

Program 60-710—Involute Splines and Inspection

Introduction

The primary purpose of this model is to provide data from ANSI Standard B92.1-1970 for Involute Splines and Inspection. This is the standard for inch-series splines based on a stub diametral pitch design. It is possible to use the model to convert the dimensions to metric, but the basic calculations are always based on diametral pitch and the inch system.

The model will automatically calculate data for splines and gages in accordance with the standard. If data is entered for a modified spline, the model will indicate that the spline is not standard and will then calculate data for measurements and gages for the modified spline.

Plots of the assembled and individual splines are available on the Plot Sheet of the TK Solver model. The plots are of the mean actual tooth thickness.

For information on the proper use and interchangeability of splines and gages refer to the standard.

In some cases the dimension given by the software will be slightly different than the data in the tables in the standard. The software uses the equations given in Appendix A of the standard and the user must decide which value should be used.

Examples

Example 1

The first example is a 26 tooth, 10/20 diametral pitch, side fit, fillet root spline. A Class 5 tolerance is desired on both the internal and external splines. (Different tolerance classes can be used on each spline if desired.) The spline length is 1.5 inches, which we enter in order to obtain analytical checking data for the tooth alignment. We also wish to use the “Standard” gaging method and will print all data needed to manufacture the gages including tapered external masters to calibrate the ring gages for the external spline.

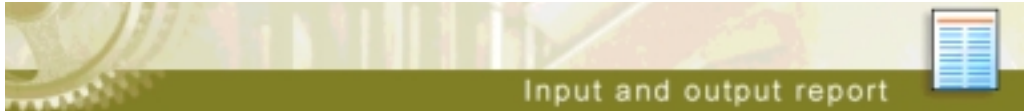
Enter the data as shown in Figure 1-1. Click “Yes” when prompted for spline length values and for plot tic marks. Report 1 gives the input and output values for the solved model.

Fig. 1-1

The screenshot shows the 'Integrated Gear Software (60-710)' dialog box with the following settings:

- Common Data:**
 - Number of teeth: 26
 - Diametral pitch: 10.000000 1/in
- Standard Pressure Angle:**
 - 30 degrees
 - 37.5 degrees
 - 45 degrees
- Type Of Fit:**
 - Side fit
 - Major diameter fit
- Spline:**

	Internal	External
Root type	Fillet	Fillet
Tolerance class	5	5
Spline length for allowable lead variation	1.50 in	1.50 in
- Dimensioning Method For Gages To Check:**
 - S**TD: Min effective and max actual space, max effective and min actual tooth
 - A**: Min and max effective with max actual space, min and min effective with min actual tooth
 - B**: Min and max effective space, min and max effective tooth (no actual dimension information)
- Plot Data:**
 - Mark Fillet/Involute/Chamfer intersections
 - Number of teeth: 1

Report 1**Model Title : Program 60-710****Unit System: US****COMMON**

Number of Teeth	26
Diametral Pitch	10.000000 1/in `
Stub Pitch	20.0000 1/in `
Spline Pitch	10/20
Standard Pressure Angle	30.0000 deg
Type of Fit ('maj or 'side Def='side)	side
Pitch Diameter	2.6000000 in
Base Dia	2.2516660 in
Max_Effective Clearance	0.0028 in
Min_Effective Clearance	0.0000 in

COMMON: Theoretical from Measured Teeth

Max_Actual Clearance	0.0064 in
Min_Actual Clearance	0.0036 in
Radial Form Clearance (Standard)	0.0026 in

INTERNAL SPLINE

Internal Spline ANSI B92.1-1970 Std?	Yes
Fillet or Flat Root ('fil/'flt)	fil
Major Diameter - Min, rounded	NA in
Major Diameter - Max, rounded	2.8010 in
Form Diameter, rounded	2.7050 in

Model Title : Program 60-710

Unit System: US

Roll Angle at Form Diameter	38.144	deg
Minor Diameter - Min, rounded	2.5000	in
Minor Diameter - Max, rounded	2.5050	in
Tolerance Class	5	
Machining Tolerance	0.0014	in
Variation Allowance	0.0018	in
Min_Effective_Space Width	0.1571	in
Specification Required or Reference	Required	
Plug Gage - Composite or Sector	GO Cmp	
Max_Effective_Space Width	0.1585	in
Specification Required or Reference	Reference	
Plug Gage - Composite or Sector	None	
Min_Actual_Space Width	0.1589	in
Specification Required or Reference	Reference	
Plug Gage - Composite or Sector	None	
Max_Actual_Space Width	0.1603	in
Specification Required or Reference	Required	
Plug Gage - Composite or Sector	NO GO Sec	

INTERNAL SPLINE: Size Between Pins

Pin Diameter	0.14400	in
Min_Between 2 Pins	2.4431	in
Max_Between 2 Pins	2.4456	in
Min_Diameter Under 3 Pins	2.4431	in
Max_Diameter Under 3 Pins	2.4456	in
Min_Pin Contact Diameter	2.6610	in

Model Title : Program 60-710**Unit System: US**Max_Pin Contact Diameter **2.6637 in****INTERNAL SPLINE: Analytical Inspection**Total Index Variation **0.0018 in**Profile Variation **0.0004 in**ProNI **-0.0006 in**Spline_Length **1.50 in**Lead Variation **0.0005 in****EXTERNAL SPLINE**External Spline ANSI B92.1-1970 Std? **Yes**Fillet or Flat Root ('fil'/ft) **fil**Major Diameter - Max **2.7000 in**Major Diameter - Min **2.6950 in**Major_Diameter Chamfer - Max **_ in**Major_Diameter Chamfer - Min **_ in**Form Diameter **2.4950 in**Roll Angle at Form Diameter **27.347 deg**Minor Diameter - Min **2.3990 in**Tolerance Class **5**Machining Tolerance **0.0014 in**Variation Allowance **0.0018 in**Max_Eff_Tooth Thickness **0.1571 in**Specification Required or Reference **Required**Ring Gage - Composite or Sector **GO Cmp**Min_Eff_Tooth Thickness **0.1557 in**Specification Required or Reference **Reference**

Model Title : Program 60-710

Unit System: US

Ring Gage - Composite or Sector	None
Max_Actual_Tooth Thickness	0.1553 in
Specification Required or Reference	Reference
Ring Gage - Composite or Sector	None
Min_Actual_Tooth Thickness	0.1539 in
Specification Required or Reference	Required
Ring Gage - Composite or Sector	NO GO Sec

EXTERNAL SPLINE: Size Over Pins

Pin Diameter	0.19200 in
Max_Over 2 Pins	2.8951 in
Min_Over 2 Pins	2.8930 in
Max_Pin Contact Diameter	2.6018 in
Min_Pin Contact Diameter	2.5998 in

EXTERNAL SPLINE: Analytical Inspection

Total Index Variation	0.0018 in
Profile Variation	0.0004 in
ProNX	-0.0006 in
Spline_Length	<i>1.50 in</i>
Lead Variation	0.0005 in

PLOTS DATA

Mark mod/inv/fil intersections?	<i>y</i>
Number of teeth on plot	<i>1</i>

Model Title : Program 60-710

Unit System: US

GAGES

Dimensioning Method (Def='std, 'A, 'B) *std*

INTERNAL SPLINE GAGES: GO Composite Plug Gage: Front Section

Major Diameter **2.7055 in**

ODxfGOi **2.7050 in**

INTERNAL SPLINE GAGES: GO Composite Plug Gage: Rear Section

Major Diameter - New _ in

ODxrGOi _ in

Major Diameter - Wear Limit _ in

INTERNAL SPLINE GAGES: GO Composite Plug Gage: Chamfer

Diameter to Chamfer, max _ in

Chamfer Cutting Angle fr CL Space _ deg

Form Diameter **2.4948 in**

Minor Diameter, Max **2.4948 in**

Tooth Thickness, New (REF) **0.1574 in**

Tooth Thickness, Wear Limit (REF) **0.1571 in**

Pin Diameter **0.1920 in**

Max Size Over Pins - New **2.89858 in**

Min Size Over Pins - New **2.89843 in**

Size Over Pins - Wear Limit **2.89796 in**

INTERNAL SPLINE GAGES: NOT GO Sector Plug Gage

Major Diameter **2.6710 in**

ODxSi **2.6690 in**

Model Title : Program 60-710

Unit System: US

Form Diameter	2.4948	in
Minor Diameter, Max	2.4948	in
Tooth Thickness, New (REF)	0.1603	in
Pin Diameter	0.1920	in
Max Size Over Pins - New	2.90295	in
Min Size Over Pins - New	2.90279	in
Number of Teeth in Sector	2	

EXTERNAL SPLINE GAGES: GO Composite Ring Gage

Bushing Bore, Max	_	in
Bushing Bore, Min	_	in
Minor Diameter, Max	2.4950	in
Minor Diameter, Min	2.4945	in
Form Diameter	2.7052	in
Major Diameter, Min	2.7056	in
Space Width, New (REF)	0.1568	in
Space Width, Wear Limit (REF)	0.1571	in
Pin Diameter	0.1728	in
Min Size Between Pins - New	2.34928	in
Max Size Between Pins - New	2.34947	in
Size Between Pins - Wear Limit	2.35004	in

EXTERNAL SPLINE GAGES: NOT GO Sector Ring Gage

Minor Diameter, Max	2.5310	in
Minor Diameter, Min	2.5290	in
Form Diameter	2.7000	in
Major Diameter, Min	2.7000	in

Model Title : Program 60-710**Unit System: US**

Space Width	0.1539 in
Pin Diameter	0.1728 in
Min Size Between Pins	2.34387 in
Max Size Between Pins	2.34406 in
Number of Teeth in Sector	2

EXTERNAL SPLINE GAGES: GO Composite Ring Gage: Tapered External Master

Major Diameter	2.6950 in
ODGORMi	2.6945 in
Form Diameter	2.4850 in
Minor Diameter, Max	2.4850 in

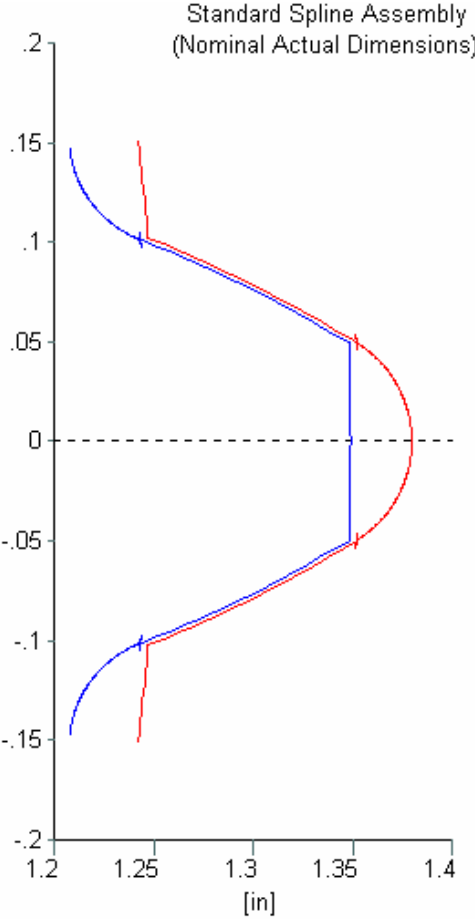
EXTERNAL SPLINE GAGES: GO Composite Ring Gage: Tooth Thickness

End of Lead Length, XX	0.1567 in
End of Fit Range, YY	0.1568 in
End of Wear Range, ZZ	0.1571 in
Pin Diameter	0.1920 in
Size Over Pins at XX	2.89733 in
Size Over Pins at YY	2.89749 in
Size Over Pins at ZZ	2.89796 in

EXTERNAL SPLINE GAGES: NOT GO Composite Ring Gage: Tooth Thickness

End of Lead Length, XX	in
End of Fit Range, YY	in
Pin Diameter	in
Size Over Pins at XX	in
Size Over Pins at YY	in

Fig. 1-2



Example 2

This is a 12 tooth, 5/10 diametral pitch, major diameter fit spline. A Class 5 tolerance is desired on both the internal and external splines. The spline length is 2” which we will enter in order to obtain analytical checking data for tooth alignment. We also wish to use the “A” gaging method and will print all data needed to manufacture the gages, including tapered external masters to calibrate the ring gages for the external spline.

Enter the data in the data input form as shown in Figure 2-1. The inputs and outputs for the solved model are shown in Report 2.

Fig. 2-1

Common Data		Standard Pressure Angle		Type Of Fit	
Number of teeth	12	<input checked="" type="radio"/> 30 degrees		<input type="radio"/> Side fit	
Diametral pitch	5.000000 1/in	<input type="radio"/> 37.5 degrees		<input checked="" type="radio"/> Major diameter fit	
		<input type="radio"/> 45 degrees			
Spline					
	Internal		External		
Root type	Fillet	Fillet			
Tolerance class	4 Min clearance	4 Min clearance			
Spline length for allowable lead variation	2.00 in	2.00 in			
Dimensioning Method For Gages To Check					
<input type="radio"/> STD: Min effective and max actual space, max effective and min actual tooth					
<input checked="" type="radio"/> A: Min and max effective with max actual space, min and min effective with min actual tooth					
<input type="radio"/> B: Min and max effective space, min and max effective tooth (no actual dimension information)					
Plot Data					
<input checked="" type="checkbox"/> Mark Fillet/Involute/Chamfer intersections				Number of teeth 1	

Report 2

Model Title : **Program 60-710**
Unit System: **US**

COMMON

Number of Teeth	12
Diametral Pitch	5.000000 1/in `
Stub Pitch	10.0000 1/in `
Spline Pitch	5/10
Standard Pressure Angle	30.0000 deg
Type of Fit ('maj or 'side Def='side)	maj
Pitch Diameter	2.400000 in
Base Dia	2.0784610 in
Max_Effective Clearance	0.0048 in
Min_Effective Clearance	0.0018 in

COMMON: Theoretical from Measured Teeth

Max_Actual Clearance	0.0090 in
Min_Actual Clearance	0.0060 in
Radial Form Clearance (Standard)	0.0024 in

INTERNAL SPLINE

Internal Spline ANSI B92.1-1970 Std?	Yes
Fillet or Flat Root ('fil/'flt)	flt
Major Diameter - Min, rounded	2.6000 in
Major Diameter - Max, rounded	2.6017 in

Model Title : Program 60-710

Unit System: US

Form Diameter, rounded	2.5610	in
Roll Angle at Form Diameter	41.246	deg
Minor Diameter - Min, rounded	2.2120	in
Minor Diameter - Max, rounded	2.2200	in
Tolerance Class		5
Machining Tolerance	0.0015	in
Variation Allowance	0.0021	in
Min_Effective_Space Width	0.3142	in
Specification Required or Reference		Required
Plug Gage - Composite or Sector		GO Cmp
Max_Effective_Space Width	0.3157	in
Specification Required or Reference		Required
Plug Gage - Composite or Sector		NO GO Cmp
Min_Actual_Space Width	0.3163	in
Specification Required or Reference		Reference
Plug Gage - Composite or Sector		None
Max_Actual_Space Width	0.3178	in
Specification Required or Reference		Required
Plug Gage - Composite or Sector		NO GO Sec

INTERNAL SPLINE: Size Between Pins

Pin Diameter	0.28800	in
Min_Between 2 Pins	2.0833	in
Max_Between 2 Pins	2.0860	in
Min_Diameter Under 3 Pins	2.0833	in
Max_Diameter Under 3 Pins	2.0860	in

Model Title : Program 60-710**Unit System: US**Min_Pin Contact Diameter **2.5226 in**Max_Pin Contact Diameter **2.5258 in****INTERNAL SPLINE: Analytical Inspection**Total Index Variation **0.0018 in**Profile Variation **0.0006 in**ProNI **-0.0008 in**Spline_Length **2.00 in**Lead Variation **0.0005 in****EXTERNAL SPLINE**External Spline ANSI B92.1-1970 Std? **Yes**Fillet or Flat Root ('fil'/flt) **flt**Major Diameter - Max **2.5999 in**Major Diameter - Min **2.5991 in**Major_Diameter Chamfer - Max **0.0340 in**Major_Diameter Chamfer - Min **0.0220 in**Form Diameter **2.2070 in**Roll Angle at Form Diameter **20.460 deg**Minor Diameter - Min **2.1140 in**Tolerance Class **5**Machining Tolerance **0.0015 in**Variation Allowance **0.0021 in**Max_Eff_Tooth Thickness **0.3124 in**Specification Required or Reference **Required**Ring Gage - Composite or Sector **GO Cmp**Min_Eff_Tooth Thickness **0.3109 in**

Model Title : Program 60-710

Unit System: US

Specification Required or Reference	Required
Ring Gage - Composite or Sector	NO GO Cmp
Max_Actual_Tooth Thickness	0.3103 in
Specification Required or Reference	Reference
Ring Gage - Composite or Sector	None
Min_Actual_Tooth Thickness	0.3088 in
Specification Required or Reference	Required
Ring Gage - Composite or Sector	NO GO Sec

EXTERNAL SPLINE: Size Over Pins

Pin Diameter	0.38400 in
Max_Over 2 Pins	2.9803 in
Min_Over 2 Pins	2.9782 in
Max_Pin Contact Diameter	2.3861 in
Min_Pin Contact Diameter	2.3843 in

EXTERNAL SPLINE: Analytical Inspection

Total Index Variation	0.0018 in
Profile Variation	0.0006 in
ProNX	-0.0008 in
Spline_Length	<i>2.00 in</i>
Lead Variation	0.0005 in

PLOTS DATA

Mark mod/inv/fil intersections?	<i>y</i>
Number of teeth on plot	<i>1</i>

Model Title : Program 60-710

Unit System: US

Form Diameter	2.2072	in
Minor Diameter, Max	2.2072	in
Tooth Thickness, New (REF)	0.3157	in
Pin Diameter	0.3840	in
Max Size Over Pins - New	2.98811	in
Min Size Over Pins - New	2.98797	in

INTERNAL SPLINE GAGES: NOT GO Sector Plug Gage

Major Diameter	2.5083	in
ODxSi	2.5063	in
Form Diameter	2.2072	in
Minor Diameter, Max	2.2072	in
Tooth Thickness, New (REF)	0.3178	in
Pin Diameter	0.3840	in
Max Size Over Pins - New	2.99113	in
Min Size Over Pins - New	2.99098	in
Number of Teeth in Sector	2	

INTERNAL SPLINE GAGES: GO Major Dia Fit Plug Gage

Major Diameter	2.6004	in
ODxGOpI	2.6002	in
Major Diameter - Wear Limit	2.6000	in
Minor Diameter, Max	2.1363	in
Tooth Thickness	0.2687	in
tGOpI	0.2657	in
Pin Diameter	0.3840	in
Max Size Over Pins	2.9189	in

Model Title : Program 60-710

Unit System: US

EXTERNAL SPLINE GAGES: NOT GO Sector Ring Gage

Minor Diameter, Max	2.2723	in
Minor Diameter, Min	2.2703	in
Form Diameter	2.5999	in
Major Diameter, Min	2.5999	in
Space Width	0.3088	in
Pin Diameter	0.3456	in
Min Size Between Pins	1.87367	in
Max Size Between Pins	1.87392	in
Number of Teeth in Sector	2	

EXTERNAL SPLINE GAGES: GO Composite Ring Gage: Tapered External Master

Major Diameter	2.5311	in
ODGORMi	2.5309	in
Form Diameter	2.1970	in
Minor Diameter, Max	2.1970	in

EXTERNAL SPLINE GAGES: GO Composite Ring Gage: Tooth Thickness

End of Lead Length, XX	0.3120	in
End of Fit Range, YY	0.3121	in
End of Wear Range, ZZ	0.3124	in
Pin Diameter	0.3840	in
Size Over Pins at XX	2.98278	in
Size Over Pins at YY	2.98293	in
Size Over Pins at ZZ	2.98336	in

Model Title : Program 60-710

Unit System: US

EXTERNAL SPLINE GAGES: NOT GO Composite Ring Gage

Minor Diameter, Max	2.2723	in
Minor Diameter, Min	2.2703	in
Form Diameter	2.6047	in
Major Diameter, Min	2.6047	in
Space Width	0.3109	in
Pin Diameter	0.3456	in
Min Size Between Pins	1.87882	in
Max Size Between Pins	1.87906	in

EXTERNAL SPLINE GAGES: NOT GO Composite Ring Gage: Tapered External Master

Major Diameter	2.5311	in
ODNGRMi	2.5309	in
Form Diameter	2.2613	in
Minor Diameter, Max	2.2032	in

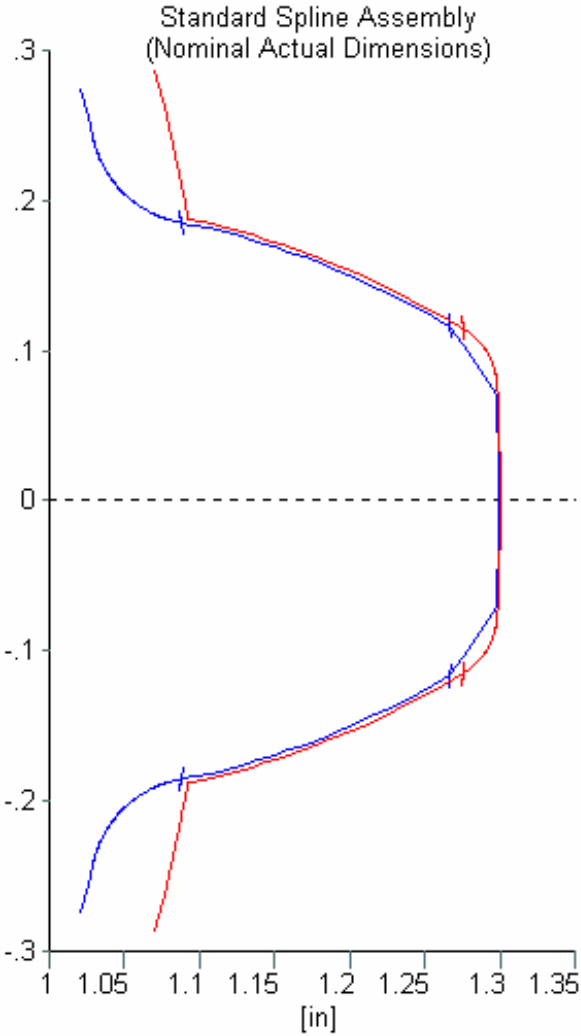
EXTERNAL SPLINE GAGES: NOT GO Composite Ring Gage: Tooth Thickness

End of Lead Length, XX	0.3109	in
End of Fit Range, YY	0.3110	in
Pin Diameter	0.3840	in
Size Over Pins at XX	2.98119	in
Size Over Pins at YY	2.98134	in

EXTERNAL SPLINE GAGES: NOT GO Sector Ring Gage: Tapered External Master

Major Diameter	2.5311	in
ODSERMi	2.5309	in
Form Diameter	2.2613	in

Fig. 2-2



Example 3

This is a 6 tooth, 20/40 diametral pitch, 45 degree pressure angle, side fit, fillet root spline. A Class 7 tolerance will be allowed on both splines. The spline length is .25 inch, which we enter in order to obtain analytical checking data for tooth alignment. We use the “B” gaging method and will print all data needed to manufacture the gages, including tapered external masters to calibrate the ring gages for the external spline.

Enter the data shown in the data input form, Figure 3-1, as described in previous examples. Note that this time we will plot 6 teeth. The inputs and outputs for the solved model are shown in Report 3.

Fig. 3-1

Common Data		Standard Pressure Angle		Type Of Fit	
Number of teeth	6	<input type="radio"/> 30 degrees		<input type="radio"/> Side fit	
Diametral pitch	20.000000 1/in	<input type="radio"/> 37.5 degrees		<input type="radio"/> Major diameter fit	
		<input checked="" type="radio"/> 45 degrees			
Spline					
	Internal		External		
Root type	Fillet		Fillet		
Tolerance class	7 Max clearance		7 Max clearance		
Spline length for allowable lead variation	0.25 in		0.25 in		
Dimensioning Method For Gages To Check					
<input type="radio"/> STD: Min effective and max actual space, max effective and min actual tooth					
<input type="radio"/> A: Min and max effective with max actual space, min and min effective with min actual tooth					
<input checked="" type="radio"/> B: Min and max effective space, min and max effective tooth (no actual dimension information)					
Plot Data					
<input checked="" type="checkbox"/> Mark Fillet/Involute/Chamfer intersections			Number of teeth 5		

Report 3

Model Title : **Program 60-710**
Unit System: **US**

COMMON

Number of Teeth	6
Diametral Pitch	20.000000 1/in `
Stub Pitch	40.0000 1/in `
Spline Pitch	20/40
Standard Pressure Angle	45.0000 deg
Type of Fit ('maj or 'side Def='side)	side
Pitch Diameter	0.3000000 in
Base Dia	0.2121320 in
Max_Effective Clearance	0.0046 in
Min_Effective Clearance	0.0000 in

COMMON: Theoretical from Measured Teeth

Max_Actual Clearance	0.0100 in
Min_Actual Clearance	0.0054 in
Radial Form Clearance (Standard)	0.0020 in

INTERNAL SPLINE

Internal Spline ANSI B92.1-1970 Std?	Yes
Fillet or Flat Root ('fil/'flt)	fil
Major Diameter - Min, rounded	NA in
Major Diameter - Max, rounded	0.3800 in

Model Title : Program 60-710

Unit System: US

Form Diameter, rounded	0.3540	in
Roll Angle at Form Diameter	76.545	deg
Minor Diameter - Min, rounded	0.2700	in
Minor Diameter - Max, rounded	0.2750	in
Tolerance Class		7
Machining Tolerance	0.0023	in
Variation Allowance	0.0027	in
Min_Effective_Space Width	0.0885	in
Specification Required or Reference		Required
Plug Gage - Composite or Sector		GO Cmp
Max_Effective_Space Width	0.0908	in
Specification Required or Reference		Required
Plug Gage - Composite or Sector		NO GO Cmp
Min_Actual_Space Width	0.0912	in
Specification Required or Reference		Reference
Plug Gage - Composite or Sector		None
Max_Actual_Space Width	0.0935	in
Specification Required or Reference		Reference
Plug Gage - Composite or Sector		None

INTERNAL SPLINE: Size Between Pins

Pin Diameter	0.09600	in
Min_Between 2 Pins	0.1540	in
Max_Between 2 Pins	0.1570	in
Min_Diameter Under 3 Pins	0.1540	in
Max_Diameter Under 3 Pins	0.1570	in

Model Title : Program 60-710**Unit System: US**Min_Pin Contact Diameter **0.3117 in**Max_Pin Contact Diameter **0.3158 in****INTERNAL SPLINE: Analytical Inspection**Total Index Variation **<10 Teeth in**Profile Variation **0.0006 in**ProNI **-0.0010 in**Spline_Length *0.25 in*Lead Variation **0.0004 in****EXTERNAL SPLINE**External Spline ANSI B92.1-1970 Std? **Yes**Fillet or Flat Root ('fil'/flt) *fil*Major Diameter - Max **0.3500 in**Major Diameter - Min **0.3450 in**

Major_Diameter Chamfer - Max _ in

Major_Diameter Chamfer - Min _ in

Form Diameter **0.2660 in**Roll Angle at Form Diameter **43.347 deg**Minor Diameter - Min **0.2400 in**

Tolerance Class 7

Machining Tolerance **0.0023 in**Variation Allowance **0.0027 in**Max_Eff_Tooth Thickness **0.0885 in**Specification Required or Reference **Required**Ring Gage - Composite or Sector **GO Cmp**Min_Eff_Tooth Thickness **0.0862 in**

Model Title : Program 60-710

Unit System: US

Specification Required or Reference	Required
Ring Gage - Composite or Sector	NO GO Cmp
Max_Actual_Tooth Thickness	0.0858 in
Specification Required or Reference	Reference
Ring Gage - Composite or Sector	None
Min_Actual_Tooth Thickness	0.0835 in
Specification Required or Reference	Reference
Ring Gage - Composite or Sector	None

EXTERNAL SPLINE: Size Over Pins

Pin Diameter	0.09600 in
Max_Over 2 Pins	0.4558 in
Min_Over 2 Pins	0.4537 in
Max_Pin Contact Diameter	0.2878 in
Min_Pin Contact Diameter	0.2862 in

EXTERNAL SPLINE: Analytical Inspection

Total Index Variation	<10 Teeth in
Profile Variation	0.0006 in
ProNX	-0.0010 in
Spline_Length	<i>0.25 in</i>
Lead Variation	0.0004 in

PLOTS DATA

Mark mod/inv/fil intersections?	<i>y</i>
Number of teeth on plot	<i>5</i>

Model Title : Program 60-710

Unit System: US

GAGES

Dimensioning Method (Def='std, 'A, 'B) *B*

INTERNAL SPLINE GAGES: GO Composite Plug Gage: Front Section

Major Diameter **0.3545 in**

ODxfGOi **0.3540 in**

INTERNAL SPLINE GAGES: GO Composite Plug Gage: Rear Section

Major Diameter - New **_ in**

ODxrGOi **_ in**

Major Diameter - Wear Limit **_ in**

INTERNAL SPLINE GAGES: GO Composite Plug Gage: Chamfer

Diameter to Chamfer, max **_ in**

Chamfer Cutting Angle fr CL Space **_ deg**

Form Diameter **0.2660 in**

Minor Diameter, Max **0.2561 in**

Tooth Thickness, New (REF) **0.0887 in**

Tooth Thickness, Wear Limit (REF) **0.0885 in**

Pin Diameter **0.0960 in**

Max Size Over Pins - New **0.45837 in**

Min Size Over Pins - New **0.45829 in**

Size Over Pins - Wear Limit **0.45811 in**

INTERNAL SPLINE GAGES: NOT GO Composite Plug Gage

Major Diameter **0.3370 in**

ODxNGi **0.3350 in**

Model Title : Program 60-710

Unit System: US

Form Diameter	0.2660	in
Minor Diameter, Max	0.2581	in
Tooth Thickness, New (REF)	0.0908	in
Pin Diameter	0.0960	in
Max Size Over Pins - New	0.46012	in
Min Size Over Pins - New	0.46003	in

EXTERNAL SPLINE GAGES: GO Composite Ring Gage

Bushing Bore, Max	_	in
Bushing Bore, Min	_	in
Minor Diameter, Max	0.2660	in
Minor Diameter, Min	0.2655	in
Form Diameter	0.3540	in
Major Diameter, Min	0.3601	in
Space Width, New (REF)	0.0883	in
Space Width, Wear Limit (REF)	0.0885	in
Pin Diameter	0.0864	in
Min Size Between Pins - New	0.17691	in
Max Size Between Pins - New	0.17703	in
Size Between Pins - Wear Limit	0.17727	in

EXTERNAL SPLINE GAGES: GO Composite Ring Gage: Tapered External Master

Major Diameter	0.3450	in
ODGORMi	0.3445	in
Form Diameter	0.2560	in
Minor Diameter, Max	0.2560	in

Model Title : Program 60-710

Unit System: US

EXTERNAL SPLINE GAGES: GO Composite Ring Gage: Tooth Thickness

End of Lead Length, XX	0.0882 in
End of Fit Range, YY	0.0883 in
End of Wear Range, ZZ	0.0885 in
Pin Diameter	0.0960 in
Size Over Pins at XX	0.45785 in
Size Over Pins at YY	0.45794 in
Size Over Pins at ZZ	0.45811 in

EXTERNAL SPLINE GAGES: NOT GO Composite Ring Gage

Minor Diameter, Max	0.2783 in
Minor Diameter, Min	0.2763 in
Form Diameter	0.3540 in
Major Diameter, Min	0.3573 in
Space Width	0.0862 in
Pin Diameter	0.0864 in
Min Size Between Pins	0.17451 in
Max Size Between Pins	0.17463 in

EXTERNAL SPLINE GAGES: NOT GO Composite Ring Gage: Tapered External Master

Major Diameter	0.3450 in
ODNGRMI	0.3445 in
Form Diameter	0.2673 in
Minor Diameter, Max	0.2541 in

UTS Integrated Gear Software

Model Title : Program 60-710

Unit System: US

EXTERNAL SPLINE GAGES: NOT GO Composite Ring Gage: Tooth Thickness

End of Lead Length, XX **0.0862 in**

End of Fit Range, YY **0.0863 in**

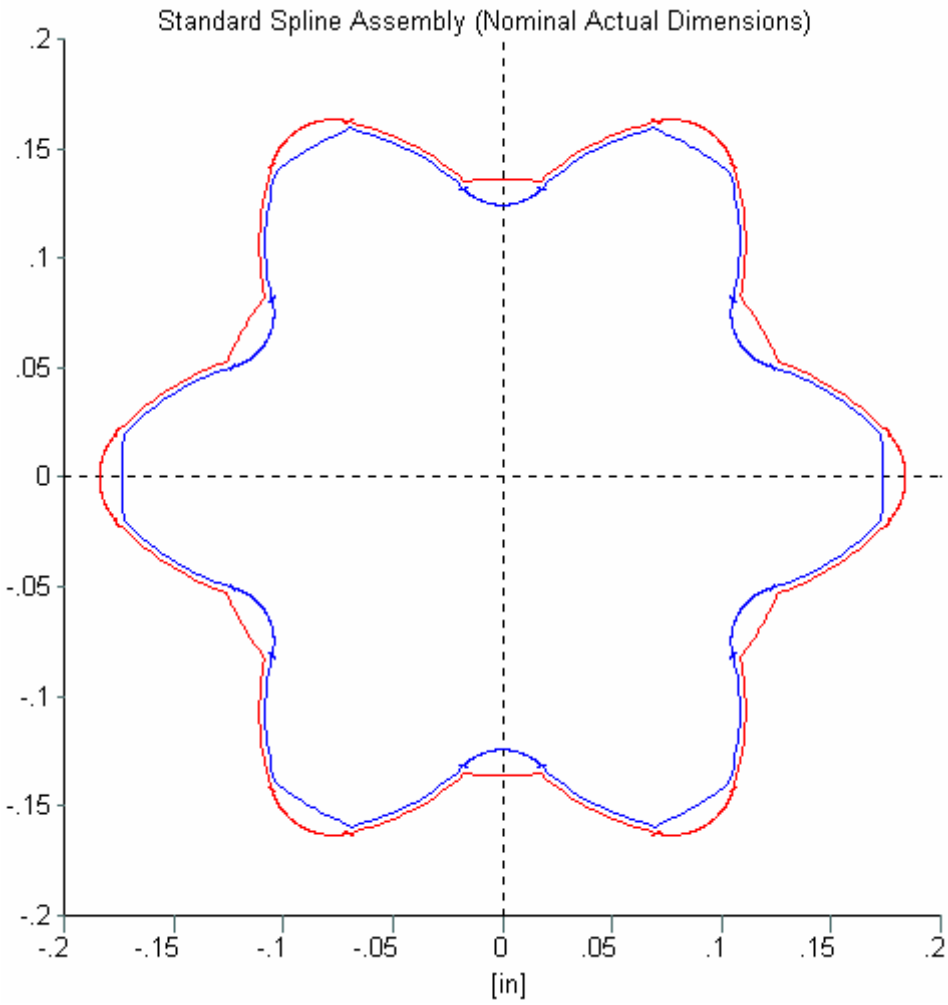
Pin Diameter **0.0960 in**

Size Over Pins at XX **0.45610 in**

Size Over Pins at YY **0.45619 in**

A plot of the teeth in assembly is available. (See Figure 3-2) This time we have plotted all six teeth.

Fig. 3-2



Example 4

This is an 11 tooth, 2.5/5 diametral pitch, 30 degree pressure angle, side fit, flat root spline with a Class 4 tolerance. This time we do not wish analytical checking data or any gage data. We will use the size over or between pins to control manufacture of the splines. Disregard the warning message about an odd number of teeth.

Enter the data in the data entry form as shown in Figure 4-1. This time click “No” when prompted for spline lengths. A report of input and output values for the solved model is shown in Report 4.

Fig. 4-1

Integrated Gear Software (60-710)

Common Data
 Number of teeth: 11
 Diametral pitch: 2.500000 1/in`

Standard Pressure Angle
 30 degrees
 37.5 degrees
 45 degrees

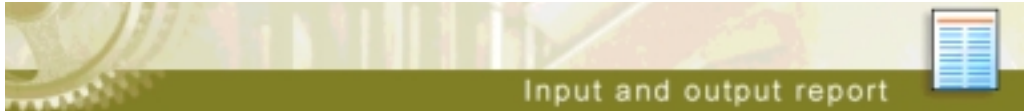
Type Of Fit
 Side fit
 Major diameter fit

Spline

	Internal	External
Root type	Flat	Flat
Tolerance class	4 Min clearance	4 Min clearance
Spline length for allowable lead variation	in	in

Dimensioning Method For Gages To Check
 STD: Min effective and max actual space, max effective and min actual tooth
 A: Min and max effective with max actual space, min and min effective with min actual tooth
 B: Min and max effective space, min and max effective tooth (no actual dimension information)

Plot Data
 Mark Fillet/Involute/Chamfer intersections
 Number of teeth: 1

Report 4**Model Title : Program 60-710****Unit System: US****COMMON**

Number of Teeth	11
Diametral Pitch	2.500000 1/in `
Stub Pitch	5.0000 1/in `
Spline Pitch	2.5/5
Standard Pressure Angle	30.0000 deg
Type of Fit ('maj or 'side Def='side)	side
Pitch Diameter	4.4000000 in
Base Dia	3.8105118 in
Max_Effective Clearance	0.0022 in
Min_Effective Clearance	0.0000 in

COMMON: Theoretical from Measured Teeth

Max_Actual Clearance	0.0056 in
Min_Actual Clearance	0.0034 in
Radial Form Clearance (Standard)	0.0044 in

INTERNAL SPLINE

Internal Spline ANSI B92.1-1970 Std?	Yes
Fillet or Flat Root ('fil/'flt)	flt
Major Diameter - Min, rounded	NA in
Major Diameter - Max, rounded	4.9440 in
Form Diameter, rounded	4.8090 in

Model Title : Program 60-710

Unit System: US

Roll Angle at Form Diameter	44.112 deg
Minor Diameter - Min, rounded	4.0330 in
Minor Diameter - Max, rounded	4.0530 in
Tolerance Class	4
Machining Tolerance	0.0011 in
Variation Allowance	0.0017 in
Min_Effective_Space Width	0.6283 in
Specification Required or Reference	Required
Plug Gage - Composite or Sector	GO Cmp
Max_Effective_Space Width	0.6294 in
Specification Required or Reference	Reference
Plug Gage - Composite or Sector	None
Min_Actual_Space Width	0.6300 in
Specification Required or Reference	Reference
Plug Gage - Composite or Sector	None
Max_Actual_Space Width	0.6311 in
Specification Required or Reference	Required
Plug Gage - Composite or Sector	NO GO Sec

INTERNAL SPLINE: Size Between Pins

Pin Diameter	0.57600 in
Min_Between 2 Pins	3.7177 in
Max_Between 2 Pins	3.7197 in
Min_Diameter Under 3 Pins	3.7618 in
Max_Diameter Under 3 Pins	3.7638 in
Min_Pin Contact Diameter	4.6407 in

Model Title : Program 60-710**Unit System: US**Max_Pin Contact Diameter **4.6431 in****INTERNAL SPLINE: Analytical Inspection**Total Index Variation **0.0014 in**Profile Variation **0.0005 in**ProNI **-0.0007 in**Spline_Length **in**Lead Variation **in****EXTERNAL SPLINE**External Spline ANSI B92.1-1970 Std? **Yes**Fillet or Flat Root ('fil'/ft) *flt*Major Diameter - Max **4.8000 in**Major Diameter - Min **4.6950 in**Major_Diameter Chamfer - Max **_ in**Major_Diameter Chamfer - Min **_ in**Form Diameter **4.0240 in**Roll Angle at Form Diameter **19.446 deg**Minor Diameter - Min **3.8420 in**Tolerance Class **4**Machining Tolerance **0.0011 in**Variation Allowance **0.0017 in**Max_Eff_Tooth Thickness **0.6283 in**Specification Required or Reference **Required**Ring Gage - Composite or Sector **GO Cmp**Min_Eff_Tooth Thickness **0.6272 in**Specification Required or Reference **Reference**

Model Title : Program 60-710

Unit System: US

Ring Gage - Composite or Sector	None
Max_Actual_Tooth Thickness	0.6266 in
Specification Required or Reference	Reference
Ring Gage - Composite or Sector	None
Min_Actual_Tooth Thickness	0.6255 in
Specification Required or Reference	Required
Ring Gage - Composite or Sector	NO GO Sec

EXTERNAL SPLINE: Size Over Pins

Pin Diameter	0.76800 in
Max_Over 2 Pins	5.5177 in
Min_Over 2 Pins	5.5161 in
Max_Pin Contact Diameter	4.3745 in
Min_Pin Contact Diameter	4.3732 in

EXTERNAL SPLINE: Analytical Inspection

Total Index Variation	0.0014 in
Profile Variation	0.0005 in
ProNX	-0.0007 in
Spline_Length	in
Lead Variation	in

PLOTS DATA

Mark mod/inv/fil intersections?	y
Number of teeth on plot	1

GAGES

Dimensioning Method (Def='std, 'A, 'B)	std
--	------------

Model Title : Program 60-710**Unit System: US****INTERNAL SPLINE GAGES: GO Composite Plug Gage: Front Section**Major Diameter **4.8095 in**ODxfGOi **4.8090 in****INTERNAL SPLINE GAGES: GO Composite Plug Gage: Rear Section**Major Diameter - New **_ in**ODxrGOi **_ in**Major Diameter - Wear Limit **_ in****INTERNAL SPLINE GAGES: GO Composite Plug Gage: Chamfer**Diameter to Chamfer, max **_ in**Chamfer Cutting Angle fr CL Space **_ deg**Form Diameter **4.0242 in**Minor Diameter, Max **4.0230 in**Tooth Thickness, New (REF) **Consult in**Tooth Thickness, Wear Limit (REF) **0.6283 in**Pin Diameter **0.7680 in**Max Size Over Pins - New **_ in**Min Size Over Pins - New **_ in**Size Over Pins - Wear Limit **5.52009 in****INTERNAL SPLINE GAGES: NOT GO Sector Plug Gage**Major Diameter **4.6737 in**ODxSi **4.6717 in**Form Diameter **4.0242 in**Minor Diameter, Max **4.0242 in**Tooth Thickness, New (REF) **0.6311 in**

Model Title : Program 60-710

Unit System: US

Pin Diameter	0.7680	in
Max Size Over Pins - New	5.52403	in
Min Size Over Pins - New	_	in
Number of Teeth in Sector	2	

EXTERNAL SPLINE GAGES: GO Composite Ring Gage

Bushing Bore, Max	_	in
Bushing Bore, Min	_	in
Minor Diameter, Max	4.0240	in
Minor Diameter, Min	4.0235	in
Form Diameter	4.8088	in
Major Diameter, Min	4.8088	in
Space Width, New (REF)	Consult	in
Space Width, Wear Limit (REF)	0.6283	in
Pin Diameter	0.6912	in
Min Size Between Pins - New	_	in
Max Size Between Pins - New	_	in
Size Between Pins - Wear Limit	3.32533	in

EXTERNAL SPLINE GAGES: NOT GO Sector Ring Gage

Minor Diameter, Max	4.1503	in
Minor Diameter, Min	4.1483	in
Form Diameter	4.8000	in
Major Diameter, Min	4.8000	in
Space Width	0.6255	in
Pin Diameter	0.6912	in

Model Title : Program 60-710**Unit System: US**Min Size Between Pins **3.31830 in**Max Size Between Pins **— in**Number of Teeth in Sector **2****EXTERNAL SPLINE GAGES: GO Composite Ring Gage: Tapered External Master**Major Diameter **4.6950 in**ODGORMi **4.6945 in**Form Diameter **4.0140 in**Minor Diameter, Max **4.0140 in****EXTERNAL SPLINE GAGES: GO Composite Ring Gage: Tooth Thickness**End of Lead Length, XX **Consult in**End of Fit Range, YY **Consult in**End of Wear Range, ZZ **0.6283 in**Pin Diameter **0.7680 in**Size Over Pins at XX **— in**Size Over Pins at YY **— in**Size Over Pins at ZZ **5.52009 in****EXTERNAL SPLINE GAGES: NOT GO Sector Ring Gage: Tapered External Master**Major Diameter **4.6950 in**ODSERMi **4.6945 in**Form Diameter **4.1393 in**Minor Diameter, Max **4.0190 in****EXTERNAL SPLINE GAGES: NOT GO Sector Ring Gage: Tooth Thickness**End of Lead Length, XX **0.6255 in**End of Fit Range, YY **Consult in**

Model Title : Program 60-710

Unit System: US

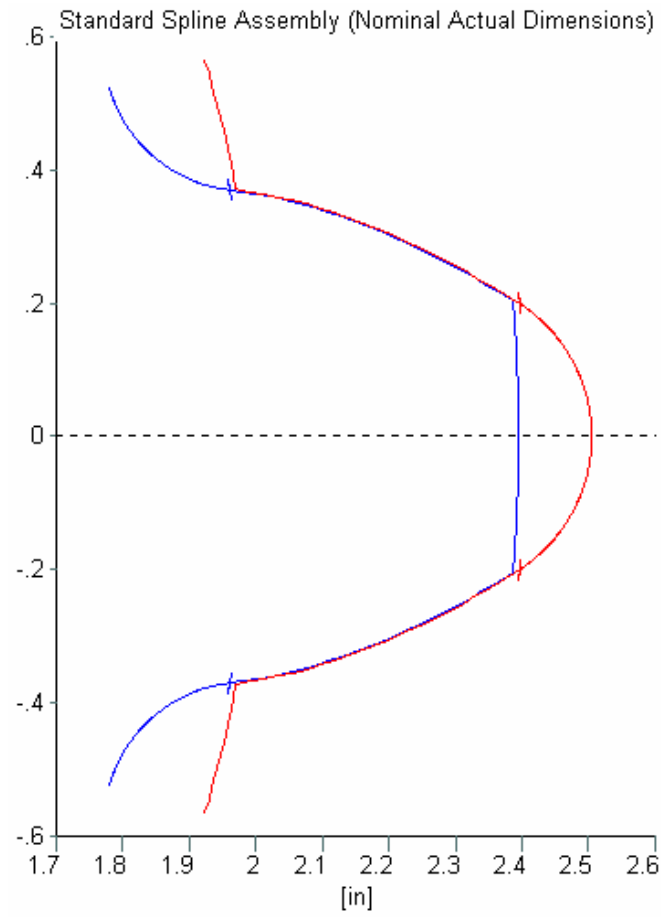
Pin Diameter 0.7680 in

Size Over Pins at XX 5.51614 in

Size Over Pins at YY _ in

A plot of the teeth in assembly is available on the Plot Sheet of the TK Solver model.
(See Figure 4-2.)

Fig. 4-2



Example 5

This is a 22 tooth, 10/20 diametral pitch, side fit, fillet root spline. A Class 5 tolerance is desired on both the internal and external splines. (Different tolerance classes can be used on each spline if desired.) The spline length is 0.75 inch, which we enter in order to obtain analytical checking data for the tooth alignment. We also wish to use the “Standard” gaging method. We will print all data needed to manufacture the gages except tapered external masters.

The standard will furnish data for a spline that has a minimum effective clearance of zero. We need a minimum effective clearance of 0.006 inch and will modify the external spline to achieve this clearance. The external spline will no longer be a standard spline.

Enter the data shown in Figure 5-1. This will give us the standard spline, which we will then modify. Report 5-1 gives the input and output values for this model. Note that the minimum effective clearance is zero.

Fig. 5-1

The screenshot shows the 'Integrated Gear Software (60-710)' dialog box with the following settings:

- Common Data:** Number of teeth: 22; Diametral pitch: 10.000000 1/in
- Standard Pressure Angle:** 30 degrees (selected), 37.5 degrees, 45 degrees
- Type Of Fit:** Side fit (selected), Major diameter fit
- Spline:**
 - Internal: Root type: Fillet; Tolerance class: 5; Spline length for allowable lead variation: 0.75 in
 - External: Root type: Fillet; Tolerance class: 5; Spline length for allowable lead variation: 0.75 in
- Dimensioning Method For Gages To Check:** STD: Min effective and max actual space, max effective and min actual tooth (selected); A: Min and max effective with max actual space, min and min effective with min actual tooth; B: Min and max effective space, min and max effective tooth (no actual dimension information)
- Plot Data:** Mark Fillet/Involute/Chamfer intersections (checked); Number of teeth: 1

Report 5-1



Model Title : Program 60-710

Unit System: US

COMMON

Number of Teeth	22
Diametral Pitch	10.000000 1/in `
Stub Pitch	20.0000 1/in `
Spline Pitch	10/20
Standard Pressure Angle	30.0000 deg
Type of Fit ('maj or 'side Def='side)	side
Pitch Diameter	2.2000000 in
Base Dia	1.9052559 in
Max_Effective Clearance	0.0026 in
Min_Effective Clearance	0.0000 in

COMMON: Theoretical from Measured Teeth

Max_Actual Clearance	0.0062 in
Min_Actual Clearance	0.0036 in
Radial Form Clearance (Standard)	0.0022 in

INTERNAL SPLINE

Internal Spline ANSI B92.1-1970 Std?	Yes
Fillet or Flat Root ('fil/'flt)	fil
Major Diameter - Min, rounded	NA in
Major Diameter - Max, rounded	2.4010 in
Form Diameter, rounded	2.3040 in

Model Title : Program 60-710**Unit System: US**

Roll Angle at Form Diameter	38.960	deg
Minor Diameter - Min, rounded	2.1000	in
Minor Diameter - Max, rounded	2.1050	in
Tolerance Class	5	
Machining Tolerance	0.0013	in
Variation Allowance	0.0018	in
Min_Effective_Space Width	0.1571	in
Specification Required or Reference	Required	
Plug Gage - Composite or Sector	GO Cmp	
Max_Effective_Space Width	0.1584	in
Specification Required or Reference	Reference	
Plug Gage - Composite or Sector	None	
Min_Actual_Space Width	0.1589	in
Specification Required or Reference	Reference	
Plug Gage - Composite or Sector	None	
Max_Actual_Space Width	0.1602	in
Specification Required or Reference	Required	
Plug Gage - Composite or Sector	NO GO Sec	

INTERNAL SPLINE: Size Between Pins

Pin Diameter	0.14400	in
Min_Between 2 Pins	2.0431	in
Max_Between 2 Pins	2.0454	in
Min_Diameter Under 3 Pins	2.0431	in
Max_Diameter Under 3 Pins	2.0454	in
Min_Pin Contact Diameter	2.2613	in

Model Title : Program 60-710

Unit System: US

Max_Pin Contact Diameter **2.2638 in**

INTERNAL SPLINE: Analytical Inspection

Total Index Variation **0.0017 in**

Profile Variation **0.0004 in**

ProNI **-0.0006 in**

Spline_Length *0.75 in*

Lead Variation **0.0004 in**

EXTERNAL SPLINE

External Spline ANSI B92.1-1970 Std? **Yes**

Fillet or Flat Root ('fil'/ft) *fil*

Major Diameter - Max **2.3000 in**

Major Diameter - Min **2.2950 in**

Major_Diameter Chamfer - Max **_ in**

Major_Diameter Chamfer - Min **_ in**

Form Diameter **2.0960 in**

Roll Angle at Form Diameter **26.272 deg**

Minor Diameter - Min **1.9990 in**

Tolerance Class **5**

Machining Tolerance **0.0013 in**

Variation Allowance **0.0018 in**

Max_Eff_Tooth Thickness **0.1571 in**

Specification Required or Reference **Required**

Ring Gage - Composite or Sector **GO Cmp**

Min_Eff_Tooth Thickness **0.1558 in**

Specification Required or Reference **Reference**

Model Title : Program 60-710**Unit System: US**

Ring Gage - Composite or Sector	None
Max_Actual_Tooth Thickness	0.1553 in
Specification Required or Reference	Reference
Ring Gage - Composite or Sector	None
Min_Actual_Tooth Thickness	0.1540 in
Specification Required or Reference	Required
Ring Gage - Composite or Sector	NO GO Sec

EXTERNAL SPLINE: Size Over Pins

Pin Diameter	0.19200 in
Max_Over 2 Pins	2.4943 in
Min_Over 2 Pins	2.4923 in
Max_Pin Contact Diameter	2.2003 in
Min_Pin Contact Diameter	2.1985 in

EXTERNAL SPLINE: Analytical Inspection

Total Index Variation	0.0017 in
Profile Variation	0.0004 in
ProNX	-0.0006 in
Spline_Length	<i>0.75 in</i>
Lead Variation	0.0004 in

PLOTS DATA

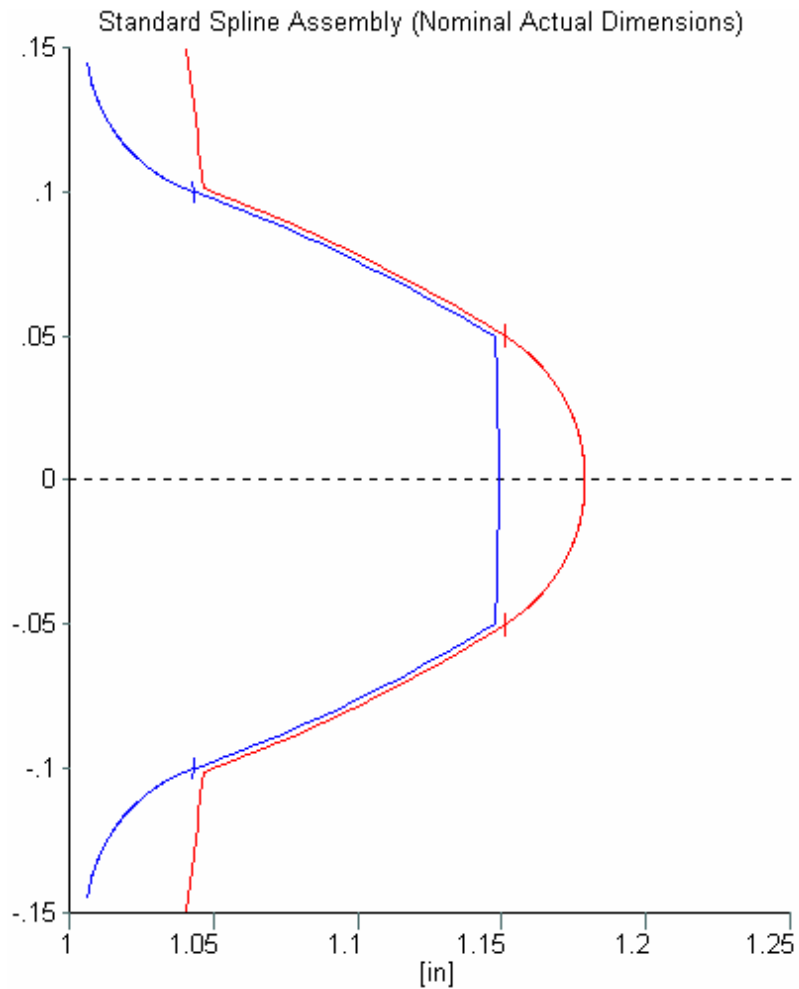
Mark mod/inv/fil intersections?	<i>y</i>
Number of teeth on plot	<i>1</i>

GAGES

Dimensioning Method (Def='std, 'A, 'B)	<i>std</i>
--	------------

Figure 5-2 is a plot of the teeth in assembly for the standard spline.

Fig. 5-2



To increase the effective clearance by 0.006 inch we will reduce the tooth thickness of the external spline by 0.006 inch and leave the internal spline standard. If a “standard” tool is used to cut the external, then the OD, form diameter and root diameter may have to be reduced also. We will assume that this is true.

60-710—Involute Splines and Inspection

To make these changes we will toggle to TK Solver and open the Variable Sheet. Enter the new data in the input column on the Variable Sheet and solve the model. After solving you should have Sheet 5.

Sheet 5

Sta	Input	Name	Output	Unit	Comment
					60-710 Ver 6.01 ANSI B92.1-1970 Involute Splines and Inspection
					COMMON:
22	N				Number of Teeth
10	P		20	1/in	*Diametral Pitch
	Ps			1/in	*Stub Pitch
	P%Ps		10/20		*Spline Pitch
30	phiD			deg	*Standard Pressure Angle
'side	typeF				*Type of Fit ('maj or 'side Def='side)
	D		2.2	in	*Pitch Diameter
	Db		1.9052559	in	*Base Dia
	cvx		.0086	in	*Max_Effective Clearance
	cvi		.0060	in	*Min_Effective Clearance
					Theoretical from Measured Teeth:
	cx		.0122	in	*Max_Actual Clearance
	ci		.0096	in	*Min_Actual Clearance
	cF		.0022	in	*Radial Form Clearance (Standard)
					*INTERNAL SPLINE:
'fil	StdI	Yes			*Internal Spline ANSI B92.1-1970 Std?
	rootI				*Fillet or Flat Root ('fil/'flt)
	Drii	NA		in	*Major Diameter - Min
	Drix	2.4010		in	*Major Diameter - Max
	DFi	2.3040		in	*Form Diameter
	EDFi	38.960		deg	Roll Angle at Form Diameter
	Dii	2.0900		in	*Minor Diameter - Min
	Dix	2.0950		in	*Minor Diameter - Max
5	classI				*Tolerance Class
	mI	.0013		in	*Machining Tolerance
	lamI	.0018		in	*Variation Allowance
	svi	.1571		in	*Min_Effective_Space Width
	DMSvi	Required			*Specification Required or Reference
	Gsvi	GO Cmp			*Plug Gage - Composite or Sector
	svx	.1584		in	*Max_Effective_Space Width
	DMSvx	Reference			*Specification Required or Reference
	Gsvx	None			*Plug Gage - Composite or Sector
	si	.1589		in	*Min_Actual_Space Width
	DMSi	Reference			*Specification Required or Reference
	Gsi	None			*Plug Gage - Composite or Sector
	sx	.1602		in	*Max_Actual_Space Width
	DMSx	Required			*Specification Required or Reference
	Gsx	NO GO Sec			*Plug Gage - Composite or Sector
					Size Between Pins:
	di	.14400		in	*Pin Diameter
	Mi2i	2.0431		in	*Min_Between 2 Pins
	Mi2x	2.0454		in	*Max_Between 2 Pins
	Mi3i	2.0431		in	*Min_Diameter Under 3 Pins
	Mi3x	2.0454		in	*Max_Diameter Under 3 Pins
	Dcii	2.2613		in	*Min_Pin Contact Diameter
	Dcix	2.2638		in	*Max_Pin Contact Diameter

UTS Integrated Gear Software

	IndexI	.0017	in	Analytical Inspection:
	ProPI	+.0004	in	*Total Index Variation
	ProNI	-.0006	in	*Profile Variation
.75	LgI		in	*Spline_Length
	LeadI	.0004	in	*Lead Variation
	StdX	No		*EXTERNAL SPLINE:
'fil	rootX			*External Spline ANSI B92.1-1970 Std?
2.2900	Dox		in	*Fillet or Flat Root ('fil/'flt)
2.2850	Doi		in	*Major Diameter - Max
	chxx	-	in	*Major Diameter - Min
	chxi	-	in	*Major_Diameter Chamfer - Max
2.0860	DFe		in	*Major_Diameter Chamfer - Min
	EDFe	25.542	deg	*Form Diameter
1.9890	Dre		in	Roll Angle at Form Diameter
5	classX			*Minor Diameter - Min
	mX	.0013	in	*Tolerance Class
	lamX	.0018	in	*Machining Tolerance
.1511	tvx		in	*Variation Allowance
	DMtvx	Required		*Max_Eff_Tooth Thickness
	Gtvx	GO Cmp		*Specification Required or Reference
	tvi	.1498	in	*Ring Gage - Composite or Sector
	DMtvi	Reference		*Min_Eff_Tooth Thickness
	Gtvi	None		*Specification Required or Reference
	tx	.1493	in	*Ring Gage - Composite or Sector
	DMtx	Reference		*Max_Actual_Tooth Thickness
	Gtx	None		*Specification Required or Reference
	ti	.1480	in	*Ring Gage - Composite or Sector
	DMti	Required		*Min_Actual_Tooth Thickness
	Gti	NO GO Sec		*Specification Required or Reference
				*Ring Gage - Composite or Sector
	de	.19200	in	Size Over Pins:
	Mex	2.4850	in	*Pin Diameter
	Mei	2.4830	in	*Max_Over 2 Pins
	Dcex	2.1920	in	*Min_Over 2 Pins
	Dcei	2.1902	in	*Max_Pin Contact Diameter
				*Min_Pin Contact Diameter
	IndexX	.0017	in	Analytical Inspection:
	ProPX	+.0004	in	*Total Index Variation
	ProNX	-.0006	in	*Profile Variation
.75	LgX		in	*Spline_Length
	LeadX	.0004	in	*Lead Variation
				Plot Data:
'y	mark			*Mark mod/inv/fil intersections?
1	teeth			*Number of teeth on plot
				GAGES:
'std	DMeth			Dimensioning Method (Def='std, 'A, 'B)

Note that the minimum effective clearance is now 0.006 inch. Report 5-2 is a report generated by the Integrated Gear Software report generator with this data. Note that the external spline gage dimensions have been modified to reflect the change in external spline specifications.

Report 5-2**Model Title : Program 60-710****Unit System: US****COMMON**

Number of Teeth	22
Diametral Pitch	10.000000 1/in `
Stub Pitch	20.0000 1/in `
Spline Pitch	10/20
Standard Pressure Angle	30.0000 deg
Type of Fit ('maj or 'side Def='side)	side
Pitch Diameter	2.2000000 in
Base Dia	1.9052559 in
Max_Effective Clearance	0.0086 in
Min_Effective Clearance	0.0060 in

COMMON: Theoretical from Measured Teeth

Max_Actual Clearance	0.0122 in
Min_Actual Clearance	0.0096 in
Radial Form Clearance (Standard)	0.0022 in

Model Title : Program 60-710

Unit System: US

INTERNAL SPLINE

Internal Spline ANSI B92.1-1970 Std?	Yes
Fillet or Flat Root ('fil'/flt)	<i>fil</i>
Major Diameter - Min, rounded	NA in
Major Diameter - Max, rounded	2.4010 in
Form Diameter, rounded	2.3040 in
Roll Angle at Form Diameter	38.960 deg
Minor Diameter - Min, rounded	2.0900 in
Minor Diameter - Max, rounded	2.0950 in
Tolerance Class	5
Machining Tolerance	0.0013 in
Variation Allowance	0.0018 in
Min_Effective_Space Width	0.1571 in
Specification Required or Reference	Required
Plug Gage - Composite or Sector	GO Cmp
Max_Effective_Space Width	0.1584 in
Specification Required or Reference	Reference
Plug Gage - Composite or Sector	None
Min_Actual_Space Width	0.1589 in
Specification Required or Reference	Reference
Plug Gage - Composite or Sector	None
Max_Actual_Space Width	0.1602 in
Specification Required or Reference	Required
Plug Gage - Composite or Sector	NO GO Sec

Model Title : Program 60-710

Unit System: US

INTERNAL SPLINE: Size Between Pins

Pin Diameter	0.14400	in
Min_Between 2 Pins	2.0431	in
Max_Between 2 Pins	2.0454	in
Min_Diameter Under 3 Pins	2.0431	in
Max_Diameter Under 3 Pins	2.0454	in
Min_Pin Contact Diameter	2.2613	in
Max_Pin Contact Diameter	2.2638	in

INTERNAL SPLINE: Analytical Inspection

Total Index Variation	0.0017	in
Profile Variation	0.0004	in
ProNI	-0.0006	in
Spline_Length	<i>0.75</i>	<i>in</i>
Lead Variation	0.0004	in

EXTERNAL SPLINE

External Spline ANSI B92.1-1970 Std?	No	
Fillet or Flat Root ('fil'/flt)	<i>fil</i>	
Major Diameter - Max	<i>2.2900</i>	<i>in</i>
Major Diameter - Min	<i>2.2850</i>	<i>in</i>
Major_Diameter Chamfer - Max	<i>_</i>	in
Major_Diameter Chamfer - Min	<i>_</i>	in
Form Diameter	<i>2.0860</i>	<i>in</i>
Roll Angle at Form Diameter	25.542	deg
Minor Diameter - Min	<i>1.9890</i>	<i>in</i>

Model Title : Program 60-710

Unit System: US

Tolerance Class	5
Machining Tolerance	0.0013 in
Variation Allowance	0.0018 in
Max_Eff_Tooth Thickness	<i>0.1511 in</i>
Specification Required or Reference	Required
Ring Gage - Composite or Sector	GO Cmp
Min_Eff_Tooth Thickness	0.1498 in
Specification Required or Reference	Reference
Ring Gage - Composite or Sector	None
Max_Actual_Tooth Thickness	0.1493 in
Specification Required or Reference	Reference
Ring Gage - Composite or Sector	None
Min_Actual_Tooth Thickness	0.1480 in
Specification Required or Reference	Required
Ring Gage - Composite or Sector	NO GO Sec

EXTERNAL SPLINE: Size Over Pins

Pin Diameter	0.19200 in
Max_Over 2 Pins	2.4850 in
Min_Over 2 Pins	2.4830 in
Max_Pin Contact Diameter	2.1920 in
Min_Pin Contact Diameter	2.1902 in

EXTERNAL SPLINE: Analytical Inspection

Total Index Variation	0.0017 in
Profile Variation	0.0004 in
ProNX	-0.0006 in

Model Title : Program 60-710

Unit System: US

Size Over Pins - Wear Limit **2.49707 in**

INTERNAL SPLINE GAGES: NOT GO Sector Plug Gage

Major Diameter **2.2703 in**

ODxSi **2.2683 in**

Form Diameter **2.0856 in**

Minor Diameter, Max **2.0856 in**

Tooth Thickness, New (REF) **0.1602 in**

Pin Diameter **0.1920 in**

Max Size Over Pins - New **2.50183 in**

Min Size Over Pins - New **2.50168 in**

Number of Teeth in Sector **2**

EXTERNAL SPLINE GAGES: GO Composite Ring Gage

Bushing Bore, Max **_ in**

Bushing Bore, Min **_ in**

Minor Diameter, Max **2.0860 in**

Minor Diameter, Min **2.0855 in**

Form Diameter **2.2944 in**

Major Diameter, Min **2.2944 in**

Space Width, New (REF) **0.1508 in**

Space Width, Wear Limit (REF) **0.1511 in**

Pin Diameter **0.1728 in**

Min Size Between Pins - New **1.93648 in**

Max Size Between Pins - New **1.93668 in**

Size Between Pins - Wear Limit **1.93729 in**

Model Title : Program 60-710**Unit System: US****EXTERNAL SPLINE GAGES: NOT GO Sector Ring Gage**

Minor Diameter, Max	2.1250	in
Minor Diameter, Min	2.1230	in
Form Diameter	2.2900	in
Major Diameter, Min	2.2900	in
Space Width	0.1480	in
Pin Diameter	0.1728	in
Min Size Between Pins	1.93100	in
Max Size Between Pins	1.93120	in
Number of Teeth in Sector	2	

EXTERNAL SPLINE GAGES: GO Composite Ring Gage: Tapered External Master

Major Diameter	2.2850	in
ODGORMi	2.2845	in
Form Diameter	2.0760	in
Minor Diameter, Max	2.0760	in

EXTERNAL SPLINE GAGES: GO Composite Ring Gage: Tooth Thickness

End of Lead Length, XX	0.1507	in
End of Fit Range, YY	0.1508	in
End of Wear Range, ZZ	0.1511	in
Pin Diameter	0.1920	in
Size Over Pins at XX	2.48718	in
Size Over Pins at YY	2.48733	in
Size Over Pins at ZZ	2.48780	in

Model Title : Program 60-710

Unit System: US

EXTERNAL SPLINE GAGES: NOT GO Sector Ring Gage: Tapered External Master

Major Diameter	2.2850 in
ODSERMi	2.2845 in
Form Diameter	2.1140 in
Minor Diameter, Max	2.0890 in

EXTERNAL SPLINE GAGES: NOT GO Sector Ring Gage: Tooth Thickness

End of Lead Length, XX	0.1480 in
End of Fit Range, YY	0.1481 in
Pin Diameter	0.1920 in
Size Over Pins at XX	2.48298 in
Size Over Pins at YY	2.48313 in

Figure 5-3 is a plot of the teeth in assembly for the modified spline.

Fig. 5-3

60-710—Involute Splines and Inspection

