10,11,12,13,14
Peak accelerations (g) calculated using Table F-3

V040

V040 1: Max G = 0
V040 2: Max G = 0
V040 3: Max G = 4.4162
V040 4: Max G = 3.7619
V040 5: Max G = 0
V040 6: Max G = 1.4439
V040 7: Max G = 0
V040 8: Max G = 2.0327
V040 9: Max G = 0
V040 10: Max G = 7.4601
V040 11: Max G = 2.3837
V040 12: Max G = 0.66806
V040 13: Max G = 1.2567
V040 14: Max G = 2.591

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SUBJECT **Peak Accelerations From Package Impacts**

V040 15: Max G = 1.1583
V040 16: Max G = 0.79429
V040 17: Max G = 1.7756

V105

V105 1: Max G = 1.5154
V105 2: Max G = 2.2732
V105 3: Max G = 11.3311
V105 4: Max G = 11.306
V105 5: Max G = 5.9423
V105 6: Max G = 4.4564
V105 7: Max G = 2.605
V105 8: Max G = 5.9702
V105 9: Max G = 0
V105 10: Max G = 15.371
V105 11: Max G = 8.5225
V105 12: Max G = 4.7381
V105 13: Max G = 2.9711
V105 14: Max G = 6.4803
V105 15: Max G = 6.8687
V105 16: Max G = 1.335
V105 17: Max G = 4.8472

V244

V244 1: Max G = 5.8278
V244 2: Max G = 8.912
V244 3: Max G = 15.2085
V244 4: Max G = 15.6745
V244 5: Max G = 8.6017
V244 6: Max G = 11.7302
V244 7: Max G = 11.4596
V244 8: Max G = 9.6571
V244 9: Max G = 2.9813
V244 10: Max G = 17.4549
V244 11: Max G = 9.2983
V244 12: Max G = 12.0322
V244 13: Max G = 9.7692
V244 14: Max G = 8.132
V244 15: Max G = 22.7815
V244 16: Max G = 5.6715
V244 17: Max G = 15.4539

V407

V407 1: Max G = 10.8204

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KEYWORD
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V407 2: Max G = 14.8985
V407 3: Max G = 23.8008
V407 4: Max G = 29.7922
V407 5: Max G = 18.6279
V407 6: Max G = 19.4108
V407 7: Max G = 15.0448
V407 8: Max G = 20.4069
V407 9: Max G = 9.4623
V407 10: Max G = 33.62
V407 11: Max G = 14.2662
V407 12: Max G = 17.9131
V407 13: Max G = 10.8758
V407 14: Max G = 14.1396
V407 15: Max G = 32.62
V407 16: Max G = 9.5515
V407 17: Max G = 18.5591

Calculating G Forces for End Impacts

Peak Acceleration (g) resulting from Package to Package Impact
Impact data from *_EI_Summary files
A maximum G = 0 corresponds to no impacts showing in EI_summary file

Peak accelerations (g) calculated using Tables F1,F2

V040

V040 1: Max G = 0
V040 2: Max G = 0
V040 3: Max G = 0
V040 4: Max G = 0
V040 5: Max G = 0
V040 6: Max G = 0
V040 7: Max G = 0
V040 8: Max G = 0
V040 9: Max G = 0
V040 10: Max G = 0
V040 11: Max G = 0
V040 12: Max G = 0
V040 13: Max G = 0
V040 14: Max G = 0

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SUBJECT **Peak Accelerations From Package Impacts**

V040 15: Max G = 0
V040 16: Max G = 0
V040 17: Max G = 0

V105

V105 1: Max G = 0
V105 2: Max G = 3.2964
V105 3: Max G = 27.5555
V105 4: Max G = 10.3665
V105 5: Max G = 2.5338
V105 6: Max G = 0.8036
V105 7: Max G = 0
V105 8: Max G = 13.9892
V105 9: Max G = 0
V105 10: Max G = 18.4992
V105 11: Max G = 7.8556
V105 12: Max G = 3.608
V105 13: Max G = 3.0094
V105 14: Max G = 5.7617
V105 15: Max G = 2.6896
V105 16: Max G = 0
V105 17: Max G = 4.551

V244

V244 1: Max G = 5.1086
V244 2: Max G = 19.9415
V244 3: Max G = 30.1676
V244 4: Max G = 33.999
V244 5: Max G = 15.9225
V244 6: Max G = 16.8674
V244 7: Max G = 23.2931
V244 8: Max G = 37.6787
V244 9: Max G = 2.6404
V244 10: Max G = 52.246
V244 11: Max G = 55.3394
V244 12: Max G = 51.1413
V244 13: Max G = 37.3623
V244 14: Max G = 21.4664
V244 15: Max G = 18.4549
V244 16: Max G = 23.9591
V244 17: Max G = 29.8319

V407

V407 1: Max G = 24.5418

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V407 2: Max G = 52.542
V407 3: Max G = 59.2665
V407 4: Max G = 58.5586
V407 5: Max G = 63.3213
V407 6: Max G = 50.825
V407 7: Max G = 63.4634
V407 8: Max G = 50.9789
V407 9: Max G = 17.7544
V407 10: Max G = 81.1615
V407 11: Max G = 62.3516
V407 12: Max G = 45.2711
V407 13: Max G = 71.6746
V407 14: Max G = 65.3006
V407 15: Max G = 51.0195
V407 16: Max G = 42.3333
V407 17: Max G = 43.8782

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