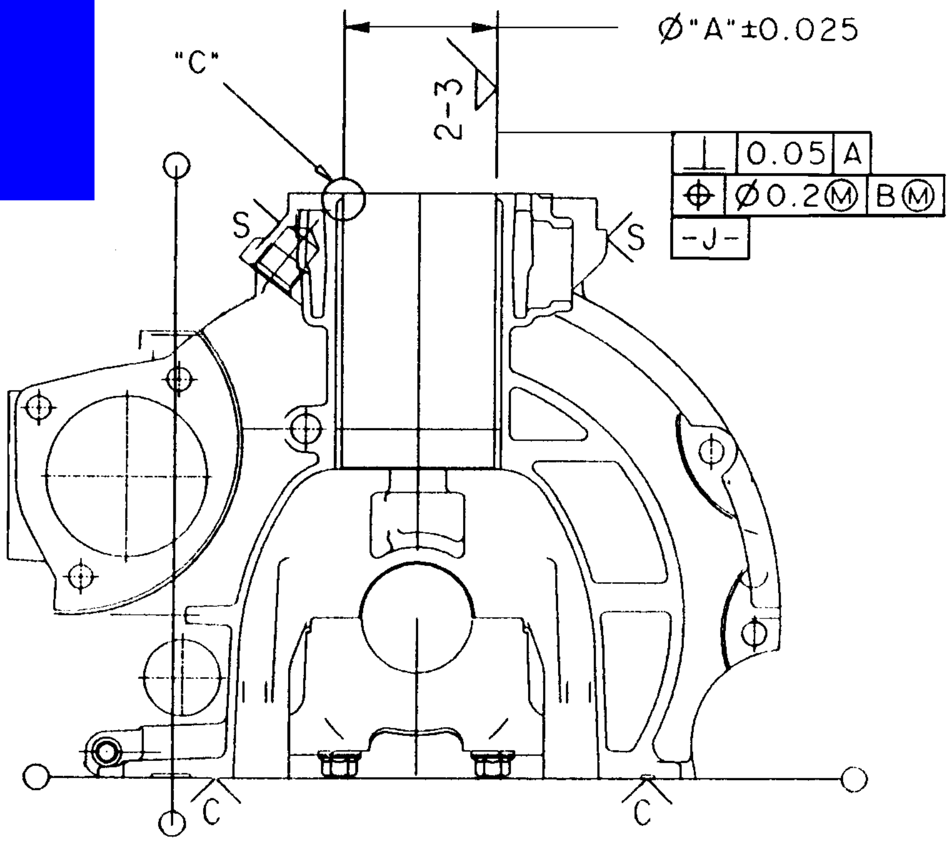
UMESS

Universal Measuring Software for UNIX and LINUX



Operating Instructions

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Preface

These operating instructions are based on the assumption that you are already familiar with the operation of the corresponding coordinate measuring machine and its components. Please always keep all of the documents included in delivery within easy reach.

About these operating instructions

Before beginning work with these operating instructions, please familiarize yourself with the conventions they employ first.

The following text will provide you with information on the fonts, characters and symbols used in this manual and the topics it covers.

Typographical conventions

The following typographical conventions apply to this manual:

- **bold**
  - A dialog element displayed on the screen
    Example: "... the **<TERMIN>** button"
  - A term
    Example: "during the calculation the spatial position of a **measured element** is determined in relation to a **reference element** ."
- *italics*
  - A highlighted text containing information of special importance
    Example: "Click with the *right* mouse button ..."
  - Cross reference
    Example: "..., see also ➤*„Reading in the W-position <DI 1712>“ auf Seite 16-10“*
- `Courier`
  Text in dialog windows and records

Characters and symbols

Special characters and symbols are used in this manual.

Danger!
Special caution is required in this case. The warning triangle on the left indicates a danger of injury. If you do not observe this warning you may possibly be injured.

Important!
This symbol is used to warn the reader of situations involving a possible data loss, measuring errors, faults during a measuring run, collisions, or damage to the CMM and/or the workpiece.

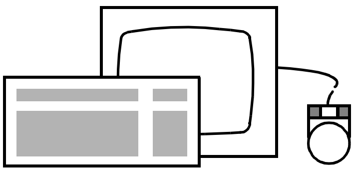
The **NOTE** symbol is placed next to important text passages and helpful additional information.

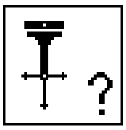
Required input

Several possibilities exist:

- Direct selection via a DI number
- Function selection via the pull-down menu
- Selection via a pictograph display

Example:



DI	Pull-down menu	Pictograph
1551 PRBMOD	CMM mode Probe head...	

TERMIN

Softkey symbol

References to softkeys are displayed in dialogs as shown on the left.

Chapter overview

These operating instructions describe the function and handling of UMESS LX Universal Measuring Software. The following topics are covered:

Direct input functions

DI Number	Abbrev.	Function	Page
I		Restore/minimize input window	➤ *Seite 3-2*
-17		Activate graphic user interface	➤ *Seite 3-41*
-18		Deactivate graphic user interface	➤ *Seite 3-41*
-34	REC ON	Deactivate result output on control panel	➤ *Seite 5-19*
-35	RECOFF	Activate result output on control panel	➤ *Seite 5-19*
1003	END	End of operation	➤ *Seite 2-20*
1013	TWCPASSIV	CNC start from another computer	Opt. LX 11
1032	CORRECT	Delete last control data line in PROG	➤ *Seite 16-17*
1040	FOCDIALDEF	FOCUS: Programming dialog	Opt. LX 17
1041		FOCUS: Change safety (clearance) plane	Opt. LX 17
1042	FOCBRBEG	FOCUS: Group start	Opt. LX 17
1043	FOCBREND	FOCUS: Group end	Opt. LX 17
1050	JUMPS	Conditional branching and jumps	➤ *Seite 16-44*
1051	LOOPS	Loops	➤ *Seite 16-17*
1055	FOCBRBEG	FOCUS: Mark alignment block (start)	Opt. LX 17
1056	FOCBREND	FOCUS: Mark alignment block (end)	Opt. LX 17
1057	FOCCLEARAN	FOCUS: Mark clearance area	Opt. LX 17
1058	FOCDETOUR	FOCUS: Mark connecting points	Opt. LX 17
1059		FOCUS: Dialog	Opt. LX 17
1060	FOCCLEARAN	FOCUS: Define clearance area	Opt. LX 17
1065		FOCUS: Element start	Opt. LX 17
1066		FOCUS: Element end	Opt. LX 17
1070	STEP	CNC debugger	➤ *Seite 18-17*
1077	MANCNC	Computer controlled manually measured sections	➤ *Seite 16-25*
1079	EXCALL	Transfer macro to learn program	➤ *Seite 16-28*
1080	BOREMISS	Continuation with missing bore	➤ *Seite 16-32*
1081	HOLE	Bore element for safety mode	➤ *Seite 16-34*
1096	PRG STOP	Programmable stop	➤ *Seite 16-21*
1100	FILE	Collect points in file	➤ *Seite 10-21*
1101	POINT	POINT	➤ *Seite 11-6*
1102	LINE	LINE	➤ *Seite 11-22*
1103	SURF	SURFACE	➤ *Seite 11-27*

DI Number	Abbrev.	Function	Page
1104	**CIRC**	CIRCLE	➤ *Seite 11-9*
1105	**SPHERE**	SPHERE	➤ *Seite 11-49*
1106	**CYLIN**	CYLINDER	➤ *Seite 11-36*
1107	**CONE**	CONE	➤ *Seite 11-41*
1108	**ELLIP**	ELLIPSE	➤ *Seite 11-19*
1109	**TORUS**	TORUS	➤ *Seite 11-46*
1110	**MINPLA**	Min flatness	➤ *Seite 14-60*
1111	**MAXPLA**	Max flatness	➤ *Seite 14-60*
1112	**MINROUN**	Min roundness	➤ *Seite 14-62*
1113	**MAXROUN**	Max roundness	➤ *Seite 14-62*
1114	**CIRCSEG**	Circle segment and radius measurement	➤ *Seite 11-53*
1120	**SPCPT**	Space point	Opt. LX 6
1121	**SPCPTMOD**	Space point mode	Opt. LX 6
1132		Call interactive contour graphics	Opt. LX 20
1133		Quit interactive contour graphics	Opt. LX 20
1135		Save points to VDA file	Opt. LX 21
1136		Graphic form tester	Opt. LX 21
1139		Plot a VDA file from **<DI 1135>**	Opt. LX 21
1140	**EXTPLA**	Min-max flatness	➤ *Seite 14-60*
1141	**EXTROUN**	Min-max roundness	➤ *Seite 14-62*
1144		Cone angle correction	➤ *Seite 13-15*
1154	**3DCIRC**	Space circle	➤ *Seite 11-58*
1159	**BOREPATT**	2D bore pattern best fit	Opt. LX 2
1164	**3DBEFIT**	3D point best fit	Opt. LX 3
1166		Data transfer in VDA format	➤ *Seite 10-26*
1168		Best fit of circle in curve	Opt. LX 3
1169		Flatness macro	➤ *Seite 11-63*
1173	**PAREPT**	Parabola edge point	Opt. LX 6
1174		4-point circle	➤ *Seite 11-17*
1176		Overlapping mode for scanning	➤ *Seite 19-37*
1178		Determine probing direc. f. single pnt. in CNC run	➤ *Seite 18-21*
1179		Specify inner/outer code	➤ *Seite 11-5*
1180	**MCC MIC**	MCC/MIC fit	Opt. LX 3
1181	**OUTLIER**	Consideration of outliers on/off	➤ *Seite 14-66*

DI Number	Abbrev.	Function	Page
1184	PBCDEF	Determine bend parameters for unclamped scan-ning	➤ Seite 7-46
1185	FILTER	Filter mode	➤ Seite 14-69
1186	PBC	Measurement with compensation of probe bend	➤ Seite 7-47
1187	CORRPRB	Probing correction	➤ Seite 10-13
1188	INTRES	Switch on display of interm. results; switch on Auto_Termin, Auto_Nominal and warning limit	➤ Seite 10-8 ➤ Seite 10-10
1189		Find kink points	➤ Seite 10-27
1190		Macro definition, standard geometric forms	➤ Seite 10-27
1202	DIST	Distance in cartesian coordinates	➤ Seite 12-20
1203	DISPOL2D	Polar distance in the plane	➤ Seite 13-7
1204	ANG	Calculation of rotation and tilt angle	➤ Seite 13-2
1206	SYMM	Symmetry elements	➤ Seite 12-22
1215	SECT3D	Intersection point of axes in space	➤ Seite 12-7
1216	CORNPT	Corner point	Opt. LX 6
1217	ROTPT	Penetration point	➤ Seite 13-11
1218	SECTPLA	Plane intersections	➤ Seite 12-2
1219	SECTMAN	Surface sections	➤ Seite 12-9
1220	CONTPT	Edge point	Opt. LX 6
1243	ADDCONE	Additional cone program	➤ Seite 13-13
1251	CONVANG	Change reference axis and direction of rotation	➤ Seite 13-5
1261	DISTPOL3D	Space diagonal	➤ Seite 13-9
1262	XYZ	Supplementary coordinates	➤ Seite 10-47
1265		Generate plane by linking	➤ Seite 12-42
1266		Generate point by projecting from point to line	➤ Seite 12-45
1267		Generate line by projecting in plane	➤ Seite 12-50
1271		Link coordinates and direction	➤ Seite 12-19
1272		Perpendicular/Perpendicular distance	➤ Seite 12-19
1285	PERPCYL	Perpendicular cylinder	➤ Seite 12-15
1286	PERDIS	Perpendicular distance	➤ Seite 12-17
1301	RECALL	Recall of a coordinate system Recall of an address	➤ Seite 9-37 ➤ Seite 10-29
1303		Write to intermediate file for duplex CMM	Duplex opt.
1304		Read from intermediate file for duplex CMM	Duplex opt.
1310	PITCH	Pitch measurements	➤ Seite 12-30

DI Number	Abbrev.	Function	Page
1311	CIRCPIT	Circular pitch	➤ *Seite 12-30*
1312	LINPIT	Linear pitch	➤ *Seite 12-30*
1341		Determine minimum from measuring results	➤ *Seite 12-40*
1343		Determine maximum from measuring results	➤ *Seite 12-40*
1345	MEANVAL	Mean value calculation	➤ *Seite 12-25*
1379	FORMULA	Formula calculation	➤ *Seite 12-27*
1401	GDTSTR	Straightness	➤ *Seite 14-19*
1402	GDTPLA	Flatness	➤ *Seite 14-21*
1403	GDTROUN	Roundness	➤ *Seite 14-26*
1404	GDTCYL	Cylindricity	➤ *Seite 14-28*
1407	GDTPOS	Position with MMC	➤ *Seite 14-45*
1408	GDTCON	Concentricity with MMC	➤ *Seite 14-55*
1409	GDTCOA	Coaxiality with MMC	➤ *Seite 14-57*
1410	GDTSYM	Symmetry	➤ *Seite 14-49*
1415	GDTPAR	Parallelism	➤ *Seite 14-31*
1425	GDTPERP	Perpendicularity with MMC	➤ *Seite 14-41*
1435	GDTANG	Angularity	➤ *Seite 14-38*
1445	GDTRUN	Runout	➤ *Seite 14-52*
1449	FORM	Form error	➤ *Seite 10-46*
1454	NAMODE	Nominal/actual mode	➤ *Seite 14-2*
1456		Reserve address	➤ *Seite 16-29*
1459	NOM	Nominal input (old 1452)	➤ *Seite 14-8*
1460	EXTREM	Extreme values	➤ *Seite 10-45*
1461		Fast plot (form plot with default values)	Opt. LX 2
1470	FPLOT	Request form plots	Opt.LX 2
1472	GDTFLAPART	Flatness with reference length	➤ *Seite 14-21*
1473	NAGRAPHI	Plotting results from nominal-actual comparisons	Opt. LX 1
1502	VECFORCE	Measuring probe head mode	➤ *Seite 6-18*
1506	JSTANG	Travel in the workpiece or control coordinate system	➤ *Seite 10-19*
1507		Coordinate display on the control panel	➤ *Seite 10-19*
1509	JSTXYZ	Joystick assignment	➤ *Seite 10-18*
1510		Intermediate position	➤ *Seite 16-31*
1511	POSITION	Position to workpiece coordinates	➤ *Seite 10-37*

DI Number	Abbrev.	Function	Page
1513	**POS-RES**	Position to result	➤ *Seite 10-38*
1514	**POSNORM**	Position to normal vector	➤ *Seite 10-40*
15141		Change probe number in ACE	Opt. MFT
1515	**STEP**	Step in WP system	➤ *Seite 10-41*
1516	**REF STEP**	Travel a fixed interval from a probing point	➤ *Seite 10-43*
1520	**RTZEROP**	Set rotary table position to zero	➤ *Seite 15-10*
1521	**RTPOS**	Rotate rotary table to angular position	➤ *Seite 15-4*
15211	**TEMCOM**	Temperature compensation by input	➤ *Seite 6-22*
15218		RDS: Display and selection of angular positions	Opt. RDS
15219		RDS: List of calibrated angular positions	Opt. RDS
1522	**RT STEP**	Rotate rotary table one angle step	➤ *Seite 15-7*
15228		Semiautomatic probe calibration (tensor calibration) for unclamped probe head	➤ *Seite 7-19*
1523	**RT PITCH**	Rotate rotary table by a pitch angle	➤ *Seite 15-8*
1524	**RT ANG**	Align rotary table parallel to machine coordinates	➤ *Seite 15-9*
15250		Large coordinate display	➤ *Seite 10-19*
1526	**DSEPOS**	DSE position	Opt. DSE
1527	**DSE STEP**	DSE step	Opt. DSE
1528	**DSE ANG**	DSE angle acc. to result	Opt. DSE
1530	**SCAN MOD**	Scanning mode	➤ *Seite 19-6*
1546		DSE: Sensor calibration	Opt. DSE
1547		DSE: End calibration	Opt. DSE
1548		DSE: Calibration mode	Opt. DSE
1551	**PRBMOD**	Probe head mode	➤ *Seite 10-16* ➤ *Seite 16-24*
1553	**PRBCHN**	Change probe cluster automatically	➤ *Seite 8-17*
1554	**RELPRB**	Remove probe manually	➤ *Seite 8-12*
1555	**PUPRB**	Pick up probe manually	➤ *Seite 8-15*
1556	**LISTSTR**	Storage (magazine) mode	➤ *Seite 6-29*
1557	**CALSTR**	Define probe storage positions (magazine)	➤ *Seite 6-32*
1558		List magazine positions	➤ *Seite 6-32*
1559		Activate/deactivate calibration interval	➤ *Seite 7-49*
1566	**RTLINK**	Rotate control coordinate system along with workpiece	➤ *Seite 15-19*

DI Number	Abbrev.	Function	Page
1567		Uncouple control coordinate system from work-piece	➤ *Seite 15-19*
1568	**RTCAL**	Store, read in, deactivate rotary table axis	➤ *Seite 15-14*
1570	**RERPT**	Reference point travel	➤ *Seite 6-2* ➤ *Seite 15-10*
1572	**OFFSET**	Linear offset correction	➤ *Seite 6-4*
1574		Adapt probing behavior for small probes	➤ *Seite 6-20*
1578		Read and execute machine commands from a file	Opt. LX 11
1590	**CMM INIT**	Initialize machine	➤ *Seite 6-37*
1601	**CHNGCOMB**	Change combination	➤ *Seite 8-11*
1602		DSE: Probe calibration	Opt. DSE
1604		Print the last 10 measurement records	➤ *Seite 5-43*
1605		DSE: Articulating probe holder	Opt. DSE
1608	**INITSTATUS**	Set the initial status	➤ *Seite 6-7*
1610	**RECORD**	Call standard record head and variable record head I	➤ *Seite 5-24*
1611	**VAR RECORD**	Call variable record head II	➤ *Seite 5-27*
1612	**MODREC**	Modification of variable record head I	➤ *Seite 5-22*
1613	**REPEAT**	Repeat record	➤ *Seite 5-40*
1614	**PRINT**	Record output to terminal and printer	➤ *Seite 5-12*
1615	**TERMINAL**	Record output to terminal only	➤ *Seite 5-12*
1617	**STATUS**	System information	➤ *Seite 6-36*
1618	**TIME**	Time function	➤ *Seite 5-38*
1624	**CONFLIS**	List probe data	➤ *Seite 8-6*
1625	**PDEVICES**	Set mode for graphic output devices	➤ *Seite 5-47*
1627	**PRBCORR**	Modify probe data	➤ *Seite 8-7*
1630	**CNCADM**	Control data administration Workpiece catalog administration	➤ *Seite 17-28* ➤ *Seite 17-5*
1631		Create a control data catalog	➤ *Seite 17-25*
1632	**P-END**	End learn (part) programming	➤ *Seite 16-85*
1634	**ENTDAT**	Enter workpiece in workpiece catalog	➤ *Seite 17-10*
1635	**DELETECNC**	Delete workpiece	➤ *Seite 17-12*
1639	**PROG**	Start learn (part) programming	➤ *Seite 16-13*
1640	**CNCRUN**	Start CNC run	➤ *Seite 18-3*
1641	**DATLIS**	List control data	➤ *Seite 17-28*

DI Number	Abbrev.	Function	Page
1642	DATCOR	Correct data	➤ Seite 17-31
1643	CNCLIN	Copy workpiece	➤ Seite 17-18
1644		Batch measurement	➤ Seite 18-8
1645	CNCMOD	Modify workpiece	➤ Seite 17-17
1646	PCMTEST	PCM test run	Opt. LX 9
1647	PCMGEN	PCM generation run	Opt. LX 9
1649		AUTOCNC start	Opt. LX 18
1650	LISCAT	List workpiece catalog to printer	➤ Seite 17-5
1651		Initialize graphics software	➤ Seite 5-48
1652		Output graphics (paper change)	➤ Seite 5-49
1661	CONMODE	Define control mode	➤ Seite 6-10
1662	OUTPMOD	Define the print format	➤ Seite 5-12
1663	NAMES	Switch name allocation on/off	➤ Seite 5-9
1664	WARNLI	Set a warning limit	➤ Seite 14-13
1665	REC DEF	Define scope of record	➤ Seite 5-14
1666	PCMEDIT	PCM edit mode	Opt. LX 9
1667		Define record output format	➤ Seite 5-17
1668	AUTORUNDEF	Set up/change one button mode	Opt. LX 5
1669	AUTORUNON	Activate one button mode	Opt. LX 5
1670	RESTORE	Restore old status	➤ Seite 6-7
1671	PCMMOD	PCM run mode	Opt. LX 9
1672	FOCPRERUN	FOCUS: Prerun	Opt. LX 17
1673	FOCDIALDEF	FOCUS: Features / graphics assignment	Opt. LX 17
1674	PRINTMAN	Administration of output devices	➤ Seite 5-50
1675	FEED or NP	Page feed in record	➤ Seite 5-19
1676	TEXT	Comments in measurement record	➤ Seite 5-33
1677	BTEXT	Comments on screen	➤ Seite 5-35
1678	CPNTXT	Comments on alphanumeric control panel	➤ Seite 5-37
1679		Comment line in control data	➤ Seite 16-28
1680	FIXPLA	Select reference plane	➤ Seite 10-50
1681	SIGMA	Mating size (Sigma factor)	➤ Seite 10-49
1682	ANGDMS	Output in degrees/minutes/seconds	➤ Seite 13-2
1683	SAVEREC	Save records	➤ Seite 5-41
1684	RECOUTP	Save, output and delete records	➤ Seite 5-42

DI Number	Abbrev.	Function	Page
1685	**SYSCOM**	Start customer programs	➤ *Seite 3-44*
1686	**SYSBEF2**	Start customer programs	➤ *Seite 3-44*
1687	**VARREC**	Variable measurement record	Opt. LX 1
1689	**PRINTSPOOL**	Print status with spooled printers	➤ *Seite 5-52*
1690	**RES**	Set record address counter to any address	➤ *Seite 6-8*
1692		Define language, unit of measurement and decimal places	3 - 46 ➤ *Seite 5-16*
1693		Address definition mode for EXCALL NP Termin line	Opt. LX 9
1694	**PRGCORR**	Correction of learn program during programming	➤ *Seite 16-17*
1698		Change operator name	➤ *Seite 5-45*
1699		FOCUS: Graphic result display (ERGANZ)	Opt. LX 17
1701	**ZEROPT**	Zero point	➤ *Seite 9-15*
1702	**TRPLANE**	Transformation plane	➤ *Seite 9-7*
1703	**TR0+1**	Rotate around zero point and one element	➤ *Seite 9-24*
1705	**TRDIS**	Rotate to distance	➤ *Seite 9-29*
1706	**TRSPACE**	Transformation space	➤ *Seite 9-4*
1707	**AXISCHA**	Select space axis	➤ *Seite 9-23*
1708	**WS->WPOS**	Store W-position in computer	➤ *Seite 16-9*
1709	**TRANGLE**	Rerotate about an angle (mode with DI 1719)	➤ *Seite 9-25*
1710	**WPTCAT**	Store/delete W position	➤ *Seite 16-7*
1711	**AXISSEL**	Rename workpiece axes / free axis selection	➤ *Seite 9-33*
1712	**WPFCAT**	Read in W-position	➤ *Seite 16-10*
1713	**WL WPC**	Form workpiece coordinate system from control coordinate system	➤ *Seite 9-31*
1719	**MOD1709**	Define mode for WP reference axis	➤ *Seite 9-27*
1720		Relative axis exchange	➤ *Seite 9-36*
1722	**BASISDIS**	Displace zero point into a theoretical plane	➤ *Seite 9-19*
1723	**DISPLACE**	Displace zero point by a defined value	➤ *Seite 9-18*
1731		X coordinate zero point	➤ *Seite 9-17*
1732		Y coordinate zero point	➤ *Seite 9-17*
1733		Z coordinate zero point	➤ *Seite 9-17*
1734		3D transformation with selectable axis	➤ *Seite 9-10*
1735		2D transformation with selectable axis	➤ *Seite 9-10*
1739		Enter nominal vector (DMIS postprocessor)	➤ *Seite 9-10*

DI Number	Abbrev.	Function	Page
1740		Alignment of nominals	➤ *Seite 9-10*
1750		Twin column: linking	Opt. LX 11
1751	**TWCROT**	Twin column: Calculate rotation	Opt. LX 11
1752	**TWCSURFACE**	Twin column: Save surface	Opt. LX 11
1753	**TWCLINE**	Twin column: Save line	Opt. LX 11
1754	**TWCSPERE**	Twin column: Save sphere	Opt. LX 11
1755	**TWCDELTR**	Twin column: Delete translation	Opt. LX 11
1756	**TWCACTIV**	Twin column: Activate link	Opt. LX 11
1757	**TWCTRANS**	Twin column: Calculate translation	Opt. LX 11
1758		Twin column: Initialization complete (caution)	Opt. LX 11
1759	**TWCLIST**	Twin column: List transformation system	Opt. LX 11
1769	**WPCPOL**	W-position displacement, polar	➤ *Seite 16-66*
1771	**WPDCCAR**	W-position displacement, cartesian	➤ *Seite 16-66*
1781		Result output for 3D elements	Opt. LX 6
1802		Generate UMESS 300 control data lines in PROG	Opt. LX 4
2100	**CADLINK**	Call CADLINK	Opt. LX 7
2300		Call GON	Opt. GON
2600	**STS**	CMM multisphere test standard (MSTS)	Opt. LX 15
2605	**TSTFILES**	CMM MSTS: Parameter input	Opt. LX 15
2610	**STSGEN**	CMM MSTS: CNC generation	Opt. LX 15
2620	**STSEVAL**	CMM MSTS: Evaluation	Opt. LX 15
2700	**KUM**	Call KUM	Opt. KUM
2800	**PIPE**	Call pipe measurement program	Opt. LX 12
2900	**SAM**	Call SAM	Opt. SAM N/V
2950	**SPC**	Call SAM-SPC	Opt. SAM N/V
2951	**SPCTRA**	SAM data transfer	Opt. SAM N/V
2952		Fetch measuring run data from SAM with PCM	Opt. SAM N/V
2990		SAM-Daten Update ab Rev. 7.0 auf Rev 7.5 Update of SAM data to Rev. 7.5 from Rev. >/=7.0	Opt. SAM N/V
3000	**ACE**	Call ACE	Opt. ACE
3001	**PRBNO**	ACE: Probe change	Opt. ACE
3002	**I-POS**	ACE: Intermediate position	Opt. ACE
3003	**PROBING**	ACE: Probing	Opt. ACE
3004	**MACRO**	ACE: Macro	Opt. ACE

DI Number	Abbrev.	Function	Page
3005	**DSEMODE**	ACE: DSE mode	Opt. ACE
3010	**RES 1LINE**	ACE: Reserve one control data line	Opt. ACE
3011	**RES NLINE**	ACE: Reserve n control data lines	Opt. ACE
3012		GON: Gear measurement	Opt. GON
3013		GON. Gear new input	Opt. GON
3014		GON: Subsequent evaluation	Opt.GON
3016		GON: Brief input	Opt.GON
3022		GON: Measurement	Opt.GON
3051		GON: Definition of standards	Opt.GON
3052		GON: Definition of graphic formats	Opt.GON
3053		GON: Data administration	Opt.GON
3054		GON: Manager	Opt.GON
3055		GON: Data output	Opt.GON
3056	**CHANCE**	ACE: Disperse data	Opt. ACE
3060		Activate measurement counter for manual CMMs	
3061		Change display coordinates for manual CMMs	
3099	**UMESS**	ACE off / UMESS on	Opt. ACE
3201	**CNCCOTUX**	Convert control data from UMESS 300	Opt. LX 4 N/V
3202		Initialize record header for **<DI 3201>**	Opt. LX 4 N/V
3301	**CNCCOT300**	Convert control data to UMESS 300 (old)	Opt. LX 4 N/V
3452	**FETCHASCII**	DATACOM: Receive file	
3453	**ASCIISEND**	DATACOM: Send file	
3457	**DACCOM-MAND**	DATACOM: Command input	
3459	**DACPATHDEF**	DATACOM: Abbreviation definition	
3460	**FETCNC**	DATACOM: Fetch CNC runs	
3461	**SENDCNC**	DATACOM: Send CNC runs	
3469	**ESNCREC**	DATACOM: Send current measurement record	
3470	**DOPSTART**	DATACOM: Offline start	Opt. LX 11
3472		DATACOM: Remote control	
3499	**DACTOTDEF**	DATACOM: LAN preassignment	
3500	**SAVE**	Save/externally store CNC programs	➤ *Seite 4-3*
3510		Copy CMM command blocks to intermediate storage	➤ *Seite 4-14*

DI Number	Abbrev.	Function	Page
3511		Restore KUM command blocks from intermediate storage	➤ *Seite 4-14*
3800	**KAM**	Call KAM	Opt. KAM
3801	**VDAKUM**	VDA data => KUM (nominal data)	Opt. KUM
3802	**KUMVDA**	KUM => VDA (measured data)	Opt. KUM
3803	**NOMMEA**	Measurement according to nominals	Opt. KUM
3811	**KAMMACRO**	Macro functions for KAM	Opt. KAM
3840		Save record for columns 1 and 2 to file	Opt. LX 11
3841		Create a double record (for wide paper only)	Opt. LX 11
3870	**FCC**	Fast contour control	Opt. KUM
4500		SAM reporter	
6501		Semiautomatic probe calibration	➤ *Seite 7-17*
6502		Manual probe calibration	➤ *Seite 7-29*
6504		Delete probe data	➤ *Seite 8-10*
6505		Set probe data to zero	➤ *Seite 8-9*
6506		Specify reference probe	➤ *Seite 7-15*
6507		Define calibration mode	➤ *Seite 7-10*
6511		Temperature compensation by input	➤ *Seite 6-22*
6512		Define temperature-sensitive probe	
6513		Define temperature limit	➤ *Seite 6-24*
6514		Check temperature limit	➤ *Seite 6-26*
6515		Temperature record	➤ *Seite 6-27*
6520	**PRB BEND**	Determine bend parameters for clamped probe head	➤ *Seite 7-36*

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Chapter3 Description of the windows

Chapter6 Preparations for a measuring run

Chapter7 Probe calibration

Chapter8 Administration of probe data/probe change

Chapter9 Mathematical alignment

Chapter10 Measuring

Chapter11 Geometric elements

Chapter12 Linking results

Chapter13 Conversion of results

Chapter14 Dimensional, form and position tolerances

Chapter15 Rotary table operation

Chapter16 Learn programming

Chapter17 Control data modification and management

Chapter18 CNC run

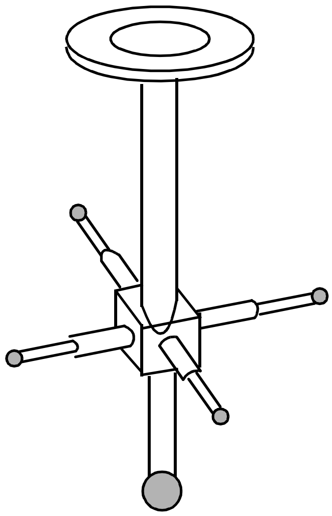
Chapter19 Scanning

Chapter 1

Introduction

This chapter contains:

Scope of the UMESS user manual



This manual describes the standard UMESS software. This comprehensive software package for measuring regular geometric elements offers the following options:

- Probe calibration,
- Mathematical alignment of the test objects,
- Measurement of all standard geometric elements by probing single points, self-centering probing and scanning,
- Mathematical measurement of all elements which cannot be probed by linking elements,
- Recall of previously measured elements for further evaluations and linkage (constructions) including transformation to new coordinate systems.
- Evaluation of all form and position tolerances,
- Flexible record structure,
- CNC programming of measuring runs,
- Use of a rotary table as the fourth axis.

Additional programs

Furthermore, UMESS provides the basis for all UMESS options and a number of special software packages, e.g. KUM, PROVACS, SAM, GON etc. Separate manuals are available for these programs.

Hardware

You will also find additional specific software functions in the corresponding hardware user manuals e.g.

- ; if you work with the FC production measuring center;
- if you have a Dynalog control panel;
- if your coordinate measuring machine has a DSE or RDS articulating probe holder;
- if you work with a duplex CMM.

How to use the operating instructions

Prerequisites

In writing this manual, we have taken into consideration the fact that you are a qualified technician in the field of metrology and have attended our UMESS training program. You will therefore normally be using it as a reference work. We have, however, also designed this manual so that untrained operators can use it to familarize themselves with UMESS.

Revision information

Any new revision subsequently delivered will be accompanied by a revision information which can be printed out using CZ Utilities.

Please follow the instructions contained therein, since the dialogs may also have changed for some functions.

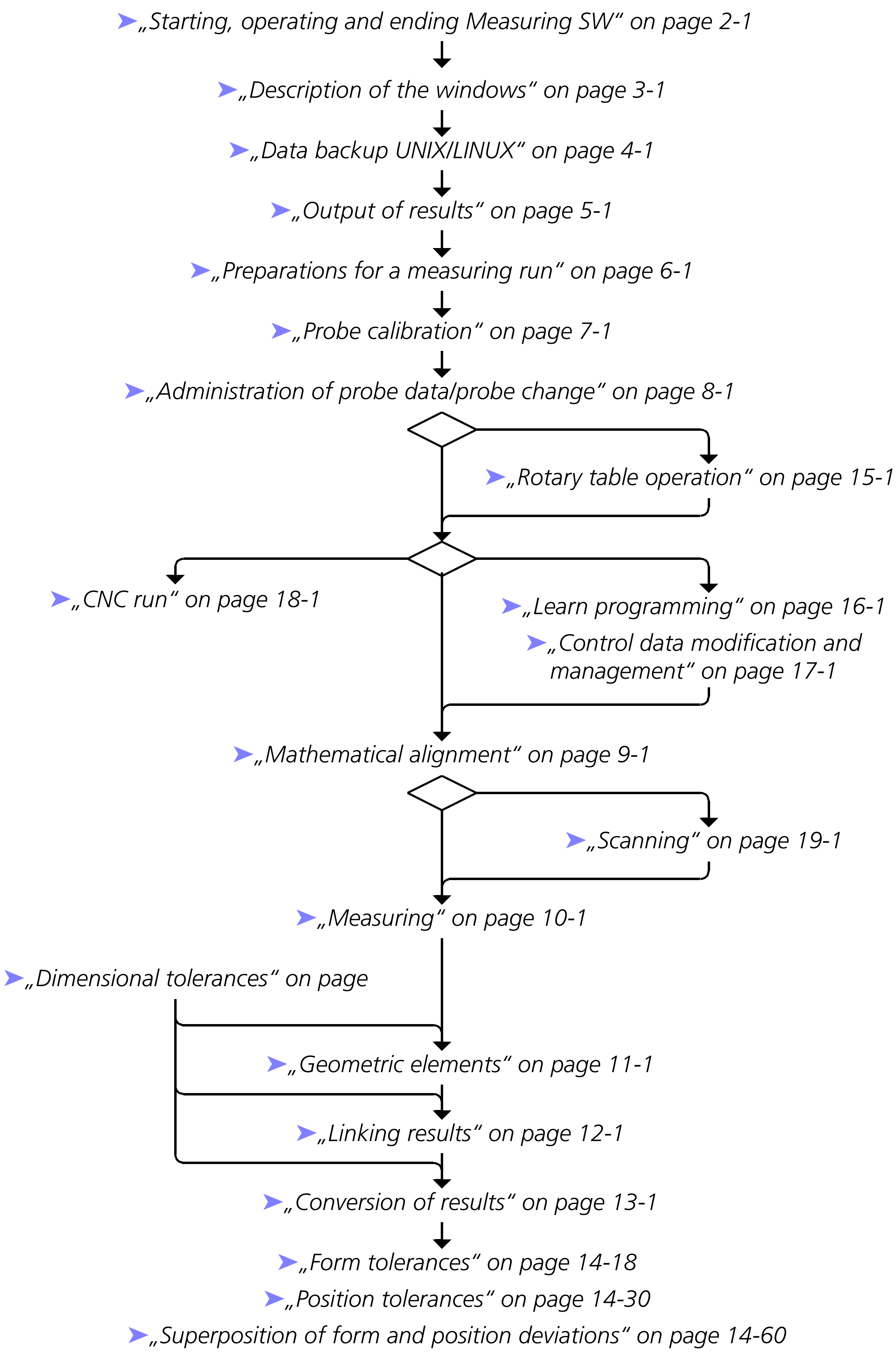
Organization

The table of contents, glossary, list of direct input functions and cross references in the text should help you find what you're looking for immediately.

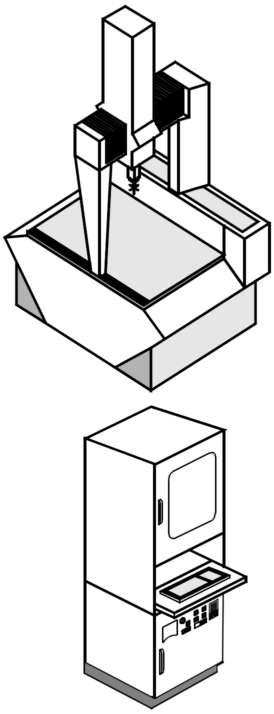
The main chapters are arranged in the sequence of the procedure usually followed when working with coordinate measuring machines (see flow chart on next page).

Subsections

- The subdivision of these main chapters can be found in the table of contents.
- A separate subchapter is normally provided for each function. Each subchapter contains the following information if required:
  - Effect of the function,
  - Applications, preparation and handling,
  - Function call (invocation),
  - Input mask or dialog,
  - Necessary and/or possible inputs,
  - Control data coding,
  - Examples.


„Starting, operating and ending Measuring SW“ on page 2-1
„Description of the windows“ on page 3-1
„Data backup UNIX/LINUX“ on page 4-1
„Output of results“ on page 5-1
„Preparations for a measuring run“ on page 6-1
„Probe calibration“ on page 7-1
„Administration of probe data/probe change“ on page 8-1
„Rotary table operation“ on page 15-1
„CNC run“ on page 18-1
„Learn programming“ on page 16-1
„Control data modification and management“ on page 17-1
„Mathematical alignment“ on page 9-1
„Scanning“ on page 19-1
„Measuring“ on page 10-1
„Dimensional tolerances“ on page
„Geometric elements“ on page 11-1
„Linking results“ on page 12-1
„Conversion of results“ on page 13-1
„Form tolerances“ on page 14-18
„Position tolerances“ on page 14-30
„Superposition of form and position deviations“ on page 14-60

Hardware



The following hardware is required to use UMESS:

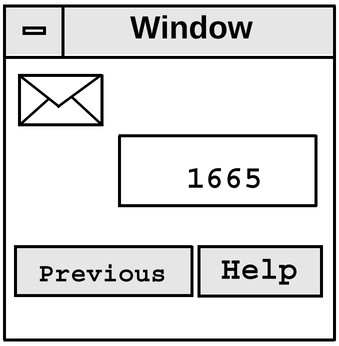
- A coordinate measuring machine with an 8-bit or 16-bit control: equipped with a trigger or measuring probe head, with or without rotary table,
  possibly with other accessories (e.g. probe changer).
- Computer

Chapter 2

Starting, operating and ending Measuring SW

This chapter contains:

General comments on windowing



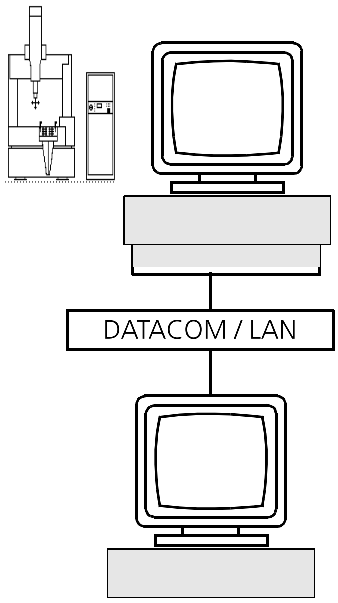
.The measuring programs and the corresponding options all employ a windows user interface.

This means that several windows in which the dialog with the computer and the output of the peripheral devices are displayed are automatically opened on your screen.

Prerequisites

Die UX-Meßprogramme werden auf Rechnern des Typs HP 9000 Serie 700 oder Serie B unter dem Betriebssystem HP-UX eingesetzt. Rechner und Peripherie müssen elektrisch zusammengeschlossen und, wenn Sie nicht an einer MFT-Station gerätefern arbeiten, mit dem Steuerschrank des Meßgerätes verbunden sein.

The computer and peripheral devices must be connected together electrically and, if you are not working on an ACE station, linked with the control cabinet of the measuring machine.



Computer with CMM and/or ACE station

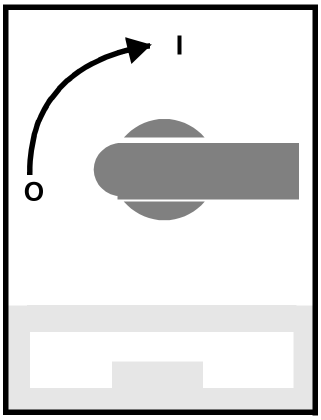
The CMM computer is linked to the ACE station via the LAN.

The DATACOM option can be used to exchange measuring data and CNC runs.

Switching on the measuring machine and computer

Differences

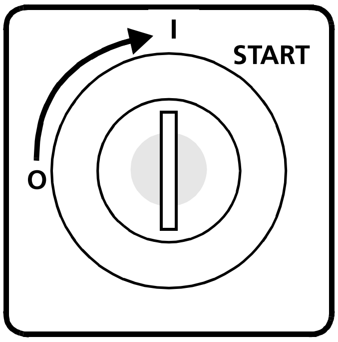
The actual operation and appearance of control and display elements may vary for individual control types.



Turn the main switch clockwise to position "I":

– The MAINS ON pilot lamps come on
– The computer cabinet with the computer units is now ready for operation

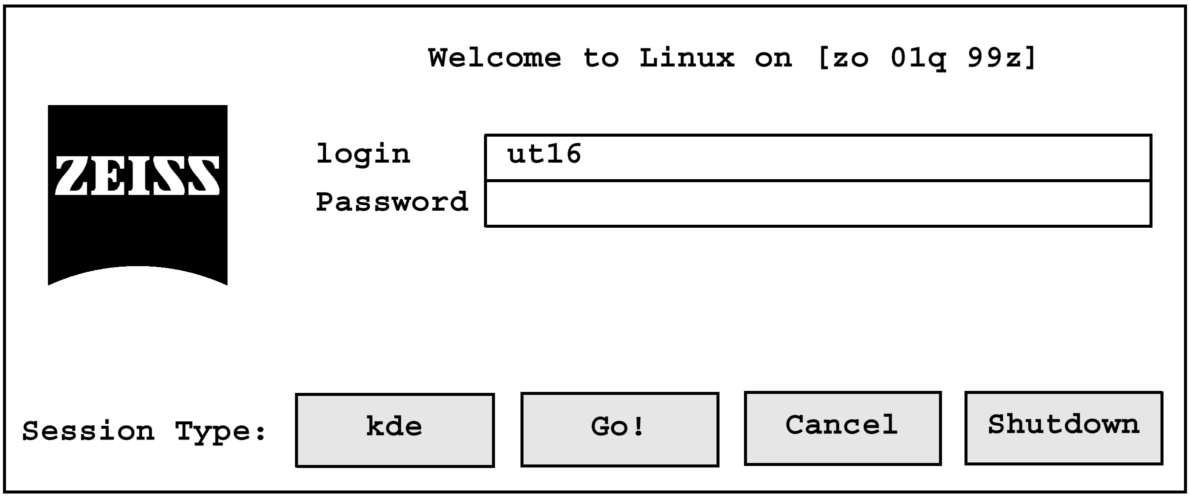
For more information in the indicator panel: see the pertaining hardware operator’s manual.

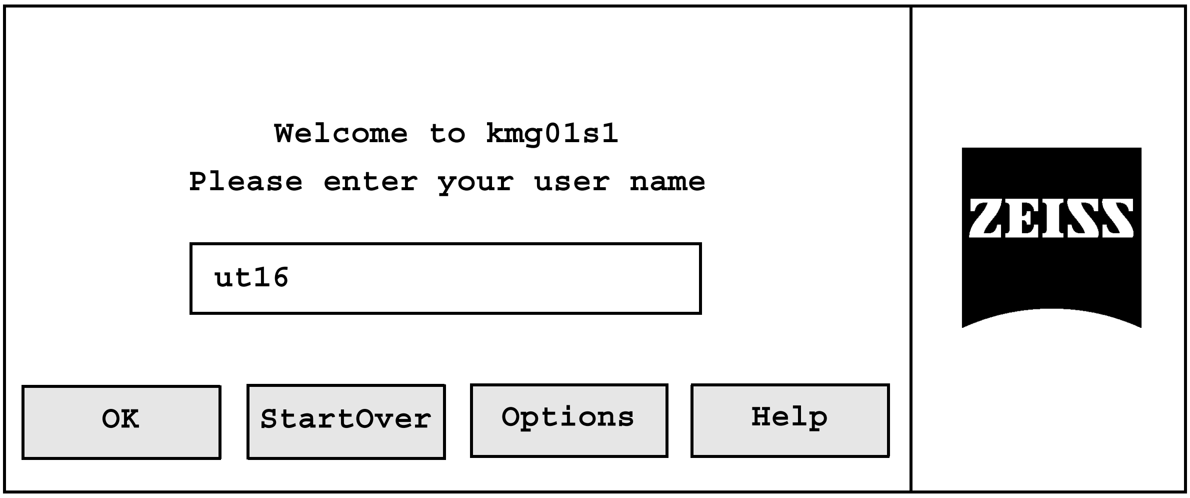


– **Turn keylock switch clockwise to position "I":**
  The control pilot lamps come on.
– **Turn keylock switch further to the START position and hold it there approx. 2 sec. until the air bearings are activated:**
  The DRIVES pilot lamps and all other signal lamps for monitoring the voltage come on.
– **Switch on the computer and monitor and wait for the automatic start of the operating system**

KDE user interface

The UNIX/LINUX operating system boot procedure stops at the LOGIN window of the KDE user interface and waits for the input of a user name.





User: ut16 — **Enter the user name 'ut16'.**

Password — **If you have a password, enter it here. In any case confirm with <Enter>.**

The LINUX operating system now starts the KDE user interface.

Start UMESS — **Start UMESS by clicking on the button for UMESS single-column or duplex operation.**

NOTE

Duplex operating mode:
Start column 2 first, and then column 1.
Wait until all windows have appeared.

If necessary, adjust the size and arrangement of the windows to suit your requirements.

Reference point travel

Dialog window

After UMESS starts, the dialog window will display either the **<Reference point travel>** input mask or the query **<Without CMM?>**

NOTE

Exception: If the measuring machine is left on after the last UMESS end, you can log on again immediately.

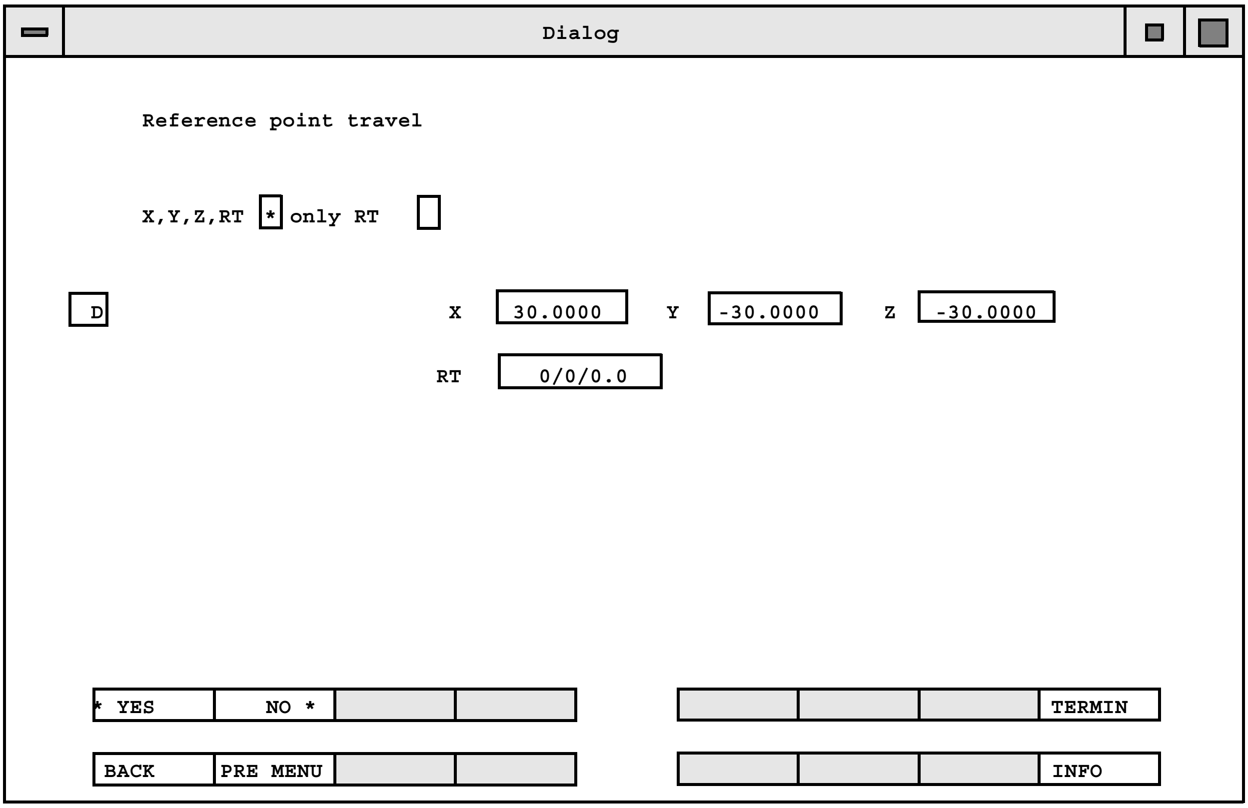
Reference point travel

The reference point travel (also called zero point travel or homing run) brings the counter readings of the three machine axes to a defined initial status. If a rotary table is connected to your CMM, it will also move to its reference point position.

For DSE, RDS and FC, please refer to the pertaining hardware operator's manual.

Caution: Risk of crushing and collision!
.Prior to the reference point travel, position the probe head so that the machine zero point later traveled to (in the upper rear left corner) can be reached without a collision.
The probe head first moves to the mechanical limit position in the Z axis, and then in the X and Y axes.

Caution: Risk of injury!
If a rotary table is connected, it will also move to its reference point. Be careful: Any workpieces clamped on the table may cause a hazard if turned along with the table.



Procedure

If necessary, change the (machine) coordinate values offered in the dialog window. The probe head will move to the position entered following the reference point travel.

TERMIN

The dialog window then closes and the message **CAUTION: CMM zero point travel** appears on the screen. The probe head first moves to the mechanical limit position in the Z axis, and then in the X and Y axes.

Limit position

On reaching the mechanical limit positions, the probe head automatically moves away from this zero point by a distance corresponding to the value entered in all axes.

NOTE

If the CMM does not move away from the zero point, you can cancel operation with **<CANCEL>**.
Check whether X, Y and Z have the correct sign and are within the measuring volume.
If the reference point is not valid (message on screen), call this function again by entering **<DI 1570>**.

NOTE

If the **<Reference point travel>** dialog window automatically appears after switching on the CMM, the dialog window must not be closed with **<PRE MENU>** or **<BACK>**.

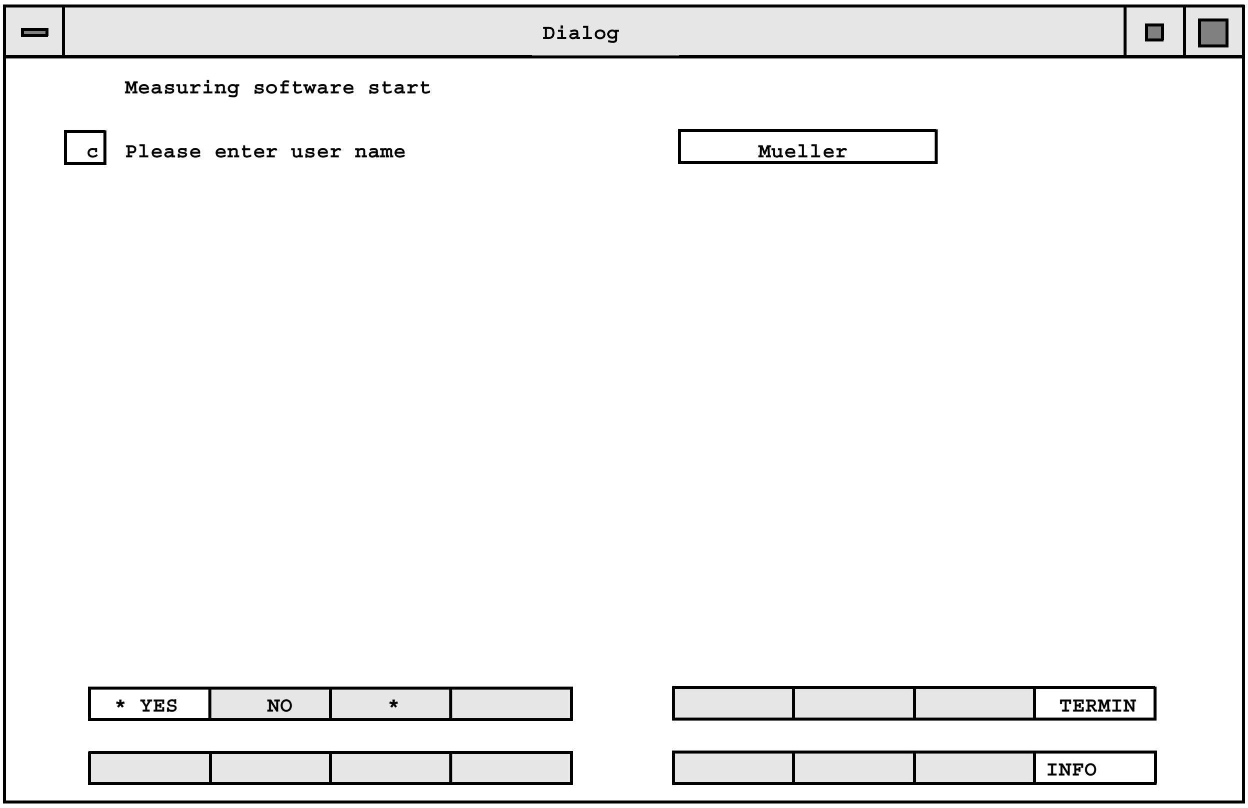
UMESS without CMM

The inquiry **Without CMM?** shows that the measuring machine was switched off during the system start or that the electrical connections have been interrupted.

YES continues the start process with a logon. In this case, you can use UMESS without a coordinate measuring machine.

NO leads to the prompt to switch on the measuring machine and/or check the connections.

Login procedure



Operator name

Following the reference point travel, after **Without CMM = <YES>** or following a start without switching off the control cabinet in-between, the dialog window will request you to log in as a user. Type in your user name and confirm it with **<Enter>**.

UMESS is now ready for operation.

Restore

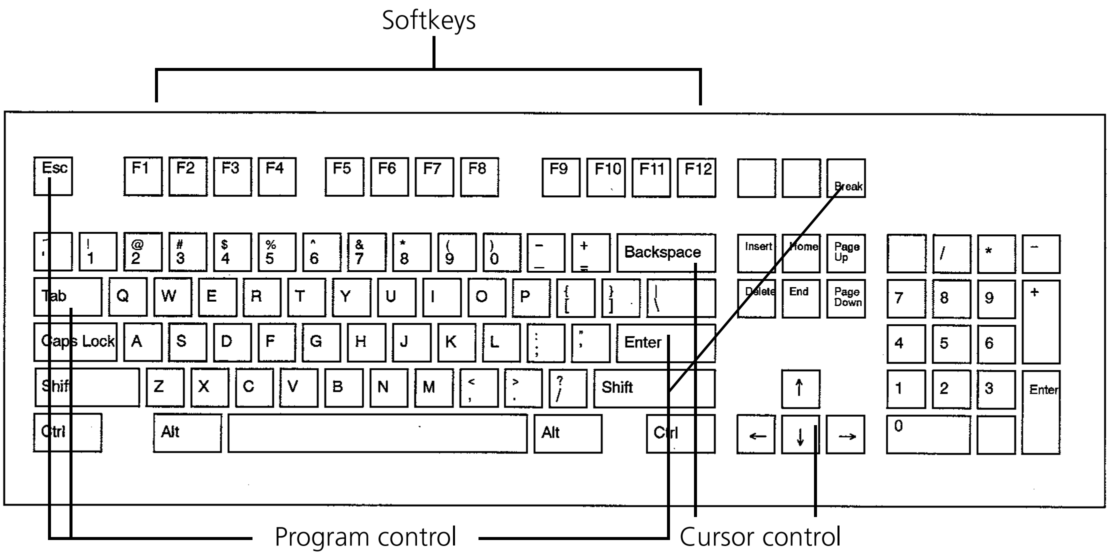
Then, if necessary, save the results from the last UMESS session with **<DI 1670>** before continuing on (➤*„Producing the old status <DI 1670>" on page 6-7*).

Keyboard

Function

With the computer keyboard

- you can type in data and transfer it to the computer,
- control the cursor (to mark the position where the following text should be entered) and
- scroll the contents of the screen memory into the visible zone.



Special keys

In addition to the usual letters, numbers and characters, the keyboard also has a few special keys:

Program control keys

Key	Function
<Tab>	Changeover between upper/lower row of softkeys
<Enter>	Terminate input / continue to next input field
<Break>	Terminate UMESS in case of malfunction ➤ *„Faults (Break)“ on page 2-18*

Cursor control keys

Key	Function
<↑>	Return to the previous input field
<↓>	Continue to the next input field
<→>	Move the cursor one place to the right
<←>	Move the cursor one place to the left
<Shift> <↑>	Scroll the screen contents upwards
<Shift> <↓>	Scroll the screen contents downwards
<Back space>	Move the cursor one place to the left; cf. ➤*„Pictograms in the UMESS main menu“ on page 3-23*

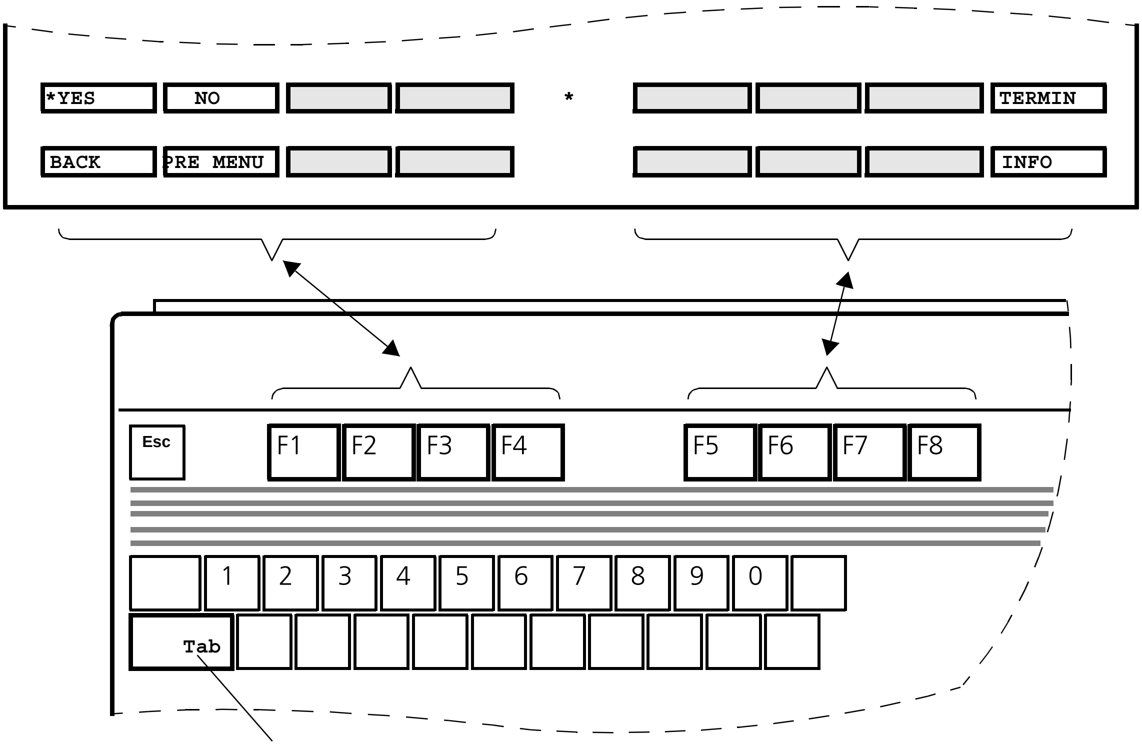
Keys for text input and processing

Key	Function
<Insert>	Insert characters to the left of the cursor: First activation: Insert mode ON, (indicated by `IC`) Second activation: Insert mode OFF
<Delete>	Delete one character at the current cursor position
<Shift> <Insert>	Insert a line (not activated in UMESS)
<Shift> <Delete>	Delete a line (not activated in UMESS)
<Home>	Jump to beginning of text (not activated in UMESS)
<End>	Jump to end of text (not activated in UMESS)
<Page Up>	Move forward one page
<Page Down>	Move back one page

Softkeys

Keys **<F1>** to **<F8>** are command input keys, i.e. softkeys with a changing function assignment.
The 16 rectangular fields highlighted at the top of the screen show the current assignment of the softkeys.

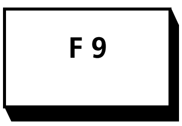
The asterisk (*****) in the center shows which softkey line is currently activated. In its initial status the asterisk appears in the upper line. If you press the **<Tab>** key, the asterisk then shifts to the lower line. Now you can activate any key in the lower line.



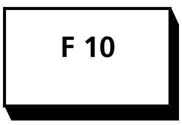
Change between upper and lower softkeys

Shift keys

Keys **<F9>** to **<F12>** are shift keys for certain window functions in the UMESS main menu.



Changes between the different "pictogram page" (icon bar) levels



Changes between the pulldown menu and the list and message window

F 11 Changes between UMESS main menu and record window.

F 12 Changes between UMESS main menu and direct input window.

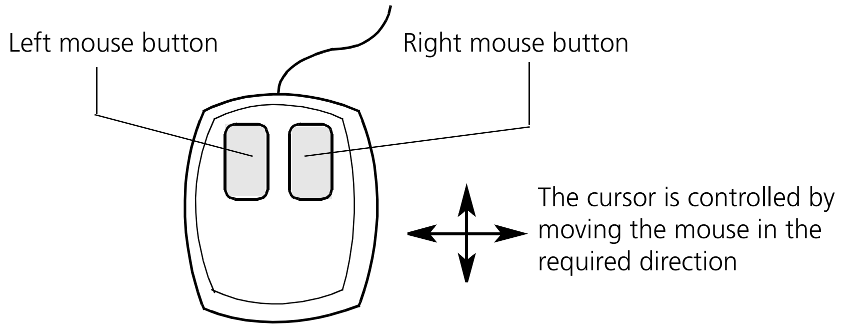
Mouse functions

The mouse is a small device for controlling the cursor (mouse pointer) on the screen as a supplement to the computer keyboard.

You can use the mouse to:

- activate and manipulate windows
- call functions
- activate input fields

Mouse



Mouse pointer

You can control the movement of the mouse pointer (cursor) on the screen with the mouse. The cursor is represented on the screen by an "***X***" or an arrow. When you move the mouse on the mouse pad, the cursor moves in the same way on the screen.

The mouse has either two or three buttons. If it has three buttons, the one in the middle has no function.

You may have to press the left button, the right button or both buttons, depending on the function required.

Function calls

Explanation of illustration

3 options

You can normally activate functions in one of three different ways:

– Using direct input **<DI>** numbers or shortcuts,

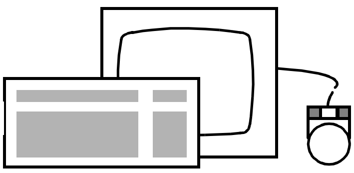
– Via pulldown menus,

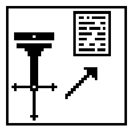
– via a "pictogram" (icon).

Type of display

The operating instructions explain three ways of calling or invoking each function:

(Example shown here: Extent of record)

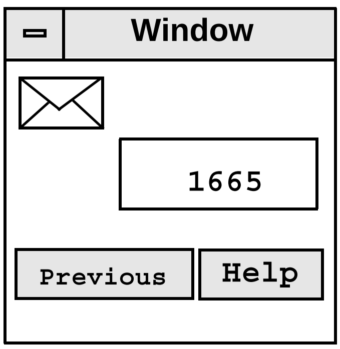


DI	Pull-Down-Menu	Pictogram
1624	Probe	
CONFLIS	Data	
a31	List	

Function call via a direct input

Function

A direct input **<DI>** is the direct call of a function without using a pull-down menu.



You can use and operate the measuring programs and their corresponding options via "windowing".

In other words, several windows in which the dialog with the computer and the output of the peripheral devices are displayed automatically open on your your screen.

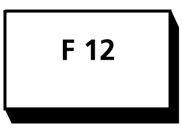
You have three options:

– Enter the corresponding DI number.

– Enter the function abbreviation (not provided for all functions).

– Enter the abbreviation from UMESS 300 (not provided for all functions).

(e.g.: **Adr.Prog.57** from UMESS 300 is entered as **a57**.)



You can use key **<F12>** to change back and forth between the UMESS main menu and the Direct Input window.

Type in the number or the abbreviation in the **Direct input** input field and confirm with **<Enter>**.

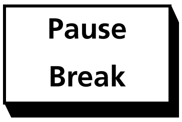
Previous The input window is closed, no UMESS function is activated.

Faults (Break)

Application

Incorrect or inadvertent activation of keys, incorrect programming, collisions and other operating errors may lead to a UMESS crash.

Information on how to eliminate the error normally appears on the screen



If these measures are not successful or the error or fault which occurred can not be remedied by the software, press the **<Break>**.key once.

This restarts the measuring software (and takes several seconds).

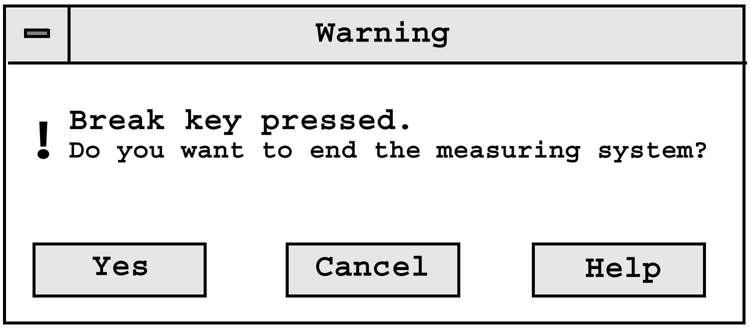
If you press **<Break>** a second time, UMESS is interrupted and must be restarted.

Prerequisite

The **<Break>** key functions only if one of the following windows is active:

- UMESS main menu,
- Record window or
- Direct Input window

Click on **<Yes>** with the mouse or press the **<Enter>** key to restart UMESS.



NOTE

Special feature of the Dynalog control panel:
Press the <Break> key two or three times immediately after acknowledging the warning window so make sure that UMESS is really interrupted. Then restart UMESS by clicking on the icon symbol. This is necessary to ensure that all UMESS windows are displayed correctly on the Dynalog.

Restore

Subsequently or, if need be, beforehand, save the results from the last UMESS session with **<DI 1670>** (➤*„Producing the old status <DI 1670>" on page 6-7*).

Faults in the CNC run (➤*„Interruption due to malfunction“ on page 18-14*).

End of operation

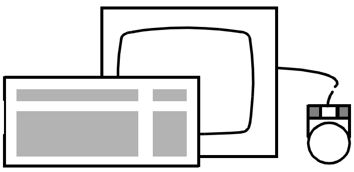
Procedure

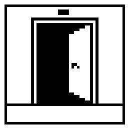
To terminate system operation, proceed as follows:

– Terminate all running operations and save any data which may be required later,

– Clear probe,

– Quit UMESS,



DI	Pull-Down-Menu	Pictogram
1003	Probe	
END	UMESS End	

Start shutdown

Start the shutdown procedure by:

1 Selecting the KDE system button

- Select **<Logoff>**
- Click on **<End KDE>**
- Click on **<Shutdown>** in the **KDE User Login** window
- Select the **<Shutdown>** function.
  The operating system is now shut down.
  or

2 Click on the logoff icon on the front panel.

- Further procedure: See point 1

Last message

Once the LINUX system has been stopped, the following message will be displayed:

<Shutdown>

Now you can switch your measuring system off, i.e.

– Switch off the computer

– Turn the keyswitch and the main switch on the control cabinet to **0**

Chapter 3

Description of the windows

This chapter contains:

Working with windows

Activating windows

Mouse pointer

You can activate a window by placing the mouse pointer inside it (the pointer appears as an "**X**") and clicking once. After the mouse pointer enters a window, its appearance will change to an "I" or another character.

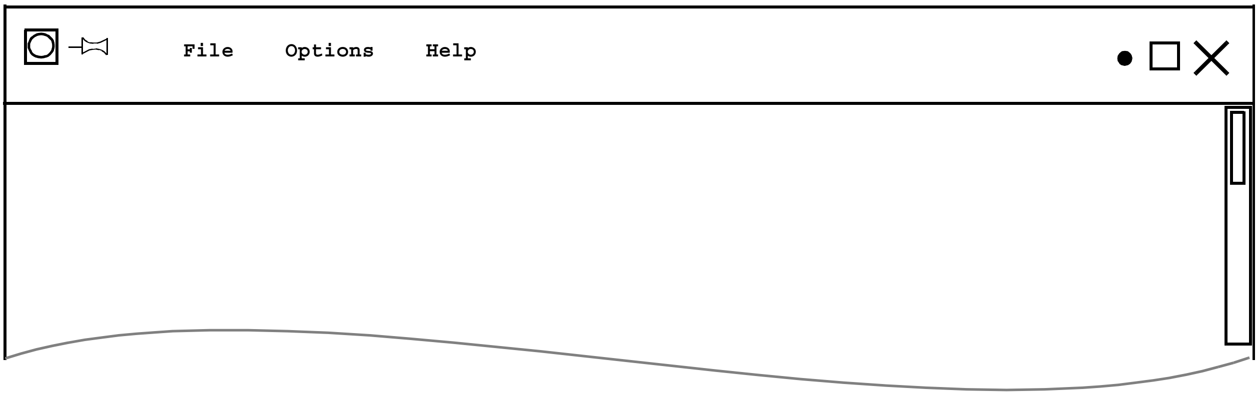
Frame color

Once a window has been activated, its frame changes color and it is moved to the front. Keyboard inputs appear in the command line of the activated window.

Moving windows

Upper edge of window

Click on the frame field at the upper edge of the window with the left mouse button and hold the button down.



The shape of the mouse pointer now changes to a "**+**"; a frame indicates the current position of the window.

Moving the mouse

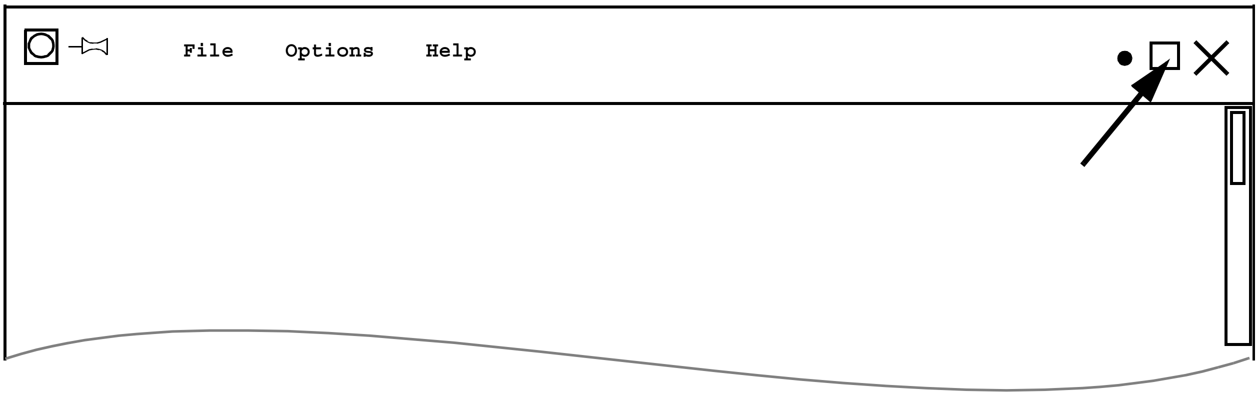
You can now change the position of the window dragging the mouse and then letting go of the left mouse button.

Shrinking the window to an icon

Minimize button

If you do not require need a certain window or your screen is simply overcrowded with open windows, you can shrink individual windows to an icon. Just click on the Minimize button in the upper right hand corner of the frame with the left mouse button

.



Icon

The window is then displayed as an icon on the left-hand margin of the screen. You can move it by clicking on it with the left mouse button and holding the button down. The icon can then be moved to another location by dragging the mouse pointer and positioned there by letting go of the button again.

Restoring the window

You can restore the icon to window size by clicking on it briefly two times with the left mouse button. The window then reappears in the position where it was before it was shrunk.

Modifying the window size

Clicking on the frame

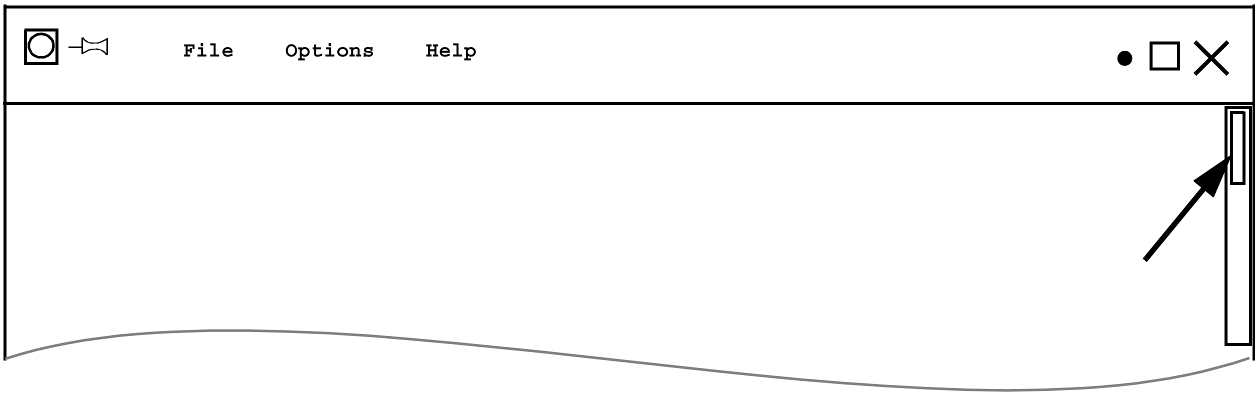
You can change the size of a window by clicking on any point of its frame with the left mouse button and keeping the button pressed. The point where you click on the frame determines the direction in which you can enlarge or reduce the size of its frame. If, for example, you click on its right border, you can change the shape of the frame by shifting its right border laterally. If you want to adjust both the height and the width of the window simultaneously, click on a corner of the frame.

Scrolling the contents of the window

Moving the scroll bar

If you would like to scroll the contents of a window vertically, many windows have a scroll bar along on their right-hand border.

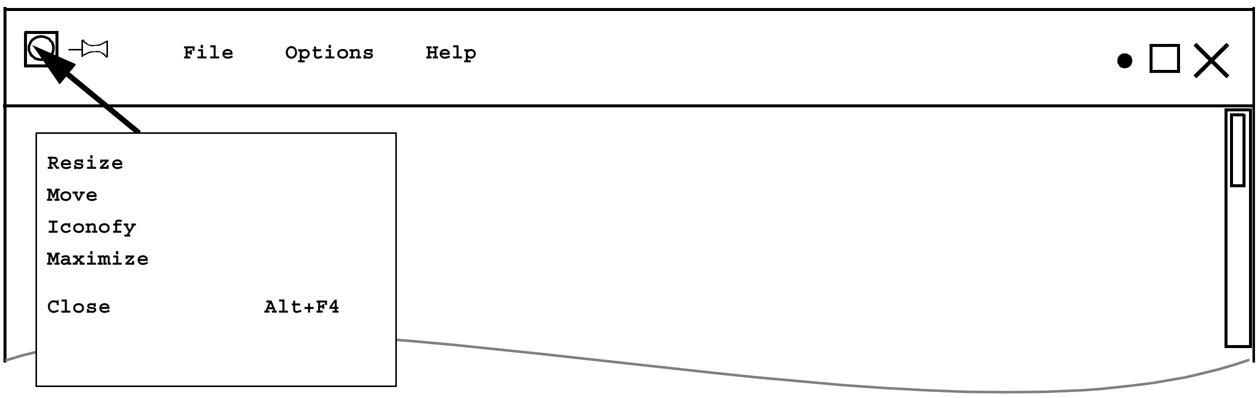
If you keep the mouse button pressed while moving the cursor up and down, the text section shown in the window will change correspondingly.



Window menu

System menu

Each window has a system menu in which you can select various functions concerning that window. To open this menu, click on the menu field in the upper left-hand corner of the frame with the left mouse button and hold it down.



Activating a function

The lines are highlighted by moving the mouse pointer up and down the system menu. The highlighted function will be executed as soon as you let go of the mouse button.

Resize Selecting **<Resize>** reverses any change you have made via the system menu. I.e. you thus *restore* the previous condition of the window.

Move If you select **<Move>** and release the button, a frame appears which can then be moved around on the screen. The coordinates of the frame in reference to the upper left-hand corner of the frame are displayed in the center of the screen. The new position of the window can be set by pressing the left mouse button once.

Iconofy The window can be shrunk to an icon with **<Iconofy>**.

Maximize **<Maximize>** enlarges the window to full screen size.

Close **<Close>** closes the window.

NOTE This command must not be used in a UMESS window, since it would cause errors in or termination of UMESS.

UMESS main menu

Functions of the UMESS main menu

Operation

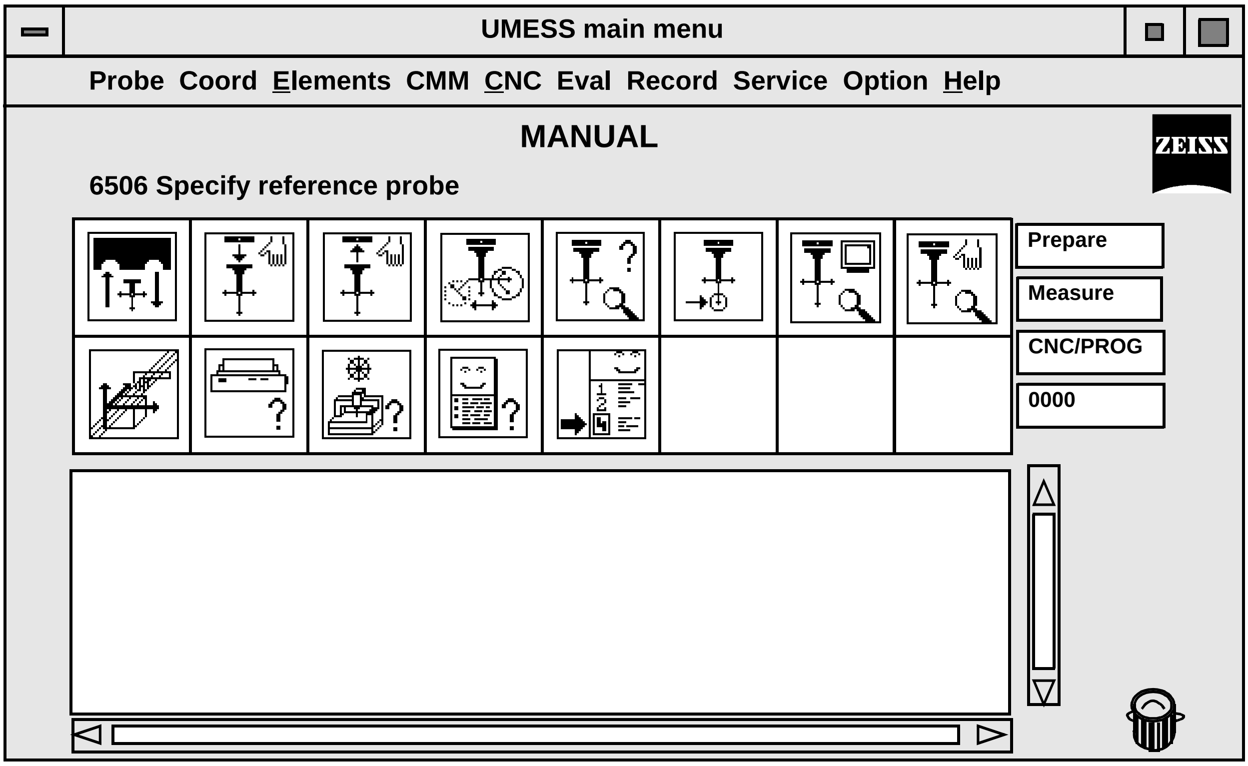
The UMESS main menu enables you to operate the UMESS program system in via windows (windowing). You can invoke all UMESS functions by selecting them from Pull-Down-Menus, via "pictograms" (icons) or by entering a direct input number **<DI no.>** (➤*„Function calls“ on page 2-16*).

Menu levels

The menus are combined under a main menu with two submenu levels. You can use these menus to select and activate the required UMESS function in plain text.

Pictogram (icon) pages

The UMESS main menu contains 64 pictograms (icons) arranged in 4 "pictogram pages" (double icon bars). You can put these pages together to meet your own special requirements.



You can use the UMESS main menu to...

- call UMESS functions via menus (➤*„Calling UMESS functions using menus“ on page 3-10*)
- call UMESS functions via pictograms (➤*„Pictograms in the UMESS main menu“ on page 3-23*)
- call UMESS functions via DI numbers (➤*„Function calls“ on page 2-16*)
- select pictogram pages (➤*„Pictograms in the UMESS main menu“ on page 3-23*)
- put together your own pictogram pages (➤*„Editing a pictogram page“ on page 3-25*)
- set type fonts and colors (➤*„Setting colors and fonts“ on page 3-33*)
- operate UMESS in other languages (➤*„Changing the language <DI 1692>“ on page 3-42*)
- change options (KUM, SAM, etc.) (➤*„"Options" menu“ on page 3-21*)

Procedure

The UMESS main menu determines the DI no. for a selected UMESS function and passes it on to the UMESS program system, thus activating the corresponding UMESS function.

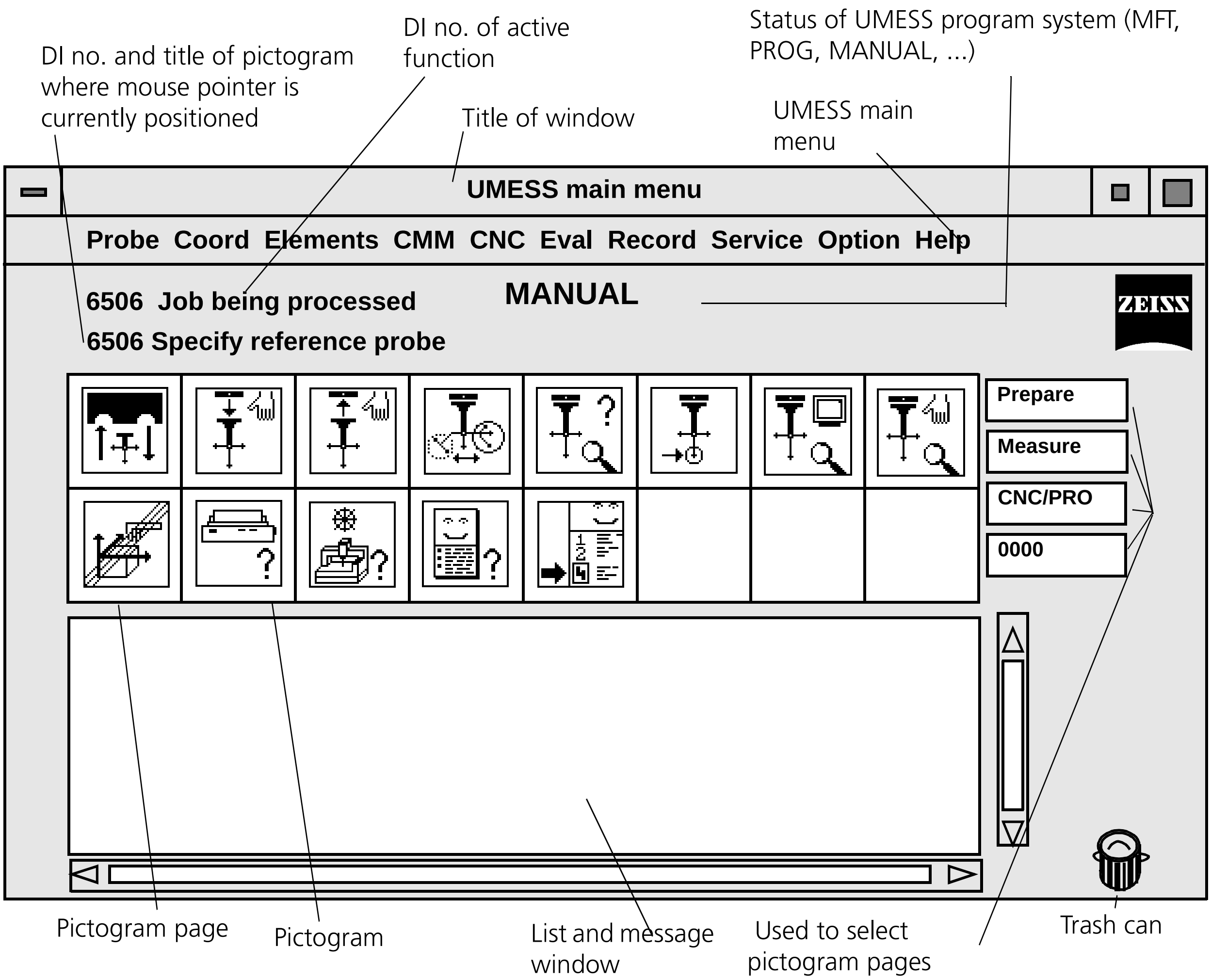
Mouse operation

Since the UMESS main menu is a graphic user interface, the easiest way to operate it is via the mouse. All you have to do to activate a function is place the mouse pointer on a pictogram or menu item and then click on it *once* with the left mouse button.

Keyboard operation

You can also operate the UMESS main menu without a mouse using the computer keyboard or from the control console.

Structure of the UMESS main menu



Active function

As long as a function is activated in the UMESS pictogram system, the DI no. of the active function is displayed along with the message **"Job being processed"** (see illustration above). No changes in the UMESS main menu, e.g. selection of pictogram pages or other UMESS functions, can be performed during this time.

Dialog window

A dialog window is automatically opened for UMESS functions requiring further inputs. (➤*„Dialog window" on page 3-38*) The dialog window must be closed with **<TERMIN>** after concluding all inputs so that the corresponding UMESS functions can be executed.

Shuffle up

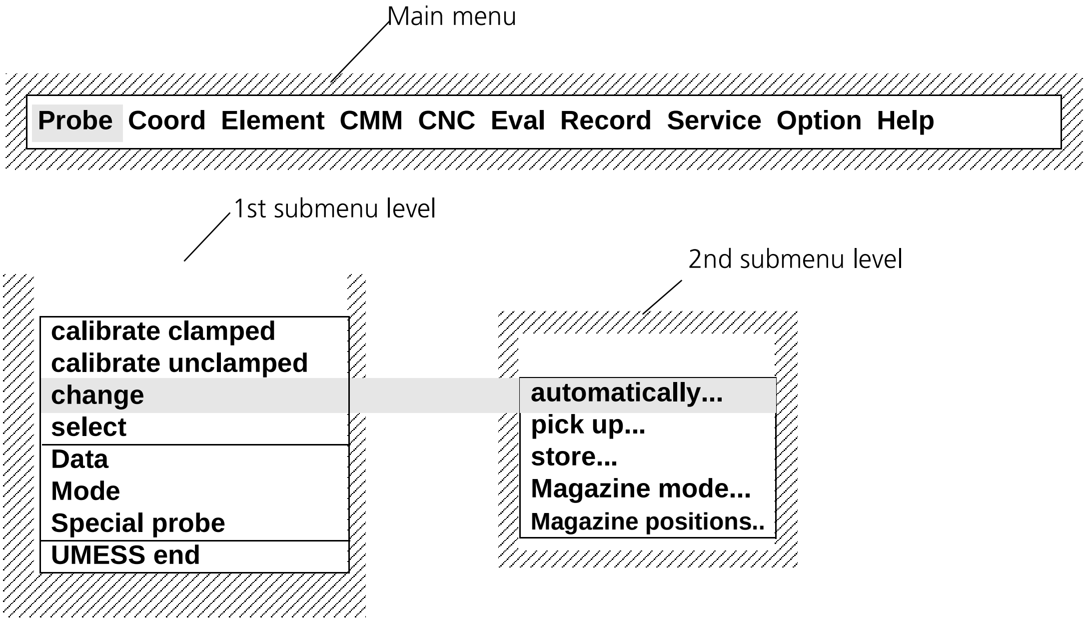
User activities may cause the dialog window to be positioned in the background . In order to be able to make inputs, the dialog window must be placed in the foreground with **<Shuffle up>**.

3 options

You can operate the UMESS main menu in three different ways, i.e.:

– using the mouse,
– using the computer keyboard,
– using the control panel.

Calling UMESS functions using menus



Menu organization

Using the menus, you can call all UMESS functions either with the mouse or by via keyboard inputs. The submenus are arranged maximally 2 levels below the main menu. (in the form of Pull-Down-Menus).

Labeling

The individual menu items are marked in the submenus as follows:

➤

a submenu follows (see figure: change ➤).

...

a function is called which requires inputs in a corresponding dialog window (➤„*Other windows in UMESS“ on page 3-36*) (see figure: **automatically**...). You can also cancel the function called using the corresponding dialog window.

(Text only)

The function is executed immediately. No window opens and there is no possibility to cancel the function (see figure: **UMESS End**).

Using the mouse

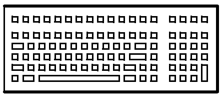
If you click on one of the options in the main menu (Probe/Coord. /Elements etc.) *once* with the left mouse button (click directly on the text), you will reach the first submenu level.

If you are in the first submenu level and click on a menu item *once* with the left mouse button, you will either activate the corresponding function or branch to the second submenu. If you click on a menu item once with the left mouse button in the second submenu level, you will activate the corresponding function.

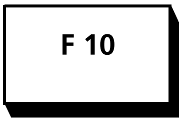
NOTE

You can search for a menu item throughout the entire menu by positioning the mouse pointer on a menu item in the main menu, pressing the left mouse button and keeping it pressed. As long as you keep the left mouse button pressed, you can move the mouse pointer back and forth through all menus. Once you find the required menu item, you can activate it by positioning the pointer directly on top and letting go of the left mouse button.

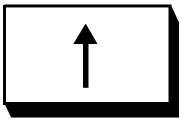
Using the keyboard



In the main menu, one letter of each option is underlined. If you press the hold the **<Alt>** key and enter the underlined letter, you will reach the corresponding first submenu level.



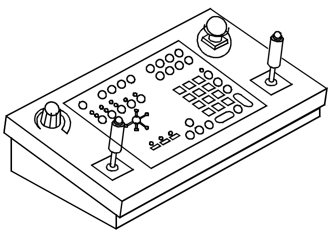
You can also move back and forth between the pictogram pages and the UMESS main menu by pressing key **<F10>**. If you have selected the UMESS main menu, you can move from one menu item to another within the UMESS main menu using the **<→>** and **<←>** cursor keys. Using the **<↓> <↑>** cursor keys, you can then branch from the UMESS main menu to the first submenu level of the menu item concerned.



In the submenu, the cursor bar is positioned on the top menu item. You can move the cursor bar up and down using the cursor keys <↓><↑>.

You can move to the second submenu level by pressing **<Enter>** or the **<→>** cursor key. You can return to the first submenu level by pressing the **<←>** cursor key. You can activate the function corresponding to the selected menu item by pressing **<Enter>**.

Using the standard control panel



You can move back and forth between the pictogram page and the UMESS main menu with softkey **<F10>**. If you have selected the UMESS main menu, you can move from one option to another with the **<→>** and **<←>** cursor keys. Using the **<↓> <↑>** cursor keys, you can branch from the UMESS main menu to the first submenu level of the menu item concerned.

In the submenu, the cursor bar is positioned on the top menu item; using the **<↓><↑>** cursor keys, you can move the cursor bar up and down. You reach the second submenu level by pressing **<Return>** or the **<→>** cursor key. You can return to the first submenu level with the **<←>** cursor key.

Pressing **<Return>** activates the UMESS function of the selected menu item.

Overview of all menus

Overview

The following text provides a complete overview of all menus, i.e. each menu item is listed along with its corresponding first and second submenu levels.

Chapters

The menus contain cross references to the chapters of the operating instructions where the corresponding information is located, for example:

➤*„Overview of all menus“ on page 3-12*).

If not specified otherwise, the chapter referred to is always a chapter of the UMESS operating instructions.

DIs

The **<DI No.>** for each menu item is specified as a cross reference to the item (➤*„Function calls“ on page 2-16*).

Menü „Taster"

Probe | Coord | Element | CMM | CNC | Eval | Record | Service | Option | Help

Menu item	Submenu	DI	
calibrate clamped.	semi automatically...	**6501**	➤ *page 7-17*
	manually...	**6502**	➤ *page 7-29*
	Bend menu...	**6520**	➤ *page 7-36*
	Include bend	**1186**	➤ *page 7-47*
calibrate unclamped.	semi automatically...	**15228**	➤ *page 7-19*
	Determine HSS bend...	**1184**	➤ *page 7-46*
	Include HSS bend	**1186**	➤ *page 7-47*
change	automatically...	**1553**	➤ *page 8-17*
	insert...	**1555**	➤ *page 8-15*
	remove...	**1554**	➤ *page 8-12*
	Magazine mode...	**1556**	➤ *page 6-29*
	Magazine positions...	**1557**	➤ *page 6-32*
	List rack positions	**1558**	➤ *page 6-32*
select	Combination...	**1601**	➤ *page 8-11*
	(ACE) Probe number...	**15141**	**MFT**
Data	list	**1624**	➤ *page 8-6*
	set to zero...	**6505**	➤ *page 8-9*
	delete...	**6504**	➤ *page 8-10*
	modify...	**1627**	➤ *page 8-7*
Mode	for defining...	**6507**	➤ *page 7-10*
	Reference probe def. ...	**6506**	➤ *page 7-15*
	Laser on/off...	**1512**	
Special probe	Temperature probe...	**15211**	➤ *page 6-32*
UMESS End		**1003**	➤ *page 2-20*

"Coordinate system" menu

Coord Element CMM CNC Eval Record Service Option Help

Menu	Submenu	DI	Reference
Preparation	Initial status	1608	page 6-7
	Read in WPOS...	1712	page 16-10
	WPS = WPOS	1713	page 9-31
	Free axis selection...	1711	page 9-33
	Relative axis selection...	1720	page 9-36
Space axis	define	1706	page 9-23
	change...	1707	page 9-23
Plane transf.	Rotate plane	1702	page 9-7
	Zero point & 1 Element	1703	page 9-24
	Rerotate...	1709	page 9-25
	Rerotate mode...	1719	page 9-27
	Distance...	1705	page 9-29
Zero point	determine	1701	page 9-15
	displace...	1723	page 9-18
	Basic displacement...	1722	page 9-19
3D Best fit...		1164	Opt. 3
Control system WL	store as WP no. x...	1710	page 16-7
	store as WP no. 1	1708	page 16-9
	Displacement cartesian...	1771	page 16-66
	Displacement polar...	1769	page 16-66
Column	list	1759	Double-column license
	Linking...	1750	
	Calculate rotation	1751	
	Store surface	1752	
	Store line	1753	
	Store sphere	1754	
	Activate linking	1756	
	Calculate translation	1757	
	Delete translation...	1755	

"Geometric elements" menu

Element CMM CNC Eval Record Service Option Help

Menu	Submenu	DI	Reference
Geometric elements	Circle...	**1104**	*page 11-9*
	Cylinder...	**1106**	*page 11-36*
	Surface...	**1103**	*page 11-27*
	Line...	**1102**	*page 11-22*
	Cone...	**1107**	*page 11-41*
	Sphere...	**1105**	*page 11-49*
	Ellipse...	**1108**	*page 11-19*
	Torus...	**1109**	*page 11-46*
Transfer macro...		**1079**	*page 16-81* and Opt.10
Recall...		**1301**	*page 9-37*, *page 10-29*
Car body	Space point...	**1120**	Opt.6
	3D point mode...	**1121**	Opt.6
	Edge point	**1220**	Opt.6
	Corner point	**1216**	Opt.6
	Parabola edge point...	**1173**	Opt.6
Data acquisition	Collect points in file...	**1100**	*page 10-21*
	Points to VDA...	**1166**	*page 10-26*
	Fixed plane...	**1680**	*page 10-50*
	Probing correction...	**1187**	*page 10-13*
	Cone correction...	**1144**	*page 13-15*
	Sigma displacement...	**1681**	*page 10-48*
	Filter...	**1185**	*page 14-69*
	Outlier elimination...	**1181**	*page 14-66*
Special elements	Point...	**1101**	*page 11-6*
	Circle segment...	**1114**	*page 11-53*
	MCC and MIC	**1180**	Opt.3
	Min/Max round...	**1141**	*page 14-62*
	Min/max Flat...	**1140**	*page 14-60*
	Min calculation...	**1341**	*page 12-40*
	Max calculation...	**1343**	*page 12-40*
Macros	Bore element...	**1081**	*page 16-34*
	4Pt circle	**1174**	*page 11-17*

"Coordinate measuring machine" menu

CMM CNC Eval Record Service Option Help

CMM		DI
Travel commands	Position...	**1511** ➤ *page 10-37*
	Pos. to result...	**1513** ➤ *page 10-38*
	Pos. in vector direction...	**1514** ➤ *page 10-40*
	Step...	**1515** ➤ *page 10-41*
	Reference point/step...	**1516** ➤ *page 10-43*
	Reference point travel...	**1570** ➤ *page 6-2* and ➤ *page 15-10*
Machine commands from file...		**1578**
Temperature comp.	Temperature compens...	**6511** ➤ *page 6-22*
	Temp. comp. gauge block...	**1621**
	Check for limit temp	**6514** ➤ *page 6-26*
	Define limit temperature...	**6513** ➤ *page 6-24*
	Define temperature probe...	**6512**
Mode	Control mode...	**1661** ➤ *page 6-10*
	Probe head...	**1551** ➤ *page 10-16*
	Vectorial measuring force...	**1502** ➤ *page 6-18*
	Parameters for small probe...	**1574** ➤ *page 6-20*
	Travel WP/control syst. ...	**1506** ➤ *page 10-19*
	Joystick-axis assignment...	**1509** ➤ *page 10-18*
	initialize	**1590** ➤ *page 6-37*
RT 05	Step...	**1522** ➤ *page 15-7*
	Position...	**1521** ➤ *page 15-4*
	Angle	**1524** ➤ *page 15-9*
	Pitch...	**1523** ➤ *page 15-8*
	set to zero	**1520** ➤ *page 15-10*
	link/unlink...	**1566** ➤ *page 15-19*
	Drift correction...	**1572** ➤ *page 6-4*
	Axis...	**1568** ➤ *page 15-14*
DSE	Position...	**1526** DSE LX
	Step...	**1527** DSE LX
	Angle acc. to result	**1528** DSE LX

"Automatic runs (CNC)" menu

CNC Eval Record Service Option Help

Menu	Submenu	DI	
Start CNC	CNC run...	**1640**	➤ *page 18-3*
	STEP mode...	**1070**	➤ *page 18-17*
	Run macro...	**1644**	➤ *page 18-8*
	by remote computer...	**1013**	Opt.11
	Set up one button mode...	**1668**	Opt.5
	Activate one button mode...	**1669**	Opt.5
	AUTO CNC...	**1649**	Opt.18
Intermediate position		**1510**	➤ *page 16-31*
PROG	Start...	**1639**	➤ *page 16-13*
	Jumps...	**1050**	➤ *page 16-44*
	Loops...	**1051**	➤ *page 16-36*
	Stop with DI...	**1096**	➤ *page 16-21*
	manual measuring section...	**1077**	➤ *page 16-25*
	Continue with problems...	**1080**	➤ *page 16-32*
	Correction	**1032**	➤ *page 16-17*
	End...	**1632**	➤ *page 16-85*
Control data	correct...	**1642**	➤ *page 17-31*
	list...	**1641**	➤ *page 17-28*
	convert CMS->LX...	**3201**	Opt.4
	convert LX->CMS...	**3301**	Opt.4
Workpiece administration	copy...	**1643**	➤ *page 17-18*
	delete...	**1635**	➤ *page 17-12*
	enter...	**1634**	➤ *page 17-10*
	Catalog...	**1630**	➤ *page 17-1*
	Modify catalog...	**1645**	➤ *page 17-17*
	Catalog on printer...	**1650**	➤ *page 17-5*
PCM	PCM Edit on/off...	**1666**	Opt.9
	PCM Run mode...	**1671**	Opt.10
	PCM Test run...	**1646**	Opt.9
	PCM generation run...	**1647**	Opt.10
FOCUS	Change of safety plane...	**1041**	Opt.17
	Start of group...	**1042**	Opt.17
	End of group...	**1043**	Opt.17
	Programming dialog...	**1040**	Opt.17
	Assignment of table to graphics...	**1673**	Opt.17
	Pretravel...	**1672**	Opt.17

"Evaluation" menu

Eval **Record** **Service** **Option** **Help**

Eval	Submenu	DI	
Form	Straightness...	1401	➤ page 14-19
	Flatness...	1402	➤ page 14-21
	Flatness/Length...	1472	➤ page 14-21
	Roundness...	1403	➤ page 14-26
	Cylinder form...	1404	➤ page 14-28
	Form dev. ...	1449	➤ page 10-46
	GDT plot...	1470	Opt.2
	Fast plot...	1461	
Position	Position...	1407	➤ page 14-45
	Concentricity...	1408	➤ page 14-55
	Coaxiality...	1409	➤ page 14-57
	Symmetry...	1410	➤ page 14-49
	Parallelism...	1415	➤ page 14-31
	Perpendicularity...	1425	➤ page 14-41
	Angularity...	1435	➤ page 14-38
	Run...	1445	➤ page 14-52
	2D Bore pattern best fit...	1159	Opt.2
Distance	cartesian	1202	➤ page 12-20
	polar 2D	1203	➤ page 13-7
	polar 3D	1261	➤ page 13-9
	Perpendicular	1286	➤ page 12-22
	Perpendicular cylinder	1285	➤ page 12-22
Inters.	Inters.	1218	➤ page 12-2
	2 Axes 3D	1215	➤ page 12-7
	Penetration point S/A	1217	➤ page 13-11
	Convex surface intersections	1219	➤ page 12-9
Symmetry element		1206	➤ page 12-22
Formula...		1379	➤ page 12-27
Mean value...		1345	➤ page 12-25
Angle	Angle	1204	➤ page 13-2
	Output Deg/Min/Sec	1682	➤ page 13-2
	Conversion...	1251	➤ page 13-5
Additions	Additional cone...	1243	➤ page 13-13
	XYZ supplement	1262	➤ page 10-47
	Extreme values...	1460	➤ page 10-45
	Circular pitch...	1311	➤ page 12-30
	Linear pitch...	1312	➤ page 12-30
	Kink recognition...	1189	➤ page 10-27
	Write intermediate file...	1303	Double-column
	Read intermediate file...	1304	license

"Record" menu

Record **Service** **Option** **Help**

Record	Submenu	DI	
Output	repeat current record	1613	➤ *page 5-40*
	Store	1683	➤ *page 5-41*
	retrieve stored data...	1684	➤ *page 5-42*
Record head	print...	1610	➤ *page 5-24*
	modify...	1612	➤ *page 5-22*
	form...	1611	➤ *page 5-27*
Mode	Printer output	1614	➤ *page 5-12*
	Screen output	1615	➤ *page 5-12*
	Print mode...	1662	➤ *page 5-12*
	Name allocation on/off...	1663	➤ *page 5-9*
	Language/unit of measure...	1692	➤ *page 5-16*
	Intermediate results...	1188	➤ *page 10-8*
	Nominal/actual...	1454	➤ *page 14-2*
	Warning limit...	1664	➤ *page 14-13*
	Extent of record...	1665	➤ *page 5-14*
	Graphics output...	1625	➤ *page 5-47*
Nominal/actual	enter...	1459	➤ *page 14-8*
	reserve	1453	cancelled
Layout	Text...	1676	➤ *page 5-33*
	Notes CRT...	1677	➤ *page 5-35*
	Notes CP...	1678	➤ *page 5-37*
	Page feed	1675	➤ *page 5-19*
	variable record...	1687	Opt.1
Plot	Actual/deviation...	1473	Opt.1
	HPGL files...	1653	➤ *page 5-52*
	Paper change	1652	➤ *page 5-49*
	Graphics output mode...	1625	➤ *page 5-47*
Address counter...		1690	➤ *page 6-8*
Output time...		1618	➤ *page 5-38*
Output buffering	Administration...	1674	➤ *page 5-50*
	Output behavior...	1689	➤ *page 5-52*

"Utilities" menu

Service Option Help

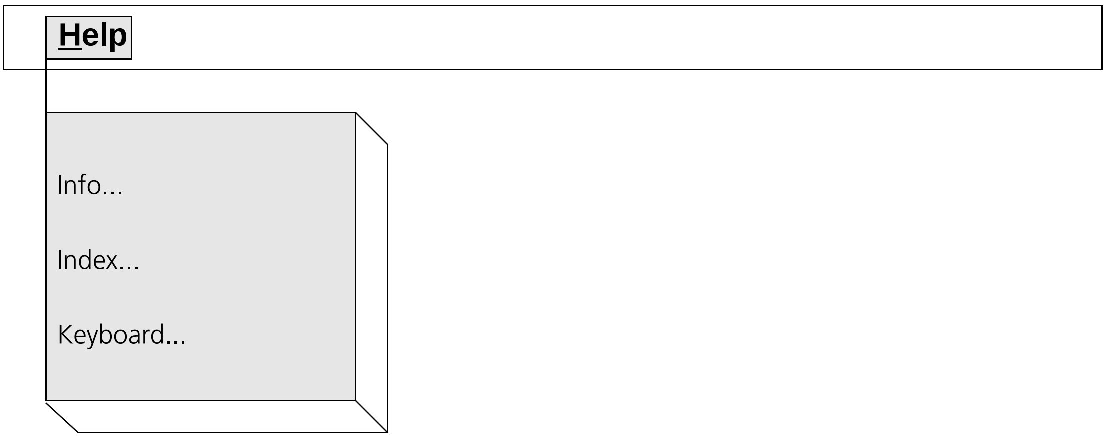
		DI	
Status...		1617	➤ *page 6-36*
Data backup...		3500	➤ *page 4-1*
DATACOM...		3460	DATACOM
General	Window init		➤ *page 3-32*
	Old status	1670	➤ *page 6-7*
	Coordinate display CP	1507	➤ *page 10-3*
	Coordinate display large	15250	➤ *page 10-3*
	System commands...	1685	➤ *page 3-44*
	Change user name...	1698	➤ *page 5-45*
	Start system process...	1686	➤ *page 3-32*
	UMESS End	1003	➤ *page 2-20*
Pictogram pages	Display		➤ *page 3-28*
	switch to background		➤ *page 3-28*
	store...		➤ *page 3-28*
	read...		➤ *page 3-28*
	horizontal		➤ *page 3-28*
	Vertical		➤ *page 3-28*
	small		➤ *page 3-28*
	mean		➤ *page 3-28*
	large		➤ *page 3-28*
Input/Output	Result CP off		
	Result CP on		
	Input computer/control panel		
	Input CP only		
	Input computer only		
Auto User Record	on...	1061	for internal
	off	1062	test purposes
	run...	1063	only
Colors...			➤ *page 3-33*
Fonts...			➤ *page 3-34*

"Options" menu

Option **Help**

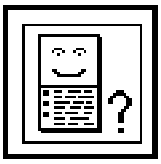
Option menu	Submenu	DI	
SAM	SAM Data transfer...	**2951**	SAM
	SAM...	**2900**	SAM
	SPC...	**2950**	SAM
MFT	I-Position...	**3002**	MFT
	Probing...	**3003**	MFT
	1 Reserve control data line	**3010**	MFT
	reserve n CNC lines...	**3011**	MFT
	DSE mode ACE...	**3005**	MFT
	Select probe...	**3001**	MFT
	Travel path plot...	**3030**	MFT
	ACE ON	**3000**	MFT
	UMESS (ACE OFF)	**3099**	MFT
KUM...		**2700**	KUM
ROM...		**2800**	Opt.12
GON...		**2300**	GON
KAM...		**3800**	MFT
CAD LINK...		**2000**	Opt.7
CMM ball plate...		**2600**	Opt.15

"Help" menu



Pictograms in the UMESS main menu

Calling UMESS functions via pictograms



Pictograms are icons with graphic symbols to which a specific UMESS function has been assigned. The UMESS main menu features 64 pictograms in 4 "pictogram pages".

Preassignment

The UMESS main menu (file DTableFile) contains four pictogram pages which are preassigned to specific job categories: **Prepare, Measure, CNC/PROG** and **0000**, whereby the last category is a blank page for your own individual entries. You can store further pictogram pages and read them in with the functions listed under **<Service> <Pictogram pages>**.

Long-term setting

The pictogram pages displayed the last time UMESS was terminated will be displayed again after UMESS is restarted, provided that they had been stored once in this form (➤*„Editing a pictogram page“ on page 3-25* Storing pictogram pages). This long-term setting thus ensures that the pictogram pages you worked with during your last UMESS session will appear unchanged the next time you work with them, e.g. on the next day.

Using the mouse

If you position the mouse pointer on a pictogram, the corresponding direct input number (DI no.) and title (name of the UMESS function in plain text) will be displayed above the pictogram page immediately.

You can then activate the corresponding UMESS function by clicking on the left mouse button *once*. The DI no. of the active UMESS function is then displayed along with the message **"Job being processed"**.

NOTE

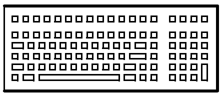
Do **not** execute a double-click. The second click would activate the function a second time, thus constituting an illegal action. If you try to activate two UMESS functions simultaneously, the following window will open when you activate the second function:

<placeholder>

Selecting another pictogram page

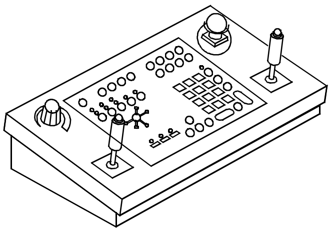
Using the mouse

If you click on one of the four index tabs to the right of the pictogram page **once** with the left mouse button, the corresponding pictogram page will be displayed.



Using the computer keyboard

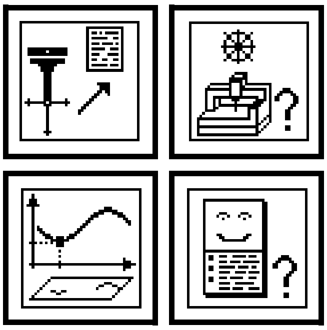
You can switch to the next pictogram page by pressing softkey **<F9>**.



Using the standard control panels

You can switch to the next pictogram page by pressing softkey **<F9>**.

Editing a pictogram page



With the UMESS main menu, you can custom design the user interface to meet your own requirements.

You can design the pictogram pages according to the jobs you most often require and store them as a file. You can also label the index tabs for selecting the pictogram pages and store multiple files.

The stored file activated last will be displayed again following the next system start.

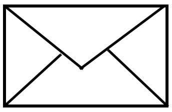
Saving a menu item as a pictogram

Selection

You can create pictograms from any menu items which are not marked with a triangle and which are UMESS functions and save them in one of the four pictogram pages.

Procedure

To fetch a menu item (i.e. a UMESS function) from the Pull-Down-Menu and save it as a pictogram, you must find the corresponding menu item. To do this, place the mouse pointer on a menu item in the main menu, press the *left* mouse button and keep it pressed. The corresponding first submenu will then be displayed. Then drag the mouse pointer through the menus until you have reached the required menu item. Now press the right mouse button as well and, keeping both buttons pressed, drag the pointer out of the menu. Let go of both mouse buttons. The mouse pointer then changes shape to an envelope symbol and the menu is closed.



Position the envelope symbol on the pictogram which you want to change (overwrite) and click once with the *right* mouse button. The envelope symbol is then closed and the graphic symbol appears. You have now stored the menu item as a pictogram on the pictogram page. If no graphic symbol is available for the selected menu item, the DI no. will be displayed instead.

Copying pictograms

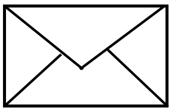
You can copy pictograms and save them on the same pictogram page or on another one.

Procedure

Position the mouse pointer on the required pictogram. Then press the right mouse button, hold it down and drag the mouse pointer out of the pictogram. The mouse pointer then changes to an envelope symbol.

Envelope symbol

Using the envelope pointer, you can select another pictogram page via the index tabs located to the right of the pictogram page. To do this, click on the corresponding index tab once with the *left* mouse button.



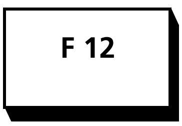
Position the envelope symbol on the pictogram which you want to change (overwrite) and click once with the *right* mouse button. The envelope symbol is then closed and the graphic symbol appears. You have copied the pictogram and saved it on another pictogram page.

Editing pictogram pages with the "Direct input" window

You can copy texts or numbers you have written to the **Direct input** window to the current pictogram page or to one of the four index tabs.

Procedure

Your pictogram will function properly if you copy a valid **<DI No.>** or a valid text abbreviation from the **Direct input** window to a pictogram. If a graphic symbol is available for the **<DI No.>**l , it will automatically be displayed when the pictogram is transferred to the pictogram page. If no graphic symbol is available, the **<DI No.>**. will be displayed in the pictogram.



Press softkey **<F12>** to open the **Direct input** window. For more details on the **Direct input** window (➤*„Function calls“ on page 2-16*).

Procedure

You can enter up to eight characters in the input field of the **Direct input** window.

To transfer your input from the input field to a pictogram page, position the mouse pointer on the input field, press the *right* mouse button and keep it pressed. If you then drag the mouse pointer out of the **Direct input** window, its shape will change to an envelope symbol. Position the envelope symbol on the pictogram or index tab you want to overwrite and click once with the *right* mouse button; the text from the input window will then be entered in the pictogram or index tab. If a graphic symbol is available for an entered **<DI No.>**, it will be displayed in the pictogram.

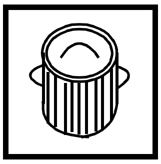
Deleting a pictogram

You can delete a pictogram by copying a blank pictogram onto the one to be deleted.

DI 0000

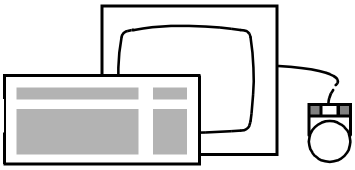
If no blank pictogram is available, you can open the **Direct input** window with softkey **<F12>** and copy the four zeroes **0000** from there to the pictogram page using the *right* mouse button.

Trash can



If you make a mistake while copying a pictogram you can also *throw it away* into the "*trash can*". A trash can icon is located in the bottom right corner of the UMESS main menu. If you place the envelope-shaped mouse pointer on the trash can icon and click on the *right* mouse button, this will cancel the copy process.

Utilities for the pictogram pages



DI	Pull-Down-Menu	Pictogram
	Service	
	Pictogram pages	

NOTE

In the **<Pictogram pages>** utility you can select the following functions:

Display — Display the pictogram pages

switch to Backgr — or mask them.

store... — See below for description.

read... — See below for description.

horizontal — The pictogram pages can either be displayed horizontally with **16 pictograms**,

vertical — or vertically with **12 pictograms**.

small
mean
large

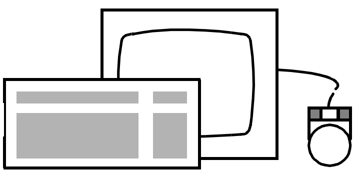
Depending on the size of your monitor, you can select a *small, mean* (average) or *large* display of the UMESS main menu and record window.

Dynalog control panel: To display the complete UMESS main menu on the monitor, you must set the display to *small*, since the display can not show any other resolution.

Saving pictogram pages

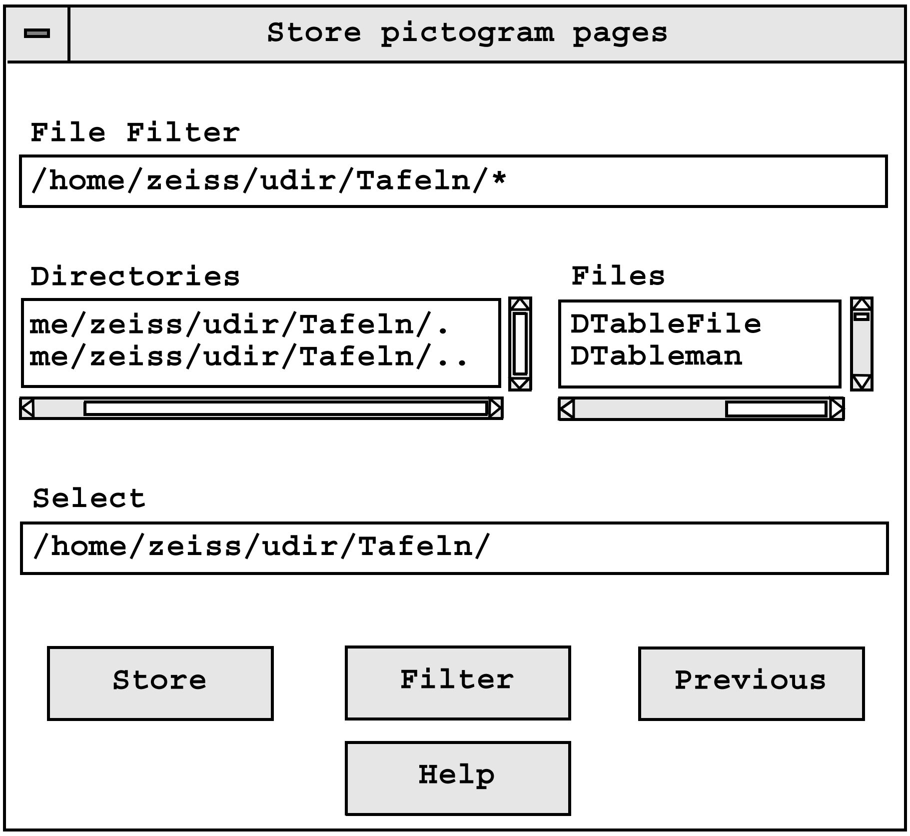
Function call

After editing the pictogram pages, you can save this status in a file.



DI	Pull-Down-Menu	Pictogram
	Service	
	Pictogram pages	
	store...	

The **Store pictogram pages** window is displayed with the function call.



Softkeys

Speichern

When this function is selected, the cursor is automatically positioned in the **Select** data box and you can enter a name directly or select a name which already exists from the **Files** display box.

All four pictogram pages are saved in a single file.

NOTE

The default assignment for the pictogram pages is saved in the **DTableFile**. Avoid overwriting this file wherever possible.

Filter

This function can help you find a specific filename more quickly. Enter a selection restriction in the **File Filter** box. When the **<Filter>** is pressed, only those files which meet the criteria entered will be listed in the **Files** display box.

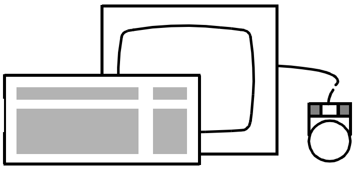
Previous

You must press this button after saving files or to quit this screen page without making any changes.

Read-in of pictogram pages

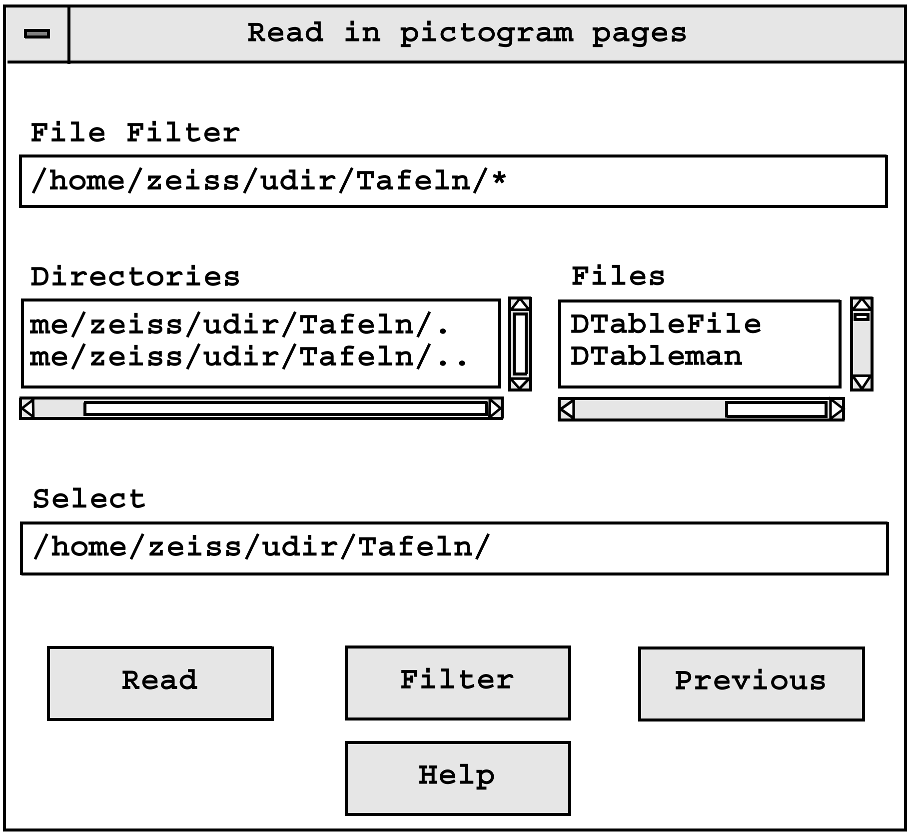
Function call

You can call (read-in) and display the files saved with your personal pictogram pages in the UMESS main menu.



DI	Pull-Down-Menu	Pictogram
	Service	
	Pictogram pages	
	read...	

The **Read pictogram pages** window is displayed when the function is called.



Softkeys

Read

When this function is called, the cursor is automatically positioned in the **Select** data box and you can enter a name directly or select a name which already exists from the **Files** display box using the mouse.

NOTE

The default assignment of the pictogram pages is saved to the **DTableFile**.

Filter

This function can help you find a specific filename more quickly. Enter a restriction in the **File Filter** data box. When the **<Filter>** button is pressed, only those files which correspond to the criteria entered are displayed in the **Files** display box.

Previous

You must press this button after saving the files or to exit this screen without making any changes.

Pictogram pages after starting UMESS

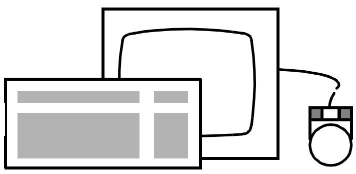
Long-term setting

The pictogram pages you stored or read-in last will be displayed again when UMESS is restarted. This means that you will find the pictogram pages you worked with the last time exactly the way you left them, e.g. when starting work the next day.

Reinitializing a window

Function call

This function is used only in connection with the window display on the **Dynalog control panel**:



DI	Pull-Down-Menu	Pictogram
	Service	
	General	
	Window init	

Window init

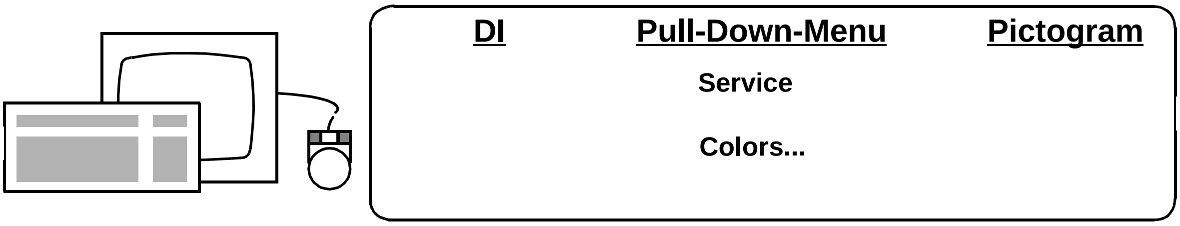
This function is used to refresh the window (see also the Dynalog manual).

Setting colors and fonts

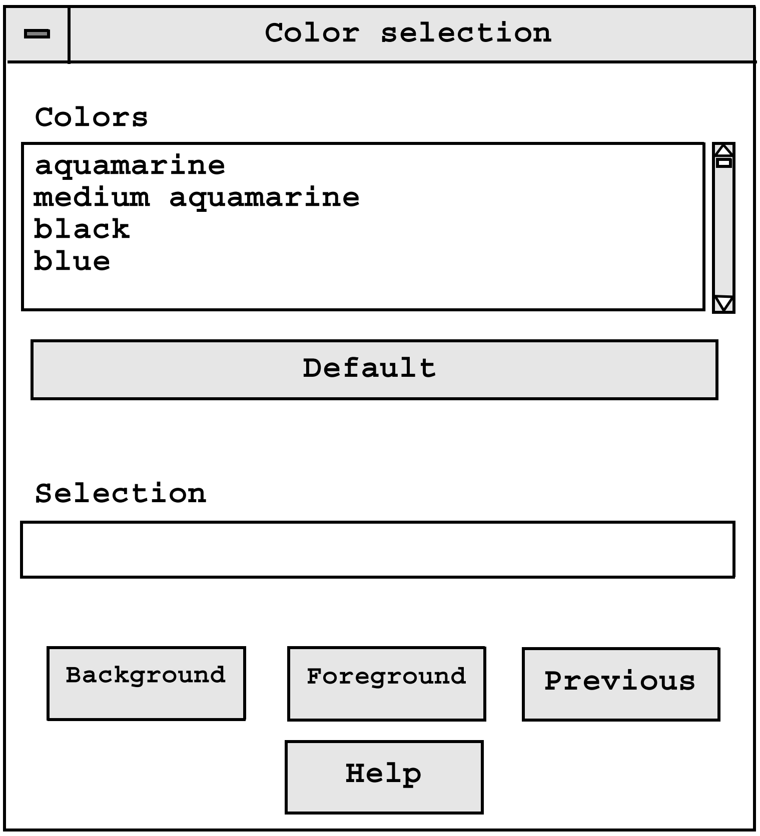
Setting colors

Function call

With the **<Colors>** program function you can temporarily set different colors for the foreground and background of the UMESS main menu.



You can select the color of your choice from the **Colors** selection box with the mouse. Use the right-hand scroll bar to browse through the entire range of colors available.



NOTE

The color and font settings remain effective only until UMESS is terminated. The default settings will always be reactivated following the next restart of UMESS.

Softkeys

Background The color selected is used as the background color.

Foreground The color selected is used as the foreground color for the fonts.

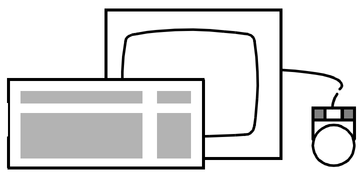
Default The default setting with a gray background and a white font is reactivated.

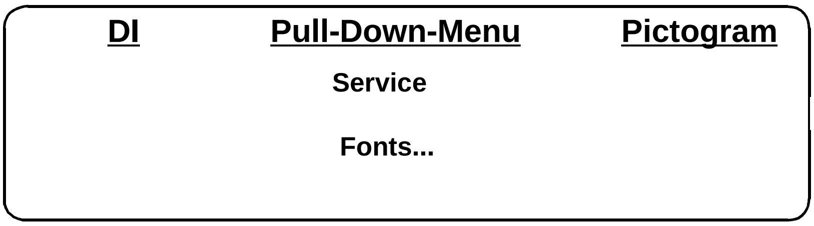
Previous Temporarily saves settings and closes input window.

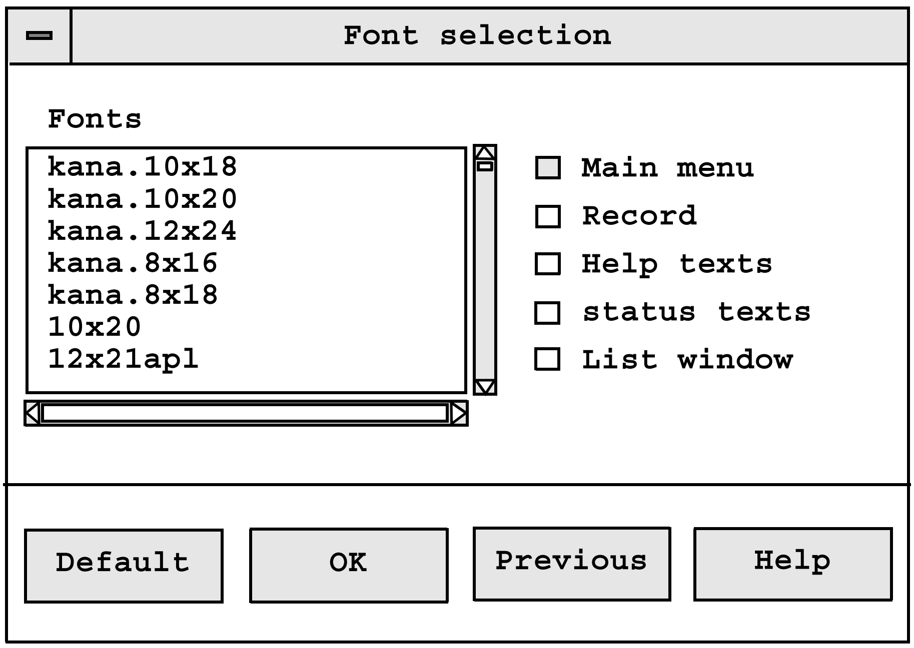
Setting fonts

Function call

With the **<Fonts>** program function, you can temporarily set different fonts and font sizes for the UMESS main menu, record, help texts, status texts and list window.







Softkeys

NOTE

First use the mouse to select the texts to which the change should apply on the right side. Then the font must be selected from the pick-list on the left.

Default The default setting for the fonts is reactivated and displayed.

OK The font selected is accepted and displayed immediately.

Previous Temporarily saves settings and closes the input window.

NOTE

The color and font settings remain effective only until UMESS is ended. The default settings are always reactivated the next time UMESS is started.

Other windows in UMESS

Printer (record) window

All of the data output by the program (e.g. measurement records, probe data, control data) are displayed in the printer window.

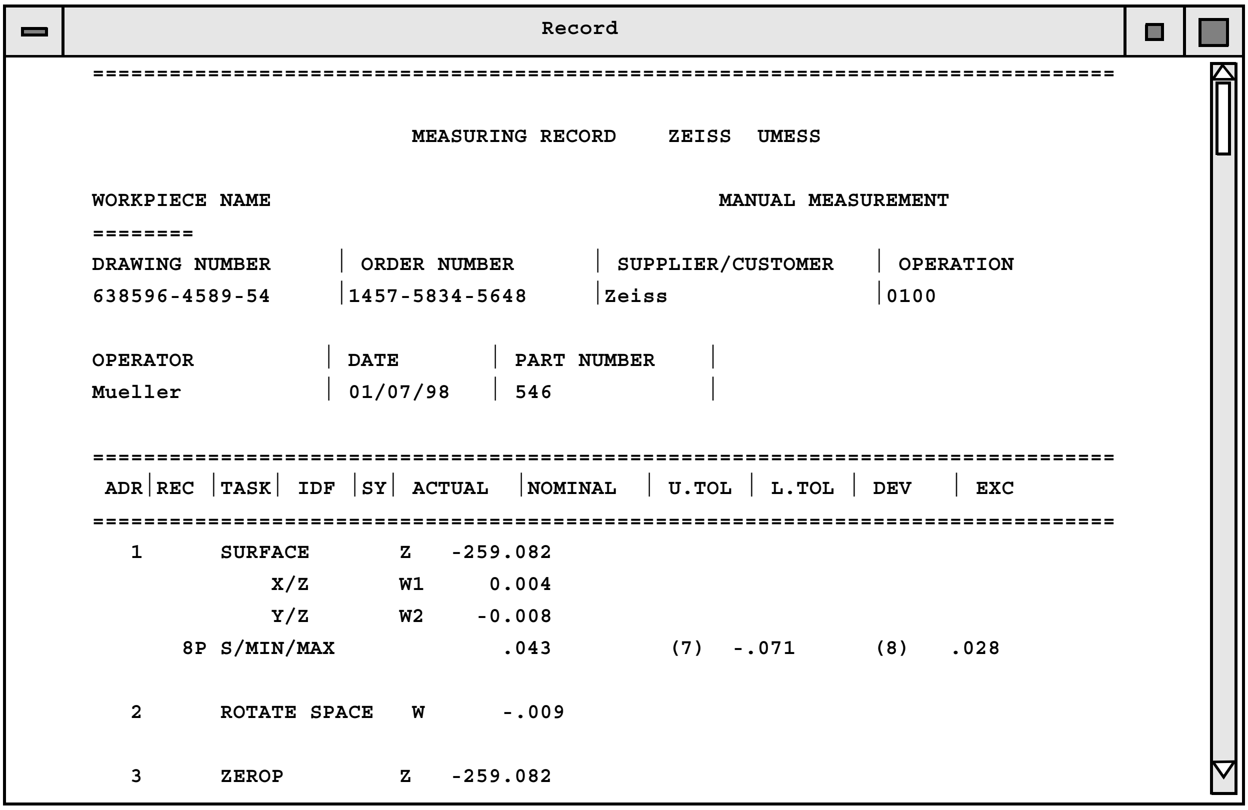
Inputs

No inputs can be made to the printer window.

Start

The printer window is automatically displayed when you start UMESS.

Example of a printer window



Description of record output

➤„Output of results“ on page 5-1

Plotter window

All of the graphics output by the program (e.g. roundness plot, KUM representation) are displayed in the plotter window.

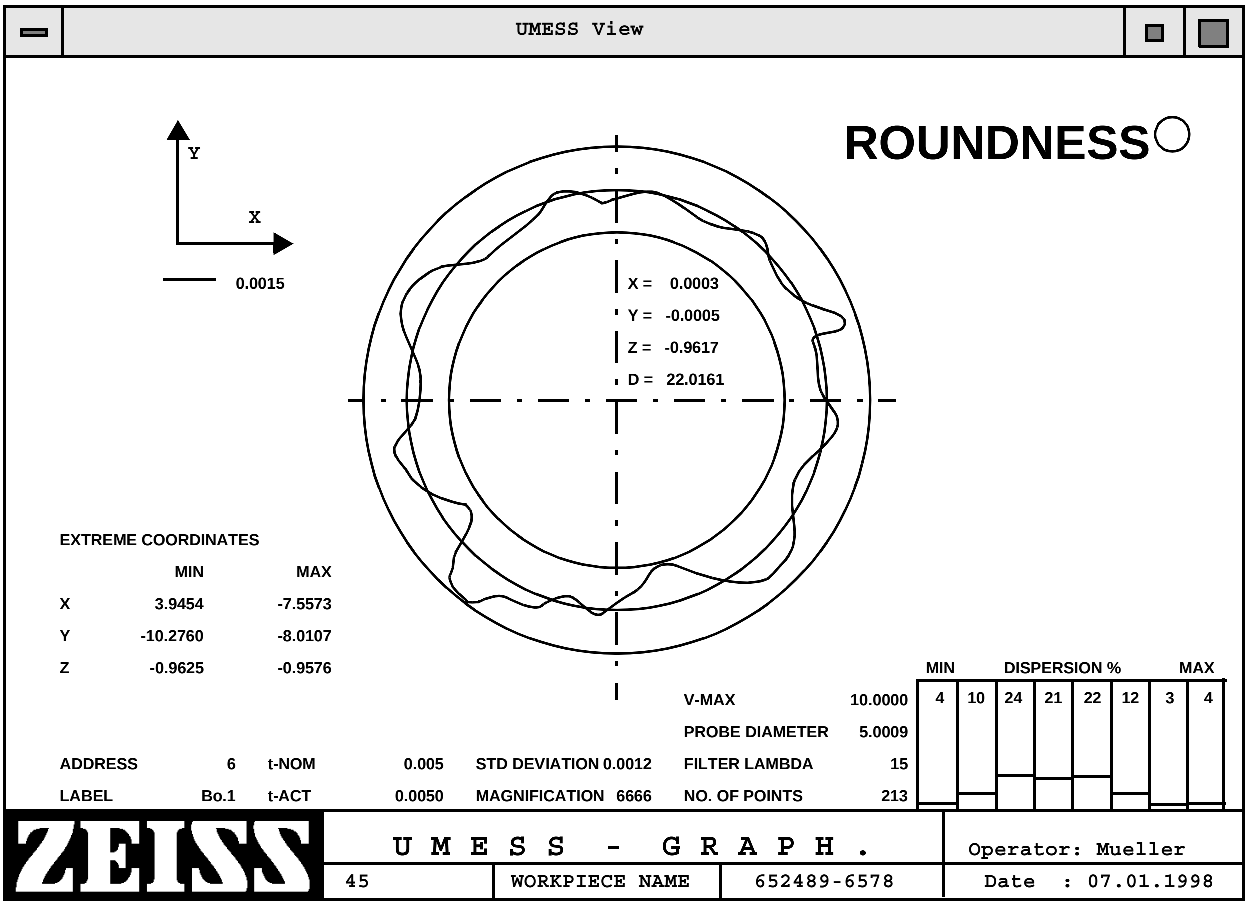
Inputs

No inputs can be made to the plotter window.

Start

The plotter window automatically opens in its default position when UMESS is started.

Example of a plotter window



Description of plot output

See operator’s manual for Option 2.

Dialog window

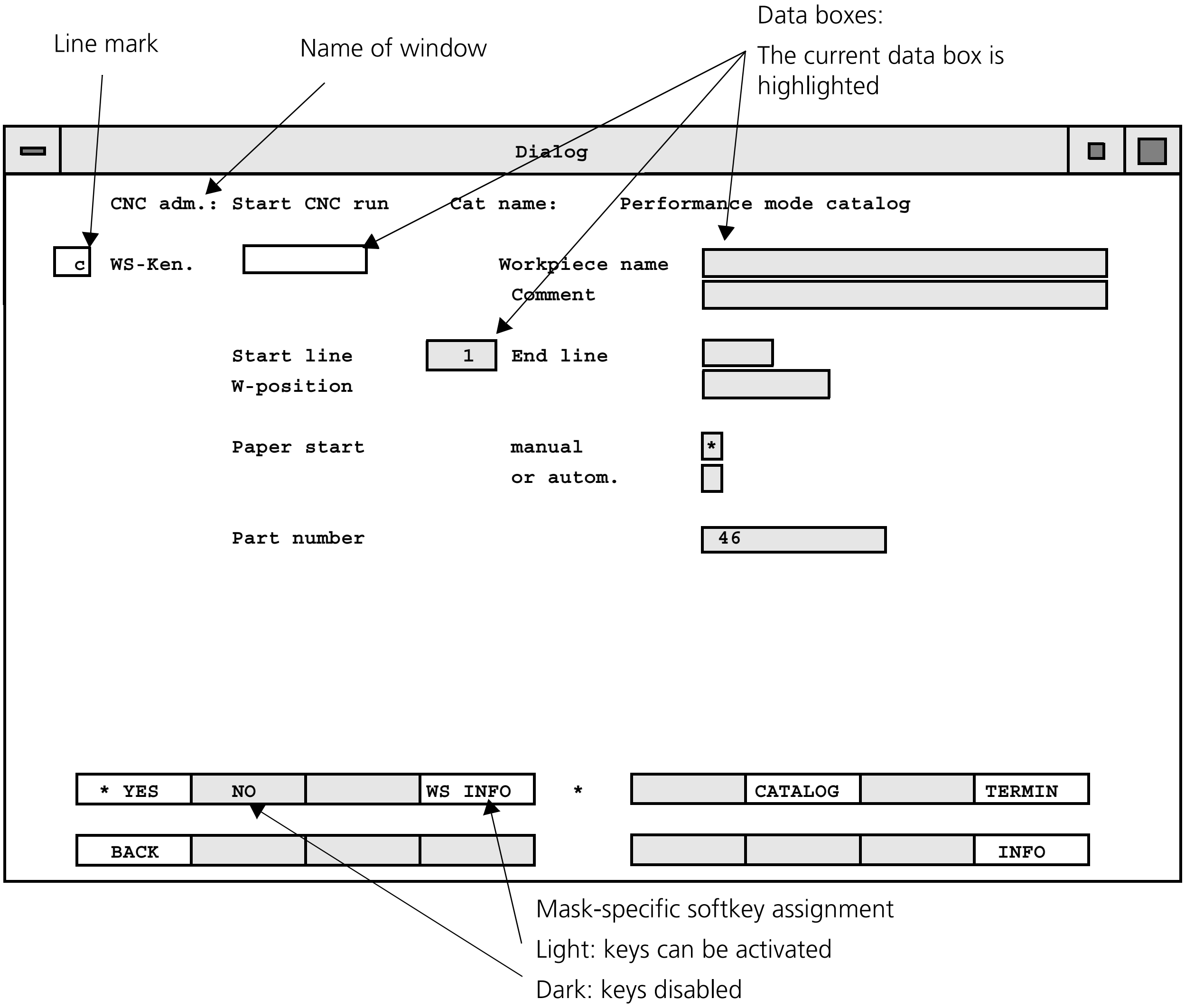
Application

After the function call, UMESS usually needs more information to execute the function. The program prompts input of this information via the dialog window(s).

Explanation

Where necessary, this UMESS operator's manual documents the dialog windows as they appear after the function call.

Example of a dialog window



Procedure

Data box

The data box where the next input is required is highlighted. In some cases it will be preassigned with a suitable default value.

- Typing an input into the box deletes the preassigned default value.
- If you move the cursor to the right with the cursor key before typing your entry, the contents of the box remain intact and can then be modified.
- Pressing **<Backspace>** (several times) causes the original contents of the box to appear again.

Line mark

The line mark indicates which values are allowed in the given box:

c	Any character, upper case or lower case is possible. Example: **Housing 1**.
C	Any upper case character possible; lower case **not** possible. Example: **WST 57**.
Y	YES/NO box, i.e. accept with **<YES>** or reject with **<NO>**. In the dialog window above **Paper start manual** and **or autom.** are yes/no boxes. **<YES>** normally enters an asterisk *****.
I	Integers (whole-number values). Examples: **1**, **204**, **-5**.
D	Integers or decimal numbers. Examples: **1.56**, **.50**, **-1004.25**, **7**.
W	Angle.

Inputs

Type in new value or accept default value and confirm with **<Enter>**. If the input is correct, the next data box will be highlighted. If the input is wrong, the program will prompt a correction. Work through all data boxes in this manner. If only individual boxes have to be changed, move to these boxes using the ˅ and ∧ cursor keys.

Inch

The line mark also has an I for inch inputs.

Softkeys

Quit or cancel the dialog window with one of the softkeys.

The following generally applies:

TERMIN Starts the function with the values entered or opens additional dialog windows if necessary.

EXECUTE Starts a function without exiting the dialog window.

BACK
PRE MENU
CANCEL
These three softkeys can all be used to exit the mask without starting the function.

REPEAT Checks the values entered.

INFO You can call any further information available using this softkey.

Special features

Exceptions and special features are explained in the section of the manual containing the corresponding functional description.

UMESS dialog window

Application

This window is used to display the bootfile when booting UMESS. Several system messages are also logged here during operation of UMESS.

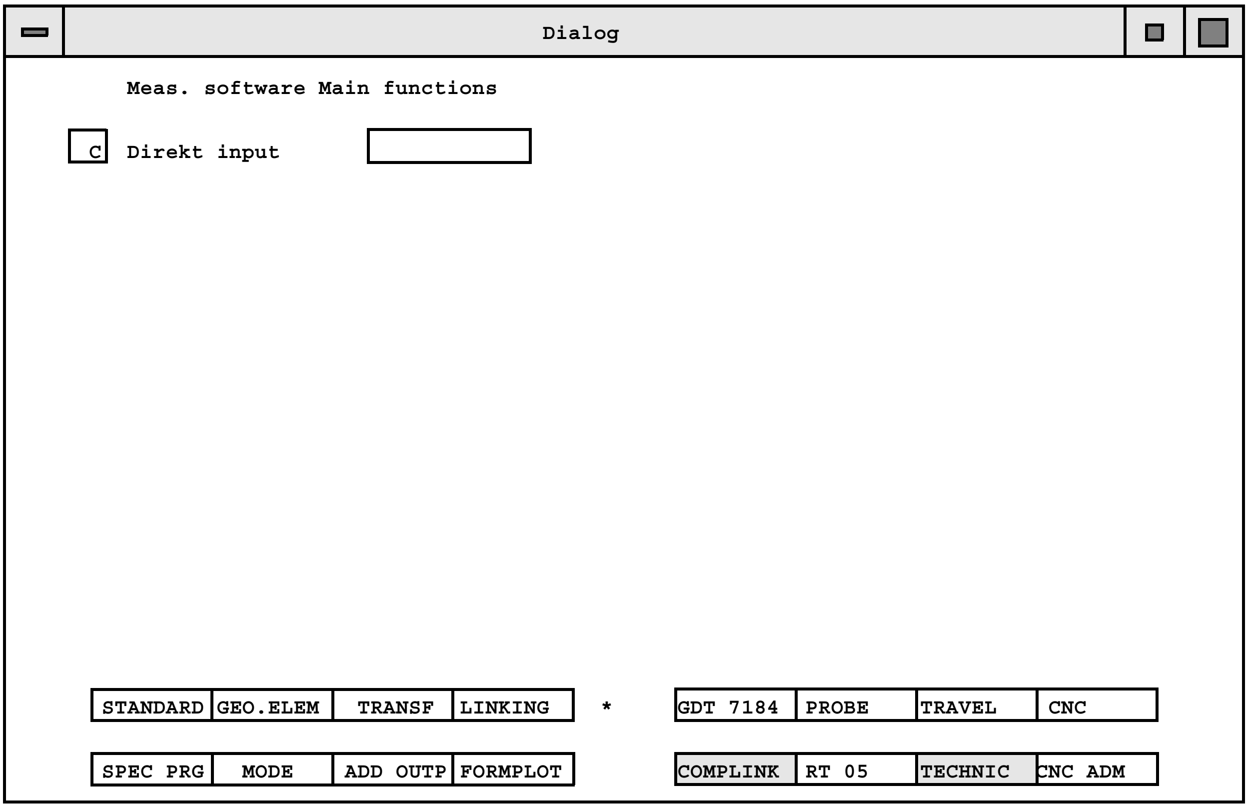
Activating/deactivating the UMESS main menu

Application

You can switch off the UMESS main menu graphic user interface to enable control of UMESS via the dialog window. This enables you to enter direct input numbers and actuate softkeys in the dialog windows.

Operation

You can deactivate the UMESS main menu by entering **<DI No.> -18** and acknowledging with **<Enter>** in the **Direct input** window.



Dialog window

When you deactivate the UMESS main menu, the **Meas. software Main functions** dialog window for entering direct input numbers is displayed and activated.

Although the UMESS main menu and **Direct input** window are still displayed on the screen, they are off-line.

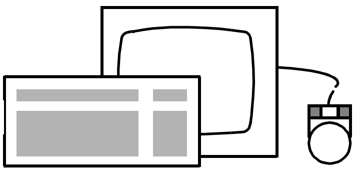
Reactivation

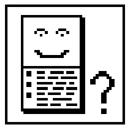
You can reactivate the UMESS main menu by entering **<DI No.> -17** in the **Direct data box** of the **Meas. software Main functions** window and acknowledging with <Enter>.

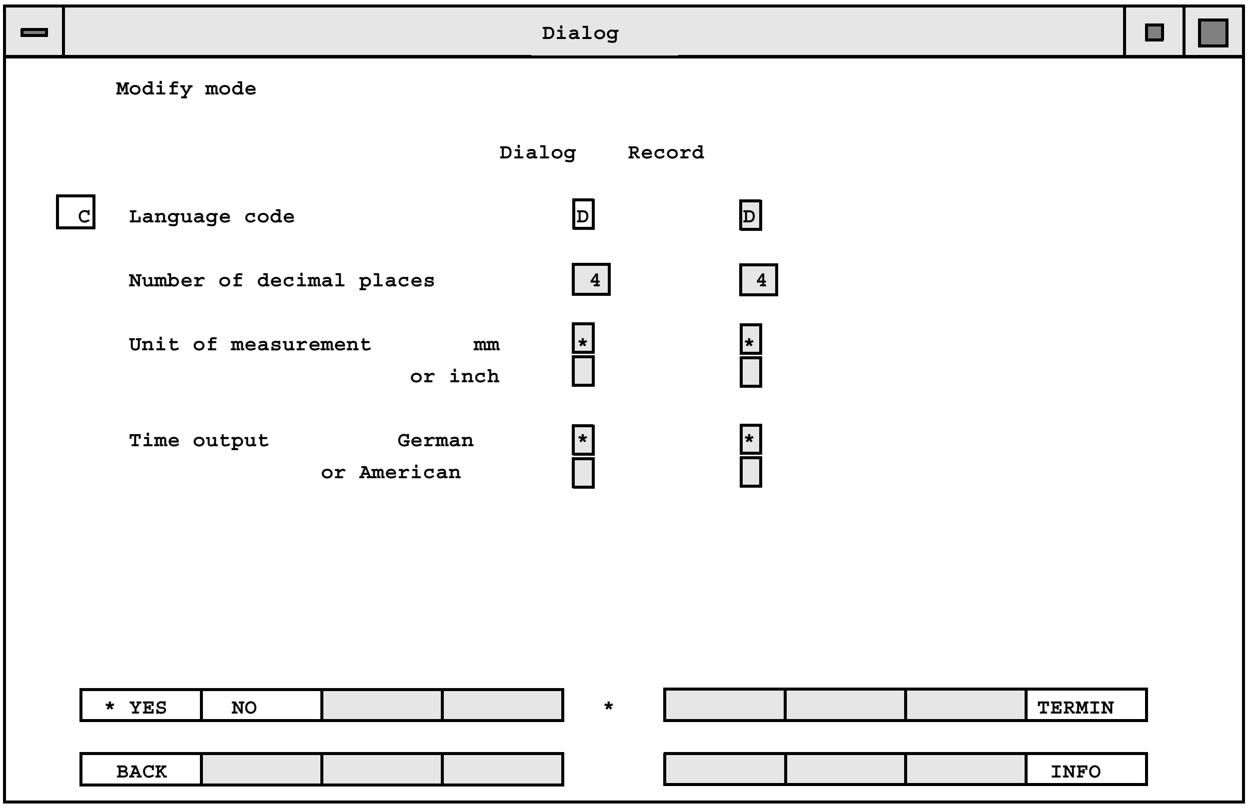
Changing the language <DI 1692>

Application

If several languages are stored in the language file on your computer, you can change the UMESS main menu, dialogs and records to one of these languages.



DI	Pull-Down-Menu	Pictogram
1692	Prot	
	Mode	
	Language/unit of measurement...	



Language abbreviations

D = German, **A** = English, **E** = Spanish, **H** = Dutch, **F** = French, **I** = Italian, **P** = Portugese, **S** = Swedish

Enter the abbreviation of the language you require and confirm with **<TERMIN>**.

NOTE

The function call initially changes languages only in the dialog and the record window.
To use the UMESS main menu in the other language, you must first end the current measuring program session with (**<UMESS End>**) and then restart UMESS.

For a description of the other functions in the dialog window: ➤*„Output of results“ on page 5-1*

NOTE

If the message: **File not found** appears when you select a language, then the language selected has not been released on your computer. Exit the dialog page with **<BACK>**.

Pictogram pages in the other language

Index tabs

The labeling of the four index tabs for selecting the pictogram pages and the pictogram pages themselves do not change when the other language is selected. If you would like to change the corresponding pictogram pages and index tabs to the other language, you must manually read them in accordingly. (➤*„Utilities for the pictogram pages“ on page 3-28*).

Filename

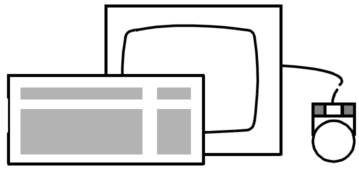
The filename begins with the abbreviation of its corresponding language and has the suffix **TableFile.**

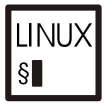
Example for English pictogram pages: **ATableFile**

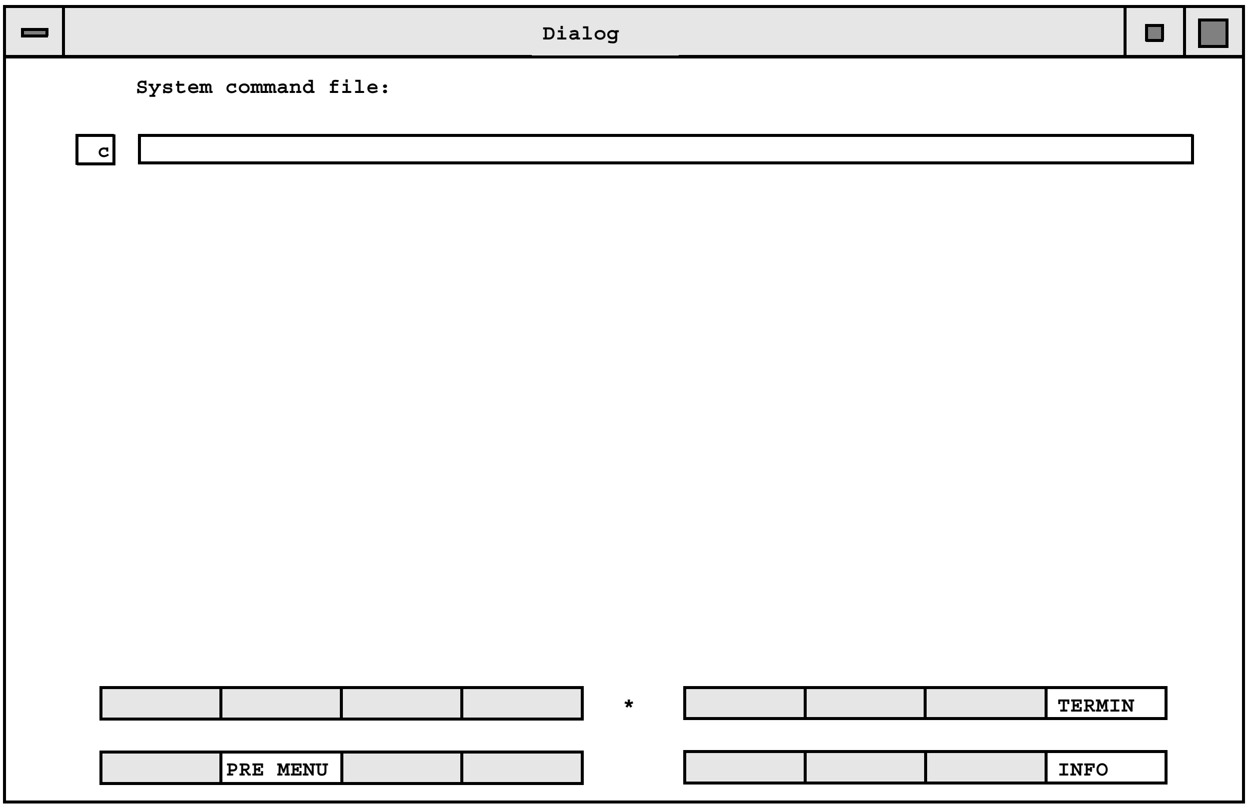
Starting system programs <DI 1685/1686>

Application

In individual cases it may be necessary to utilize customized command files or programs you yourself have created in addition to the measuring SW provided by Carl Zeiss. The programmable **<DIs 1685>** and **<1686>** can be used to start such "learn" or "part" programs:

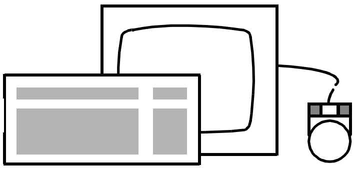


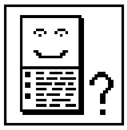
DI	Pull-Down-Menu	Pictogram
1685	Service Mode System commands...	

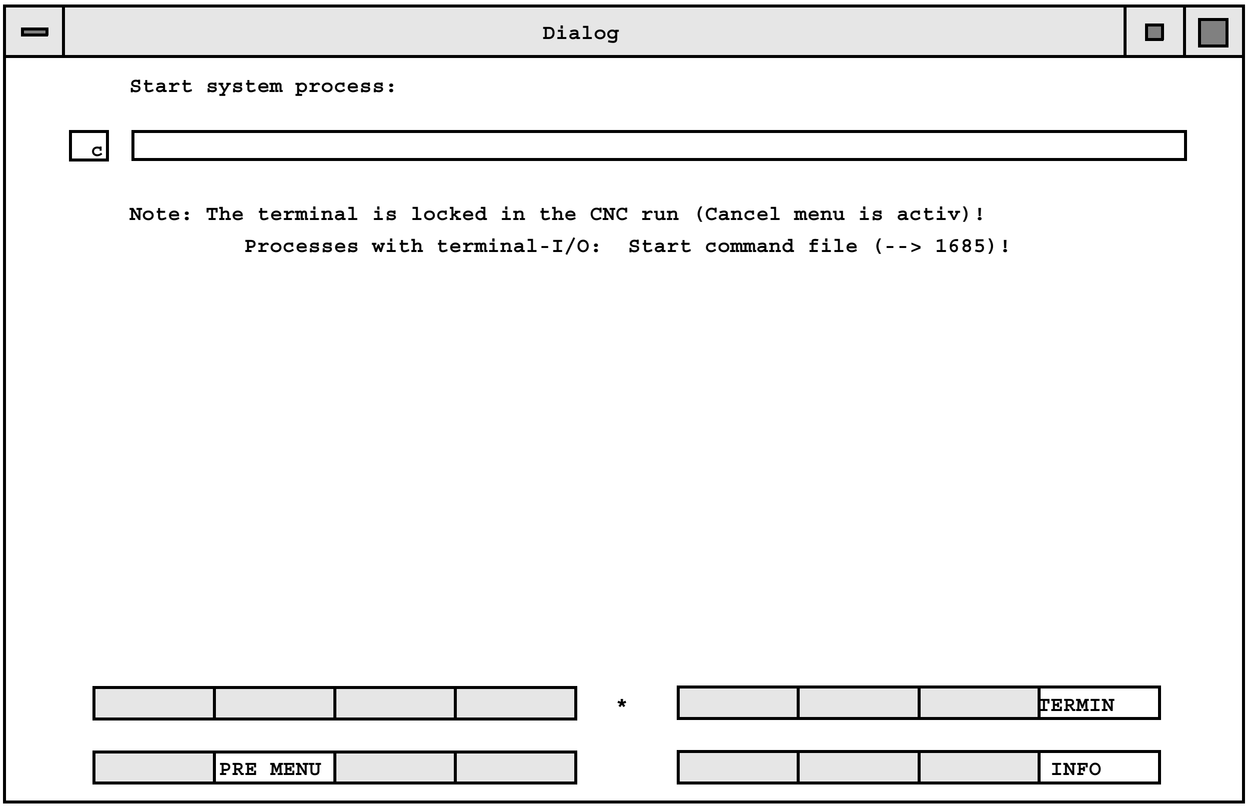


Special feature

<DI 1685> is intended for dialog-oriented customized programs. If the screen is enabled for dialogs, the **<STOP>** or **<CANCEL>** softkeys are no longer available during the CNC run. The CNC mode must therefore be interrupted.



DI	Pull-Down-Menu	Pictogram
1686	Service General Start system process...	



Special feature

<DI 1686> makes it possible to start programs which do not require a dialog. The screen is not enabled for dialogs so that the CNC mode does not have to be interrupted.

Data boxes

Input of a run string comprising max. 72 characters.

TERMIN

Execution and return to UMESS.

Path

A path to the customer programs must be defined, e.g.: **/opt/zeiss/tool** or another path to personal program directories.

Types of program

You can use shell scripts, Fortran or C programs. Parameter transfer is usually performed as for the start, i.e. from the shell level.

Parameters

Return of the parameters:

– from the shell script with the command **CZ_return**.

– from a C program with the command **exit()**.

– from a Fortran program with the subroutine **ftn_exit()**.

NOTE

– The parameters must be transferred in the run string.

– An integer*2 type error variable and an error string with a length of 80 characters are provided as return parameters.

– If an error is transferred, a CNC run may be canceled. If an error string is set, it will be output to (and displayed on) the screen.

Chapter 4

Data backup UNIX/LINUX

This chapter contains:

General information on data backup UNIX

Loss of data

Operating errors (unintentional deletion) or exceptional disk faults may result in a loss of CNC programs, control data, performance modes (standards), probe data etc. or even the entire software revision.

In such cases, all of your valuable data may under certain circumstances be lost if you have not run a data backup.

IMPORTANT!
If no system administrator is responsible for data backups of your system, every user is responsible for performing regular and timely backups of his own data!

The data backup can be performed in various ways:

<DI 3500>

In UMESS you can save CNC runs using **<DI 3500>** and KUM data using **<DI 3510>** to disk or DAT tape.

User data backup

User data can be saved to DAT tape (DDS) using CZ Utilities.

Full backup

Using the UNIX system with SAM, the entire hard disk can be saved to DAT tape (DDS).

Network

A data backup can be automated by your system administrator via the network.

Reconstruction

The following backup procedure is recommended to enable reconstruction in cases involving the loss of very small amounts of data:

Full backup and user data backup

Backup of all data to DAT tape (DDS):

Between once a week and once a month, depending on the amount of new or changed data => using CZ Utilities (➤*„Backup and restoration of user data with CZ Utilities“ on page 4-16*).

Use at least two different DAT tapes alternately.

<DI 3500>

Control data and KUM workpieces:

On date of creation or change => via **<DI 3500>** (➤*„Backing up and restoring CNC programs <DI 3500>“ on page 4-3*).

As with the DAT tapes, you should alternate diskettes here as well.

Before the update

We strongly recommend backing up important UMESS data prior to every new installation or update of measuring software!

Backing up and restoring CNC programs <DI 3500>

Intermediate storage

Application

With this function you can copy UMESS and KUM workpieces from the workpiece catalog to a backup medium via an intermediate or temporary store. Furthermore, this function ensures that workpieces from other systems, e.g. UMESS 1000 can also be used in UMESS UX.

KUM data

KUM command blocks can be copied to the intermediate store via **<DI 3510>** and restored with **<DI 3511>**.

Application examples

Backup

For backup of new or modified measuring runs, preferably every day and in duplicate. In this way, you also back up those workpieces which have been added or modified since the last full data backup .

External storage

If the workpiece catalog is full, you can swap-out CNC programs you no longer need to external storage, from where they can also be retrieved.

Transport

Used to send or transport CNC programs, or to load runs sent on a backup medium.

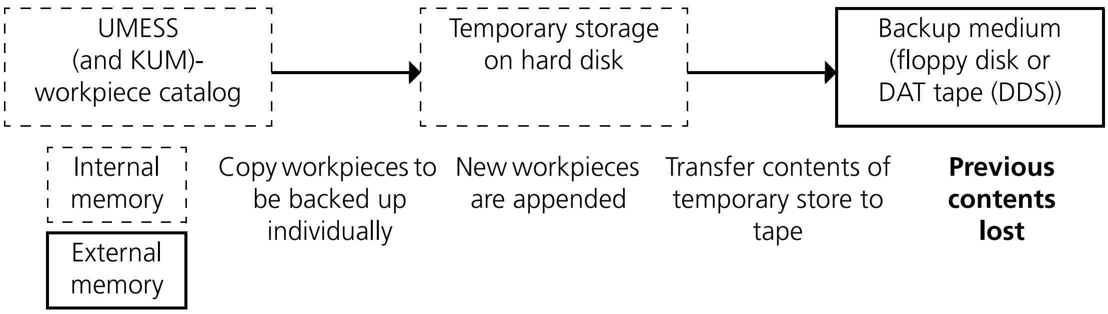
Other

You can also copy workpiece files and other files outside of UMESS to and from backup media using UNIX commands.

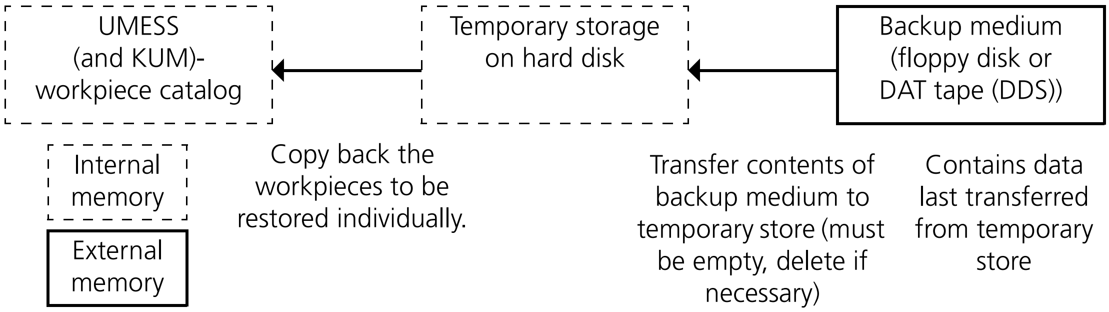
Directory

The following directory is used for intermediate storage on the hard disk: **/var/opt/zeiss/CZ_BACKUP_SCR**.

Principle of external data storage with **<DI 3500>** (backup):



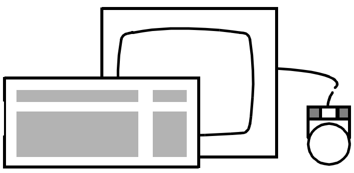
Principle of restoring data with **<DI 3500>**:

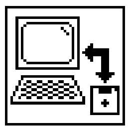


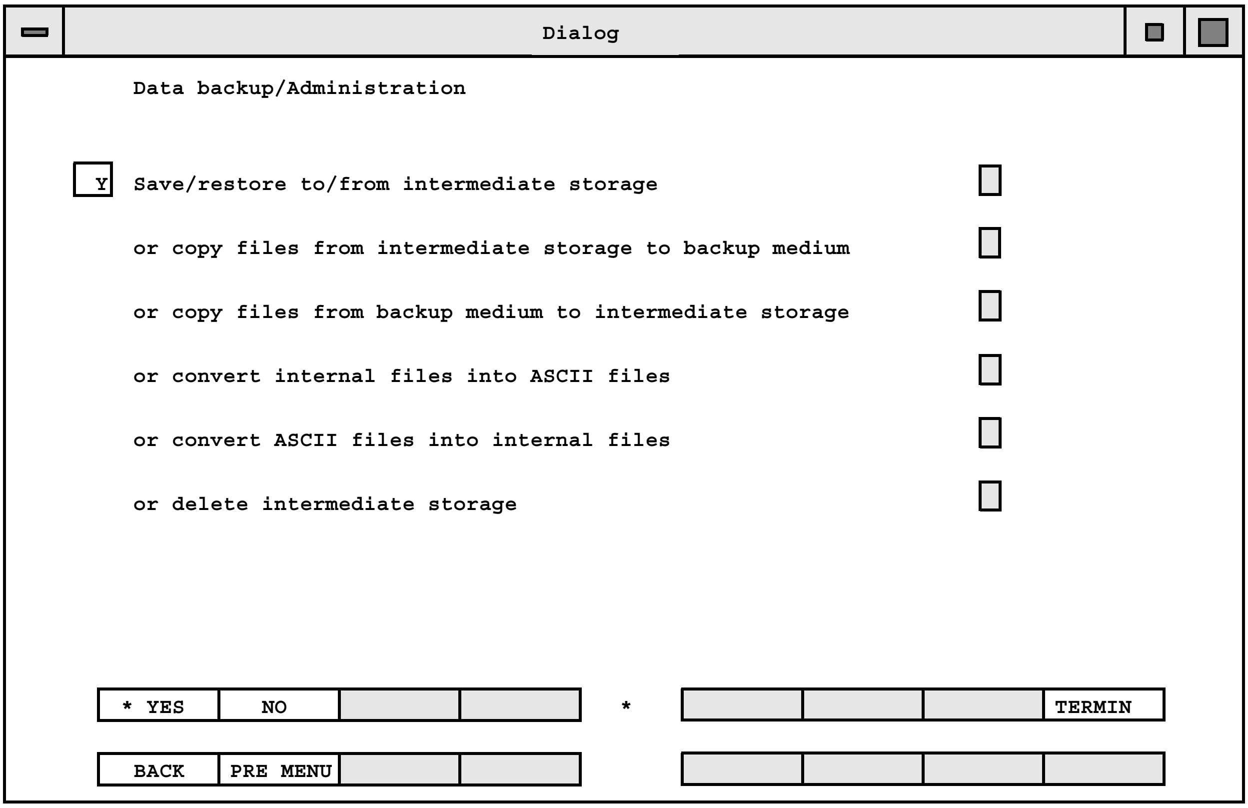
Dialog page for data backup

Function call

You must always start all operations involving the external storage and retrieval of workpieces or any conversion required between the internal and ASCII format from the **<Data backup/Administration>** dialog window.



DI	Pull-Down-Menu	Pictogram
3500	Service Data backup...	



Function selection

Function selection can not be performed with the mouse, but only via the keyboard. Only the softkeys in the dialog window can be operated with the mouse.

Softkeys

*** YES**
NO

Select/reject the appropriate function with these softkeys.
(**<YES>** = entry of *****)
Selection of individual boxes is also possible with the ˅ and ˄ cursor keys.

TERMIN

This key is used to confirm execution of the selected function.

PRE MENU
BACK

After finishing all copying procedures, you can close the dialog window with one of these two keys.

Clearing the intermediate store

Application

The intermediate store must be cleared

- if you want to create a new backup or
- to prepare for data restoration from a backup medium.

Function call

Select the function required with the **<YES/NO>** keys and confirm with **<TERMIN>**.

Backup to/restoration from intermediate storage

Application

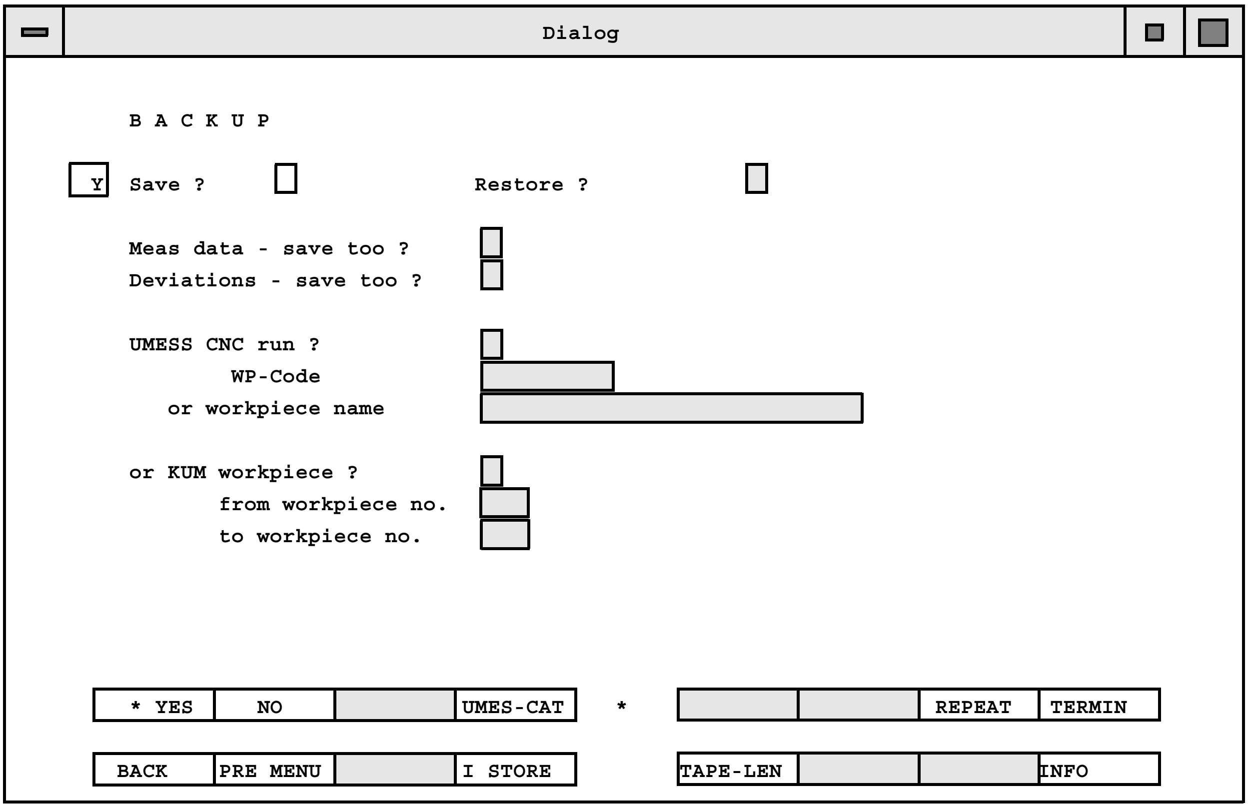
With the procedure described below you can

– copy (back up) CNC runs or KUM workpieces intended for backup to intermediate storage,

– copy (restore) workpieces from intermediate storage to the workpiece catalog,

– define the size of the intermediate store (depending on the backup medium used),

– list the contents of the intermediate store.



Softkeys

*** YES**

NO

Task selection (**<* YES>** = enter *****).

UMES-CAT

Outputs workpiece catalog to screen (see also ➤*„Control data modification and management“ on page 17-1*).

REPEAT

Used to complete missing entries (e.g. workpiece names).

TERMIN

Closes the dialog window and causes the workpiece entered to be copied in the specified direction. Then the dialog window reappears.

If when **Restore = *** the workpiece specified already or still exists in the workpiece catalog, the program will request a new workpiece name. In this way you have the option of duplicating UMESS workpieces in the workpiece catalog.

BACK

PRE MENU

Return to the **<Data backup / Administration>**.

I STORE

Lists current contents of intermediate store on screen specifying the workpiece number, workpiece name, file name, date of backup and type of data.

The following data type codes are used:

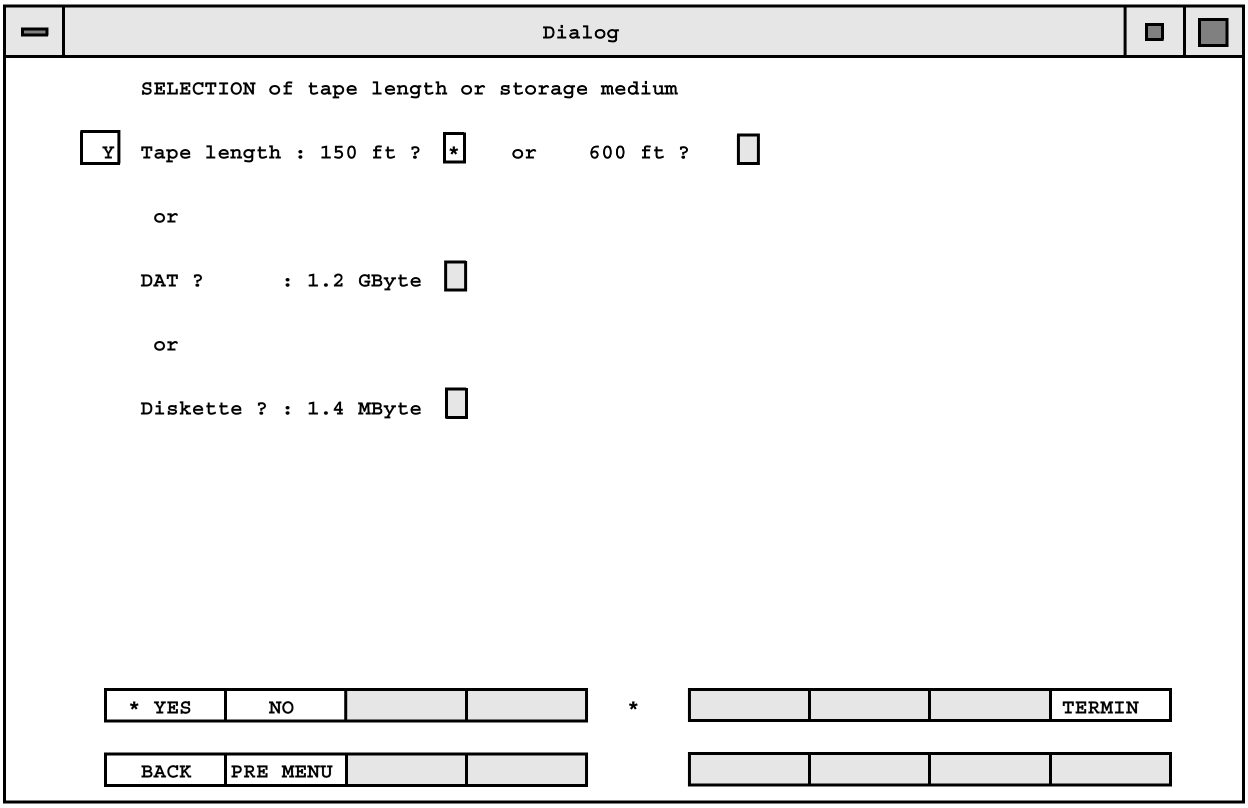
A ASCII format.

B Internal format.

U Faulty conversion (e.g. insufficient temporary storage space).

TAPE LEN

In the dialog window **<SELECTION of tape length or storage medium>** specify the length or type of backup medium used (select **<* YES>/<NO>**, confirm with **<TERMIN>**). Based on this information, the program calculates the size of the intermediate or buffer store.



Please note

The intermediate or temporary store will accept as many workpieces as a type of the specified length can store. Once this capacity is exceeded, the a message will appear stating **the workpiece concerned is not transferred to the intermediate storage**. If this case, clear the intermediate store by copying the data to a backup medium or using the appropriate function call (➤*„Clearing the intermediate store“ on page 4-5*).

Data boxes

Save?
Used to copy from workpiece catalog to intermediate (buffer) store.

Restore?
Used to copy to the workpiece catalog from the intermediate store.

Meas data - save too?
Concerns KUM, cf. applicable operating instructions. Input does not apply with **Restore**.

Deviations - save too?
Concerns KUM, cf. applicable operating instructions. Input does not apply with **Restore**.

UMESS CNC run?
Used to copy CNC programs. The workpieces to be copied must be specified by workpiece name or number (as usual for the workpiece catalog). If a CNC program contains KUM calls, the workpiece-specific KUM data will also be backed up.

KUM workpiece?
Used to copy KUM programs. The workpieces to be copied must be specified via their numbers (cf. KUM operating instructions).

Procedure

Tape length

If you work with various backup media or are creating the intermediate store for the first time: Specify the tape length (**<TAPE LEN>** soft key).

Copying direction

Select the desired copying direction:

- From workpiece catalog to intermediate storage (backup): **Save = ***.
- From intermediate storage to workpiece catalog (restoration): **Restore = ***.

KUM data

KUM users: also specify the data to be saved where applicable (measured data, deviations).

Workpiece

Specify the workpieces to be copied. Start copying with **<TERMIN>**. In KUM several workpieces can be copied if they have consecutive numbers. This also applies to UMESS if you make entries in the form e.g. **1-2** or **110-119** (i.e. the numbers of the first and last workpieces separated by a hyphen without blanks).

List intermediate storage

If required, list the contents of the intermediate storage with the **<I STORE>** softkey.

NOTE

The intermediate store is located on the hard drive in the directory **/var/opt/zeiss/CZ_BACKUP_SCR.**
If a serious malfunction (disk crash) occurs, the data stored here is just as much in danger of being destroyed as the other UMESS and KUM control data. You only have a true backup after copying the data buffered in the intermediate store to a backup medium.
Only a backup of the complete data stock (full backup) also includes the contents of the intermediate store.

Copying the contents of the intermediate store to a backup medium

Application

Using the dialog window described below, you can copy the entire contents of the intermediate store to a backup medium.

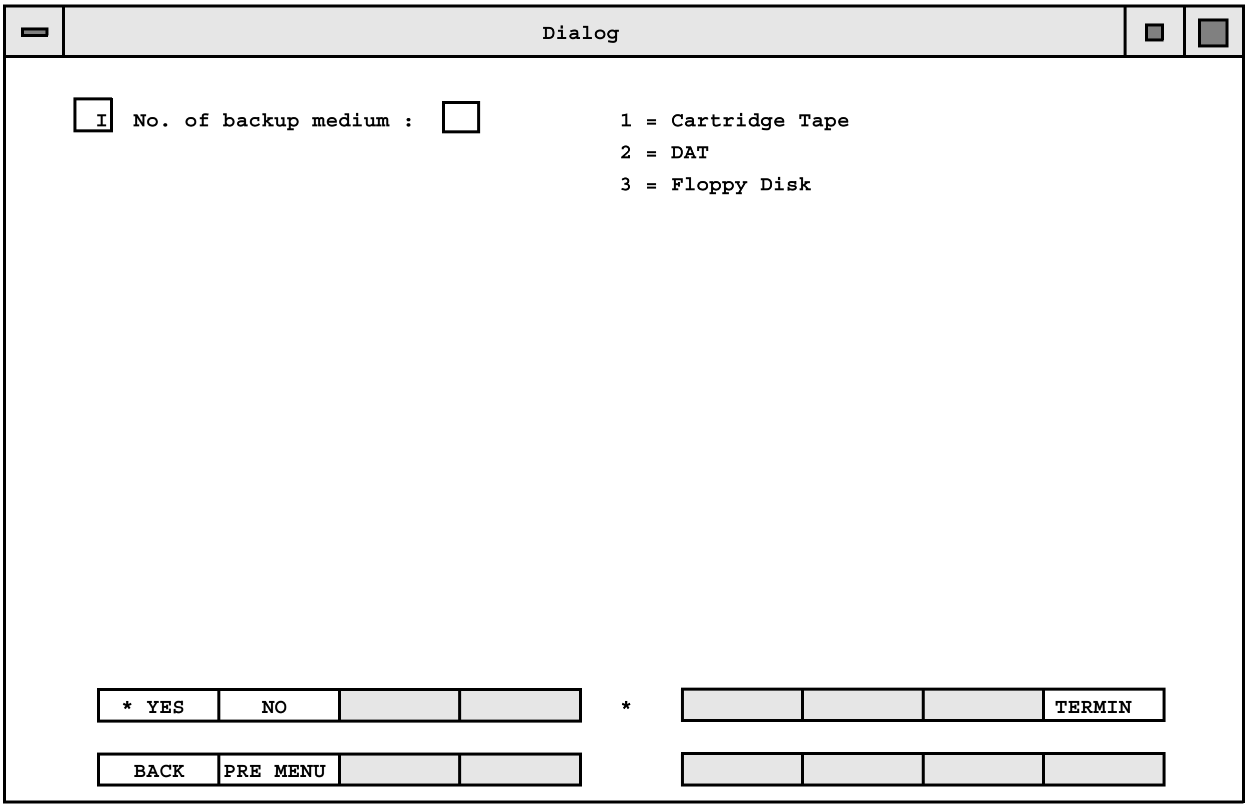
Procedure

Backup medium

Insert a backup medium of the size you specified with **<TAPE LEN>** (➤*„Backup to/restoration from intermediate storage“ on page* 4-6), in the drive.

Selection function

Call dialog window (➤„*Dialog page for data backup“ on page 4-4*) and select **<copy files from intermediate storage to backup medium>**.



Code

Enter the code corresponding to your backup medium and confirm with **<TERMIN>**.

The following warning is then displayed:

The data on tape/diskette will be overwritten!

Verification inquiry

Is the tape/diskette inserted and the write protect removed?

Acknowledge with **<YES>** or cancel with **<NO>**.

Background processes

The following functions are then run automatically:

– The contents of the intermediate or buffer store are copied to the backup medium in **tar** format.
  All UMESS and KUM data copied are displayed in the UMESS dialog window as a background process. A catalog file with the name **SAVE_INFO____K** is also copied.

– The previous contents of the backup medium are lost!

– If an error occurs during the copy procedure, this will be documented accordingly in the UMESS dialog window.

– The intermediate store is cleared automatically!
– The **<Data backup/Administration>** dialog window is then diaplayed.

Check

If necessary, list the contents of the backup medium outside of UMESS using the UNIX command (**tar tvf /dev/dat** or **tar tvf /dev/rdsk/floppy** depending on the medium used).

Copying data from the backup medium to the intermediate store

Application

The procedure described below is used to copy the entire contents of a backup medium to the empty intermediate (i.e. buffer) store.

Prerequisite

This function can be used only for backup media to which data has been written via **<DI 3500>** or using the previous KUM backup program (SKUMS). The data stored on the backup medium may also be in ASCII format, e.g. if it was backed up from UMESS 1000.

Procedure

Prerequisite

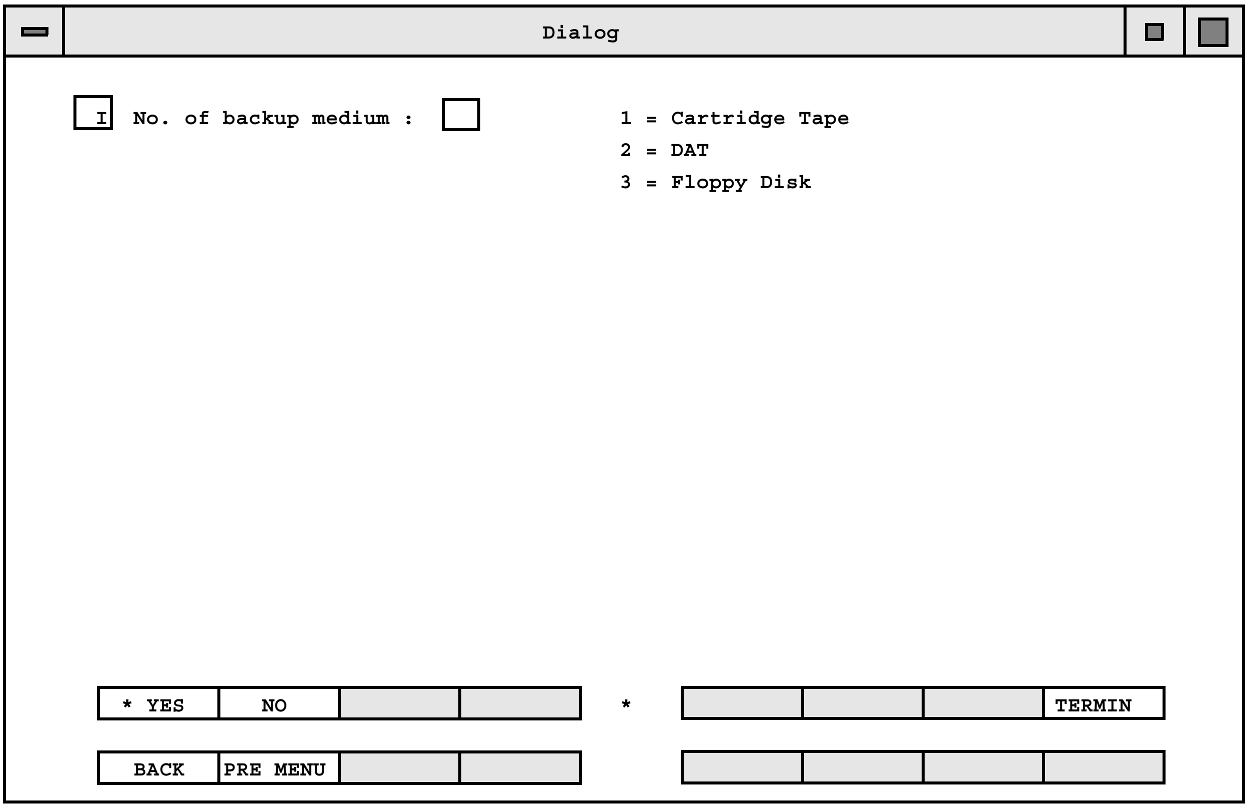
Clear the intermediate store (➤*„Clearing the intermediate store“ on page 4-5*).

Backup medium

Insert backup medium in drive.

Select function

Call dialog window (➤*„Dialog page for data backup“ on page 4-4*) and select (check) **<copy files from backup medium to intermediate storage>**.



Note You do not have to enter the length of the tape.

Code Enter the code matching your backup medium and confirm with **<TERMIN>**.

The following message is then displayed:

Copy from tape/diskette to intermediate storage!

Verification inquiry **Has the tape/diskette been inserted?**

acknowledge with **<YES>** or cancel with **<NO>**.

Background processes The following functions then run automatically:

- All UMESS and KUM data copied are displayed in the UMESS dialog window in the background.
- If an error occurs during the copying procedure, this will be documented in the UMESS dialog window.
- The **<Data backup/Administration>** window will then be displayed.

Restore Now you can copy the workpieces from the intermediate store to the workpiece catalog (➤*„Backup to/restoration from intermediate storage“ on page 4-6*);

Convert ASCII data to the internal format beforehand (➤*„Converting control data to the ASCII or internal format“ on page 4-13*).

Converting control data to the ASCII or internal format

Prerequisites

In principle you can also use workpieces in UMESS/KUM UX which you have created with a compatible system, e.g. UMESS/KUM 1000, and vice versa.

Please note

- Conversion is a very time consuming process. For this reason, you should start a conversion only if you are really sure that you need it for the other system (with the target format).
- ASCII data require roughly twice as much storage space as data in the internal format. The storage space available in the buffer store may therefore be insufficient for this format. Two options:
  - Start the conversion as described below and wait for the screen display **Disk full**. Use **<I STORE>** to check which data has been and which has not been processed. (➤*„Backup to/restoration from intermediate storage“ on page 4-6*). Then repeat the conversion process for workpieces of data types **B** and **U**.
  - Always convert and transfer workpieces as described below.

Procedure

From system A (e.g. UMESS 1000):

Intermediate storage

Clear the intermediate store if necessary: (➤*„Clearing the intermediate store“ on page 4-5*).

Copy workpiece

Copy workpiece(s) to the intermediate store: (➤*„Backup to/restoration from intermediate storage“ on page 4-6*)**.**

Convert format

Convert workpiece files from the internal format to the ASCII format:

The conversion affects all workpieces located in the intermediate store.

Backup medium

Transfer ASCII data from intermediate store to backup medium: (➤*„Copying the contents of the intermediate store to a backup medium“ on page 4-9*) For the correct procedure and input, refer to the operating instructions for the system concerned.

From system B (e.g. UMESS UX):

Backup medium

Transfer contents of backup medium to the intermediate store: (➤*„Copying data from the backup medium to the intermediate store“ on page 4-11*)

Convert format

Convert the workpiece files from ASCII format to the internal format.

The conversion affects all workpieces in the intermediate store.

Copy workpiece

Transfers workpieces from the intermediate store to the workpiece catalog: (➤*„Backup to/restoration from intermediate storage“ on page 4-6*)

Perform any adjustments required.

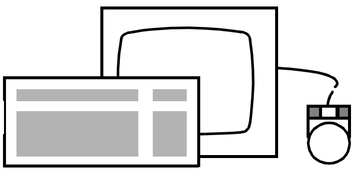
Backup and restoration of all workpiece-independent KUM data with <DI 3510> and <DI 3511>

Application

CNC runs and the corresponding KUM data are saved with **<DI 3500>**. The workpiece-independent performance modes and performance mode command blocks can be copied to the intermediate store and converted to ASCII format with **<DI 3510>**.

<DI 3510>

Backup to intermediate storage

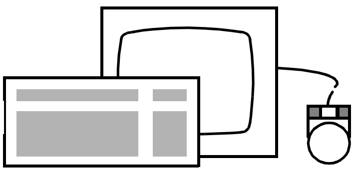


DI	Pull-Down-Menu	Pictogram
3510		

During the backup, all relevant performance modes and performance mode blocks are automatically taken into account and converted to ASCII format. The files included in the backup are then displayed in the list and message window.

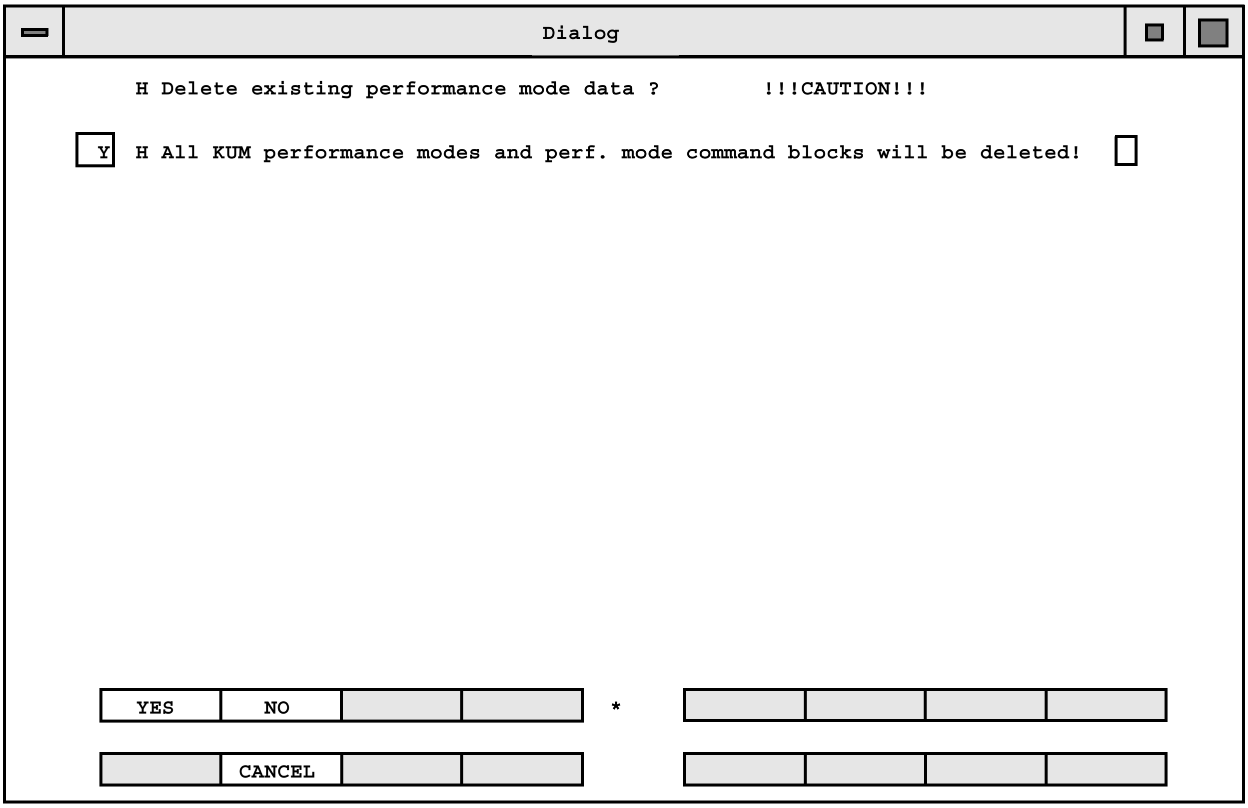
<DI 3511>

Restoring from intermediate storage



DI	Pull-Down-Menu	Pictogram
3511		

KUM workpieces with relevant performance mode data may be located in the intermediate store. During restoration, you must check to determine whether any performance mode data is located there. You can decide in a dialog whether or not you want to restore the existing performance mode data.



IMPORTANT!
If you decide to restore the performance mode data, all of the performance mode data in the intermediate store will be restored. Any performance mode data which may be stored in your computer will then be overwritten!
Then all the performance mode data located in the intermediate store will be deleted. This ensures that a performance mode which has been restored and can be reused will not have to be restored repeatedly. Apart from CNC runs, only workpiece-dependent KUM data is now still located in the intermediate store.
Even the performance modes for those KUM workpieces which have not yet been restored are now already located in your computer.

Backup and restoration of user data with CZ Utilities

Application

Backup of important UMESS data is very easy with CZ Utilities.

No special knowledge of the operating system is required.

Local or LAN

You can back up the data either locally or via LAN (local area network). When performing data backups via LAN, you must always start CZ Utilities on the computer where the backup drive is located (tape cartridge or DAT).

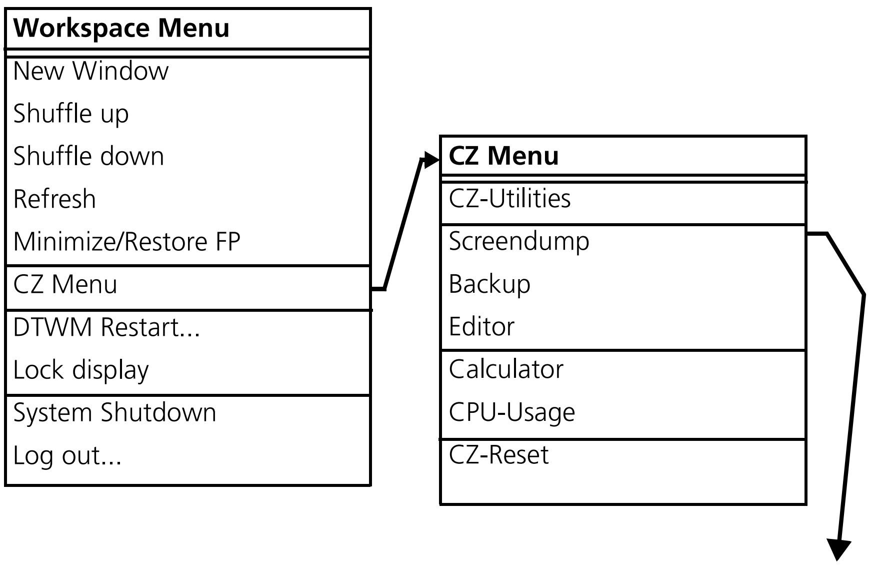
Starting CZ Utilities for data backup

Workspace menu

The background on which all windows are displayed is referred to as the workspace. If you click anywhere on this workspace, the Workspace menu will open.

CZ menu

Here you will find the CZ menu. If you keep the mouse button pressed and then "drag" the pointer to the CZ menu, you can start CZ Utilities by positioning the pointer on this option and then letting go of the button.

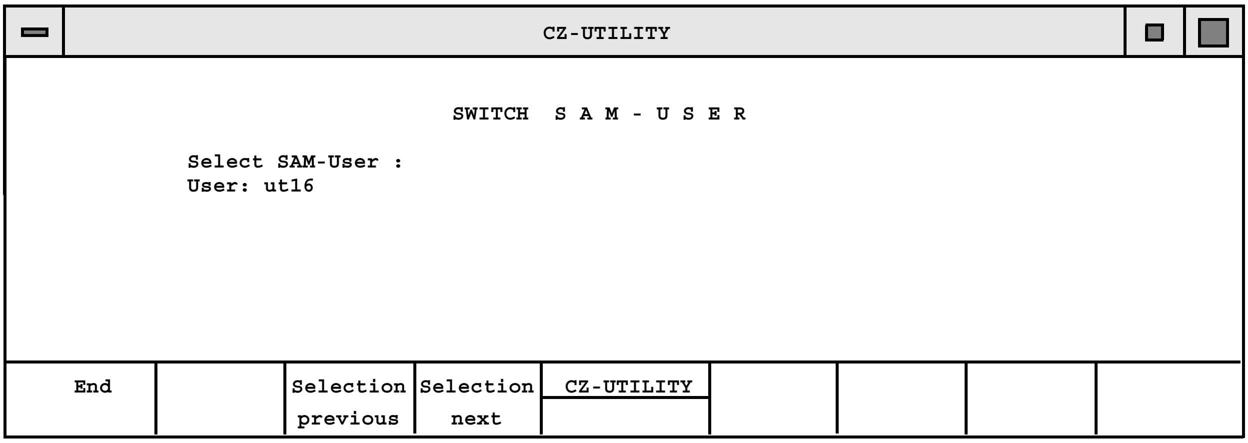


Data backup

The data backup can be started more directly with **Workspace Menu -> CZ Menu -> Backup**. However, you can not change to the **root** superuser.

CZ-Utilities -> SAM

When CZ-Utilities is called, the program branches to the **System Administration Manager (SAM)** and first asks which **user** you would like to use the function for.



The default user is **ut16**. Press softkey **<F4>** until the **root** user is displayed.

SAM

Within SAM you must call the following menus by double-clicking to reach the user data backup:

- **CZ_UTILITIES**
- **CZ_DATASAVE**
- **SAVE_CZ_USERDATA**

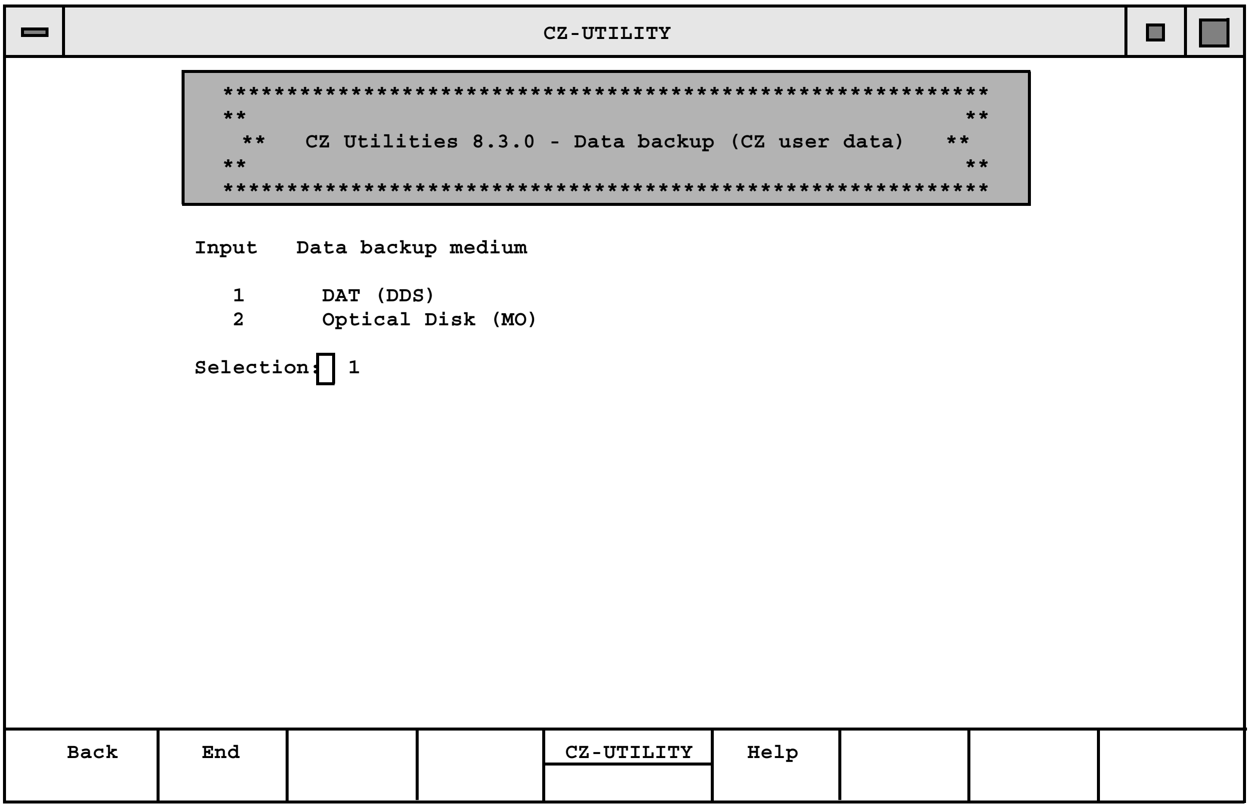
or

- **RESTORE_CZ_USERDATA**

Backup of User Data

Function call

See ➤„*Starting CZ Utilities for data backup“ on page 4-16*



Backup medium

Select the medium you want to use for the backup by entering the appropriate code no.

Computer name

You will then be prompted to enter the computer from where the backup should be made. The local computer from where the data backup was started will always be offered as the default value. You can confirm this selection with **<Enter>**.

Data list

A list of all data to be backed up will then be created. You can print this list or edit it as required.

Starting a backup

```
CZ-UTILITY

************************************************************
**                                                        **
**     CZ Utilities 8.3.0 - Data backup (CZ user data)    **
**                                                        **
************************************************************

Data being prepared .........o.k.

Data backup from local system (kmg01s1).

Medium: DAT Tape (/dev/dat)
Format: FBACKUP

Total size: 44552 kBytes.

Please insert DAT Tape.
Wait until the BUSY lamp on the drive has gone out.

Continue with <RETURN>, cancel with <q>

YES   NO   CZ-UTILITY
```

NOTE

You will then be prompted to insert a tape cartridge in the matching drive. Wait until the loading procedure for the tape cartridge has been completed (i.e. until the 'Busy' lamp on the drive goes out) and start the data backup by pressing the **<Enter>** key.
If the capacity of the tape cartridge is insufficient for a full backup, you will be prompted to insert an additional tape cartridge.

Restoring user data

Function call

See ➤*„Starting CZ Utilities for data backup“ on page 4-16*

```
CZ-UTILITY

    **************************************************************
    **                                                          **
               **   CZ Utilities 8.3.0 - Restore   **
    **                                                          **
    **************************************************************

  Input    Data backup medium

     1       DAT (DDS)
     2       Optical Disk (MO)

  Selection:  1

 Back | End | | | CZ-UTILITY | Help | | |
```

Backup medium

Select the medium you want to use for the backup by entering the code number.

Starting the restore process

You will now be prompted to insert a tape cartridge in the correspon-ding drive. Wait until the loading process for the tape cassette has been completed (i.e. until the ‘Busy’ lamp on the drive has switched off) and start the restoration by pressing the **<Enter>** key.

Executing and restoring a full backup

Application

All of the data on the hard disk can be backed up to the DAT tape.

NOTE

To do this you must be familiar with the operating system! Be very careful with all inputs and avoid typographical errors!

Full backup using CZ Utilties

A full backup can be created using CZ Utilities, however, this is **not recommended**. Many background processes are still running in UNIX while CZ Utilities are being executed. For this reason, certain files may not be included in the backup.

Single User mode

Application

A full backup should be executed or restored only in the Single User mode. This ensures that the operating system does not have any further actions running in the background mode.

If the computer is switched off:

Switch the computer on and immediately press the **<Esc>** key several times. The Boot Administrator will then start. Enter the following commands:

BOOT_ADMIN> boot scsi.6.0 isl

ISL> hpux -is boot

UNIX will then boot a minimum system and display the following message:

WARNING: YOU ARE SUPERUSER !!

If the computer is switched on:

- Terminate UMESS and any other applications.
- Open a system window ("New window").
- Log in as superuser with the command: **su**
- Set the computer to runlevel 1 **init 1**
- **Welcome to HP-UX ...**
  Console Login:
  Enter: **root**

UNIX displays the following message:

WARNING: YOU ARE SUPERUSER !!

Second hard disk

If a second hard disk is installed in the computer, it must also be mounted with: **mount -a**

Executing a full backup

Application
A full backup should be created in the **Single User mode**.

Function call
/etc/fbackup -v -n -0 -f /dev/dat -i /(-0 = -zero)

Duration
30 - 60 minutes, depending on the amount of data stored. The files backed up will be displayed on the monitor.

2. DAT tape
If the amount of data on the hard disk exceeds the capacity of the DAT tape, the backup process will be halted with the following message:

fbackup(xxxx): hit return when volume 2 is ready on /dev/dat?

Insert a second DAT tape and press **<Enter>**

SAM
A full backup can also be executed in the System Administration Manager (SAM). To do this, call **sam** in the single user mode.

Restarting the software
shutdown -r 0

Restoring a full backup

Application
A full backup should be restored only in the Single User mode.

Function call
/etc/frecover -xov -f /dev/dat -i /

Duration
30 - 60 minutes, depending on the amount of data. The restored files are displayed on the monitor.

DAT tape
If more than one DAT tape was required to create the full backup, the following message will be displayed during the restoration process:

fbackup(xxxx): tape drive error during fastsearch mark positioning

fbackup(xxxx): Volume 1 completed

fbackup(xxxx): Press return when next volume is ready on /dev/dat:

Insert the next DAT tape and press **<Enter>.**

Partial restoration
Individual files or directories can also be restored with the following command:

/etc/frecover -xov -f /dev/dat -i /directory/Filename

Restarting the software
shutdown -r 0

Data backup modes LINUX

The following data backup modes can be selected via **KDE system button** ➛ **CZ_Utilities** ➛ **CZ_Datasave**:

- **CZ_Fullbackup** ➛ backs up entire hard disk.
  Format: tar
  Medium: DAT drive
  Remote data backup between: **LINUX** ➛ **LINUX**
  LINUX ➛ **HPUX 10.20**
- **Save_CZ_Userdata** ➛ performs backup acc. to backup list.

The backup list can be edited by the user.
Format: tar
Medium: DAT drive
Remote data backup between: **LINUX** ➛ **LINUX**
LINUX ➛ **HPUX 10.20**

- **Restore_CZ_Userdata** ➛ restores user data backup to hard disk.
  Format: tar
  Medium: DAT drive
  Remote data backup between: **LINUX** ➛ **LINUX**
  LINUX ➛ **HPUX 10.20**
- **CZ_SAM_ASCII_Data** ➛ backs up SAM data ***.SAM** and ***.ERR** to the local directory **/home/zeiss/UF**.
  Format: tar
  Medium: DAT drive, floppy
  Remote data backup between: **LINUX** ➛ **LINUX**
  LINUX ➛ **HPUX 10.20**

Chapter 5

Output of results

This chapter contains:

Basic Principles

Components of the measurement record

Organization

A measurement record comprises the following:

– **Texts**

  entered using the **<TEXT>** function (**<DI 1676>** ➤*„Comments in the measurement record <DI 1676>“ on page 5-33*).

– **Results**

  subdivided into

  – results with nominal capability

    (results from measurements, conversions or linkings (constructions) for which a nominal-actual or variance comparison can be executed, e.g. **<CIRCLE>**, **<GDT-ROUND>**, **<INTERSECTION>** etc.,➤*„Dimensional, form and position tolerances“ on page 14-1*) and

  – results without nominal capability

    (results from functions which influence the coordinate systems, e.g. **<ROTATE SPACE>, <ROTATE PLANE>, <ZERO POINT>** No nominal can be specified for these results).

– **Graphics**

  created e.g. with the GDT plot function **<DI 1470>** (see Option 2, ➤*„Graphic output“ on page 5-46*).

Variants of the record output

Extent of record

The format of the record can be defined with **<DI 1665>** (➤*„Defining the scope of the record <DI 1665>“ on page 5-14*) and **<DI 1667>** (➤*„Defining the print format <DI 1667>“ on page 5-17*).

Output device

Output to the printer is activated/deactivated with **<DI 1614>** and **<DI 1615>** (➤*„Defining the record output medium <DI 1614 /1615>“ on page 5-12*).

Additional output

The measurement record is output to the selected output device and at the same time stored on the hard drive.

It can be output again either with **<DI 1613>** (repetition record, ➤*„Repetition record <DI 1613>“ on page 5-40*) or, if it has been stored with **<DI 1683>** (➤*„Saving, outputting and deleting records“ on page 5-41*), via **<DI 1684>**.

Display of results in the measurement record

Possibilities

The measurement record can be shown in two different ways. It can be set with **<DI 1667>** (➤*„Defining the print format <DI 1667>“ on page 5-17*).

Example

Default record

```
=================================================================================
ADR|REC |TASK| IDF |SY| ACTUAL | NOMINAL | U.TOL | L.TOL |  DEV |  EXC
================================================================================

BORE_1
  1       CIRCLE I  M22  X    13.4045    13.5000   0.1000  -0.1000  -0.0955  ----
                   M25  Y   45.1076   45.0000   0.1000  -0.1000  -0.1076 0.0076
                   M12  D   10.0328   10.0000   0.1000  -0.1000   0.0328  ++
  8P S/MIN/MAX               0.5960   (5)      -0.3640  (1)       0.312
```

Feature

A max. of 5 characters can be entered in the identification box.

Example

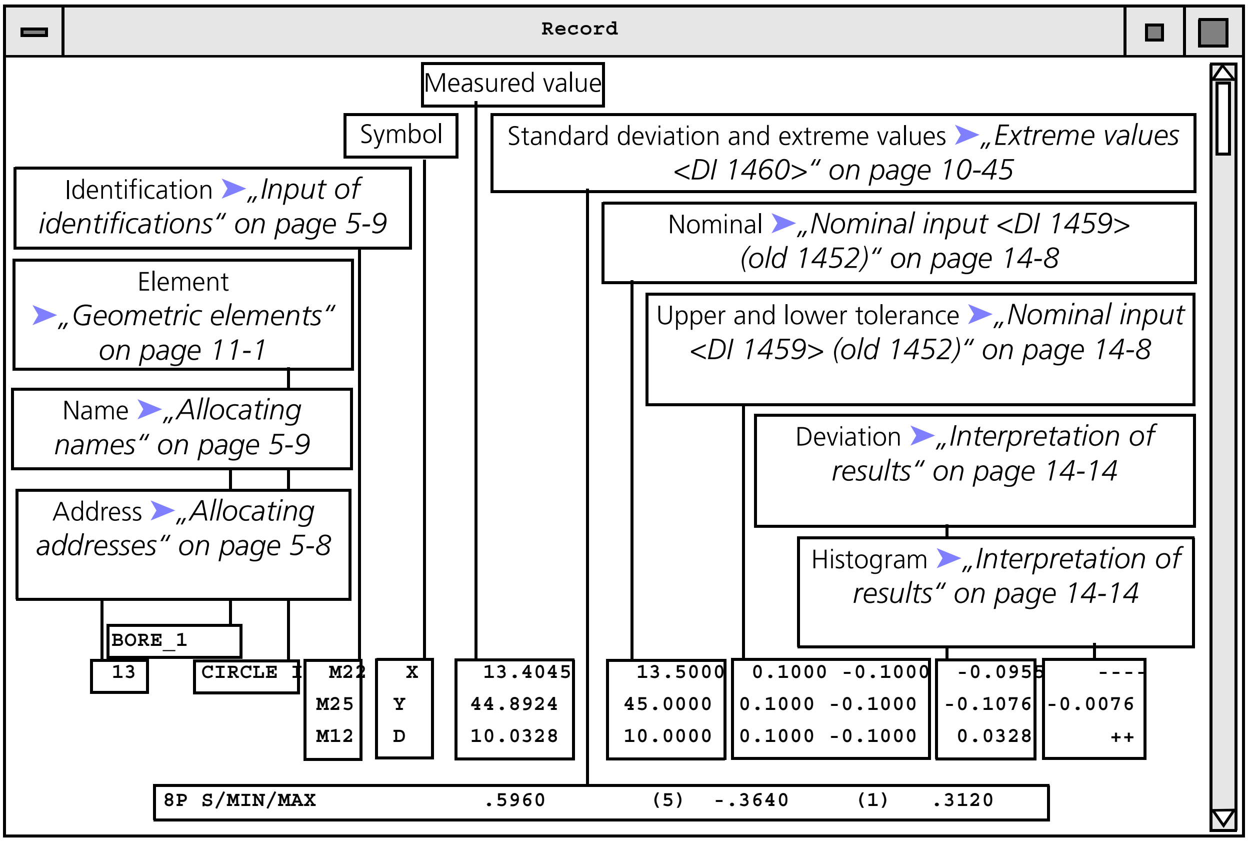
Extended record output

```
=================================================================================
ADR|   NAMES / IDF |SY| ACT VAL| NOM VAL| U.TOL | L.TOL |  DEV |  MAG
================================================================================

  1 CIRCLE_0001         CIRCLE I
    X_00000045         X   13.4045   13.5000   0.1000  -0.1000  -0.0955  ----
    Y_00000055         Y   45.1076   45.0000   0.1000  -0.1000  -0.1076 0.0076
    D_00000050         D   10.0328   10.0000   0.1000  -0.1000   0.0328  ++
      8P S/MIN/MAX          0.5960   (5)      -0.3640  (1)       0.312
```

Feature

A max. of 10 characters can be entered in the identification box.

Explanation of element output



Explanation of abbreviations in the measurement recordl

Abbreviation	Meaning
DEV	Deviation from nominal value
ADR	Current address
TASK	Measuring task
IDF	Freely selectable identification

Abbreviation	Meaning
DIN- **PLA** **LINE** **COA** **CON** **RUN** **ANG** **PAR** **POS** **PER** **RND** **SYM** **CYL** **(M) A (M)**	Evaluation acc. to DIN 7184 Plane Line Coaxiality Concentricity Radial/axial runout Angularity Parallelism Position Perpendicularity Roundness Symmetry Cylindricity Calculation with maximum material condition
DIST	Distance
ROTATE PLANE	2D alignment to 1 projected angle
ROTATE SPACE	3D alignment to 2 projected angles
ELLIP O/I	Outer/inner ellipse
U.TOL/L.TOL	Upper/lower tolerance
MIN PLANE	Minimum plane from DI 1140
MAX PLANE	Maximum plane from DI 1140
RES.	Result of conversion with formula DI 1379
Formplot **t-NOM** **t-ACT** **STD DEV** **MAGNIFICAT.** **V-MAX** **PROBE DIA**	GDT plot with DI 1470 or fast plot with DI 1461 Entered form deviation Measured form deviation Standard deviation Entered magnification Maximum scanning speed Probe diameter in mm
ACTUAL	Measured value
NO RESULT	No result can be calculated
CONE O/I	Outer/inner cone
CONE DIA	Cone diameter at given height
CON CO	Cone coordinates at given diameter
CIRCLE O/I	Outer/inner circle
CIR SE	Circle segment with DI 1114
PERP DIST	Perpendicular distance output with DI 1286

Abbreviation	Meaning
PERP CYL	Perpendicular distance output with DI 1285
MEAN	Arithmetical mean
NOMINAL	Nominal dimension in the drawing
ZEROPT	Coordinates of the last address are set to zero
..P S/MIN/MAX	Number of measured points Standard deviation/minimum/maximum value Element referring to best fit element
3D POINT	3D point
RADMES	Radius measurement with DI 1114
REC *	Recall of an element **without** coordinate transformation
REC !	Recall of an element **with** coordinate transformation
MIN-R	Min radius from DI 1141
MAX-R	Max radius from DI 1141
3D POLAR	3D polar = 3D polar distance with DI 1261
S-G FF	Intersection line from two surfaces
I-PT **FG** **FZ** **GG** **KF** **KG** **KK** **KZ**	Intersection point from surface and line surface and cylinder axis line and line circle and surface circle and line circle and circle circle and cylinder axis
SYM- **A** **F** **P**	Symmetry Axis Surface Point
SY **X Y Z D R** **W1 W2 WK** **RD WX WY WZ** **t tD** **tX tY tZ**	Symbols: Axes, diameter, radius, Plane angles W1 and W2, cone angle, Length and direction of the 3D diagonals, Form and position deviation acc. to DIN 7184
PART NO	Current part number of workpiece measured

Abbreviation	Meaning
PITCH **p** **pk** **fp** **Fp** **fu** **Fr** **POS**	Pitch measurement with DI 1310 Distance between elements Distance to first element Individual pitch error Cumulative pitch error Distance between adjacent pitches Radial runout Nominal position
EXC +/-	Tolerance exceeded or degree of utilization 25% toleance utilization more or less
EDGE PT	Edge point
W-NAME	Name of workpiece measured
CYL O/I	Outer/inner cylinder

Identification of results

Organization

Results must be clearly identified in the record to simplify name allocation and subsequent retrieval.

This can be done by:

– **Address**
  allocating addresses (➤*„Allocating addresses" on page 5-8*)
– **Identification**
  entering identifications (➤*„Input of identifications" on page 5-9*)
– **Name**
  allocating names (➤*„Allocating names" on page 5-9*)

Allocating addresses

Address allocation

An address is automatically allocated to *every* result. This is a consecutive number under which the result is stored in the internal record.

Counting

The address of a result is determined by the address counter, which is set to 1 following the start of UMESS and incremented by 1 for every result.

Address counter

The following functions influence the address counter:

– **<DI 1608>**; set to initial status (➤*„Setting the initial status <DI 1608>" on page 6-7*) The address counter is set to 1.
– **<DI 1610>**; call up record header (➤*„Calling the default header and variable header I <DI 1610>" on page 5-24*) The address counter is set to 1.
– **<DI 1690>**; set address counter (➤*„Setting the address counter to a random address <DI 1690>" on page 6-8*) The address counter can be set to any value.

NOTE

Each address can exist only once in the internal record. If the address counter is reset, all previous results will be overwritten.

Input of identifications

Application

A remark can be entered for every measured value with a nominal-actual (variance) comparison (➤*„Dimensional, form and position tolerances“ on page 14-1*). However, this remark is used only for relating the measurement results to the drawing dimensions etc.

Options

The identification box may have either 5 characters as for the default record or 10 characters as for the extended record. It is set with **<DI 1667>** (➤*„Defining the print format <DI 1667>“ on page 5-17*).

Allocating names

Application

If the name allocation is activated, a name is assigned to each result which has *nominal capability*. The same applies to the following functions with which coordinate transportations are executed:

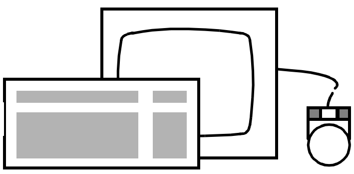
- Zero point **<DI 1701>**
- Rotate plane **<DI 1702>**
- Rotate zero point + 1 element **<DI 1703>**
- Rerotate about an angle **<DI 1704>** and **<DI 1709>**
- Rotate to distance **<DI 1705>**
- Rotate space **<DI 1706>**
- Change space axis **<DI 1707>**
- Free axis selection **<DI 1711>**
- W-position according to workpiece system **<DI 1713>**
- Basic displacement **<DI 1722>**
- Zero point displacement **<DI 1723>**.

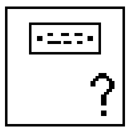
Activating/deactivating name allocation

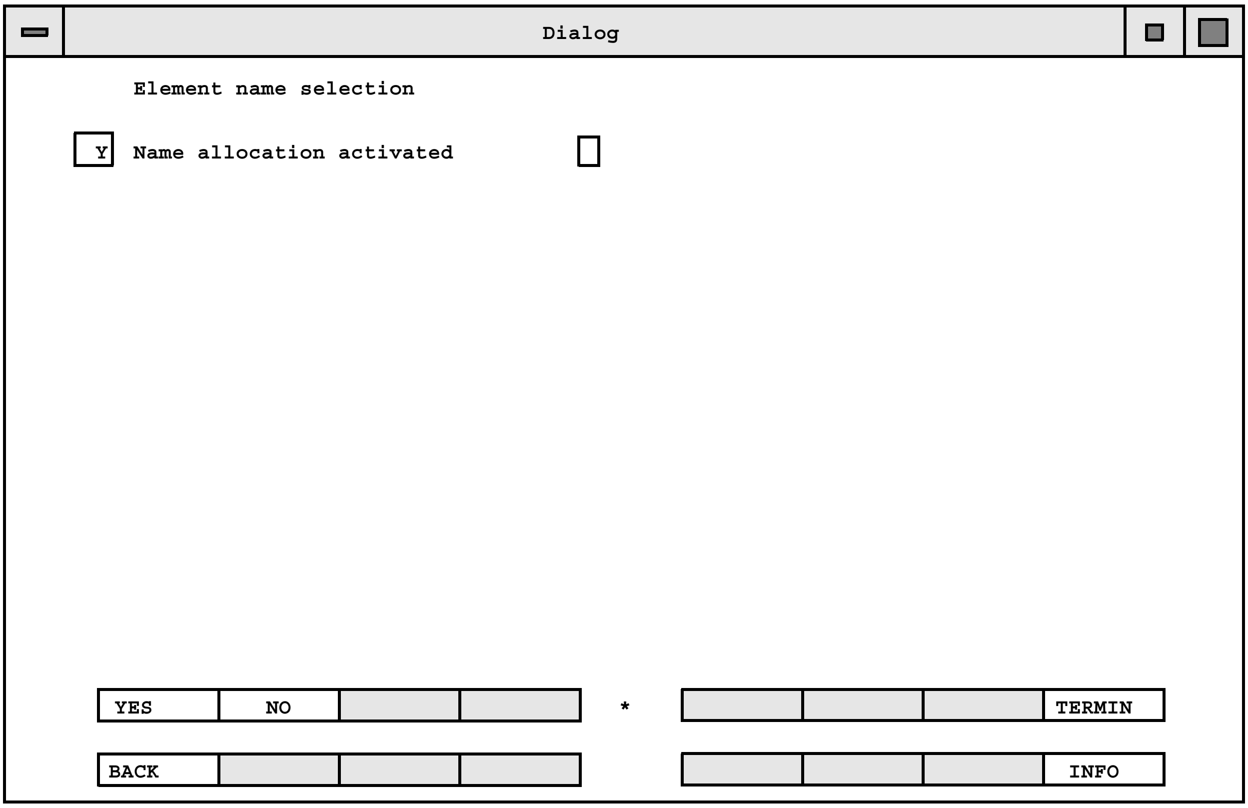
<DI 1663>

Long-term mode

The setting selected is a long-term mode. I.e. the setting selected here is retained even after the computer is switched off.



DI	Pull-Down-Menu	Pictogram
1663	Record	
NAMES	Mode	
	Name allocation on/off...	



YES **NO**	These buttons activate/deactivate the name allocation.
TERMIN	Press **<TERMIN>** to close dialog window.

Input functions

If the name allocation function is activated, then

- a result name is output to the measurement record,
- a **result name** is prompted for functions with dialog input,
- a default value is offered in the result name box for functions with input via dialog boxes.

Default names

The computer offers a default name which can be changed by the user.

Allocation rules

The following rules must be observed when allocating names:

- Maximum length: default 10 characters. Can be changed to 24 characters with **<DI 1667>** (➤„*Defining the print format <DI 1667>“ on page 5-17*).
- Permissible characters: **A - Z** (upper case), **0 - 9**, underline ("_").
- The first character must be a letter.

- The last character must not be an underline.
- The names must be unambiguous, i.e. each name may appear only once per measuring run.

Preassignment

A standard indexed name (for example **CIRCLE_1**) is always offered as the default entry. The index is increased each time the same element is called again.

(CIRCLE_2 -> CIRCLE_3 -> CIRCLE_4 -> . . . -> CIRCLE_n)

Subsequent calls

If the preassignment (default name) is not accepted, but overwritten with another name, this name will then always be offered during subsequent calls of the same function with an increased index.

Prerequisite: The name ends with a digit.

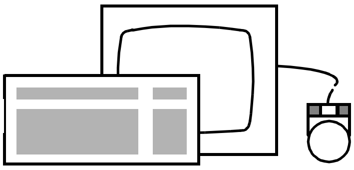
Example

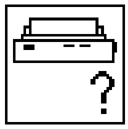
The **<CIRCLE>** function is called. The preassignment **CIRCLE_1** is not accepted. The user enters **BORE_10**. In this case **BORE_11** will be offered as the preassigned or default value the next time the **<CIRCLE>** function is called.

NOTE

- If you use your own result names, they must be entered in upper case letters.
- The result name index must not exceed the value 32767 (e.g. **CIRCLE_32767**).
- With the alphanumeric control panel, the "_" character can be entered by keying in **<CTRL> + <->**.
- *Indexed* names *must* be preassigned to functions in which several addresses are output to the measurement record. Examples: Extreme values, form deviation and pitch.
- Loops in CNC programs: Starting with the second loop, an additional index is appended to each result name. This prevents results with different addresses from being assigned the same name.
- Examples: **CIRCLE_5 -> CIRCLE_5_1**
  LINE -> LINE_1
- Results can be recalled or linked by entering the name.
- The name allocation is activated with **<DI 1663>**.

Output mode <DI 1662>



DI	Pull-Down-Menu	Pictogram
1662	Record	
OUTPMOD	Mode	
	Print mode...	

Scope of functions

The following measurement record output parameters can be defined with the output mode:

Softkeys

REC DEF

Scope of record (➤ *„Defining the scope of the record <DI 1665>“ on page 5-14*)

REC OUTP

Record format, with output to printer (➤ *„Defining the print format <DI 1667>“ on page 5-17*)

GRPH MOD

Graphics mode (➤ *„Graphic output“ on page 5-46*)

LANGUAGE

DEC PLAC

Language, unit of measurement and number of decimal places (➤ *„Defining the language, unit of measurement and decimal places <DI 1692>“ on page 5-16*)

TERMINAL

PRINTER

Record output medium (➤ *„Defining the record output medium <DI 1614 /1615>“ on page 5-12*)

Alternative call

All of the functions listed above can be called centrally using **<DI 1662>** and the appropriate softkey, by using their own specific DI number, or from the Pull-Down-Menu.

Defining the record output medium <DI 1614 /1615>

Printer/screen

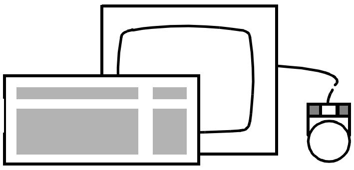
The measurement record is always output to the screen. It can also be additionally output to the printer.

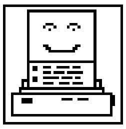
The output device can be defined in one of two ways:

– By initializing the record output. Explanation (➤ *„Defining the print format <DI 1667>“ on page 5-17*).

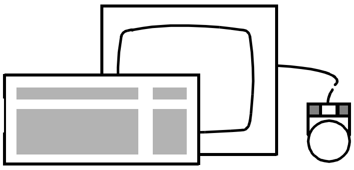
– By selecting the output device directly.

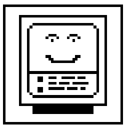
Activating output to the printer



DI	Pull-Down-Menu	Pictogram
1614	Record	
PRINT	Mode	
	Printer output...	

Deactivating output to the printer



DI	Pull-Down-Menu	Pictogram
1615	Record	
TERMINAL	Mode	
	Screen output...	

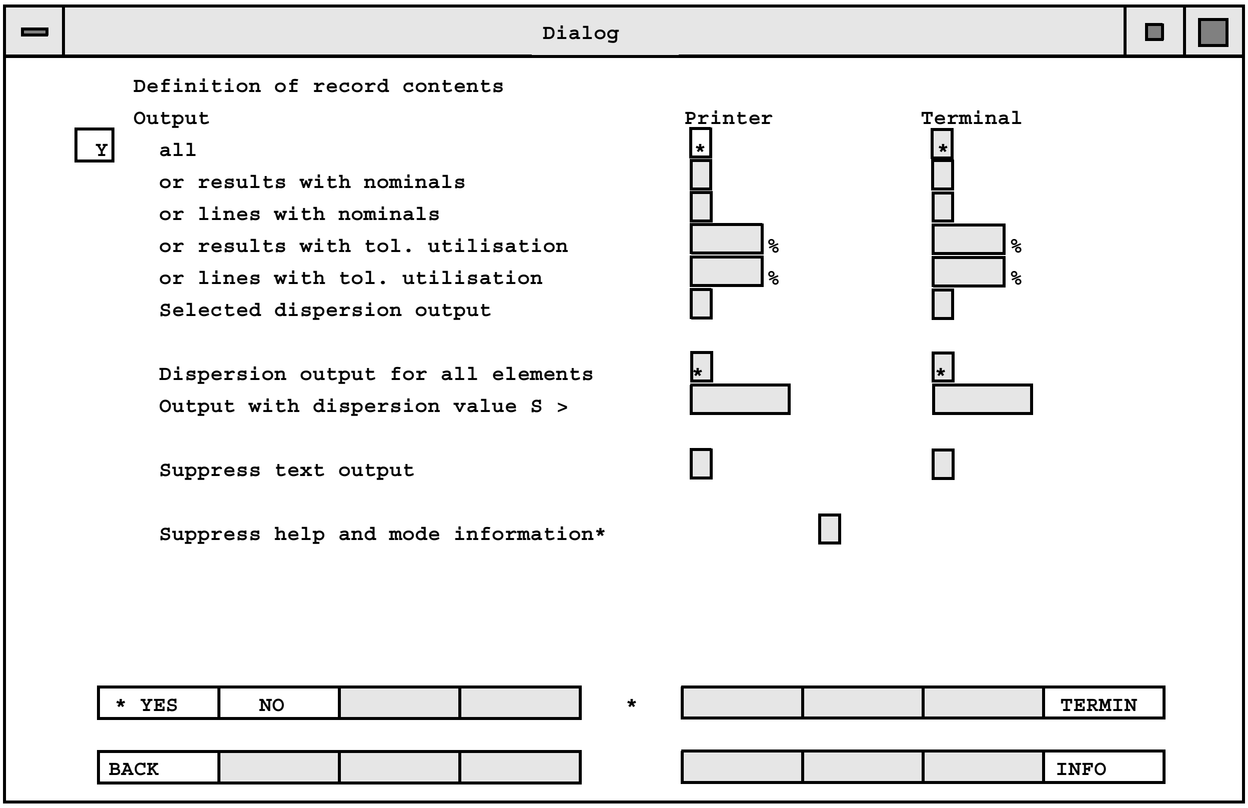
NOTE

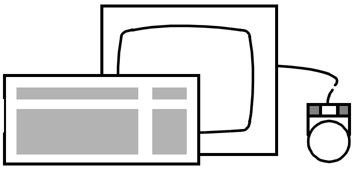
The output device selection is stored in a long-term file. This means that the output medium selection will be retained even after the computer is switched off. This setting can be changed again only by calling the corresponding function.

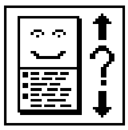
Defining the scope of the record <DI 1665>

Function

The scope of the measurement record can be defined using **<DI 1665>**.





DI	Pull-Down-Menu	Pictogram
1665	Record	
REC DEF	Mode	
a57	Extent of record...	

Documentation

The mode set is documented in the measurement record according to the input.

Exception: The box for suppressing the mode information has been selected.

Data boxes

all

The entire measurement record is output.

or results with nominals
or lines with nominals

The measurement result is output only if the nominals have been defined.

or results with tol. utilisation **or lines with tol. utilisation**	The measurement result is output only if a certain percentage of the entered tolerance range has been utilized or exceeded. Enter the tolerance utilization from which a result is to be output
Dispersion output for all elements	The dispersion output can be preselected.
Output with dispersion value S >	The dispersion is output only if the limit entered in the next box has been exceeded. The average point dispersion, smallest value (MIN) and largest value (MAX) are output.
Suppress text output	Suppression of all texts which have been entered with **<TEXT>**.
Suppress help and mode information	Suppression of texts on the stored output mode.

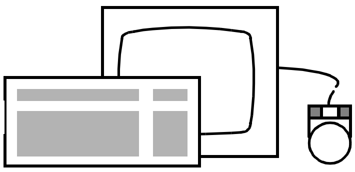
Defining the language, unit of measurement and decimal places <DI 1692>

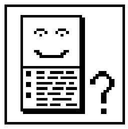
Function

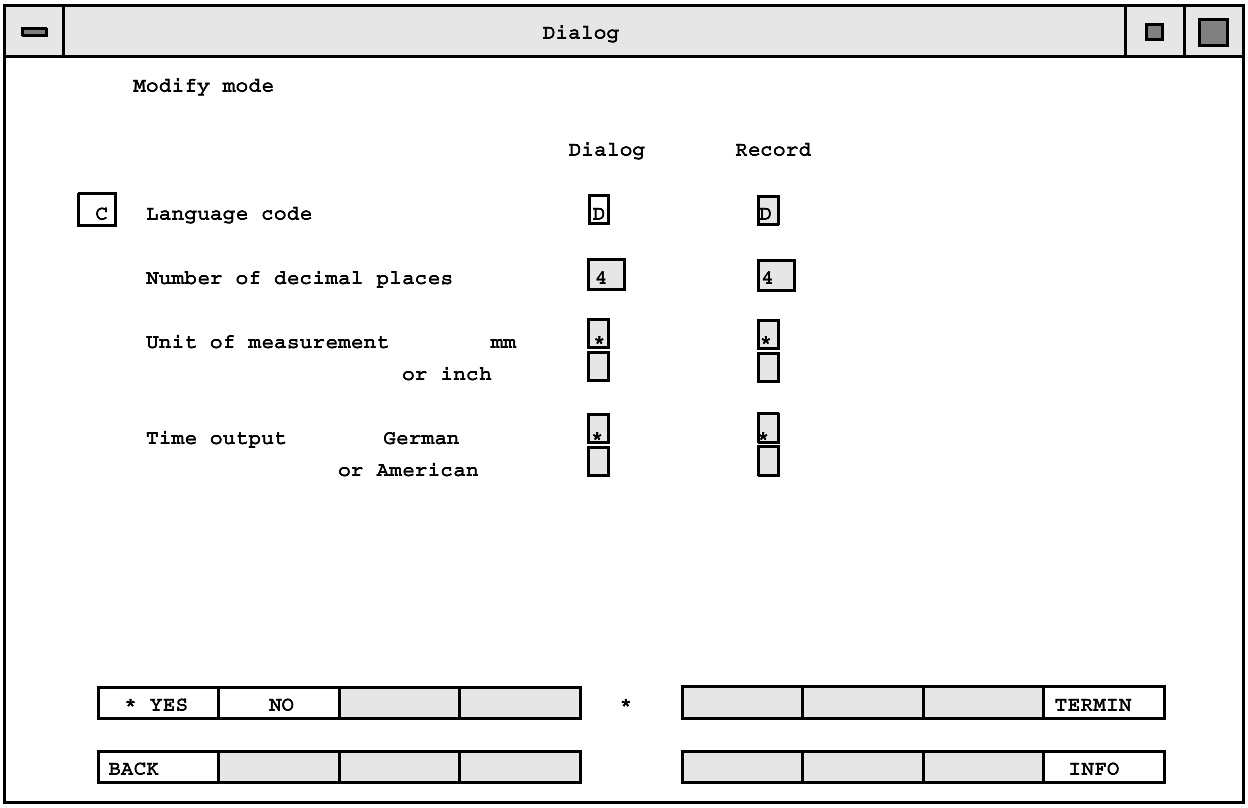
This function is used to define the parameters:

- language
- number of decimal places and
- unit of measurement

for the dialog and the record.



DI	Pull-Down-Menu	Pictogram
1692	Record	
	Mode	
	Language/unit of measurement...	



Data boxes

Language code

Abbreviations used:

D = German	**A** = English
E = Spanish	**H** = Dutch
F = French	**I** = Italian
P = Portugese	**S** = Swedish

Either accept the default code or overwrite and confirm with **<Enter>**.

Number of decimal places

Enter the number of decimal places (0 to 5) required and confirm with **<Enter>**.

Unit of measurement

Inches or **mm** can be selected with **<YES>/<NO>**.

Time output format

German = DD.MM.YYYY

American = MM/DD/YY

The time output is linked with the language setting. If for example English is selected, the time will be output in the American format.

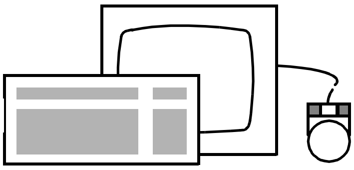
Defining the print format <DI 1667>

Function

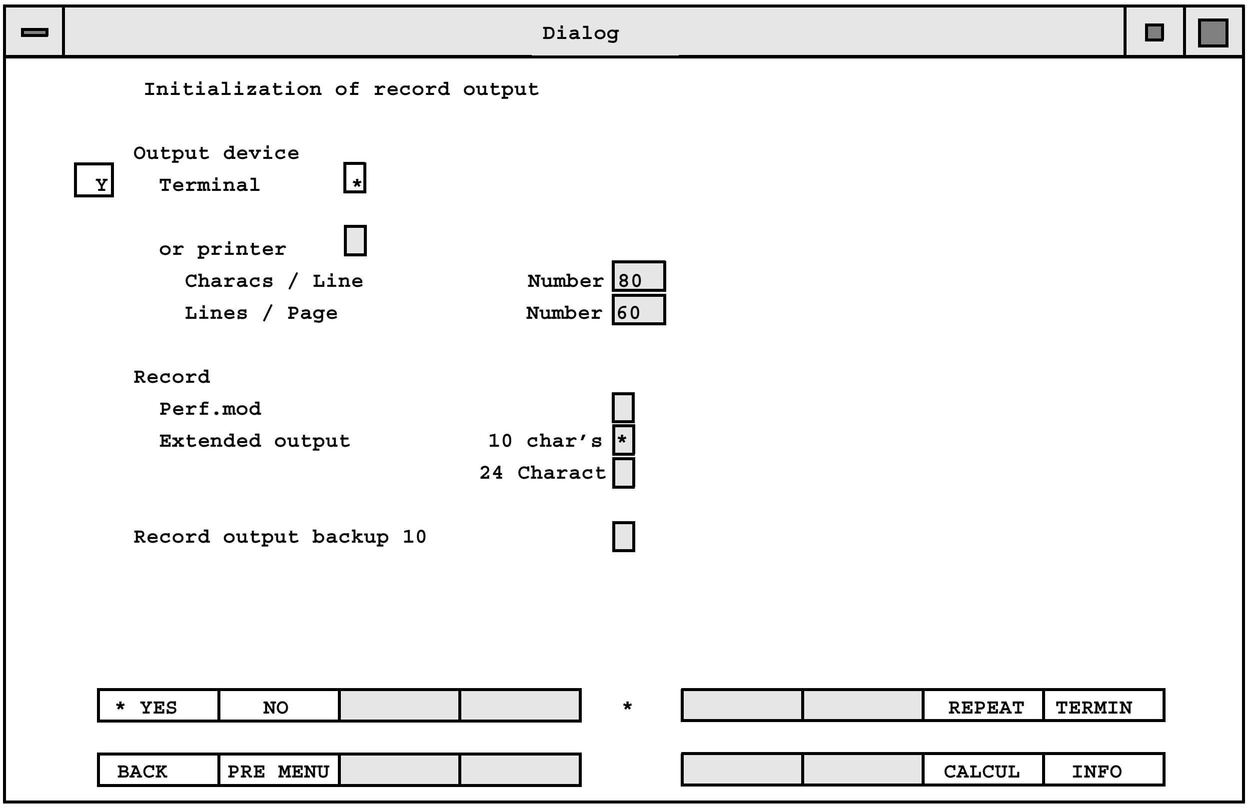
You can use the **<REC OUTP>** function as an alternative to **<DI 1614>** and **<DI 1615>** to select the output device for the measurement record (➤*„Defining the record output medium <DI 1614 /1615>“ on page 5-12*).

Long-term mode

The setting selected is retained until changed.



DI	Pull-Down-Menu	Pictogram
1667		



Data boxes

Output device
Printer and screen data output can be selected with **<YES>** and **<NO>**.

Characs/Line
Input option: 80 to 132 characters per line. Default value: 80

Lines/Page
Input option: 10 to 120 lines per page. Default value: 60

Record Perf.mod

- **Standard**
  Output of the normal record. A maximum of 5 characters can be entered for the identification box and a maximum of 10 characters for the name allocation box.
- **Extended output 10 char's**
  - The result name may have up to 10 characters. It is located in the same line as the address and the element name.
  - The identification may have up to 10 characters (default 5 characters). It is located below the result name.

– **Extended output 24 Charact**
  The result name may have up to 24 characters. (Examples ➤*„Display of results in the measurement record“ on page 5-3*.)

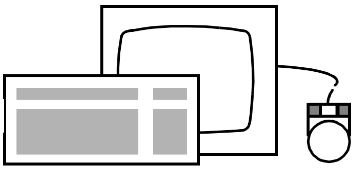
Record output backup 10

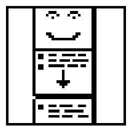
If this function is selected, the last 10 measurment records will automatically be saved to the directory **/home/zeiss/UF**. The printout can be started with **<DI 1604>** (➤*„Printing the last 10 measurement records <DI 1604>“ on page 5-43*).

Page feed in the record <DI 1675>

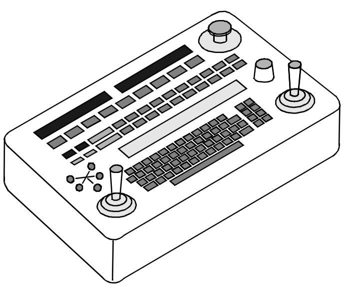
Function

You can invoke or program a page feed with **<DI 1675>**.



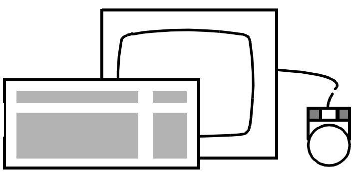
DI	Pull-Down-Menu	Pictogram
1675	Record	
NP or FEED	Layout	
a617	Page feed...	

Result output on alphanumeric control panel



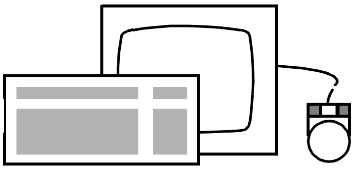
The result is not output to the alphanumeric control panel as a standard feature. It is, however, possible to display coordinate transformations and measured results on the alphanumeric control panel in a single line and without nominals.

Activating the alpha control panel output



DI	Pull-Down-Menu	Pictogram
.34		
REC ON		

Deactivating the alpha control panel output



DI	Pull-Down-Menu	Pictogram
.35		
RECOFF		

Header

Application

Before starting a measuring run, you can attach a header to the corresponding record for documentation purposes. This header contains information on the allocation of measuring results to the test object, the operator, the department, the customer etc. The following functions are required to create or output a record header:

– **<DI 1612>** to select between the default record header and variable record header I.

– **<DI 1610>** to call and output the default record header and variable record header I.

– **<DI 1611>** to call and output variable record header II.

Default record header and variable record header I

Layout of the default header

```
================================================================================
                         MEASURING RECORDZEISS  UMESS

WORKPIECE NAME                       MANUAL MEASUREMENT
========
DRAWING NUMBER   | ORDER NUMBER    | SUPPLIER/CUSTOMER | OPERATION
638596-4589-54   |1457-5834-5648    |Zeiss            |0100

OPERATOR | DATE   | PART NUMBER|
Mueller | 11/30/98| 45               |

================================================================================
 ADR|REC |TASK| IDF |SY| ACTUAL |NOMINAL | U.TOL | L.TOL | DEV | EXC
================================================================================
```

Features

– Included in UMESS as a default feature.

– Form can not be altered.

– Data boxes can be filled in.

Structure of variable header I

```
================================================================================
                         MEASURING RECORD ZEISS  UMESS
1       Any
2
3       text
4
5       from
6
7       line 1 to
8
9       line 9

WORKPIECE NAMEMANUAL MEASUREMENT
========
DRAWING NUMBER    | ORDER NUMBER | SOFTWARE            | MEASURING DEVICE
638596-4589-54     |1457-5834-5648 |UNIX                    |CMM

OPERATOR | DATE             | PART NUMBER | CUSTOMER | COMMENT
Mueller | 07.01.1998       | 45          |         |

================================================================================
 ADR|REC |TASK| IDF |SY| ACTUAL |NOMINAL | U.TOL | L.TOL | DEV | EXC
================================================================================
```

Features

- A maximum of 9 permanently stored text lines.
- The number and names of columns can be changed. (This does not apply to the **OPERATOR**, **DATE** and **PART NUMBER** columns).
- Produced with **<DI 1612>** (➤*„Modification of variable header I <DI 1612>" on page 5-22*).

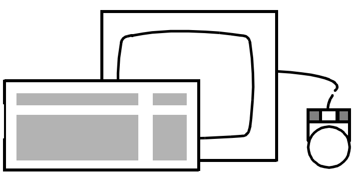
Modification of variable header I <DI 1612>

Application

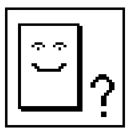
The type of header required can be selected with this function.

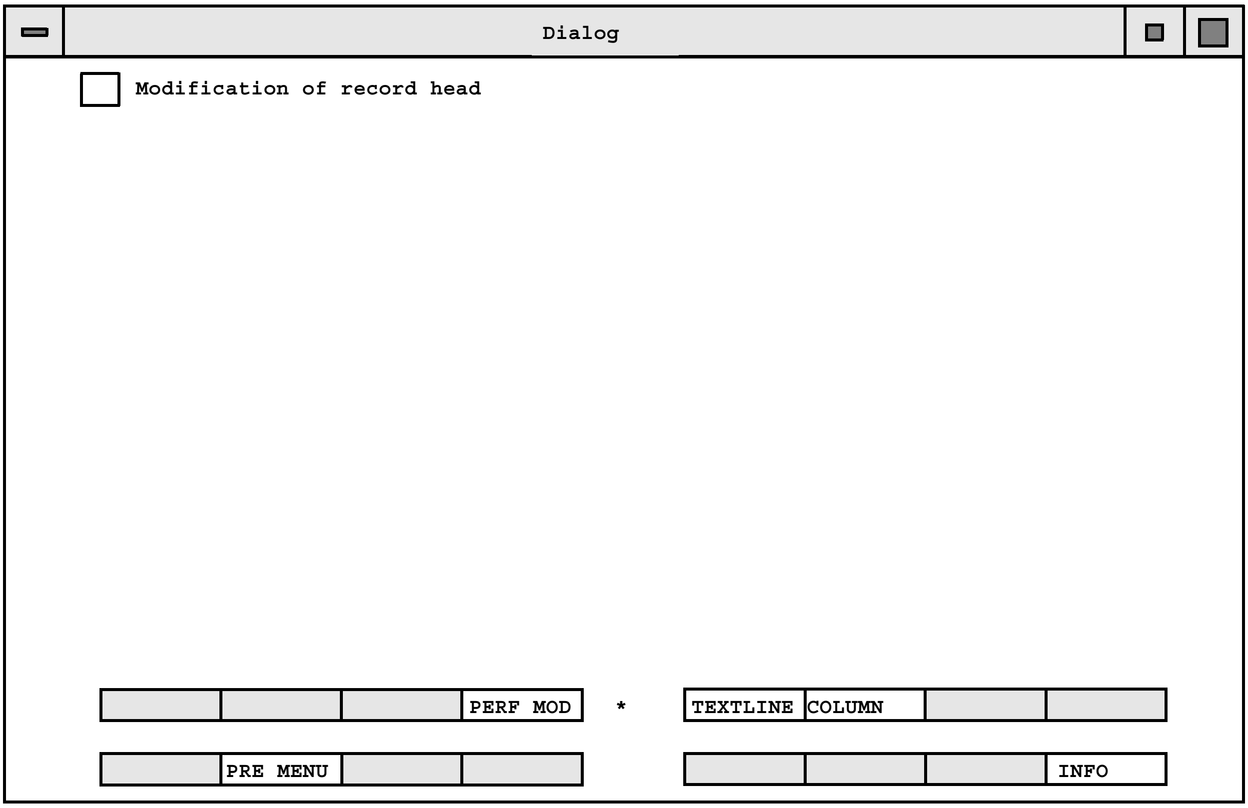
Options

- Input or modification of text lines and column labels
- Initialization of header. If variable header I is deleted, the default header will be set.



DI	Pull-Down-Menu	Pictogram
1612	Record	
MODREC	Record head	
a58	modify...	





Softkeys

STANDARD

Initializes the protocol header.

- Activates the default header.
- Deletes all text lines previously entered.
- Resets modifications of column identifications.
- All header inputs are deleted. The operator name can be changed by logging in again in UMESS or by entering **<DI 1698>**.
- Returns to main menu without outputting the header.

TEXTLINE

Text lines 1 to 9 can be entered or edited. Following termination with **<TERMIN>** the system returns to the main functions.

COLUMN

The length, identifications and number of the columns can be changed. (This does not apply to the **OPERATOR**, **DATE** and **PART NUMBER** columns).

If the first character of a column is an asterisk (*****), the column is automatically requested with each CNC start.

Note that the columns are separated by a vertical line (|).

NOTE

Note for CNC mode
You must define the header before starting the learn (part) programming, since the number of control lines required varies according to the layout.

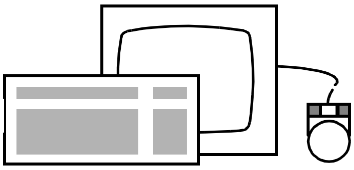
Calling the default header and variable header I <DI 1610>

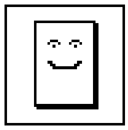
This function

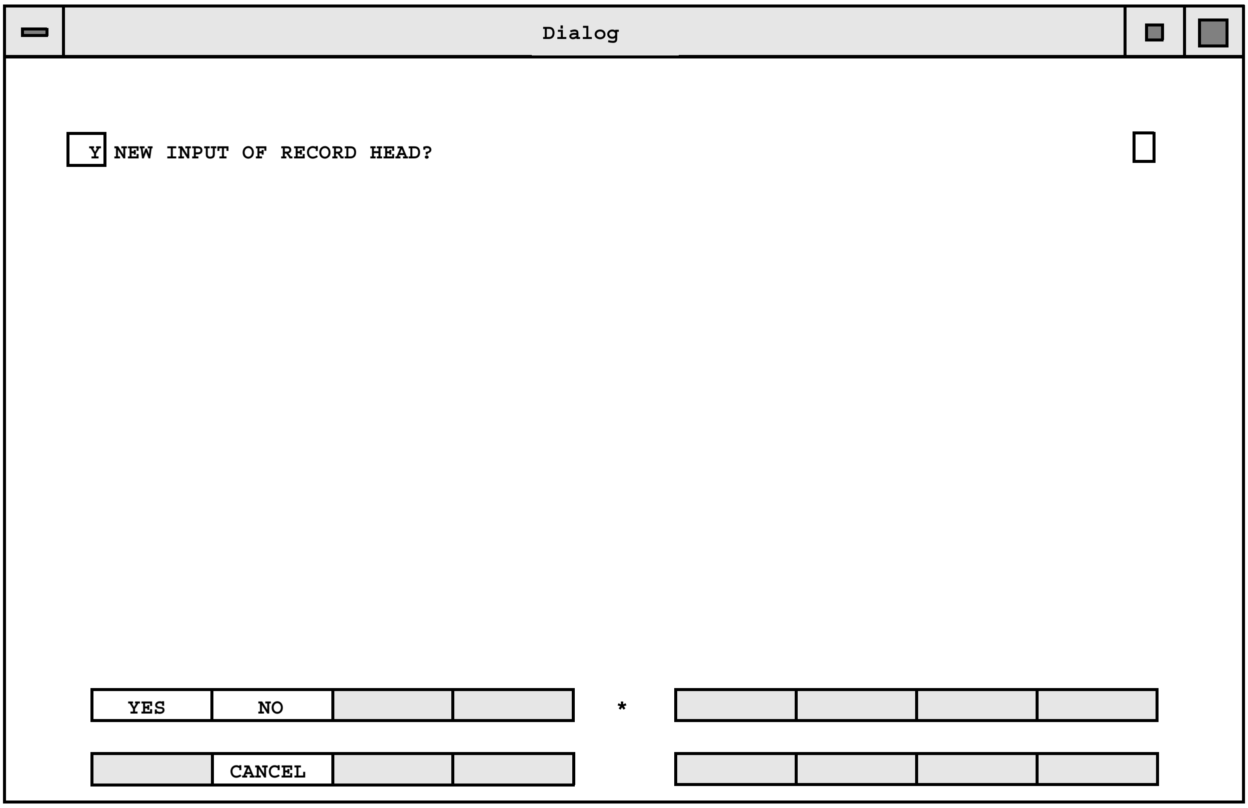
- enables you to input the information which is to appear in the header;
- prints the header;
- deletes all alignment angles and zero points and sets the address counter to **1**.
- Previous measurement results are lost, the initial status is set.
- The axis identifications set with **<DI 1711>** are *not* deleted.

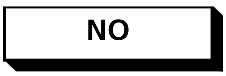
Application

The header is normally invoked at the beginning of a new measuring run or CNC program.



DI	Pull-Down-Menu	Pictogram
1610	Record	
RECORD	Record head print...	



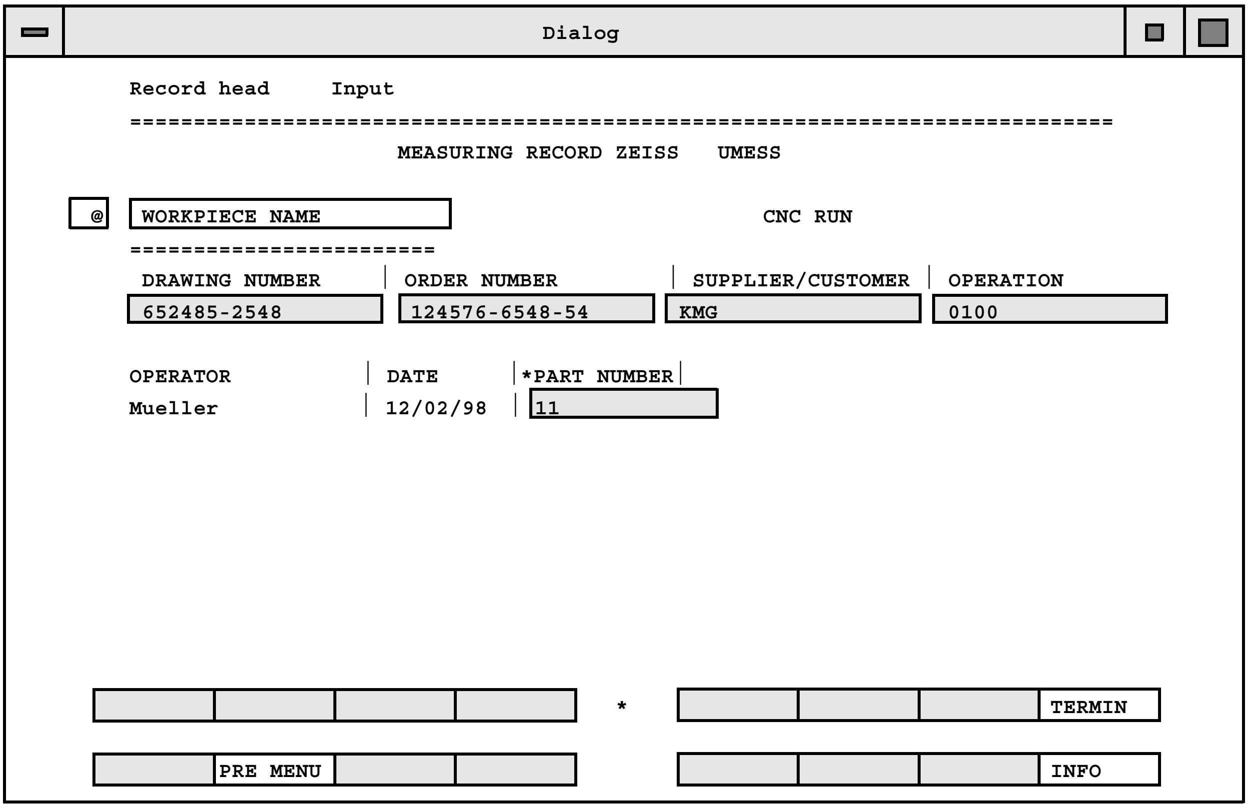


Accepts all data from the last input. Only columns marked with an asterisk (*) are requested in a separate dialog window.

SET PRINTER TO TOP OF PAGE! (RETURN)

If record output to the printer is selected and the printer is being operated in the direct mode, you will be prompted to set the printer to the top of the page.

YES The program will then prompt you to fill in all of the header columns except for **OPERATOR** and **DATE**.



TERMIN End of input and return to previous menu.

SET PRINTER TO TOP OF PAGE! (RETURN) If record output to the printer is selected and the printer is being operated in the direct mode, you will be prompted to set the printer to the top of the page

SYSTEM INITIALIZED Displayed as information in the list and message window.

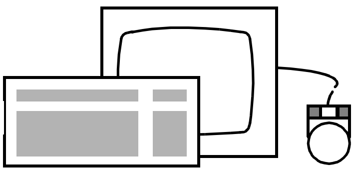
Call des Variablen Protokollkopfes II <DAW 1611>

Definition

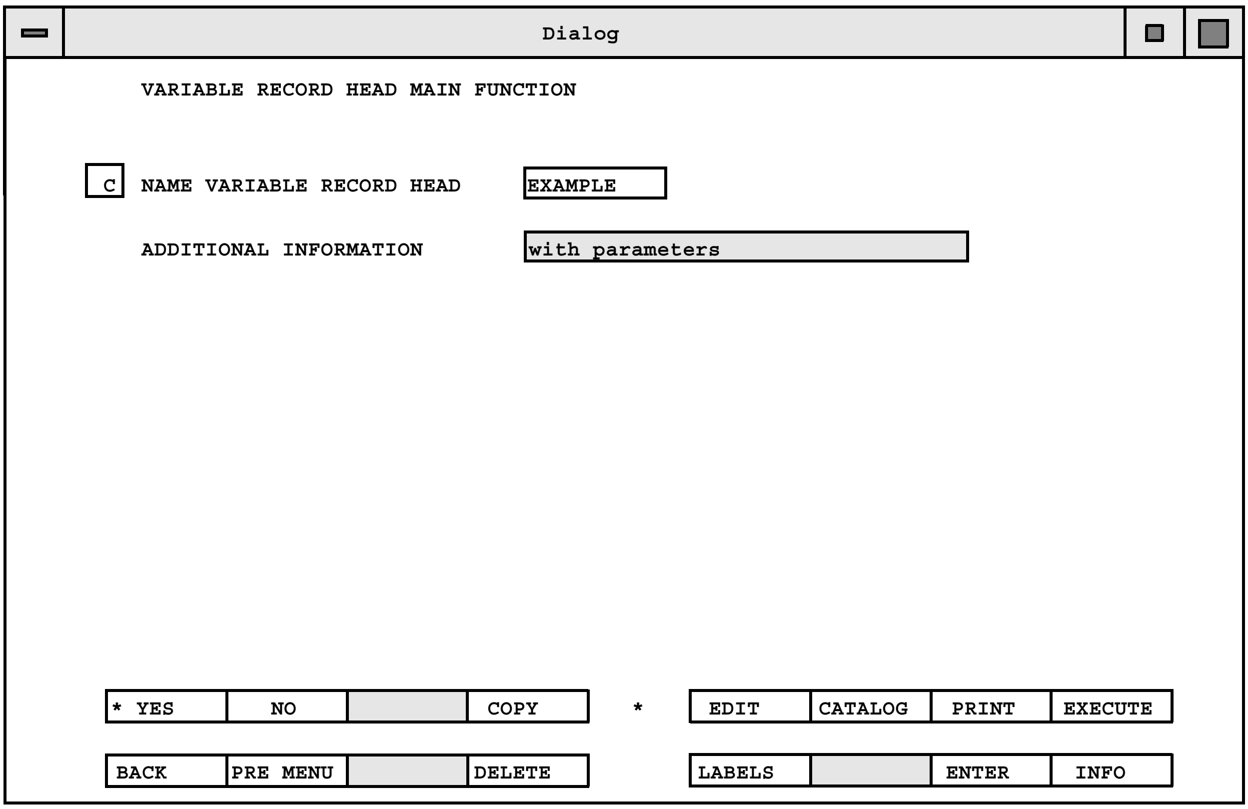
You can arrange the layout of variable header II with a max. of 65 lines of texts and data boxes.

NOTE

Restriction: The **operator**, **date**, **workpiece name** and **part number** boxes must be included in the layout.



DI	Pull-Down-Menu	Pictogram
1611	Record Record head form...	



Softkeys

CATALOG

A list of the available header files is displayed. The file required can be selected using the **<YES>/<NO>** keys.

COPY

To copy an existing header file:

Enter the name of the header file you want to copy, press **<COPY>** and enter the new name of the file.

NOTE

A new header file can be created by copying and then editing an existing file.

EDIT

Calls the text editor to edit an existing header file.

LABELS

Used to enter or edit the labels of user parameters in the database.

DELETE

Deletes a header. A file thus selected will be deleted from the hard disk only following a confirmation inquiry.

PRINT

Outputs the header currently selected without prompting inputs to the data boxes. The header is created with data from the database. The initial system is activated.

EXECUTE

Inputs and outputs the header currently selected. The initial system is activated.

ENTER

Enters and saves data in the database. No printout is performed.

Labels

The parameters stored are displayed after calling **<LABELS>**.

User parameters can be edited here:

```
Edit PTS

File Help

H1:  OPERATOR
H2:  DATE                                1)
H3:  PART NUMBER
H4:  WORKPIECE NAME
H5:  WORKPIECE NAME FROM CONTROL DATA CAT.     1) 2)
H6:  CONTROL DATA FILE                   1) 2)
H7:  CREATE DATE                         1) 2)
H8:  UPDATE DATE                         1) 2)
H9:  NAME OF GENERATOR                   1) 2)
H10: NAME OF CHANGER                     1) 2)
H11: REVISION CODE MSW                         1) 2)
H12: TIME                                1)
H13: DRAWING NUMBER
H14: WORKPIECE NAME FROM CONTROL DATA CAT. 1) 2)

T1:  PROBE COMBINATION                   1)
T2:  PROBE NUMBER                        1)
T3:  PROBE CONFIGURATION                 1)

U1:  VARIABLE RECORD HEADER UMESS (example)
U2:  USER PARAMETER2
U3:  USER PARAMETER3
U4:  USER PARAMETER4
U5:  USER PARAMETER5
U6:  USER PARAMETER6
U7:  USER PARAMETER7
U8:  USER PARAMETER8
U9:  USER PARAMETER9
U10: USER PARAMETER10
```

1) output only

2) only assigned in **PROG** or **CNC**

NOTE

After calling the **<EDIT>** or **<LABELS>** softkeys, the editors must be termined by selecting **File** → **Termin** from the Pull-Down-Menu.

Defining the boxes for output

[= Box start (first character)

] = Box end (last character)

Operator : [H1]

H1 = contents of parameter H1 = operator name

Alternative:

[$H1] : [H1]

$H1 = parameter label H1 = **OPERATOR**

Defining the boxes for input and output

{ = Box start (first character)

} = Box end (last character), if no "**:**"
} or " | " is specified.

Operator : {nnnH1 :mm

mm = 1 to 2 digits for the box length (required only if the box length is shorter than the box label)

H1 = contents of parameter H1 = operator name

nnn = 0 - 9 digits for operating modes in which parameters are requested

Possible operating modes:

0 = no input (corresponds to [ ])

1 = manual

2 = programming mode

3 = CNC run, input from database

4 = man CNC, input from control data

Parameters

The labels and contents of data boxes can be defined by parameters:

- System parameters (H1 - H14)
- Technical parameters (T1 - T3)
- User parameters (U1 - U99)

H and T parameters are system and technical parameters which are always provided in updated form. Since they are also used in other UMESS programs, they should not be changed.

In contrast to the above, U parameters can be used as required. They are also session-specific, i.e. must be redefined for each session.

Line length

Data boxes may be defined only up to the 77th character in each line. A box may have a maximum of 69 characters.

Tab stops

Tabs are not allowed.

Data boxes

If an data box has op. mode code 3 or 4 or an output box has [ ], the output value will be taken from the current data base. In all other cases, the output value is taken from the control data.

Control data

The complete record header is stored in the control data and output depending on the value of column SC2. If a definition file is missing, it will automatically be created in the CNC run and entered in the catalog. A record header with the same contents can thus be selected either manually or during PROG.

If the creation of a definition file is prevented, the lowest value position in column SC2 must be changed to **0**.

Interpretation of the codes in column SC2

0	Control data from old version (corresponds to the value 6)
bit 0 = 1	The record head is updated in the CNC mode and entered in the catalog if required.
bit 1 = 1	Input in the database.
bit 2 = 1	Output in record with values from database or control data.
bit 3 = 1	Read in "**TEMPFILE___SNB**" file from **/home/zeiss/UC** (special case for DNC mode, can not be created using PROG).

Example

Header edited

```
==============================================================================
=
[$U1                                                                         ]
==============================================================================
=

[$H1        ] :  {123H1                       }     [$U10        ]:  {1234U10:3}

DRAWING      :  [¤U1                       ] from[H2          ]

DETAIL         :  [¤U2                       ]     PART NUMBER: {13H3         }

WORKPIECE NAME:  {123H4                       }

SUPPLIER      :  [¤U3                                    ]
                   [¤U4                                    ]

------------------------------------------------------------------------------
-
[$T3                ] : [T3           ]

                                                 INSP.DATE   : {OOH2          }
                                                       TIME : {OOH12         }
```

Header output

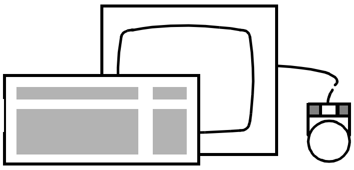
```
===============================================================================
Content of Userparameter U1
===============================================================================

OPERATOR      :  Mueller                        Serial No.     :   001

DRAWING       :  Contents of User parameter U1               DATE 02/04/1998

DETAIL          :  Contents of User parameter U2       PART NUMBER : 25

WORKPIECE NAME:  TEST

SUPPLIER      :  Contents of User parameter U3
                   Contents of User parameter U4

-------------------------------------------------------------------------------
PROBECONFIGURATION : 17

                                                   INSP.DATE : 02/04/1998
                                                   TIME: 13:15:20

================================================================================
   ADR|    NAME / IDF |SY| ACT VAL|NOM VAL| U.TOL | L.TOL | DEV | MAG
================================================================================
```

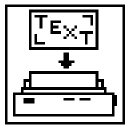
Comment input

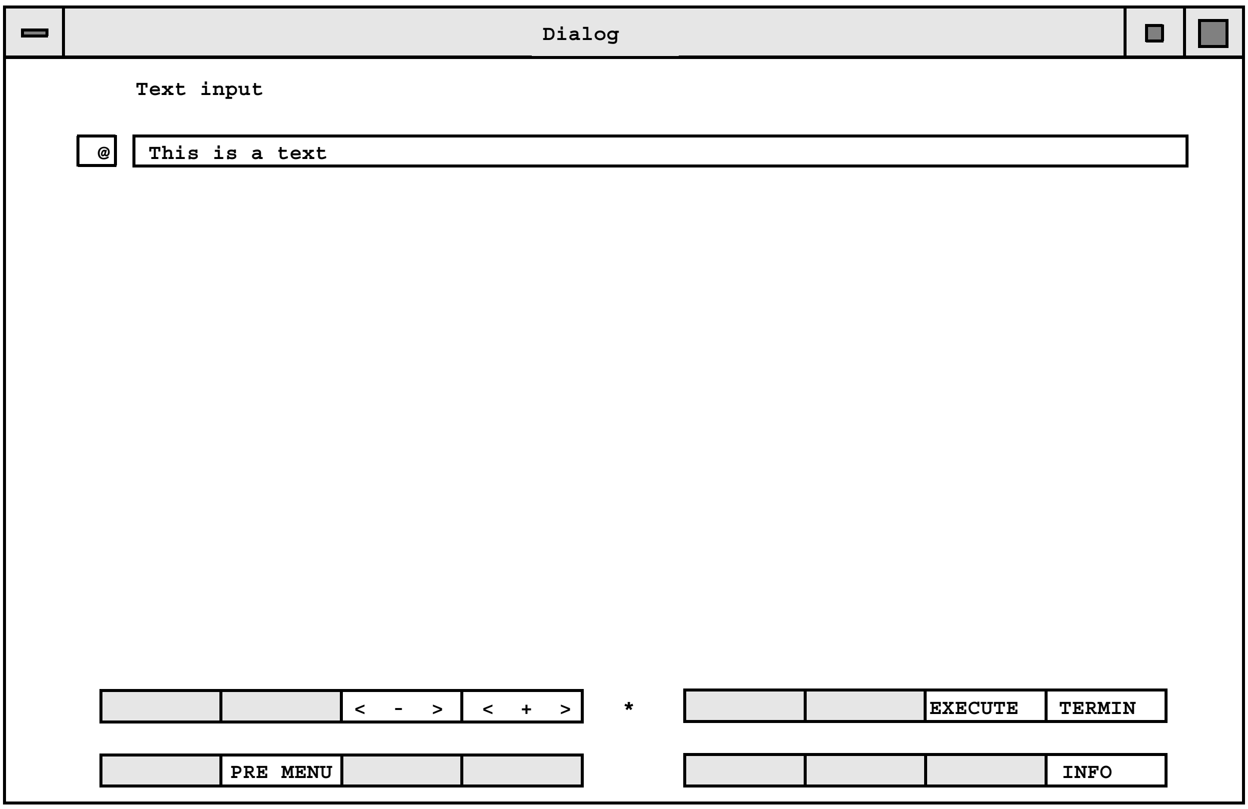
Comments in the measurement record <DI 1676>

Application

Any number of texts can be printed in the measurement record with this function.



DI	Pull-Down-Menu	Pictogram
1676	Record Layout Text...	



< - >
< + >

The last 10 text inputs remain stored. They can be recalled to the data box and output using the **< + >** / **< - >** keys.

EXECUTE

The text entered is printed. The dialog window remains open and more texts can be entered.

TERMIN

Pressing **<TERMIN>** or **<Enter>** causes the text to be printed and closes the dialog window.

NOTE

– Maximum of 77 characters per line.

– Actuals from measurement results can be inserted in the following form:

  ... #SY(ADR)# ...

  SY = symbol of measured value to be output,

  (ADR) = address of measured value to be output. The field reserved for output can be enlarged by blanks after ADR.
  Example:

  Diameter of bore = #D(15)# mm

– The **<Insert>** and **<Delete>** simplify text processing.

– The texts are printed left-justified.

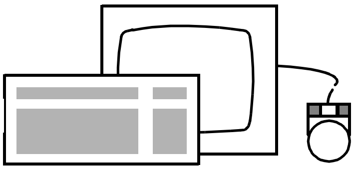
NOTE

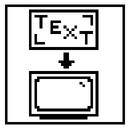
This function can not be used to enter screen notes during a CNC measuring run. (➤*„Screen display of comments <DI 1677>" on page 5-35*).

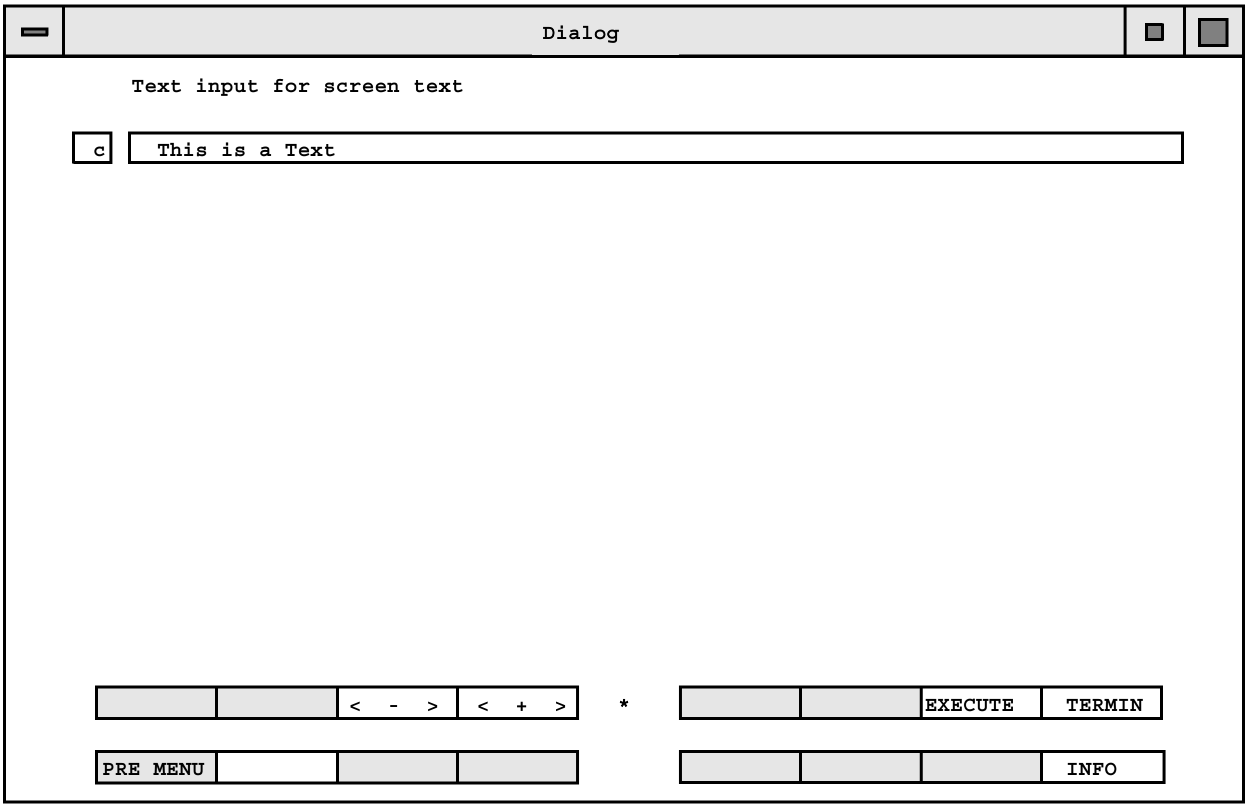
Screen display of comments <DI 1677>

Application

You can use this function to enter notes for the user. These notes will be displayed on the screen during the CNC measuring run.



DI	Pull-Down-Menu	Pictogram
1677	Service	
BTEXT	Layout	
	Notes CRT...	



< - >
< + >

The last 10 text inputs remain stored. They can be recalled to the data box for display and output using the **< + >** / **< - >** keys.

EXECUTE

The text entered is printed. The dialog window remains open and more texts can be entered.

TERMIN

Pressing **<TERMIN>** or **<Enter>** prints the text entry and closes the dialog window.

NOTE

- Maximum of 77 characters per line.
- Actuals from measurement results can be inserted in the text in the following form:

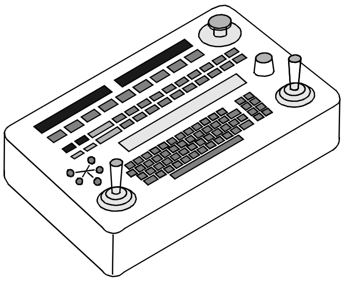
  ... #SY(ADR)# ...

  SY = symbol of measured value to be output,

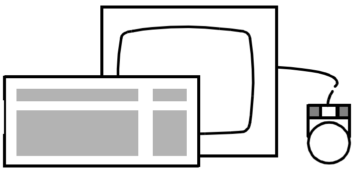
  (ADR) = address of measured value to be output.The field reserved for the output can be enlarged by adding blanks after ADR. Example:

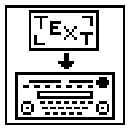
  Diameter of bore = #D(15)# mm
- The **<Insert>** and **<Delete>** keys facilitate text processing.
- The texts are printed left-justified.

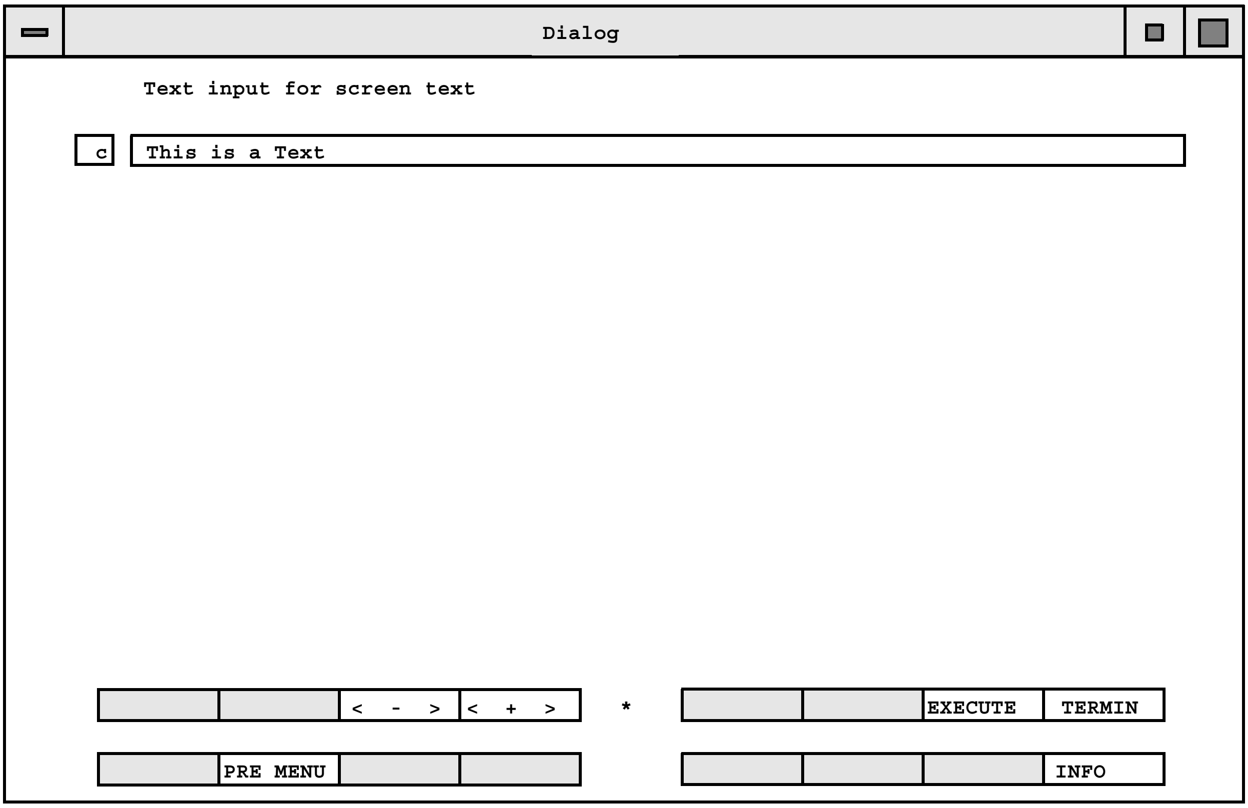
Comments on the alphanumeric control panel <DI 1678>



Notes for the user can be entered with this function. These notes are displayed both on the monitor screen and in the second dialog line of the control panel during the CNC measuring run.



DI	Pull-Down-Menu	Pictogram
1678	Record	
CPNTXT	Layout	
	Notes CP...	



For information on applicaiton, see ➤*„Screen display of comments <DI 1677>“ on page 5-35*.

Time function <DI 1618>

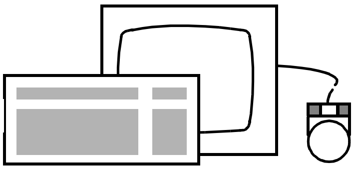
Application

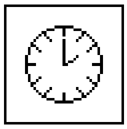
The following will be output if you enter **<DI 1618>** in the measurement record:

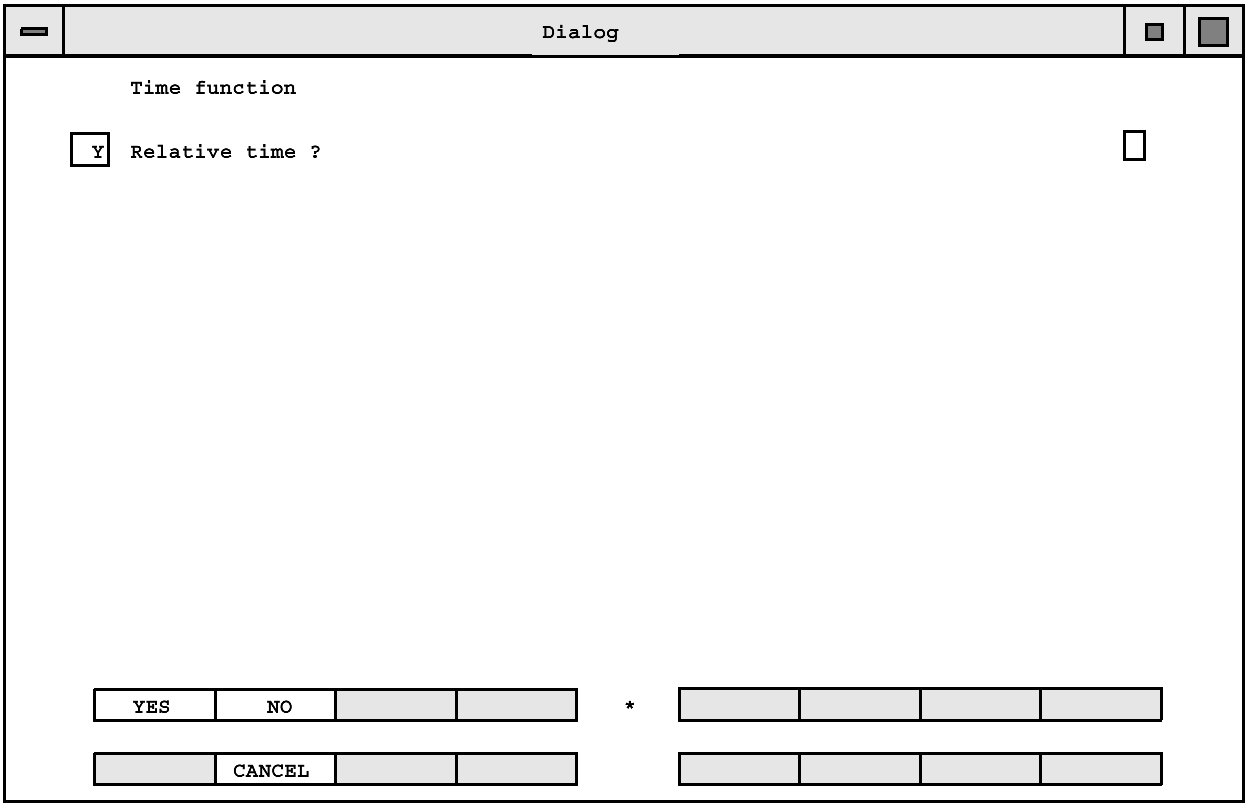
– the current time or

– the time which has elapsed since the last time the given function was called (relative time).

This makes it possible to determine the amount of time required to perform specific measurement tasks and output this information directly to the measurement record.



DI	Pull-Down-Menu	Pictogram
1618	Record Time Output time..	



YES

The time which has passed since the last time this function was called is output.
The current time will automatically be displayed the first time this function is called after the system is switched on.

NO

The current time is output.

Multitasking of the control and evaluation functions may result in a time lag between the printed time (=end of evaluation) and the machine standstill time (=end of control).

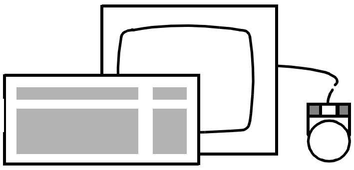
NOTE

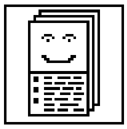
This situation can be remedied via synchronization, e.g. by running offset adjustment x=y=z=0 prior to PROG End.

Repetition record <DI 1613>

Application

When this function is called, the measurement record of the last measuring run stored will be output to the printer or screen.



DI	Pull-Down-Menu	Pictogram
1613	Record Output repeat current record...	

Extent

The extent of record settings from **<DI 1665>** also apply to the repetition record.

Function

The record of the last measuring run is retained even after the computer has been switched off and can be output as a repeat record.

Reset of address counter

The following functions reset the address counter to 1:

– Call of record header **<DI 1610>**

– Setting the initial status **<DI 1608>**

NOnce one of these functions has been called, the record of the previous measuring run can *no longer* be printed out.

Saving, outputting and deleting records

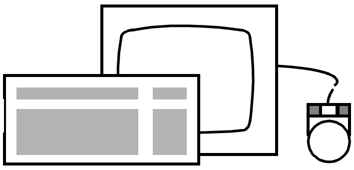
Saving records with a workpiece number or code <DI 1683>

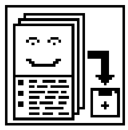
Application

When this function is called, the current record will be saved to the **/home/zeiss/UF** directory of the hard disk in ASCII format.

Extent

The settings of **<DI 1665>** restricting the extent of the record have no influence. All of the data is always saved.



DI	Pull-Down-Menu	Pictogram
1683	Record	
SAVEREC	Output	
	Store	

Filename

The filename has the following syntax:

PD_xxx_yyyyy_B

xxx

is the workpiece code (number or first 3 characters) from the control data catalog (only for the CNC or PROG mode).

yyyyy

is the part number from the header

Example

PD_15__3_____B is the record of workpiece no. 15 in the control data catalog with part no. 3.

NOTE

If this function is called in the manual mode (without **PROG**), the workpiece number will be assigned with zeros.

If a backup is required only for a specific measuring run, you must first set the initial status by entering **<DI 1608>** (set initial status) or **<DI 1610>** (call record head).

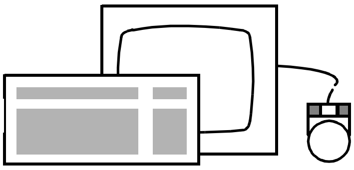
Saving, outputting and deleting records <DI 1684>

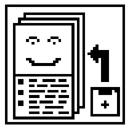
Application

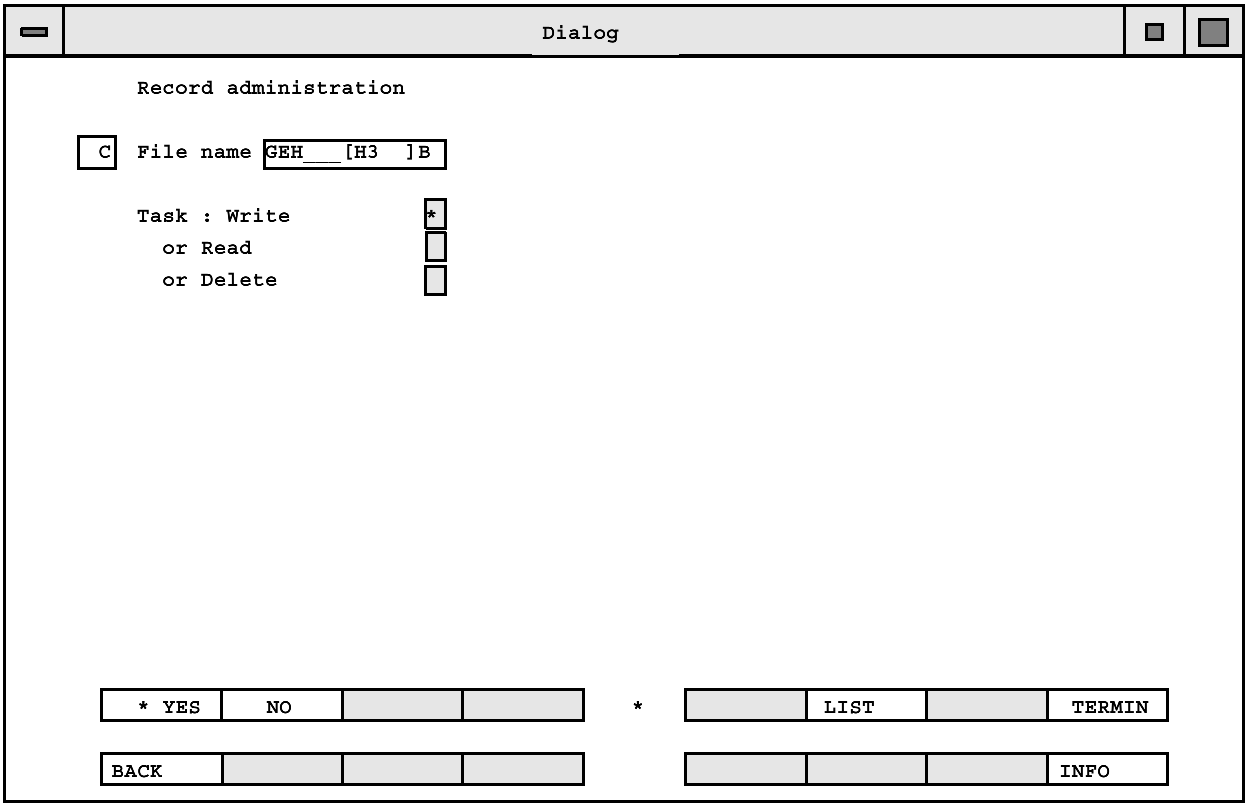
You can save records in ASCII format under a single file name in the **/home/zeiss/UF** directory of the hard drive by entering **<DAW 1684>**. Saved records can also be output or deleted.

Extent

The settings from **<DI 1665>** for restricting the extent of the record have no influence here. All of the data is always saved.



DAW	Pull-Down-Menu	Pictogram
1684	Record	
RECOUTP	Output	
	Retrieve stored data...	



Softkeys

LIST

The names of all records stored are output in the list and message windows on the screen.

A preselection can be made by entering a suitable abbreviation, e.g. **HOU***

File name

If you want to store a current record, read or delete a stored record, the correct filename must be specified here.

Name conventions

The filename must comprise max. 13 characters + **B**, i.e. its first character must be a letter. Special characters, e.g.. "**/**" are not allowed.

Continuous saving

If records are to be saved automatically without overwriting previous records during the CNC run, additional placeholders or blank spaces must be inserted in the filename for the part number.

Example: **GEH___[H3]__B**

At least one blank is required inside the brackets. Blank spaces outside of the brackets must be filled in with "_" (underlines).

During the CNC run, the space reserved in **[H3]** is replaced by the part number (**GEH___001____B**).

Task: Write, read or delete

– **Write**
  Saves the current record under the filename specified.

– **Read**
  Reads the record stored under the filename to the current measurement record. The record is then output.
  Once this has been done the repetition record <DI 1613> can no longer be called up, since the record file has been overwritten.

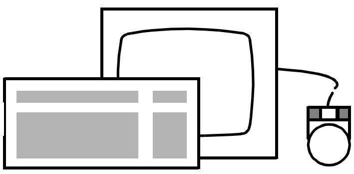
– **Delete**
  Deletes the record with the specified filename.

Printing the last 10 measurement records <DI 1604>

Application

This function is used to list and print the last 10 measurement records.

The measurement records are saved under the name **PR_LAST_xx_ssB** in the **/home/zeiss/UF** directory of the hard disk, where **xx** here stands for the consecutive number and **ss** denotes the session number.

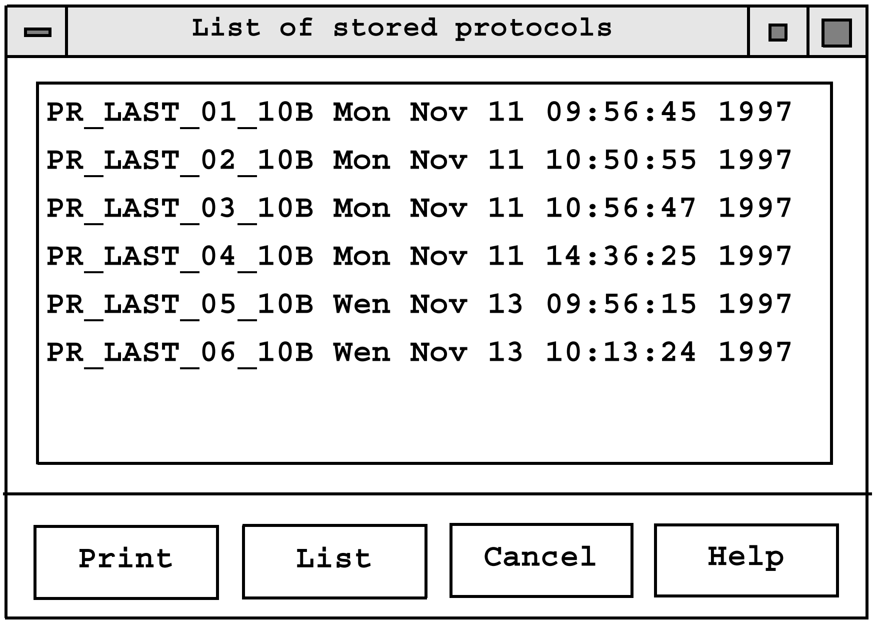


DI	Pull-Down-Menu	Pictogram
1604		

Important
This function also internally executes **<DI 1608>** and therefore resets to the initial status. This is necessary to ensure that the latest record has been closed and saved.

Procedure

The records are displayed in a list window, where they can be selected with the mouse and printed.



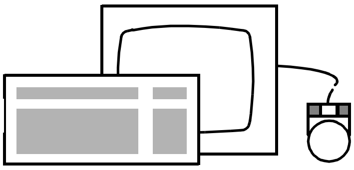
Changing the user name <DI 1698>

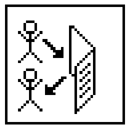
Application

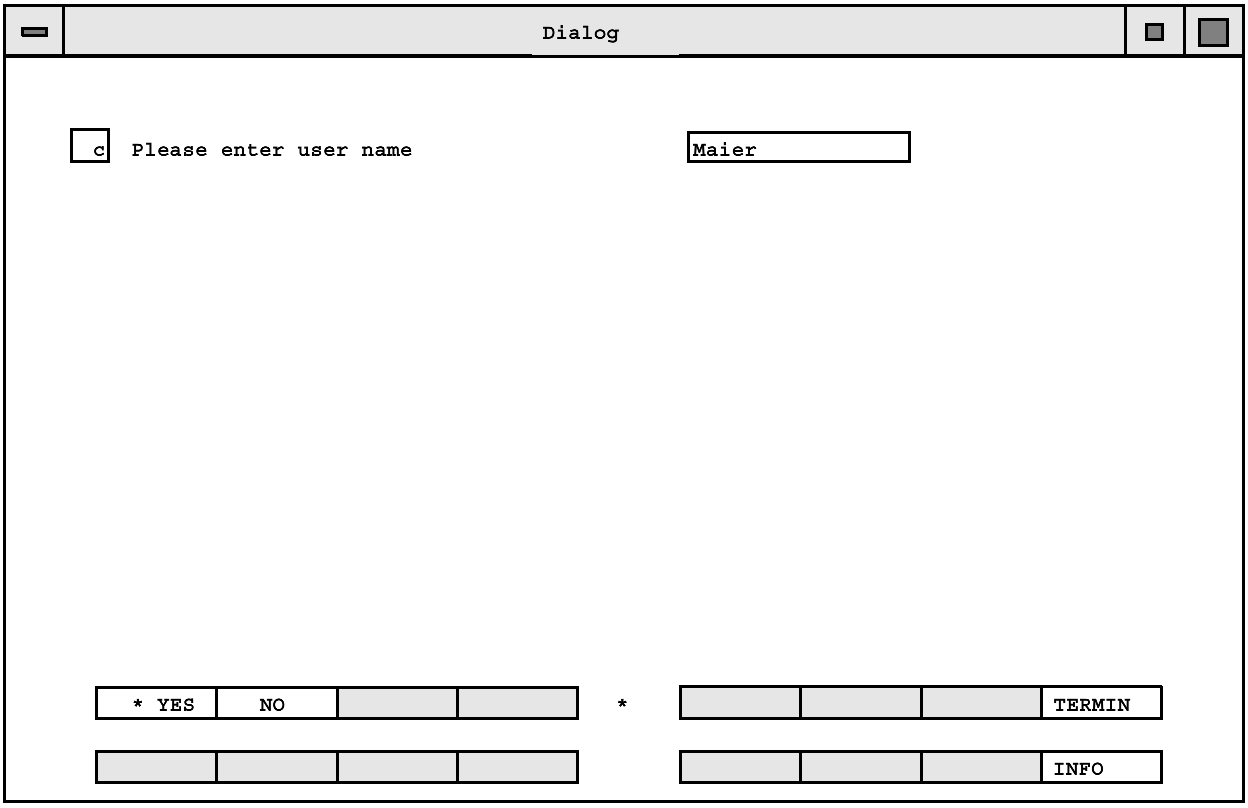
With this function, you can change the user name entered while a measuring run is in progress.

CNC run

If this function is started during a CNC run, the CNC run will be halted until it has been completed.



DI	Pull-Down-Menu	Pictogram
1698	Service General Change user name...	



Graphic output

Procedure

Proceed as follows to print or plot a graphic display (e.g. form plot) on the printer or plotter:

1. Select graphic device

First select the required output device with **<DI 1625>** (➤ *„Setting the mode for graphic devices <DI 1625>" on page 5-47* or Option 2).

2. Create form plot

You can create a form plot using **<DI 1470>** or a fast plot using **<DI 1461>**. (Option 2)

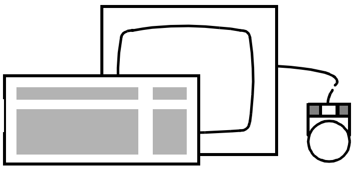
3. Start printout

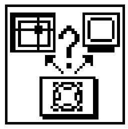
The "Paper change" function is started with **<DI 1652>** (➤ *„Output of graphics <DI 1652>" on page 5-49*). Only then will the graphic information be fed to the printer or plotter.

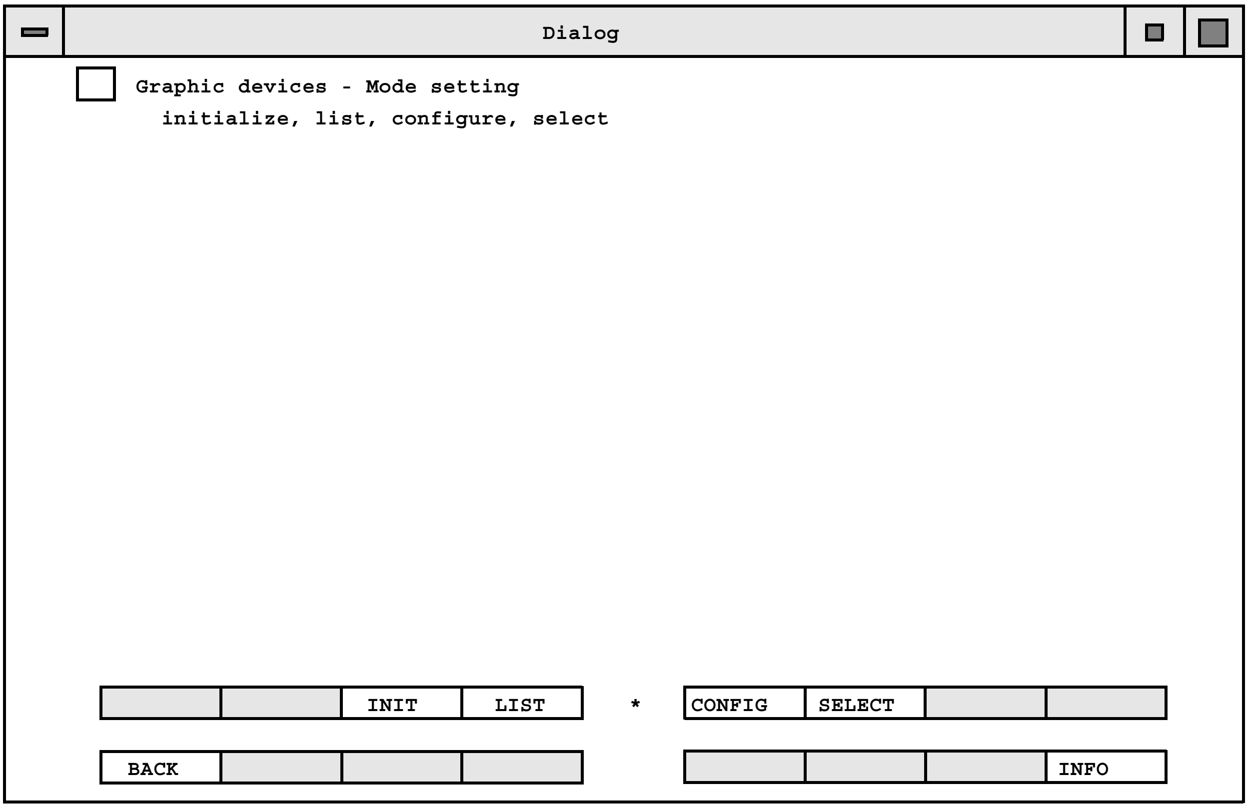
Setting the mode for graphic devices <DI 1625>

Application

With this function you specify the device where the graphic displays should be output (see UMESS Options 1 and 2, KUM).



DI	Pull-Down-Menu	Pictogram
1625	Record	
PDEVICES	Plot	
	Graphics output mode...	



Softkeys

INIT

The graphic system and all other devices selected (see **<SELECT>** soft-key) are initialized; the device status is output to the record.
<DI 1651> contains the same function, however, without a message output (➤*„Initializing the graphic software <DI 1651>“ on page 5-48*).

LIST

The current configuration is output to the record.

CONFIG

With this function you can change the size and position of the frame in the device box Xmin, Xmax, Ymin, Ymax.

SELECT

The devices where graphic output is to be performed must be selec-ted here.

True-to-scale representation

NOTE

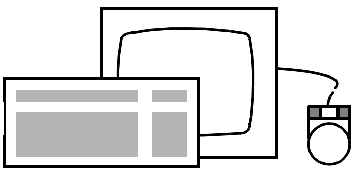
If you activate several different devices:
The true-to-scale representation is always referenced to the activated device with the lowest device number. If the height-width ratio of the other activated devices differs from the one referred to, the graphics printed or plotted on them will appear distorted or partially cut off.

Initializing the graphic software <DI 1651>

Application

The graphic software and all devices selected (➤*„Setting the mode for graphic devices <DI 1625>“ on page 5-47*) must be set to a defi-ned initial status during the system start or after a fault.

This initial status can also be produced by entering **<DI 1625>** and pressing the **<INIT>** softkey (➤*„Setting the mode for graphic devices <DI 1625>“ on page 5-47*).



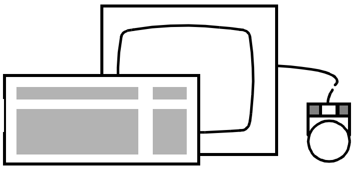
DI	Pull-Down-Menu	Pictogram
1651		

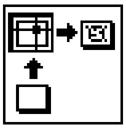
NOTE

You can use this function to delete buffered graphic files during ope-ration if the graphic output function is to be canceled.

Output of graphics <DI 1652>

In order to output the graphic file to your plotter or graphic printer, you must first initiate the "Paper change" function by calling **<DI 1652>**.



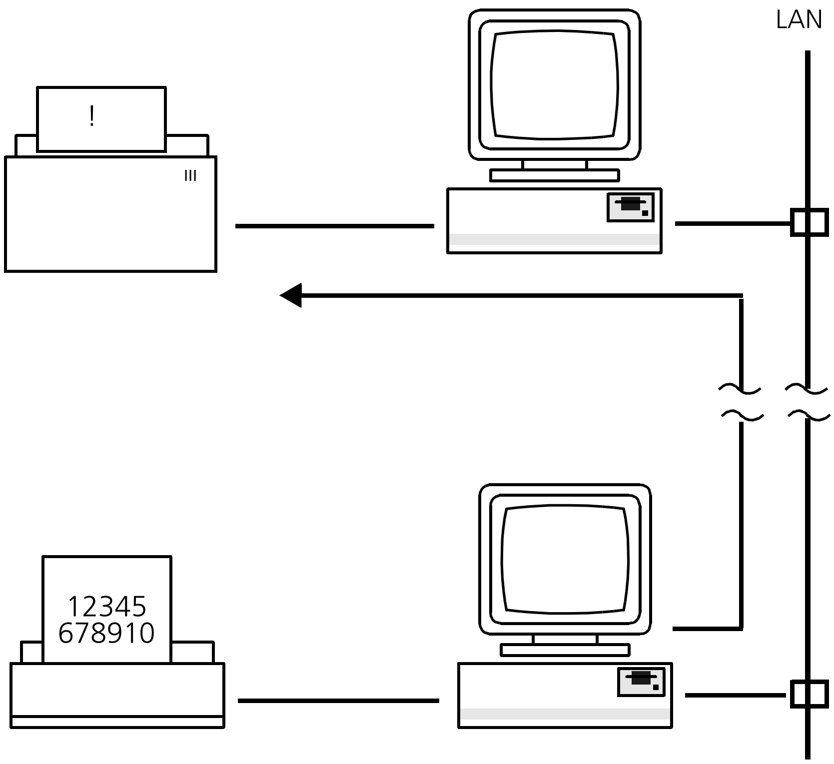
DI	Pull-Down-Menu	Pictogram
1652	Record Plot Paper change	

Printing and plotting in a network

Administration of output devices <DI 1674>

Application

Networked computers can share a remote printer.

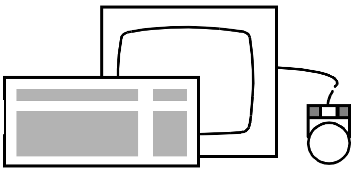


Possible operating modes

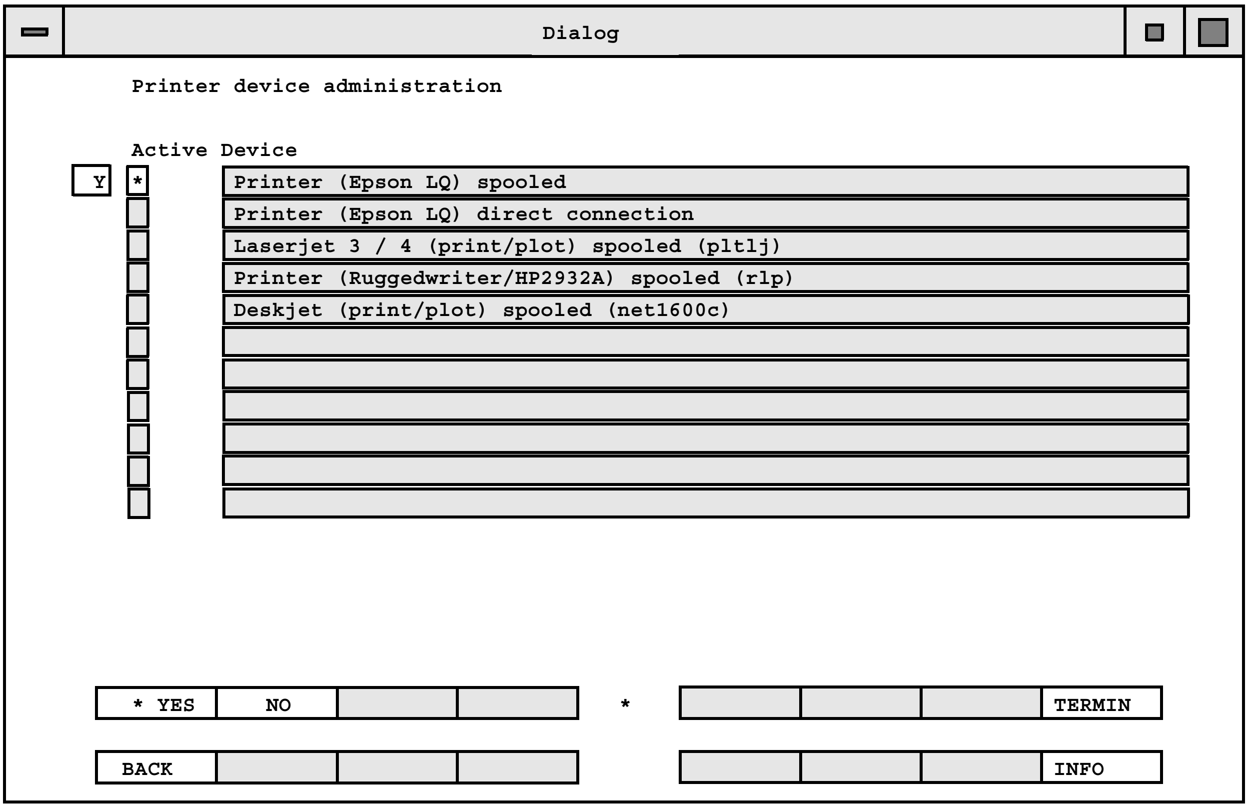
– **Unspooled mode**
  A printer is used by only one computer.
– **Spooled mode**
  A remote printer is shared by several computers via the network. The print jobs are buffered in a queue and processed by the printer in the order in which they arrive.

Function

If several printers can be accessed within a network, you can change printers by entering **<DI 1674>**.



DI	Pull-Down-Menu	Pictogram
1674	Record	
PRINTMAN	Output buffering	
	Administration...	



Active

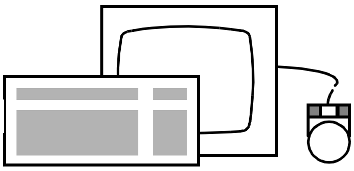
The device to be used for record output must be selected with the **<YES>/<NO>** keys.

The selection made can be stored as a long-term file by confirming with **<TERMIN>**.

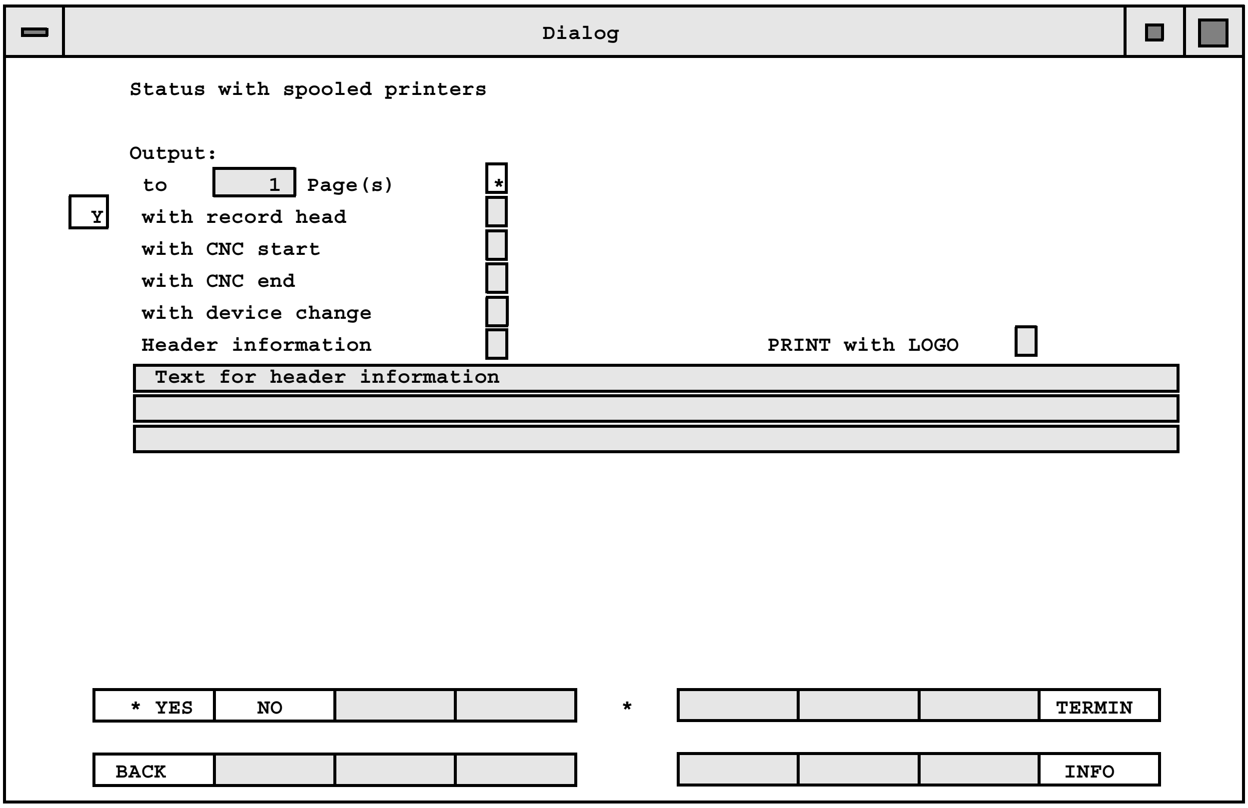
Status with spooled printers <DI 1689>

Application

In the spool mode printing starts by canceling the connection to the printer (e.g. switchover to the screen) or according to other criteria selectable via **<DI 1689>**.



DI	Pull-Down-Menu	Pictogram
1689	Record	
PRINTSPOOL	Output buffering	
	Output behavior...	



NOTE

When printing single pages, it is advisable to include header information (sender) in the record.

Chapter 6

Preparations for a measuring run

This chapter contains:

Reference point travel <DI 1570>

Application

The zero point of the machine coordinate system must be defined exactly for all coordinate measuring machines.

The zero point of the machine coordinate system is assigned to the mechanical limit position of the individual axes by a reference point or zero point travel (homing run). If a rotary table is connected, it can also be rotated to its reference position.

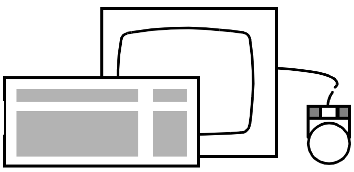
Important
Before executing the reference point travel, position the probe head so that the machine zero point subsequently to be traveled to (upper rear left-hand corner) can be reached without a collision.
The probe head first moves to the mechanical limit position in the Z axis, and then in the X and Y axes.

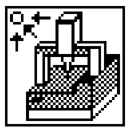
Danger
If a rotary table is connected, it will be positioned to its reference point. Be careful if workpieces are clamped to the table (danger of collision).

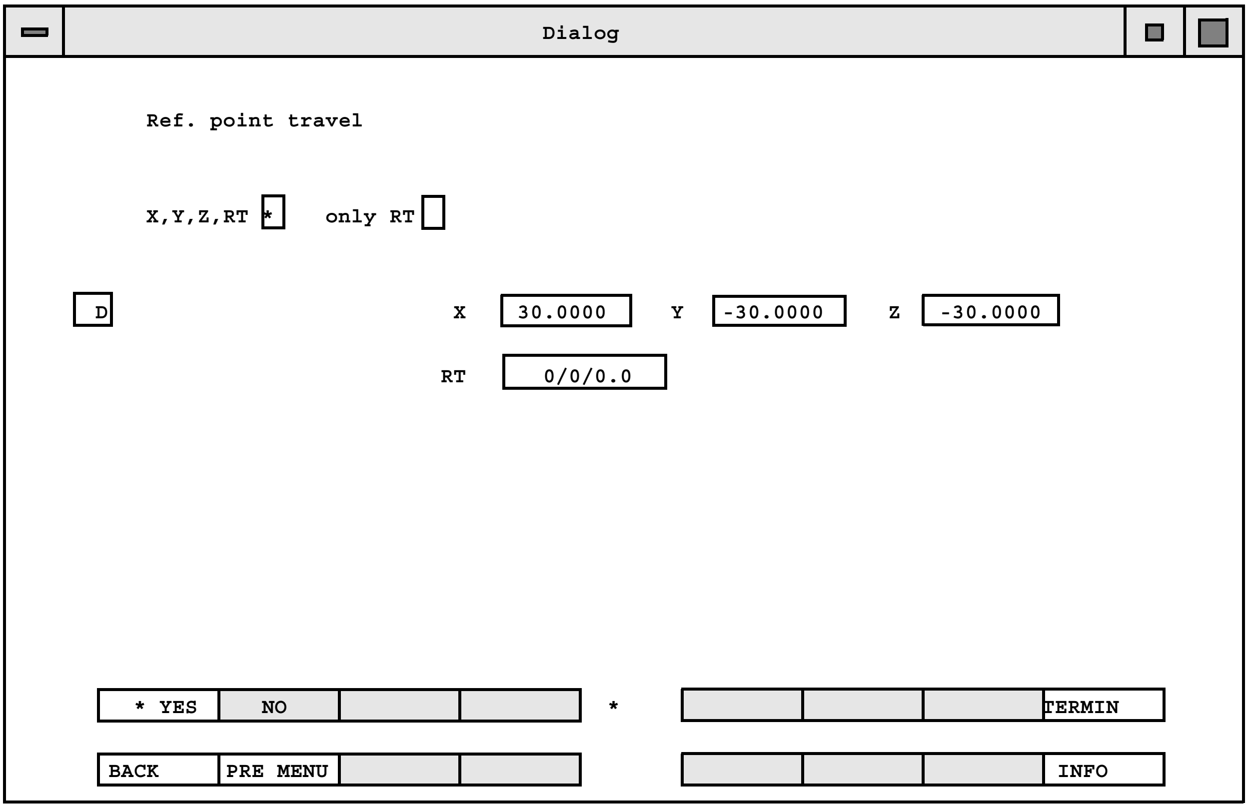
Function call

The reference point travel is called by

– switching on the CMM and starting UMESS
– calling **<DI 1570>**



DI	Pull-Down-Menu	Pictogram
1570	CMM	
RERPT	Travel commands	
	Reference point travel...	



Procedure

After reaching the mechanical limit position, the probe head automatically travels in all axes from this zero point. The amount or distance to be traveled can be entered in the lower data boxes.

TERMIN

This key terminates the dialog window. The following message appears on the screen: **Caution! CMM zero point travel!**

The probe head first travels to the mechanical limit position in the Z axis and then in the X and Y axes.

Limit position

After reaching the mechanical limit position, the probe head automatically moves away from this zero point by the value entered in all axes.

NOTE

If the <Reference point travel> dialog window automatically appears after the machine is switched on, the dialog window must not be terminated with **<PRE MENU>** or **<BACK>**.

NOTE

If the machine does not travel away from the zero point, you can cancel by pressing **<CANCEL>**. Check to make sure that X, Y and Z have the correct +/- sign and lie within the measuring volume. If the reference point is not valid (message on screen) call this function again.

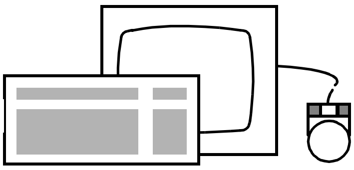
Linear offset correction <DI 1572>

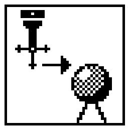
Application

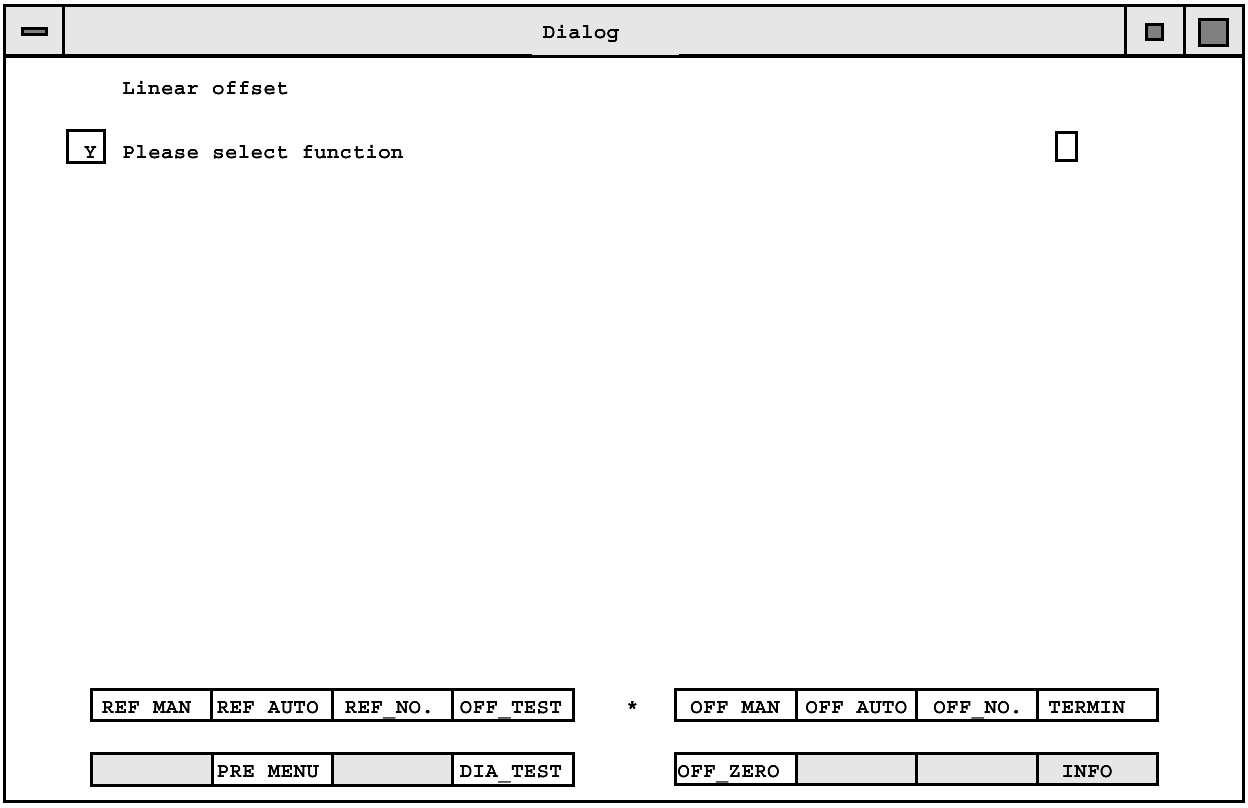
After a reference point travel, the W-position and the axis position of the rotary table may no longer mathematically correspond to the previous positions. Since the CMM zero point is defined via the limit switch, a linear offset then results. This offset can be measured using a master sphere and then corrected mathematically.

Prerequisites

- Calibrated probe
- The position of the calibration sphere must have been defined before the reference point travel.



DI	Pull-Down-Menu	Pictogram
1572	CMM	
OFFSET	RT 05	
a73	Drift correction...	



Procedure

- Create a reference to the workpiece system by performing a reference measurement on the calibration sphere.
- Reference point travel.
- Measure the position of the calibration sphere again with a calibrated probe.
- If you have defined a control point: Sie einen Kontrollpunkt festgelegt haben: Probe the control point.

Softkeys

REF MAN The reference position of the sphere is measured manually.

REF AUTO The reference position of the sphere is measured automatically. This is done by probing once in the direction of the shaft. A subprogram then roughly determines the position of the sphere and measures it again with the points generated for this purpose (function not implemented for laser).

REF_NO. The reference position is displayed; no change is possible.

OFF_TEST An offset test is performed.

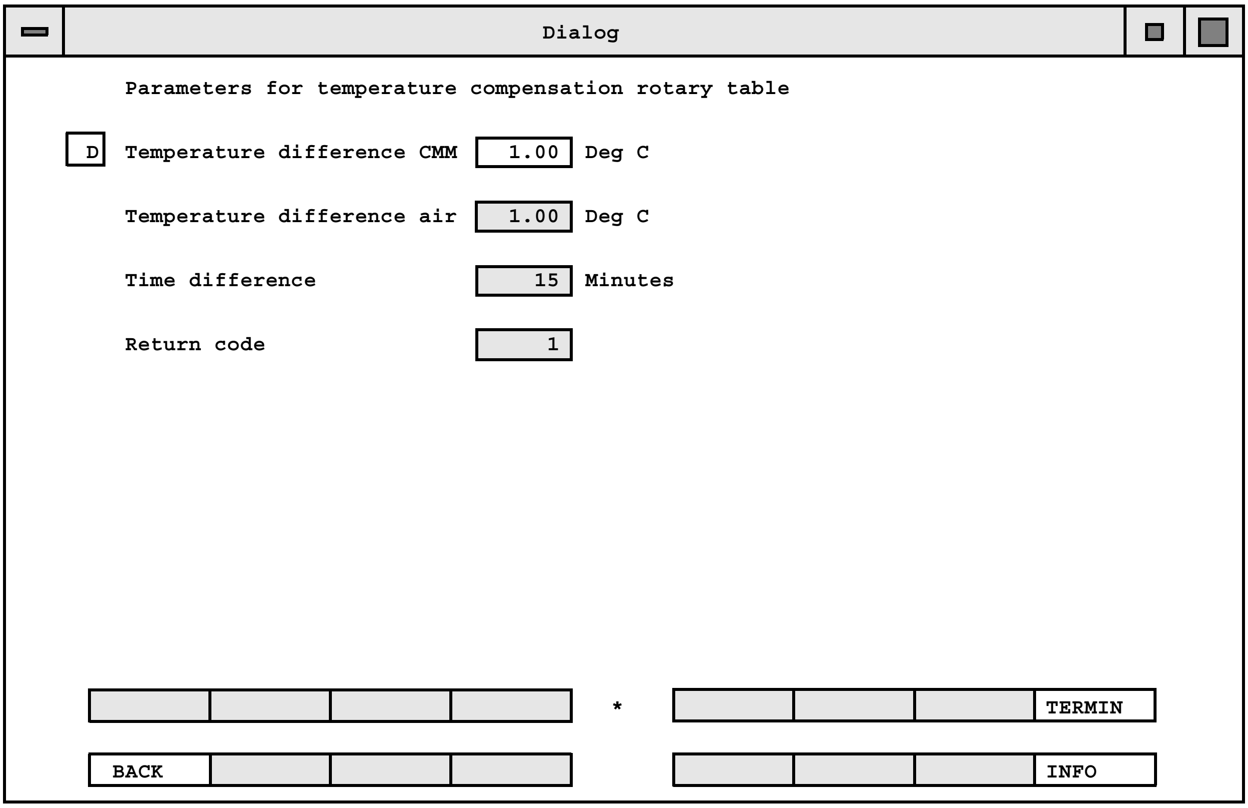
OFF MAN The offset is measured manually.

OFF AUTO The offset is measured automatically (similarly to **REF AUTO**). If the probing is inaccurate, the computer assumes that the probe is at an inclined angle and the vector is displayed. A correction may be entered (e.g. 0, 0, -1 for a probe oriented in the -Z direction).

OFF NO. The offset is displayed and can be changed as required.

OFF_ZERO Resets the offset to zero.

DIA_TEST The parameters for the temperature compensation of the rotary table can be entered.



NOTE

The following functions can be programmed:

REF MAN **OFF MAN**

The user must program all positions. The intermediate positions are stored in the W-position system and the probings in the workpiece system.

REF AUTO **OFF AUTO**

The user only has to enter the start position, which is then stored in the workpiece system. The normal determined is also stored.

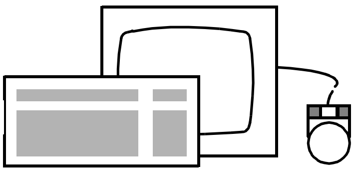
Setting the address counter

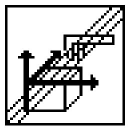
Setting the initial status <DI 1608>

Application

All results and alignments of a previous measuring run are erased with this function. It should be started before every new measuring run. The following then takes place:

- The address counter is set to 1.
- The alignment angles and zero points of the workpiece coordinate system are deleted.
- **FIXED PLANE** is set to automatic ("0") (➤„*Selecting the reference plane <DI 1680>" on page 10-50*).
- The rotary table rotation and workpiece coordinate system are separated from one another.



DI	Pull-Down-Menu	Pictogram
1608	Coord	
INITSTATUS	Preparation	
a11	Initial status	

Display

The list and message window displays the following message:
SYSTEM INITIALIZED

NOTE

- The free axis selection, sigma displacement and **PRB MOD** are *not* deleted.
- During learn (part) programming, the control data are stored in machine coordinates if **W-POS** is called following the initial status.

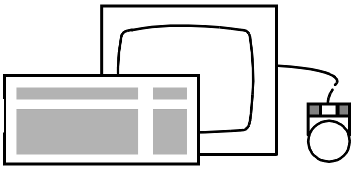
Producing the old status <DI 1670>

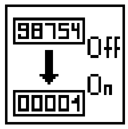
Application

The address counter is reset to 1 after the computer boots up and UMESS is started. The results of the previous measurement run are oversritten by new measurement results.

<DI 1670> sets the address counter to the position where it was before the system was switched off.

Measurement results or programming steps can be "saved" or "salvaged" following a system crash. If a rotary table is coupled, this status is retained.



DI	Pull-Down-Menu	Pictogram
1670	Service	
RESTORE	General	
	Old status	

NOTE

This function can be called immediately after starting UMESS.

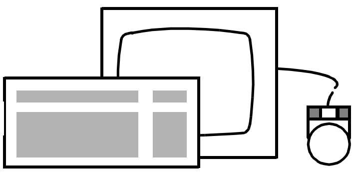
Setting the address counter to a random address <DI 1690>

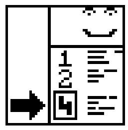
Application

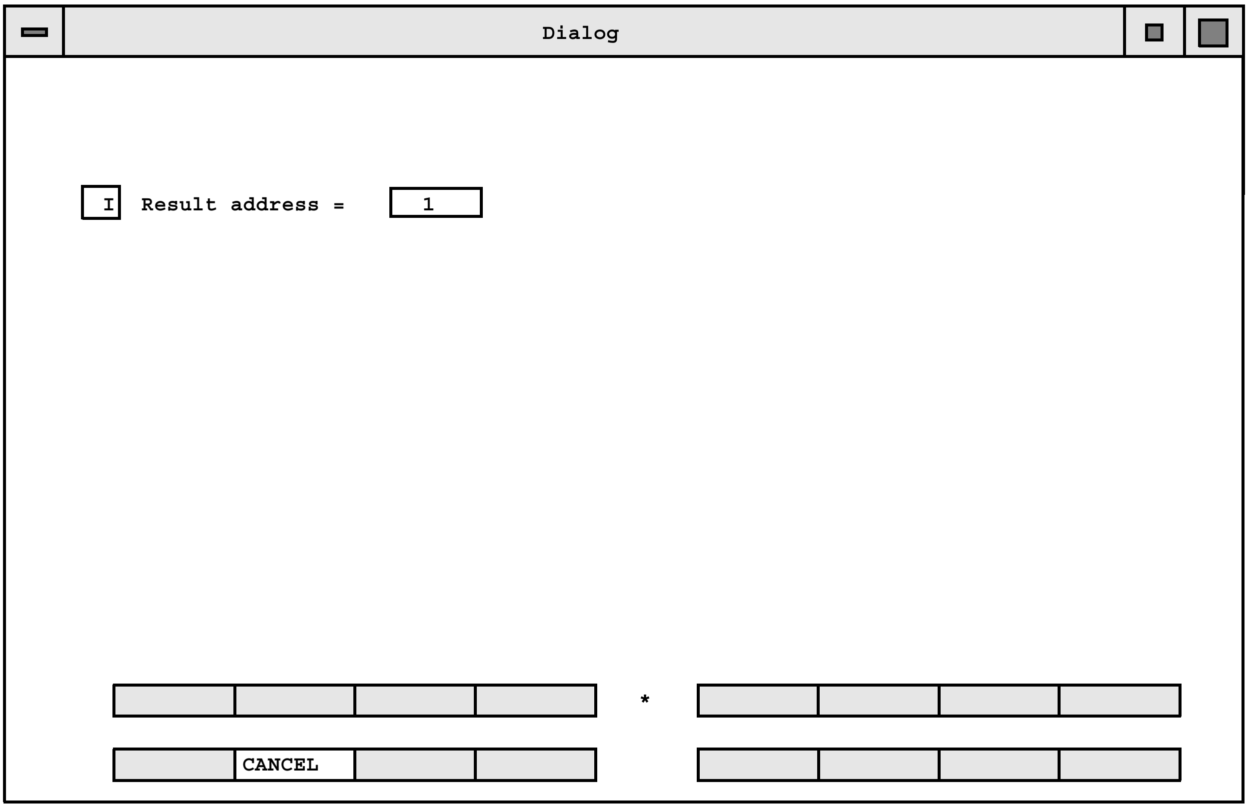
With **<DI 1690>** the address counter of the measurement record can be set to any number required.

Example

Addresses with faulty measurements can be overwritten by resetting the address counter.



DI	Pull-Down-Menu	Pictogram
1690	Record	
RES	Address counter...	
a29		



Procedure

Enter the address required and confirm with **<Enter>**.

NOTE

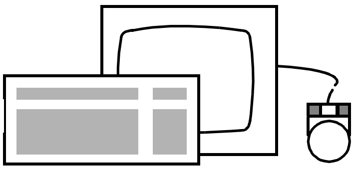
A control data line will be generated if the function is called in the PROG mode. If this is not required, the control data line can be deleted with **<DI 1032>**.

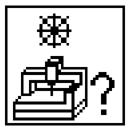
Defining the control mode <DI 1661>

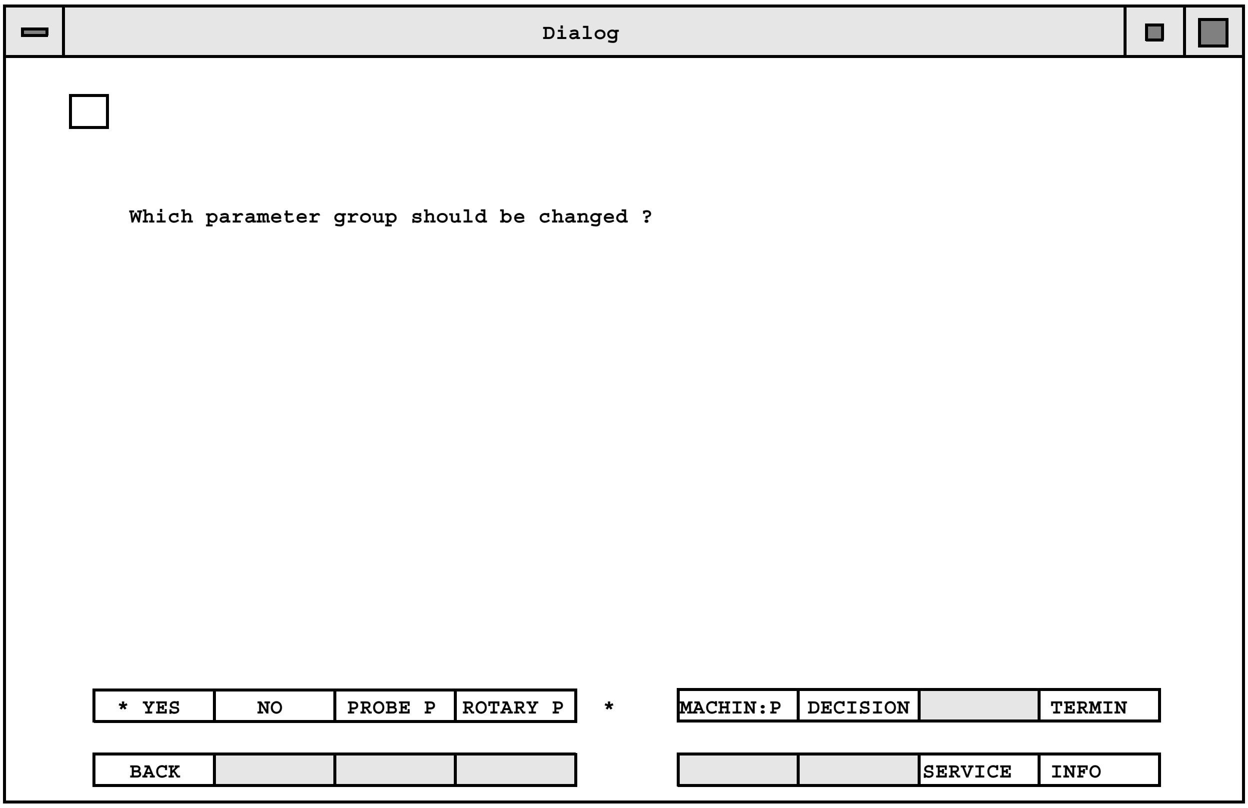
Types of parameters

The CMM control can be influenced by three groups of parameters:

- Probing parameters ➤*„Probing parameters <PROBE P>" on page 6-11*
- Machine parameters ➤*„Machine parameters <MACHIN.P>" on page 6-13*
- Decisions ➤*„Decisions <DECISION>" on page 6-16*



DI	Pull-Down-Menu	Pictogram
1661	CMM	
CONMODE	Mode	
a157	Control mode...	



Softkeys

ROTARY P

This key is disabled.

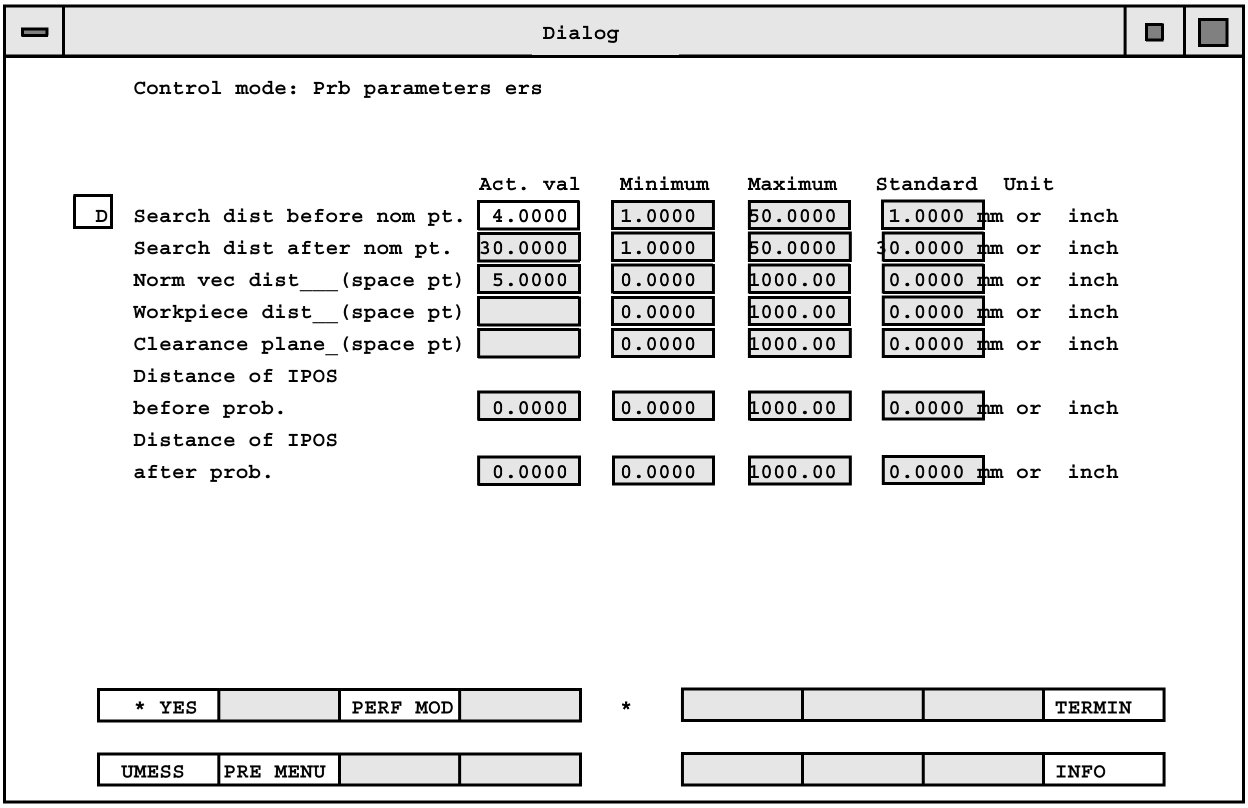
SERVICE

Only service technicians should make changes in this dialog page. For this reason, it is protected by a password.

Probing parameters <PROBE P>

Application

The probing parameters for CNC measuring runs can be set with this function.



Display

The following is shown on the screen for each parameter:

- current setting,
- permissible minimum and maximum values,
- the generally recommended (default) setting and the
- unit of measurement

Softkeys

*** YES**

Accepts the value offered in the selected box; the cursor jumps to the next line.

PERF MOD

Used to accept all of the default values listed in the Perf. mod column as the current values (except for lines concerning the space point measurement) and return to the previous dialog window. All changes will be accepted as soon as they have been confirmed with **<TERMIN>**.

TERMIN

Used to quit current dialog window, accept changes and return to previous dialog window. Changes are accepted as soon as they are confirmed by pressing **<TERMIN>**.

UMESS

Used to quit the dialog window without changing data and return to the main menu.

PRE MENU

Used to return to previous dialog window without accepting the changes.

Data boxes

Inputs are possible only in the **"Act. val"** column.

Search dist before nom pt.

Distance traveled before a programmed probing with switchover to probing speed. For rough-tolerance workpieces (with uncertain W-pos. calibration), higher values should be entered here to prevent probings at Vmax (rapid traverse).

However, please note that higher default probing values result in longer measuring times.

Search dist after nom pt.

Maximum travel path at probing speed in the probing direction if a probing has not found at its programmed coordinates.

Norm vec dist__ (space pt)_, Workpiece dist__ (space pt), Clearance plane__ (space pt)_

A current value may be assigned to only one of these three data boxes at a time:

Length and direction of backaway or retract path after completing a space point (3D) measurement.

Distance of IPOS before prob., Distance of IPOS after prob.

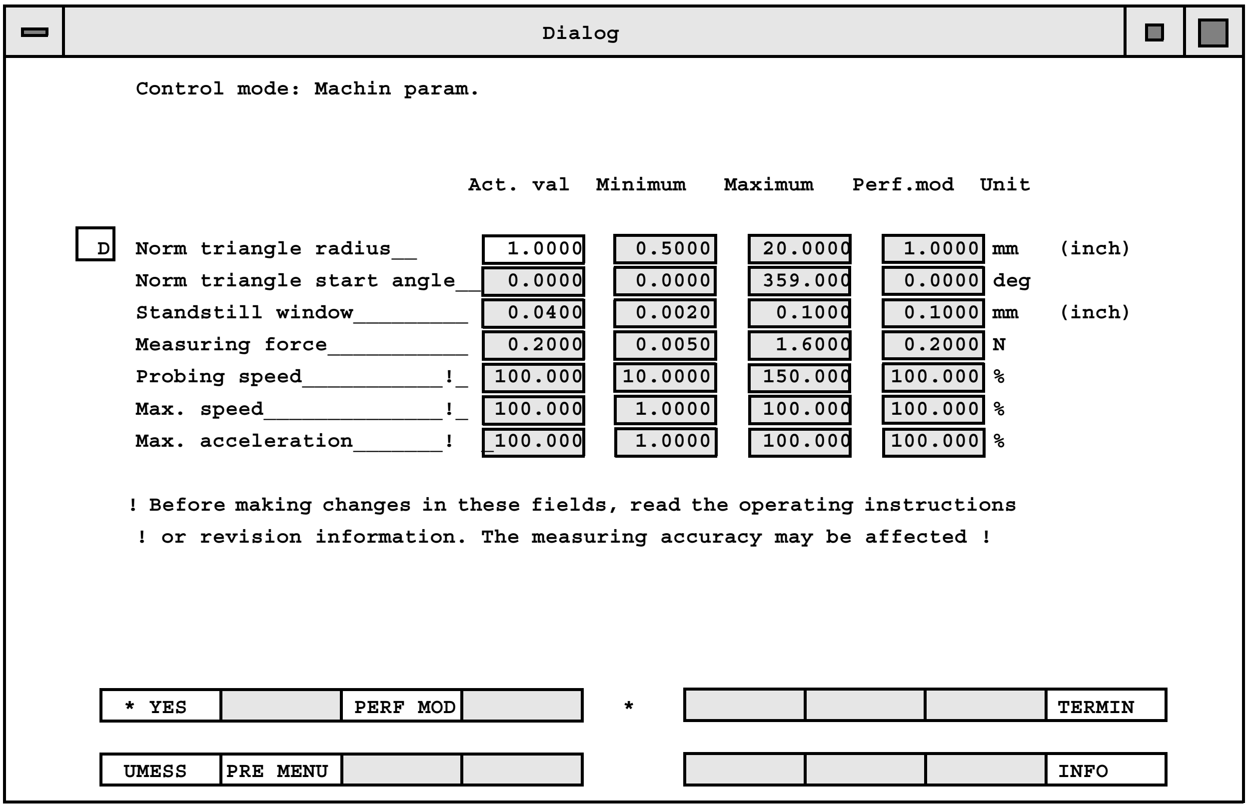
Simplified learn (part) programming on CMMs equipped with a trigger probe head:

With values > 0, the probe automatically travels to intermediate positions before/after each probing in the CNC mode.

Machine parameters <MACHIN.P>

Application

The machine parameters for CNC controlled runs can be preselected with this function.


Dialog

Control mode: Machin param.

	Act. val	Minimum	Maximum	Perf.mod	Unit	
Norm triangle radius__	1.0000	0.5000	20.0000	1.0000	mm	(inch)
Norm triangle start angle__	0.0000	0.0000	359.000	0.0000	deg	
Standstill window__________	0.0400	0.0020	0.1000	0.1000	mm	(inch)
Measuring force____________	0.2000	0.0050	1.6000	0.2000	N	
Probing speed____________!_	100.000	10.0000	150.000	100.000	%	
Max. speed_______________!_	100.000	1.0000	100.000	100.000	%	
Max. acceleration_______!	100.000	1.0000	100.000	100.000	%	

! Before making changes in these fields, read the operating instructions
! or revision information. The measuring accuracy may be affected !

* YES		PERF MOD		*				TERMIN
UMESS	PRE MENU							INFO

Display

The following is displayed for each parameter:

– current setting,

– permissible minimum and maximum values,

– the generally recommended (default) setting and

– the unit of measurement.

Softkeys

*** YES**

Accepts the value offered in the selected box; the cursor jumps to the next line.

PERF MOD

Used to accept all of the default values listed in the Perf. mod column as the current values (except for lines concerning the space point measurement) and return to the previous dialog window. All changes will be accepted as soon as they have been confirmed with <TERMIN>

TERMIN

Used to quit current dialog window, accept changes and return to previous dialog window. Changes are accepted as soon as they are confirmed by pressing **<TERMIN>**

UMESS Used to quit the dialog window without changing data and return to the main menu

PRE MENU Used to return to previous dialog window without accepting the changes.

Data boxes

Inputs possible only in the **"Act. val"** column.

Norm triangle radius
Norm triangle start angle

Concerns space point measurement:

Definition of the three auxiliary points at 120° intervals from the space point coordinates and of the start angle with iterative determination of the normal.

Standstill window

The control checks the standstill during probings and fine positioning travels. The accuracy of the standstill/position check can be set with the standstill window: If the standstill window is decreased, both the accuracy and the measuring time will increase. Depending on the measuring run involved, a coarse setting will result in a shorter measuring time. At the same time, this will result in nonrepeatable measured results due to workpiece form errors.

Measuring force

Contact probing (with probes) results in deformations (bending, flattening) which influence the effective probe tip (sphere) diameter.

Since these deformations are dependent on the measuring force, the measuring force selected for calibration must also be used for the measuring run.

The measuring force is continuously adjustable between a minimum and a maximum value. Measurements are normally performed with a measuring force of **0.2 N**. If greater deformations of the probe shaft or workpiece may be expected (e.g. in thin-walled plastic parts), a measuring force of 0.1 N should be selected.

During "self-centering" probings, a higher measuring force may be advisable in the MAN mode to achieve better centering.

Other measuring forces can also be programmed for special applications (unstable or elastic parts, plastic parts)

Important!
When scanning with a measuring force of 0.1 N at a high travel speed, the probe may lift off of the workpiece, thus leading to falsified measurements. For this reason, you should always select a slow travel speed when scanning with a low measuring force.

Probing speed

The probing speed depends on the machine type. Only a percentage value can be entered.

In the following cases the probing speed can be set to a value other than the default setting:

Probe radius	<0.7 mm	<1.4 mm	≥1.4 mm
Probing speed	≈ 25 %	≈ 50 %	Default

With the measuring probe system, the probing speed should be reduced for probing angles of approx. 30° to 50°.

Max. speed, Max. acceleration

Concerns travels in the CNC mode; application example:

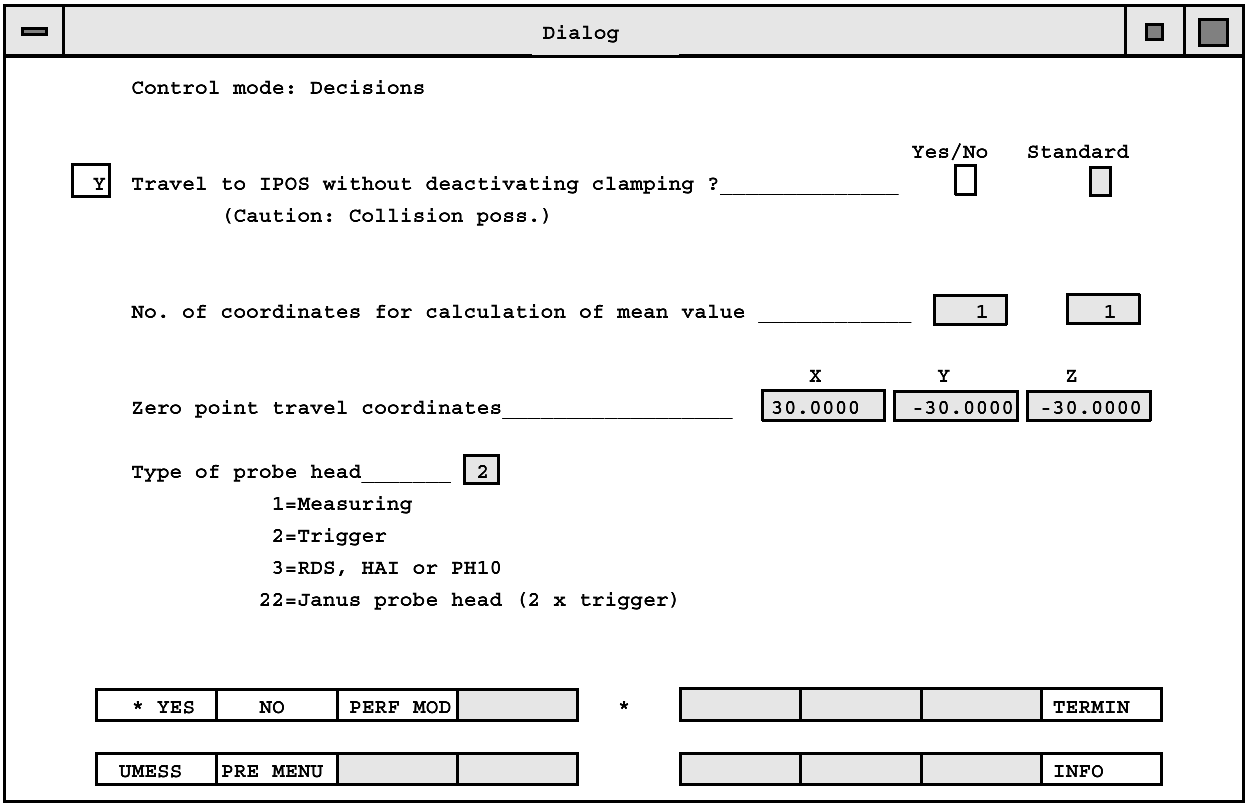
Predeflection of the measuring probe head at maximum speed (collision protection) causes a path deviation. This could be a hindrance, e.g. when entering narrow, slanting bores. To remedy this, reduce the probing speed until the predeflection is switched off and the probe head travels exactly along its programmed path.

Important!
Changing the values for the probing speed, the max. speed and the maximum acceleration could impair the accuracy of the CMM.
For this reason, values are expressed in terms of % in UMESS.
For ACE (off-line parts programming) permissible fixed values must be entered for v-max und a-max.

Decisions <DECISION>

Application

The control parameters listed below are of interest only in special cases.



Softkeys

See ➤„Machine parameters <MACHIN.P>" on page 6-13

Data Boxes

Travel to IPOS without deactivating clamping?

Caution: This option may be used only by experienced operators in exceptional cases! Suppression of the clamping function deactivates the collision protection.

Danger!
Risk of crushing and/or damage to the probe head!

No. of coordinates for calculation of mean value

Vibrations affecting the machine resolution can never be suppressed completely. For particularly high accuracy demands, these vibrations can be compensated via a mean value compensation The number of values required for the mean value calculation must be entered in this data box.

NOTE

The mean value calculation increases the measuring time.

Zero point travel coordinates

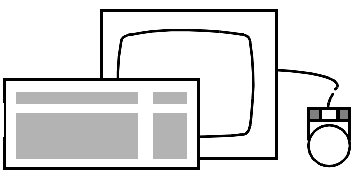
Following a zero point travel, a probe head position which deviates from the usual values (X=+30 mm, Y=-30 mm, Z= -30 mm) can be entered here (in machine coordinates).

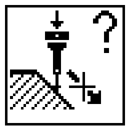
Type of probe head

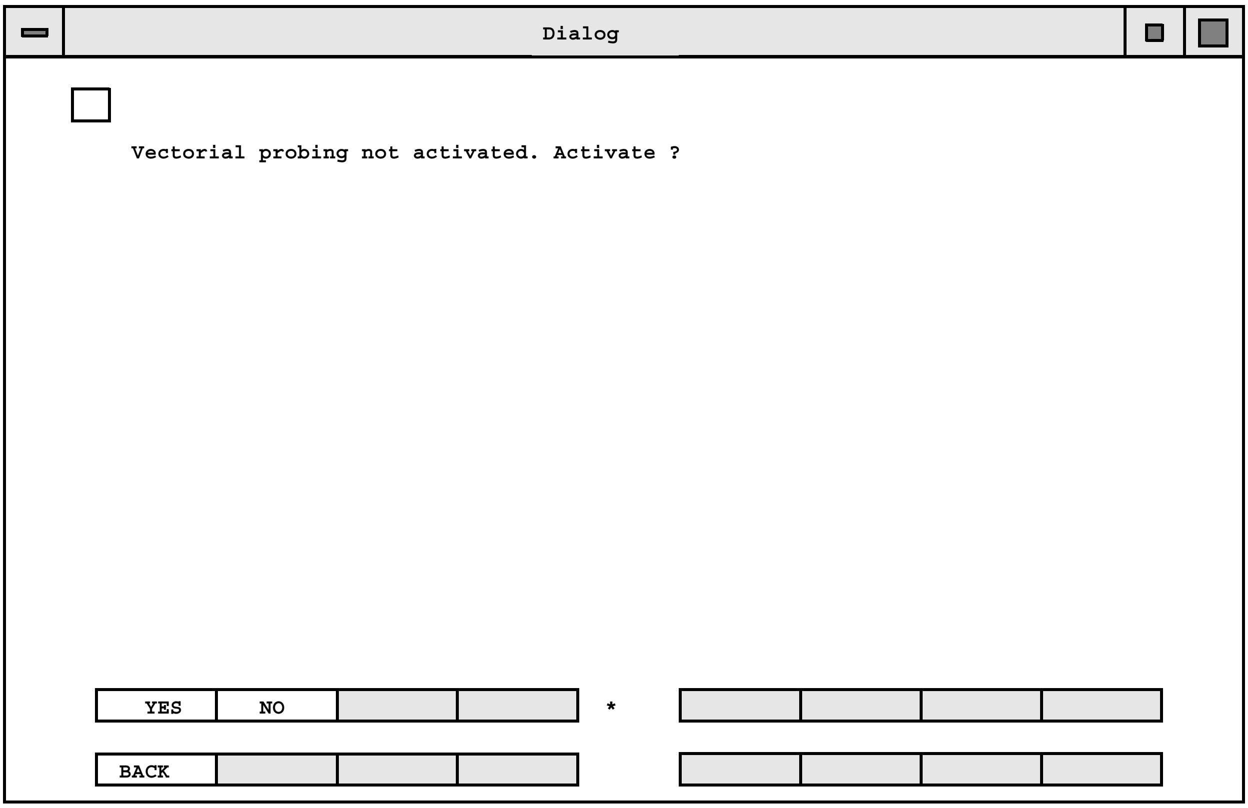
The type of probe head used must be entered by the code number.

Setting the operating mode for the measuring probe head <DI 1502>

Operating mode	Single points	Scanning
clamped **<DI 1502>** = OFF	e.g. for probings on small surface segments and self-centering probings	e.g. for keeping to the scanning path exactly on curved 3D surfaces and self-centering scanning.
unclamped **<DI 1502>** = ON	High accuracy for probings in any direction	Maximum accuracy at high speeds.



DI	Pull-Down-Menu	Pictogram
1502	CMM	
VECFORCE	Mode	
	vectorial measuring force...	



NOTE

No warning will be displayed if the bending data has not been determined.

Dialog

Vectorial probing not activated. Activate?

YES

Vectorial probing activated.

Vectorial probing is activated. Activate?

NO

Vectorial probing deactivated.

NOTE

After defining the operating mode, the probes can be calibrated using a suitable method:

Probe head operating mode	Probe calibration method
clamped **<DI 1502>** = OFF	Manual: **<DI 6502>** Semi-automatic: **<DI 6501>**
unclamped **<DI 1502>** = ON	Semi-automatic: **<DI 15228>**

NOTE

When measuring with small probe tip (sphere) diameters, adjust the probing behavior with **<DI 1574>**.

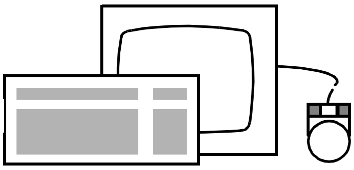
When scanning according to (KUM) nominal data, you can optimize the probing (insertion) depth and the maximum acceleration with **<DI 1533>**.

The probe calibration and the measuring run must always be performed in the same operating mode setting. The op. mode setting is stored in the probe data (➤*„Output of probe data <DI 1624>“ on page 8-6*).

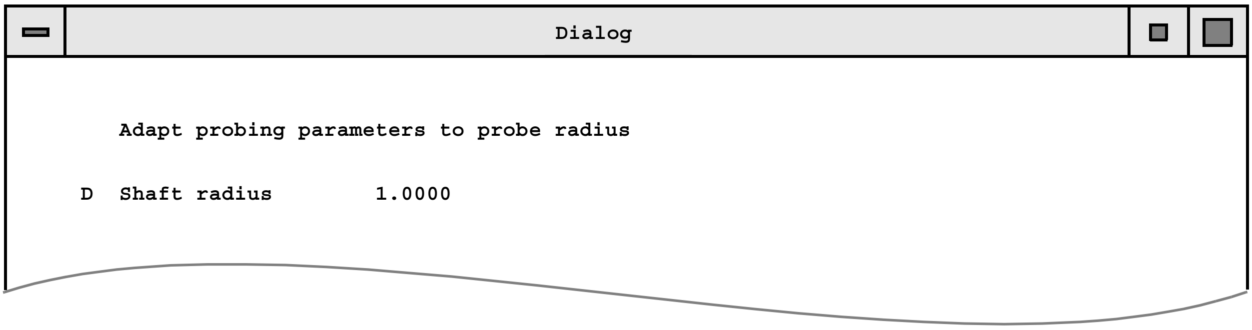
Adapting the probing behavior <DI 1574>

Application

When using probes with a probe tip radius < 1 mm, you must adapt the probing behavior of the measuring probe head to the rigidity of the probe. The radii of the probe tip and the probe shaft are mutually allocated by the program.



DI	Pull-Down-Menu	Pictogram
1574	CMM	
	Mode	
	Parameter for small probe...	



NOTE

When calibrating a probe, you must always use the same probing behavior values as will be used when measuring with the same probe later on.

If high scanning speeds are required, it is advisable to correct the probe bend with **<DI 1184/1186>** instead of calibrating with **<DI 15228>**.

Influence, correction and monitoring of temperature changes

Influence

Temperature influences

The reference temperature for measurement is defined as 20°C (see the relevant CMM operating instructions). I.e. a correct result can be obtained only if both the workpiece *and* the glass scales (material measure) have a temperature of 20°C.

If the temperature of the material measure exceeds the reference temperature, the material measure is too long.⇒ Any measurements made by the machine will therefore be too short. If the temperature of the test piece exceeds the reference temperature, the test piece is too long.

The result will be output as if the measurement had taken place at 20°C only if the material measure and the test piece have the same expansion coefficient and the same temperature.

NOTE

The following principles should be observed to keep measuring errors caused by temperature to a minimum:

Constant temperature

Maintain temperature conditions during measurements.

If the ambient temperature changes, the workpiece will adapt more quickly than the machine. To keep this measuring uncertainty to a minimum, temperature changes should not exceed 1K/h.

Intervals for redefining the coordinate system

For workpieces with long measuring times: Redefine the workpiece coordinate system (zero points) at regular intervals. The correct interval depends on the temperature deviations in the measuring room and the accuracy required.

Rotary table axis

When using a rotary table over an extended period of time, the axis of the rotary table must be recalibrated at regular intervals.

Environmental influences

Avoid temperature variations between different locations on the CMM (caused by drafts or irradiated heat), as this would alter its geometry (perpendicularity).

Probes

If an inadmissible probe temperature change occurs during probe calibration, the probe must be recalibrated (calculation of the permissible tempeature range ➤*„General procedure“ on page 7-5*).

Application examples

A temperature correction should be performed if

- the ambient temperature deviates from 20°C (reference temperature) when measuring (cf. also machine operating instructions)
- and/or the temperatures of the test piece and the material measure (CMM) differ.

The following functions are provided for this purpose:

- Manual input of temperature values and the workpiece expansion coefficient for calculation of the correction factor.
- Automatic detection of scale and workpiece temperatures via appropriate sensors.

Temperature compensation via input <DI 6511>

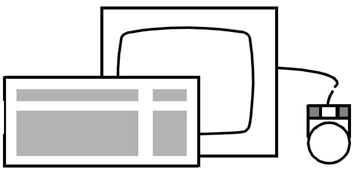
Correction factor

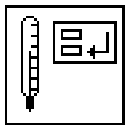
The correction factor is calculated from

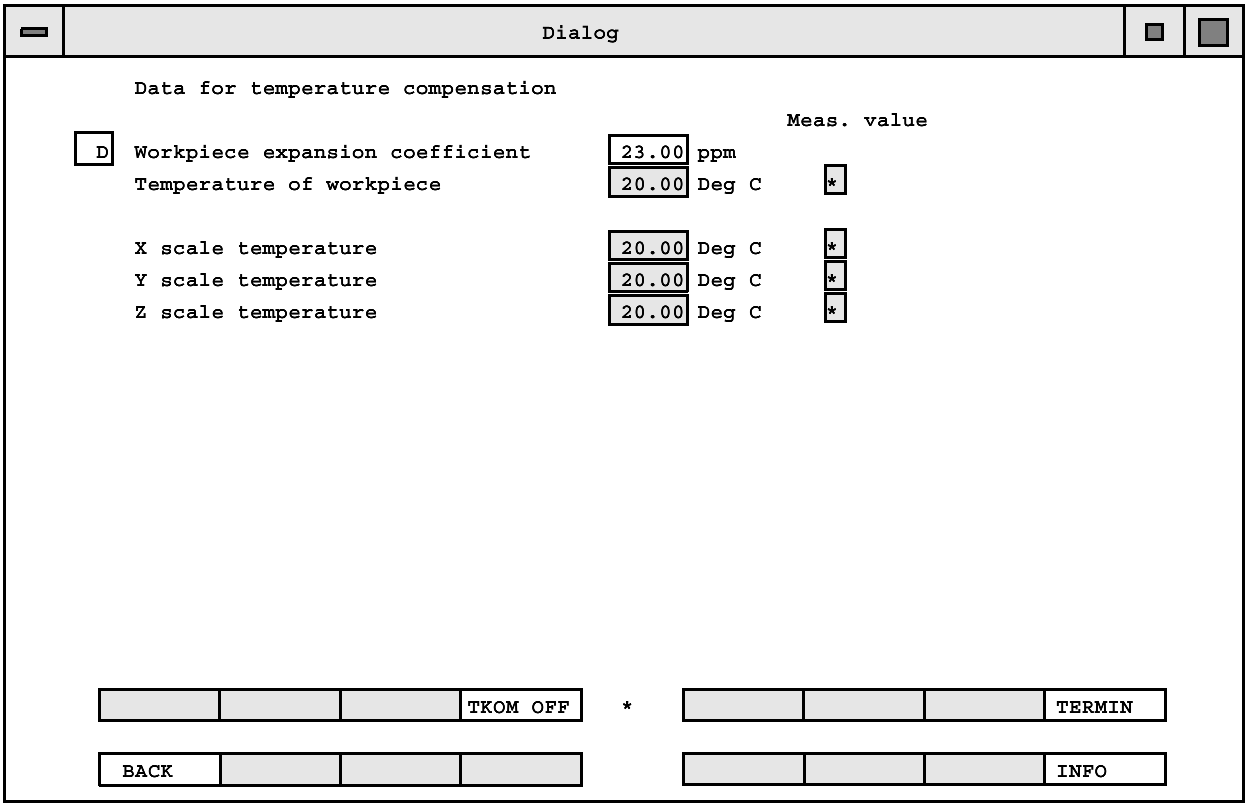
- the expansion coefficient of the workpiece
- the temperature of the workpiece and
- the temperature of the measuring machine / scales.

Application

These values can be entered directly in a dialog window after calling **<DI 6511>**.



DI	Pull-Down-Menu	Pictogram
6511 or **15211**	**CMM**	
TEMCOM	**Temperature comp.**	
a623	**Temperature compens...**	



Softkey

TKOM OFF

Resets changes made in the dialog window; the default settings appear (expansion coefficient = 0, temperatures = 20 deg C) and the dialog box automatically closes.

Data boxes

Workpiece expansion coefficient

Enter the expansion coefficient of the workpiece to be measured. The value stored last will be offered for input. The expansion coefficients of the different materials can be taken from appropriate references. (ppm means 10^{-6}/K).

Workpiece temperature

If no temperature sensor is connected, enter the temperature of the workpiece to be measured. The value stored last will be offered.

Temperature of X/Y/Z scales

If no temperature sensors are connected, the temperature of the individual scales must be entered manually. These temperature readings can be taken at locations with thermoconducting contact to the scales. If no temperature sensors are installed, manual input is not possible.

Meas. value

These boxes show whether the corresponding temperature sensors are ready for measurement. If a temperature sensor can be used for measurement, the corresponding box will be marked with an asterisk.

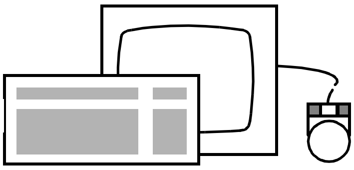
Temperature monitoring <DI 6513>

NOTE

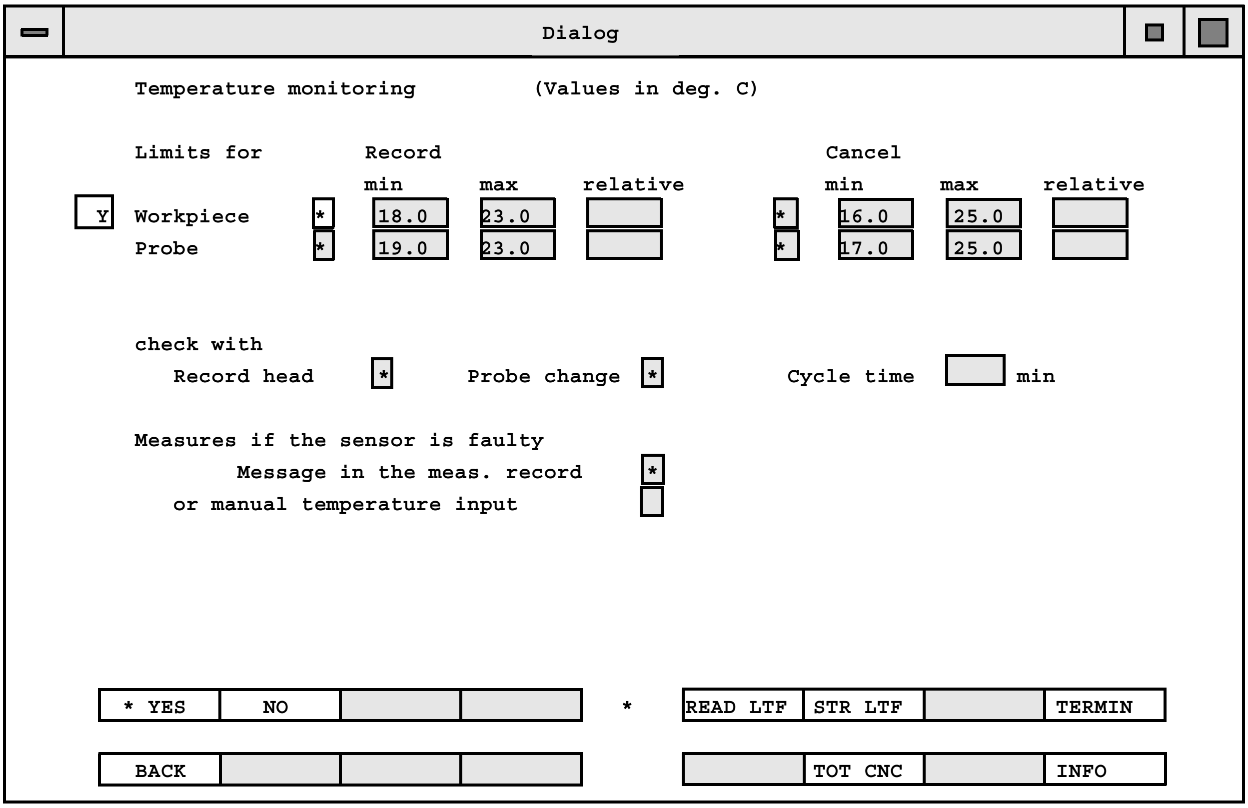
This function requires special temperature sensors and adaptation of the software!

Application

Individual temperature limit values can be defined for the sensors available. You can also specify when the temperature measurement should take place and whether a warning message should be printed in the record (log) or the program should be interrupted of a limit is exceeded.



DI	Pull-Down-Menu	Pictogram
6513	CMM	
	Temperature comp.	
	Define limit temperature...	



SoftkeyS

STR LTF

Saves the data currently entered in the dialog window to the long-term file.

READ LTF

Reads in temperature limits and measures from the long-term file and displays them in the corresponding boxes of the dialog window.

TERMIN

Used to accept the data currently entered in the dialog window and close the dialog window. Only data which was previously changed will be saved as control data in the PROG mode.

TOT CNC

This softkey is active only in the PROG mode. If you press it, all of the data displayed in the dialog window will be saved as control data.

Data boxes

Limits for Record/Cancel

Here you have the option of choosing whether a warning note should be printed in the record or the measuring run should be canceled if the temperature limits defined below are exceeded.

The nominal temperature of the ambient air sensor is based on the temperature at which the probe was calibrated. The nominal temperature of the workpiece sensor is referenced to the value of the last temperature compensation.

min / max

Data boxes for the lower and upper temperature limits in degrees Celsius (with one decimal place)

relative

As an alternative to absolute temperature limits, a permissible fluctuation, i.e. a deviation from the nominal temperature, can be specified.

check with
Record head

There are several ways to define when the temperature will be measured. If you confirm the first box with **<YES>**, a check will be made to ensure that the current temperatures lie within the permissible range when the record header is called.

Probe change

Automatic check of current temperatures with every probe change.

Cycle time

The periodic temperature check function is not available for FC program runs. If necessary, a temperature check can be performed manually whenever required by entering **<DI 6514>**.

Measures if the sensor is faulty
Message in the meas. record

If a fault is determined by a temperature sensor during a program run, an error message will be output to the measurement record.

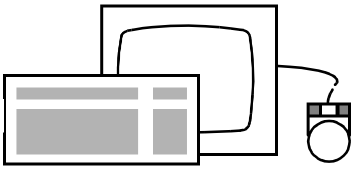
or manual temperature input

This function cannot be activated for FC program runs.

Temperature check with <DI 6514>

Application

With this direct input, a temperature check can be made by the user at any time. The ambient air temperature is measured and compared with the entries in the dialog window of **<DI 6513>**. If the temperature reading lies within the permissible limits, the measuring program will continue uninterrupted. Otherwise - depending on the inputs made in the dialog window - a warning message will be output to the record or the program run will be interrupted.



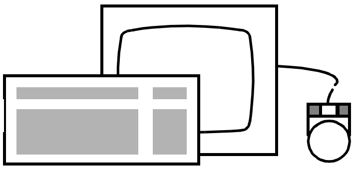
DI	Pull-Down-Menu	Pictogram
6514	CMM	
	Temperature comp.	
	Check for limit tempo	

Temperature record with <DI 6515>

Application

With this direct input, the data of the last temperature measurement can be listed. The temperatures measured at the two measuring points are specified in the table:

Workpiece 22.5 means that the sensor is attached to the workpiece. **Air 23.0** indicates a temperature sensor which can be positioned as required.



DI	Pull-Down-Menu	Pictogram
6515		

```
Record
===============================================================================

                         MEASURING RECORD    ZEISS   UMESS

WORKPIECE NAME                           MANUAL MEASUREMENT
========
DRAWING NUMBER       | ORDER NUMBER       | SUPPLIER/CUSTOMER | OPERATION
638596-4589-54       |1457-5834-5648      |Zeiss               |0100

OPERATOR           | DATE          | PART NUMBER     |
Mueller            | 11/30/98     | 45              |

===============================================================================
 ADR|REC |TASK| IDF |SY| ACTUAL   |NOMINAL  | U.TOL | L.TOL | DEV    | EXC
===============================================================================

Temperature of the defined sensors
DATE:      11/30/98         Time:    2:58
                            sensor - number
Component      I       1         2         3         4
--------------------------------------------------------
Workpiece      I      22.5      22.6
Air            I      23.0
```

Position of probe rack

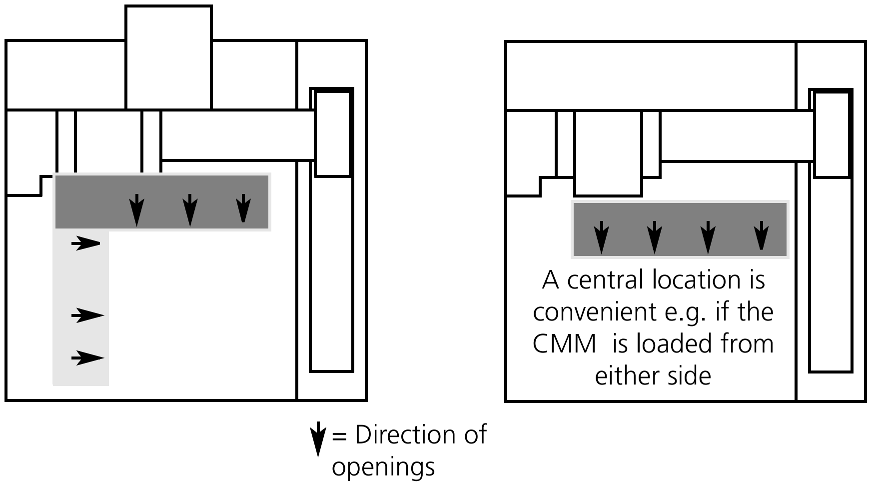
Restriction

Only for measuring machines with a probe changer.

A probe rack is required to store all of the probe configurations automatically removed by a probe changer during a CNC measuring run.

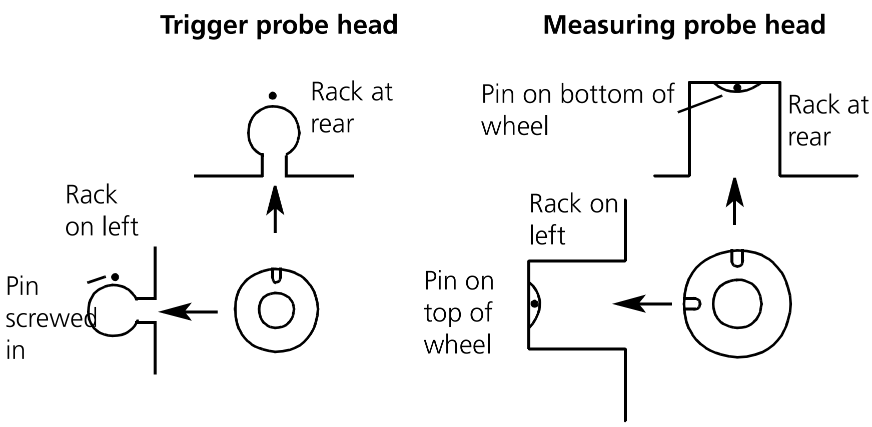
Position

The layout drawing below shows possible locations for a probe rack on the CMM.



Coding

A coding pin on the probe holder opening engages in a recess of the probe adapter plate to ensure that the adapter plate is always deposited in the correct probe holder.



Prerequisites

The computer must know the exact position of each individual holder to automatically deposit and pick up probes. The following functions are available to make these positions known to the computer:

– Magazine mode ➤„*Magazine mode <DI 1556>“ on page 6-29*

– Magazine definition ➤*„Defining the probe holder positions <DI 1557>" on page 6-32*

Magazine mode <DI 1556>

Options

This function offers the following options:

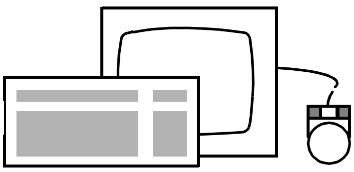
– Determine length of probe to define position of holder.

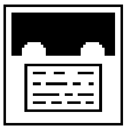
– List stored rack positions

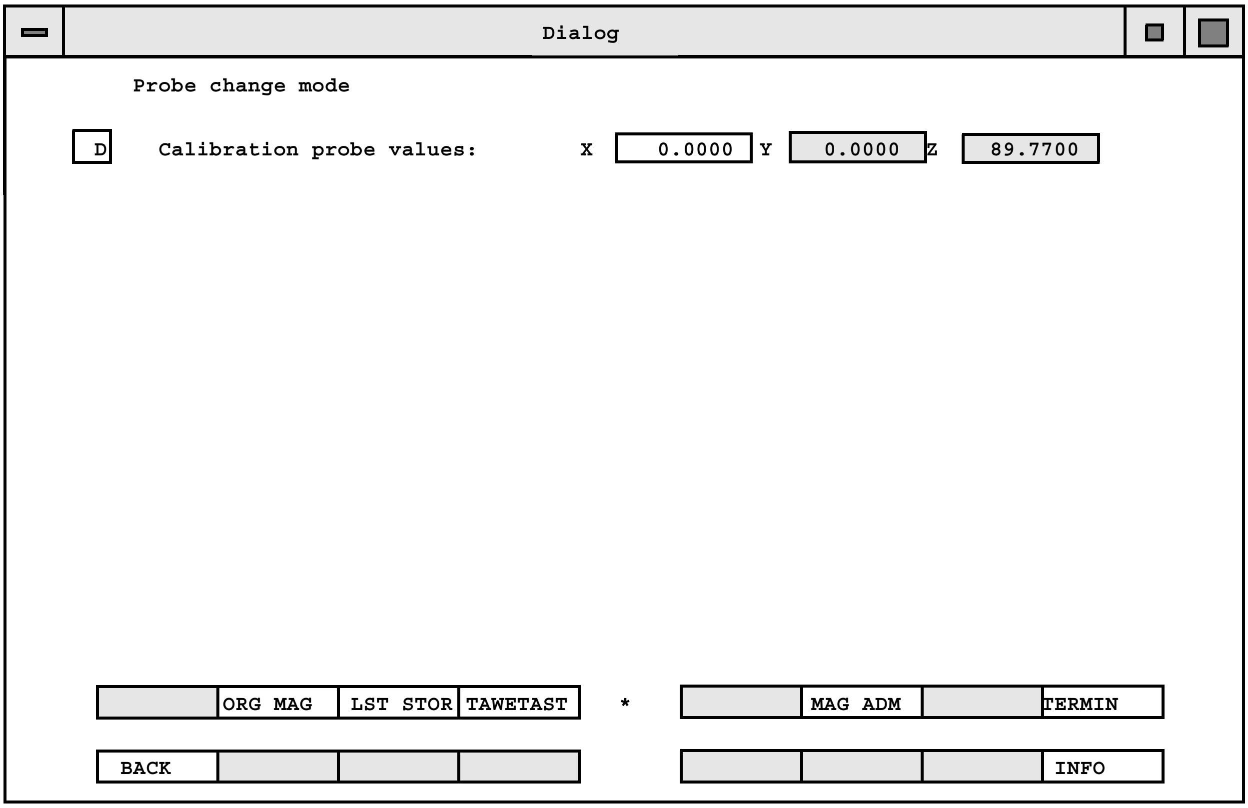
– Code for type of storage (e.g. FC)

Application

The positions of the probe rack locations are stored in the machine coordinates. For this reason, the exact length of the probe to be used for position determination (calibration) must be known.



DI	Pull-Down-Menu	Pictogram
1556	Probe	
LISTSTR	change	
a188	Magazine mode...	



Calibration probe values

<DI 1556> displays the current valid length of the probe in the **Calibration probe values** data box. This value can be changed in two ways, i.e.:

– By overwriting the default value and confirming with **<Enter>** or

– By redefining the probe length with the **<TAWETAST>** softkey.

NOTE

When using the new (black plastic) rack, you must correct the calibration probe values:

X = 64.0000, Y = 0.0000, Z = increase value displayed by 10 mm.

Determining the length of the probe for defining the probe holder <TAWETAST>

Prerequisites

– The probe must be screwed in vertically downwards in the mounting plate.

– The diameter of the probe tip (sphere) equals 8 mm for the measuring probe head.

– Any probe tip diameter is permissible for the trigger probe head.

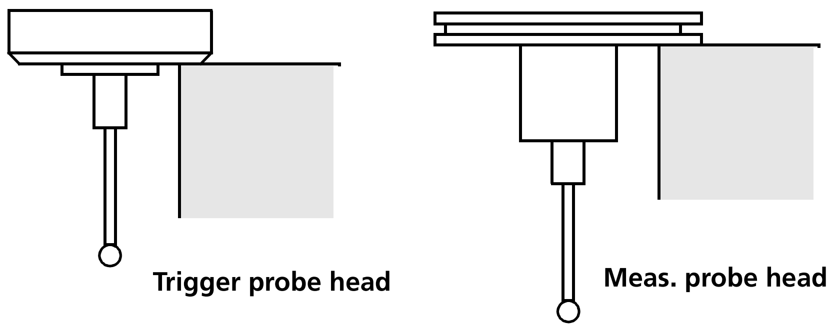
Procedure

When you press the **<TAWETAST>** softkey, the following dialog will appear:

– **Length determination for probe change calibration probe**

– **Probe surface with probe sphere with normal in shaft dir. (meas. ph 8mm)**
  Probe a flat surface parallel to the XY plane in -Z (e.g. upper surface of probe rack) with the probe tip.

– **Probe the same surface with the edge of the plate in the shaft direction**
  Probe the same surface with the bottom of the mounting plate:



Calculated value

The probe length is calculated as the difference between the Z values of the probings and stored on the hard disk.

Fixed assignment of configurations to rack locations <ORG MAG>

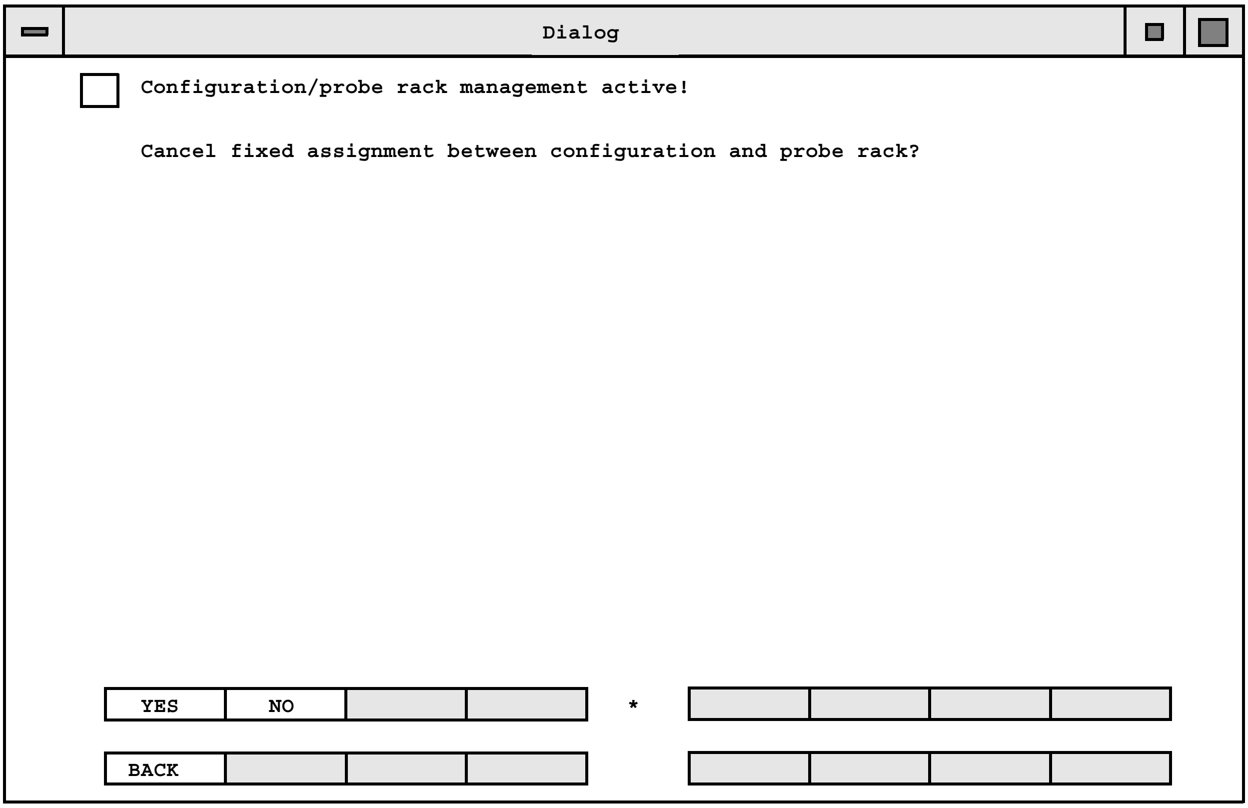
Application

If the assignment is activated, just enter the configuration number to change probes. The configuration always must be deposited in and removed from the probe rack by the probe head. This status is set in the control data by entering a 1 in the first line for the probe changer in column SC2.

This default setting can not be changed for the FC.

Special case

If you have more configurations than rack holders during a CNC run, the fixed assignment of configurations to probe rack locations must be canceled.



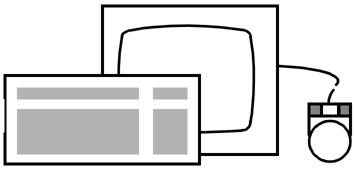
Important

If the assignment is deactivated, an operator error may under certain circumstances cause a collision when changing probes.

Listing the storage positions <LST STOR> <DI 1558>

Application

When you press the **<LST STOR>** softkey, the positions of all saved probe holders will be printed out and displayed on screen.



DI	Pull-Down-Menu	Pictogram
1558	Probe change List rack positions	

Record

==

MEASURING RECORD ZEISS UMESS

WORKPIECE NAME MANUAL MEASUREMENT

========

DRAWING NUMBER	ORDER NUMBER	SUPPLIER/CUSTOMER	OPERATION
638596-4589-54	1457-5834-5648	Zeiss	0100

OPERATOR	DATE	PART NUMBER
Mueller	11/30/98	45

==

ADR | REC | TASK | IDF | SY | ACTUAL | NOMINAL | U.TOL | L.TOL | DEV | EXC

==

Mag. pos.	Config.	Coordinates			Approach dir
A	1	114.6420	-83.4141	-387.4454	+Y
B	2	286.8847	-83.3695	-387.3998	+Y
C	3	459.3701	-83.3393	-387.4693	+Y
D	4	631.2547	-83.2940	-387.4777	+Y
E	-	803.5263	-83.2894	-387.4586	+Y

Current config. 2 is in magazine B

Position in machine coordinates (with active column coupling in coupled system)

Defining the probe holder positions <DI 1557>

Application

After setting up new probe racks or modifying existing ones, the following data must be input to the computer via **<DI 1557>**:

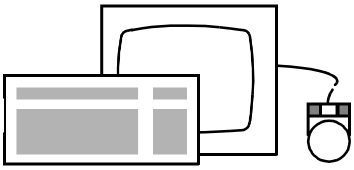
- Positions of probe holders
- Codes of probe holders
- Approach direction for entering probe rack (holder)

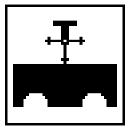
Prerequisites

The length of the probe used must be defined before calling the function.

Differences

The procedure and dialog differ for the measuring and the trigger probe head, however, the function call is the same.

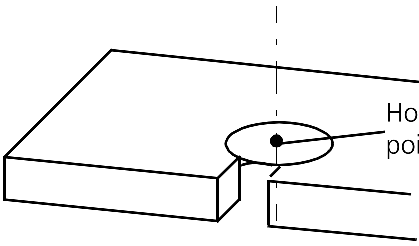


DI	Pull-Down-Menu	Pictogram
1557	Probe	
CALSTR	change	
a187	Magazine positions...	

Trigger probe head

Definition

The holder center point (i.e. the point where the perpedicular or normal and the upper surface of the probe holder intersect) must be determined and saved.



Procedure

– **<DI 1608>**
  Set initial status,

– **<DI 1619>**
  Zeroize (reset) probe data,

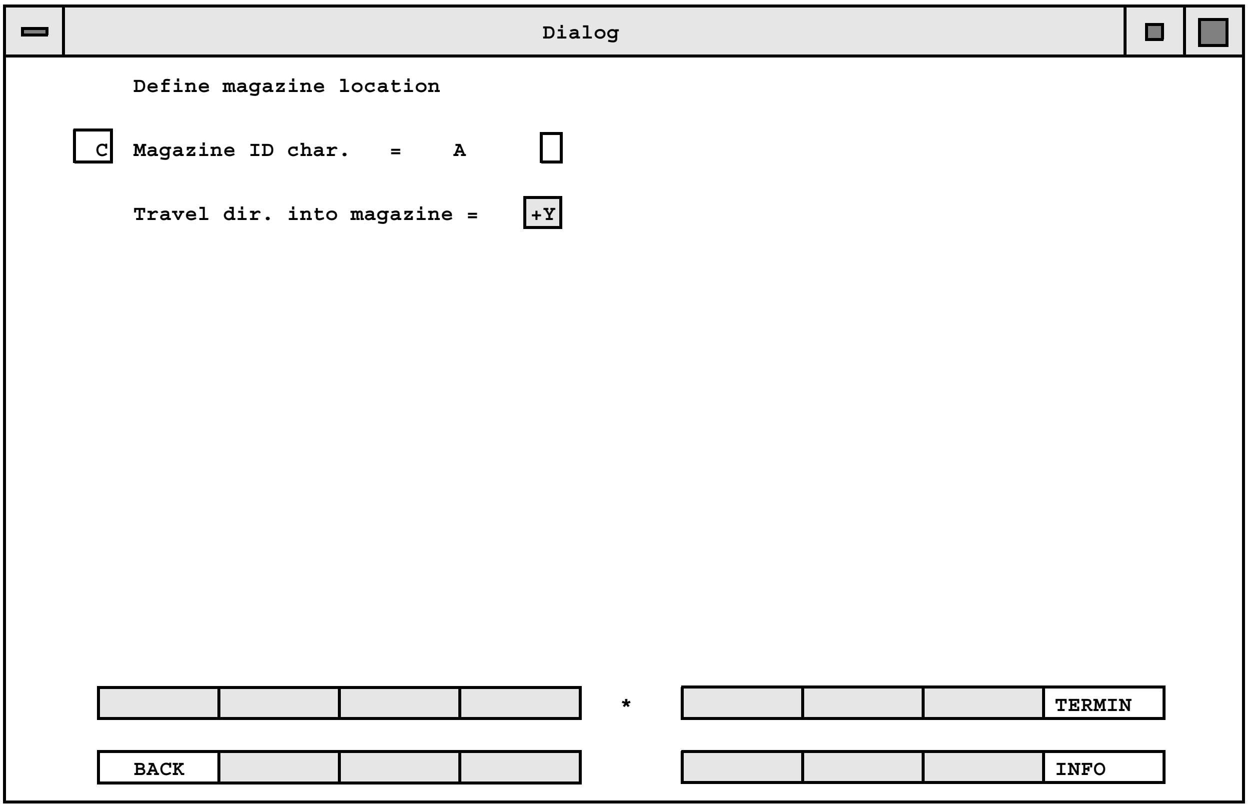
– **<CIRCLE>**
  Measure location opening as circle,

– **<SURFACE>**
  Measure upper surface of holder,

– **<DI 1285>**
  Calculate perpendicular from circle center point to surface,

– **<DI 1218>**
  Intersection point of perpendicular and surface; yields holder point,

– **<DI 1557>**
  Store position, enter code letter and approach direction.



NOTE

Entering **<DI 1557>** save the last result in the measurement record to the hard disk as the position of the probe holder.
Therefore, please make sure that the point of intersection between the perpendicular and the surface is entered as the last address in the record before calling **<DI 1557>.**

Data boxes

Enter a letter code for the probe holder and the approach direction and confirm your input with **<Enter>**.

Documentation

The position stored can be checked by calling **<DI 1556> <LST STOR>**.

Measuring probe head

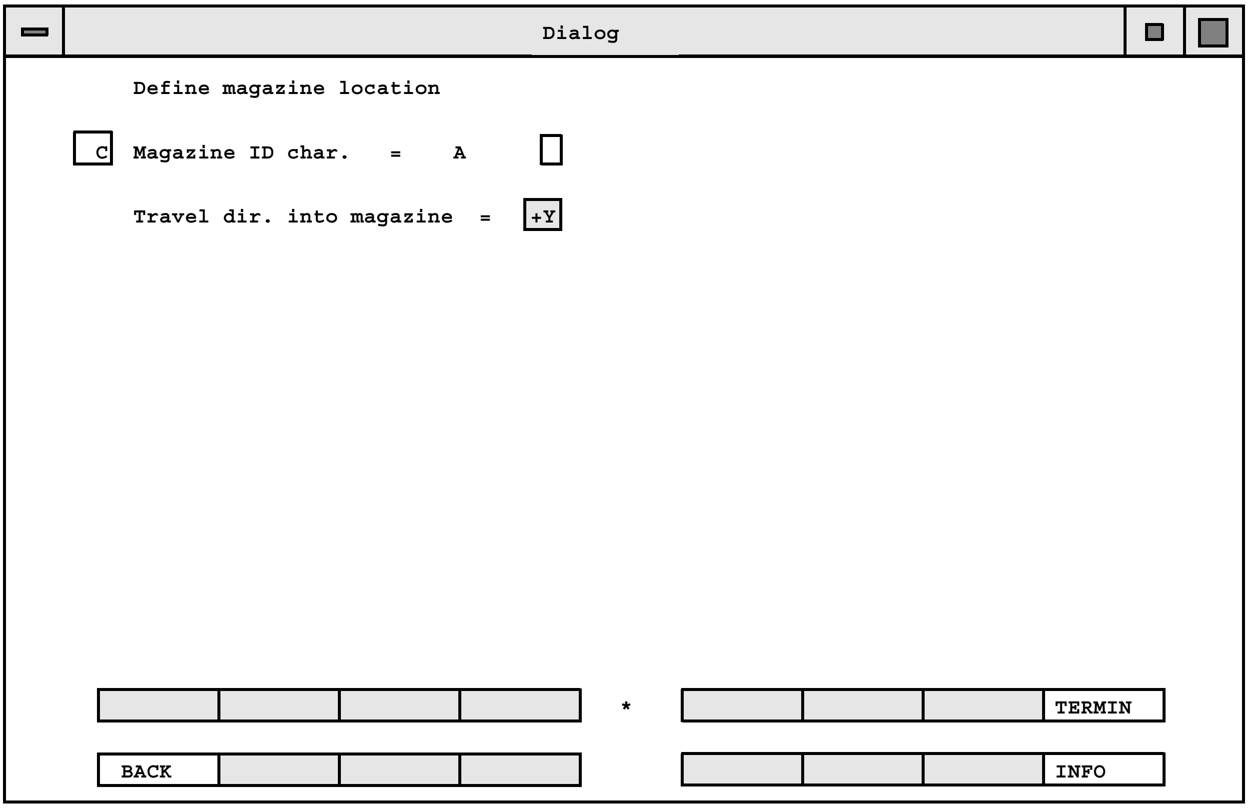
Prerequisite

Probe tip diameter 8mm; length of probe must be defined.

Procedure

The position is defined or calibrated by self-centering probing of the tapered bore in the probe holder. After **<DI 1557>** is entered the following dialog appears:

- **Probe store determination for measuring probe head**
- **Position the probe above the cone bore of the store to be determined**
  Position the probe about 3 mm above the tapered bore of the probe rack cover. Then start a self-centering probing of the tapered bore by pressing **<TERMIN>**. The result is stored on the hard drive as the position of the probe holder.



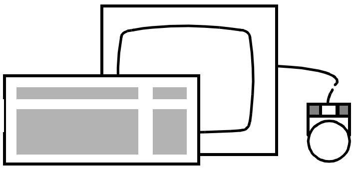
Data boxes

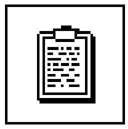
Enter the code for the probe holder and the approach direction for entering the probe rack and confirm with **<Enter>**.

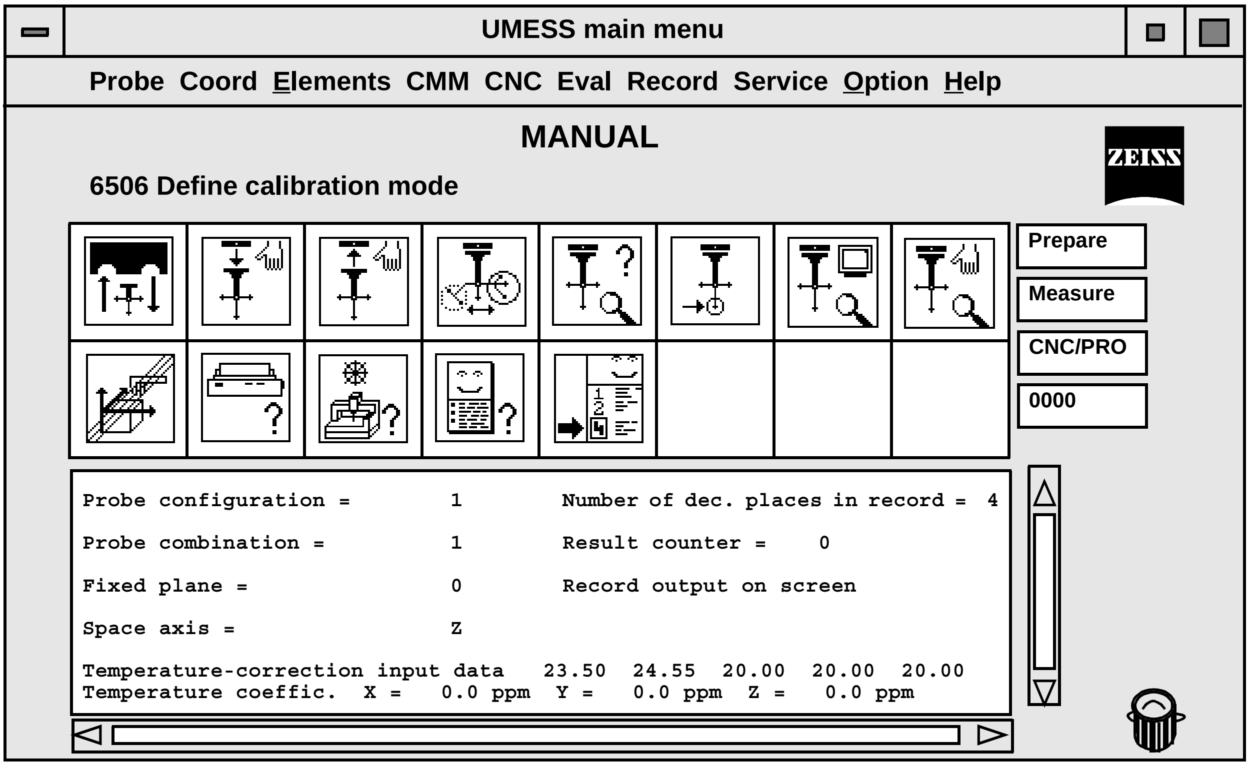
System information <DI 1617>

Application

The current system configuration is displayed on the screen after this function is called.



DI	Pull-Down-Menu	Pictogram
1617	Service	
STATUS	Status...	

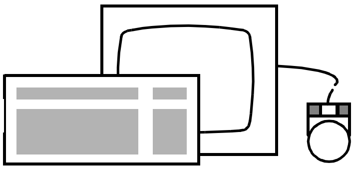


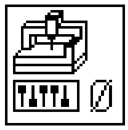
Initializing the machine <DI 1590>

Application

In certain cases (e.g. after a collision) the measuring run can not be continued.

Instead of terminating and rebooting the measuring software, you can also initialize the control and thus set it to a defined status.



DI	Pull-Down-Menu	Pictogram
1590	CMM	
CMM INIT	Mode	
	Initialize	

NOTE

If **<DI 1590>** does not prove successful, press **<Break>** or quit UMESS.
Save previous results with **<DI 1670>** after logging in again!

Chapter 7

Probe calibration

This chapter contains:

General information

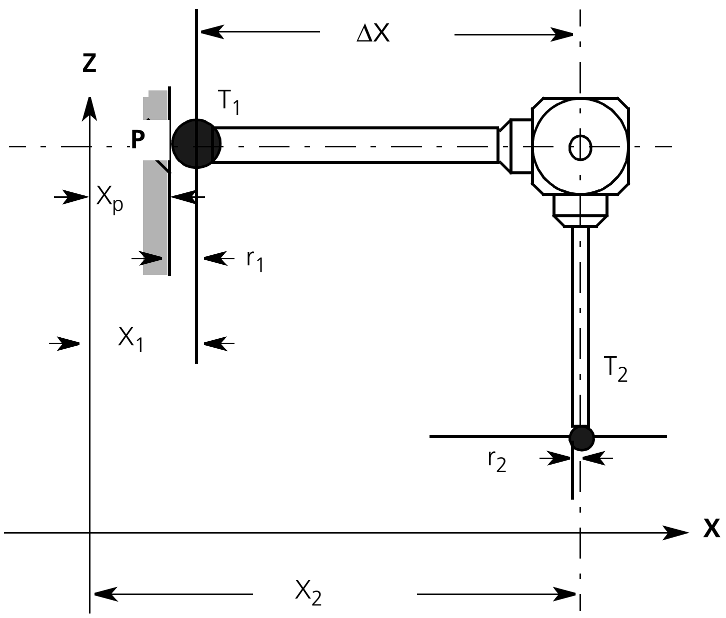
Reason for calibration

In most cases, a workpiece must be probed from several sides. To do this, you need several probes arranged displaced in relation to one another.

These probes must be "defined" or, to put it more aptly, calibrated before you can starting measuring with them. This is done by probing a reference sphere.

The computer then determines the arrangement and radius of the probe tips (spheres) and takes these factors into account during all subsequent measurements.

Example



Method of calculation

A surface is probed at point P with probe T_1 and then with probe T_2. Based on the probe calibration, the computer knows the distance between the two sphere center points ΔX as well as radii r_1 and r_2. It therefore takes these values into account and calculates the same value for x_p both times.

Terms

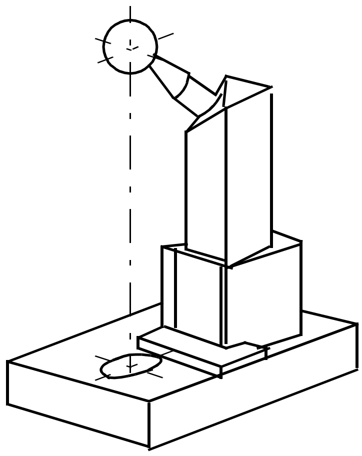
Calibration standard

A calibration standard is required for probe calibration.

This is a high-precision sphere which is fastened to a stand so that it can be probed from all sides. Its exact diameter is known to, i.e. stored in, the computer.

The calibration standard is permanently assigned to your CMM ex works.

If the calibration standard is moved or a reference point travel is performed, its position must be redefined (recalibrated) via a reference measurement.



Reference measurement

Measure the calibration sphere with a calibrated probe. A reference measurement must be performed whenever you want to:

– give the same reference to several different configurations or
– recalibrate one or more probes

and the computer does not know the exact position of the calibration standard (e.g. because you have redefined (recalibrated) the machine zero point).

A reference measurement does not always have to be executed with the reference probe. Any calibrated probe can be used.

However, we recommend recalibrating the calibration standard with the master probe prior to every calibration procedure.

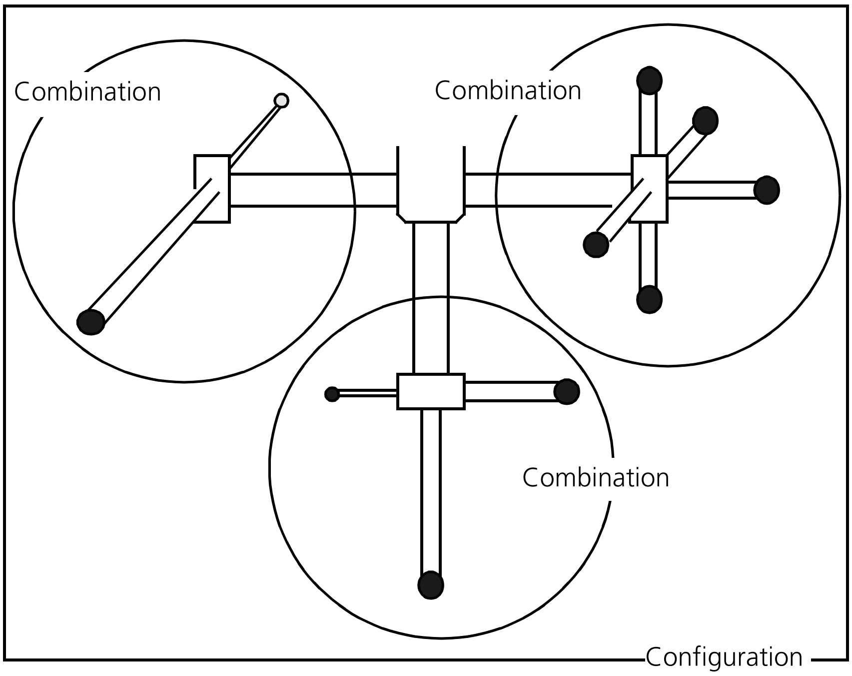
Master probe

During a measurement, all of the probes in a configuration must have a common reference. The computer must know how far away each probe tip or sphere is from a defined point. This defined point is the center point of the tip or sphere of the reference probe.

For probe calibration on CMMs without CAA, the first probe is usually designated as the reference probe. For machines with CAA, the master probe is automatically the reference probe as well. The reference probe is used only for the display with the configuration list. All coordinates are referenced to it; however, it has no signficance for the measurement.

Combination The data from a maximum of five probes with the same reference form a combination.

Configuration A maximum of five combinations with the same reference can be combined to form a configuration.



Recalibration Recalibration is required in two cases, i.e.:

– if you want to add more probes to a a configuration which has already been calibrated or

– if you want to replace a damaged probe and recalibrate it.

Reference measurement With a reference measurement, you determine the exact position of the calibration standard. This is always necessary after moving the calibration standard or performing a reference point travel.

Master probe The master probe is marked with a red dot. Like the calibration standard, it is a component of your coordinate measuring machine. Its exact dimensions are known to the computer. Always use the master probe only for reference measurements!

Types of probe calibration

Options

There are three types of probe calibration:

Manual

(all points are probed manually).

- Can be used for all probes
- Possible inaccuracy due to incorrect probings
- Time-consuming

Semiautomatic

(The first point for each probe is probed manually. The remaining probings are determined by the computer).

- High accuracy due to exact probings
- Time-saving compared to manual calibration
- Can not be used for all probes

CNC-mode

(Manual and semiautomatic calibration can also be integrated in a CNC run).

- Time-saving if the same probe is calibrated frequently.

Application

You can always perform manual probing. It is, however, advisable to use semiautomatic calibration whenever possible and calibrate only difficult probes manually.

If a given probe must be calibrated fairly often, e.g. due to large temperature fluctuations, you can program the entire calibration procedure in a CNC run.

General procedure

Probe

Preparing the probes

- Select the probes, taking the geometry of the workpiece and the measuring range of the CMM into account.
- Screw all probe styli into their sockets securely.
- Wait for all probes to adapt to room temperature.

CMM

Preparing the CMM

Balance the weight of the probe head (measuring probe head) or set its prestress (trigger probe head), see machine operating instructions; the measuring probe head with microprocessor control is balanced automatically.

- Select the measuring force (measuring probe head only). See information on setting the measuring force (in the CMM operating instructions)

Calibration standard

Preparing the calibration standard

- Clean the calibration standard and check for damage.
- Screw centerable calibration standard into any table grid bore.

Reference measurement

Calibrate the position of the calibration sphere with the master probe.

Calibration

Calbrating

- Semiautomatic, manual or in a CNC run (➤*„Semiautomatic probe calibration“ on page 7-17*, ➤*„Manual probe calibration <DI 6502>“ on page 7-29*, ➤*„Learn programming“ on page 16-1*)

Check

Checking the results

- Check whether the magnitude of the deviation between the reference and the master probe is realistic.
- Check the accuracy.

Accuracy of probe calibration

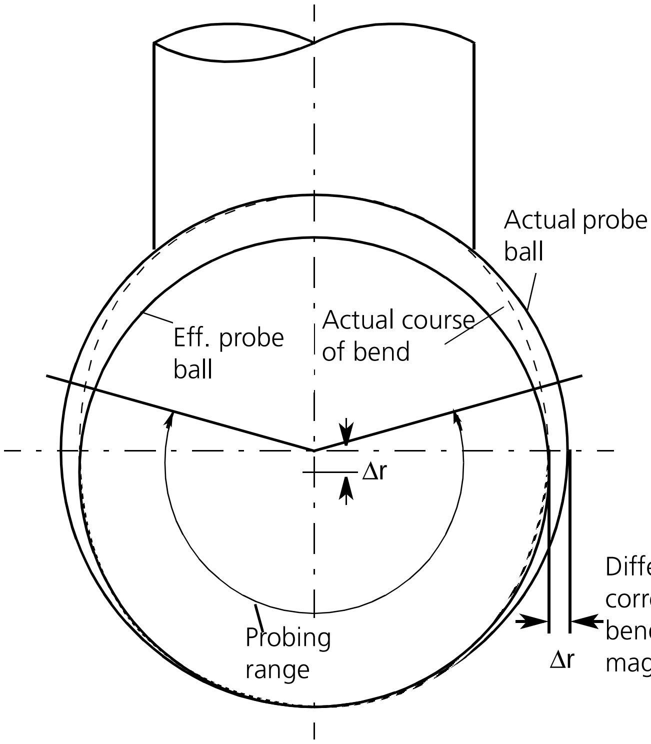
Bending

For maximum measuring accuracy, always calibrate the probes very carefully.

The effective diameter of the probe tip (sphere) is less than its actual diameter (unless it has been calibrated with **<DI 15228>**).

This is due to the fact that the shaft bends in response to a lateral probing (especially if you use long, thin styli).

This bending is best compensated by probing close to the equator of the sphere. The easiest way to do this is by performing semiautomatic probe calibration (➤*„Semiautomatic probe calibration" on page 7-17*).



Check

Always check the results of a probe calibration:

– Is the standard deviation "S" (dispersion) low enough?
– Is the effective diameter of the probe ball output less than the nominal diameter (this does not apply to calibration with **<DI 15228>**)?

If these two conditions have not been met, check the prerequisites and repeat the calibration procedure.

Accuracy

If you want to improve the accuracy:

– Recalibrate using standards for measurements in specific axes or planes (➤*„Recalibration with reference standards" on page 7-33*).

Permissible temperature range

Influence of temperature

When calibrating a probe combination, you must determine the 3D distances of all probe styli from the reference probe in addition to the radii of the probe balls.

These distances vary with changes in temperature. The data of a probe combination thus applies only to a limited temperature range. If the temperature of the probes changes to a point where it lies outside of this range, the probes must be recalibrated.

The size of the permissible temperature range (T_{zul}) depends on

- the maximum permissible deviation of the probe data (A_T),
- the length of the probes (styli) (l) and
- the material the probes are made of (expansion coefficient α).

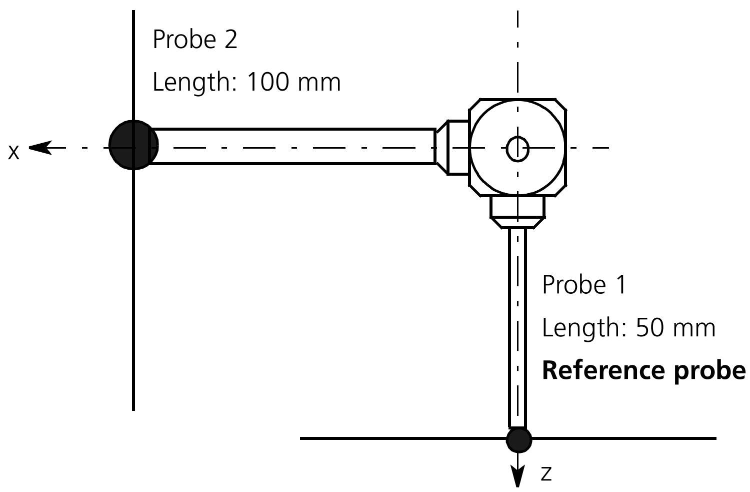
Formula

The size of the temperature range is calculated based on the formula

$T_{zul} = A_T / (l \cdot \alpha)$.

Example

A probe combination consisting of 2 probes. Material: Steel. Calibration temperature: 21 °C. The maximum permissible deviation of the probe data has thus been defined as 2.5 µm.



Calculation

Permissible temperature change T_{perm} , i.e. the temperature change at which the 2.5µm error allowed is not exceeded in any direction, is determined.

Probe 1, Z direction:

$T_{perm} = A_T / (l \cdot \alpha) = 2.5\ \mu m / (0.05\ m \cdot 11.5\ \mu m/m{\cdot}K) = 4.4\ K$

Probe 2, X direction:

$T_{perm} = A_T / (l \cdot \alpha) = 2.5\ \mu m / (0.1\ m \cdot 11.5\ \mu m/m{\cdot}K) = 2.2\ K$

The smaller value specifies the limit. Here it is the expansion in X.

The permissible temperature range thus equals 21 °C ± 2.2 K - temperatures between 18.8 °C and 23.2 °C are permissible.

(Note: The center point coordinates of the reference probe always equal zero in the probe data display. The change in the length of the reference probe affects the Z coordinate of probe 2 in our example.

Documentation

It will save you a lot of work if you enter important data in a probe book, e.g.:

– The identification (designation) of the probe configuration
– The identification (designation) of the corresponding CNC calibration program
– The date of the last calibration
– The temperature during the last calibration
– The permissible temperature change

Both the reference measurement of the calibration sphere (reference sphere) and the result of the calibration process are printed out in the measurement record.

Standard values

For simple cases, you can use the standard permissible temperature change values listed in the following table:

Permissible deviation of probe date in µm	Permissible change in temperature compared with the temperature during calibration in °K			
	Steel probe (α = 11.5 µm/mK)		Aluminum probe (α = 23 µm/mK)	
	100 mm	200 mm	100 mm	200 mm
1.0	0.9	0.4	0.4	0.2
1.5	1.3	0.6	0.7	0.3
2.0	1.7	0.9	0.9	0.4
2.5	2.2	1.1	1.1	0.6
3.5	3.0	1.5	1.5	0.8
5.0	4.4	2.2	2.2	1.1
12.0	10.4	5.2	5.2	2.6

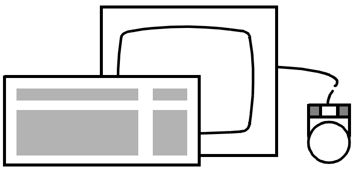
Preparing for probe calibration

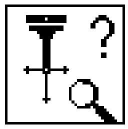
Application

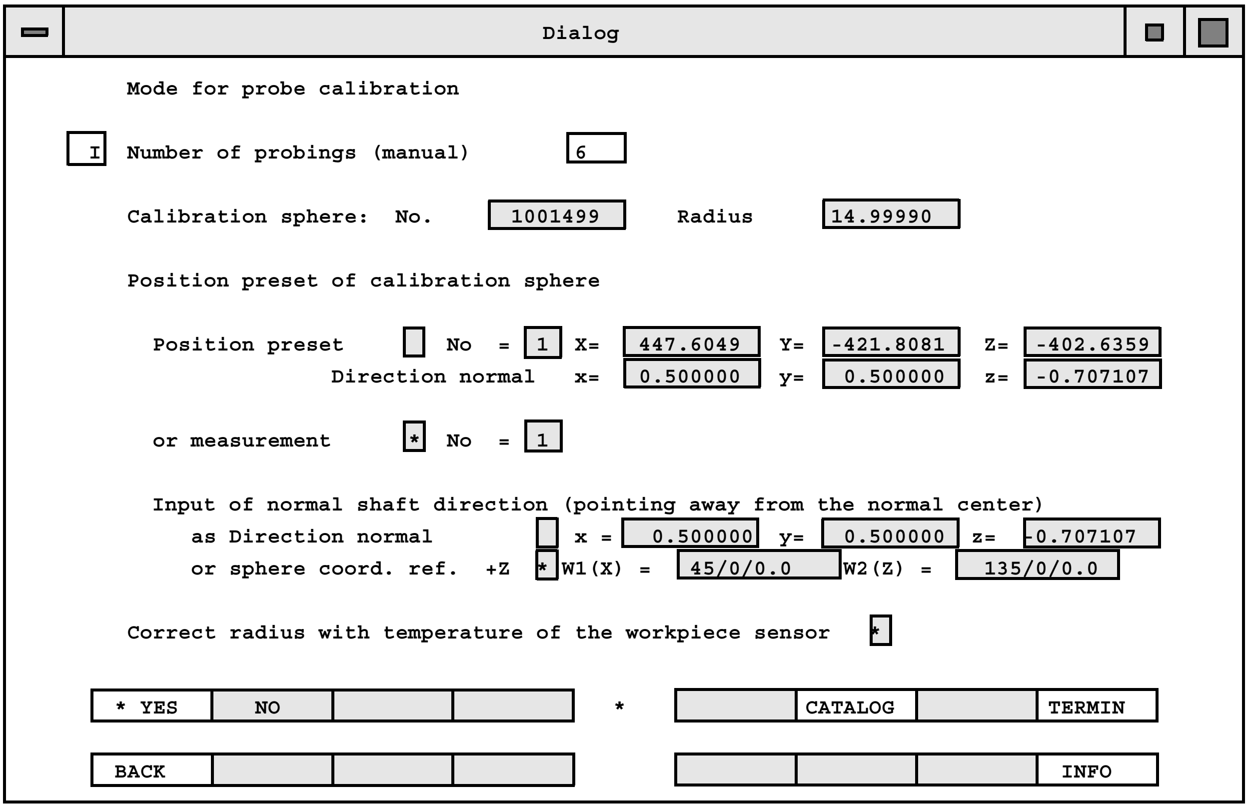
If you are performing probe calibration for the first time, you will have to make a few basic inputs after starting the measuring software.

You will also have to establish a calculated reference between the probe used and the machine zero point.

Defining the calibration mode <DI 6507>



DI	Pull-Down-Menu	Pictogram
6507	Probe Mode for defining...	



Dialog

Mode for probe calibration

I Number of probings (manual) 6

Calibration sphere: No. 1001499 Radius 14.99990

Position preset of calibration sphere

Position preset No = 1 X= 447.6049 Y= -421.8081 Z= -402.6359
Direction normal x= 0.500000 y= 0.500000 z= -0.707107

or measurement * No = 1

Input of normal shaft direction (pointing away from the normal center)
as Direction normal x = 0.500000 y= 0.500000 z= -0.707107
or sphere coord. ref. +Z * W1(X) = 45/0/0.0 W2(Z) = 135/0/0.0

Correct radius with temperature of the workpiece sensor *

* YES | NO | * | CATALOG | TERMIN

BACK | INFO

NOTE

The line **Direction normal ...** and the lines **Input of normal shaft direction ...** are displayed in the dialog window only if your CMM is equipped with a measuring probe head.

Softkey

CATALOG

The Catalog dialog window appears for input of:

– The number and radius of the calibration spheres if the cursor is located in the box behind **Calibration sphere: No.**
– The number and coordinations of the positions if the cursor is located in the box after **Position present No.=**.

Data boxes

Number of probings (manual)

This inquiry is activated only during manual calibration. Enter the minimum number of points you want to probe when calibrating (at least 5). You can probe up to 100 points.

Calibration sphere: No. Radius

Specify the serial number of your calibration sphere. The corresponding radius is displayed.

NOTE

If the message **Incorrect order code number** appears, press **<CATALOG>**, enter the correct data and save it with **<ENTER>**.

Position preset No.= X = Y = Z =

If you enter **<YES>** here, you can specify the different positions of the calibration sphere stored under the numbers **1** to **10**. All you have to do is enter the corresponding number.

The current reference probe is saved. Overview with **<CATALOG>**.

Direction normal, display only, only with a measuring probe head.

or measurement

If you enter **<YES>** here, you can locate the position of the calibration sphere and store it under numbers 1 to 10 with **<TERMIN>**.

For measuring machines with CAA, you must measure with the master probe.

The master probe automatically becomes the reference probe (as indicated by configuration=0 and probe number=0 ➤*„Specifying the reference probe <DI 6506>“ on page 7-15*)

NOTE

Ideally the location of the calibration sphere should be redefined each time!
An existing position should be selected only if it can be guaranteed that the calibration sphere has not been moved and the ambient influences (e.g. temperature) have not changed since it was defined.

Correct radius with temperature of the workpiece sensor

Select **<YES>** to correct the radius of the calibration sphere. This is recommended for UPMC CMMs. The measuring SW automatically switches to the expansion coefficient stored for ceramics = 0.0000055 x1/K um.

Preset of standard shaft direction (pointing away from the normal center)

as Direction normal X = Y = Z =

or sphere coord. ref. +Z A1(X)= A2(Z)=

These lines will be displayed only if a measuring probe head is used.

Application

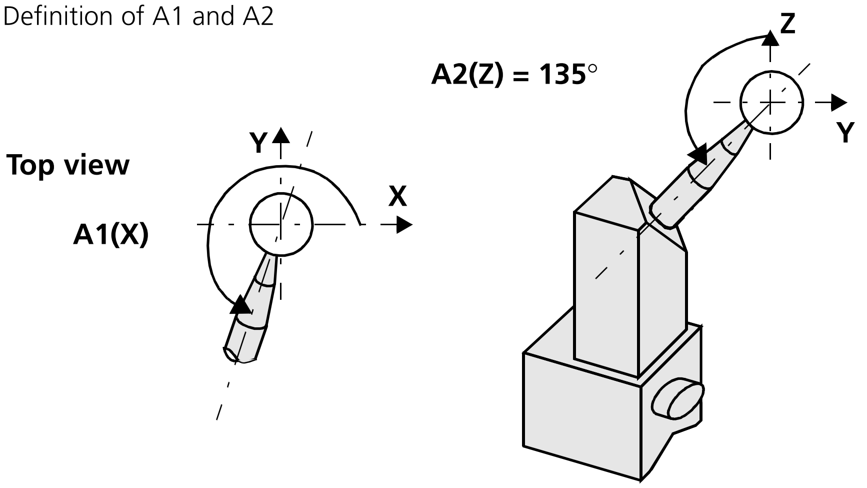
In order to calibrate probes located opposite each other without reclamping during tensor calibration and simultaneously ensure that no collision with the neck of the calibration standard occurs, an appropriate probing point must be omitted. To determine which point can be omitted, you must specifiy the current orientation of the neck of the calibration sphere.

You can specify the orientation of the neck either as a direction normal or as a sphere coordinate.

Standard case

Normally the sphere coordinates are determined by angles **A1** and **A2**.

Definition of A1 and A2



Angle A2 (Z)

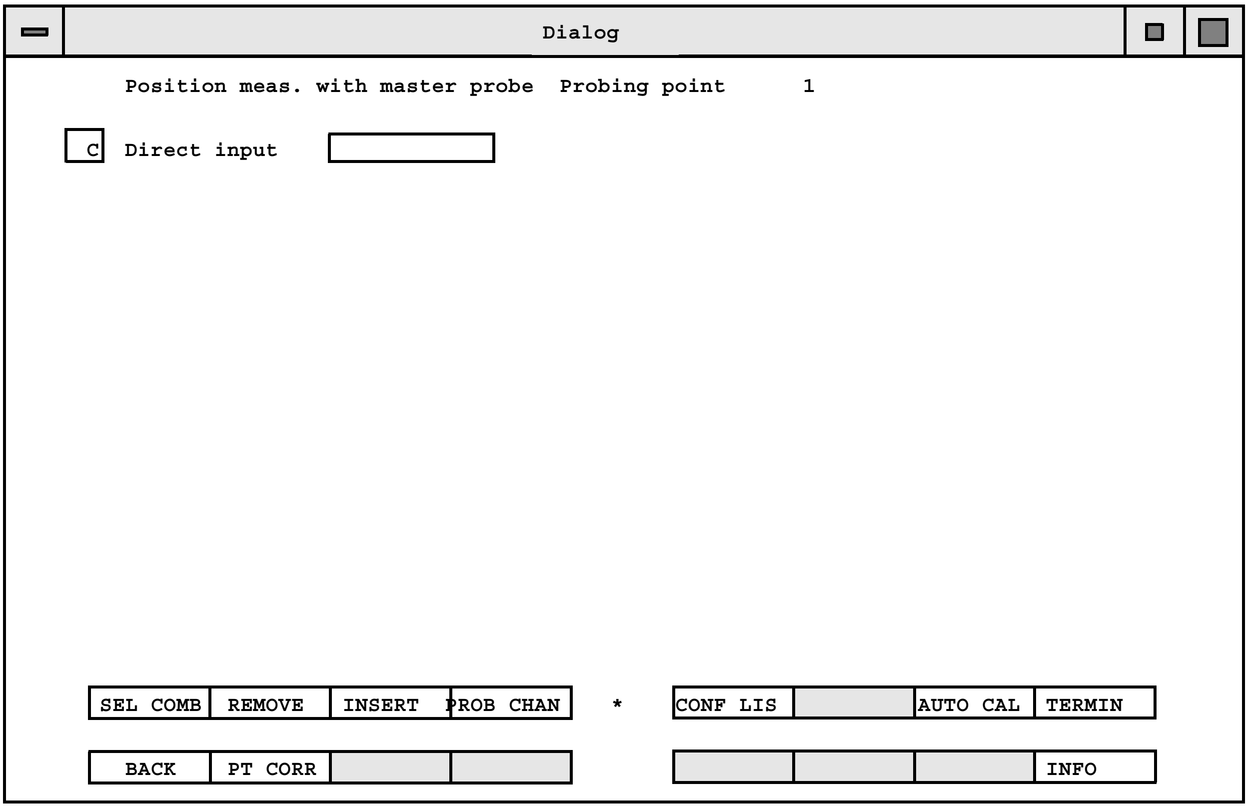
If the calibration sphere is fastened in the plane of the machine table, angle A2(Z) always equals 135 degrees.

Softkey

TERMIN

Used to quit the dialog function.

If the **measurement function was** selected, the following dialog window will be displayed.



Selection

You now have the option of changing probes or manually probing the master sphere ... (exact description of softkeys ➤*„Manual probe calibration <DI 6502>“ on page 7-29*).

AUTO CAL

However, it is advisable to define the position of the master sphere automatically:

Semiautomatic probe calibration

Probe in direction of shaft (note probe number)

After you have probed the highest point (pole) manually, a subprogram will determine the dimensions and perform the remaining probings.

Output

The result is output in the record as a sphere measurement with an address

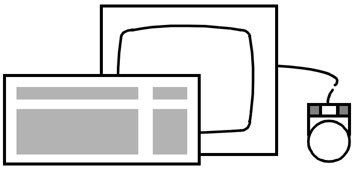
In this way, the diameter or the standard deviation can be accessed e.g. via an **IF inquiry**.

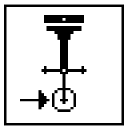
```
Record

Result of the measurement of position  1 of the sphere standard
   1     SPHERE
                        X     246.1188
                        Y   -1026.9727
                        Z    -292.2540
                        D -19999965.0
       6P S/MIN/MAX                .0010        (5)   -.0007      (6)    .0007
```

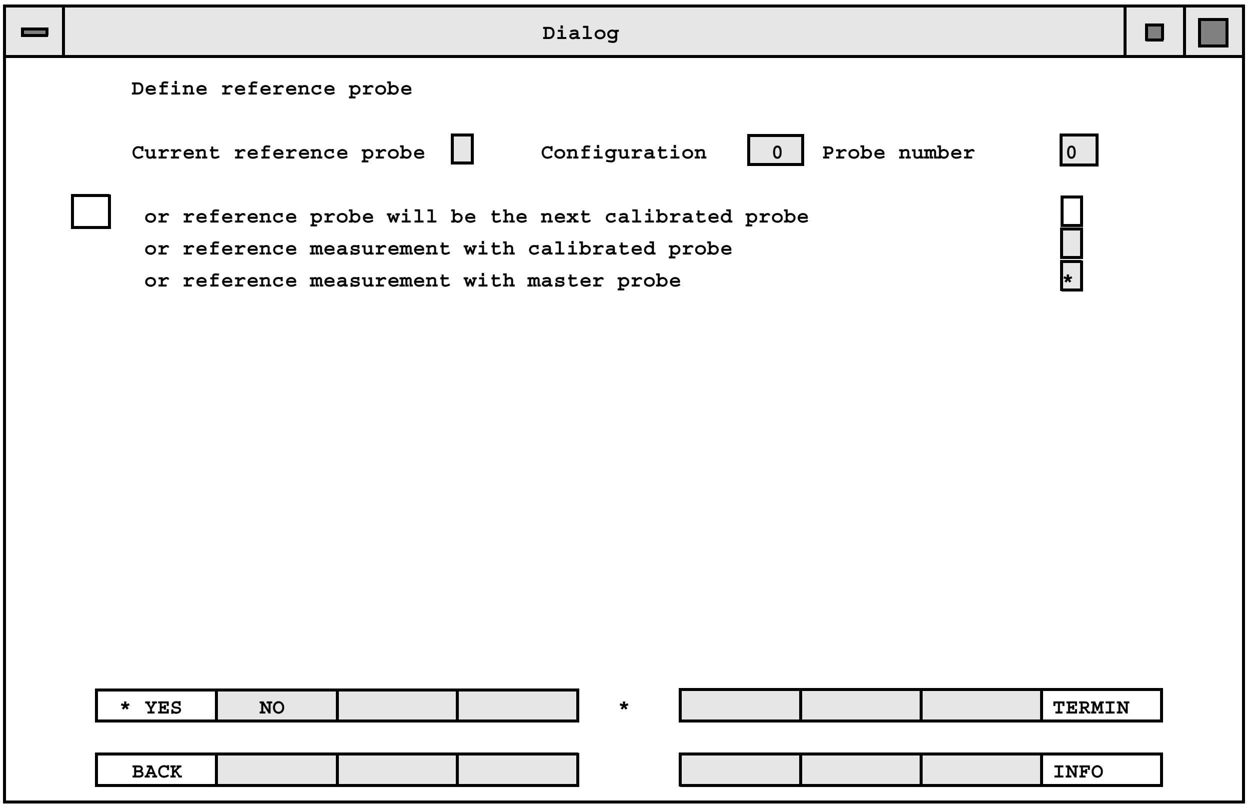
The result is output as the result of a sphere calculation. The diameter depends on the diameter of the probe ball. If the probe ball has not yet been calibrated, the sum of the diameter of the calibration sphere and the probe diameter will be output.

Specifying the reference probe <DI 6506>

Only the probe data representation after calibration is referenced to the center point of the reference probe ball. Mathematically speaking, the data is referenced to the master probe.



DI	Pull-Down-Menu	Pictogram
6506	Probe Mode Reference probe def. ...	



Data boxes

Current reference probe

Display of the current reference probe. Configuration=0 and probe number=0 identify the master probe as the reference probe. Acknowledge with **<YES>** or continue with **<NO>**.

reference probe will be the next calibrated probe

The probe measured next becomes the reference probe. No additional measurement is required.

reference measurement with calibrated probe

The reference is restored by an additional measurement with a calibrated probe.

reference measurement with master probe

The reference is restored by an additional measurement with the master probe

NOTE

The default setting should be **reference measurement with master probe**.

Semiautomatic probe calibration

Overview

Probe calibration programs

Depending on the probe system and operating mode involved, various programs must be started for semiautomatic probe calibration.

Before calling any calibration technique for a measuring probe head, always check to make sure that the operating mode has been properly set with **<DI 1502>**:

Type of probe head	**Operating mode**	**<DI 1502>**	**Semiautomatic probe calibration**
Measuring probe head	**Vectorial probing** In this operating mode the probe head can move freely in all axes. This is required for unclamped measurement and scanning.	**ON**	**<DI 15228>**
	Probe in axis direction In this operating mode the probe head can move only in one axis.	**OFF**	**<DI 6501>**
Trigger probe head	Only one operating mode is possible.	not applic.	**<DI 6501>**

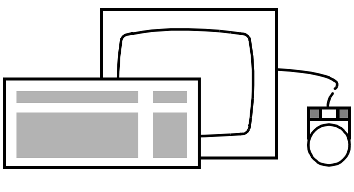
Semiautomatic probe calibration with <DI 6501>

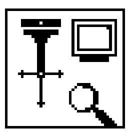
Definition

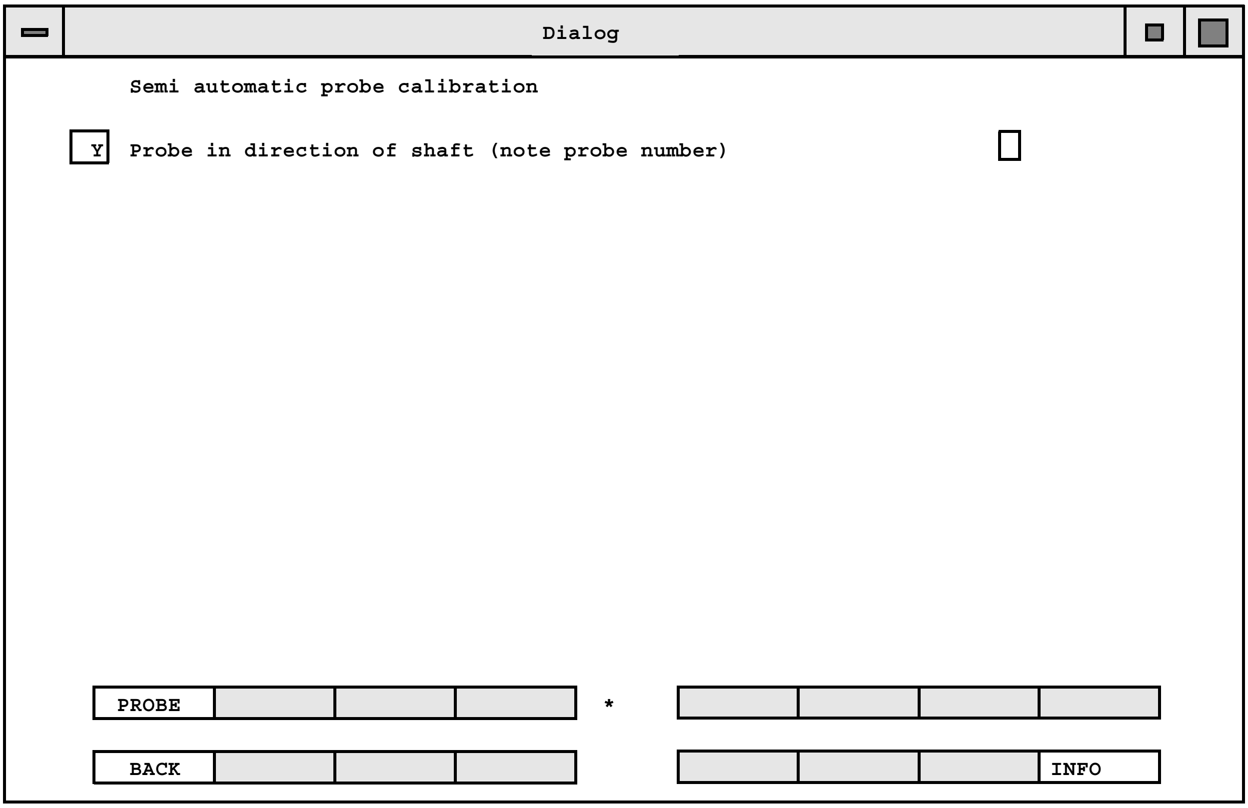
This method of probe calibration is intended for trigger and measuring probe heads in the **Probing in axis direction** operating mode.

Prerequisite

For the measuring probe head, the **Vectorial probing** operating mode must first be switched **OFF** with **<DI 1502>**.



DI	Pull-Down-Menu	Pictogram
6501	Probe calibrate clamped semi automatically...	



Softkey

PROBE

If the probe has already probed in the correct position, you can accept the value as a probing.

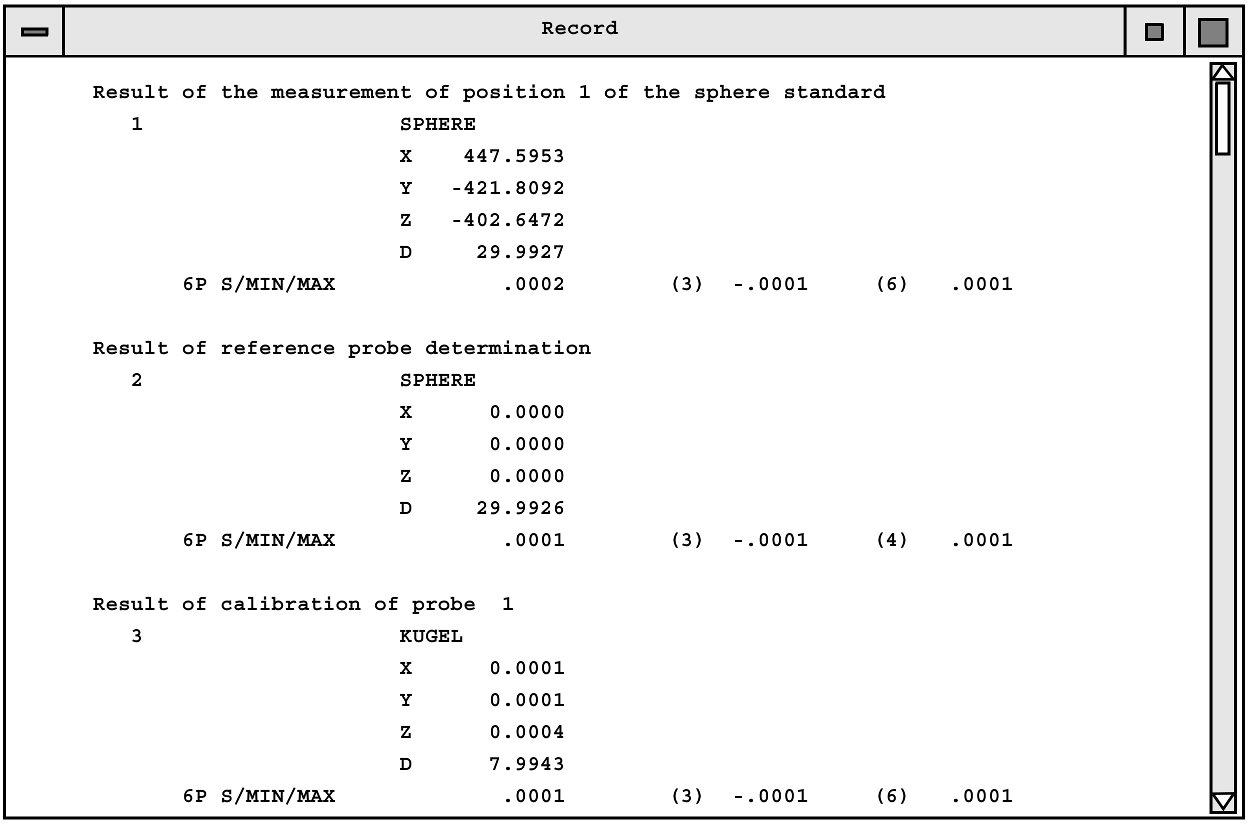
Procedure

Probe the highest point in the shaft direction (pole) of the calibration sphere one time.

A subprogram then determines (calculates) the dimensions, automatically probes twice on the pole and four times on the equator and evaluates these probings. (➤*„Inclined probes during semiautomatic probe calibration“ on page 7-27*)

Record

The result of the calibration is documented accordingly in the measurement record.



```
Record

Result of the measurement of position 1 of the sphere standard
   1                       SPHERE
                           X     447.5953
                           Y    -421.8092
                           Z    -402.6472
                           D      29.9927
       6P S/MIN/MAX                .0002        (3)   -.0001      (6)    .0001

Result of reference probe determination
   2                       SPHERE
                           X       0.0000
                           Y       0.0000
                           Z       0.0000
                           D      29.9926
       6P S/MIN/MAX                .0001        (3)   -.0001      (4)    .0001

Result of calibration of probe  1
   3                       KUGEL
                           X       0.0001
                           Y       0.0001
                           Z       0.0004
                           D       7.9943
       6P S/MIN/MAX                .0001        (3)   -.0001      (6)    .0001
```

Semiautomatic probe calibration with <DI 15228> (tensor calibration)

Definition

This is the standard probe calibration method for all measuring machines equipped with a measuring probe head and high-speed scanning.

Prerequisites

The **Vectorial probing** operating mode must be switched **ON** with **<DI 1502>**.

The probe being calibrated must be able to probe the hemisphere of the calibration sphere without causing a collision. The neck of the calibration standard is automatically omitted for tensor calibration.

(➤*„Defining the calibration mode <DI 6507>“ on page 7-10* **<DI 6507>**).

Probe bend

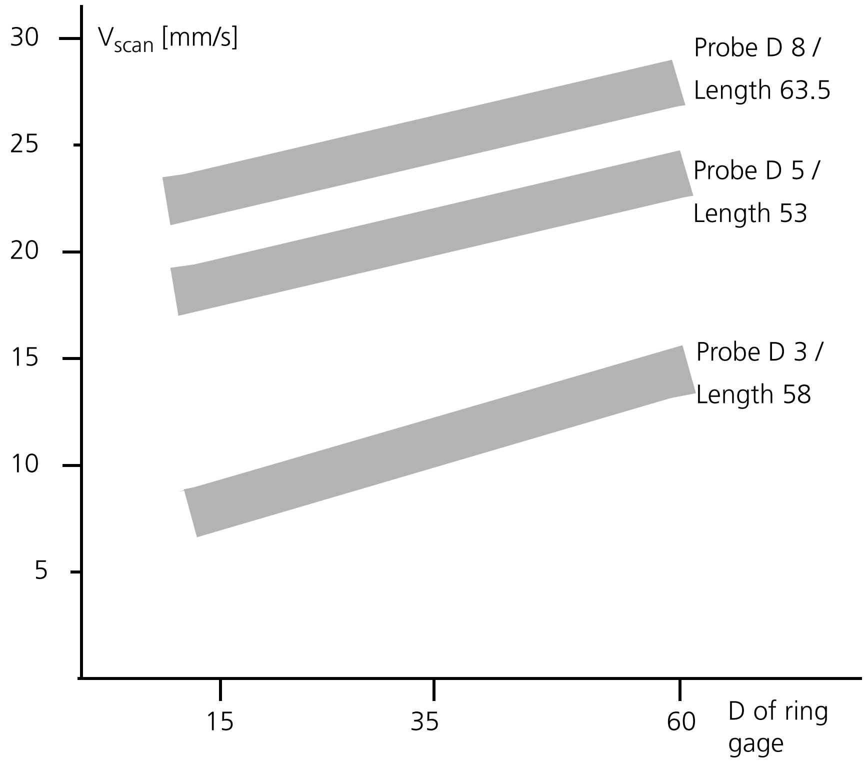
Various measuring force settings are used during probe calibration. In addition to the usual probe data, the parameters for correcting the probe bend are also determined. These values are taken into account during the following measurements:

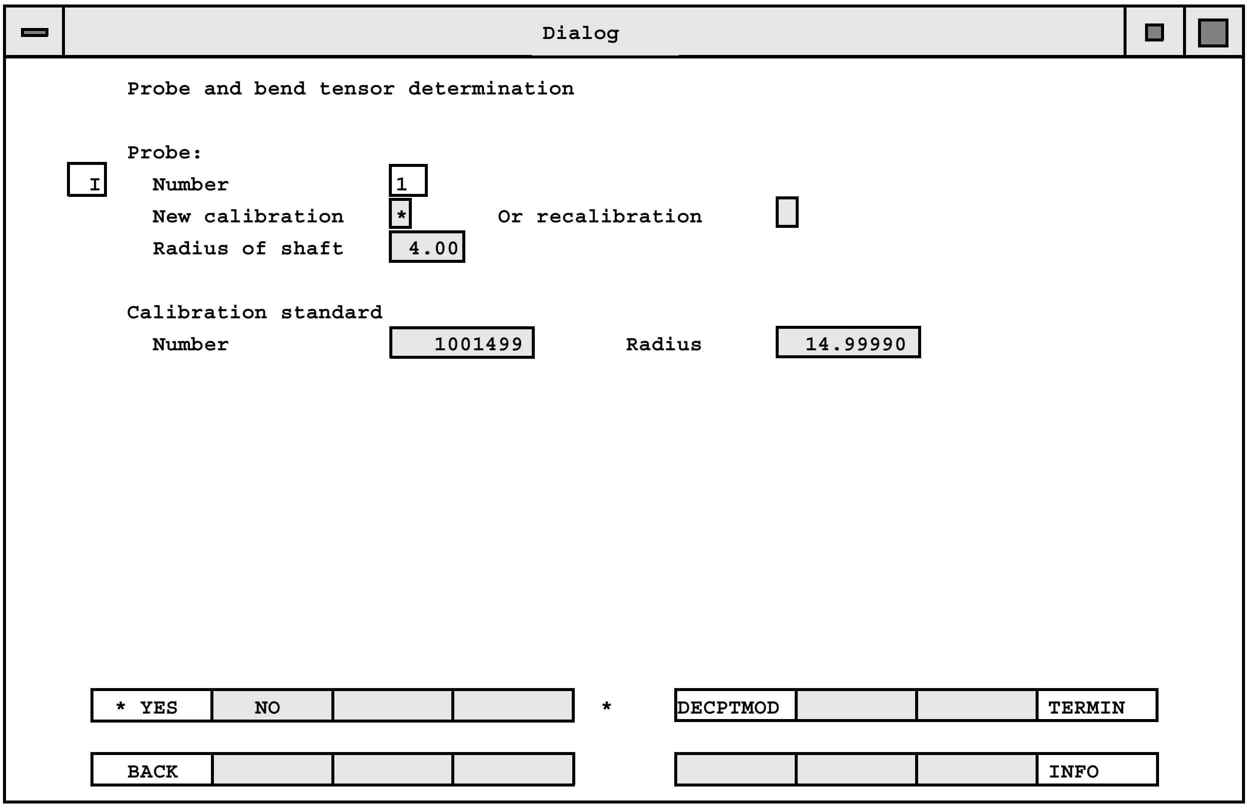
– Probing single points with an unclamped probe head and

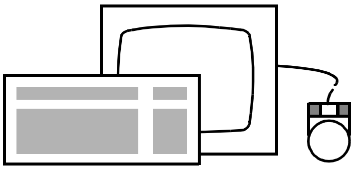
– Scanning inner and outer features (bores and shafts) in all measuring planes and in space. The accuracy of the bend correction depends on the scanning speed and the curvature radius.

Diagram

The following overview gives you a rough idea of the scanning speed which can be reached if the specified probing uncertainty of the UMC CARAT, i.e. V2 = 1.2 µm and U_3 = 1.8+L/450, is maintained. Measurement was performed with hard metal probes assembled from probe kit components without extensions. Evaluation was made with a 2.5 filter in compliance with ISO/TC 57.







DI	Pull-Down-Menu	Pictogram
15228	Probe	
	calibrate unclamped	
	semi-automatic...	

Data boxes

Probe: Number

Enter number of probe

New calibration
Or recalibration

New calibration is the default setting. For procedure ➤*„Tensor calibration: Full calibration or recalibration“ on page 7-25*

Radius of shaft

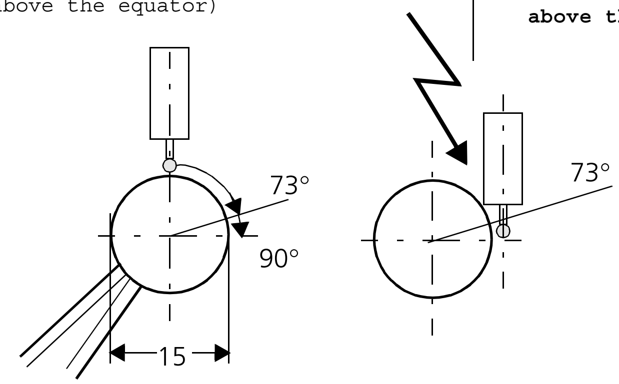
The default input is the probe radius. This information is required for the program-controlled distribution of the probing points.

If a deviating value is entered, the calibration sphere will be probed below or above the equator during semiautomatic calibration. This is advisable if probing under a similar angle will be required during the actual measurements later on.

You can enter a larger shaft radius if e.g. other probes are in the way. For example: If probe 1 is very long and probe 2 is short, a larger shaft radius must be entered to prevent collisions. The calibration procedure then takes place above the equator.

$\frac{\text{Shaft radius}}{\text{Probe radius}}$	Angle =	Calibration area
about the same (deviation < 0.15 mm)	90° (equator)	up to the equator
Shaft radius smaller than probe radius	$90° + \cos \frac{\text{Radius of calibr. standard + probe radius}}{\text{Radius of calibr. standard + shaft radius}}$ max. 95°	to below the equator
Shaft radius larger than probe radius	$90° - \cos \frac{\text{Radius of calibr. standard + shaft radius}}{\text{Radius of calibr. standard + probe radius}}$	above the equator
Special case:	max. 73° (above the equator)	above the equator

To prevent collisions with small probes (D < 0.6 mm), enter 0.3mm or less for shaft radius and probe radius.



Use a calibration standard with a sphere diameter = 15 mm!

Calibration standard Number Radius

The number offered can be accepted. If the number is changed, the matching radius will automatically be accepted if it is entered in the corresponding list.

Procedure

TERMIN

Exit the completed dialog page with **<TERMIN>**.

Probe and bend tensor determination Probe sphere in shaft direction

Probe the calibration sphere once at the highest point in the direction of the shaft. A subprogram calculates the dimensions and automatically probes thirty times within the hemisphere. The probings are then evaluated.

(➤*„Inclined probes during semiautomatic probe calibration“ on page 7-27*)

NOTE

In the list of probe data (➤*„Output of probe data <DI 1624>“ on page 8-6*) the calibration data is marked by a "+" in the last position. The actual diameter of the probe ball is calculated by compensating the measuring force and the probe bend. The results of calibrations with **<DI 15228>** and with **<DI 6501>** are therefore not comparable.

NOTE

If the operating mode changes (clamped or unclamped), it is advisable to additionally perform a probe calibration with **<DI 6501>** using a different probe combination.

If probes with disk-shaped (instead of spherical) tips are to be used for fast scanning: First calibrate the disk probe with **<DI 6501>** in the "**Probing in axis direction**" operating mode. Then record the probe bend in the "**Vectorial probing**" mode via **<DI 1184>**.

Record

The result of the calibration will be documented in the measurement record.

This makes it possible to access the diameter or standard deviation or dispersion with an **IF inquiry.** For example:

```
Record

Result of the measurement of position  1 of the sphere standard
   1                        SPHERE
                            X     447.5953
                            Y    -421.8092
                            Z    -402.6472
                            D      29.9927
       6P S/MIN/MAX                .0002        (3)   -.0001     (6)    .0001

Result of reference probe determination
   2                        SPHERE
                            X       0.0000
                            Y       0.0000
                            Z       0.0000
                            D      29.9926
       6P S/MIN/MAX                .0001        (3)   -.0001     (4)    .0001

Result of calibration of probe  1
   3                        SPHERE
                            X       0.0006
                            Y       0.0004
                            Z       0.0047
                            D       8.0011
      30P S/MIN/MAX                .0002       (21)   -.0002    (10)    .0005
```

Tensor calibration: Full calibration or recalibration

Application

A probe can be:

- completely calibrated, i.e. the geometry (X, Y, Z and radius) and the bend data (bend tensor) are defined or
- recalibrated, i.e. only the geometry is redefined and the previous bend data is retained.

Full calibration

Full calibration is performed as usual. The calibration result is displayed and saved as the sphere result.

Recalibration

The prerequisite for recalibration is the availability of bend data from a previous full measurement.

Only 6 points are probed for a recalibration.

Limit values

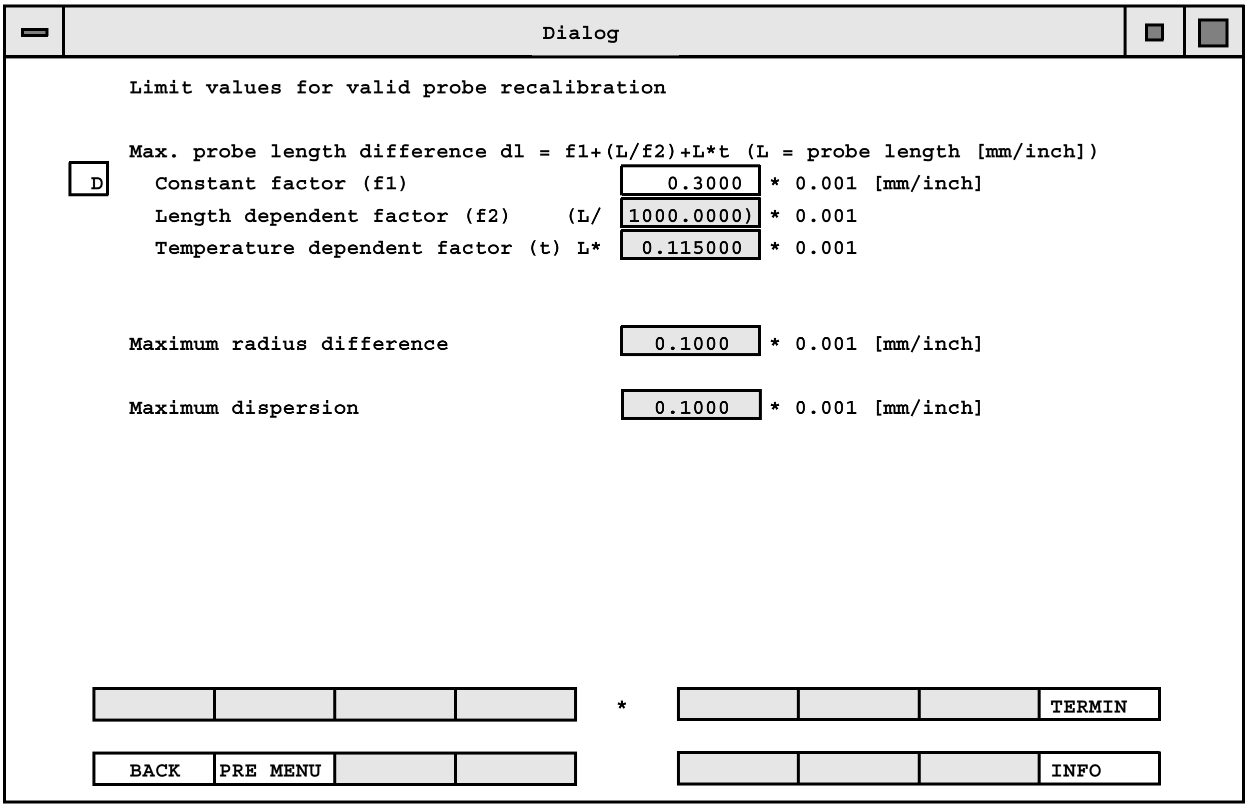
The calibration data gained during the recalibration is compared with the data from the full calibration. **Limit values** are used for the comparison. If the new calibration data lies above the limit.

DECPTMOD

The limit values for recalibration are entered in a dialog window which can be opened by pressing the **<DECPTMOD>** key in the tensor calibration dialog window.

Limit values for recalibration

The limit values entered are saved to a file and read-in again each time the software is restarted. They are used to monitor recalibration in order to prevent recalibration with the wrong bend parameters.



dl = f1 + (L / f2) + L * t (L = probe length referenced to the master probe)

Probe length difference

Constant factor (f1)	Dependent on the constant term from U3 of the CMM.
Length-dependent factor (f2)	Dependent on the length-dependent term from U3 of the CMM.
Temperature-dependent factor (t)	Dependent on the maximum temperature variance and the probe material.

Maximum difference in radius

Dependent on the rigidity of the probe. Only a constant factor is provided for the radius.

Maximum dispersion

Dependent on the machine accuracy and quality of the probe. An absolute check is made of the dispersion of the recalibration.

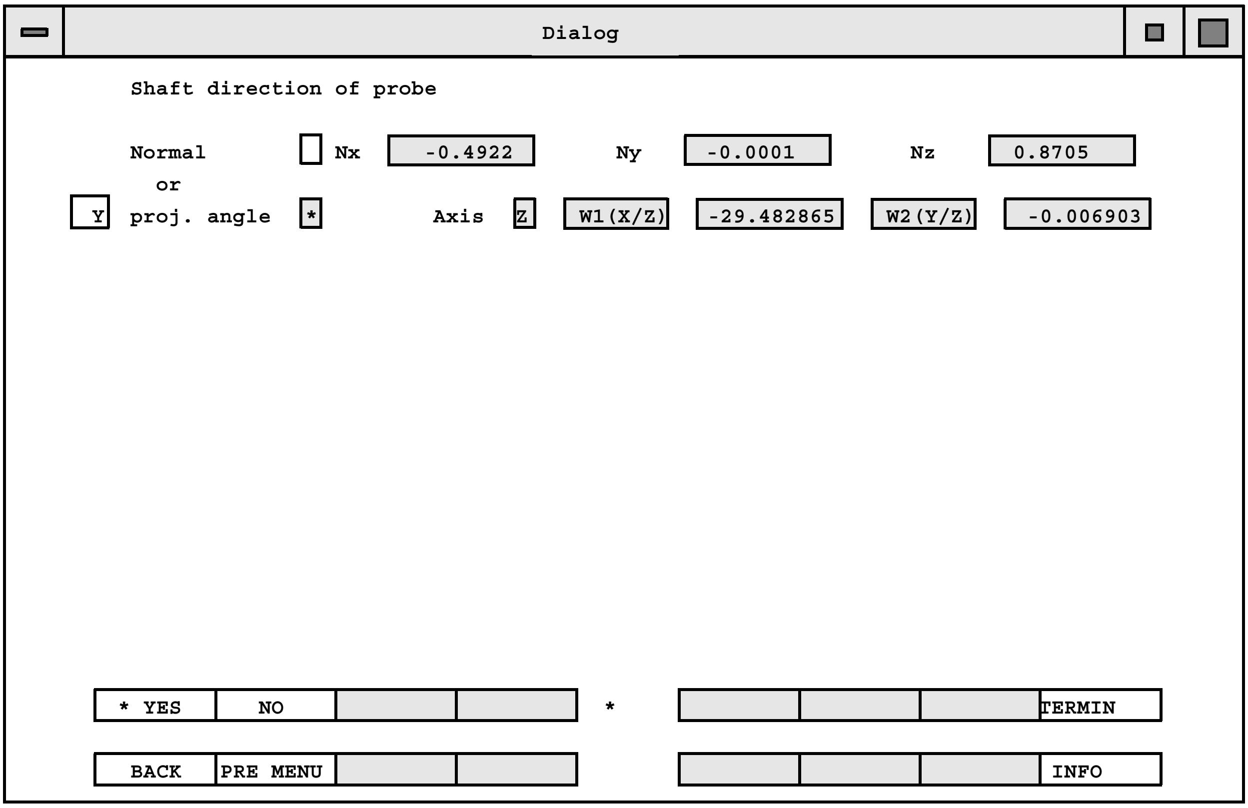
When selecting the limit values, note that the bend data have a considerable influence on the radius of the probe ball and the dispersion, but only a minimum influence on the probe geometry. For this reason, the limit values should be selected so that they are as small as possible for the radius and dispersion but larger for the geometry. The limit values for the geometry have the purpose of preventing the bend data for probes being used with any geometry other than the one for full calibration. It should here be noted the the deviation of the probe geometry in X, Y and Z depends on the basic accuracy of the machine and expansion changes due to temperature fluctuations. The accuracy of the machine is dependent on a constant and a length-dependent factor. For this reason, both a **constant (f1)** and a **length-dependent (f2)** limit value as well as a **length-dependent factor (t)** for the temperature are provided for recalibration.

Inclined probes during semiautomatic probe calibration

Application

If inclined probes are used, another dialog window will open following probing in the shaft direciton. The normal direction and projected angles calculated during the position calibration are offered for acceptance. This data may also be connected if necessary.

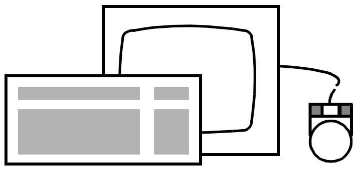
Calibration is performed after closing the dialog window with **<TERMIN>**.

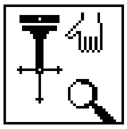


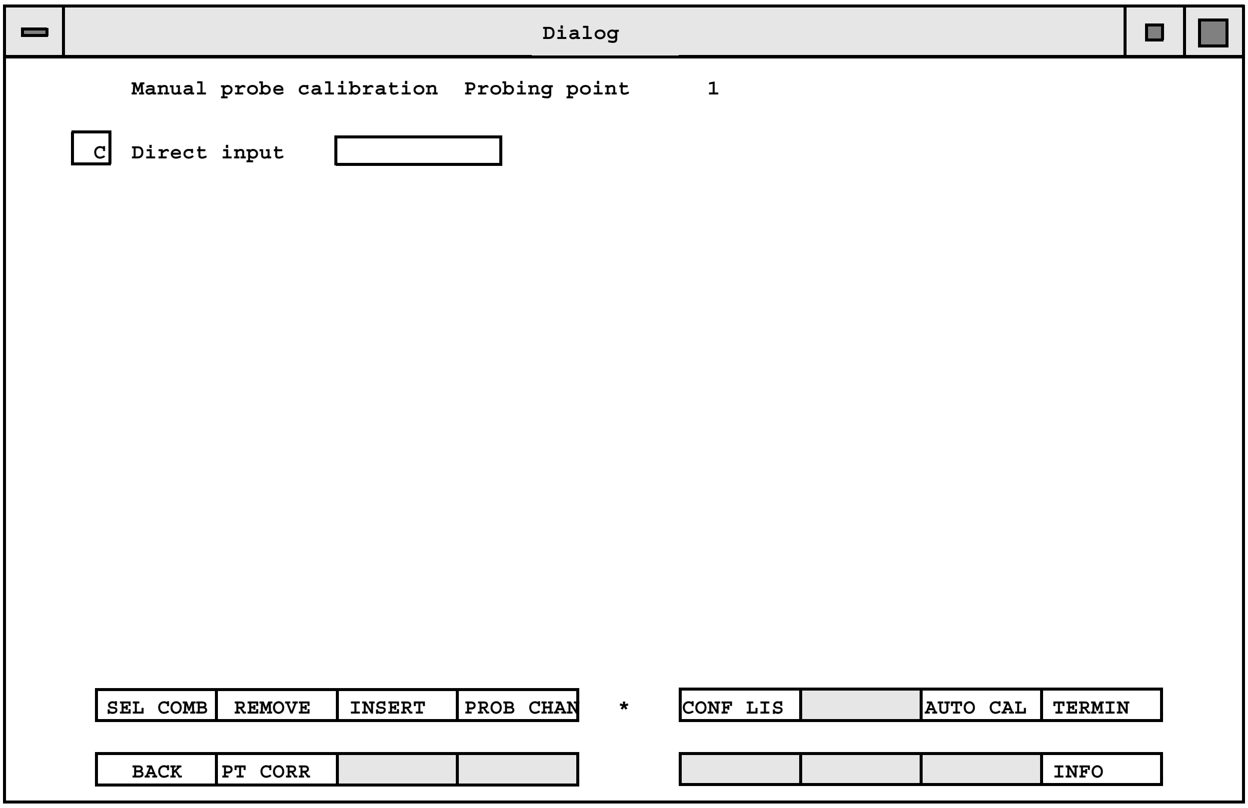
Manual probe calibration <DI 6502>

Application

If semiautomatic probe calibration can not be used (e.g. due to very short or special probes), the probe must be calibrated manually.



DI	Pull-Down-Menu	Pictogram
6502	Probe calibrate clamped manually...	



Procedure

Probe the points manually. You must probe at least as many points as you defined in the calibration mode (➤*„Defining the calibration mode <DI 6507>“ on page 7-10*).

Softkeys

SEL COMB

changes the combination/configuration (➤*„Changing the combination <DI 1601>“ on page 8-11*)

REMOVE

is used to remove the probe manually (➤*„Removing probes manually <DI 1554>“ on page 8-12*)

INSERT	is used to insert the probe manually (➤*„Removing probes manually <DI 1554>" on page 8-12*)
PRB CHAN	starts automatic probe change (➤*„Inserting probes manually <DI 1555>" on page 8-15*)
CONF LIS	outputs data from the current configuration.
AUTO CAL	starts semiautomatic probe calibration (➤*„Semiautomatic probe calibration" on page 7-17*)
PT CORR	is used to delete incorrectly probed points. Each time you press this key, you delete one more point in reverse order to the order of probing.
TERMIN	terminates the current function. The computer then evaluates the probed points and calcuates the probe data.

CNC probe calibration

Frequent calibration

If you have to calibrate probes frequently, it makes sense to create a CNC program for this job (➤*„Learn programming“ on page 16-1*). Either manual and semiautomatic probe calibration is suitable for this purpose.

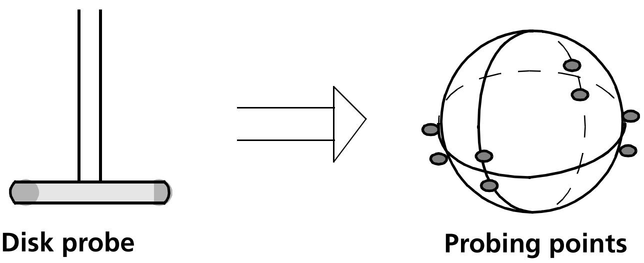
Calibrating disk and cylinder probes

Application

When calibrating disk and cylinder probes, i.e. probes with disk-shaped and cylindrical tips, you must follow a different procedure than for probes with spherical tips.

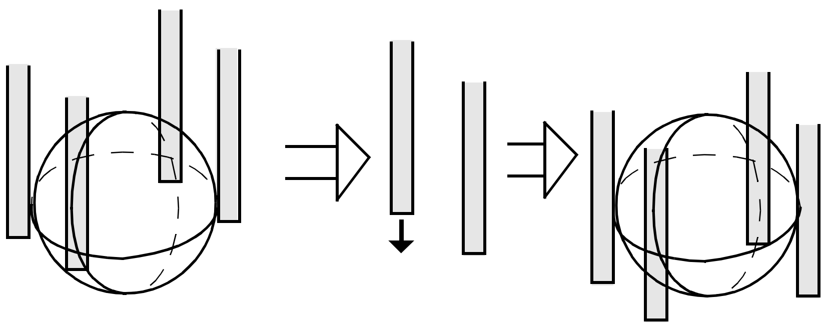
Disk probe

- Only manual probe calibration can be used.
- Probe 6 to 8 times near the equator.
- Travel at least once in the direction of the shaft.



Cylinder probe

- Only manual probe calibration can be used.
- Probe the calibration sphere four times on its equator.
- Travel in the direction of the shaft.
- Probe the calibration stand another 4 times on its equator.



NOTE

With this probing strategy the center coordinates of the cylinder probe are defined correctly, however, its radius is incorrect. For this reason, cylinder probes must be recalibrated on gage blocks (➤*„Recalibration with reference standards“ on page 7-33*).

Recalibration with reference standards

Application

An incorrect radius is calculated for cylinder probes with the normal calibration process (➤*„Calibrating disk and cylinder probes“ on page 7-32*). For this reason, these probes must be recalibrated with reference standards (gage block, ring gage, etc.).

Recalibration also increases the calibration accuracy for measurements performed with sphere-tip probes in specific axes or planes.

Basic procedure

- Calibrate probe(s) and save data.
- Measure a suitable reference standard in such a way that the conditions which you expect to occur during the high-precision workpiece measurement (probing direction, plane, diameter, etc.) are simulated as closely as possible.
- Correct the probe tip radius based on the difference between the actual and nominal dimension of the standard and save the corrected radius with **<DI 6510>** (➤*„Modifying probe data <DI 1627>“ on page 8-7*).

Example

Calibration of a cylinder probe using a gage block.

- Calibrate the probe.
- Align the gage block (**<RO SPACE>**, **<RO PLANE>**, **<ZERO POINT>**)
- Measure length of gage block.
- Calculate difference between nominal and actual dimension.
- Divide the value by 2. The result is the correction value.
- Subtract the correction value from or add it to the probe radius. The result is the correct probe radius.
- Enter and save the correct probe radius with **<DI 6510>**.

Probe bend compensation

General information

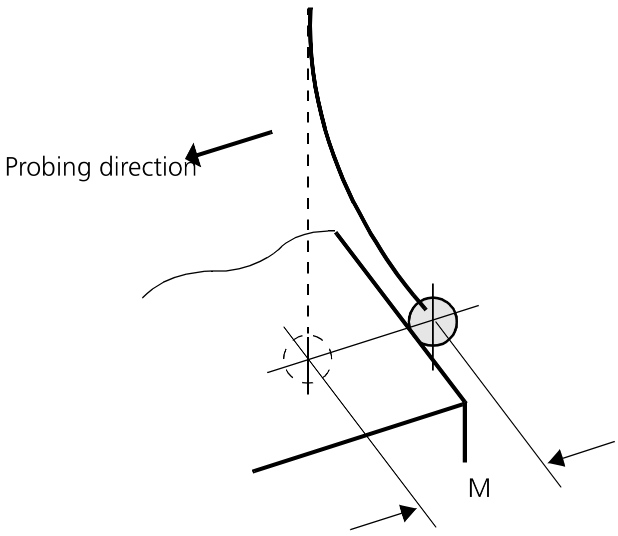
Application

When using a measuring probe head, measuring errors may result from static and/or dynamic bend. In either case, the bend parameters can be determined and taken into account during measurement:

Operation	**Operating mode of measuring probe head**	
	Probe head unclamped **<DI 1502> = ON** Default measuring mode for CMMs with a measuring probe head. Compliance with probing uncertainty v_2 can be guaranteed if probe calibration is performed via **<DI 15228>**.	Probe head clamped **<DI 1502> = OFF** Used only in special cases: Probing of small, inclined surface elements, self-centering probing. Compliance with probing uncertainty v_2 can **not** be guaranteed in this mode even if the probe bend is corrected.
Static bend	Bend correction is taken into account if calibration is performed with **<DI 15228>**.	The bend must be determined via **<DI 6520>**.
Dynamic bend	Bend correction is taken into account when calibrating with **<DI 15228>**. See illustration ➤*„Semiautomatic probe calibration with <DI 15228> (tensor calibration)“ on page 7-19* If maximum accuracy and scanning speed are required, an additional bend correction must be performed with **<DI 1184>**. After calibrating disk probes, compensate the probe bend with **<DI 1186>**.	Bend must be determined with **<DI 6520>**.

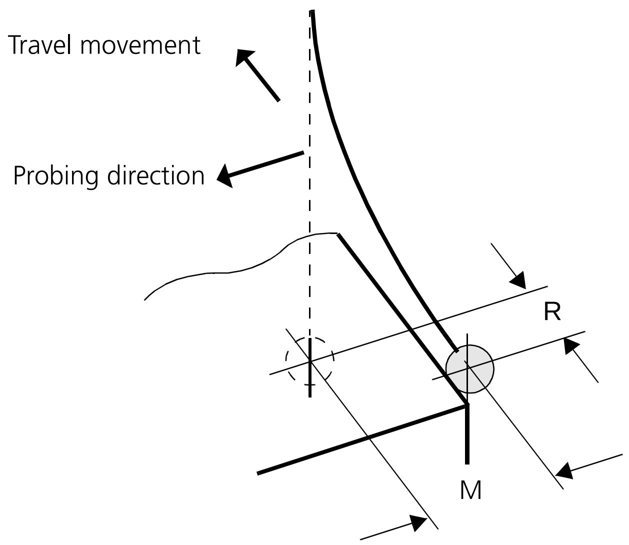
Static bend

Probe bend M caused by measuring force during point probings.



Dynamic bend

Probe bend M and R resulting from measuring force and friction during scanning.



NOTE

It is advisable to determine the bend parameters with **<DI 6520>** when operating the probe head in the clamped mode (see above) and:

- The surface normal is slanted in relation to the probing direction at the probing point.
- Only one section of a geometric element can be measured.
- A high measuring force (≥0,4N) must be used.

- The bend of the probe is greater than 1mm/0.1N.
- When calibrating angle probes, high dispersions occur despite a low measuring force and a rigid probe design.
- The dynamic bend caused by friction between the probe and the test piece during scanning is not negligible.
- The uncertainty should be minimal for every measurement.

Basic procedure

- Calibrate probes
- Determine the bend parameters **<DI 6520>**
- Take the bend into account during measurement **<DI 1186>**

Determining bend parameters for the "clamped" probe head mode <DI 6520>

Procedure

Measuring force

Preselect the measuring force

Set the measuring force with which the measurement should be performed.

Calibration

Calibrate the probes

- Calibrate the probes manually or automatically.

Alignment

Determine the position of the ring gage or plug gage.

- Only for determining the dynamic bend parameters (scanning parameters). Depending on the measuring job involved, use a ring gage or plug gage with roughly the same diameter as the feature to be measured.
  Alignment procedure:

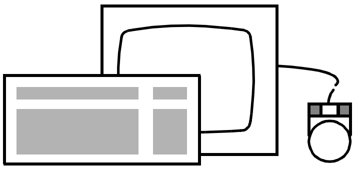
Ring gage:	- Measure plane surface with **<SURFACE>** - **<RO SPACE>**
Plug gage:	- Measure surface with **<CYLINDER>**. - **<RO SPACE>**

Bend parameters

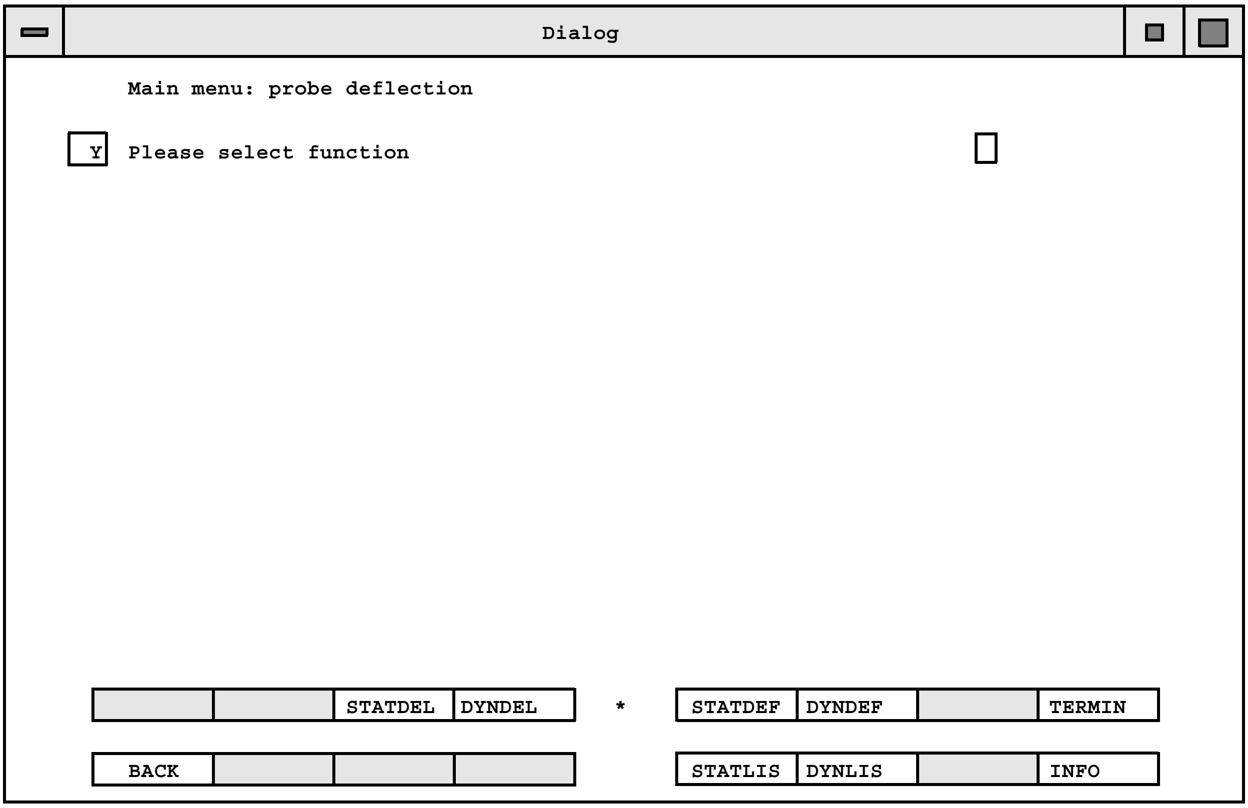
Determine bend parameters.

Function call

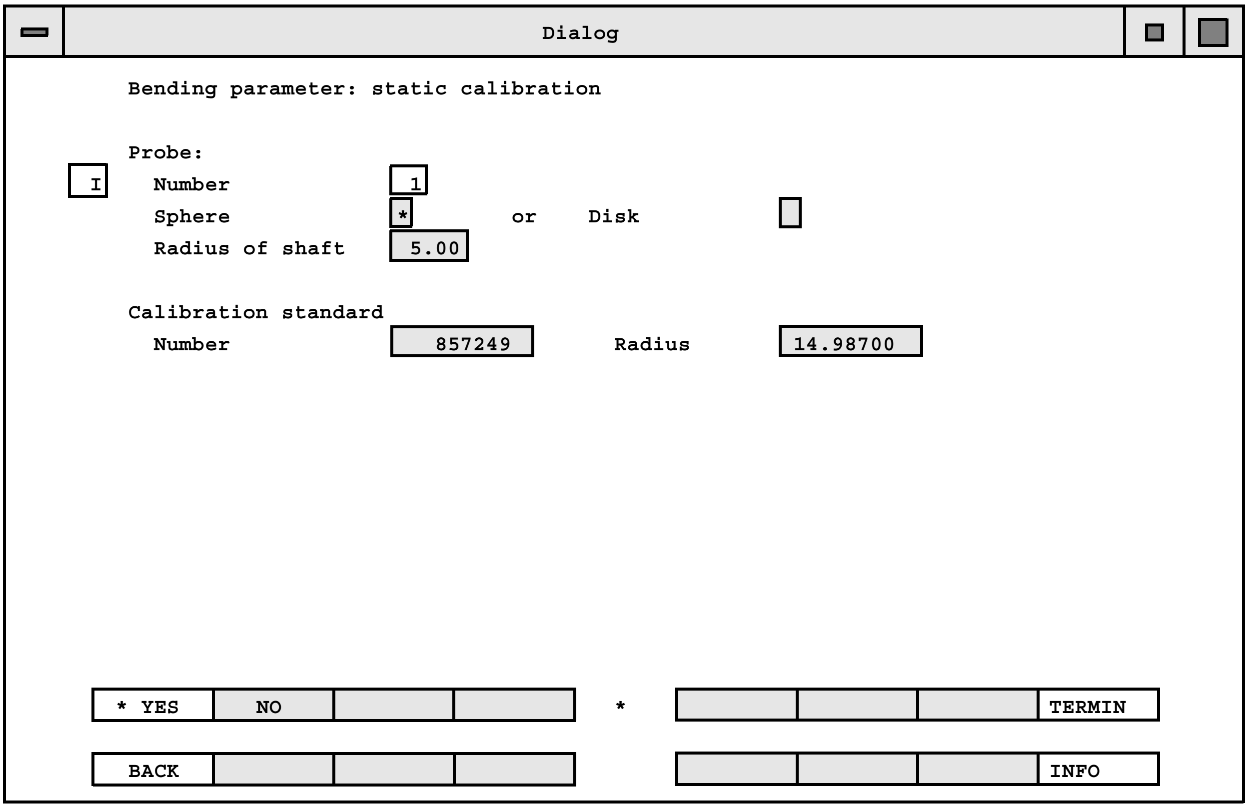
Following the function call, you will first return to the main menu. From there you can continue on to other submenus.



DI	Pull-Down-Menu	Pictogram
6520	Probe	
PRB BEND	calibrate clamped	
a101	Bend menu...	



Determining the static bend parameters <STATDEF>



Explanation

Probe

Number	Enter probe number (1-5).
Sphere or disk	Specify shape of probe tip by entering **<YES>/<NO>**.
Shaft radius	Enter the shaft radius. An angular range for determining static bend parameters is determined by the program here.

Calibration standard Number, Radius

The number offered can be accepted. If the number is changed, the relevant radius will automatically be transferred from the catalog.

Procedure

After closing the dialog window, probe the calibration standard in the direction of the shaft as soon as soon as you are prompted to do so on the screen.

Documentation

When you have completed the calibration procedure, the probe data and bend parameters will be printed out in the record:

```
                                Record

Configuration =  147
Co no          Coordinates           Radius   Force Temp.  Date       Dev    SD
 2 1    -.0002    -.0002    -.0052    3.9847   .20    .0   2. 3.1998  .0006  *-

Bending parameter: accuracy display
Probe no.     1
Parameter calibration (static):
Prbdir No.pts  Dispersion MIN       Pt.     MAX        Pt.      Plnnom.   Pt.
  -X   12        0.00458   0.00121 (5   )    0.00595 (12  )    0.00055  (2   )
  +X   12        0.00378   0.00085 (5   )    0.00509 (1   )    0.00037  (11  )
  -Y   12        0.00417   0.00054 (5   )    0.00584 (12  )    0.00024  (11  )
  +Y   12        0.00336   0.00078 (5   )    0.00483 (12  )    0.00027  (2   )
  -Z   21        0.00284   0.00012 (6   )    0.00540 (21  )    0.00083  (19  )
```

The bend parameters is marked in the **SD** column:

***** = **yes**

- = **no**

S = **static bend parameter**

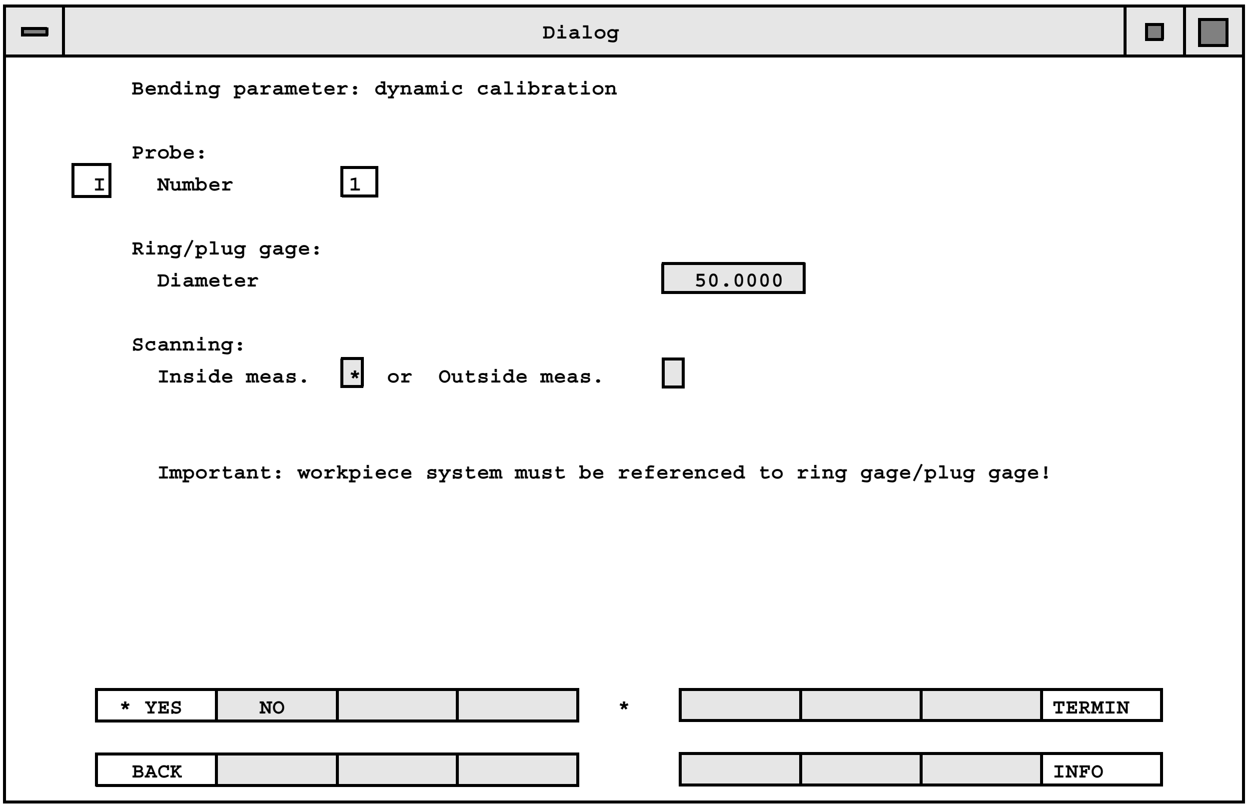
D = **dynamic bend parameter**

If the bend parameters already exist for the probe concerned, the following message will appear in the above case:

Static bending parameter for probe No. 21 already exists.

(2 = combination, 1 = probe number)

Determining the dynamic bend parameters <DYNDEF>



Explanation

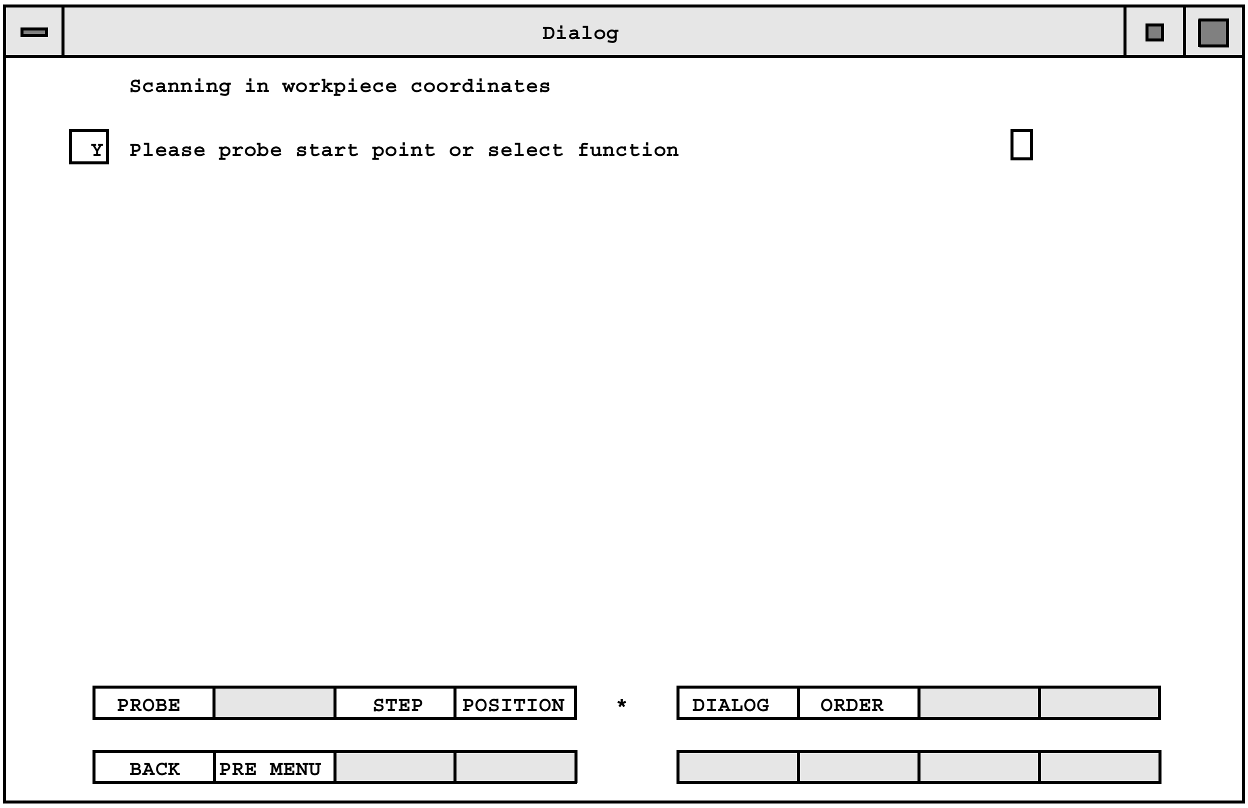
Probe: Number
Input of the probe number (1 - 5).

Ring/plug gage: Diameter
Input of the diameter to be scanned immediately afterwards.

Scanning: Inside meas. or Outside meas.
Select the type of measurement required with **<YES>** / **<NO>**.

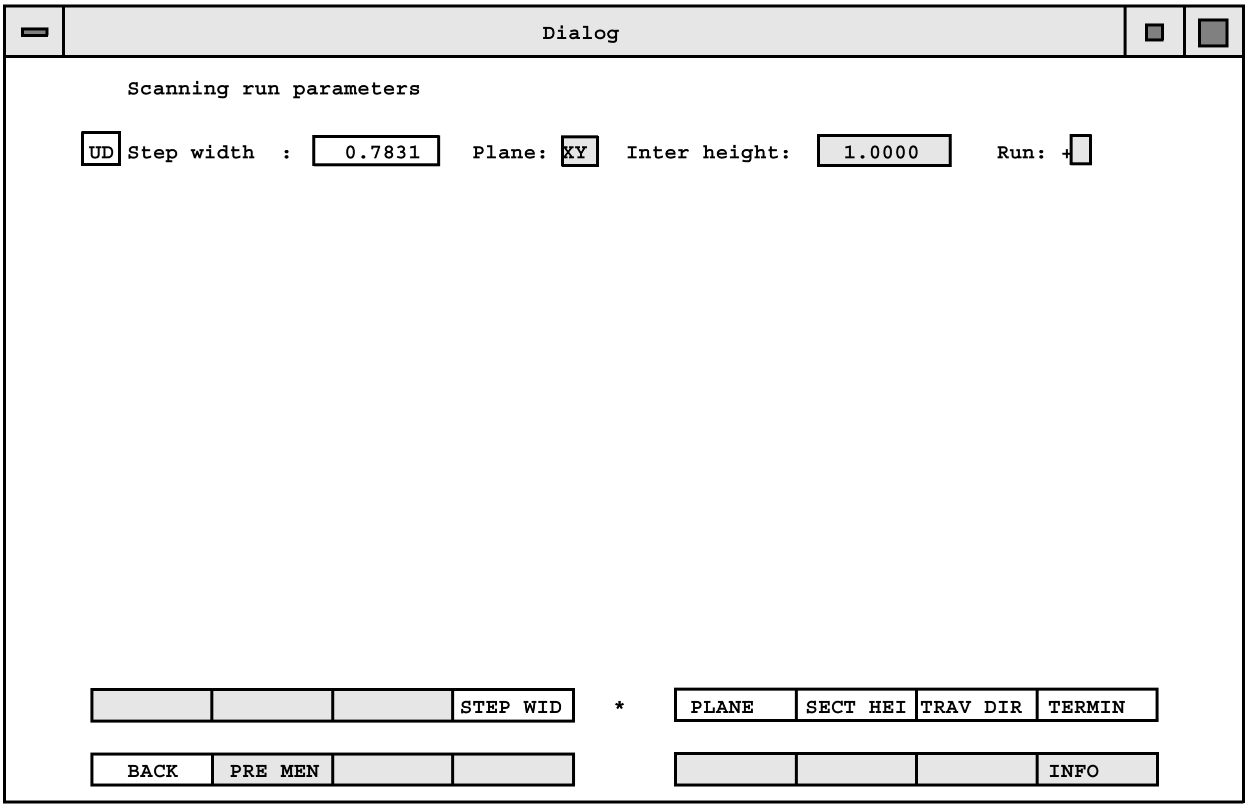
Following dialog
(For more information: ➤*„Details on the scanning mode“ on page 19-15* - Scanning run.)

TERMIN
After you close the dialog window for the bend parameters, the program switches over to the dialog window for the scanning run.


Dialog
Scanning in workpiece coordinates
Y
Please probe start point or select function
PROBE
STEP
POSITION
*
DIALOG
ORDER
BACK
PRE MENU

Scanning in workpiece coordinates Please probe start point or select function

You will be prompted to probe the start and end point or to select a function.



The measurement starts after transferring or changing the run parameters with **<TERMIN>**.

Documentation

If the bend parameters are defined, they will be output to the record:

```
Record

Configuration =  147
Co Nr          Coordinates           Radius   Force Temp.  Date     Dev SD
 2 1    -.0002    -.0002    -.0052   3.9847   .20    .0   2. 3.1998  .0006  **

Bending parameter: accuracy display
Probe no.     1
Parameter calibration (dynamic):
Prbdir No.pts Dispersion  MIN       Pt.      MAX        Pt.      Plnnom.   Pt.
  -X   51       0.00187  0.00049 (27  )    0.00433 (51  )    0.00061  (48  )
  -Y   50       0.00174  0.00035 (25  )    0.00393 (50  )    0.00072  (4   )
  +X   49       0.00196  0.00047 (23  )    0.00500 (49  )    0.00044  (28  )
  +Y   50       0.00167  0.00020 (24  )    0.00407 (50  )    0.00076  (31  )
```

The bend parameter is marked in the **SD** column:

***** = **yes**

- = **no**

S = **static bend parameters**

D = **dynamic bend parameters**

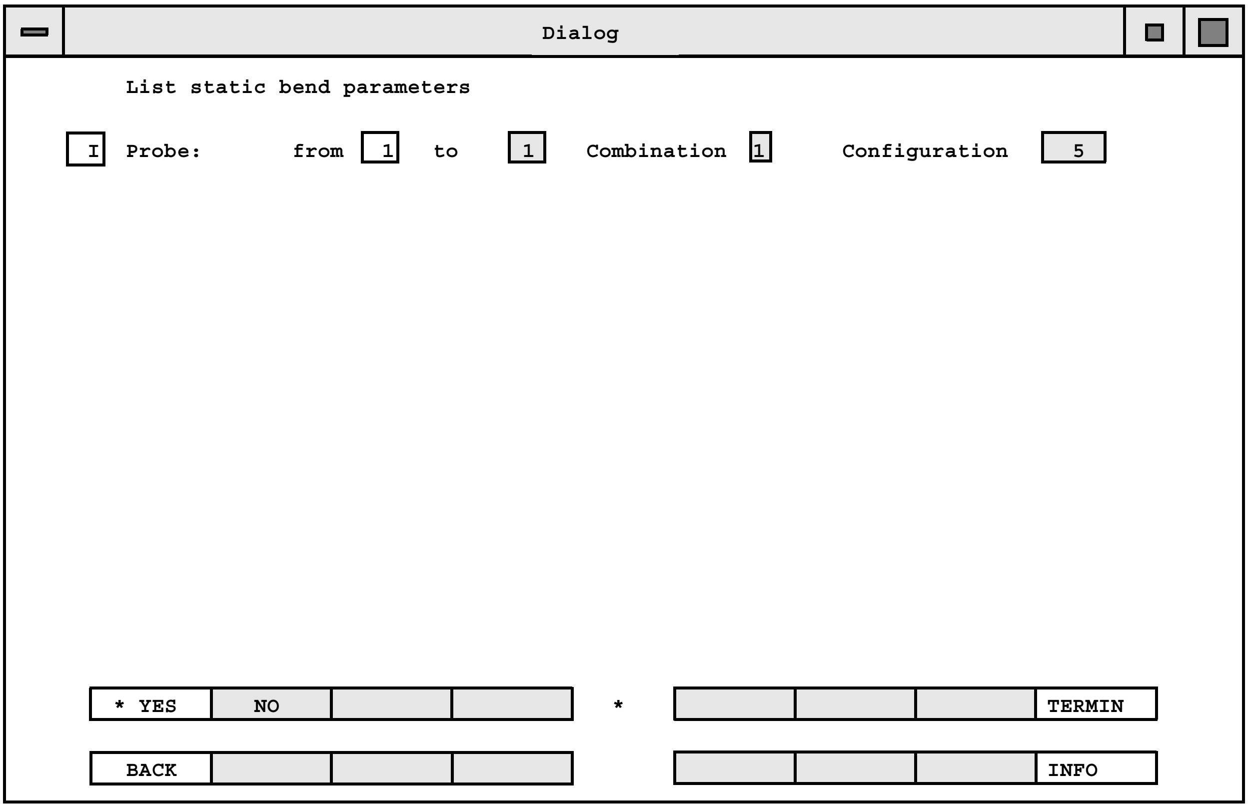
If the bend parameters already exist for the probe, the following message will appear in the above case:

Dynamic bending parameter for probe No. 21 already exists!

(2 = combination, 1 = probe number)

Output and deletion of bend parameters

Output of bend parameters <STATLIS>, <DYNLIS>



NOTE

Limit values for probes: 1 - 5

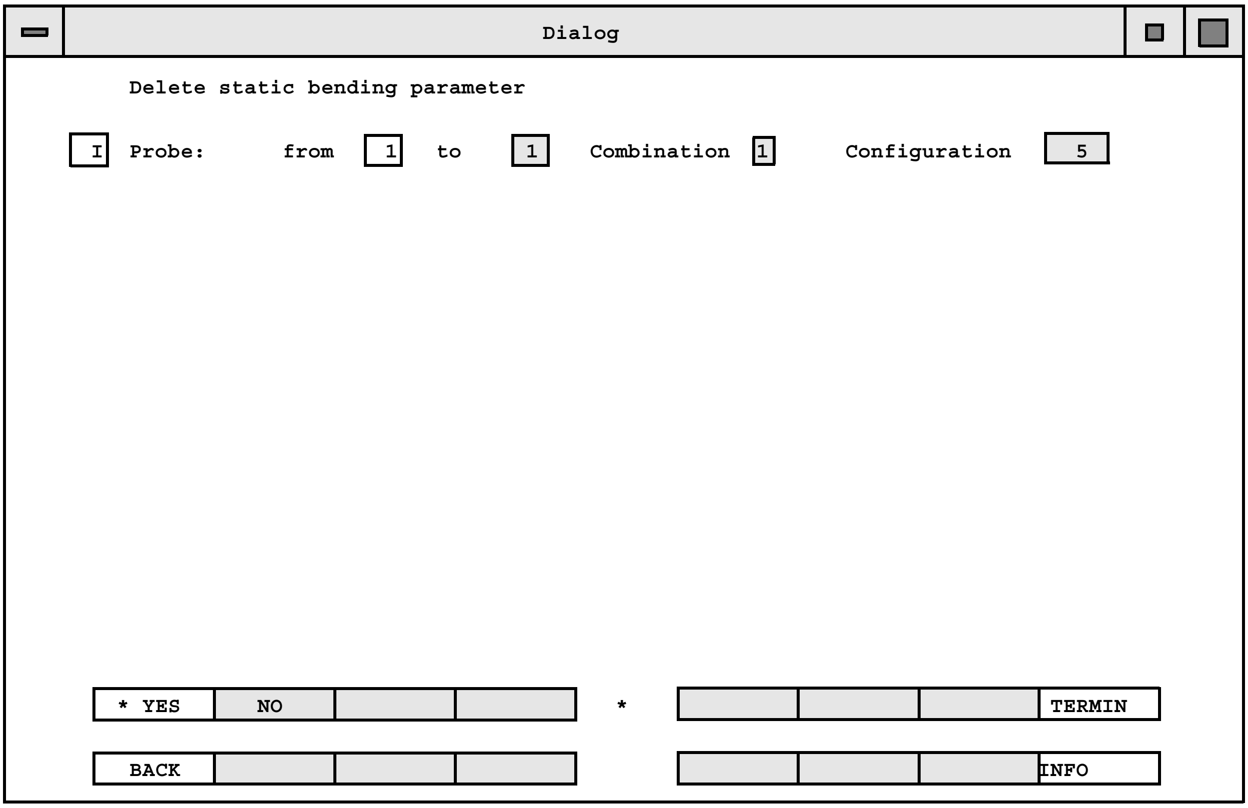
Limit values for combinations 1 - 9

Limit values for configurations 1 - 9999

If no bend parameters are stored, the following message will be displayed:

No static/dynamic bend parameters for probe 1 exist !

Deleting bend parameters <STATDEL>, <DYNDEL>



NOTE

Limit values for probes: 1 - 5

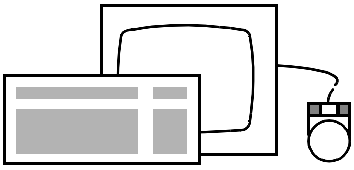
Limit values for combinations 1 - 9

Limit values for configurations 1 - 9999

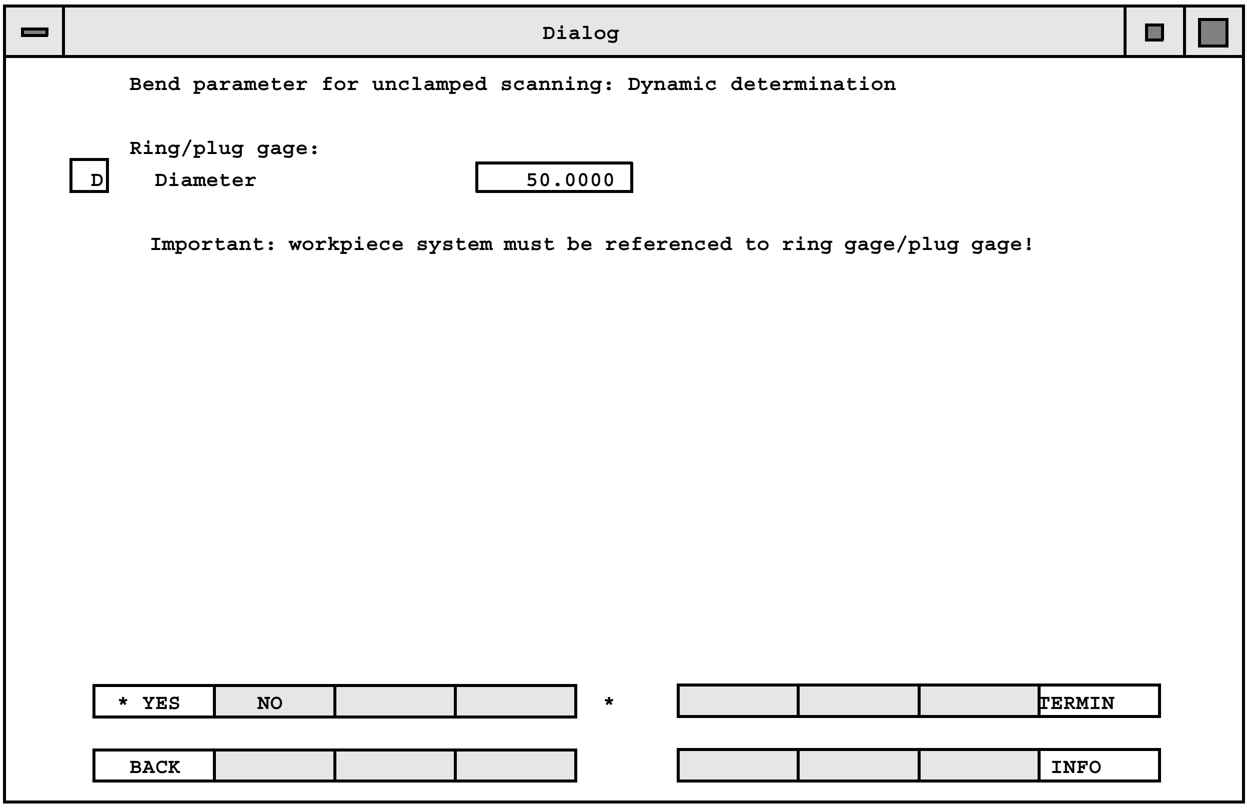
Determining bend parameters for unclamped scanning <DI 1184>

Application

This bend correction is required for high-accuracy measurement of circles at maximum scanning speed or if disk probes are to be used for unclamped scanning.



DI	Pull-Down-Menu	Pictogram
1184	Probe	
PBCDEF	calibrate unclamped	
	Determine HSS bend...	



Procedure

Operation	<DI>	Explanation
Calibrate the probe ball. or calibrate the disk.	**<15228>** **<6502>**	
Clamp the plug gage (ring gage) on the CMM and determine/align the work-piece coordinates		The diameter of the gage should correspond to the object to be measured later and the clamping location should correspond to the measurement location to be used later.
Determine the bend parameters for the unclamped probe head.	**<1184>**	
Call the circle element and scan the ring gage.	**<1104>**	The speed and step size should be selected the same way as for the workpiece later on.

The diameter measured is used as a basis for calculating the bend parameters.

Measuring with compensation of the probe bend <DI 1186>

Application

<DI 1186> can be used only for the measuring probe head. The probe bend can be compensated for the following geometric elements:

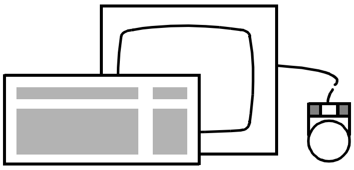
SURFACE, **CIRCLE**, **SPHERE**, **CYLINDER**, **CONE**, **TORUS**, **3D CIRCLE**, **3D POINT**, **NET POINT**.

For the **POINT** program, the probe bend is compensated without calling **<DI 1186>** (correction in direction of workpiece coordinate system).

When used in the unclamped operating mode, compensation is especially advantageous for very fast scanning of circles. A special calibration on a gage with **<DI 1184>** is required for this purpose.

NOTE

<DI 1186> must be called again for each new measured element (part feature).



DI	Pull-Down-Menu	Pictogram
1186	Probe	
PBC	calibrate unclamped	
	Include HSS bend	

The following message is displayed in the list and message window:

Probe bend correction with the next geometric element

NOTE

If **<DI 1186>** is used, geometric elements may be probed only with one probe. The scanning speed must correspond to the speed used during calibration to achieve optimum accuracy.

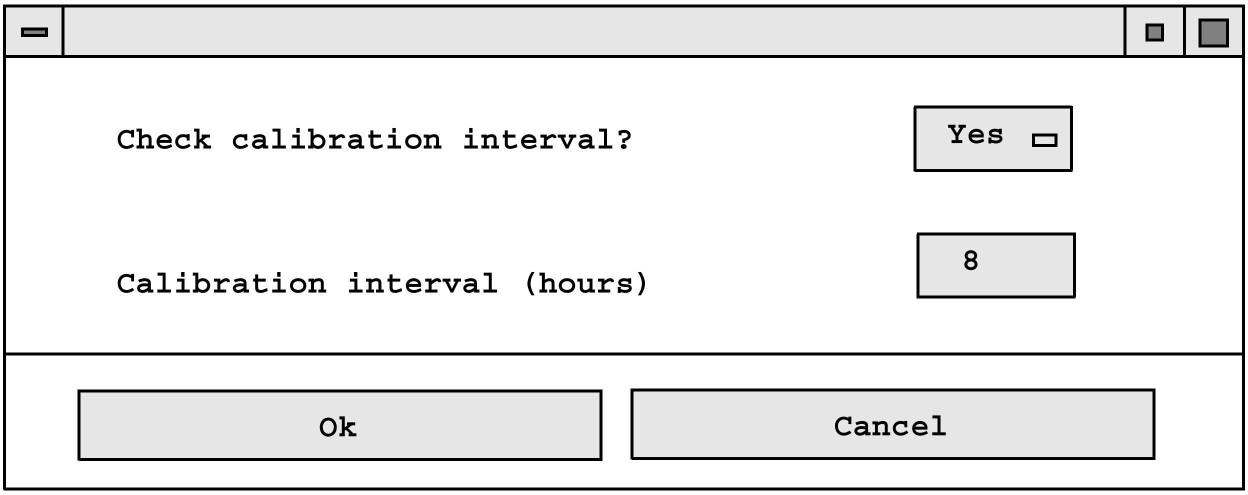
Comparison of methods

Calibration with **<DI 15228>**	Calibration with **<DI 1184>**, Measurement with **<DI 1186>**
- Correction performed automatically without an additional program call. - Can be used universally for – all measuring planes – inner and outer diameters – regardless of the diameter of the object being measured – at low and average scanning speeds (➤*„Semiautomatic probe calibration with <DI 15228> (tensor calibration)“ on page 7-19*)	Correction performed only after calling **<DI 1186>**. For high scanning speeds if the calibration was performed under the same conditions as the subsequent measurement (same speed, position in measuring volume, measuring plane, inner/outer diameter):

Checking the calibration at regular intervals <DI 1559>

Application

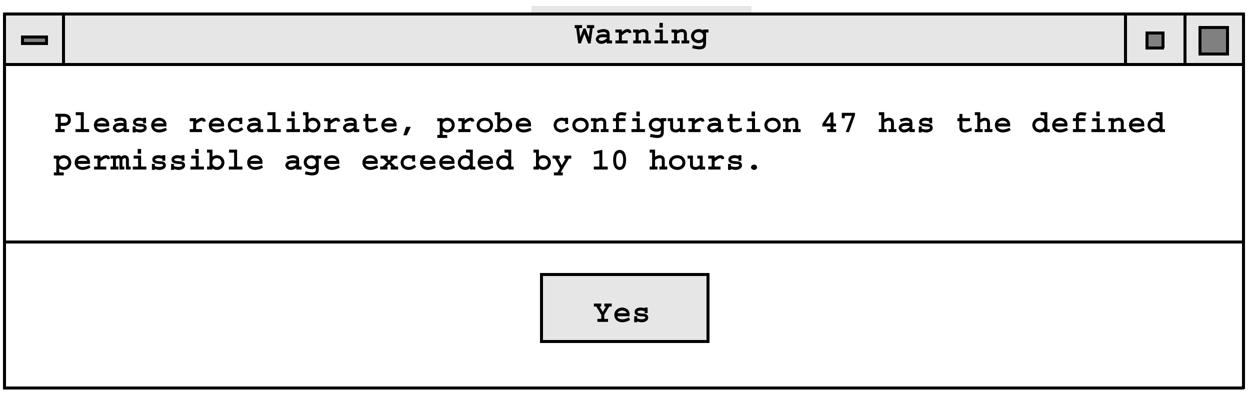
<DI 1559> is used to enter and activate or deactivate a calibration interval. The user can enter a time period after which a message will automatically appear prompting recalibration.



Function

This message is displayed each time the configuration concerned is changed.

It has no influence on the program run, i.e. it serves only to inform the user.



The above message disappears when the configuration in question has been recalibrated.

Chapter 8

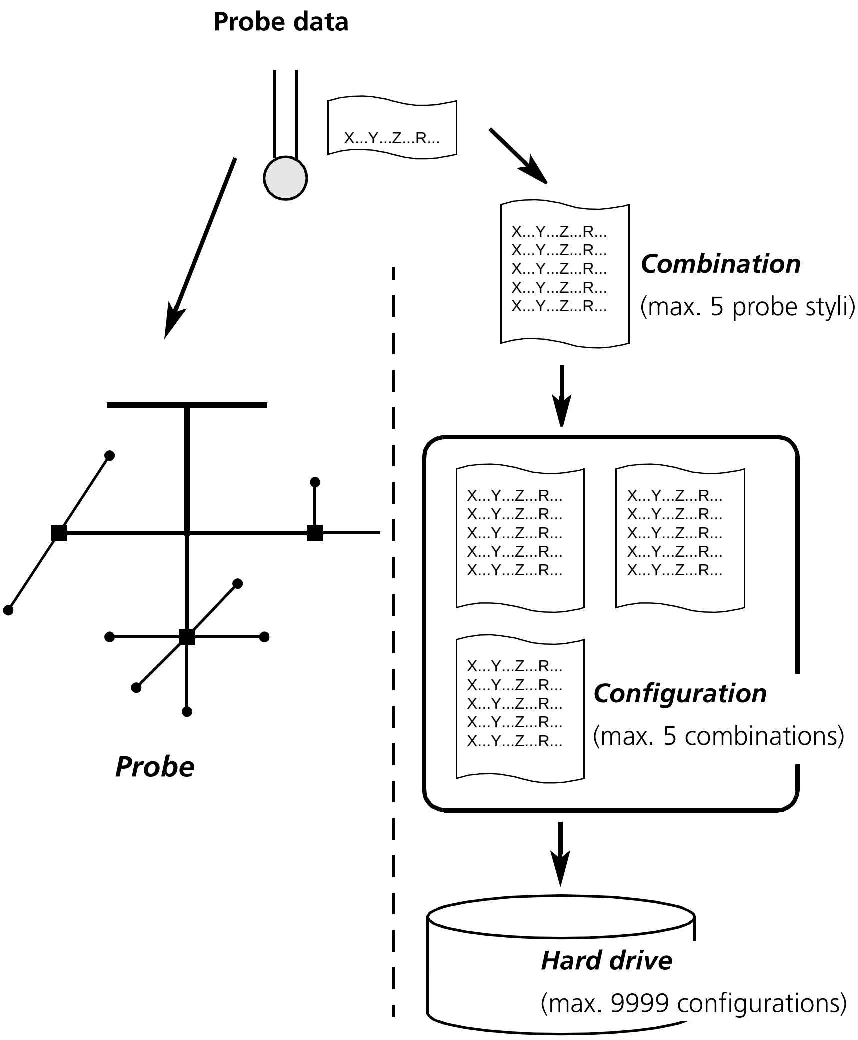
Administration of probe data/probe change

This chapter contains:

Terms

Probe

Individual probe styli can be combined *mechanically* to form any type of *probe* or *probe cluster* required. Restrictions apply only regarding the weight of the probe (especially for the RST).



Organization

The probe data is stored in UMESS according to a defined scheme:

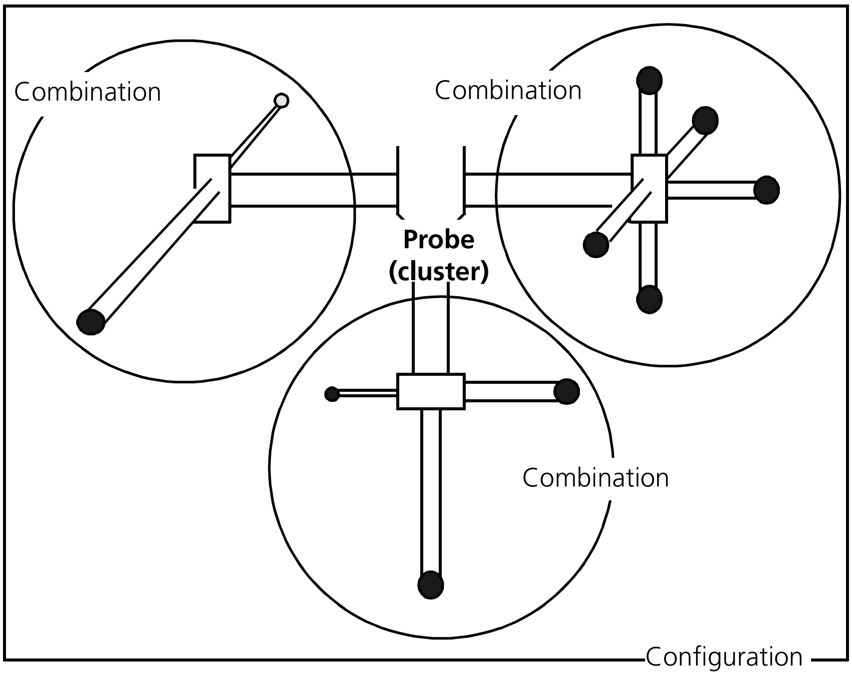
– A maximum of five probes are combined to form a **combination**

– A maximum of five combinations form a **configuration**

– A maximum of 9999 configurations can be stored (only configuration 1 exists for machines without a probe changer)

The terms **combination** and **configuration** therefore always refer to the probe data.

The term **probe or probe cluster** refers to the mechanical arrangement of the probes in the probe head or in the probe changer rack.



General

Without probe changer

In measuring machines not equipped with a probe changer, the probes or probe clusters (mechanical) and the configuration (data) automatically correspond to one another.

With probe changer

However, there are several different methods for storing the probe cluster data in measuring machines with a probe changer:

– The probe cluster data is stored as a single combination. The configuration comprises several probe clusters.

– The probe cluster data forms a configuration.

– The probe cluster data is stored under different configurations.

Select probe

Before the probing can actually takes place, the computer first must know which probe is requried.

This is done as follows:

Select configuration

<DI 1553>

➤ *„Automatic probe change <DI 1553>" on page 8-17* (automatic probe change)

or

<DI 1555>

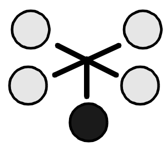
➤ *„Removing probes manually <DI 1554>" on page 8-12*(manual probe change)

Select combination

<DI 1601>

➤ *„Changing the combination <DI 1601>" on page 8-11*

Select probe

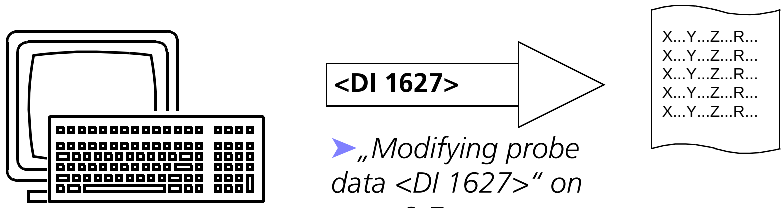


Selector switch on control panel

Administration

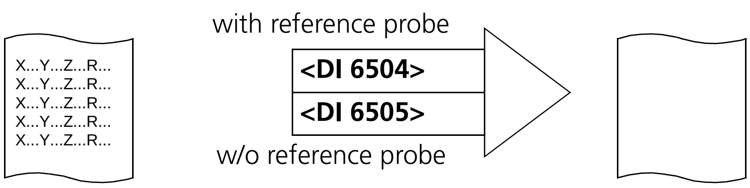
The following functions are available for administering the probe data:

Modify combination



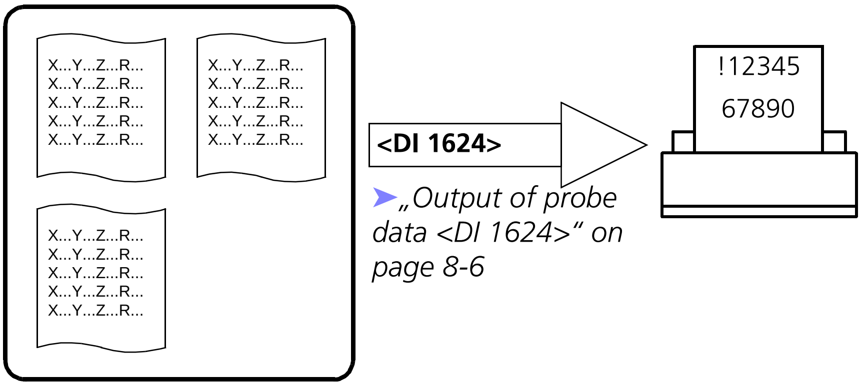
➤ *„Modifying probe data <DI 1627>" on page 8-7*

Delete combination



➤ *„Deleting and resetting probe data" on page 8-9*

List configuration

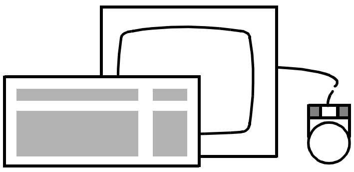


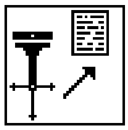
➤ *„Output of probe data <DI 1624>" on page 8-6*

Output of probe data <DI 1624>

Application

This function outputs the data of all calibrated probe styli in the complete current probe configuration to the record.



DI	Pull-Down-Menu	Pictogram
1624	**Probe**	
CONFLIS	**Data**	
a31	**list**	

Output

The following data is output:

- Combination number
- Probe number
- Center coordinates
- probe ball radii
- Measuring force used for calibration (not yet activated)
- Temperature of glass scale during calibration (not yet activated)
- Date of last calibration or manual input
- Standard deviation of calibration result
- Flag (static/dynamic) for the calibration method:
  Tensor calibration is indicated by a "+" in the 3rd position (- -+)

Example of a configuration list

Center coordinates of probe balls
Flag for calibration process
Combination number
Measuring force
Scale temperature
Probe number
Effect. probe ball radius
Standard deviation

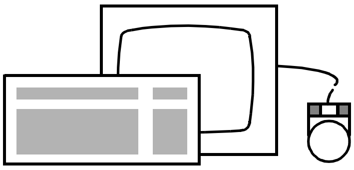
```
Configuration =   1

Co   no             Coordinates               Radius    Force   Temp.     Date      Dev     SD
==================================================================================================

1     1      0.0000     0.0000     0.0000     2.5080    0.0       20.0   16.7.1987  .0001   --+
1     2      0.8697    37.7008    36.4041     2.5097    0.0       20.0   16.7.1987  .0005   --+
1     3     37.6524     -.8423    40.1763     2.5097    0.0       20.0   16.7.1987  .0009   ---
1     4     -1.0258   -37.7045    36.2374     2.5095    0.0       20.0   16.7.1987  .0004   ---
1     5    -37.7127     1.0045    40.4668     2.5095    0.0       20.0   16.7.1987  .0007   ---

2     1      0.0000     0.0000     0.0000     4.0045    0.0       20.0   16.7.1987  .0002   ---
```

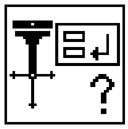
Modifying probe data <DI 1627>

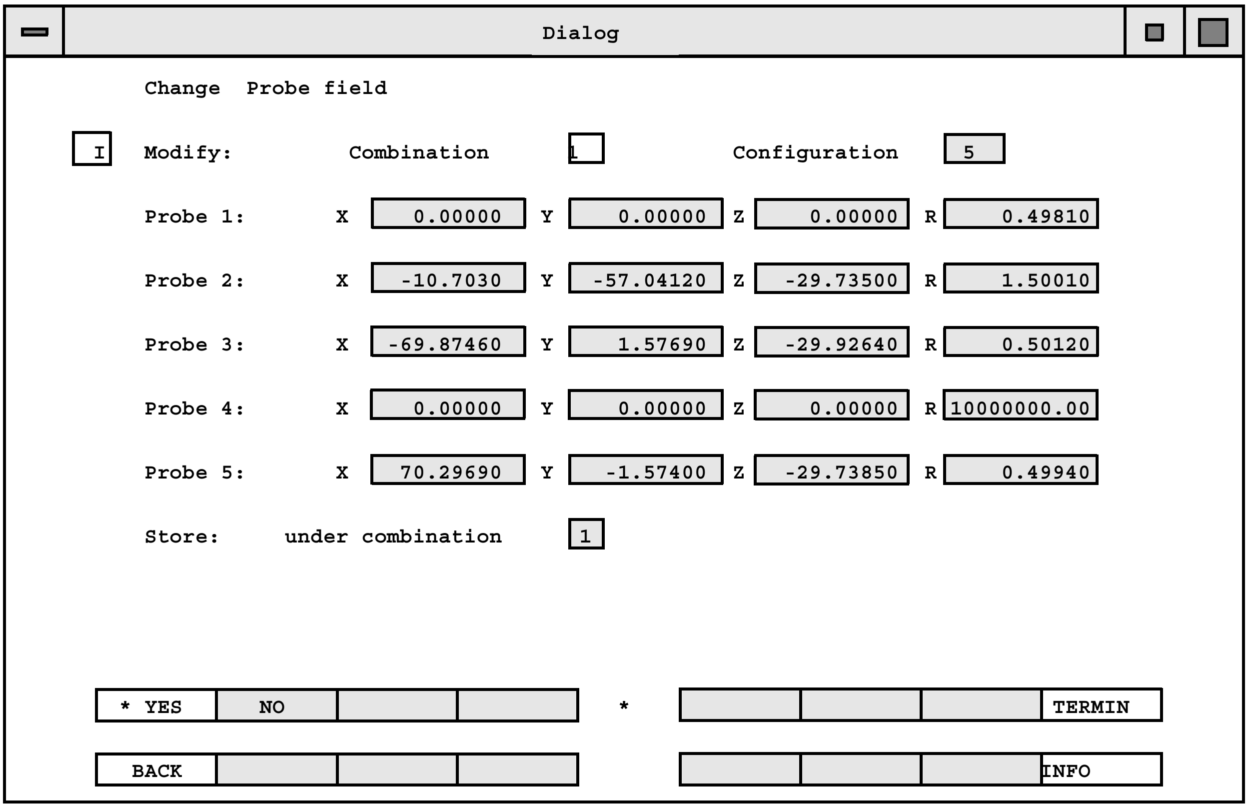
Application

In special cases, manual input or correction of the probe data may be necessary.

The data of the current combination can be modified with **<DI 1627>**.



DI	Pull-Down-Menu	Pictogram
1627	Probe	
PRBCORR	Data	
a32	modify...	



Application example

Correction of Z and R for a cylinder probe after calibrating it with the calibration standard (➤*„Recalibration with reference standards" on page 7-33*).

Changes

The activated data box is highlighted.

Only the number of the configuration is displayed.

The center coordinates and radii of the probe balls in the current combination are offered for modification.

Probes which have not been calibrated can be recognized by the radius displayed, i.e. 10000000.00

Modified data can be stored under another combination.

Deleting and resetting probe data

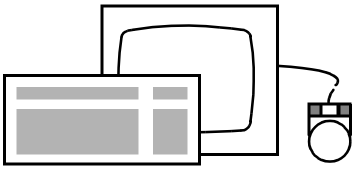
Application

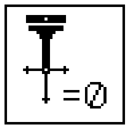
If a probe which has already been calibrated is recalibrated, the existing data will be overwritten; the data does *not* have to be deleted beforehand.

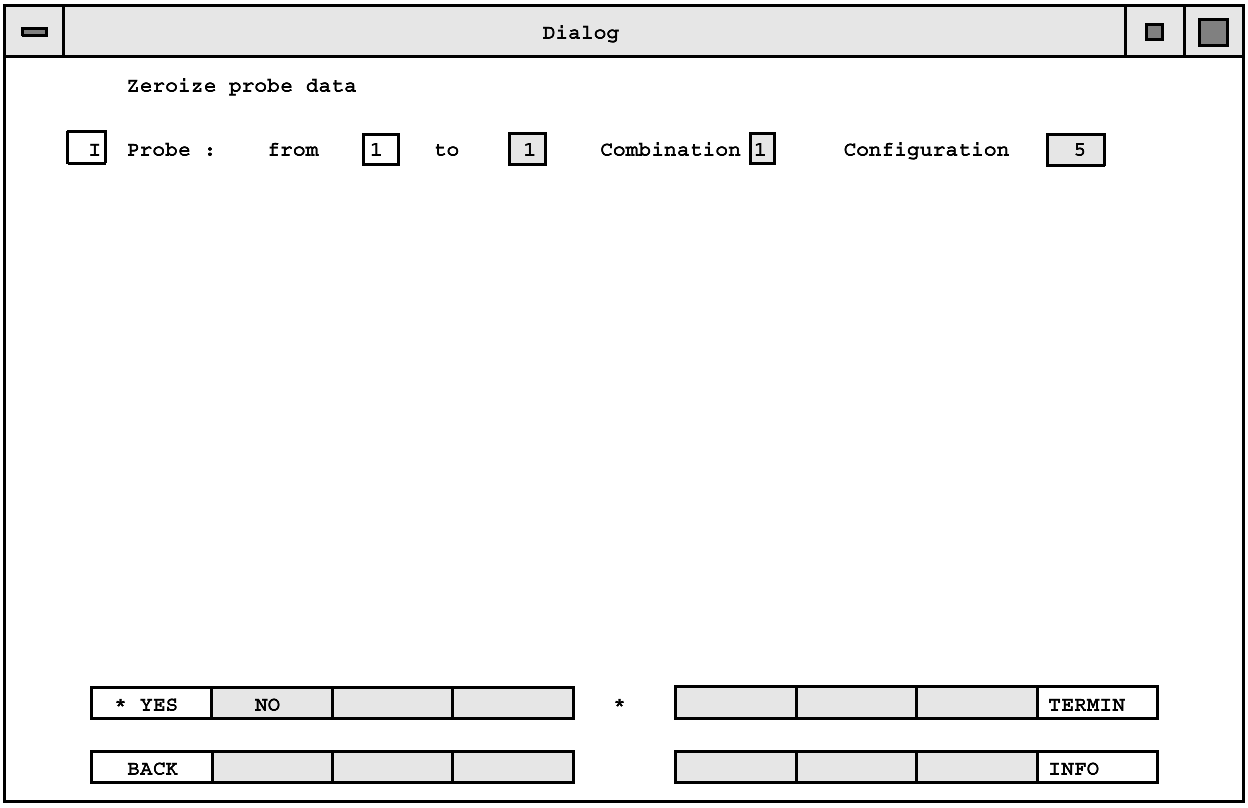
Resetting probe data (to zero) <DI 6505>

Application

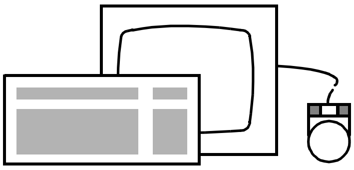
After starting this function, you can reset probes 1 to 5 of any combination and/or configuration to zero.

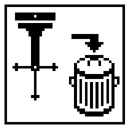


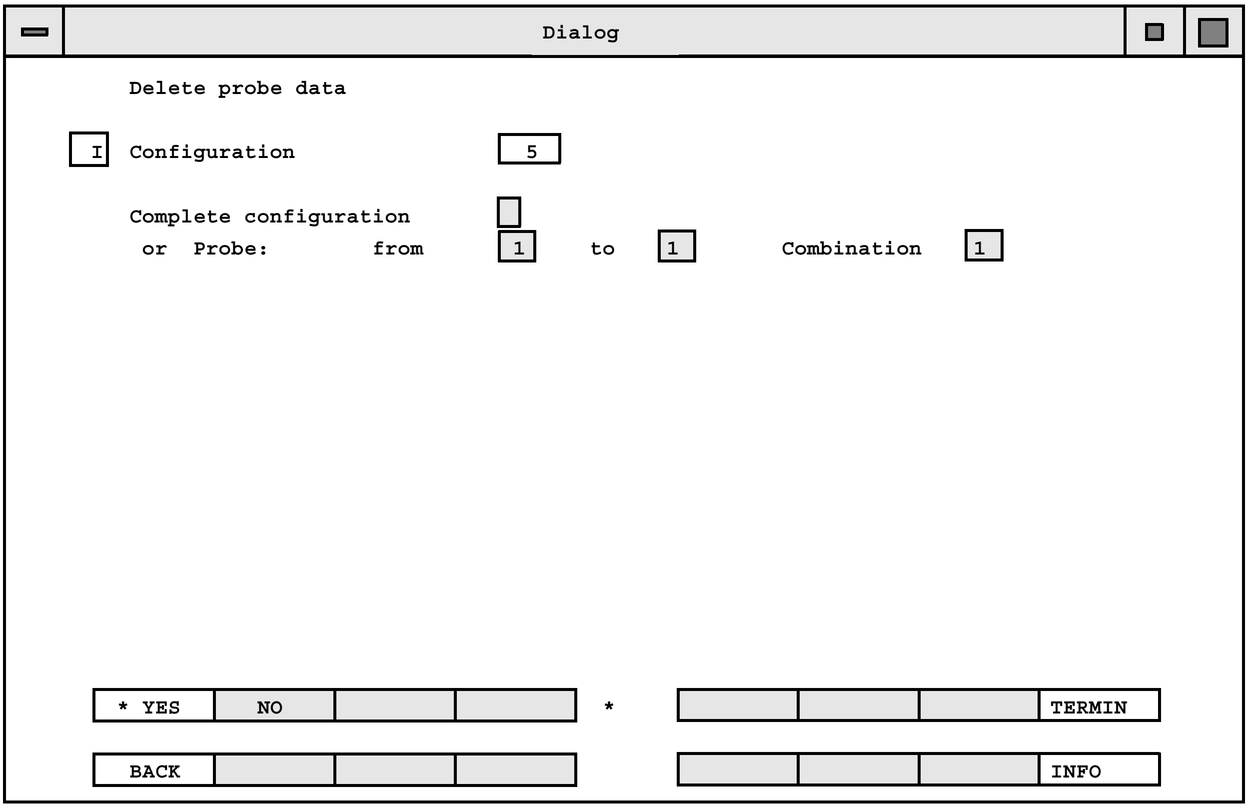
DI	Pull-Down-Menu	Pictogram
6505	Probe Data set to zero...	



Deleting probe data <DI 6504>



DI	Pull-Down-Menu	Pictogram
6504	Probe Data delete...	



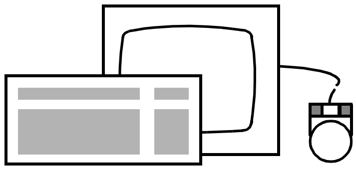
Application

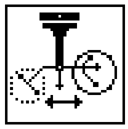
For CNC calibration if:

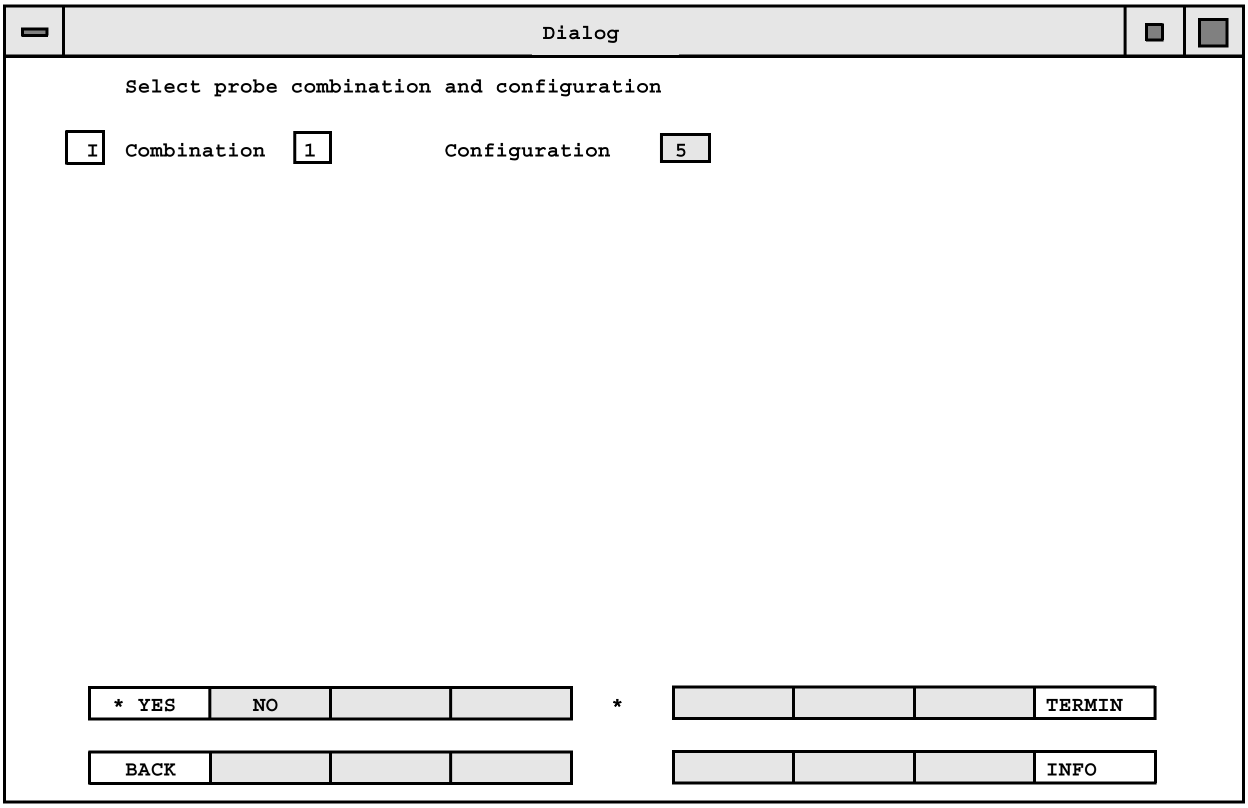
- A combination is to be recalibrated.
- Several combinations or configurations are to becalibrated during a CNC run.
- Individual probes have been unscrewed and removed from a configuration.
- The configuration is no longer required

Changing the combination <DI 1601>

Application The combination can be changed with **<DI 1601>**.



DI	Pull-Down-Menu	Pictogram
1601 CHNGCOMB a7	Probe select Combination...	



NOTE

– The configuration number can also be entered when changing probes (➤*„Changing probes“ on page 8-12*).
– Only configuration no. 1 exists for machines without a probe changer.
– The old configuration and combination will be reactivated following the next UMESS start.

Changing probes

NOTE Only for measuring machines with a probe changer!

Application

Assembled probe clusters can be exchanged without recalibration on coordinate measuring machines with a probe changer.

Options

Probes can be changed in two ways, i.e.:

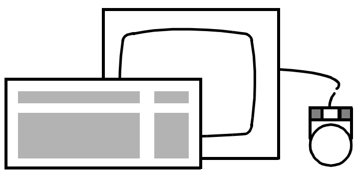
- manually (➤*„Removing probes manually <DI 1554>“ on page 8-12*) or
- automatically (➤*„Inserting probes manually <DI 1555>“ on page 8-15*)
  Automatic change requires a probe changer rack.

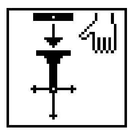
With a double trigger probe head the upper probe can be changed only manually.

Removing probes manually <DI 1554>

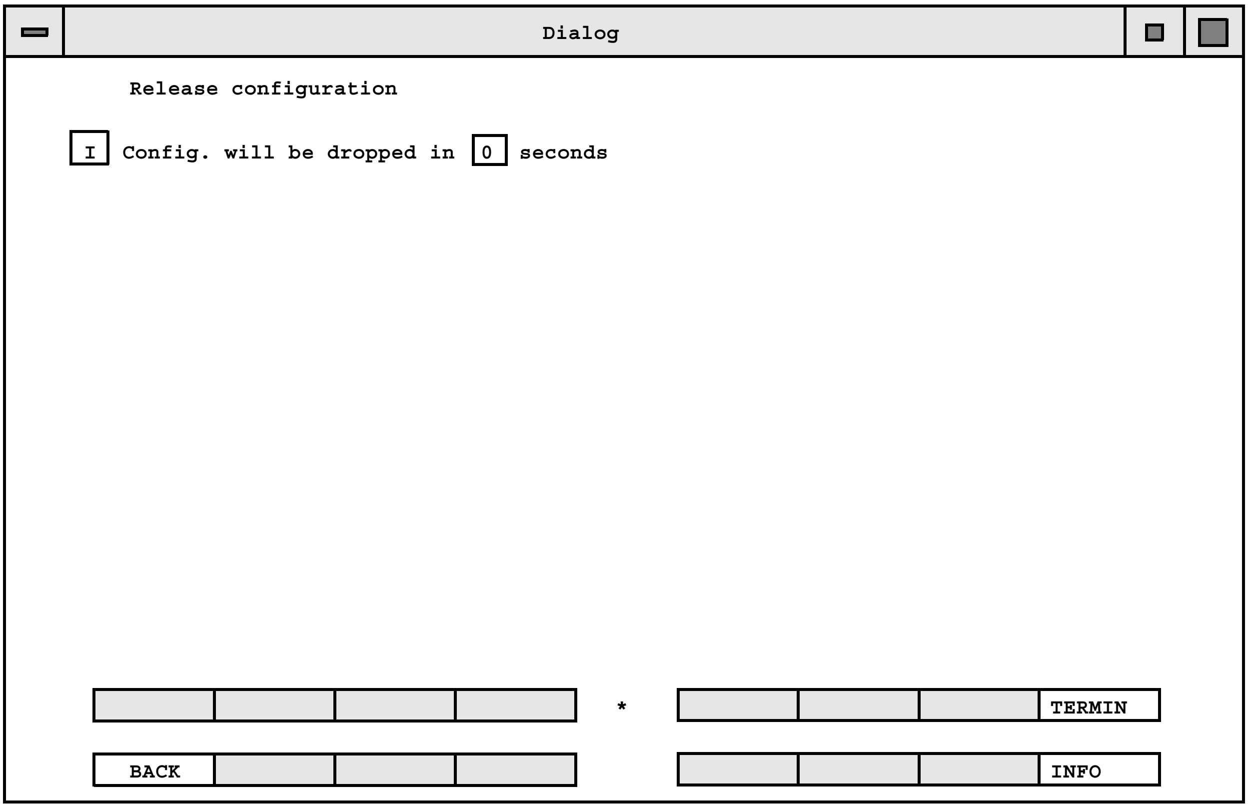
Application

You can call this function to enable manual removal of the configuration inserted in the probe head.



DI	Pull-Down-Menu	Pictogram
1554 RELPRB a179	Probe change remove...	

Dialog for the measuring probe head

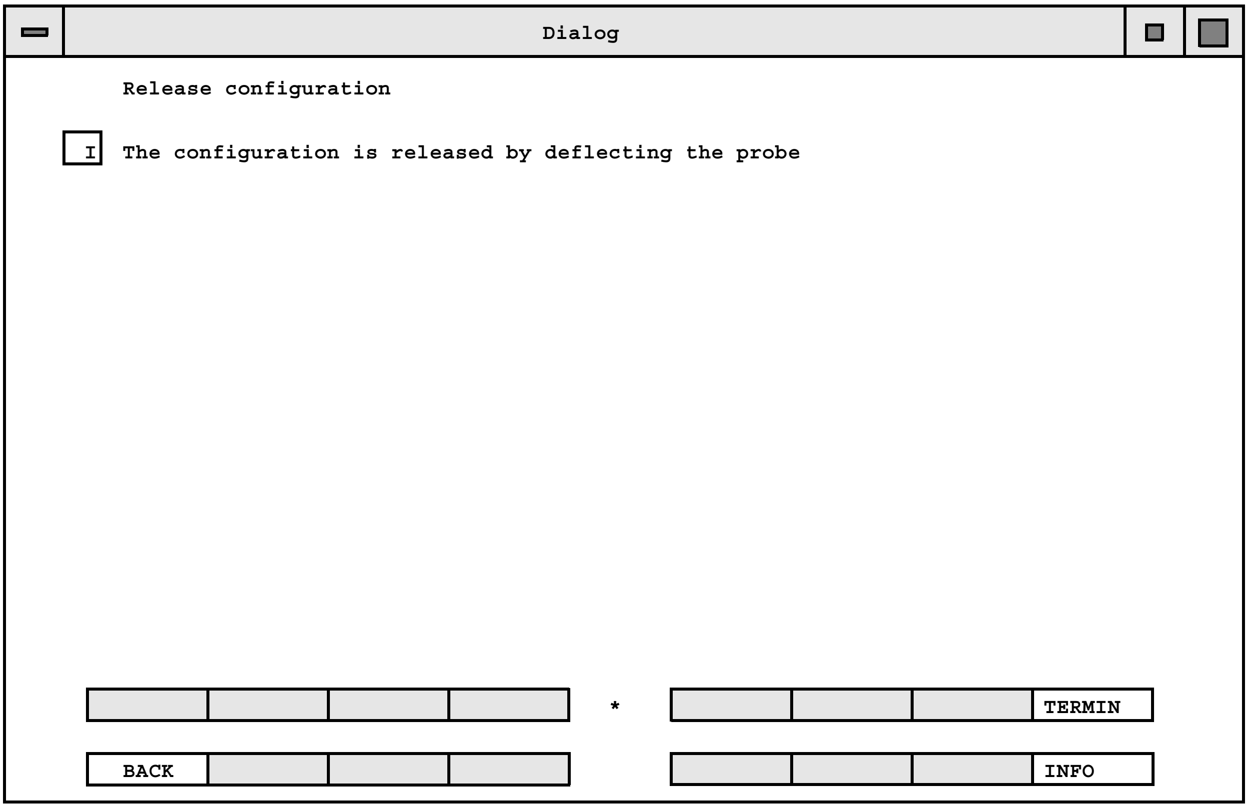


Application

The attracting force of the locking solenoid is deactivated ... seconds after **<TERMIN>** is selected. The probe can now be removed by pulling it downward gently.

Important!
The probe may fall out of the mount under the force of its own weight at the end of the waiting period (... seconds)!
You therefore must either make sure that the probe is located above a rack storage position or remove it by hand.

Dialog for the trigger probe head



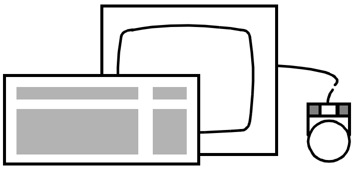
NOTE

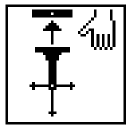
- This function can not be integrated in a learn (i.e. part) program.
- A probe changer mount should always be inserted in the probe head to protect against dirt.
- With a trigger probe head, the holding force of the locking solenoid is deactivated only after the probe head contact is actuated.
- If the dialog displayed does not match the probe head type, please check the probe head type setting with **<DI 1661> <DECISION>**.
- When using a double trigger probe head (probe head type 22) in **<DI 1661> <DECISION>**, the dialog will always ask whether the "top probe" is meant.

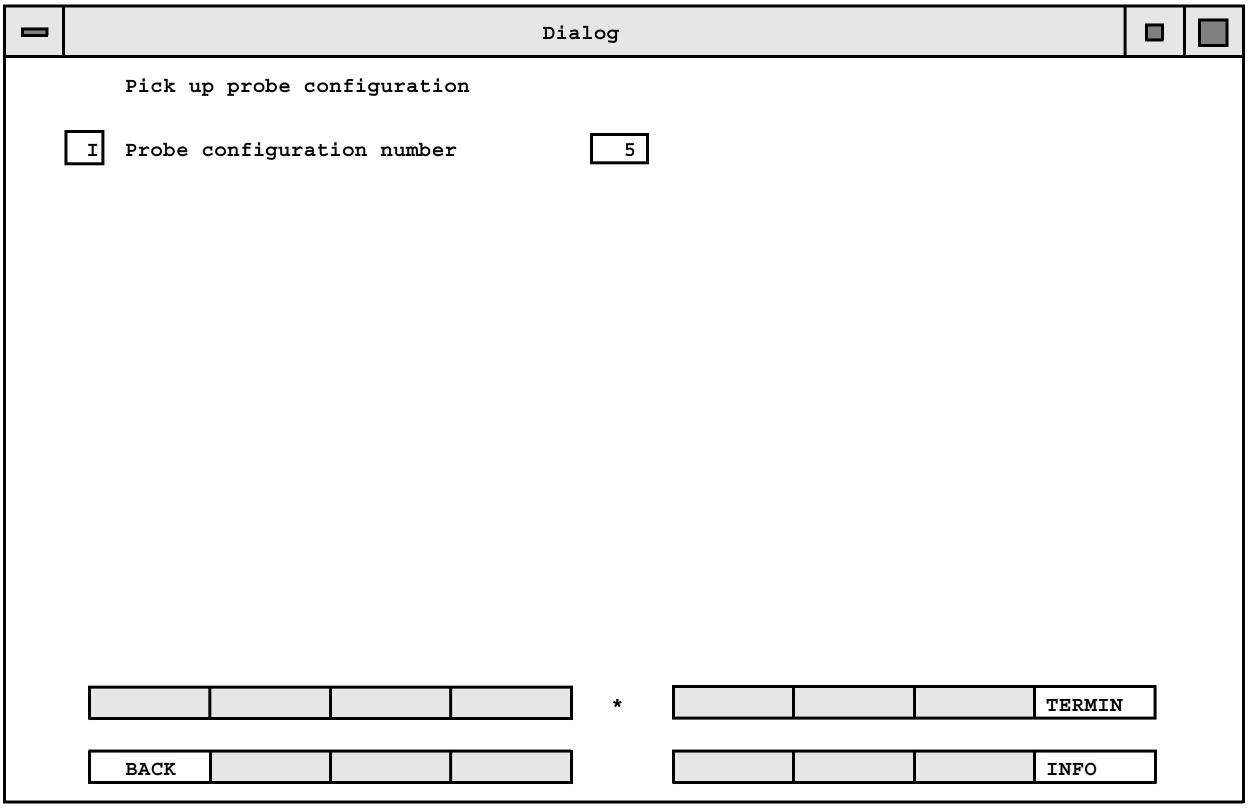
Inserting probes manually <DI 1555>

Application

This function can be used to insert a new probe (cluster) in the probe head. The corresponding configuration can be read-in simultaneously.



DI	Pull-Down-Menu	Pictogram
1555	Probe	
PUPPRB	change	
a181	insert...	



Explanation of Dialog

Probe configuration number

Here you must enter the number under which the calibration data of the probe being inserted is stored or should be stored on the hard drive. A maximum of 9999 configurations are possible.

Stored data

The data which has already been stored under this configuration number is read in to the computer; no renewed calibration is therefore required.

Data storage

During the following calibration procedure, the data measured is stored on the hard disk under this configuration number.

NOTE

To avoid confusion, all probes should be marked with the configuration number (e.g. with adhesive labels).

Features of the ST3 probe head with ATAC

Special balancing

With the ST3 probe head, you can adapt the balancing of the probe configuration inserted.

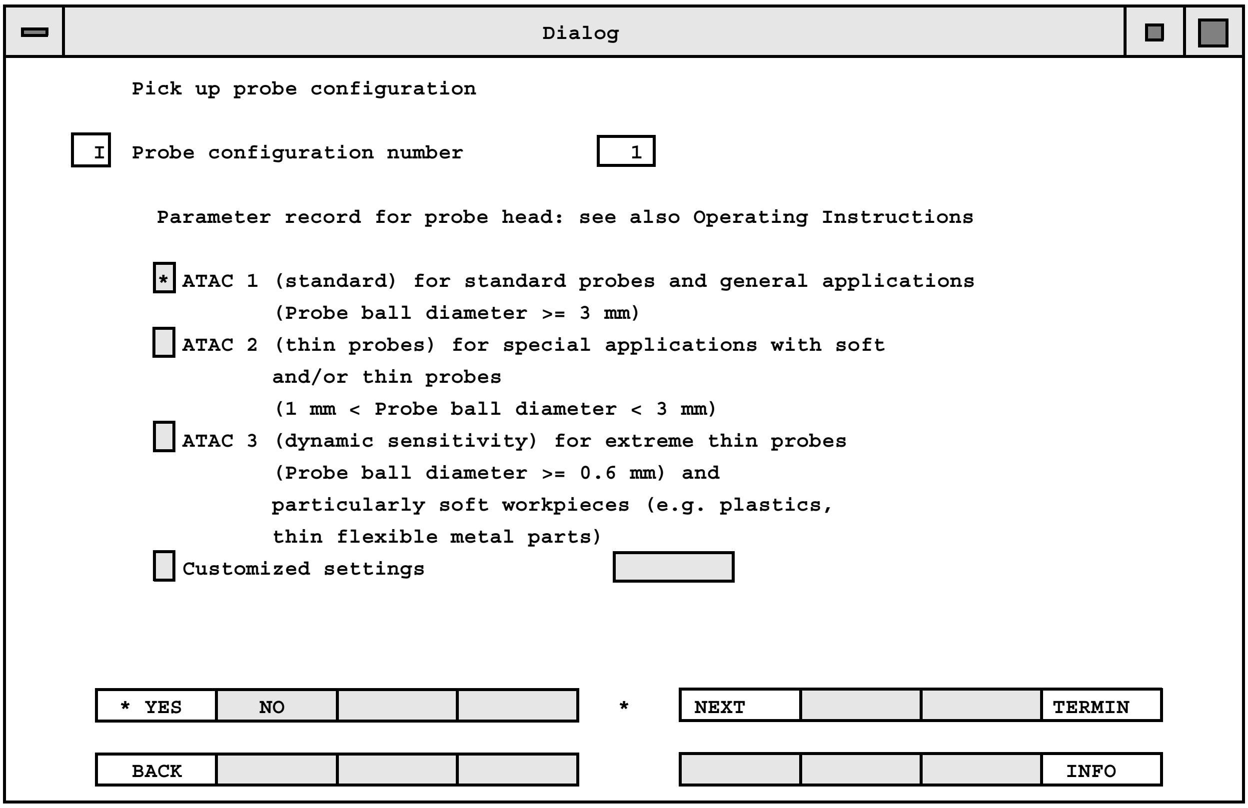
Depending on the type of probe configuration inserted (standard, soft or dynamic sensitivity), you can select a parameter record which contains the data for special balancing.

Customized settings

If you have a special probe configuration, the name of the corresponding parameter record will be displayed. The matching parameter record is supplied along with every special probe configuration.

Dialog window

The option of selecting a parameter record will be offered in the dialog window only if you have installed an ST3 probe head.



NEXT

If you have several different special probe configurations, you can select the corresponding parameter records in succession. The name of the current parameter record will be displayed.

Conventions for the filenames of ST3 parameter records

Customized settings

– **ST3SSTANDARD-B**
  Filename of a file with ST3 parameters for standard probe configurations

– **ST3-LENKGEH1-B**
  Filename of a file with ST3 parameters for special probe configurations

The filename of all ST3 parameter records starts with "ST3".

The fourth position in the filename specifies the type of ST3 parameter record.,

"**S**"	Parameter record for standard probe configurations (standard, soft or dynamic).
"**-**"	Parameter record for special probe configurations.

In the filename of the parameter record for special probe configurations, the following max. 8 positions up to the next "_" (here e.g.: **LENKGEH1**) are displayed as the name in the dialog window.

Directory

The files of the ST3 parameter records are stored in the directory **/home/zeiss/UC**.

Automatic probe change <DI 1553>

Application

<DI 1553> initiates automatic storage of the inserted probe configuration in and removal of a selected configuration from the probe changer rack.

Prerequisite

The probe socket position is defined (calibrated) (➤*„Defining the probe holder positions <DI 1557>“ on page 6-32*).

Assignment

If you fetch a configuration from or deposit it in a socket, the program will assign the socket and the configuration to one another.

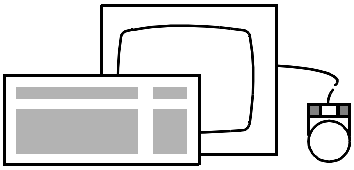
This assignment is retained until you define a new assignment or store the configuration manually.

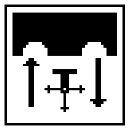
Intermediate positions

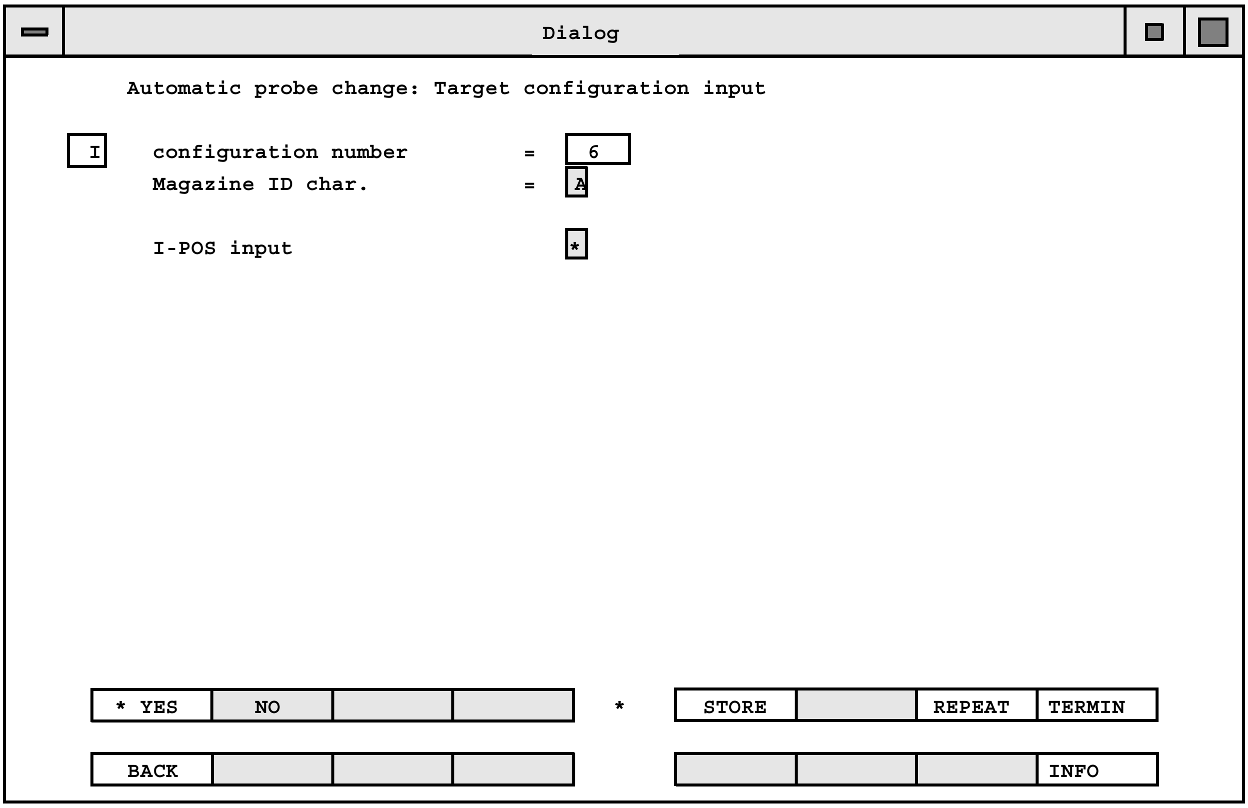
You can enter intermediate positions to move around obstacles on the way from one probe socket to another.

Procedure

If you want to store a configuration, the control must know the socket position. If you have already stored or fetched the configuration, a corresponding assignment has already been stored.



DI	Pull-Down-Menu	Pictogram
1553 PRBCHN a183	Probe change automatically...	



Data boxes

configuration number

The number of the configuration inserted in the probe head before probe change must be entered for orientation purposes. (If no configuration is inserted in the probe head, the box remains empty. If the number of the configuration inserted in the probe head is unknown, you will be prompted to enter it again manually).

Enter the number of the configuration which must be inserted in the probe head following probe change.

– The data previously stored under this configuration number is read into the computer. No required calibration is required following probe change.

– If probe calibration is subsequently performed, the data thus determined is stored on the hard drive under this configuration number.

Magazin ID char.

If a socket configuration assignment already exists and does not have to be changed, no entry is required. However, if no assignment has been made yet or the assignment must be changed, you can specify the letter corresponding to the socket where the required configuration is located.

I-POS input

<YES>

Dialog window for additional intermediate positions is called (see following pages).

Labeling

To avoid confusion, all probe clusters used should be marked (e.g. with adhesive labels).

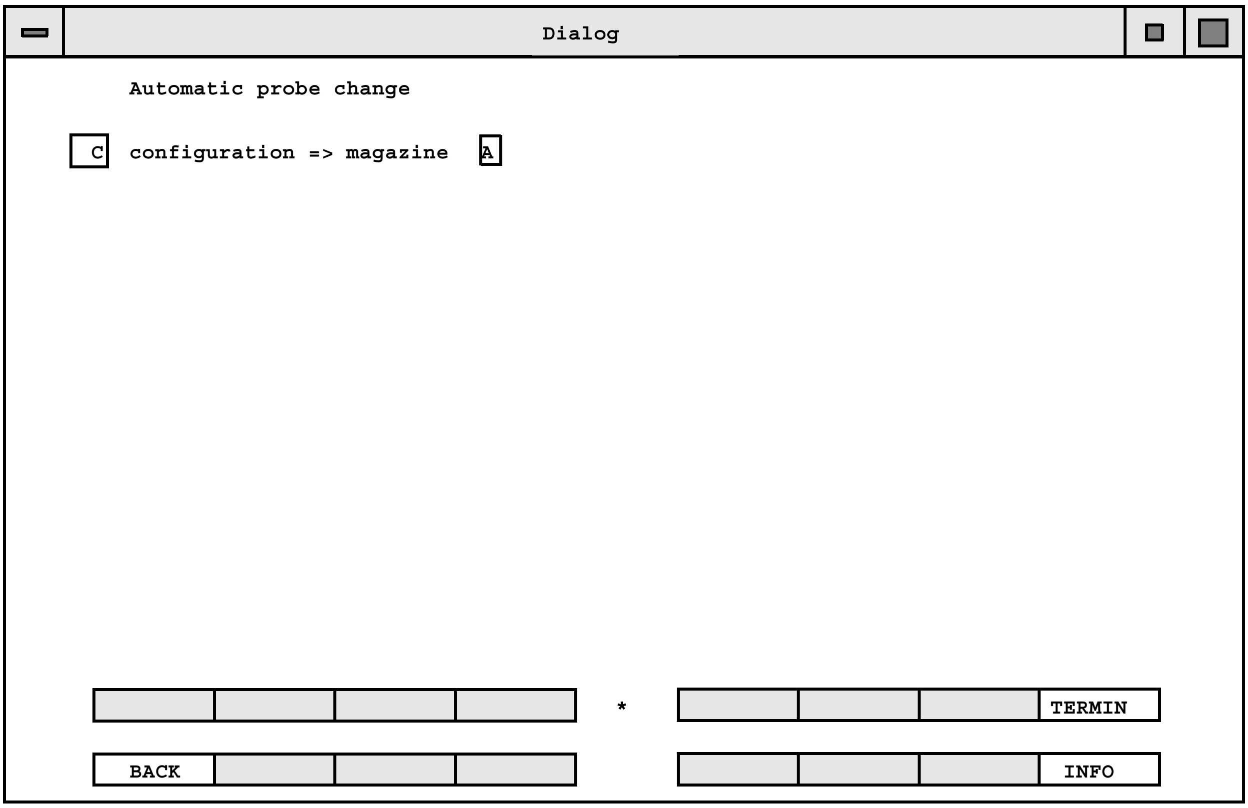
Softkeys

REPEAT

If you enter the configuration number and press **<REPEAT>**, the socket assigned to the configuration number will be displayed and vice versa if the box to be filled in is blank. In this way, you can easily check the socket-configuration assignment.

STORE

If no configuration-socket assignment exists, e.g. because the probe was inserted manually, the following dialog window sill appear and prompt you to enter the target storage location.



Data boxes

configuration => magazine

Enter the call letter of the socket in which the configuration is to be stored. If you then acknowledge with **<TERMIN>,** the **Automatic probe change** dialog described above will be displayed.

Examples of error messages

Example 1

Configuration 1 was stored manually in socket C. This means that the program has not yet fetched it from or deposited it in a socket (and therefore no assignment exists).

Case 1: No storage socket has been specified.

- Error message: **This confiugration has not been assigned to a socket.**
- Remedy: Enter **C i**n the **Magazine ID char.** box.

Case 2: Socket C has been entered in the **Magazine ID char.** box. However, this call letter has already been allocated to configuration 6.

- Error message: **Conf. 6 is entered in socket C, please confirm new allocation**.
- Remedy: Press **<TERMIN>** again. Configuration 1 is entered for socket C. Configuration 6 is no longer allocated to a socket.

Example 2

Configuration 1 has been stored in another socket by hand (e.g. old socket = F, new socket = A). It is therefore still assigned to socket F.

Case 1: An input is made specifying only the configuration.

- Error: If another configuration is deposited in socket F, the program will then fetch this configuration as configuration 1 along with the corresponding probe data.
- Remedy: If the configuration has been moved, the new storage socket also must be specified!

Case 2: Socket A is specified, but no configuration was previously stored there.

- Error message: **Conf. 1 is entered in socket F, please confirm new allocation.**
- Remedy: Press **<TERMIN>** again. Configuration 1 is entered for socket A and deleted from socket F.

Case 3: Socket A is specified. Configuration 6 was formerly stored in socket A.

- Error message: **Conf. 1 is entered in socket F, socket A has conf. 6.**
- Remedy: Press **<TERMIN>** again. Configuration 1 is entered for socket A and deleted from socket F. Conf. 6 is no longer allocated to a socket.

Input of intermediate positions

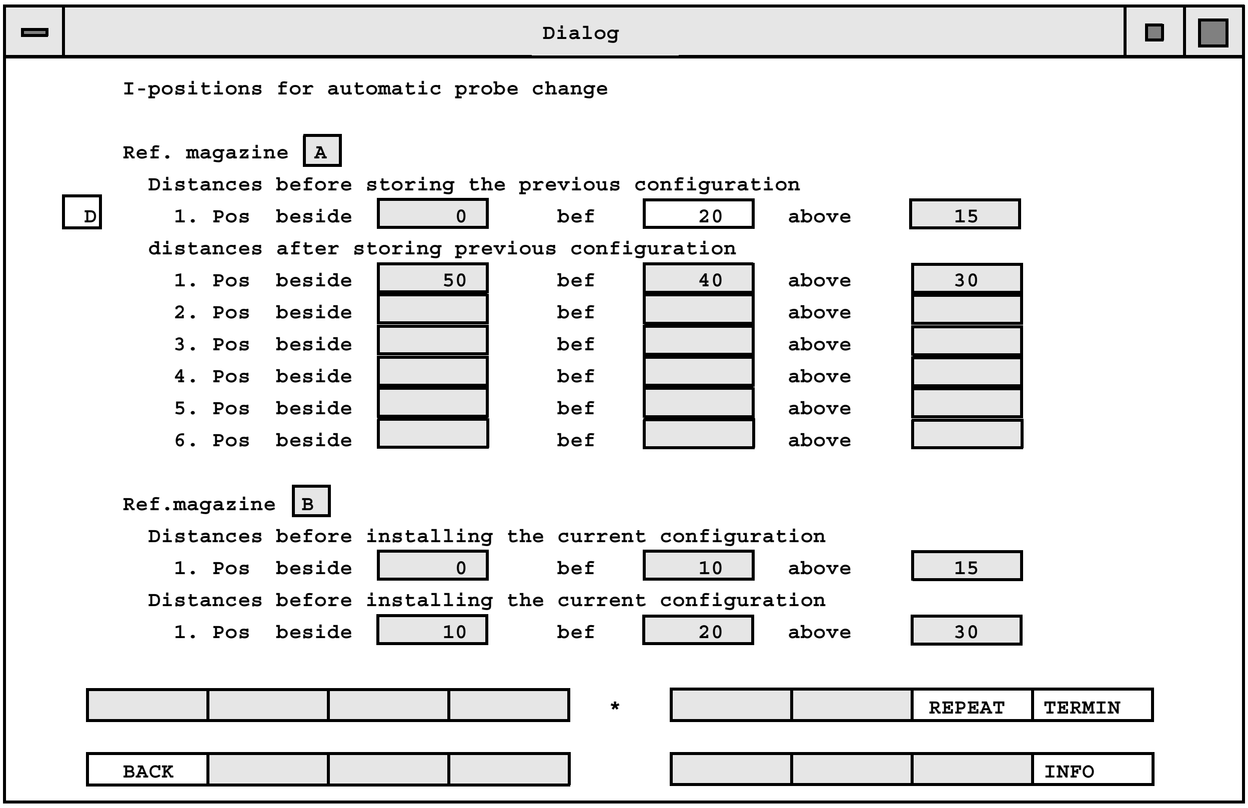
Automatic probe change is a closed function. For this reason, you can not program intermediate positions with I-POS (➤*„Intermediate position <I-Pos> in the W-position system" on page 16-31*) if the machine travels from one socket to another. If you nevertheless must by-pass obstacles, you can define intermediate positions relative to the sockets.

Function call

If you enter **<YES>** for

I-POS input in the **Automatic probe change** window,

the following dialog window will be displayed.



Data boxes

Ref. magazine

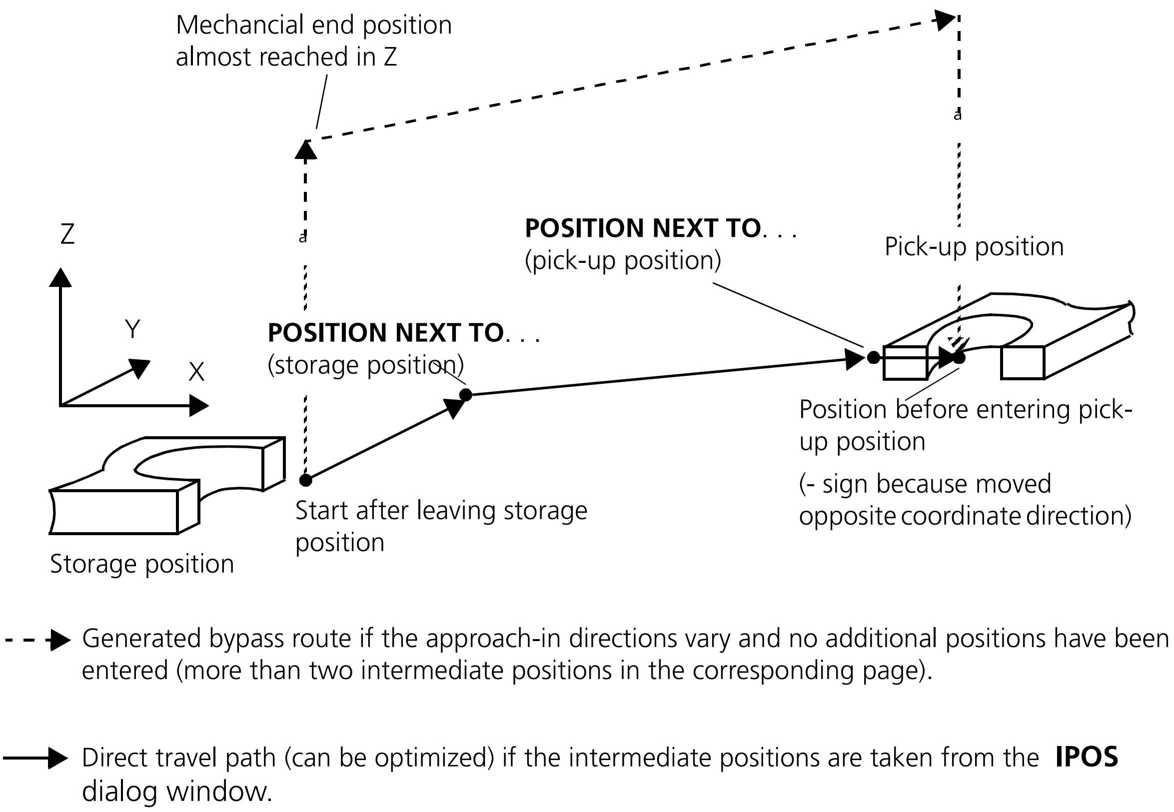
The first reference socket is the one in which you stored the configuration currently inserted in the probe head.

The second reference socket is the one from which the new configuration will be fetched.

Distances before storing the previous configuration, distances after storing previous configuration

The distances between the first and/or last intermediate position refer to the interval before storing or after picking up the configuration, and can be supplemented by intermediate positions outside of the automatic probe changer rack. You can not enter a distance beside the socket for the first intermediate position.

If you want to enter one or more intermediate positions after storing the probe, an intermediate position will also be requested prior to probe pick-up. If you enter no intermediate position after probe storage, you will not be able to enter an intermediate position prior to pick-up either.



The current position referenced to the sockets concerned is displayed.

The distances **bef.** and **above** socket A are in the first intermediate position. The distance **beside** socket A is in the second intermediate position.

The distances **bef.** and **above** socket B are in the last intermediate position. The distance **beside** socket B is in the next to last intermediate position.

The probes stored and picked up during a CNC run must be identical to the corresponding probes in the learn (part) program. To prevent complications, the first probe change should always be programmed. with **POSITION NEXT TO = 0**.

Control data

The control data for a probe change comprises at least 4 lines:

Line 1:	Information specifying probe to be picked up.
Line 2:	Intermediate position before storage position (correspon-ding to input for **DISTANCE. . .BEF. . ./HEIGHT. . .ABOVE. . .**).
Line 3:	Same as line 2, only for intermediate position after storage position.
Line 4:	Generation of a combination change (temporarily still required).

Values ≠ 0 entered in the **IPOS** page produce additional control data lines between lines 2 and 3. These additional lines can be modified with the control data editor to optimize the travel path.

The following is possible:

– At least 1, max. 6 lines (additional lines can be created e.g. by copying) for position(s) referenced to the socket after the probe is stored and

– Max. 1 line for the position referenced to the pick-up position before probe pick-up. If 1 or more lines have been entered with the positions referenced to the storage position after probe storage, this line must be programmed. The user is automatically prompted to enter this line.

  Be careful when correcting the control data:

  If you use more than two position lines, there must be a total of at least four. The next to last line refers to the position referenced to the pick-up position before probe pick-up.

Format of position information:

1st word	Position next to socket;
2nd word	Position in front of socket;
3rd Wort	Position above socket.

Important::
The empty probe head has no collision protection!
Extreme care should be taken when modifying the control data in order to prevent damage to the machine resulting from a collision.

Chapter 9

Mathematical alignment

This chapter contains:

Coordinate systems

A general distinction is made between the following types of coordinate system:

The machine coordinate system

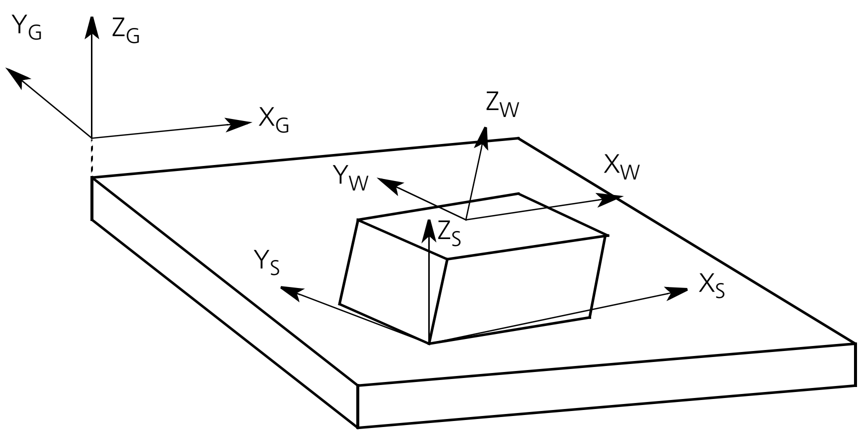
- comprises the coordinates X_G, Y_G, $Z_{G,}$
- is embodied by the mechanical construction of the measuring machine,
- can not be changed.

The workpiece coordinate system

- comprises the coordinates X_W, Y_W, $Z_{W,}$
- is used to form the measured value,
- can be rotated and moved according to the drawing requirement.

The control coordinate system

- comprises coordinates X_S, Y_S, $Z_{S,}$
- is used as a reference for travel and probing movments during an automatic measuring run,
- is formed from any workpiece coordinate system by calling **<W-POS>**.

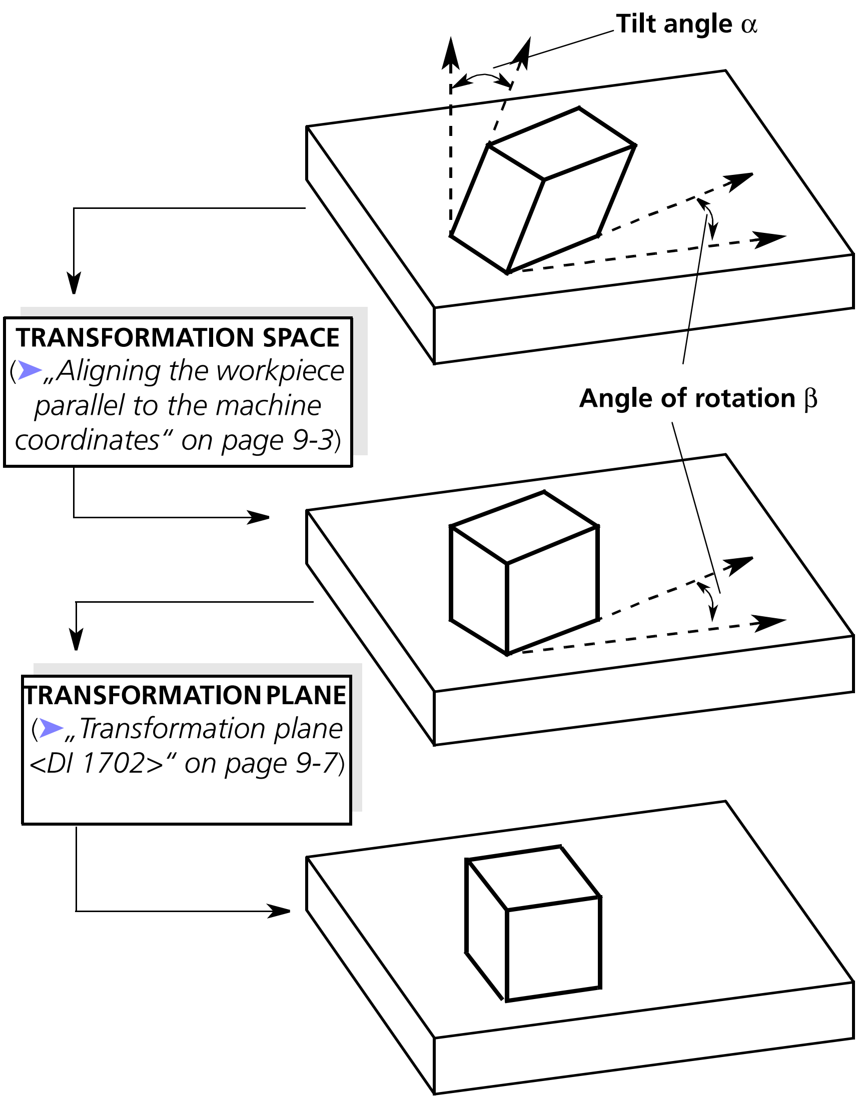


Aligning the workpiece parallel to the machine coordinates

Application

The workpiece to be measured can be clamped on the table of the measuring machine in an inclined or rotated position. The position of the workpiece in reference to the machine axes must therefore be defined before beginning a measurement. The workpiece is mathematically tilted and rotated until specific geometric elements are positioned parallel to the machine axes.

Recommended procedure for mathematical alignment of a workpiece:



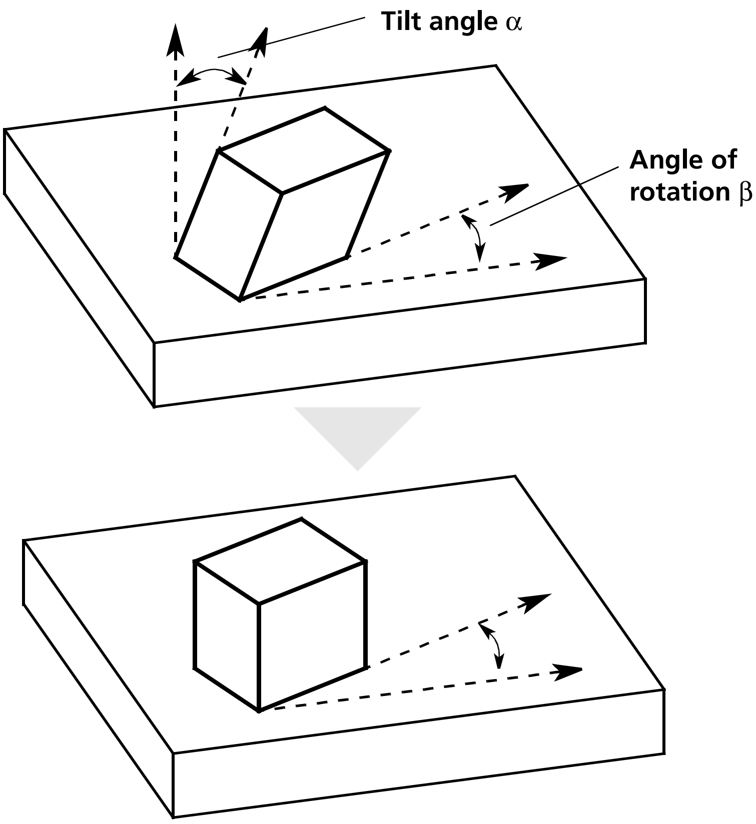
Remarks

- Despite the subsequent mathematical alignment, you must mechanically align the workpiece as precisely as possible when clamping it in order to prevent "shaft probings".
- No TILTING of the workpiece coordinate system is required when measuring flat workpieces clamped parallel to the machine table.
- No ROTATION of the workpiece is required for parts which have a rotationally symmetric shape and are measured only in the direction of the rotational axis.

Transformation space <DI 1706>

Main direction

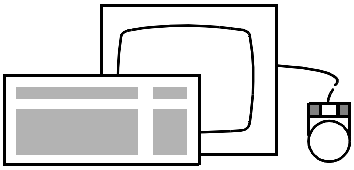
Defines the "main direction" (as per DIN 32 880). The last element in the measuring record is mathematically tilted so that it lies parallel to a machine axis. This machine axis thus becomes the space axis.

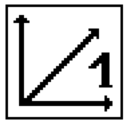


Prerequisite

– The last element in the measurement record is spatially (three dimensionally) defined or

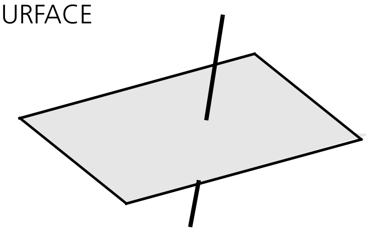
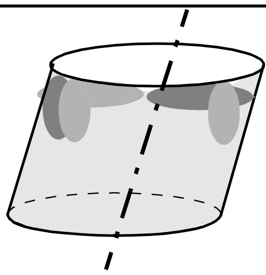
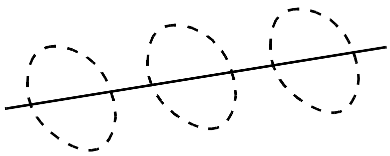
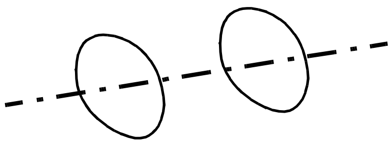
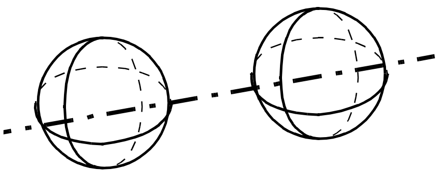
– The computer can form a spatially defined element from the last two elements in the measurement record (examples on next page).



DI	Pull-Down-Menu	Pictogram
1706	Coord	
TRSPACE	Space axis	
	define	

Examples

The following table shows elements suitable for the application of **<RO SPACE>**:

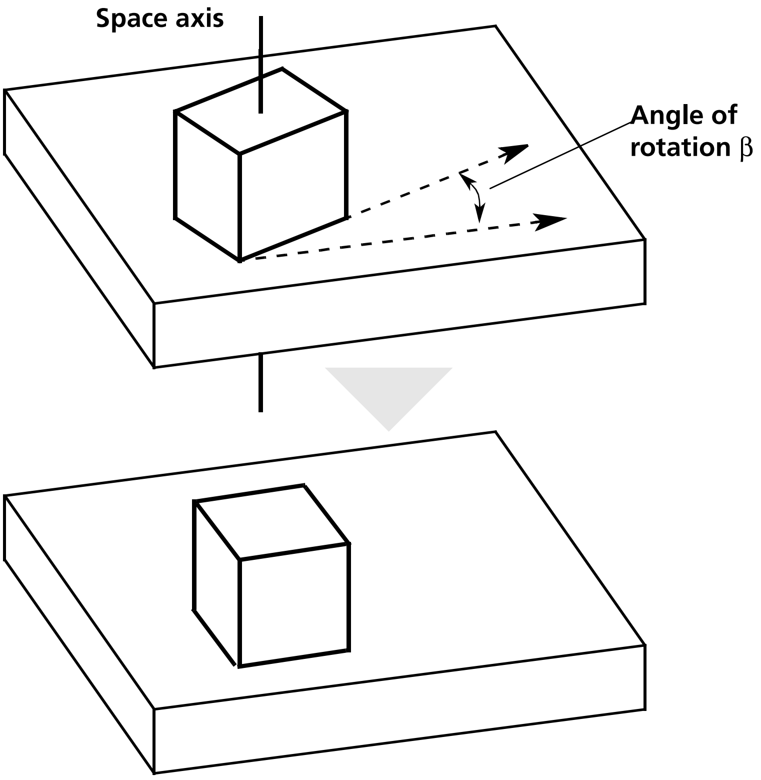
Example	Step sequence	Aligned
SURFACE 	**<SURFACE>** **<RO SPACE>**	Surface normal
CYLINDER / CONE 	**<CYLINDER>** **(<CONE>)** **<RO SPACE>**	Cylinder/cone axis
LINE (e.g. calculated via multiple ellipses) 	**<RECALL>** **(<LINE>)** **<RO SPACE>**	Line
ELLIPSE / ELLIPSE (measured in *one* cylinder/cone) 	**<ELLIPSE>** **<ELLIPSE>** **<RO SPACE>**	Connecting line between ellipse center points (cylinder/cone axis)
SPHERE / SPHERE 	**<SPHERE>** **<SPHERE>** **<RO SPACE>**	Connecting line between sphere center points

Transformation plane <DI 1702>

Secondary direction

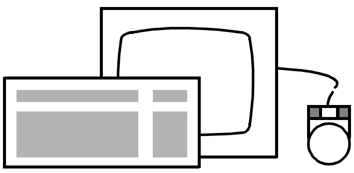
Defines the "secondary direction" (as per DIN 32 880).

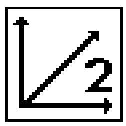
The last element in the measurement record is rotated mathematically about the space axis so that it lies parallel to a machine axis.



Prerequisite

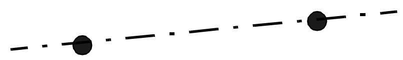
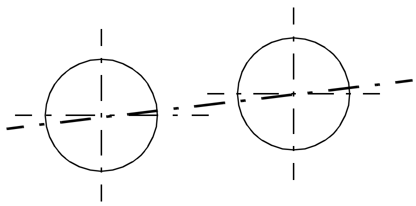
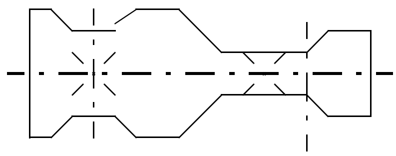
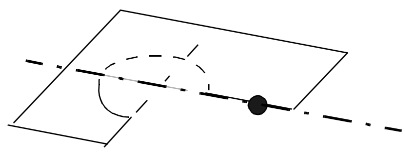
- The last element in the measuring record contains a 3D or 2D defined axis or
- the computer can form a 3D or 2D defined axis from the last two elements in the measuring record. This axis must not lie parallel to the space axis!



DI	Pull-Down-Menu	Pictogram
1702	Coord	
TRPLANE	Plane transf.	
	Rotate plane	

Examples

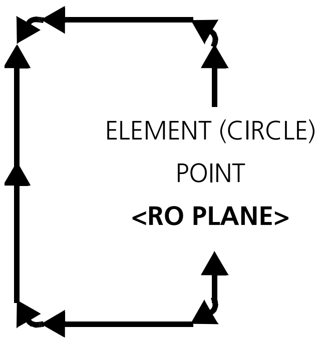
The following table shows examples of combined geometric elements for which the **<RO PLANE>** function can be applied. This application is also possible for elements specified with **<RO SPACE>**.

Example:	**Step seq.:**	**Aligned:**
POINT / POINT 	**<POINT>** **<POINT>** **<RO PLANE>**	Connecting line between points
CIRCLE / CIRCLE 	**<CIRCLE>** **<CIRCLE>** **<RO PLANE>**	Connecting line between circle center points
SYMMETRY POINT/ SYMMETRY POINT 	**<SYM.POINT>** **<SYM.POINT>** **<RO PLANE>**	Connecting line between symmetry points
CIRCLE / POINT 	**<CIRCLE>** **<POINT>** **<RO PLANE>**	Connecting line betw. circle center point and point (see remark below)

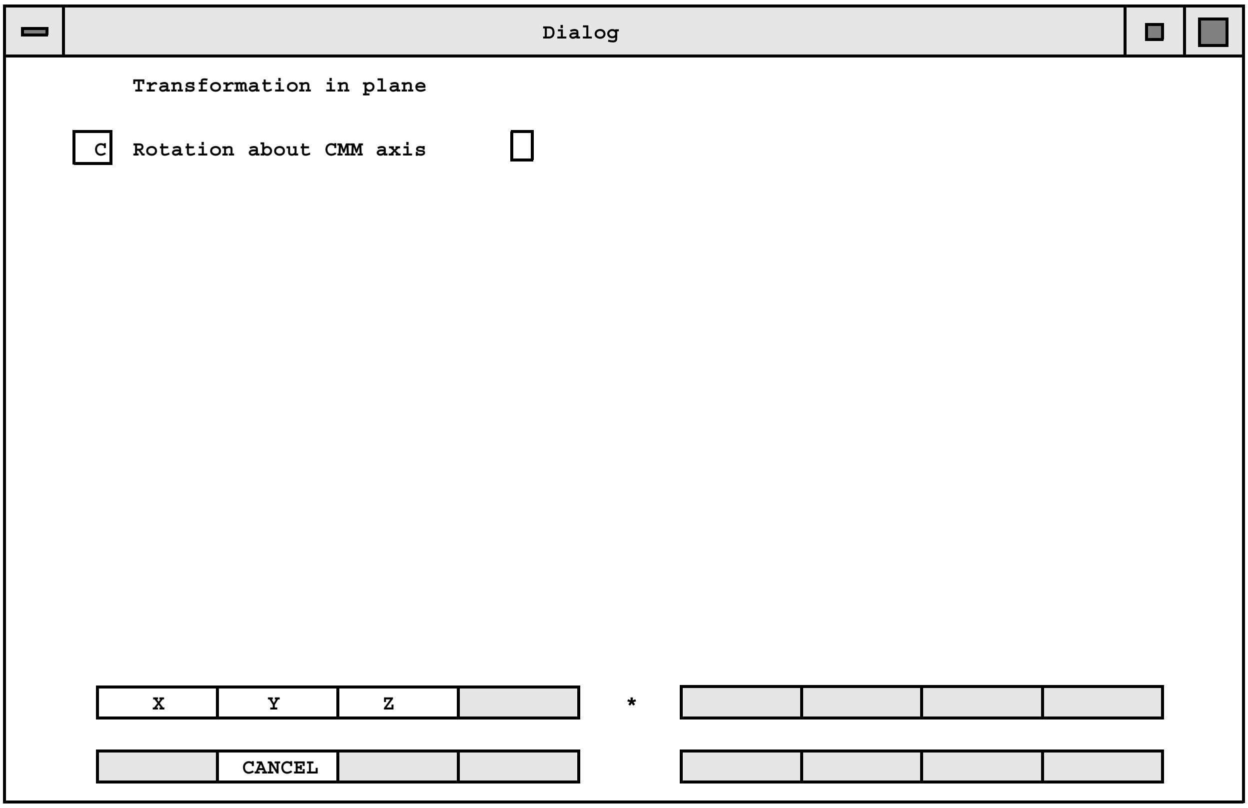
Remarks

If the line to be aligned is determined by combining a POINT probing with any geometric element (see example 4), please note the following:

The radius correction for POINT probings takes place in the direction of the coordinate system currently valid, and not in the actual contact point. The entire alignment procedure should be repeated several times (iterative alignment) to ensure that the radius correction and the contact point coincide.



If the workpiece coordinate system is not tilted with **<RO SPACE>**, the following dialog window will automatically be displayed:



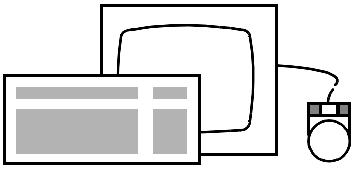
The axis about which the coordinate system will be rotated is specified by pressing this softkey.

Transformation with selectable coordinate axs

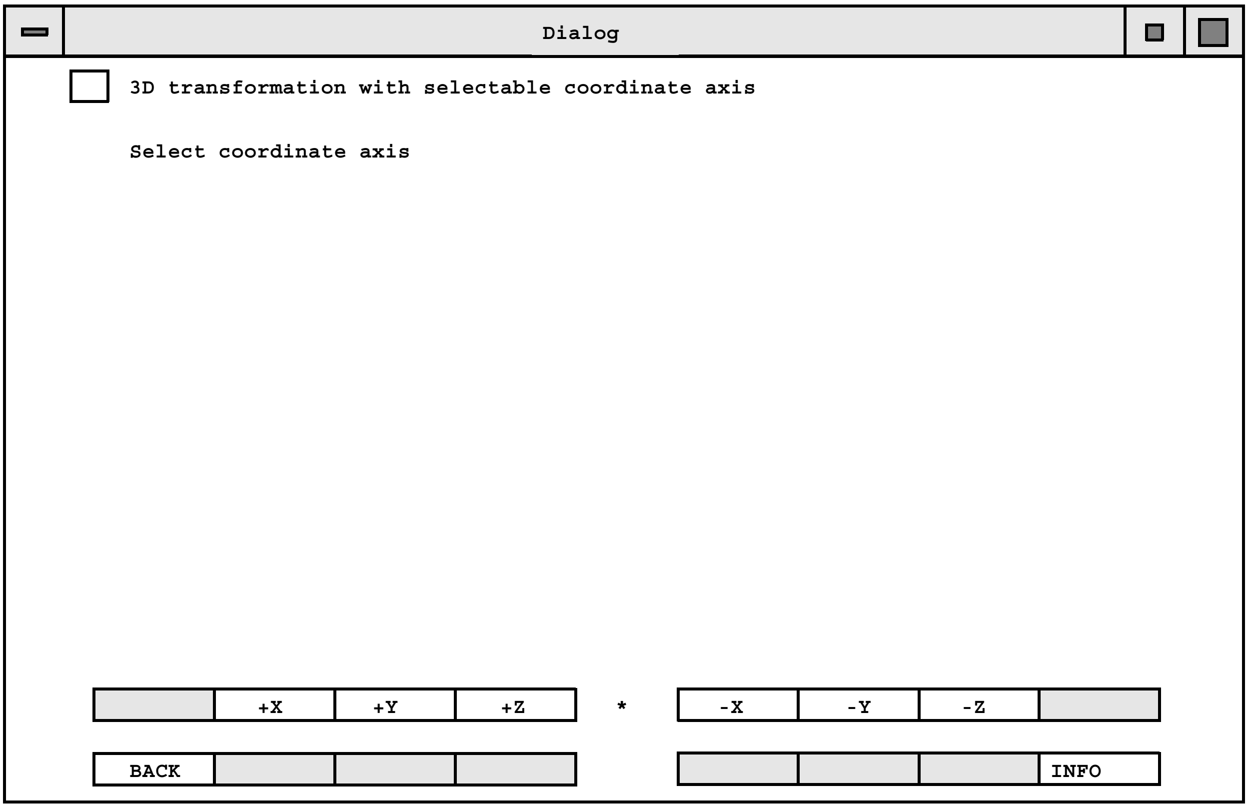
Application

If you want to take over the orientation of a workpiece from a drawing as the coordinate system, this can be done with the following functions:

3D transformation with selectable coordinate axis



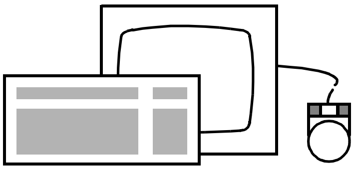
DI	Pull-Down-Menu	Pictogram
1734		



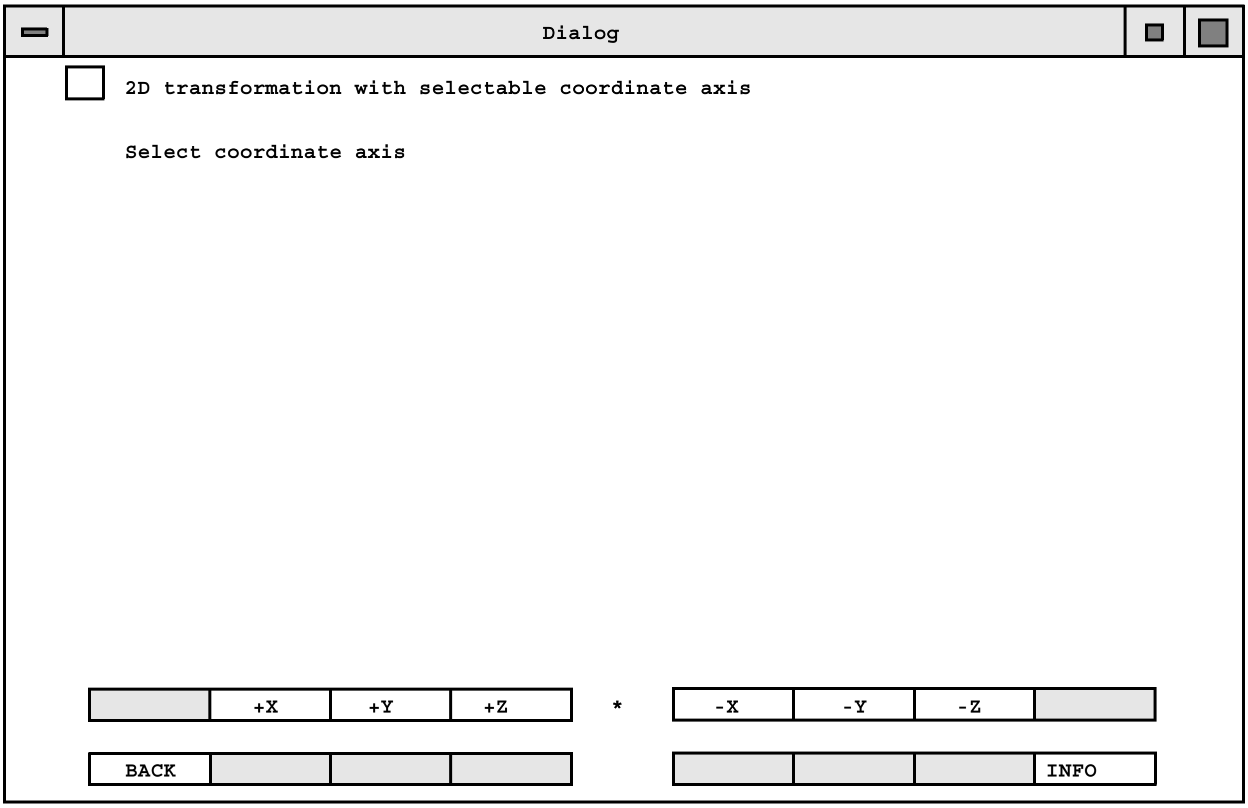
Example

For example, you can assign a calculated connecting line or the axis of a geometric element as the workpiece axis.

2D transformation with selectable coordinate axis



DI	Pull-Down-Menu	Pictogram
1735		

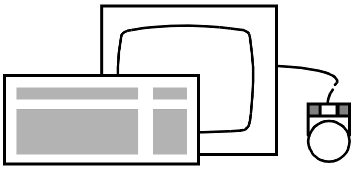


You can also select an axis for 2D transformation in one of four other ways. For more details: ➤*„Renaming the workpiece axes“ on page 9-33*

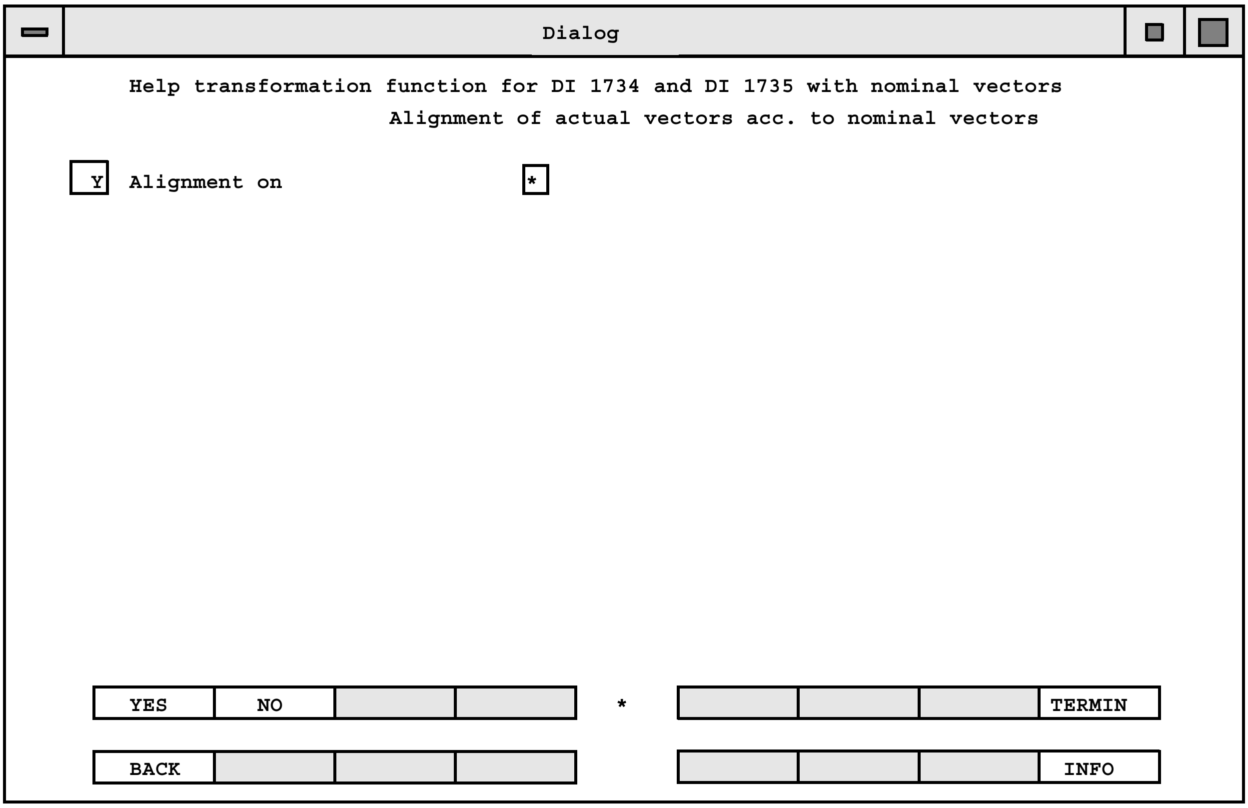
These functions also include **<DI 1711>** "Rename workpiece axis" (➤*„Renaming the workpiece axes“ on page 9-33*).

Entering a nominal vector

You can enter a nominal vector for alignment functions **<DI 1734>** and **<DI 1735>**.



DI	Pull-Down-Menu	Pictogram
1739		



DMIS postprocessor

These nominal vectors are preset e.g. by the DMIS postprocessor.

DI <1740> Alignment according to nominals

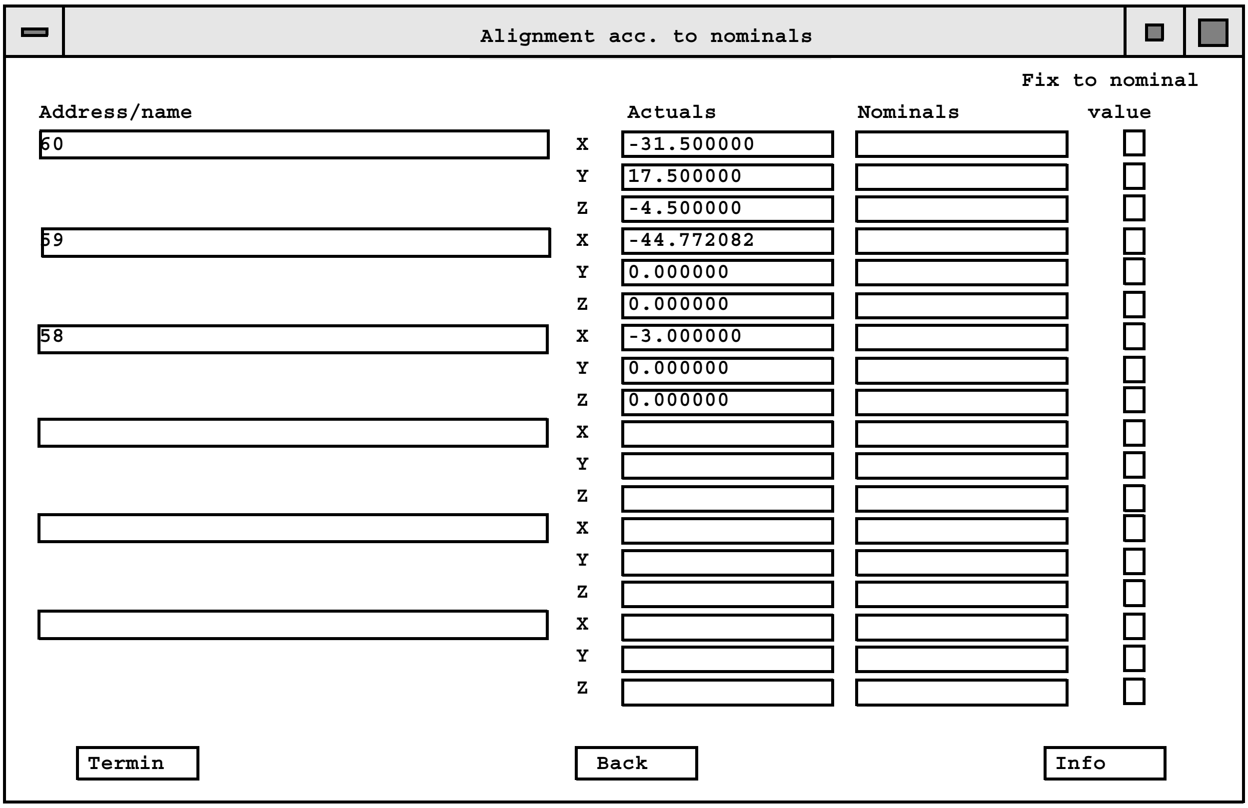
– Enter the address/names of the elements to be aligned.

– The actual values are preassigned and can not be changed.

– Enter the nominal values.

– Click on **Fix to nominal value**.
  The actual values will then be rotated and shifted until they agree with the nominal values.

X, Y, Z must be selected for one address. These values are used for the zero point.
X, Y or Y, Z or Z,X must be selected for **Rotate Space** for one address.
X or Y, Y or Z, or Z or X must be selected for **Rotate Plane** for one address.



Printout in measuring record

```
62    3D FIT       X     -1.5000
                   Y     10.0000
                   Z     -6.0000
        SPACE      W      2.5100
        PLANE      W     9.9423 ABOUT SPACE AXIS Z
```

Parallel displacement of the workpiece coordinate system

Organization

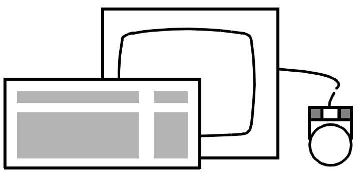
The following functions are important for parallel displacement of the workpiece coordinate system:

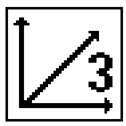
- Zeroing an element (**<ZERO POINT>** ➤*„Zeroing an element <DI 1701>“ on page 9-15*)
- Zeroing a coordinate (**<DAW 1731**, **1732**, **1733**> ➤*„Zeroing a coordinate <DI 1731, 1732, 1733>“ on page 9-17*)
- Displacement of the zero point by a defined value (**<DISPLACE>** ➤*„Displacing the zero point by a defined value <DI 1723>“ on page 9-18*)
- Displacement of the zero point into a theoretical reference plane (**<BASIC DISPLACEMENT>** ➤*„Displacing the zero point into a theoretical reference plane <DI 1722>“ on page 9-19*)

Zeroing an element <DI 1701>

Application

The **<ZERO POINT>** function enables the origin of the workpiece coordinate system to be placed in a defined geometric element.



DI	Pull-Down-Menu	Pictogram
1701 ZEROPT	Coord Zero point determine	

Reference

After the function call, the coordinates of the last element in the measurement record are set to zero.

Example

The last element in the measurement record is a circle.

- **<ZERO POINT>**
- The center pont coordinates of the circle are set to zero.
- The 3rd coordinate remains unchanged.

Function call

The **<ZERO POINT>** function in connection with **<RO SPACE>** and **<RO PLANE>** can be integrated in the following procedure without renewed probing:

<RO SPACE>

<SURFACE> <RO SPACE> <ZERO POINT>

OR

<SURFACE> <ZERO POINT> <RO SPACE>

ONE SPATIALLY
DEF. ELEMENT

ANGLE INFORMATION
FOR TRANSFORMATION SPACE

<ELLIPSE> <ELLIPSE> <RO SPACE> <ZERO POINT>

TWO PLANE
ELEMENTS

<RO PLANE>

<LINE> <ZERO POINT> <RO PLANE>

OR

<LINE> <RO PLANE> <ZERO POINT>

ONE SPATIALLY
DEF. ELEMENT

ANGLE INFORMATION
FOR TRANSFORMATION PLANE

<POINT> <POINT> <RO PLANE> <ZERO POINT>

OR

<CIRCLE> <CIRCLE> <RO PLANE> <ZERO POINT>

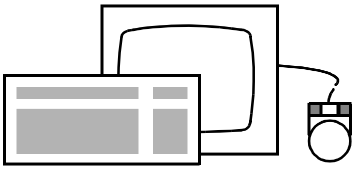
TWO PLANE
ELEMENTS

Zeroing a coordinate <DI 1731, 1732, 1733>

Application

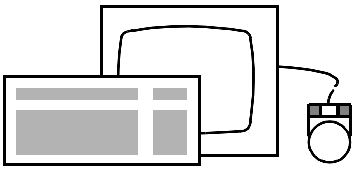
These functions make it possible to reset one coordinate of the last element in the measurement protocol to zero.

To zero (reset) the X axis:



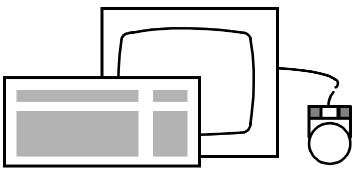
DI	Pull-Down-Menu	Pictogram
1731		

To zero (reset) the Y axis:



DI	Pull-Down-Menu	Pictogram
1732		

To zero (reset) the Z axis:

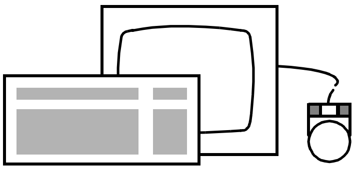


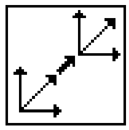
DI	Pull-Down-Menu	Pictogram
1733		

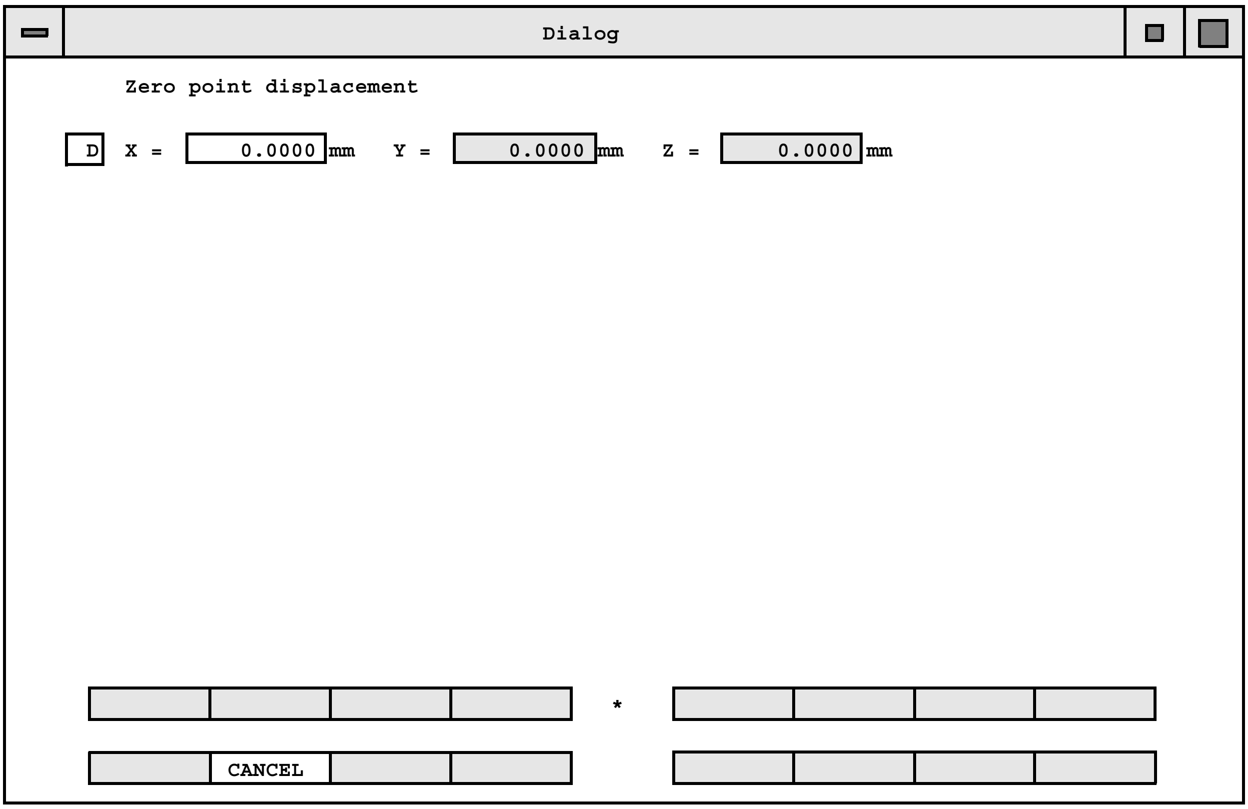
Displacing the zero point by a defined value <DI 1723>

Application

The **<DISPLACE>** function enables you to place the origin of the workpiece coordinate system in all three coordinate axes to a position which can not be probed. First, however, a reference to a geometric element of the workpiece which can be probed must be established via the **<ZERO POINT>** function.



DI	Pull-Down-Menu	Pictogram
1723 DISPLACE	Coord Zero point displace...	



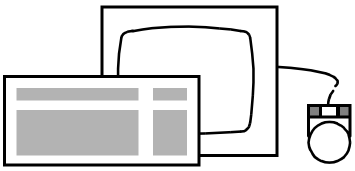
Procedure

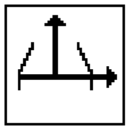
Enter or accept displacement values. Then press **<Enter>** to continue on to the next box or, following the last box, execute zero-point displacement.

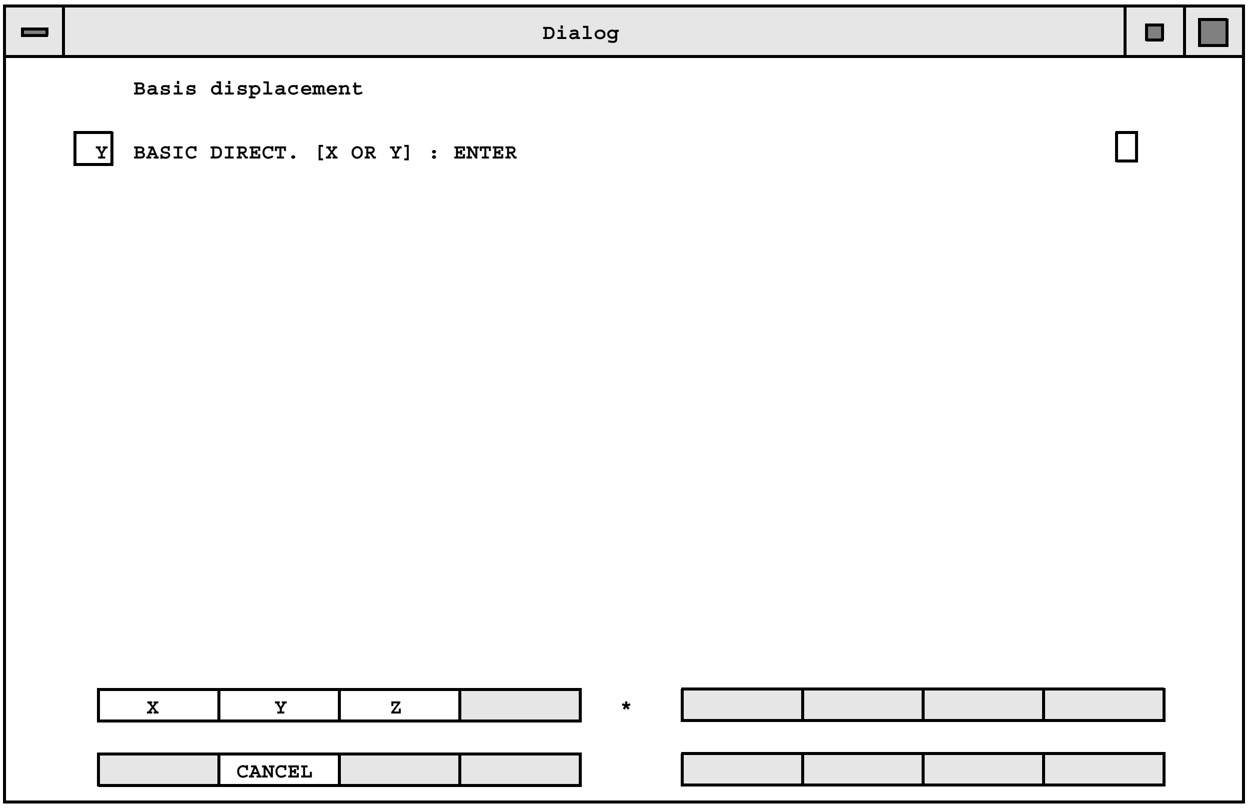
Displacing the zero point into a theoretical reference plane <DI 1722>

Application

This function enables the origin of the workpiece coordinate system to be placed in a theoretical reference plane.

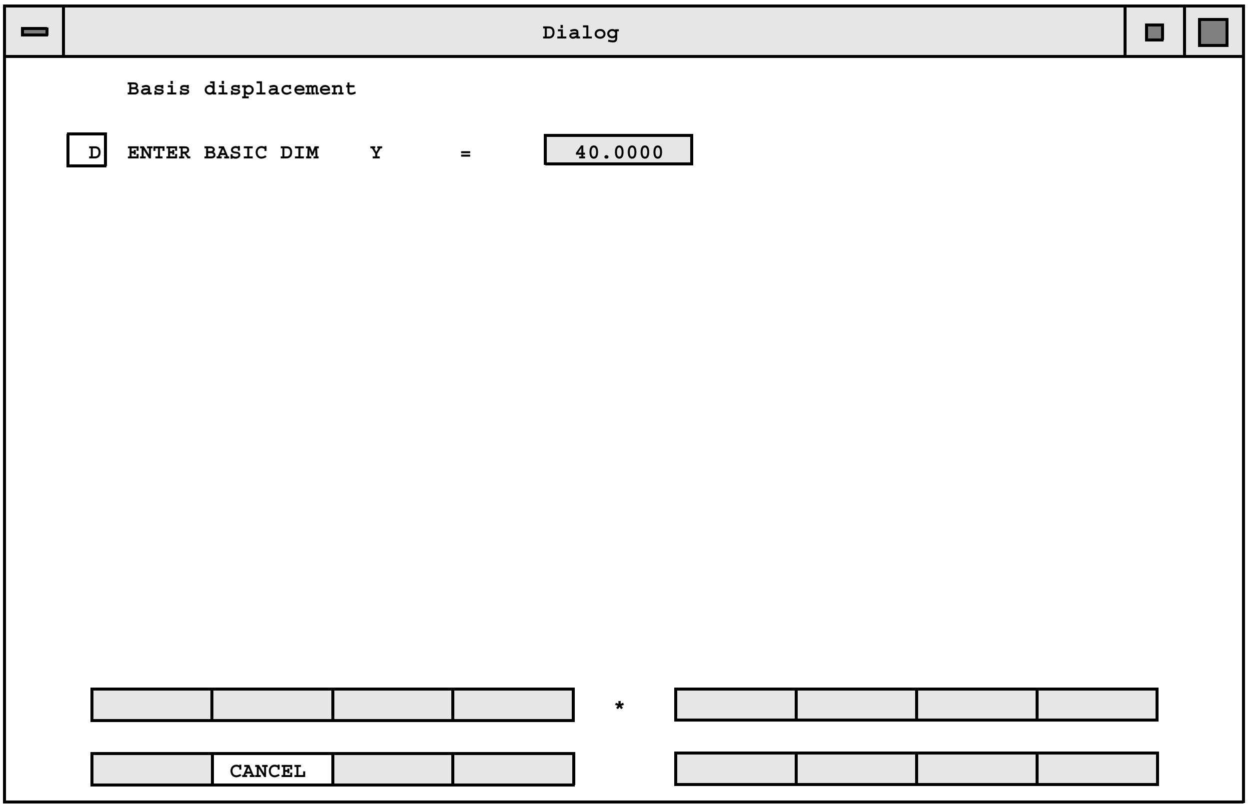


DI	Pull-Down-Menu	Pictogram
1722	Coord	
BASISDIS	Zero point	
a119	Basic displacement...	



Procedure

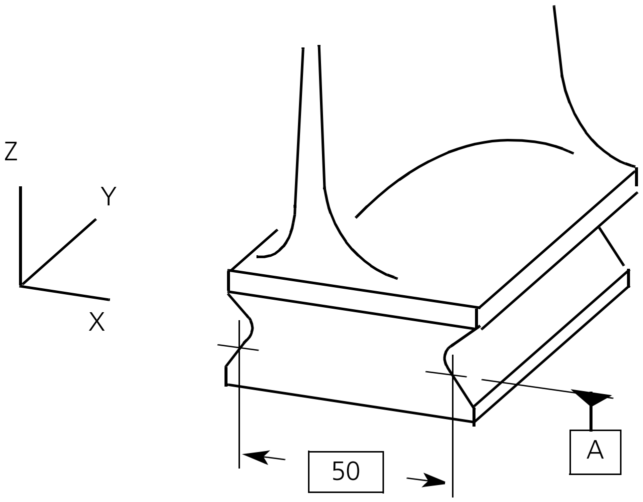
Define the coordinates by pressing the softkey.

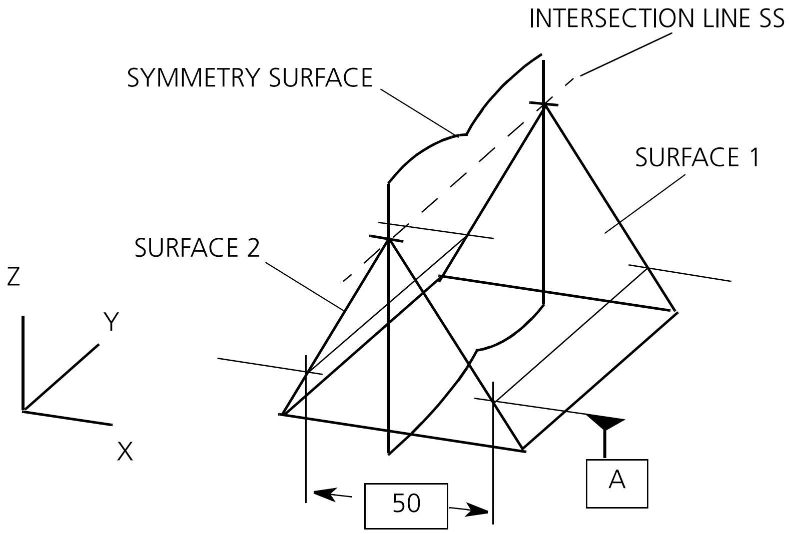


Procedure

Enter the basic dimension and conclude with **<Enter>**.

Example Dovetail





- Probe SURFACE 1	1 SURFACEZ -156.8550 X/Z A1 44.9816 Y/Z A2 0.2677 4P S/MIN/MAX 0.0011 (3)-0. ...
- Probe SURFACE 2 (note correction order of surfaces to maintain required symmetry surface)	2 SURFACE Z -1947.8424 X/Z A1 -44.9813 Y/Z A2 -0.4278 4P S/MIN/MAX 0.0004 (2)-0. ...
- **<SYMMETRY>**	3 SYM-F X 896.0717 Y/X A1 0.3480 Z/X A2 0.0001
- <INTERS> (Intersection line SURFACE/SYMMETRY SURFACE)*	4 S-G FF Z -1052.3535 X 896.0734 Z/Y A1 0.0800 X/Y A2 -0.3480
- **<RO SPACE>**	5 ROTATE SPACE W 0.3571
- **<ZERO POINT>**	6 ZERO PT Z -1052.3524 X 896.0480
- **<RECALL>** (of the sym. surface into the new coord. sys.)	7 3! SURFACE X 0.0000 Y/X A1 -0.0000 Z/X A2 -0.0004
- **<RO PLANE>**	8 ROTATE PLANE A-0.0004ABOUT SPACE AXIS
- **<RECALL>** (of SURFACE 2 into new coordinate system for negative displacement **The +/- sign of the surface angle determines the direction of the displacement!) ***	9 2! SURFACE Z 0.0000 X/Z A1 -44.9820 Y/Z A2 0.0000
- Function call: basic displ.	10 DISPLACE X 0.0000 Y 0.0000 Z -24.9843
If positive displ is required: - **<RECALL>** (of SURFACE 1)	11 8* COORD.SYSTEM AS FOR ADR.8
- Function call: Basic (base) displ. *Note: A negative displacement makes sense in the example shown here.	12 1! SURFACE Z 0.0000 X/Z A1 44.9820 Y/Z A2 -0.0000
	13 DISPLACE X 0.0000 Y 0.0000 Z 24.9843

Rotating the workpiece coordinate system

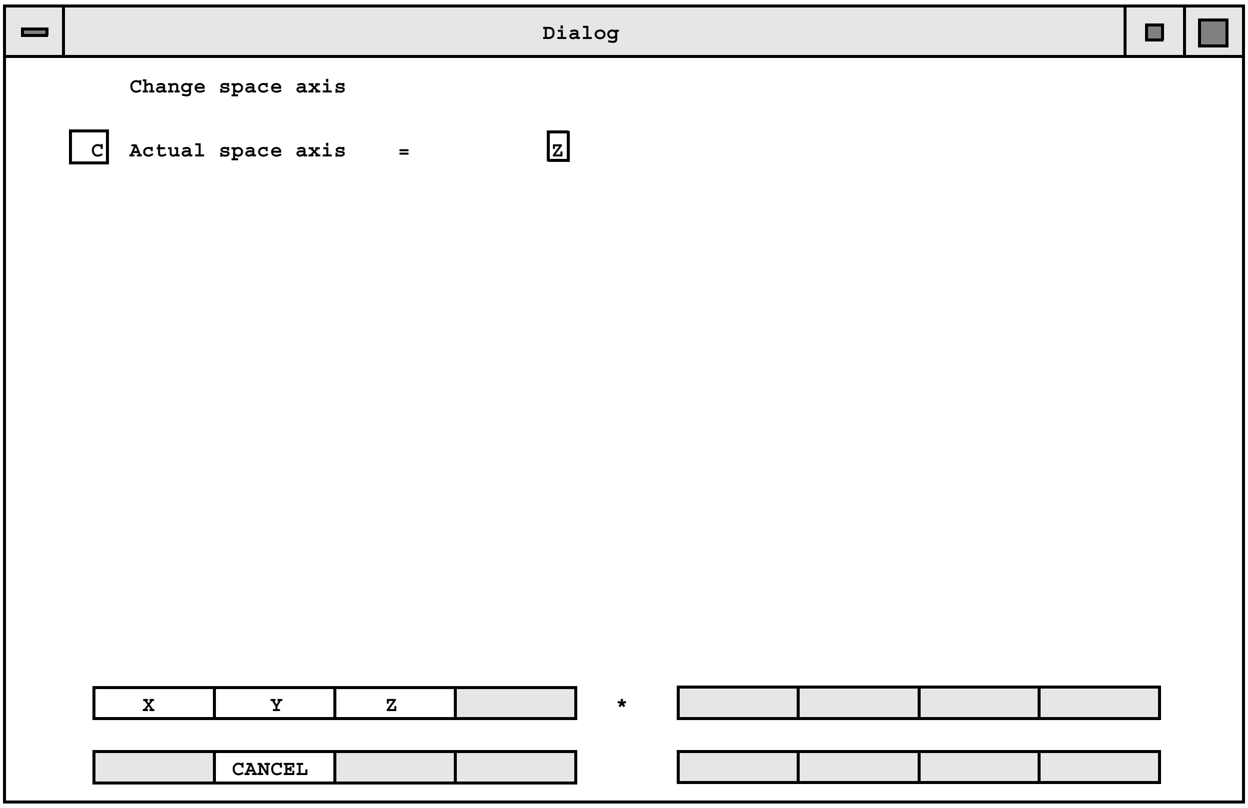
Selecting the space axis <DI 1707>

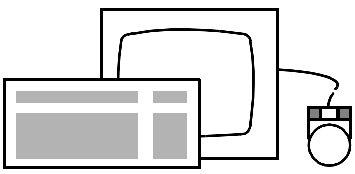
Application

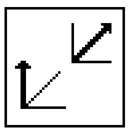
With **<DI 1707>** it is possible to declare any axis of the workpiece coordinate system as the space axis.

Application possibility

Rotation of the workpiece coordinate system about an axis which is not the space axis.





DI	Pull-Down-Menu	Pictogram
1707	Coord	
AXISCHA	Space axis	
a79	change...	

Procedure

Select the required space axis with the softkey. The new space axis will then be output in the measurement record.

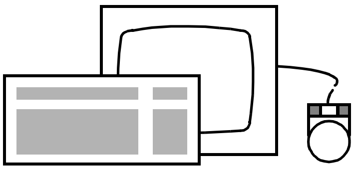
Rotation about the zero point and one element <DI 1703>

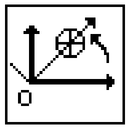
Application

The workpiece coordinate system is rotated about the zero point so that a coordinate axis runs through the last element in the measurement record.

Application e.g. with

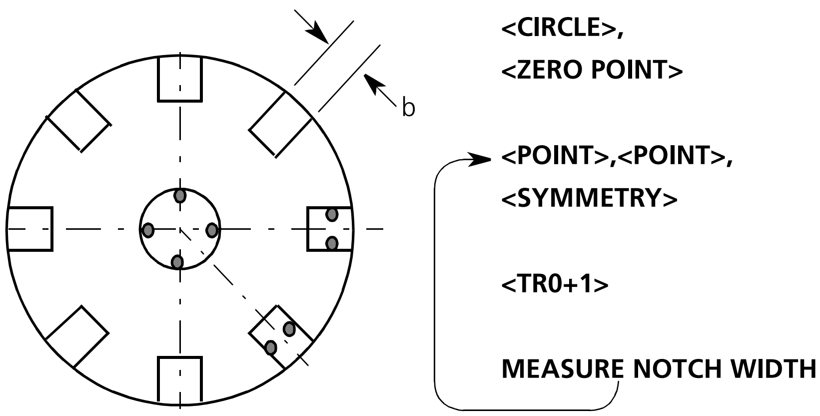
- rotationally symmetrical parts (see example below)
- iterative alignment (➤*„Transformation plane <DI 1702>“ on page 9-7* example 4)



DI	Pull-Down-Menu	Pictogram
1703	Coord	
TR0+1	Plane transf.	
a23	Zero point & 1 Element	

Example

A notched plate must be realigned so that the width of each of its notches can be measured.



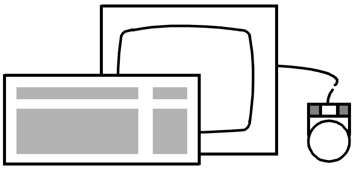
Procedure

- Place origin of coordinate system (**<ZERO POINT>**) in the center bore
- Probe first notch (**<POINT>** ,**<POINT>**, **<SYMMETRY>**)
- Call up **<TR0+1>**
- Measure notch width
- Probe second notch
- Call up **<TR0+1>**.

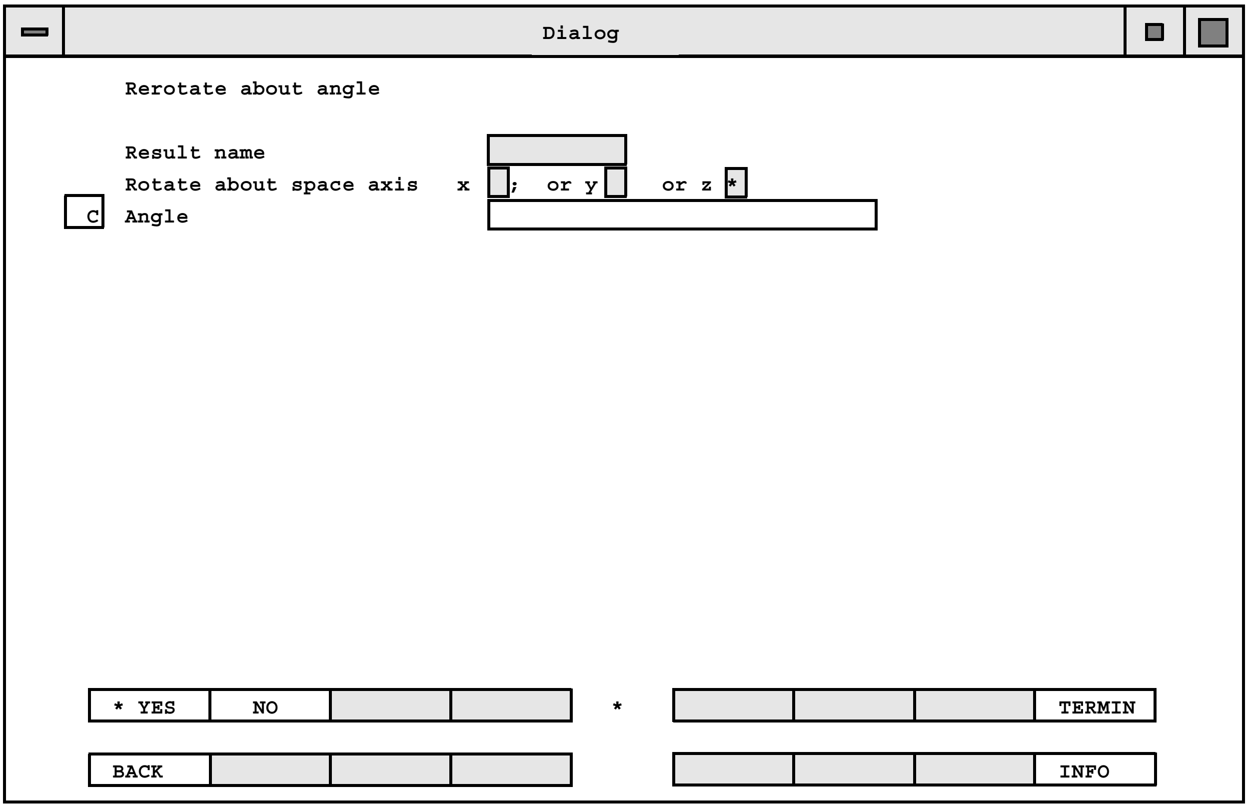
Rerotating by an angle <DI 1709>

Application

This function enables the workpiece coordinate system to be rotated by a defined angle about about the space axis.



DI	Pull-Down-Menu	Pictogram
1709	Coord	
TRANGLE	Plane transf.	
a213	Rerotate...	



Data boxes

Result name

Accept or overwrite the default value.

Rotate about space axis

Specify the machine axis about which the coordinate system is to be rotated if **<RO SPACE>** has not been executed. If the space axis is defined, the boxes are inaccessible.

Angle

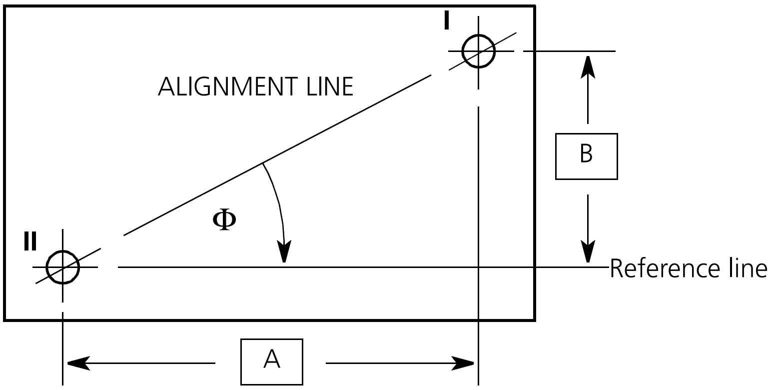
If you view the plane of the rerotation angle from the positive direction of the 3rd axis, the following applies:

Rotation counterclockwise (mathematically positive direction of rotation) ⇒ positive sign

Enter the rerotation angle with the correct sign and conclude with **<Enter>**.

Example

A workpiece is to be aligned according to 2 fitting bores, however is dimensioned to them by the angle Φ. The workpiece coordinate system therefore must be rotated by the angle Φ following alignment.



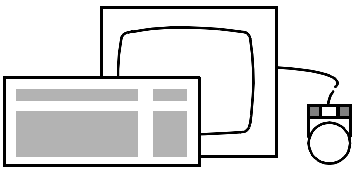
Procedure

- **<CIRCLE>** (measure bore I)
- **<CIRCLE>** (measure bore II)
- **<RO PLANE>** (alignment parallel to the fitting bores)
- **<ZERO POINT>** (in bore II)
- **<DI 1709>** (enter machine axis about which rotation is be performed and enter rerotation angle Φ)

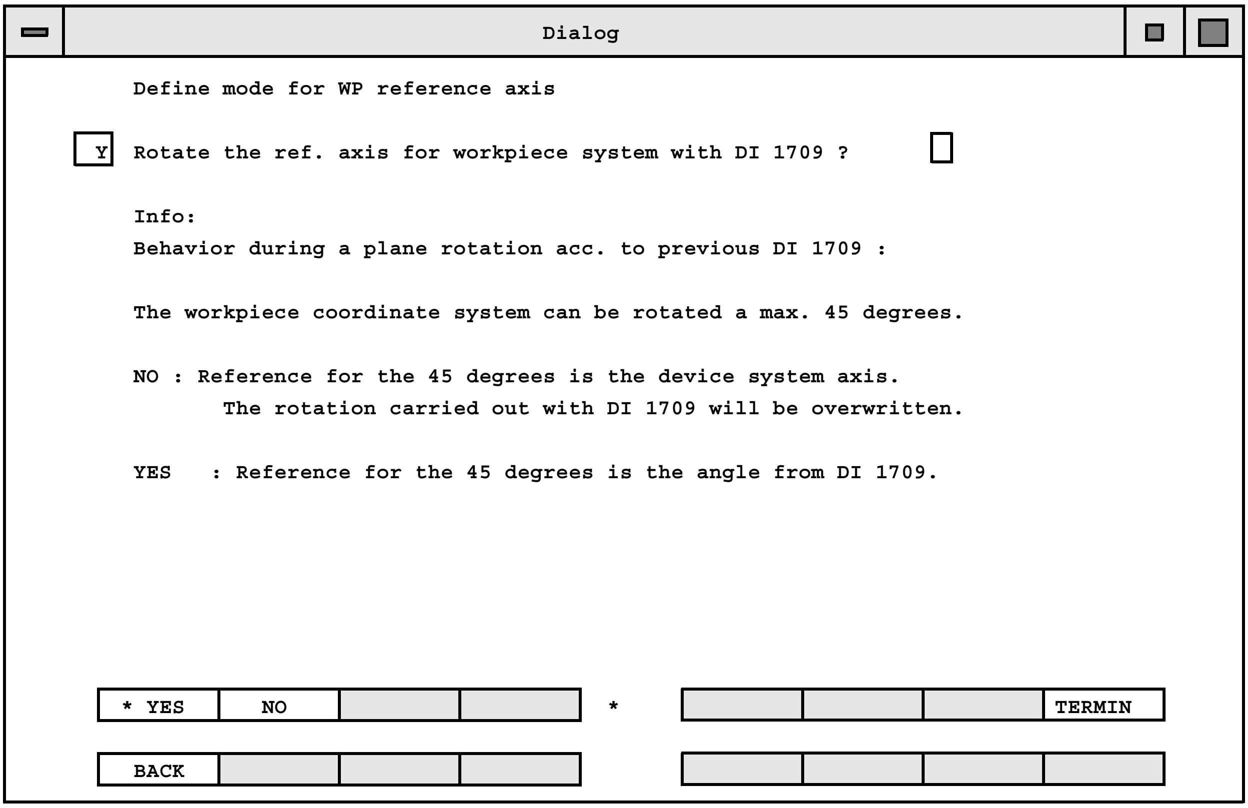
Defining the mode for the WP reference axis <DI 1719>

Application

The reference axis of the workpiece coordinate system is usually changed if the angle of rotation reaches ±45°. This function can be used to suppress changing of the reference axis.



DI	Pull-Down-Menu	Pictogram
1719	Coord	
MOD1709	Plane transf.	
	Rotate mode...	



Data box

Rotate the ref. axis for workpiece system with DI 1709 ?

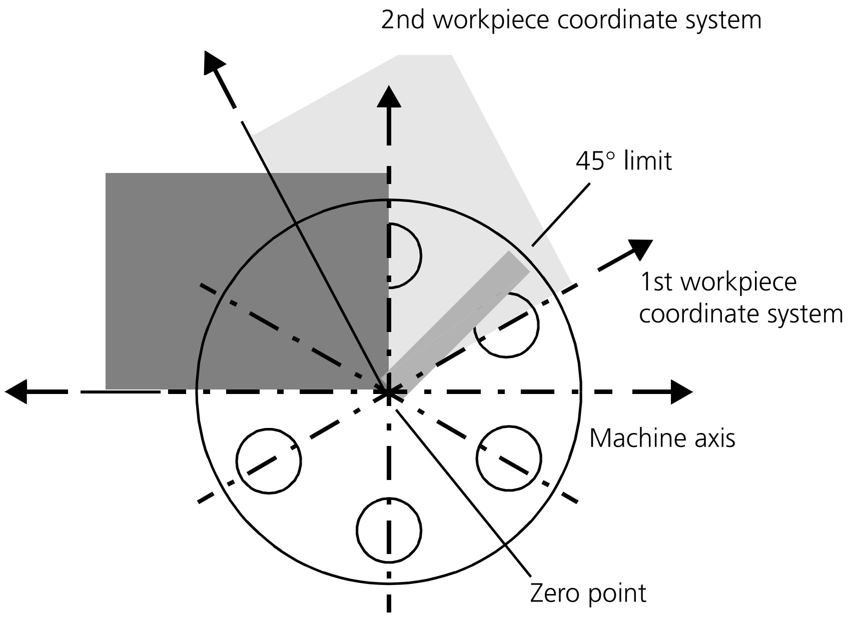
- **<YES>**
  Always whenever the workpiece coordinate system is rotated with **<DI 1709>** and fine alignment **<DI 1702**, **1703**, **1705**> is also required. The axes are not changed if the 45° limit is exceeded.
- **<NO>**
  Normal setting when starting UMESS and after calling <**DI 1608**, **1610**, **1707**, **1706**, **1711>.**

NOTE

If **<DI 1709>** is called repeatedly, the sum of all rerotation angles is the reference for the 45° limit.

Example

The workpiece coordinate system must be rotated about the zero point and one element repeatedly.



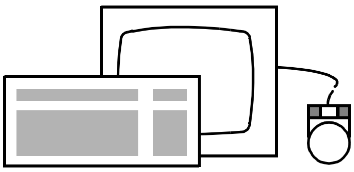
Rotating to distance <DI 1705>

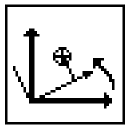
Application

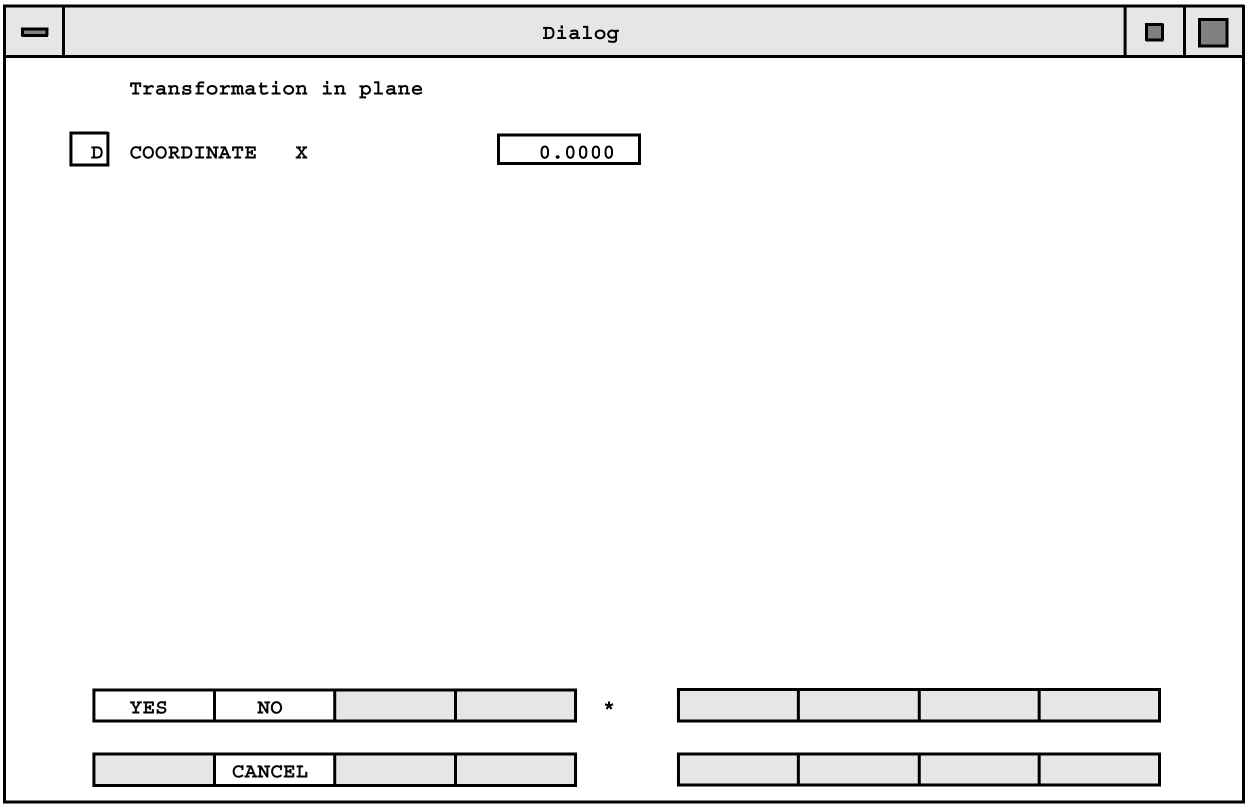
This function enables the workpiece coordinate system to be rotated so that a coordinate of a measured element assumes a specified value.

Prerequisite

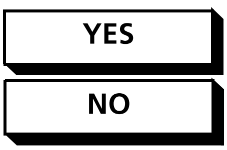
The element required must be the last address in the record.



DI	Pull-Down-Menu	Pictogram
1705	Coord	
TRDIS	Plane transf.	
a65	Distance...	



Softkeys

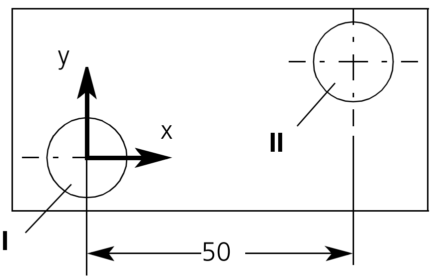


Use **<YES>** / **<NO>** to select the coordinate which should be set to a defined size. When the required coordinate is displayed, enter the nominal value and acknowledge with **<Enter>**.

Example

Initial status:

The center point of bore II in X has a distance of 50 mm from the zero point of the workpiece coordinate system (in bore I).

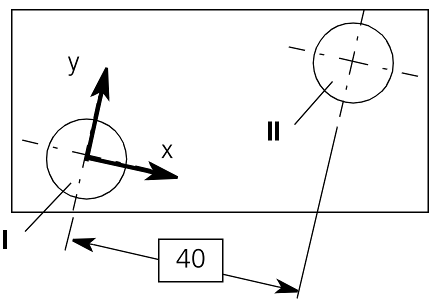


Rotate coordinate system

<TRDIS>

Aim:

The workpiece coordinate system is aligned so that the distance between the two bores equals 40 mm in X (nominal).



Procedure

- Place the origin of the coordinate system (**<ZERO POINT>**) in bore I.
- Measure or recall bore II.
- Then rotate to distance with **<TRDIS>** (nom. value in X = 40).

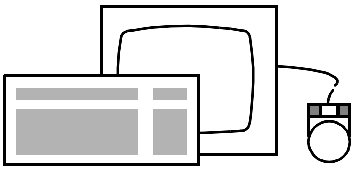
NOTE

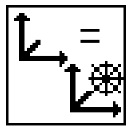
- Rotation is always performed about the space axis. The space axis can be changed if necessary with **<DI 1707>** (➤*„Selecting the space axis <DI 1707>“ on page 9-23*).
- A nominal value can be entered only for *one* coordinate direction.
- The nominal value must be smaller than the polar distance of the element concerned from the zero point.
- the coordinate system is rotated in the direction in which the smaller angle of rotation is required.

Forming a workpiece coordinate system from a control coordinate system <DI 1713>

Application

With this function the workpiece coordinate system is equated with the control coordinate system activated last. An initial (under certain circumstances approximate) workpiece coordinate system can thus be activated after entering **<DI 1608>** or **<RECORD>**.



DI	Pull-Down-Menu	Pictogram
1713	Coord	
WLWPC	Preparation	
	WPS = WPOS	

NOTE

- Then the coordinate system called should be optimized by an exact mathematical alignment.
- Calling **<DI 1608>** or **<RECORD>** deletes all stored zero points and angles, and therefore the workpiece coordinate system. The machine coordinates remain valid until they are redetermined.

Overview

The following table shows the effect individual operations have on different coordinate systems when performed in the sequence shown:

OPERATION	**STORED COORDINATE SYSTEMS** ON DATA CARRIER CONTROL COORD.	IN THE COMPUTER WORKP.COORD.	IN THE COMPUTER CTRL COORD.
1 AFTER SWITCH-ON	**OLD SYSTEM**	○	○
2 **<DI 1608>** **<RECORD>**	**OLD SYSTEM**	○	○
3 DETERMINATION OF WORKPIECE COORDINATES	**OLD SYSTEM**	●	○
4 **<W-POS>** (MANUAL)	●	●	●
5 **<RECORD>** **(<DI 1608>)**	●	○	●
6 **<DI 1713>**	●	●	●

○ = MACHINE COORDINATES ● = WORKPIECE COORDINATES

Renaming the workpiece axes

Free axis selection <DI 1711>

Application

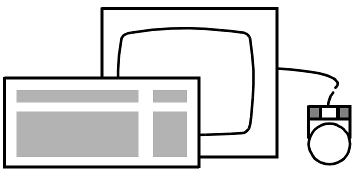
With **<AXISSEL>** you can change the identifications of the workpiece axes.

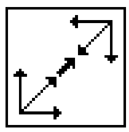
This DI is suitable for use in cases where:

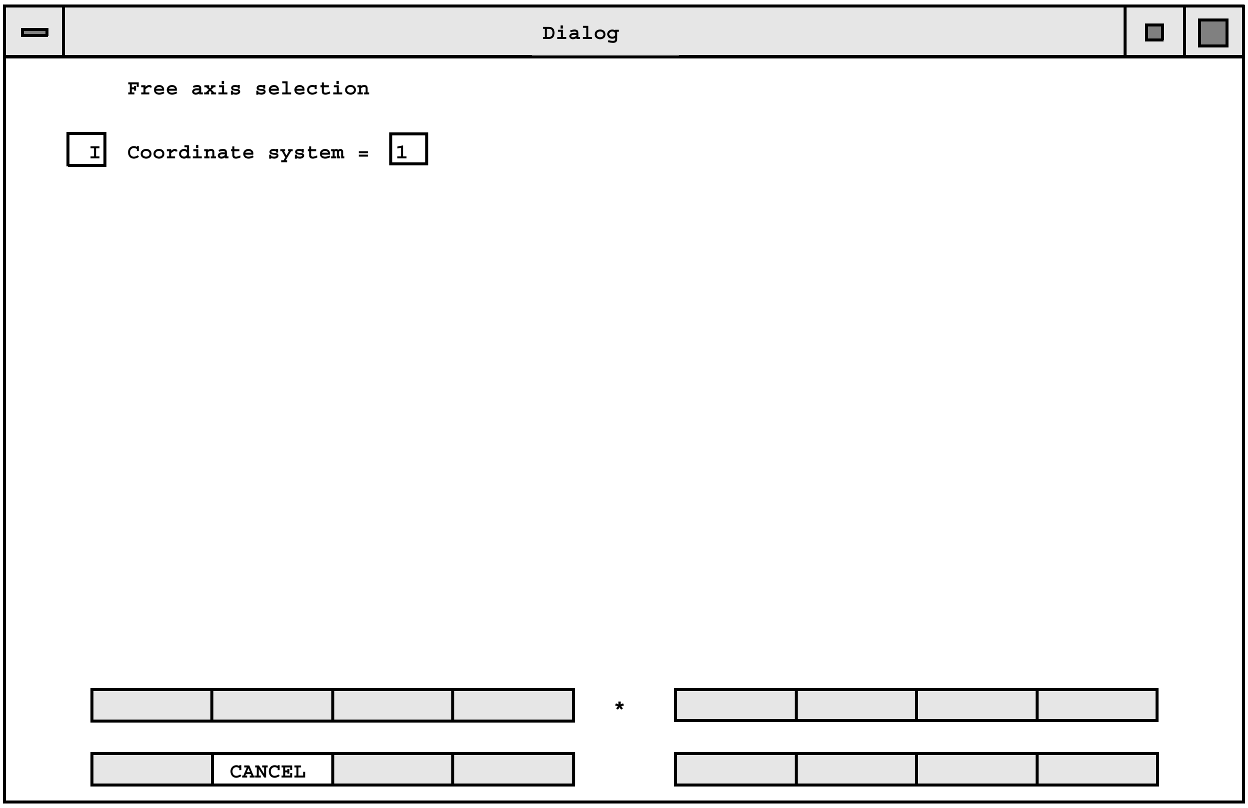
- The identification (designation) of the axes in the measurement record must be adapted to the identification in the drawing.
- A workpiece is aligned differently on the CMM. The existing control data can be further used. The probe numbers must, however, be corrected in the control data (**<CNCCORR>**) or renamed accordingly during probe calibration.

Procedure

- Set initial status **<DI 1608>**
- Enter required axis assignment **<DI 1711>**
- Calibrate required probes **<DI 1602>**
- Call record header if necessary **<DI 1610>**
- MEASURE
- If the identification of the axes should be canceled **<DI 1711>**



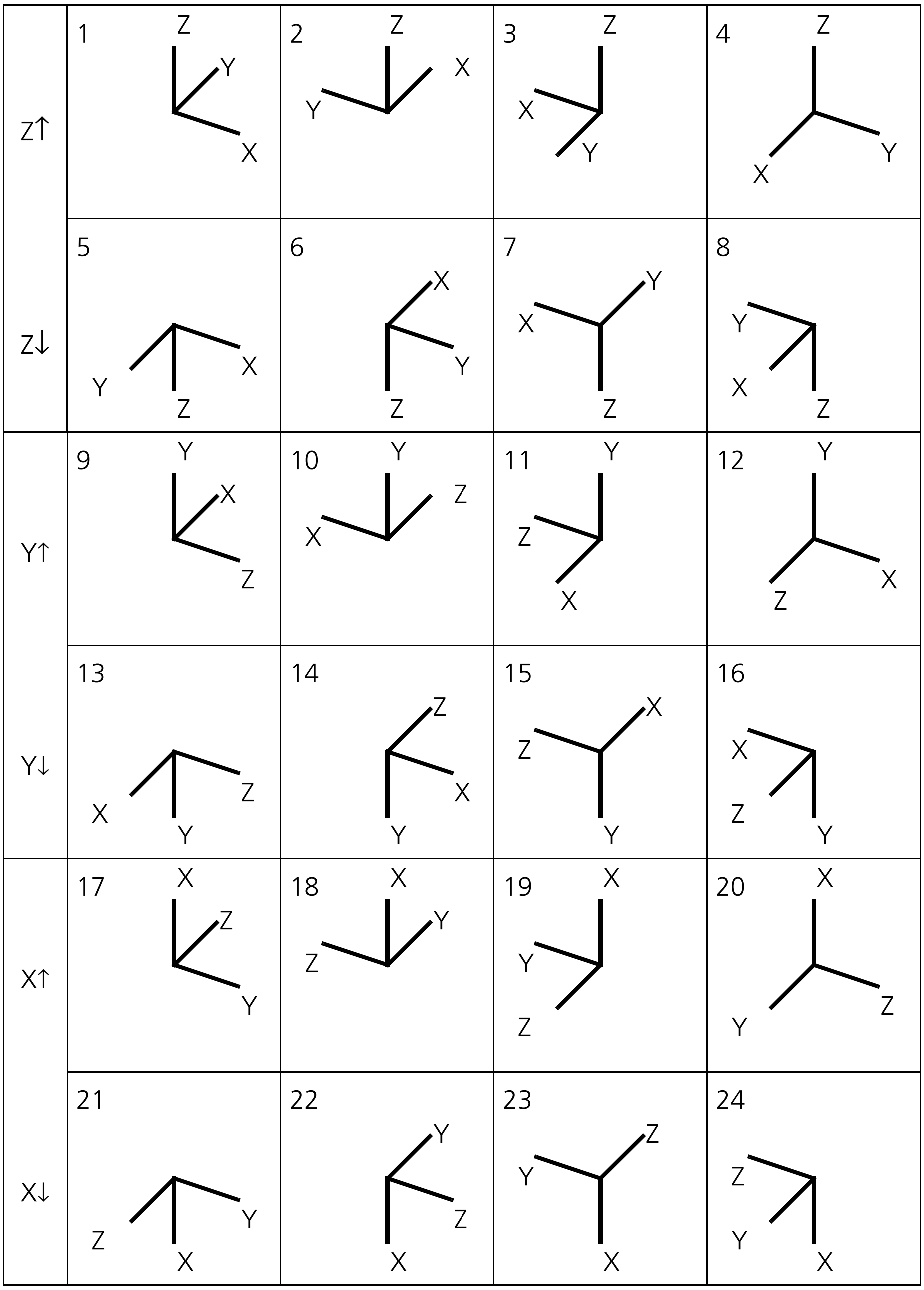
DI	Pull-Down-Menu	Pictogram
1711	Coord	
AXISSEL	Preparation	
a143	Free axis selection...	



Procedure

Enter the number of the axis identification required and confirm with **<Enter>**.

Overview



Explanation

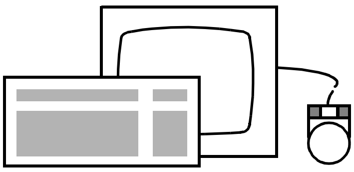
System 1 corresponds to the original identification of the machine axes. Each of the above diagrams shows the positive semiaxis of the coordinate system.

Relative axis selection <DI 1720>

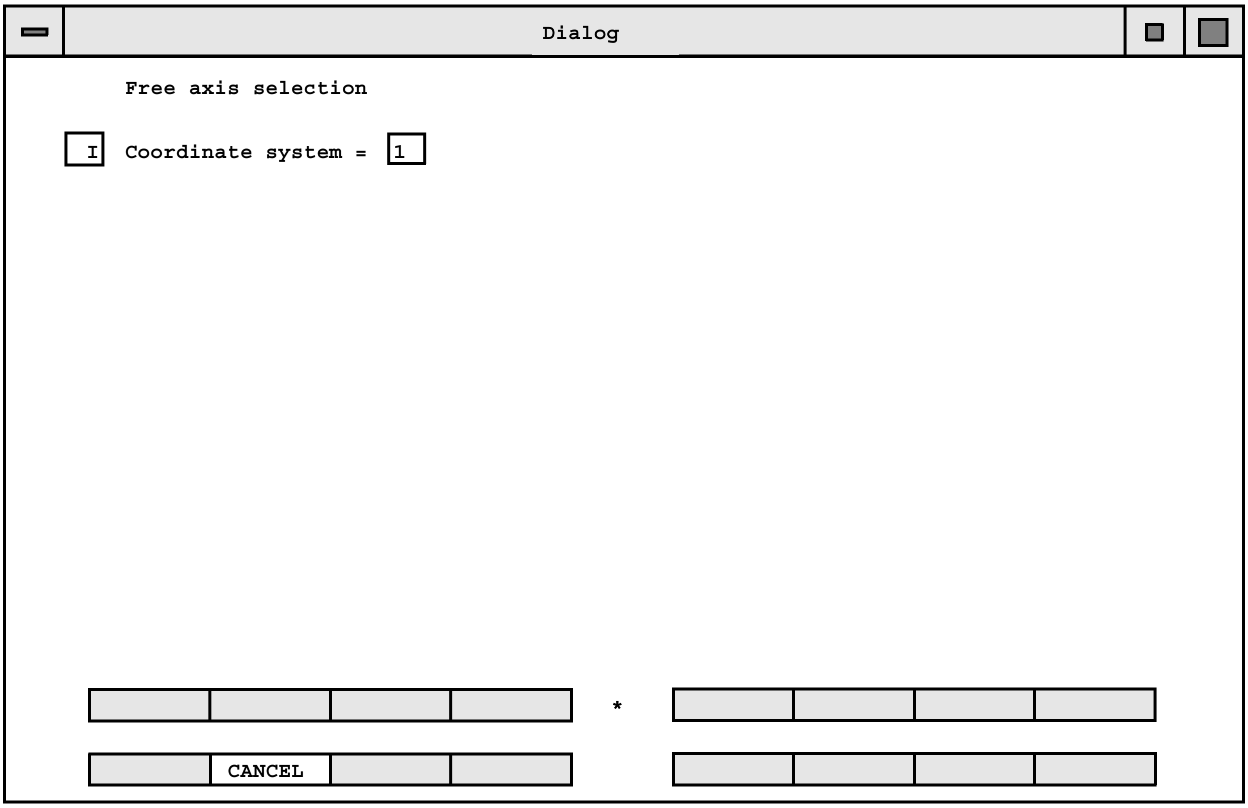
Application

With this function, the designations of the workpiece axes can be changed. The change refers to the coordinate system currently valid (which is always the initial system with **<DI 1711**>).

This function is mainly required for the DMIS postprocessor. It can, however, also be called up in the manual or CNC measurement mode.



DI	Pull-Down-Menu	Pictogram
1720	Coord	
	Preparation	
	Relative axis selection...	



Procedure

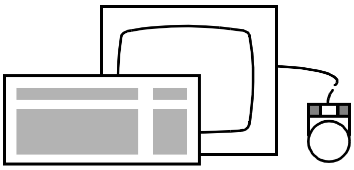
The code numbers of the required axis designations must be selected from the table for **<DI 1711>**.

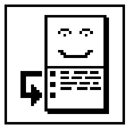
Recall of an element or a coordinate system <DI 1301>

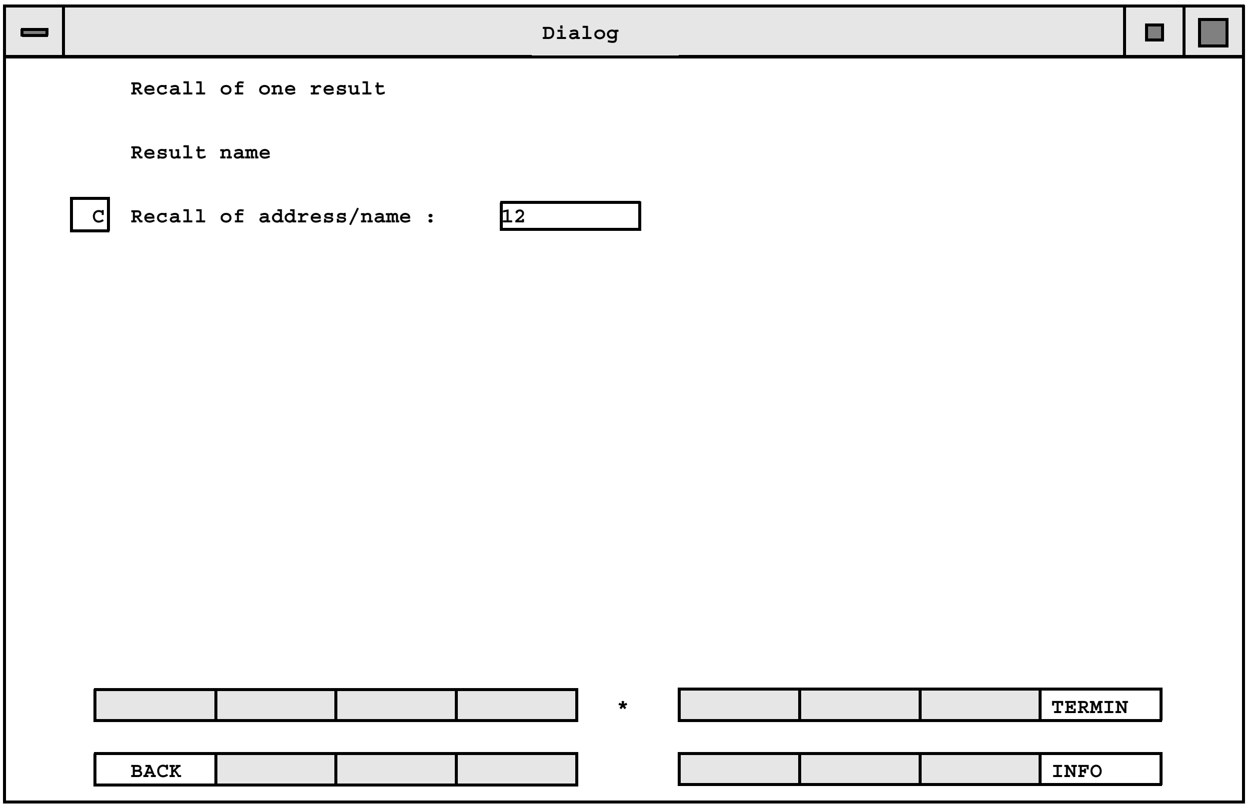
Application

During a measurement, any number of workpiece coordinate systems can be defined for a workpiece.

With **<RECALL>** it is possible to reactivate a previously defined coordinate system. The *last* address with which the required coordinate system was defined must be recalled (e.g. **<ZERO POINT>, <DISPLACE>**).



DAW	Pull-Down-Menu	Pictogram
1301	Elements	
RECALL	Recall...	



Example

```
                              Record

   1       SURFACE        Z    -413.752
               X/Z        A1      0.051
               Y/Z        A2     -0.058

   2       ROTATE SPACE   A      0.0773

   3       ZERO PT        Z    -413.751

   4       SURFACE        Y    -603.517
               Z/Y        A1      0.029
               X/Y        A2     -1.052

   5       ROTATE PLANE   A     -1.0521    ABOUT SPACE AXIS Z

   6       ZERO PT        Y    -603.416

   7       POINT          X     262.438

   8       ZERO PT        X     262.438

                           .
                           .
                           .

  67   8*COORD. SYSTEM AS FOR ADR.   8
```

NOTE

You can convert a result with an address = n only into a coordinate system with an address < n.

With iterative alignment (car body metrology), you therefore must generate a coordinate system (e.g. displacement XYZ=0) at the start of a loop.

Chapter 10

Measuring

This chapter contains:

Procedure

Procedure

To measure geometric elements, proceed as follows:

Call measurement program

The measurement program call tells the computer which geometric elements should be calculated from the probings which follow. A program call is not always necessary for POINT measurements (➤„*General“ on page 11-2*).

Probe an element

Note the number and position of the probing points when probing (➤„*Geometric elements“ on page 11-1*).

Terminate the measurement program

By pressing the **<TERMIN>** key, you tell the computer that no further probings will follow.

The program then checks whether the geometric element has the required minimum number of points. The best fit geometric element is calculated for the points probed and the result printed.

If it is not possible to calculate the element called from the existing probings, this will be acknowledged by the output **NO RESULT** (➤„ "*No result*" *function“ on page 10-55*).

Point file

With **<DI 1100>** measured points can initially be saved to a point collection file and evaluated later (➤„*Creating/evaluating point collection files“ on page 10-21*)

The individual probing points remain stored and can be used for further calculations.

Probings

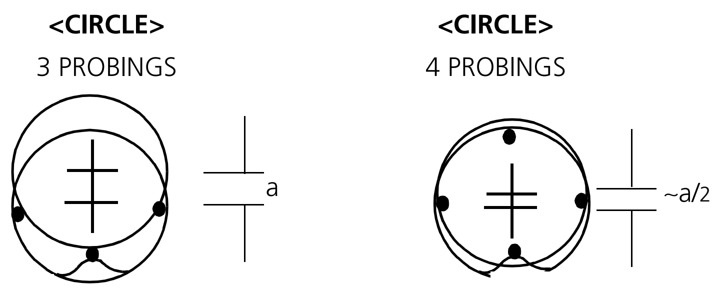
Probing strategies

Best fit

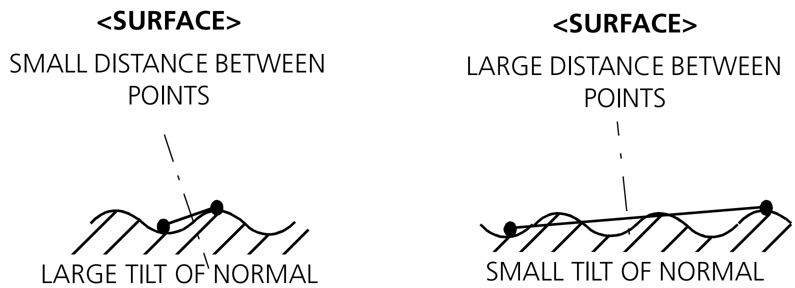
The computer always calculates the best fit ideal geometric element from the probing points.

The following principles should be noted when probing:

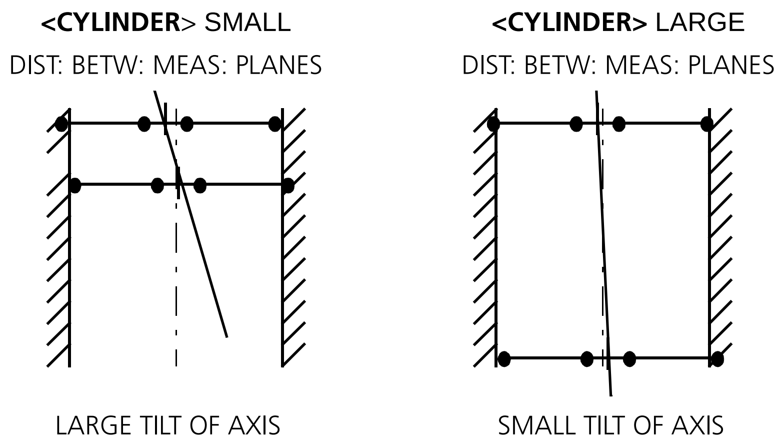
Perform as many probing as possible:



Large distance between probing points:

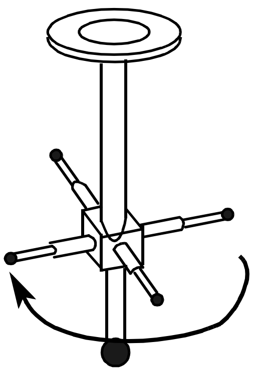


Large distance between intersection planes:



NOTE

- The program automatically checks whether the required minimum number of probings (➤*„Geometric elements“ on page 11-1*) has been performed.
- If the element called can not be calculated from the probings available, this will be indicated in the measurement record by the comment **NO RESULT**.
- A geometric element is initially calculated through the probe ball centers. Then a correction is performed by an amount equal to the radius of the probe selected last.

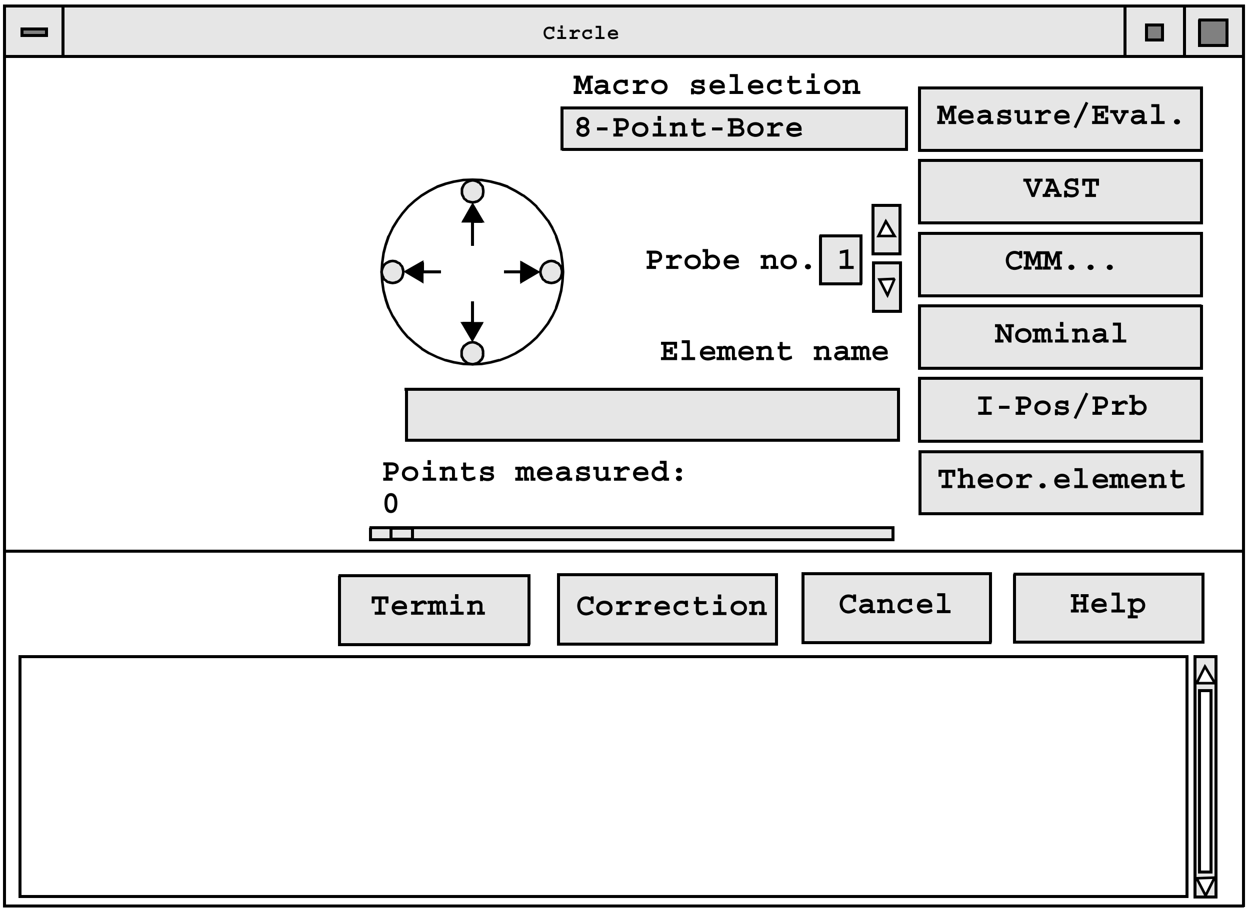


A probe change within an N POINT PROGRAM is therefore permissible only if the radii of the probes used are within the required measuring uncertainty!

Probing possibilities

Function call

If a geometric element (**<CIRCLE>**,**<SURFACE>**, etc.) is called, the following dialog window will be displayed:



Probings

The measuring points for the geometric element selected can be probed manually or determined via a softkey function.

Element name

The performance mode name offered in the **Element name** data box can not be changed. (Observe rules in ➤*„Allocating names“ on page 5-9*).

Softkeys

Measure/Eval...

Combined measurement and evaluation functions.

Measure macro

Calls the macros defined previously.

ACE Macro

Calls a macro for off-line programming in ACE.

Scanning mode	Defines the scanning mode (➤*„Preparations“ on page 19-3*).
Scanning run	Starts a scanning run (➤*„Details on the scanning mode“ on page 19-15*).
Laser measurement	Starts a laser measurement.
Recalls	Calculates the geometric element by recalling multiple addresses (➤*„Recall of several elements“ on page 10-32*).
File evaluation	Calculates the geometric element by evaluating a point collection file (➤*„Creating/evaluating point collection files“ on page 10-21*).
REP EVAL	The probing points of the previous geometric element are reevaluated.
CMM...	Combined CMM control functions.
Step	Initiates travel to the probing point or intermediate position with the **<STEP>** function (➤*„Travel from the current position in fixed steps <DI 1515>“ on page 10-41*).
Position	Initiates travel to the probing point or intermediate position with the **<POSITION>** function (➤*„Positioning to workpiece coordinates <DI 1511>“ on page 10-37*).
RT-Step **RT-Position** **RT-Pitch**	Function calls for RT table control (➤*„Rotary table operation“ on page 15-1*).
DSE Step **DSE Position**	Travel commands for the articulating probe holder.
VAST	Branches to the dialog window for VAST functions.
Nominal	Terminates element with transfer to nominal input.
I-Pos/Prb	With a measuring probe head, points can be accepted with the probe in contact by pressing this softkey.

Theor.element

Branches to the dialog window for entering a theoretical element.
(➤*„Theoretical elements" on page 11-61*)

Termin

Informs the computer that all of the points required have been defined. The element is then calculated and output to the record.

Correction

Used to delete the last probing point.

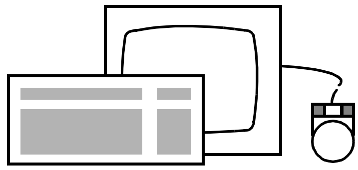
Cancel

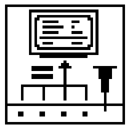
Used to quit the dialog window without calculating the element.

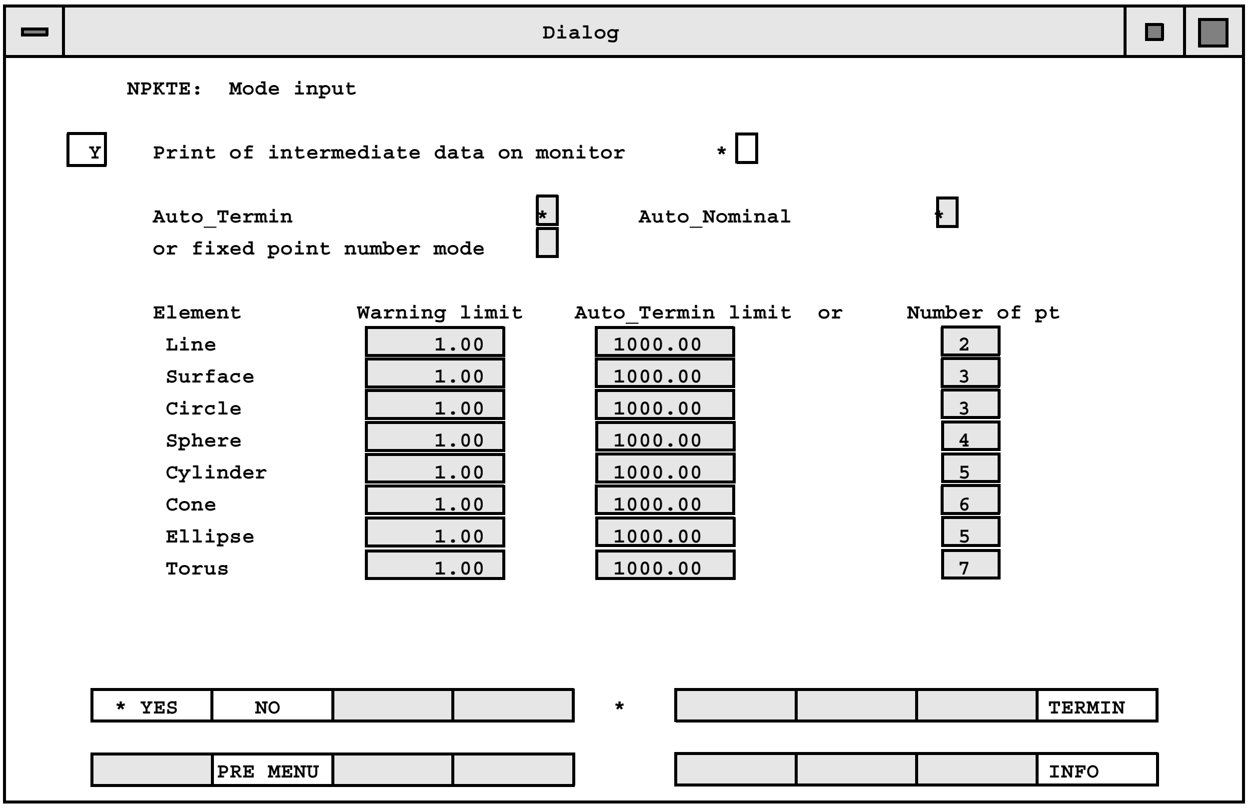
Switching on the intermediate result display <DI 1188>

Application

When probing a geometric element, you can also have the intermediate positions displayed. These results are displayed in the Elements window as soon as the minimum number of probings for the element concerned has been reached.



DI	Pull-Down-Menu	Pictogram
1188	Record	
INTRES	Mode	
	Intermediate results...	

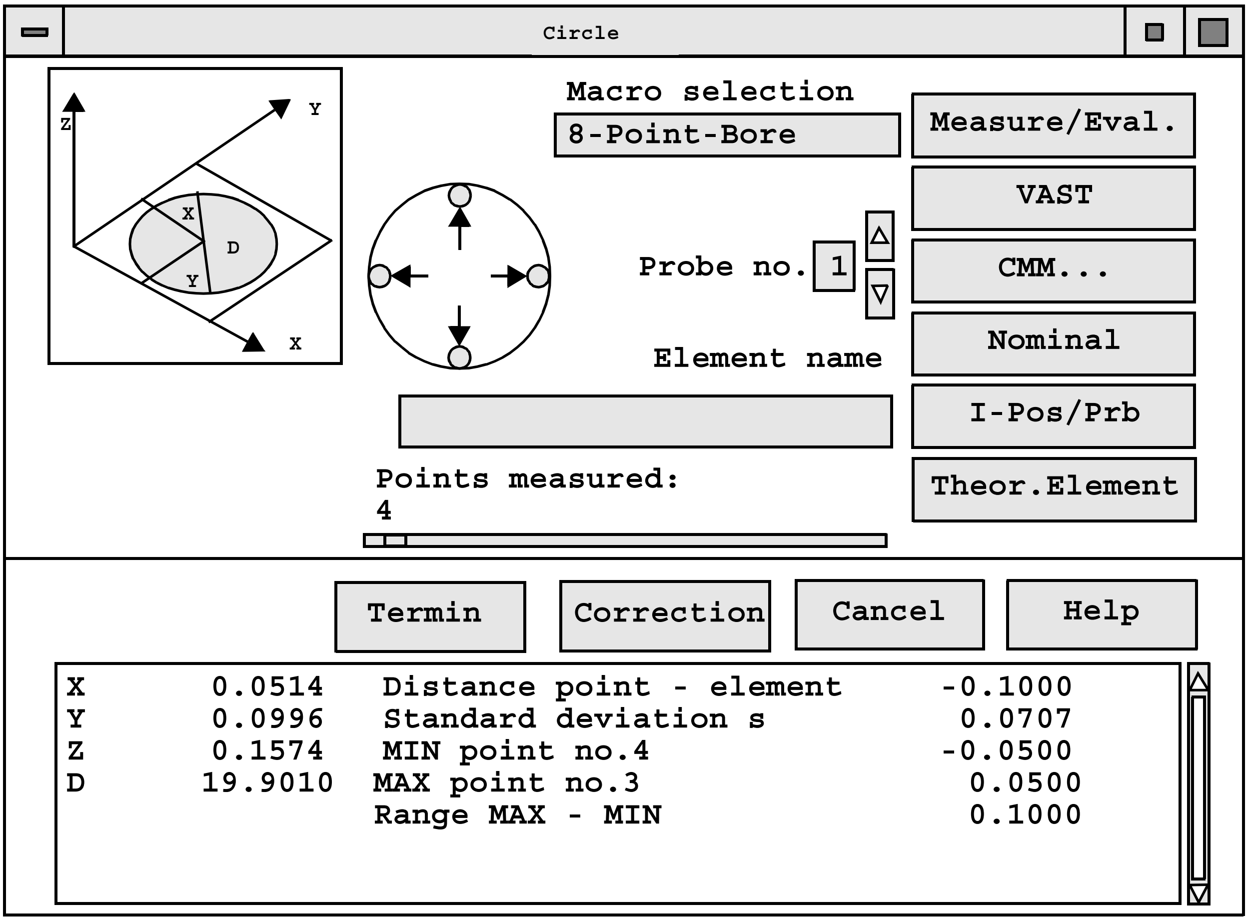


Data boxes

Print of intermediate data on monitor

Enter **<YES>** and terminate with **<TERMIN>**.

Additional display If you now call and probe a geometric element, you will see an extended dialog window when the minimum number of probings has been reached.



Data boxes

Element name A default name is offered here. If the name allocation is activated, you can overwrite this name.

Display boxes

X, Y, Z Display of coordinates.

D (D1, D2) Diameter of a rotationally symmetrical element, supplementary diameter.

A1, A2 Projected angles (position of element relative to axes).

AC Generating angle of cone.

Distance point - element

Distance between the last point and the element. This includes a warning limit if an unfavorable probing is performed and the Auto_Termin function with which a new element is automatically started (➤*„Simplified termination of probings, Warning limit input < DI 1188>" on page 10-10*).

Standard deviation s

Statistical deviation of individual points from the best fit measured element.

MIN point no.
MAX point no.

Minimum/maximum deviation of individual points from the best fit element.

Range MAX - MIN

Range of measured points (Range).

Simplified termination of probings, Warning limit input < DI 1188>

Application

Normally you terminate the probing of an element with **<TERMIN>** as soon as you have probed a sufficient number of points. You can terminate the probing of a geometric element more simply with the functions

- Nominal input
- Auto Termin

Nominal input

Procedure

If you probe a geometric element and press **<NOMINAL>**, the probing will be concluded and the element will be calculated. The dialog window for the nominal input appears (➤*„Nominal input <DI 1459> (old 1452)" on page 14-8*). The boxes required for the nominal-actual (variance) comparison are already marked and preassigned with the rounded off measurement results. You can change these values or accept them. Then conclude the input with **<TERMIN>**.

Prog mode

In the programming mode, the nominal is written to the reserved control data line (➤*„Computer controlled manually measured sections <DI 1077>" on page 16-25*).

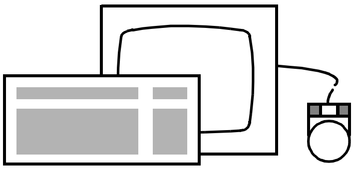
Auto Termin

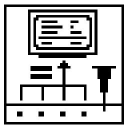
You can also terminate an element automatically with **Auto Termin**.

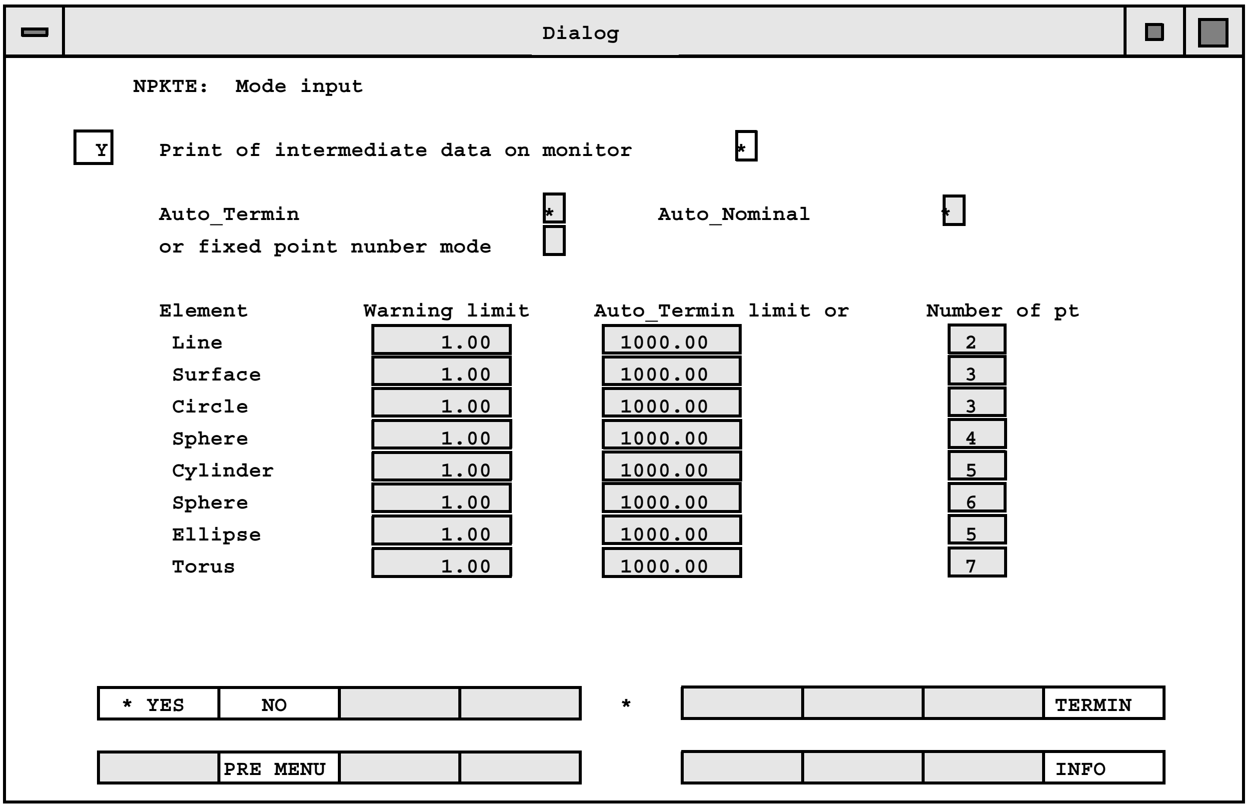
You have two options:

- Enter cancel limit
- Enter number of points

Set both values with **<DI 1188>**.



DI	Pull-Down-Menu	Pictogram
1188	Record	
INTRES	Mode	
	Intermediate results...	



Data boxes

Auto_Termin

If you enter **<YES>**, the Auto Termin limit displayed in the table will take effect for the matching element. You can determine and enter a suitable value. If the last probing point deviates more from the element previously calculated, Auto_Termin will become effective. The element will then be terminated and calculated without the last probing point. Then the following message will be displayed:

NOTE

Auto_Termin limit has been exceeded.

The last point then becomes the first point of a new element of the same kind.

Restrictions: The function is effective only in the manual mode, with single points (without scanning) and without name allocation.

or fixed point number mode

If you confirm here with **<YES>**, the number of points displayed in the table will become effective for the corresponding element. You can determine and enter a suitable value.

Auto_Nominal

If you enter **<YES>**, a **RES NOMINAL** control data line will be inserted in front of each geometric element during learn (parts) programming. This does not apply if a nominal was entered beforehand.

Warning limit

If the point-element distance (i.e. the distance between the last point probed and the element displayed as an intermediate result) exceeds the value entered in the table as the warning limit, a signal will sound. The following error message will then also be displayed:

NOTE

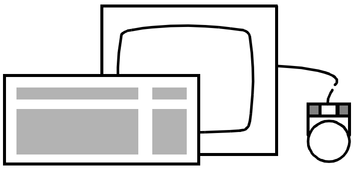
Warning limit has been exceeded.

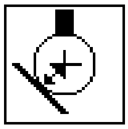
You can then delete this value with **<Correction>** or accept it for the measurement.

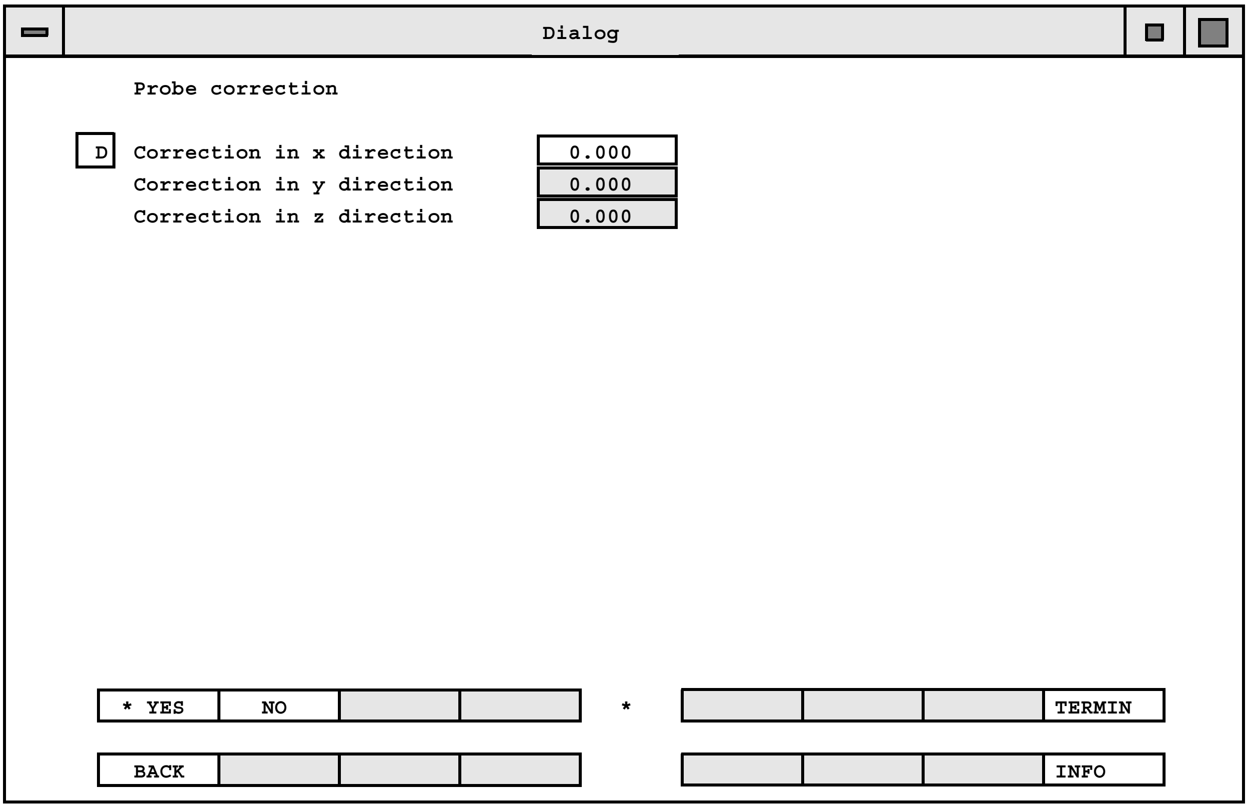
Probing correction <DI 1187>

Application

Used to correct the coordinate values of probing points. If you call **<DI 1187>** and enter correction values, the coordinates of a subsequently probed point will be corrected by the value entered.



DI	Pull-Down-Menu	Pictogram
1187	Elements	
CORRPRB	Data acquisition	
a21	Probing correction...	



Procedure

Enter the required value and close the dialog window with **<TERMIN>**. The point element window is then displayed and you can perform a probing.

The correction values are displayed on the screen.

NOTE

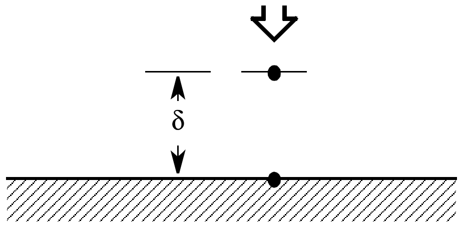
The probing correction affects only the next point probed.
Recalled points or other geometric elements are not corrected.

Application examples

Example 1

Output of a point located δ mm above the contact point:

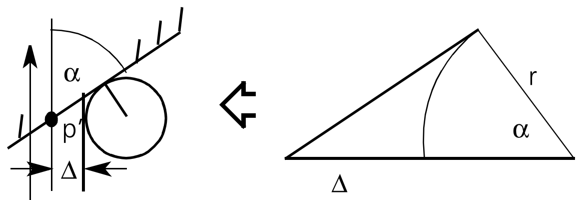
Call **<DI 1187>**, enter correction value (–δ) and then probe.



Example 2

Output of point P’ when probing a surface rotated by angle α:

Call **<DI 1187>**, enter correction value (Δ) and probe.

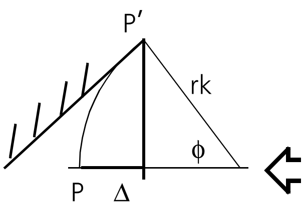


$\Delta = r_{SPHERE} \cdot (1/\cos\alpha - 1)$

Example 3

Output of contact point P’ when probing a surface rotated by angle ϕ:

Call **<DI 1187>**, enter correction value (-Δ) and probe.

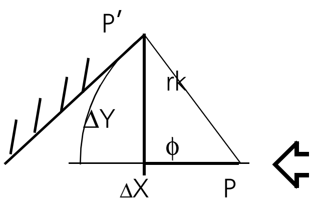


$\Delta = r_{SPHERE} \cdot (1 - \cos\phi)$

Example 4

Output of contact point P, when probing with **<FIXED PLANE>**:

Call **<DI 1187>**, enter correction values ΔX and ΔY, then probe.



$\Delta X = r_{SPHERE} \cdot \cos\phi,$

$\Delta Y = r_{SPHERE} \cdot \sin\phi$

Correction of probing errors

Application

There are three ways to correct probing errors in UMESS:

– **Deleting individual measuring points**

  As long as an N point program or the function **"Collect points in file"** is active, individual measuring points or function calls can be deleted with the **<Correction>** key. Pressing the <Correction> key deletes the last probing point or the last function call (**<RECALL>, <FILEVAL>** etc.) within an N point program. By pressing the key repeatedly, you can move back to the N point program call step by step.

  Example:

  CIRCLE PRB POINT 1 → **CIRCLE PRB POINT 2** →
  CIRCLE PRB POINT 3 → **<CORR>** →
  CIRCLE PRB POINT 2 → **<CORR>** →
  CIRCLE PRB POINT 1

– **Deleting the N point program completely**

  As long as an N point program or the "Collect points in file" function is active, all measured points and the program call can be deleted with **<Cancel>**.

  The N point program must be recalled for a new measurement.

– **Overwriting a geometric element**

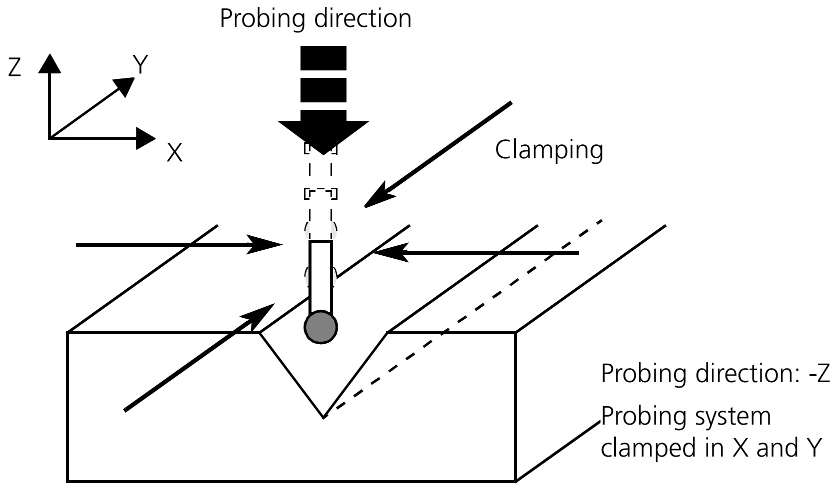
  An N point program which has already been terminated can be overwritten by a repeat measurement

  To do this, you first must reset the address counter with **<DI 1690>** (➤*„Setting the address counter to a random address <DI 1690>“ on page 6-8*). The address with the incorrect measurement will then be overwritten by the new measurement.

Self-centering probing (for the measuring probe head only)

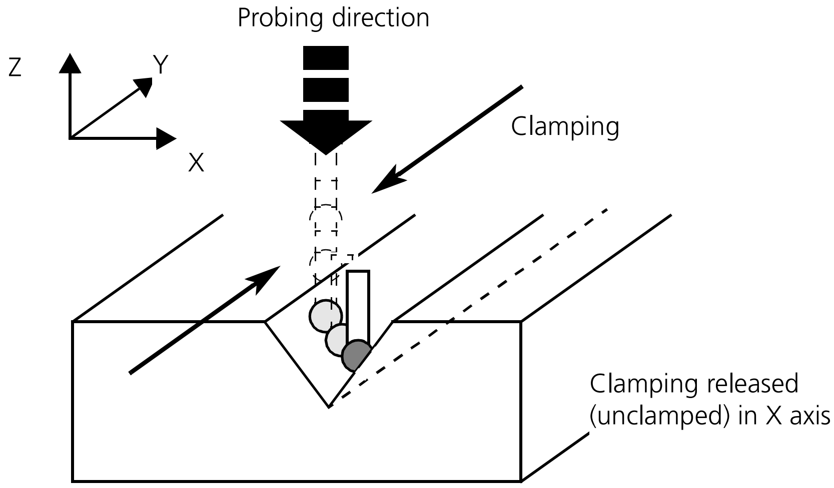
Application

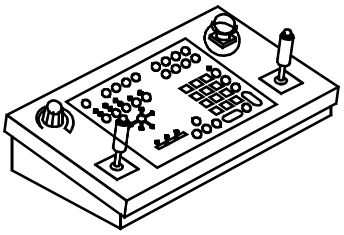
The probe head is normally unclamped only in the probing direction. This means that the probe head can move only in the direction in which the joystick is deflected.



Clamping release

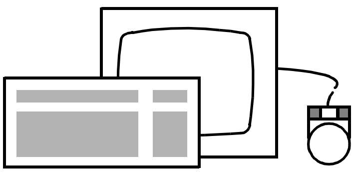
For self-centering probing in tapered bores, tooth spaces or V slots, the clamping of one or both of the other axes must be released.

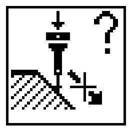


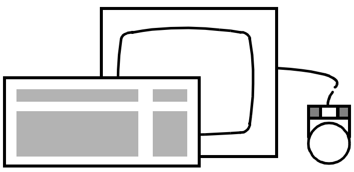


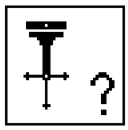
Procedure

Now set the **force direction** and **clamping** (see the relevant control console operating instructions).



DI	Pull-Down-Menu	Pictogram
1502	CMM	
VECFORCE	Mode	
	vectorial measuring force...	



DI	Pull-Down-Menu	Pictogram
1551	CMM	
PRBMOD	Mode	
	Probe head...	

Set the operating mode, measuring forces and clamping on the control panel!

Accept settings with **<TERMIN>**.

NOTE

The force direction selected must always coincide with the probing direction.
Don't forget to switch back to the **vectorial** operating mode after finishing the self-centering probing. This can be done with **<DI 1502>**.

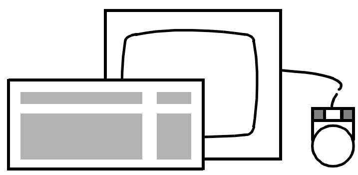
Changing the allocation of joystick deflection to travel movements <DI 1509>

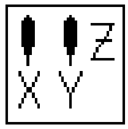
Application

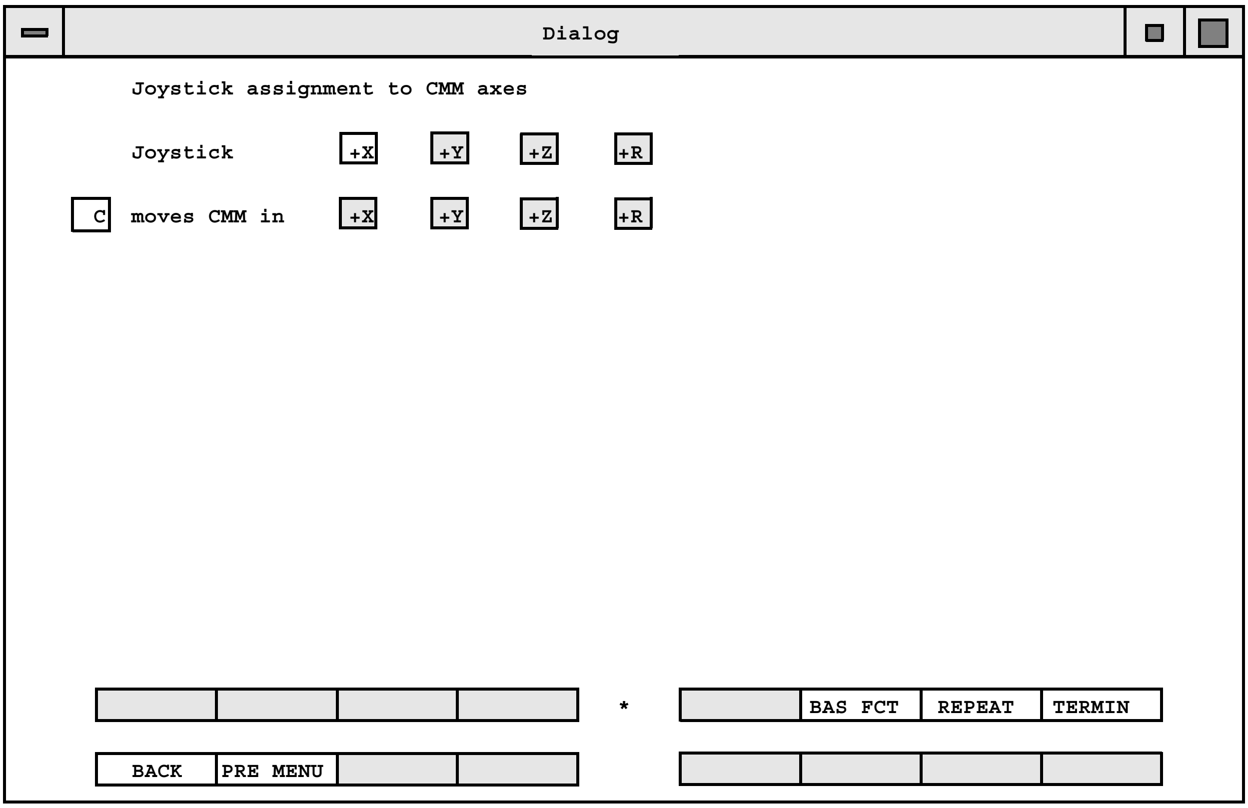
After calling **<DI 1509>**, you can (re)define the allocation between deflection of the joysticks and the travel direction of the probe head. This is useful e.g. if you want to locate the control panel to one side of the machine instead of at the front so that you can better observe travel movements.

Prerequisite

This function can be executed only with a 16-bit control.



DI	Pull-Down-Menu	Pictogram
1509	CMM	
JSTXYZ	Mode	
	Joystick-axis assignment...	



Data boxes

Define the required allocation. If you enter a space (blank), the corresponding axis will be deactivated.

BAS FCT

Restores the default initial status.

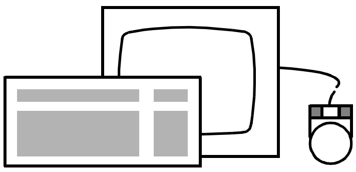
Travel in the workpiece or control coordinate system <DI 1506>

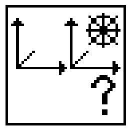
Application

With **<DI 1506>** you can assign the travel movement of the probe head to different coordinate systems.

Prerequisite

This function can only be executed with a 16-bit control.



DI	Pull-Down-Menu	Pictogram
1506	CMM	
JSTANG	Mode	
	Travel WP/control syst. ...	

Joystick travel system

Softkeys

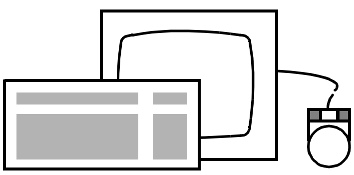
MC	Control in machine coordinate system
WP	Control in control coordinate system (W-Pos)
WS	Control in workpiece coordinate system
SENSOR	See DSE / LX operating instructions

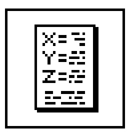
Displaying workpiece coordinates <DI 1507> <DI 15250>

Application

It is often useful to know the current position of the probe when it is traveling along the workpiece. The center point coordinates of the selected probe are therefore displayed in the workpiece coordinate system.

Display of workpiece coordinates on the control panel



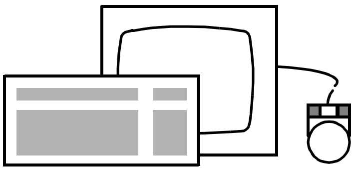
DI	Pull-Down-Menu	Pictogram
1507	Service	
	General	
	Coordinate display CP	

Probe change If you change probes on the control panel, the display will show this immediately.

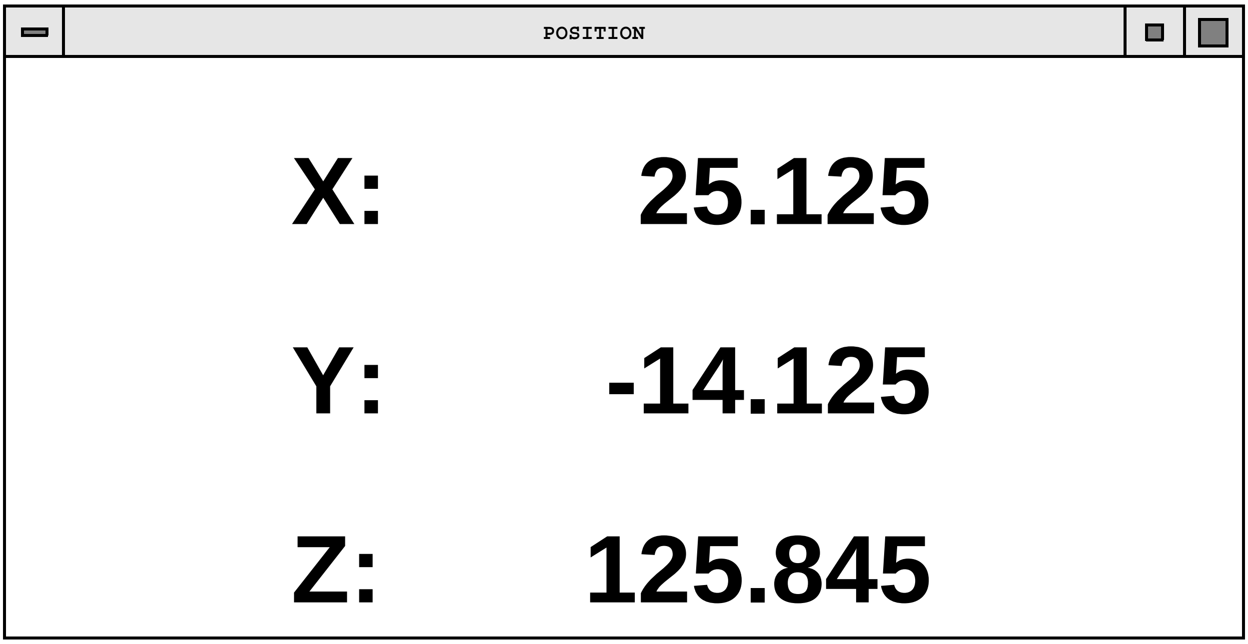
Disadvantage No other function can be called as long as the coordinate display is active on the control panel.

Other functions will be accepted only after you actuate the **<CAN-CEL>** key.

Displaying workpiece coordinates on the monitor



DI	Pull-Down-Menu	Pictogram
15250	Service	
	General	
	Coordinate display large	



Window size Unfortunately, the size of the display can not be changed.

Advantage All other functions can be called even while the display is active.

Changing probes If you change probes on the control panel, the display will be updated only after a probing has taken place!

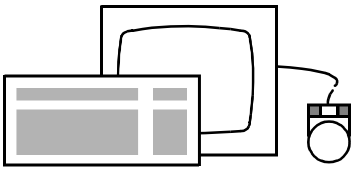
Closing the window If you call **<DI 15250>** again, the display closes.

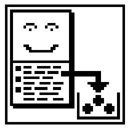
Creating/evaluating point collection files

Collecting points in a file <DI 1100>

Application

<DI 1100> stores points for calculation of a geometric element in a file. The geometric element for which these points are collected is irrelevant. It is thus possible to collect points for different elements using various measuring modes (manual probing, scanning etc.) and evaluate them later on with the **<File evaluation>** function (➤*„File evaluation“ on page 10-22*).



DI	Pull-Down-Menu	Pictogram
1100	Elements	
FILE	Data acquisition	
	Collect points in file. ...	

Procedure

The points can now be acquired by manual probing or one of the softkey functions (➤*„Probing possibilities“ on page 10-5*).

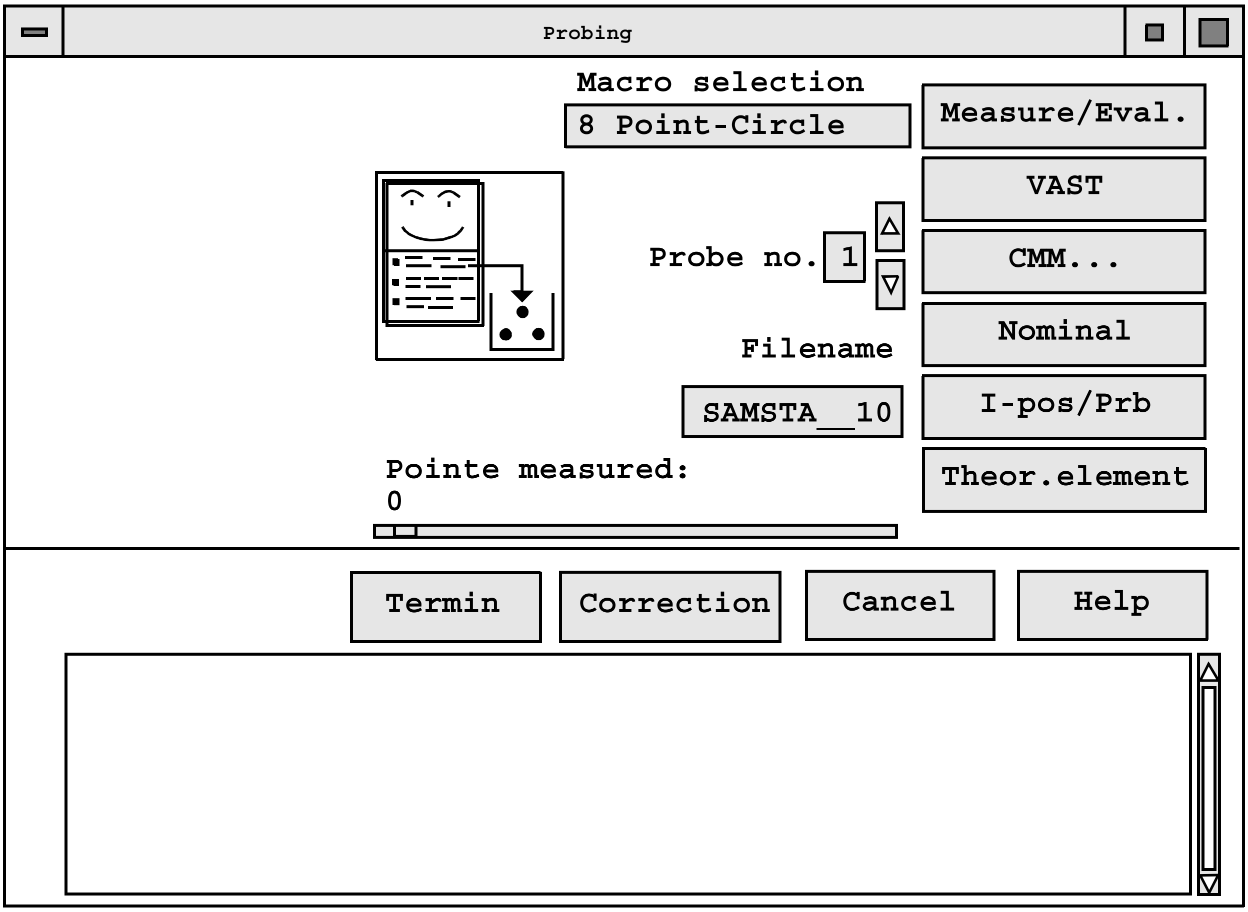
VAST

Branches to the dialog window for VAST functions.

VAST Circle

VAST surface

First you must select either the **VAST Circle** function or the **VAST surface** function for probing point acquisition (➤*„Geometric elements“ on page 11-1*).



Filename

The default name offered in the Filename box can be changed.

The prefix "**PKT**" and the suffix "**_U**" are added to the filename so that it has a total of 14 characters, after which the filename is stored in the **/home/zeiss/UG** directory on the hard disk.

File evaluation

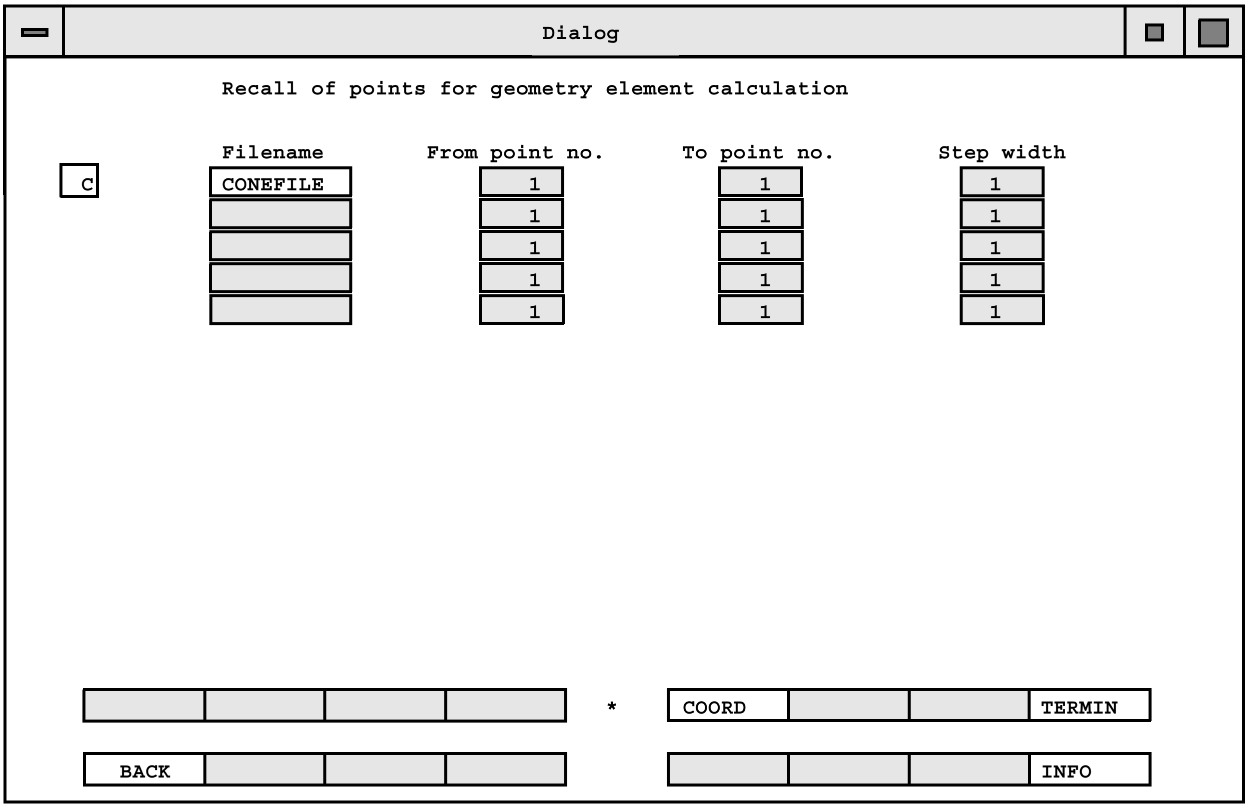
Application

You can use this function to calculate geometric elements from measured points which have been stored in a point collection file.

Procedure

– Call a geometric element (e.g. **<CIRCLE>**, **<SURFACE>** etc. ➤ *„Geometric elements“ on page 11-1*)

– Press the **<Measure/Eval> <File evaluation>** softkeys.

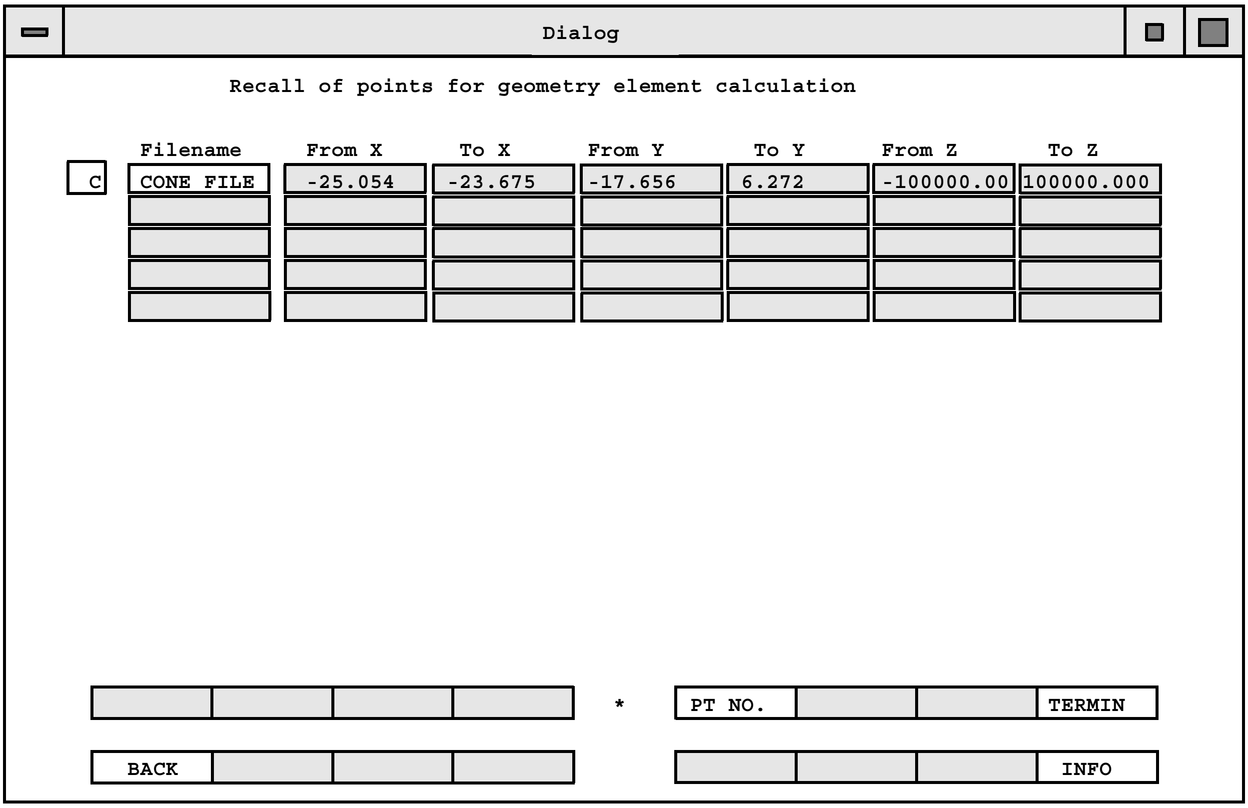


Explanation

Points from up to 5 different collection files can be used to calculate the geometric element (enter filenames).

Selection by coordinates

Depending on the geometric element involved, you can select points either by their numbers or by their coordinates. You can change dialog windows by pressing the **<COORD>** or **<PT NO.>** softkey.



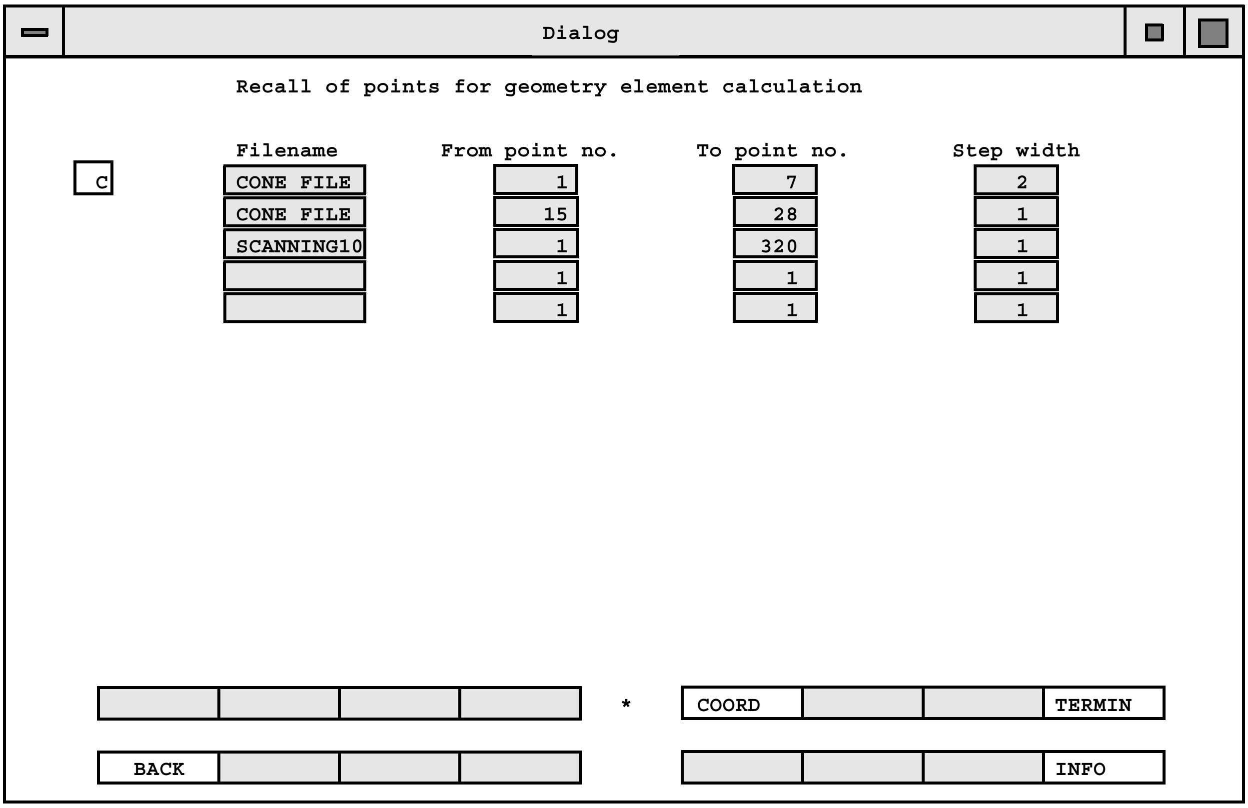
Application tip — If more than 5 point files must be used to form an element, proceed as follows:

<DI 1100> — Call **Collect points in file** and combine 5 of the point files to form a new file.

Call element — Perform file evaluation in the element concerned.

Example

Points from different point collection files must be evaluated to calculate (reconstruct) a cone. Points 1, 3, 5 and 7 and 15 to 28 from the **CONE_FILE** as well as points 1 to 320 from the **SCANNING** file are required for this purpose.



Press **<TERMIN>** to close the dialog window. The element is calculated and output to the record.

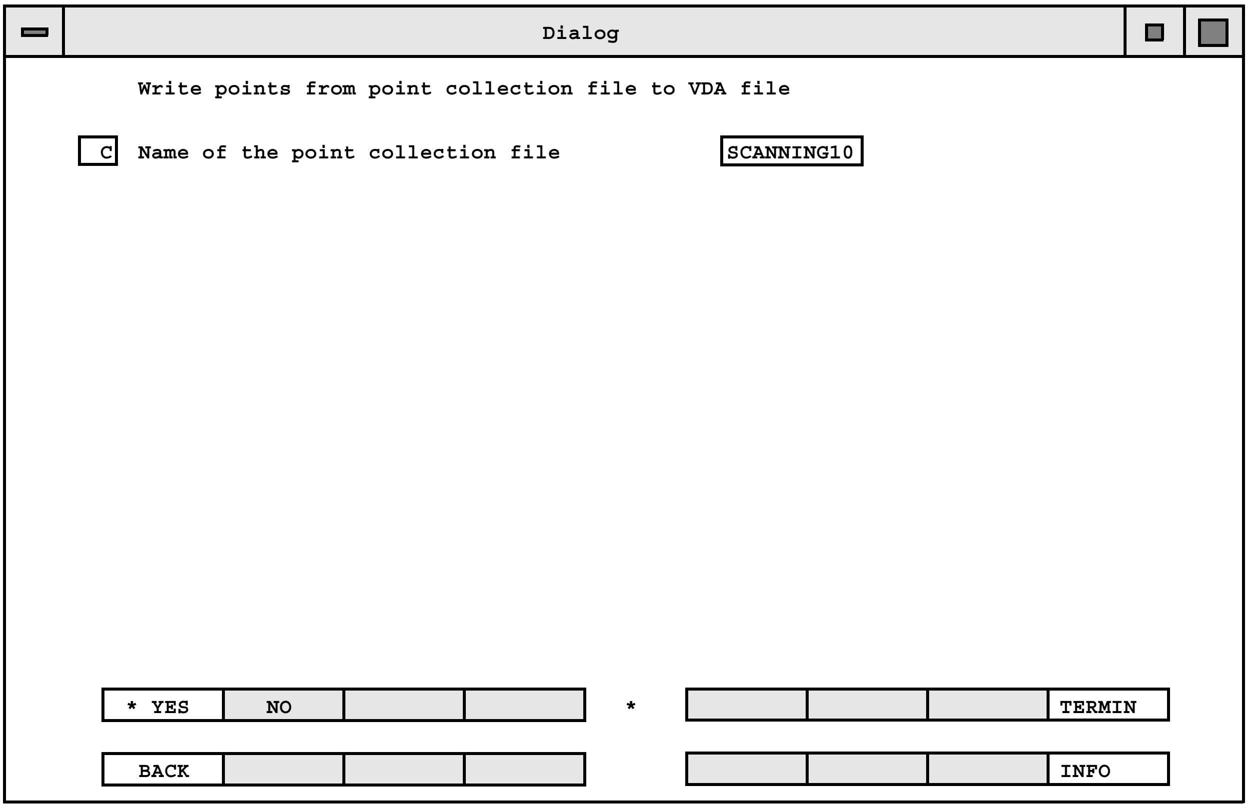
NOTE

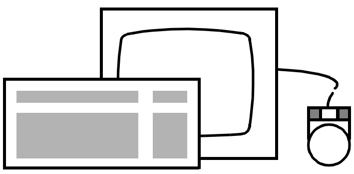
Recalled points and probed points must not be mixed.

Data transfer in VDA format <DI 1166>

Application

Individually probed or scanned points (in probe center coordinates) can be converted to VDA format and then transferred to other systems.





DI	Pull-Down-Menu	Pictogram
1166	ElementS	
	Data acquisition	
	Points to VDA...	

Procedure

– After calling **<DI 1100>,** collect the points in a file (stored internally in machine coordinates). The filename must be specified after terminating with **<TERMIN>**.

– Call **<DI 1166>** and specify the name of the point collection file created with **<DI 1100>**.
The data is converted to VDA format and the current workpiece coordinate system.

NOTE

The point collection files are stored in the **/home/zeiss/UI** directory of the hard disk (**VDA<Filename>__B**).

Finding kink points <DI 1189>

Application

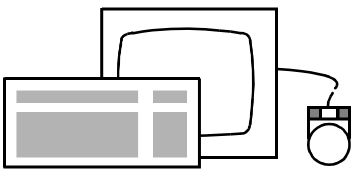
Scanned contours may be made up of lines and/or arcs of circles. Prior to further processing with N-Point programs, point sets of this type must be divided into segments. Separation into segments always takes place at points where the program detects a distinct change in direction: e.g. line/arc of circle or arc of circle/arc of circle transitions.

Prerequisite

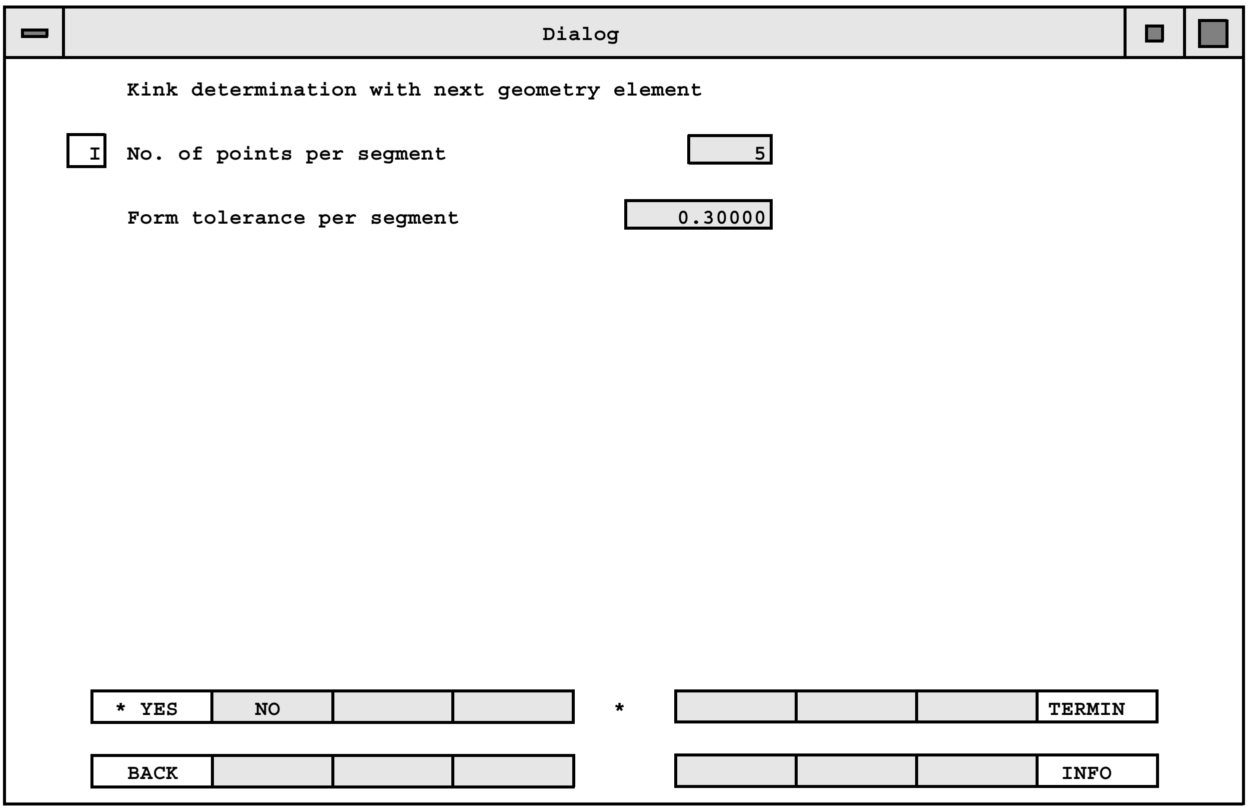
The points must be probed in a continuous sequence.

Procedure

– Save points to a collection file **<DI 1100>**.
– Probe contour in the scanning mode.
– Call **<DI 1189>** before each N-point program.
– Call N-point program. Access points from collection file by calling **<File evaluation>**, select segment.



DI	Pull-Down-Menu	Pictogram
1189	Eval	
	Additions	
	Kink recognition...	



Data boxes

Number of points per segment

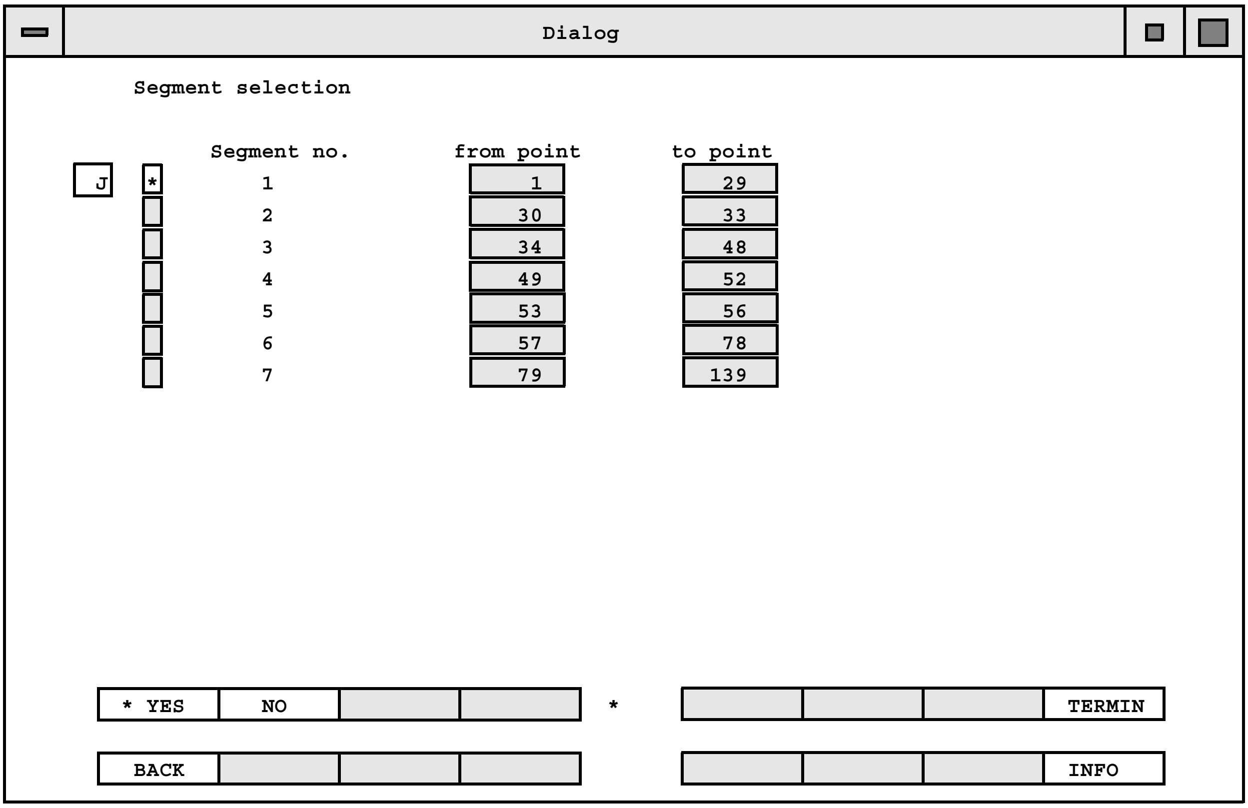
This input determines the minimum number of points per segment. Kinks with fewer points are ignored.

Form tolerance per segment

Kinks which lie within the specified form tolerance are ignored. A kink will be registered only if the form tolerance specifying the minimum number of points per segment is exceeded.

Procedure

The point set of the preselected file is seached through using the kink determination parameter. The segments found are then offered for selection. Use **<YES>/<NO>** to select one or more segments. Then start the calculation of the N-point element with **<TERMIN>**.



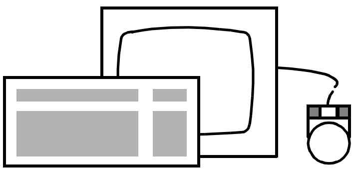
NOTE This function can find max. 7 segments.

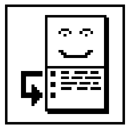
Recalling results

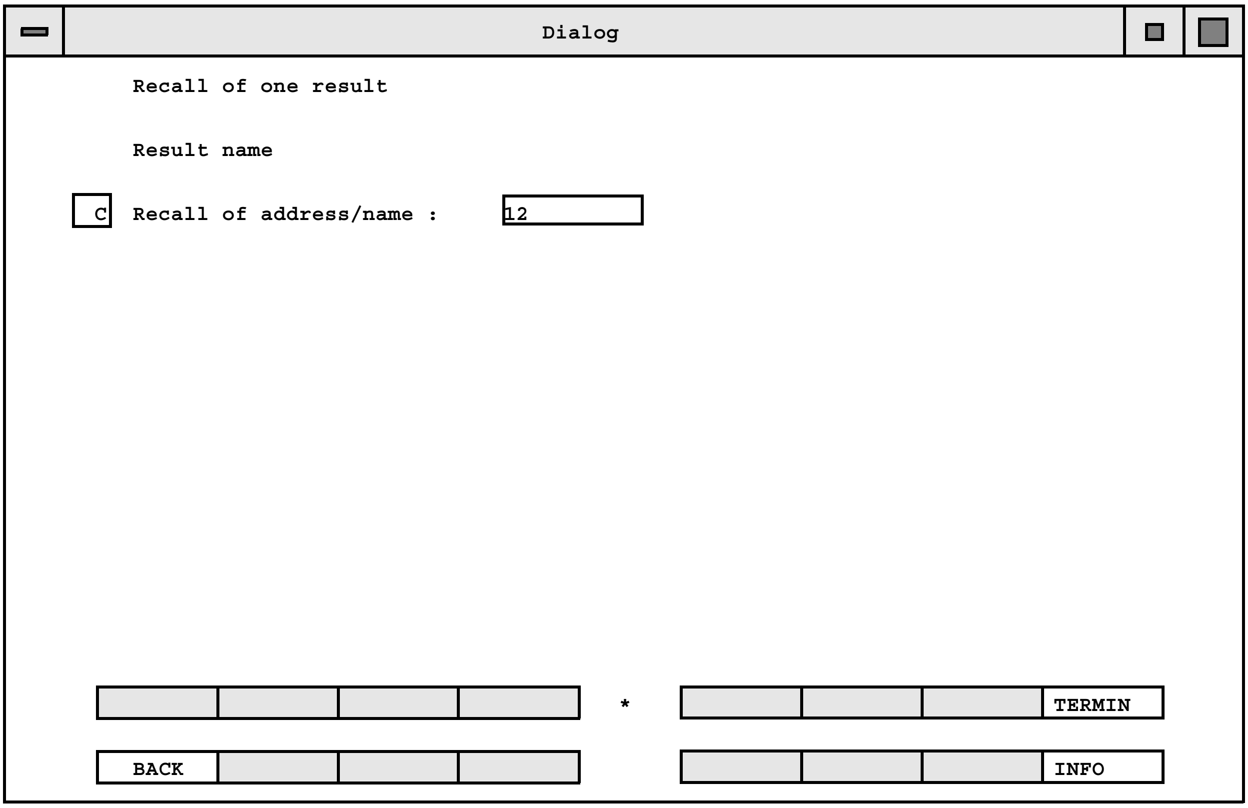
Recall of an address <DI 1301>

Application

Certain functions in UMESS always refer to the last element in the measurement record. With the **<RECALL>** function you can reprint any previously determined result and thus place it in the last position of the measurement record.



DI	Pull-Down-Menu	Pictogram
1301	Elements	
RECALL	Recall...	



Data boxes

Result name

Enter the name you want to assign to the recalled element here (follow rules ➤„Allocating names“ on page 5-9).

Recall of address/name:

Specify the element you want to recall here.

Your options include:

– **Absolute recall**
  Enter the name or address under which the element you wish to recall has been saved in the measurement record.

– **Relative recall**
  Calculate the difference between the address printed last and the address of the required element, add 1, and enter this sum with a "-" sign. In this way, you can recall an element regardless of the current count on the address counter. A relative recall makes sense, e.g. when repeating program steps in loops, since an absolute recall would always access the same geometric element in such cases.

Comparison of absolute and relative recalls:

	ADR address counter, absolute recall	Relative recall
	20	-4
Last ADR in the record	21	-3
	22	-2
	23	-1

NOTE

If several different functions are to be used for a single result, the result must be recalled before every function.

Additional inquiry

If the workpiece coordinate system has been changed between the definition and recall of an element, the following inquiry will be displayed:

Current coordinate system?

YES

The data of the element recalled is converted to the currently valid workpiece coordinate system.

NO

The data is retained in the original coordinate system.

The type of transformation selected is indicated in the measurement record:

ADR	RKF	
25		GEOMETRIC ELEMENT
40	25*	GEOMETRIC ELEMENT
42	25!	GEOMETRIC ELEMENT

Specification of recall address

* = Recall in the original coordinate system

! = Recall with transformation to another, currently valid coordinate system

= Recall from another column

Current record address

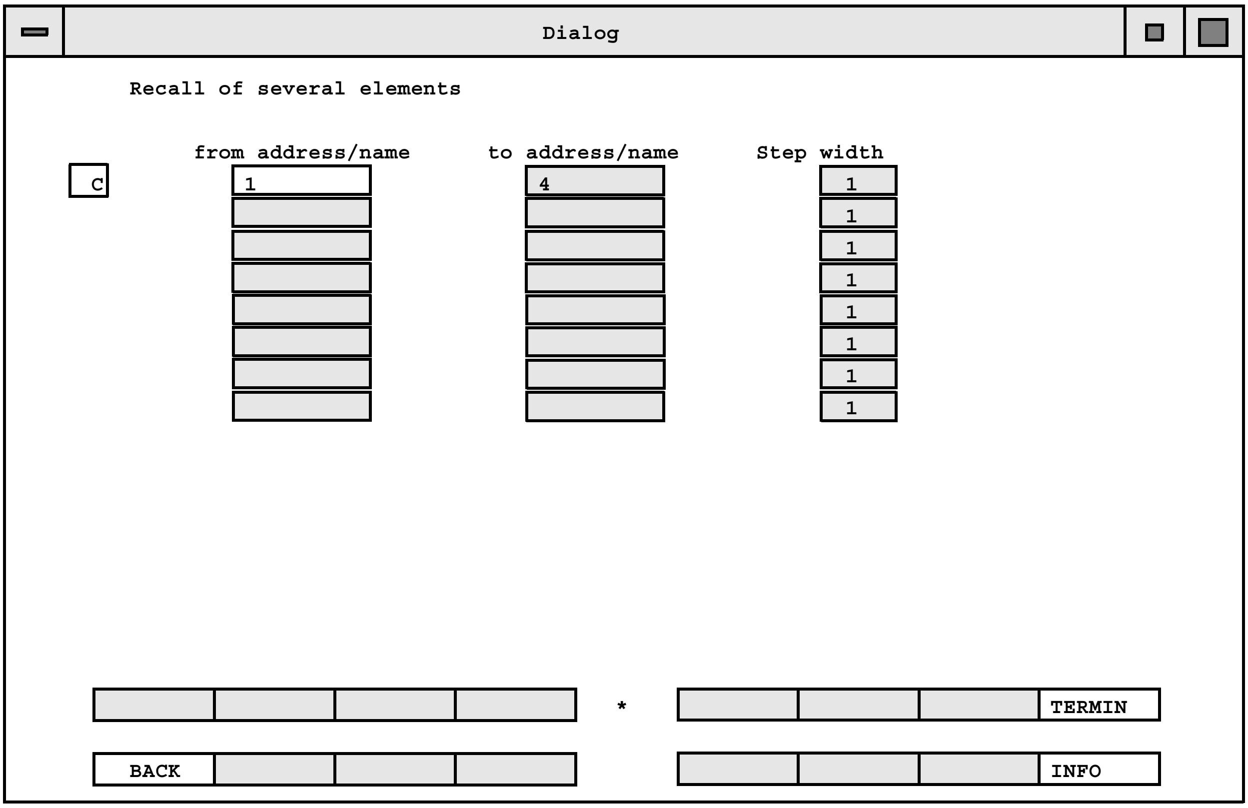
Recall of several elements

Application

In the **Recall of several elements** dialog window individual results previously printed in the measurement record can be linked to construct a new element.

Function call

The dialog window is called by actuating the <Recalls> softkey within an element. Aufgerufen wird die Eingabemaske über den Softkey **<Rueckrufe>** innerhalb eines Elementes.



Data boxes

from address/name

Enter name or address of first element of area to be recalled.

to address/name

Enter name or address of last element of area to be recalled.

Step width

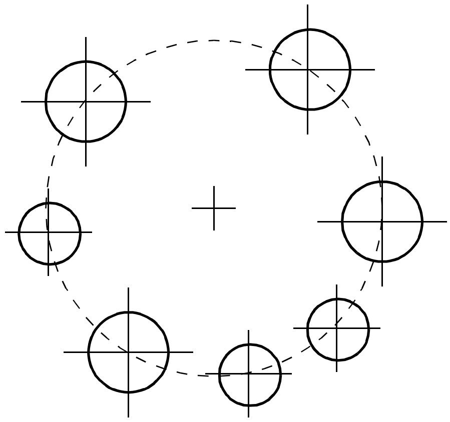
Distance between required elements within an area.

NOTE

- Elements can be recalled from a maximum of eight areas.
- The use of relative addresses is possible (➤*„Recall of an address <DI 1301>“ on page 10-29*).

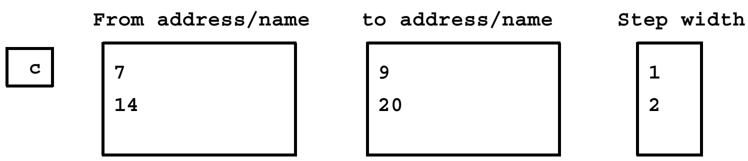
Example

Calculation of a new circle from 7 previously measured circles. The individual elements required are stored under the addresses 7, 8, 9, 14, 16, 18 and 20.



Procedure

- Call **<CIRCLE>** function.
- Press the **<Measure/Eval> <Recalls>** softkeys.
- Enter elements required:



- Close dialog window with **<TERMIN>**.

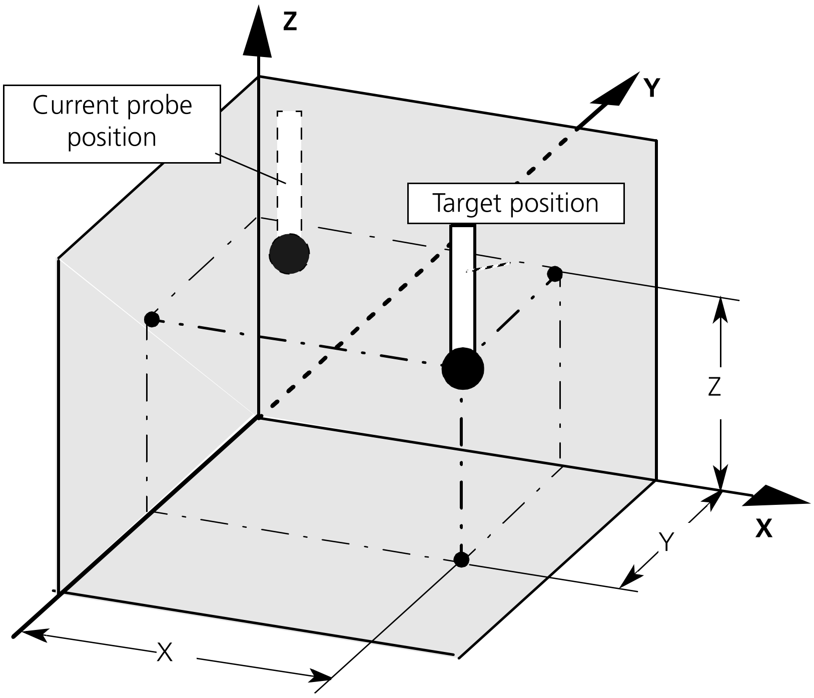
Travel commands

Application

The current probe can be brought to an exactly defined target position using the travel commands. The target position can either be entered directly in workpiece coordinates or via travel paths.

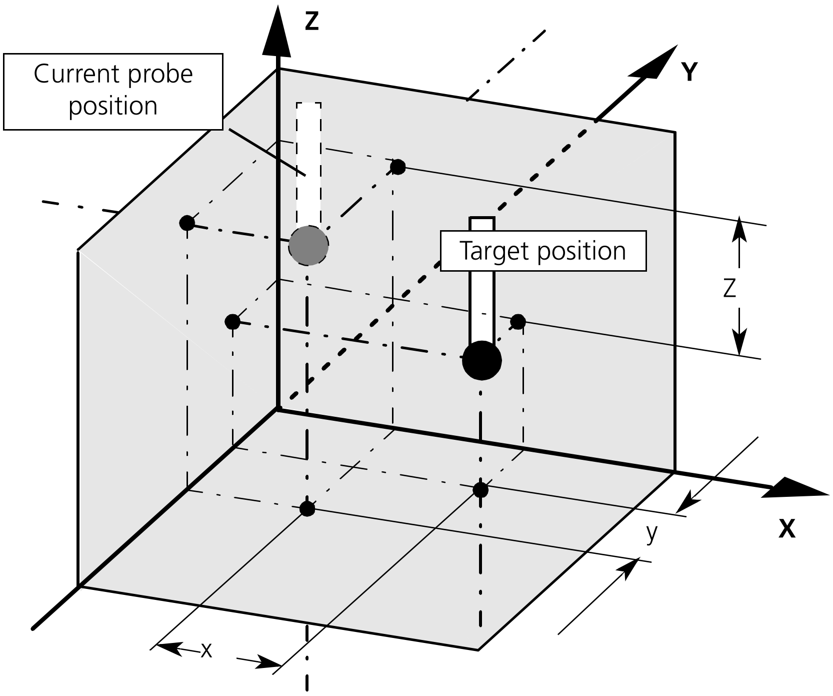
Input in workpiece coordinates

To be used with: **<POSITION>**, **<POS.RES>**, **<POS NORM>** (➤*„Positioning to workpiece coordinates <DI 1511>“ on page 10-37* to ➤*„Positioning to a normal vector <DI 1514>“ on page 10-40*)



Input as travel path

To be used with: **<STEP>**, **<REF PT.>** (➤*„Travel from the current position in fixed steps <DI 1515>" on page 10-41*, ➤*„Travel from a probing position in fixed steps <DI 1516>" on page 10-43*).

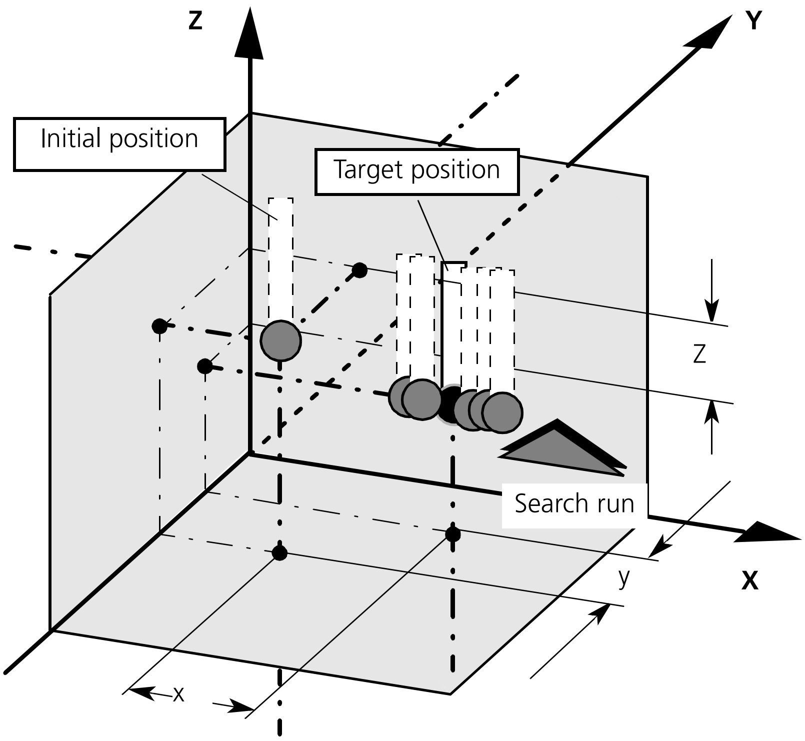


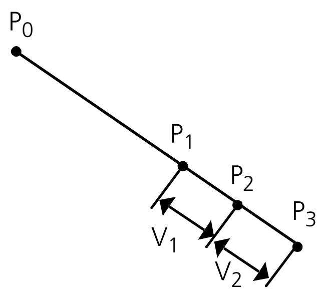
Application

With every travel command it is possible to probe a point with a search run. Before the machine reaches the target position, it is switched to probing speed. The machine then travels at this speed until a probing occurs. Probing search paths can be defined before and after the nominal position with the probing parameters (➤*„Probing parameters <PROBE P>" on page 6-11*).

Seach run

The search run is always performed in the direction traveled by the machine to reach the target position (exception: positioning to normal vector ➤*„Positioning to a normal vector <DI 1514>“ on page 10-40*).





P_0: Initial position

P_1: Position before nominal probing point. From here the machine switches to probing speed.

P_2: Target position (nominal probing position)

P_3: Position after nom. probing point. The error message: **No probing found** is displayed here.

V_1: Probe search path before nom. position

V_2: Probe search path after nom. position

V_1 and V_2 can be set with **<DI 1661>**, **<PROBE P>** (➤*„Probing parameters <PROBE P>“ on page 6-11*).

Prog mode

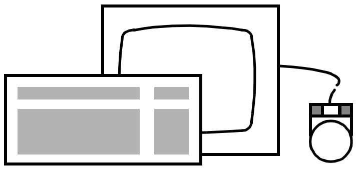
In learn (part) programming, the travel path required to reach the target position and the following search run are stored in the control data as a single travel command.

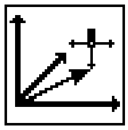
Positioning to workpiece coordinates <DI 1511>

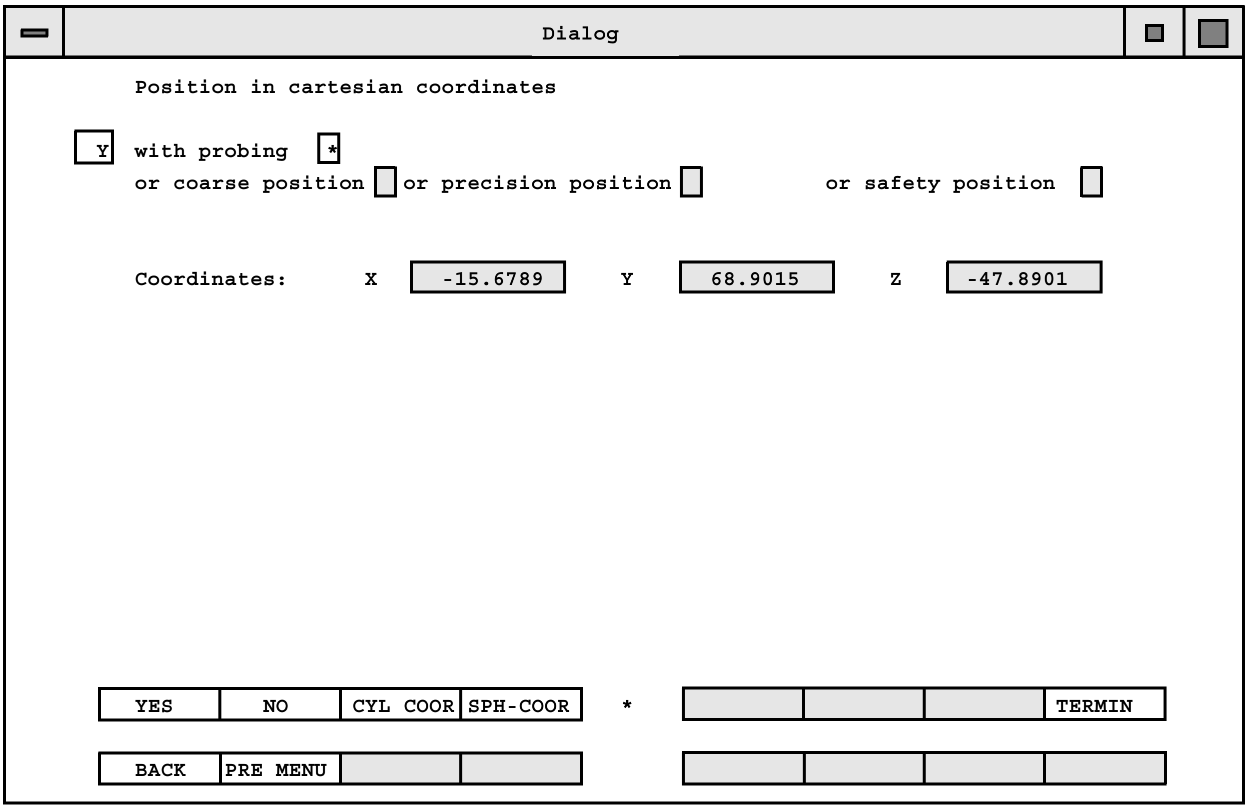
The target position must be entered in workpiece coordinates.

Application possibilities

– Fine positioning in the workpiece coordinate system for CNC programs
– Probing defined points on surfaces
– Positioning the probe in narrow bores
– Checking the current workpiece coordinate system.



DI	Pull-Down-Menu	Pictogram
1511	CMM	
POSITION	Travel commands	
	Position...	



Data boxes

with probing

- **<YES>**
  Probing with search run,
- **<NO>**
  Intermediate position

or coarse position
or precision position
or safety position

These boxes are currently treated as precision positions.

Coordinates:
X ……. Y ……. Z …….

Input of the target position in the workpiece coordinate system. The position is traveled to with **<TERMIN>**.

CYL COOR

SPH-COOR

With these softkeys you can change between:

- cartesian coordinates,
- cylinder coordinates and
- sphere coordinates.

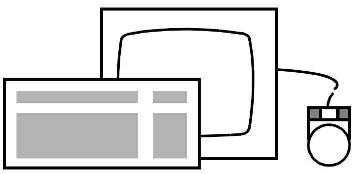
Positioning to a result <DI 1513>

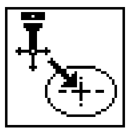
Application

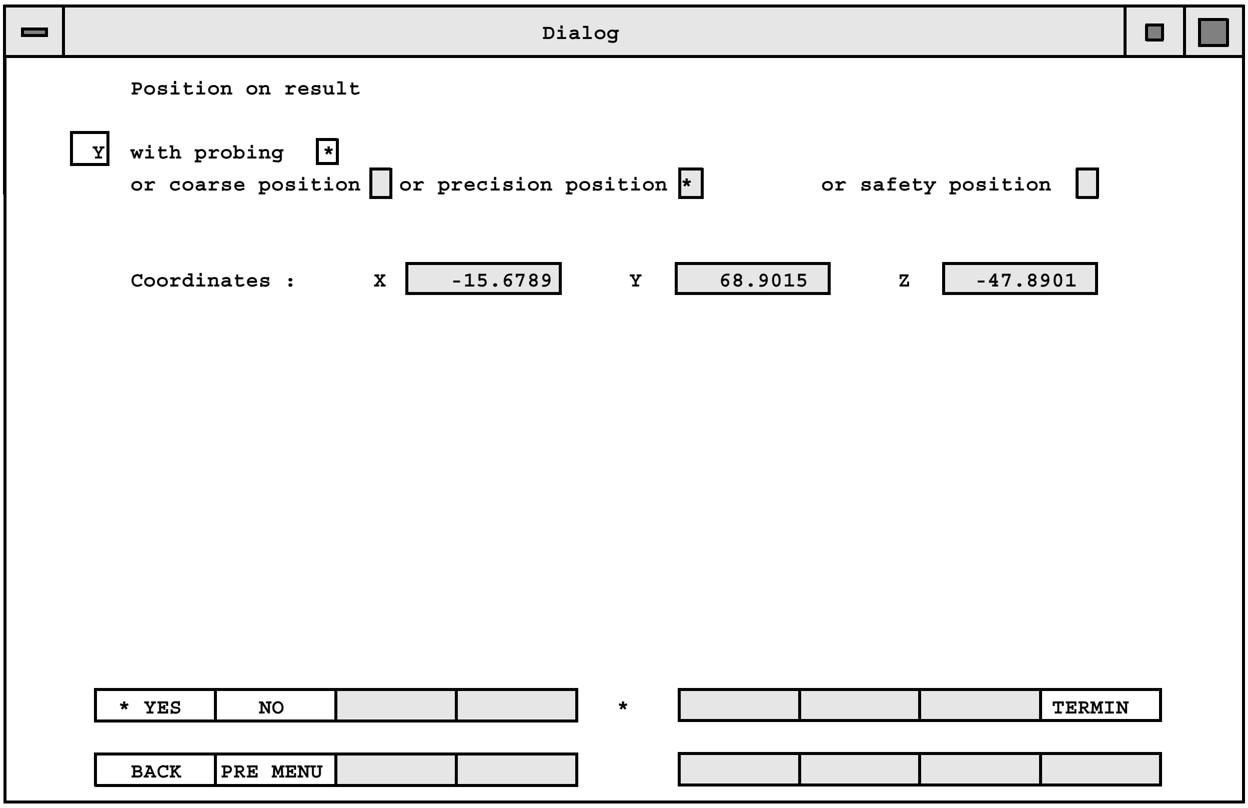
This function is called to position the current probe to the coordinates of the last result in the measurement record.

Application possibilities

- Fine positioning in the workpiece coordinate system in CNC programs
- Positioning the probe to the center of a bore
- Travel to a symmetry point
- Probing of defined points



DI	Pull-Down-Menu	Pictogram
1513	CMM	
POS-RES	Travel commands	
a97	Pos. to result...	



Data boxes

with probing

– **<YES>**
  Probing with search run,
– **<NO>**
  Intermediate position

or coarse position
or precision position
or safety position

These boxes are currently treated as precision positions.

Coordinates:
X .... Y .... Z ....

Input of target position in the workpiece coordinate position. Travel to target position is started with **<TERMIN>**.

NOTE

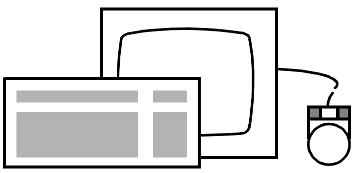
– The element concerned must be located under the last address in the measurement record when the function is called.
– By including the **<FORMULA>** program (➤*„Determining the minimum and maximum of measurement results <DI 1341> <DI 1343>“ on page 12-40*), it is possible to probe defined points based on the results of measurements.

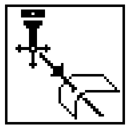
Positioning to a normal vector <DI 1514>

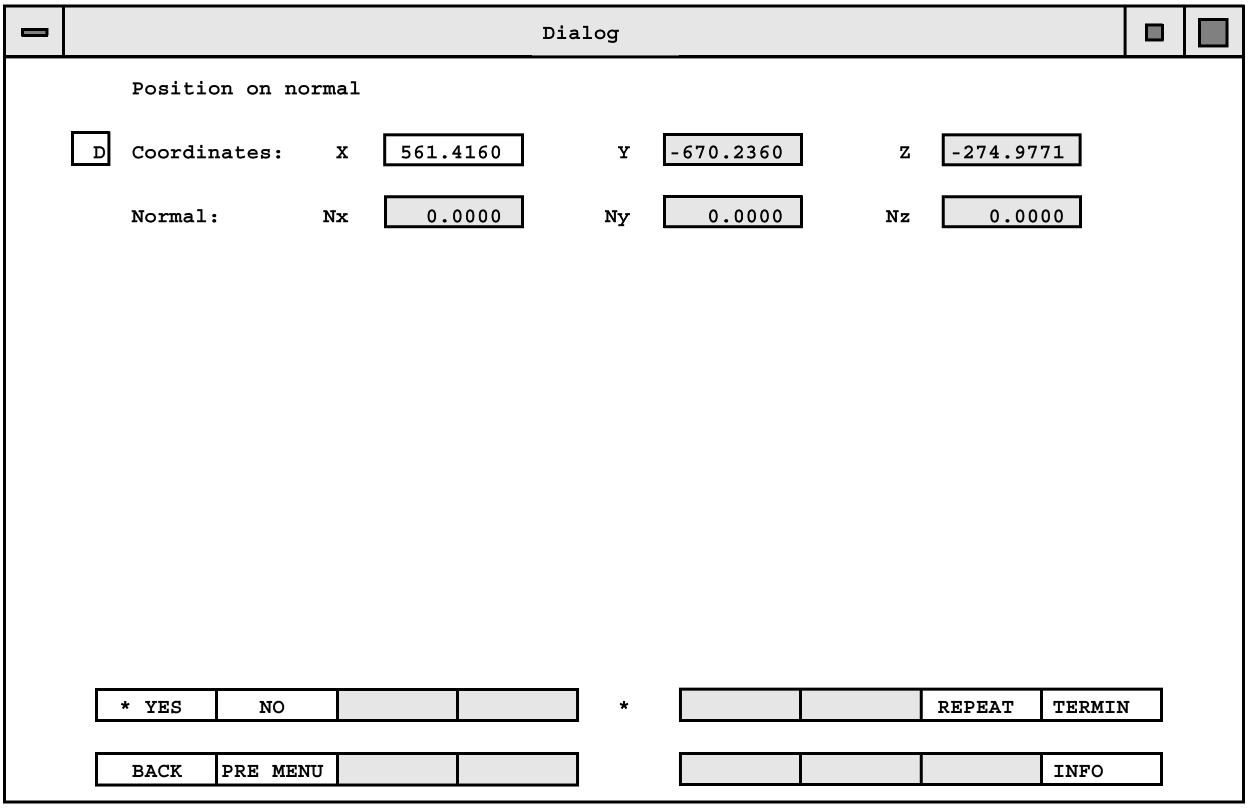
Application

With this function a space point, i.e. a point on any curved surface, can be probed in the normal direction.

The direction of the normal also must be entered. The specified target point is automatically probed during the search run.



DI	Pull-Down-Menu	Pictogram
1514	CMM	
POSNORM	Travel commands	
	Pos. in vector direction...	



Data boxes

Coordinates:
X .... Y .... Z ....

Enter the nominal position of the contact point in the direction of the normal in cartesian coordinates.

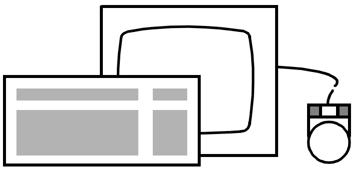
Normal:
Nx...... Ny....... Nz.......

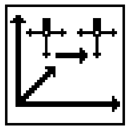
Enter the direction of the normal. Travel to the position is initiated with **<TERMIN>**.

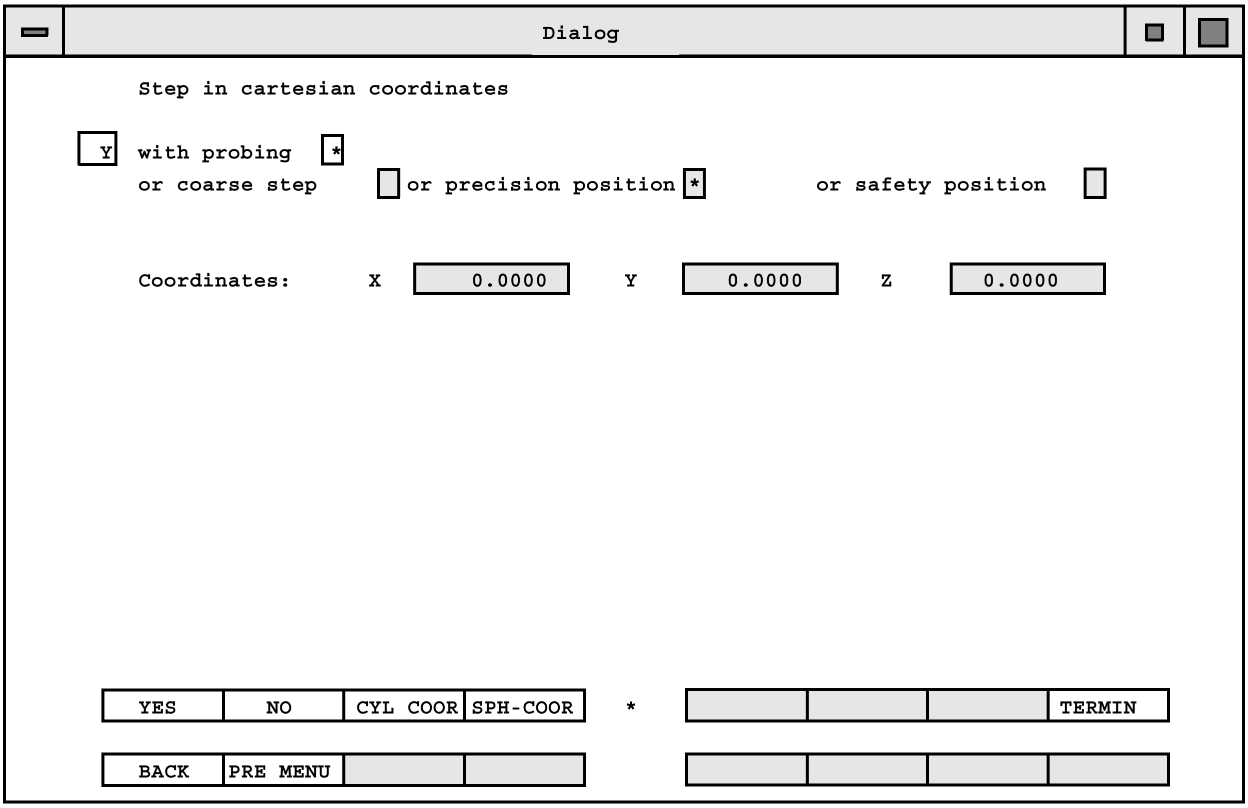
Travel from the current position in fixed steps <DI 1515>

Application

By calling the **<STEP>** function, the probe can be moved out of the current position in one or more axes. In this way a uniform matrix of probings can easily be realized. With the measuring probe head, probe travel while in contact can also be performed via the **<STEP>** function.



DI	Pull-Down-Menu	Pictogram
1515	CMM	
STEP	Travel commands	
	Step...	



Data boxes

with probing

– **<YES>**
  Probing with search run,

– **<NO>**
  Intermediate position

or coarse position
or precision position
or safety position

These boxes are currently treated as precision positions.

Coordinates:
X .... Y .... Z ....

Input of target position in the workpiece coordinate system. Travel to the position is started with **<TERMIN>**.

CYL COOR

SPH-COOR

With these softkeys you can change between:

– cartesian coordinates,
– cylinder coordinates or
– sphere coordinates.

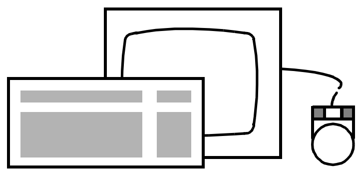
NOTE

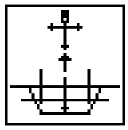
– The positioning errors accumulate following repeated program calls in the manual mode.
– In the CNC and PROG modes, a step away from a probing is always referenced to the center point of the probe ball in the probing position, even during automatic backaway (trigger probe head). The backaway or retract distance has no influence on the step matrix.

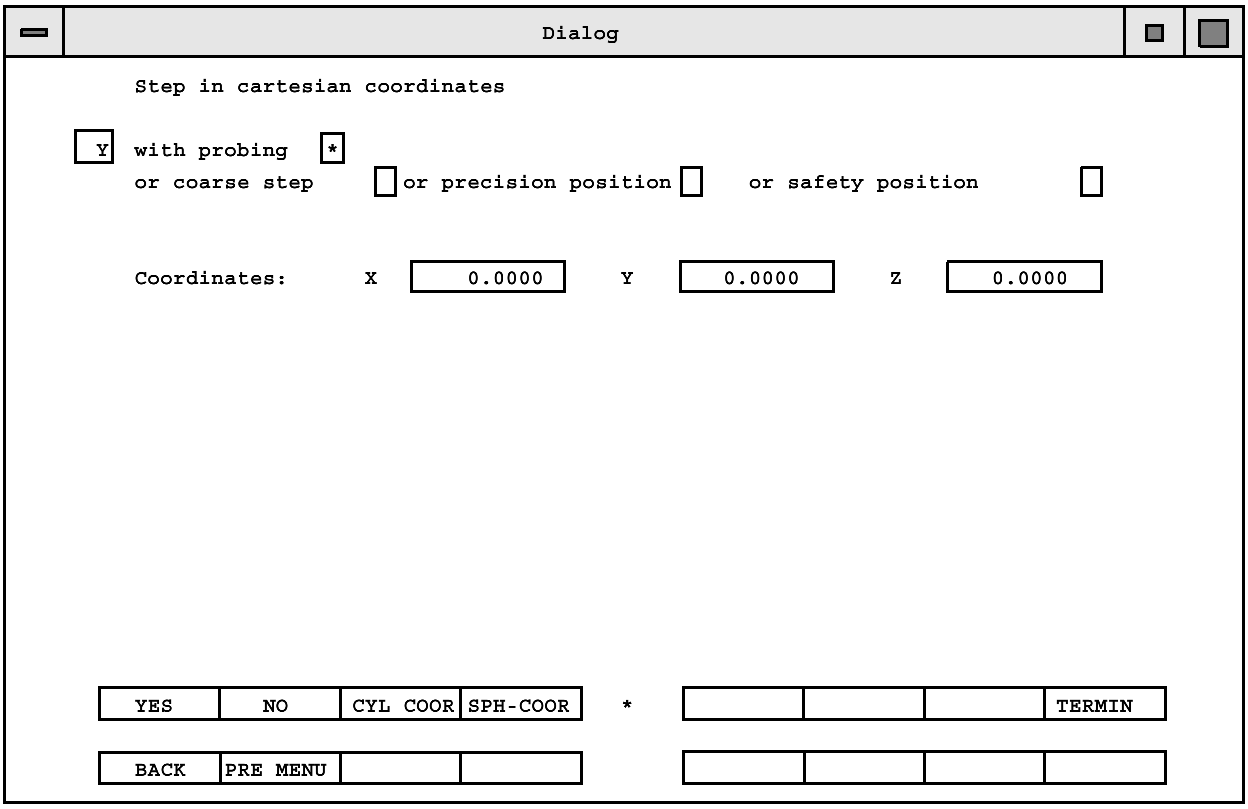
Travel from a probing position in fixed steps <DI 1516>

Application

By calling the **<REF STEP>** function, probe travel can be performed by a defined distance. The travel path entered is here referenced to the coordinates of the last probing point. This makes it possible to program CNC travel paths which are referenced to an individual probing point for every workpiece.



DI	Pull-Down-Menu	Pictogram
1516	CMM	
REF STEP	Travel commands	
	Reference point/step...	



Data boxes

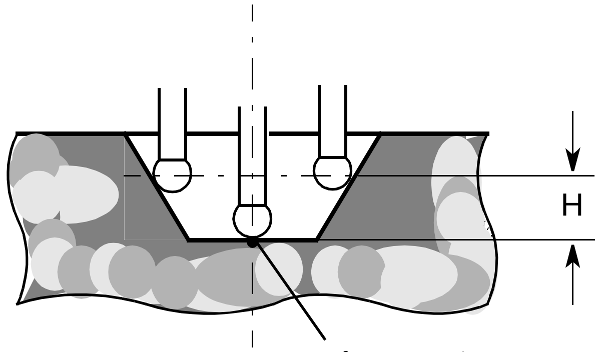
Operation as with **<DI 1515>**

NOTE

- The function must be called with the probe in contact.
- The reference point defines a temporary control coordinate system. I.e. all subsequent travel commands executed with the **<STEP>** function refer to the reference point. The reference to the W-POS system is reestablished by setting an intermediate position.

Example

Measurement of the diameter of a conical bore at a defined distance (H) from the base of the bore.



Procedure

- Probe base of bore
- Call **<REF STEP>** with the probe in contact. Enter distance H.
- Call **<CIRCLE>** and probe the required points with the **<STEP>** function.
- After completing the circle measurement, reestablish a reference to the W-POS system by setting an intermediate position.

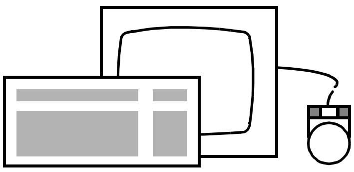
Additional information

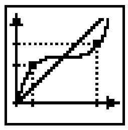
Extreme values <DI 1460>

Application

If the minimum point number is exceeded, an N POINT ELEMENT will be mathematically fitted to the point set so that the sum of the errors squared is reduced to a minimum (Gauss method of least square errors).

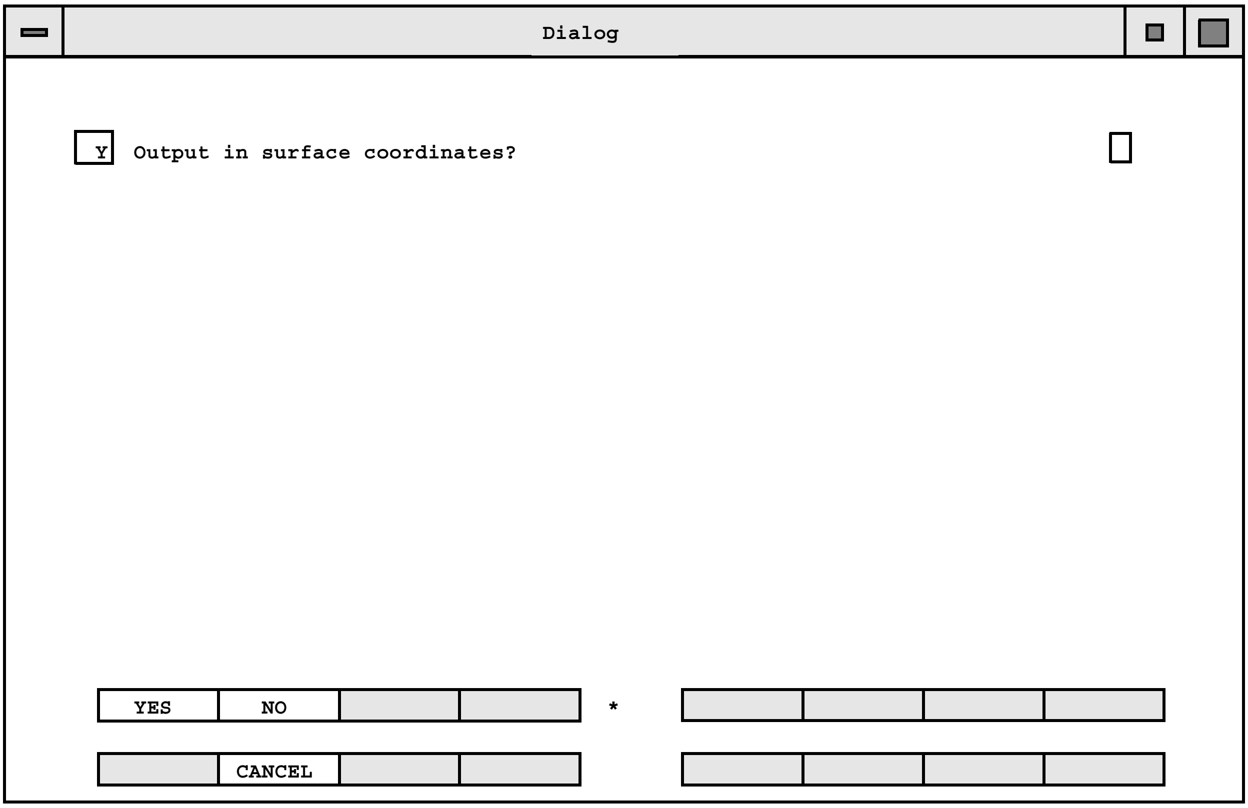
Immediately after calculating a geometric element, the positions of the extreme values can be output with **<EXTREME>** if the minimum number of probing points has been exceeded. The positions of the MIN and MAX values are output in workpiece coordinates.



DI	Pull-Down-Menu	Pictogram
1460	Eval	
EXTREME	Additions	
a59	Extreme values...	

NOTE

The extreme values (L-EXTREME and U-EXTREME) are output in two consecutive record addresses. The specified nominals apply for both extreme values. If individual nominals are to be assigned to each extreme value, this can be done by recalling every address: Specify nominals with **<DI 1459>**. Then recall an extreme value (output as POINT).



YES The actual probing points of the extreme values are output.

NO The coordinates of the probe ball center point at the extreme probing points are output.

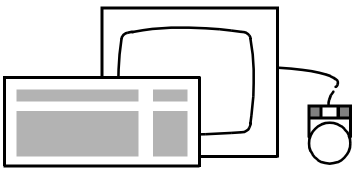
Form error <DI 1449>

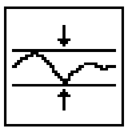
Application This function calculates the form error of geometric elements.

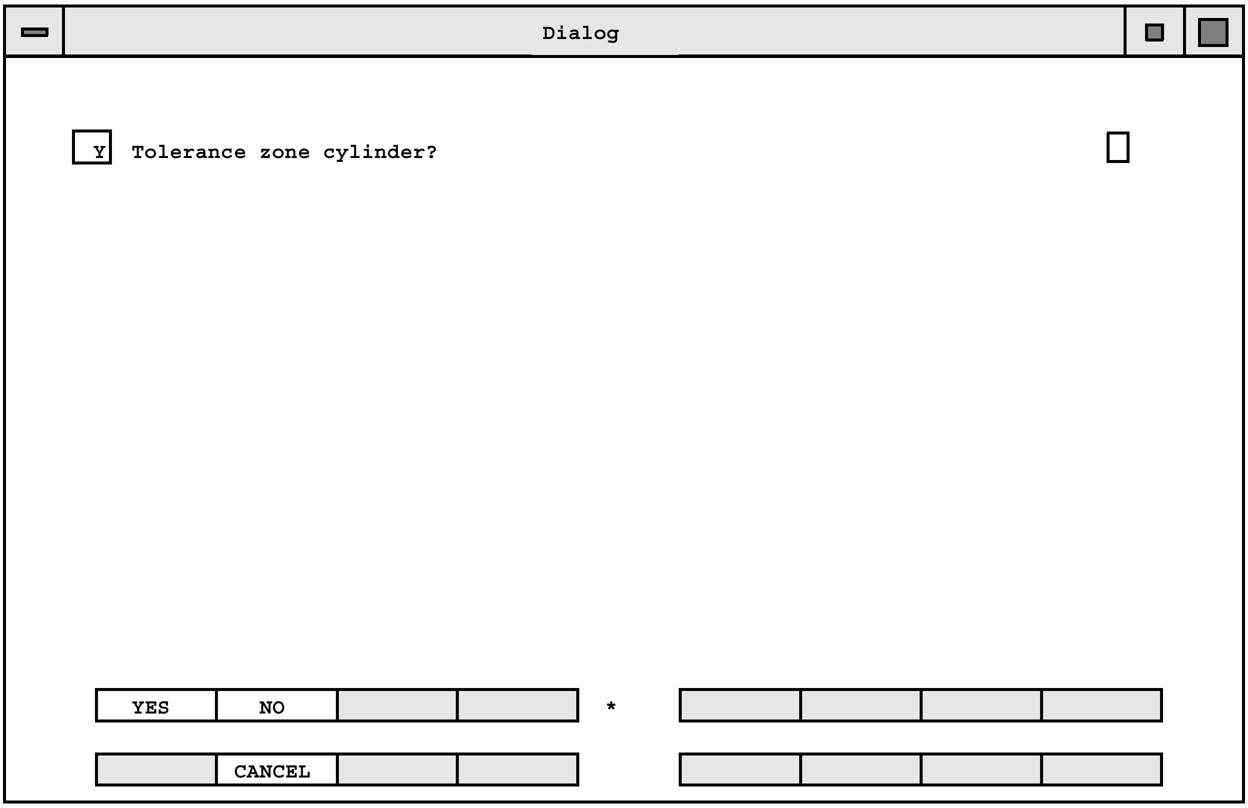
Prerequisites

– The minimum number of probings was exceeded while measuring the element.

– The element in question must be the last one in the record (measured or via **<RECALL>**).



DI	Pull-Down-Menu	Pictogram
1449	Eval	
FORM	Form	
a93	Form dev. ...	



Explanation of dialog

Tolerance zone cylinder?

This inquiry appears only if the last element in the record is a **LINE**. If **<YES>** is selected, the calculation will be based on a cylindrical tolerance zone; if **<NO>** is selected, a cube shaped tolerance zone will be used.

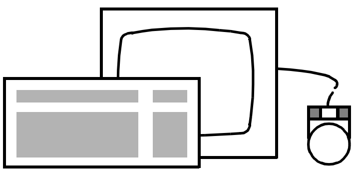
NOTE

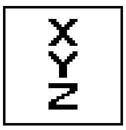
If a **NOM-ACT COMPARISON** is to be performed for the form deviation, the permissible form devation must be entered in line D. In this case, a zero must be entered for both the upper and the lower tolerance.

Supplementary coordinates <DI 1262>

Application

For point probings, only the coordinate in the probing direction is output. The remaining coordinates can also be output by calling **<XYZ>**.



DI	Pull-Down-Menu	Pictogram
1262	Eval	
XYZ	Additions	
	XYZ supplement	

NOTE

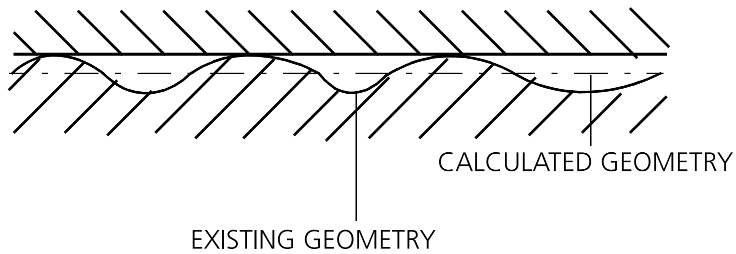
- The result is not assigned a separate address or name.
- The function must be called immediately after the element concerned (not after **<RECALL>**).

Mating size (sigma factor) <DI 1681>

Application

If the minimum number of points is exceeded during an N point program, the best fit geometric element will be calculated (according to the Gauss method for standard elements).

The actual contact points deviate from the calculated ones depending on the nature of the surface probed.

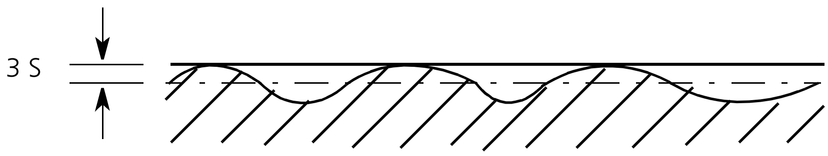


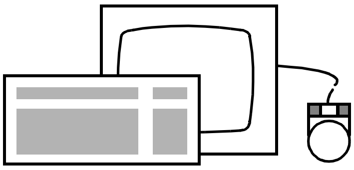
Mating size

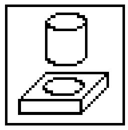
The calculated geometry is mathematically displaced to obtain the mating size (actual contact points). The direction of displacement is always away from the material.

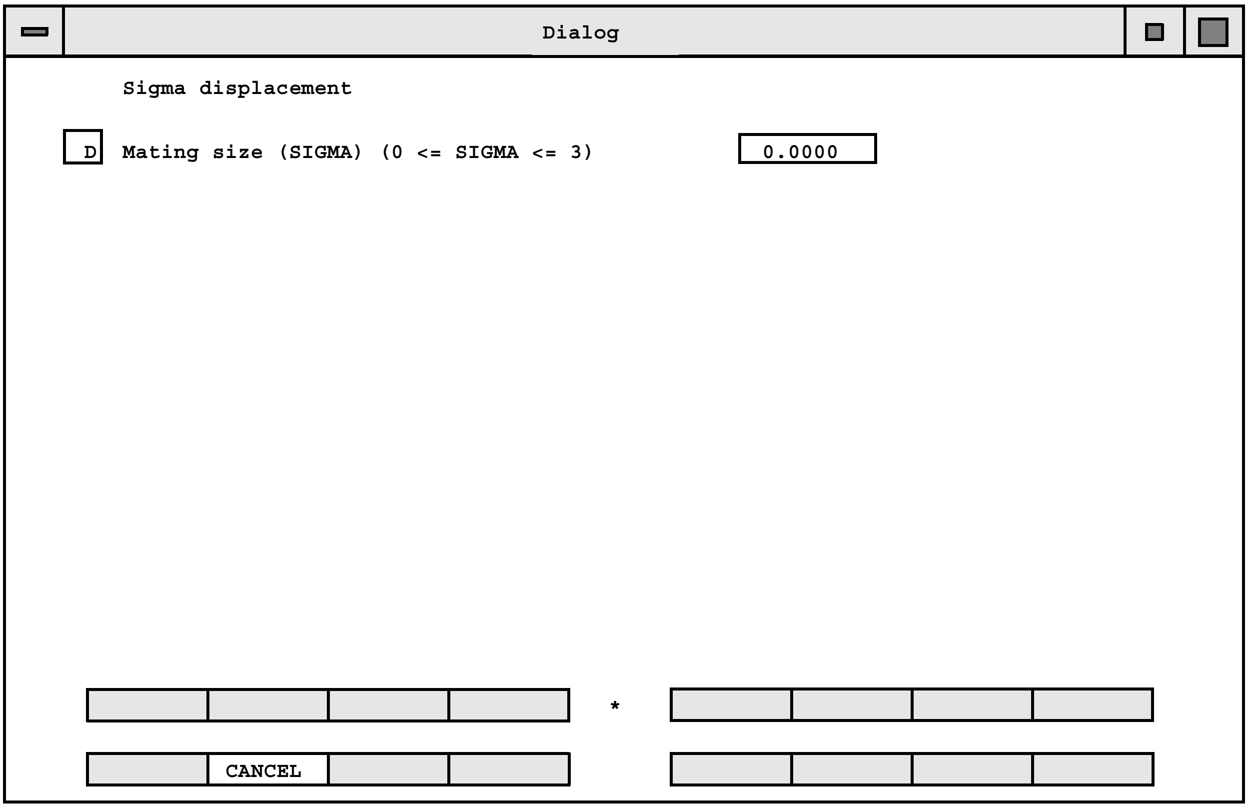
The displacement value is calculated from point spread S and a factor 0...≤3. This factor must be empirically defined for each workpiece (the macrostructure of the workpiece surface and the diameter of the probe ball may influence the required displacement factor).

If the point spread has a normal distribution, the actual contact points and the calculated geometry will coincide provided that the displacement factor reaches a value of 3.





DI	Pull-Down-Menu	Pictogram
1681	Elements	
SIGMA	Data acquisition	
	Sigma displacement...	



Procedure

Enter the required sigma displacement factor. Values of 0 to 3 can be selected.

Each change of the sigma factor is documented

0 ⇒ outp. of normal, SIGMA = 0,

0 < sigma factor £ 3 ⇒ Output mating size, calculation with ....SIGMA

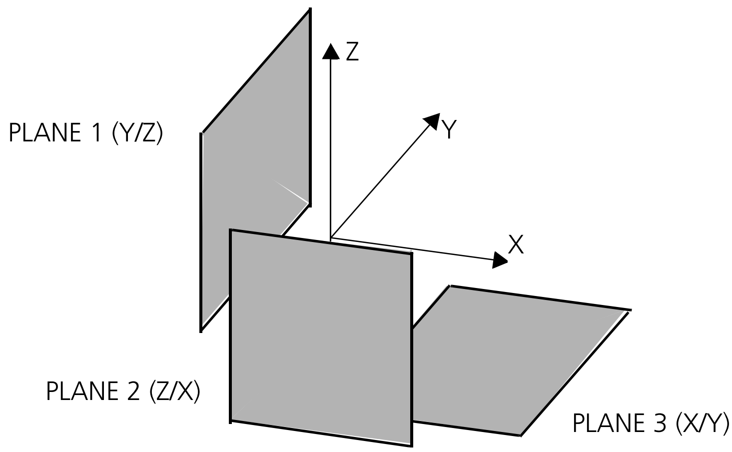
All subsequent calculations of geometric elements are corrected with the selected factor if the minimum number of probings is exceeded.

Normal output is selected by entering SIGMA factor = 0.

Selecting the reference plane <DI 1680>

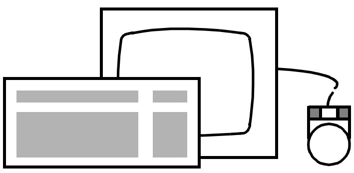
Application

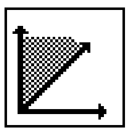
In a spatial coordinate system, a distinction can be made between three measuring planes, which are here designed as follows:



Reference plane

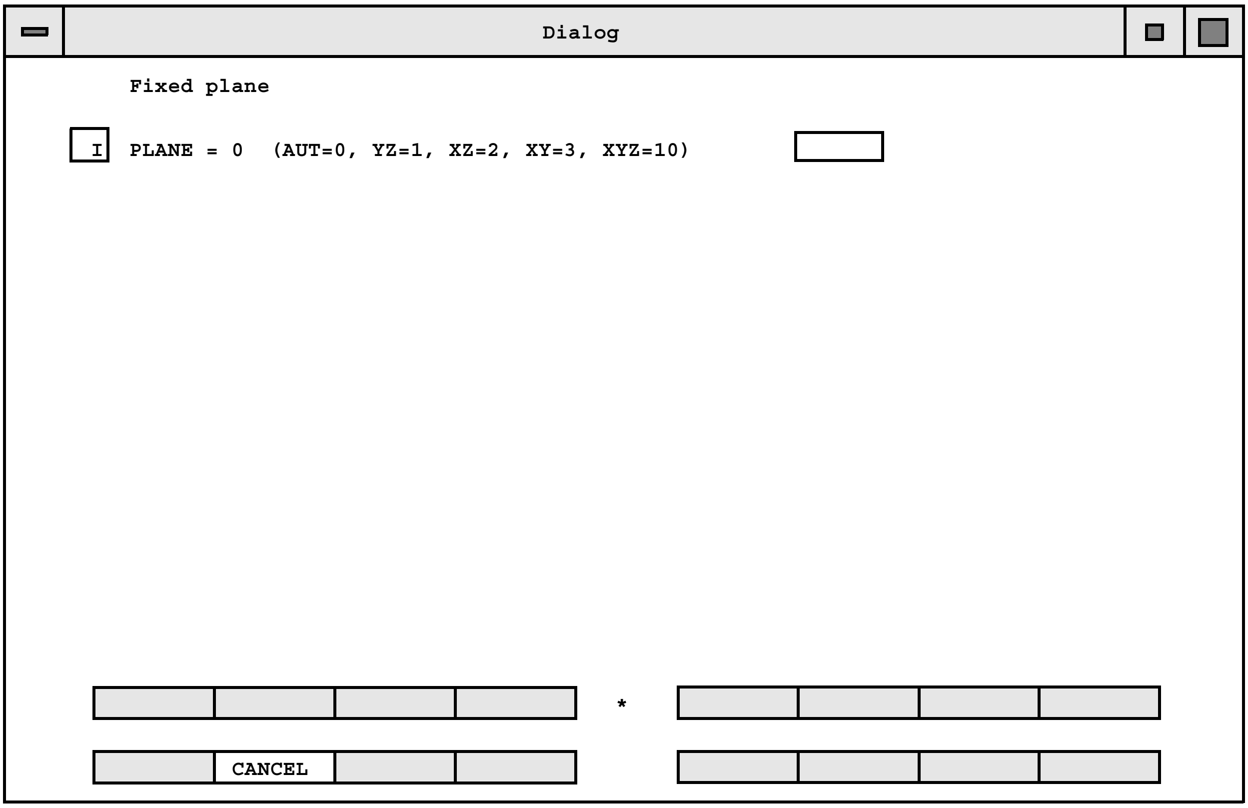
One of these planes is always the reference plane for spatially defined elements. Normally the computer determines the reference plane from the position of the respective geometric element (plane = 0). In special cases, however, another reference plane may be required. In these cases the required reference plane can be selected by entering **<FIXED PLANE>**.



DI	Pull-Down-Menu	Pictogram
1680	Elements	
FIXPLA	Data acquisition	
	Fixed plane...	

Procedure

The current reference plane is displayed. Enter the required reference plane and confirm with **<Enter>**.



Meaning of codes

0	The computer defines the reference plane for every geometric element (default setting).
1, 2, 3	The corresponding plane is the reference plane for all following measurements.
10, 11 **12, 13**	The points probed are output in three coordinates and are *not* corrected by the amount of the probe ball radius. The reference plane is defined by the 2nd number (see above). E.g.: An input of "10" means that the computer defines the reference plane (see "0") and 3 coordinates are output for the probing points.

NOTE

The setting selected here applies until the next time it is changed with **<FIXED PLANE>**.

The following table gives an overview of the application possibilities:

<table>
<tr><th rowspan="2">PROGRAM</th><th rowspan="2">FIXED PLANE
0</th><th colspan="3">FIXED PLANE</th></tr>
<tr><th>1</th><th>2</th><th>3</th></tr>
<tr><td rowspan="3">POINT</td><td rowspan="3">OUTPUT OF PROBING COORDINATE WITH CORRECTION OF R_k IN THE DIRECTION OF THE COORDINATE SYSTEM</td><td colspan="3">OUTPUT OF COORDINATE PAIRS REGARDLESS OF PROBING DIRECTION WITHOUT CORRECTION OF R_k</td></tr>
<tr><td>Y</td><td>Z</td><td>X</td></tr>
<tr><td>Z</td><td>X</td><td>Y</td></tr>
<tr><td rowspan="6">LINE

CYLINDER

CONE</td><td rowspan="9">REFERENCE AXIS SELECTED SO THAT PROJECTED ANGLES ARE <45° (REGARDLESS OF PROBING DIRECTION)

THE RESULTS OF A PREVIOUSLY SELECTED F-PLANE CAN BE OUTPUT AS SHOWN ON THE RIGHT BY PRESSING <RECALL></td><td colspan="3">COORDINATES OF PENETRATION POINT</td></tr>
<tr><td>Y</td><td>Z</td><td>X</td></tr>
<tr><td>Z</td><td>X</td><td>Y</td></tr>
<tr><td colspan="3">3RD COORDINATE BECOMES REFERENCE FOR A1/A2</td></tr>
<tr><td>A1 Y/X</td><td>Z/Y</td><td>X/Z</td></tr>
<tr><td>A2 Z/X</td><td>X/Y</td><td>Y/Z</td></tr>
<tr><td rowspan="3">SURFACE</td><td>X</td><td>Y</td><td>Z</td></tr>
<tr><td>A1 Y/X</td><td>Z/Y</td><td>X/Z</td></tr>
<tr><td>A2 Z/X</td><td>X/Y</td><td>Y/Z</td></tr>
<tr><td>CIRCLE
ELLIPSE</td><td colspan="4">ONLY THE PLANE CODE NO. OF THE MEASURING PLANE MAY BE SELECTED FOR THESE MEASURING PROGRAMS</td></tr>
<tr><td>POLAR</td><td colspan="4">POLAR ASSUMES ACCESS TO 1 COORDINATE PAIR.. IF 3 COORDINATE VALUES ARE GIVEN (SPHERE; SURFACE-AXIS PENETRATION POINT); THE COORDINATE PAIR MUST FIRST BE SELECTED BY FIXED PLANE.</td></tr>
</table>

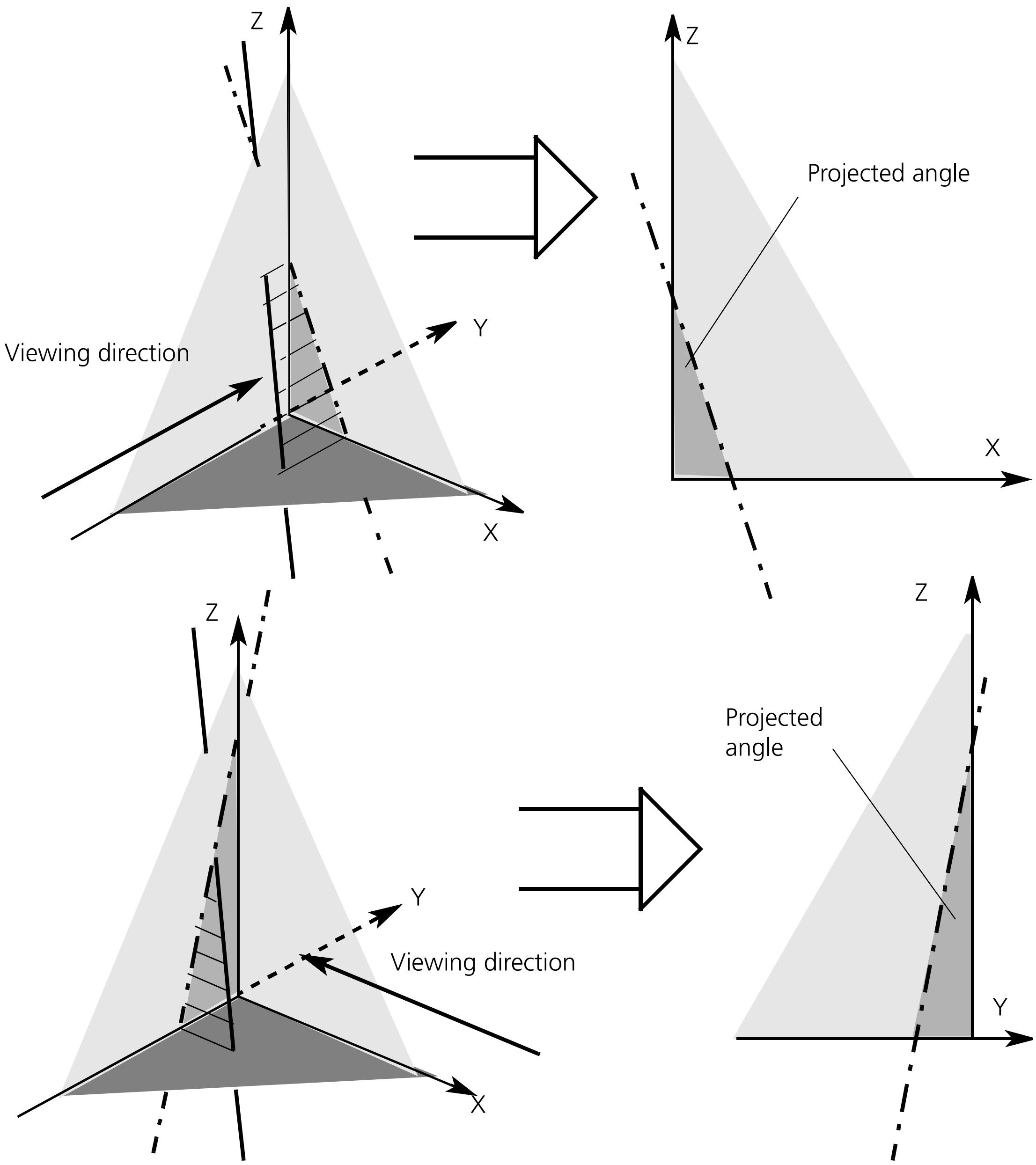
Interpretation of the measurement results

Projected angles

Definition

The direction of an axis in a spatial coordinate system is defined by two projected angles. A projected angle is the angle which results in a workpiece plane when viewed from the 3 axis.

Example



Reference axis

The reference axis is the coordinate axis which is common to both projection planes (the Z axis in this example).

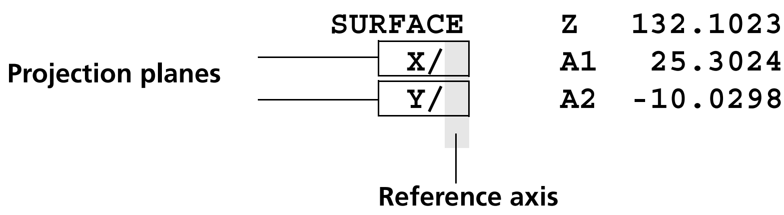
Representation in UMESS

If a measuring result obtained in UMESS contains a line, an axis or a normal, two projected angles will always be output. The projection planes (and therefore the reference axis) are

– determined by the computer (**<FIXED PLANE>** = 0)

– or defined by calling <**FIXED PLANE>** (➤*„Selecting the reference plane <DI 1680>“ on page 10-50*).

Output example

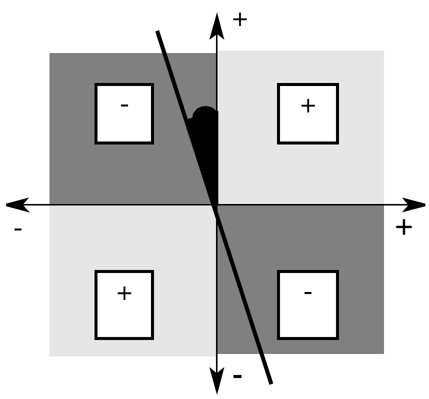


Angles A1 and A2

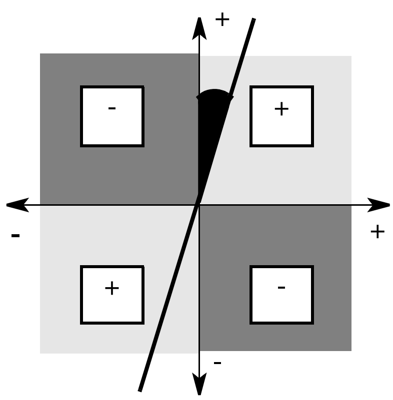
A1 and A2 refer to different projection planes depending on the reference axis. Definition of A1 and A2:

Reference axis	Angle	Projection plane
X	A1 A2	Y / X Z / X
Y	A1 A2	Z / Y X / Y
Z	A1 A2	X / Z Y / Z

Move the zero point of the projection plane to the axis. Then define the +/- signs according to the following diagram:



Angle sign negative



Angle sign positive

Dispersion (standard deviation)

Best fit

If the minimum number of points is exceeded, the N POINT ELEMENT is mathematically fitted in the point set so that the sum of the errors squared is kept to a minimum (Gauss method of least square errors).

In this case the following is output in the measurement record:

- Standard deviation S of the probing points
- The probing points with the greatest distance from the calculated element (vertical distance) including the number of the probing.

```
  SURFACE          Z      132.102
     X / Z         A1      25.302
     Y / Z         A2     -10.286
 7P S/MIN/MAX               0.596  (4)  -0.545  (1)  0.411
  |                           |     |     |      |     |
 (1)                         (2)   (3)   (4)    (5)   (6)
```

(1) Number of probing points

(2) Standard deviation (S)

(3) Number of the probing with the greatest distance from the calculated element in the negative direction.

(4) Greatest deviation in the negative direction (minimum value).

(5) Number of probing with the greatest distance from the calculated element in the positive direction.

(6) Greatest deviation in the positive direction (maximum value).

"No result" function

Definition

In the safety mode (➤*„Continuation after a missing bore <DI 1080>“ on page 16-32*) a CNC program must be able to continue running even if a bore which should be probed is missing. Also, not every error should result in cancellation of the CNC run. And that is the reason for the **No result** function.

This result occurs if an element can not be calculated, resp. if **No result** is recalled or the element is) linked with other results.

Special case

The CNC run will be canceled and an error message will be output if no result is obtained for the following functions:

- Zero point **<DI 1701>**
- Rotate plane **<DI 1702>**

- Rotate plane + 1 element **<DI 1703>**
- Rerotate to distance **<DI 1705>**
- Rotate space **<DI 1706>**

Chapter 11

Geometric elements

This chapter contains:

General

Definition

In UMESS measurement results are output in the form of defined geometric elements. With the exception of the **POINT** element, all other required geometric elements must be called before probing. The element must subsequently be defined by probing. Certain rules apply to the different elements which are explained in the following text.

NOTE

When calculating an N point element, up to a maximum of 32,766 points can be edited.

Procedure

– Call the N-point program.

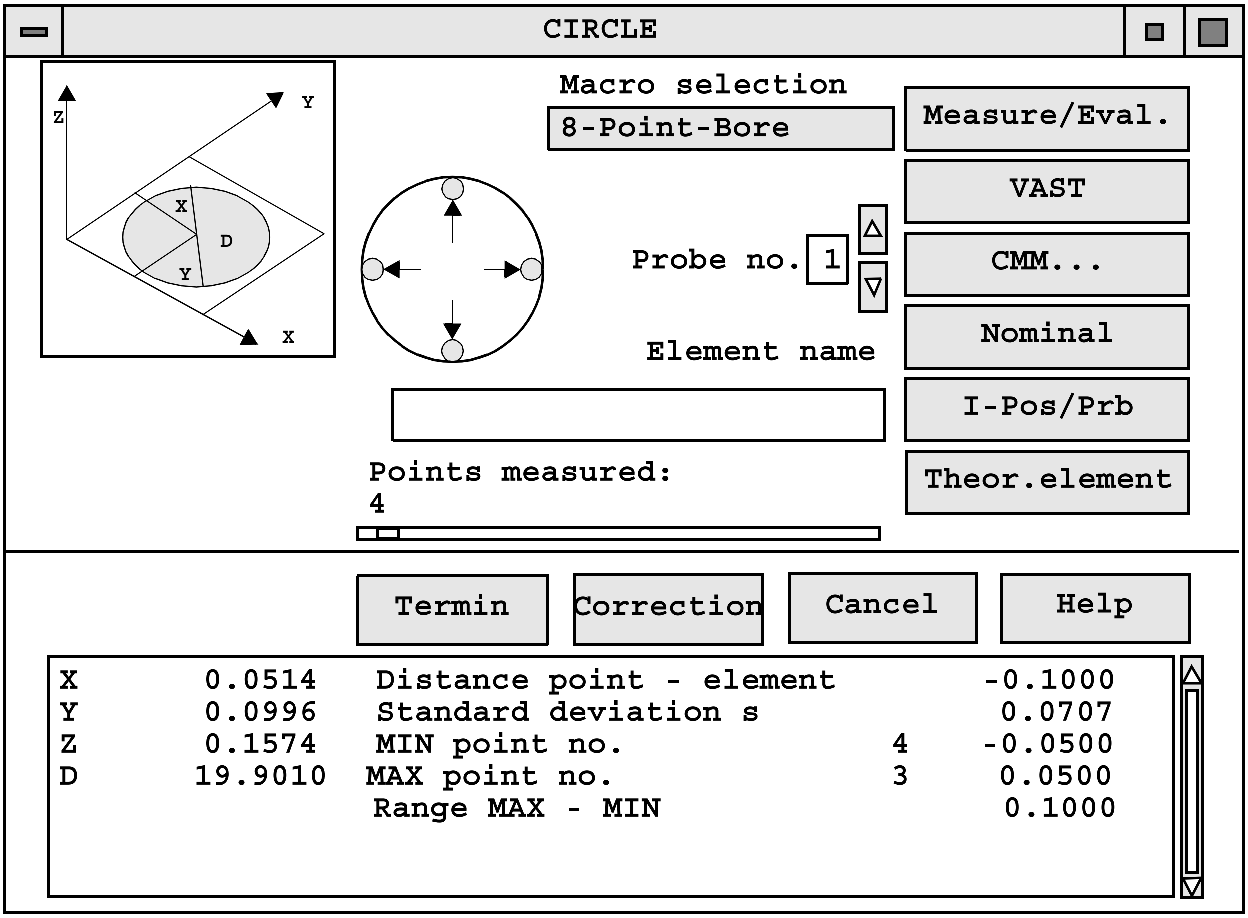
– Select the probe number.

– Obtain measuring points via single probings, scanning, or existing data.

– Terminate evaluation with **<TERMIN>**.

Input and dialog window for N point programs

A dialog window is displayed when the N point program is called (as explained based on the circle program in the following example). This window enables convenient measurement and evaluation:



Description

See ➤*„Probing possibilities" on page 10-5*

Macro selection

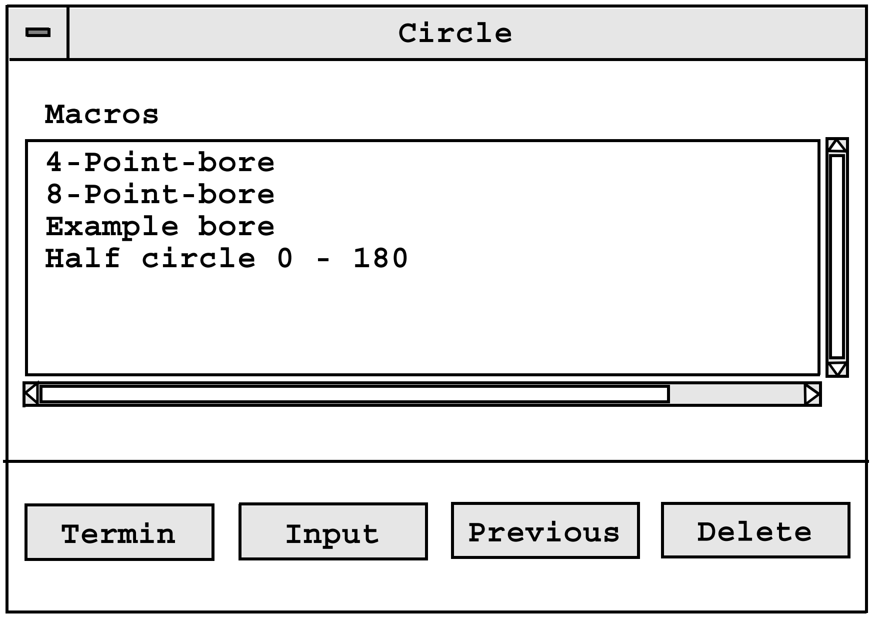
Box description

The macro which has just be selected is displayed in the **Macro selection** box.

It is also used as an data box for branching to the macro input.

If an existing macro is to be selected:

By clicking in the **Macro selection** display box, you can branch to the window for macro selection. There you can click on the required macro and close the window with **<Termin>**.



If a new macro is to be created

Input

By clicking in the **Macro selection** display box, you can branch to the window for macro selection. Then you can branch to the macro input window by clicking on the **<Input>** softkey. (Description of the dialog window for each individual element)

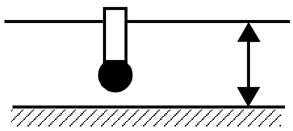
Then transfer the new macro by clicking the **<Store>** box, exit the window by clicking the **<Previous>** box.

Delete

If a defined macro is no longer needed, it can be removed by actuating the **<Delete>** softkey.

NOTE

Define a **clearance height** above the workpiece surface which can be traversed by the probe without a collision via an intermediate position.



Clearance plane

Then the location of the element to be measured is determined by auxiliary probings.

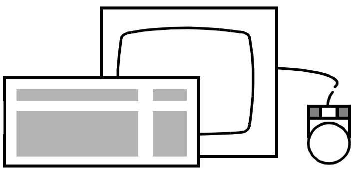
The macro programs described below require only a minimum number of auxiliary probings to promote operating convenience. The prerequisite for a reliable program run is therefore that the axes of the elements to be measured are tilted only slightly in reference to the machine coordinates. This applies in particular to the circle, cylinder and cone macro programs.

NOTE The travel paths are based on the the W-pos coordinate system!

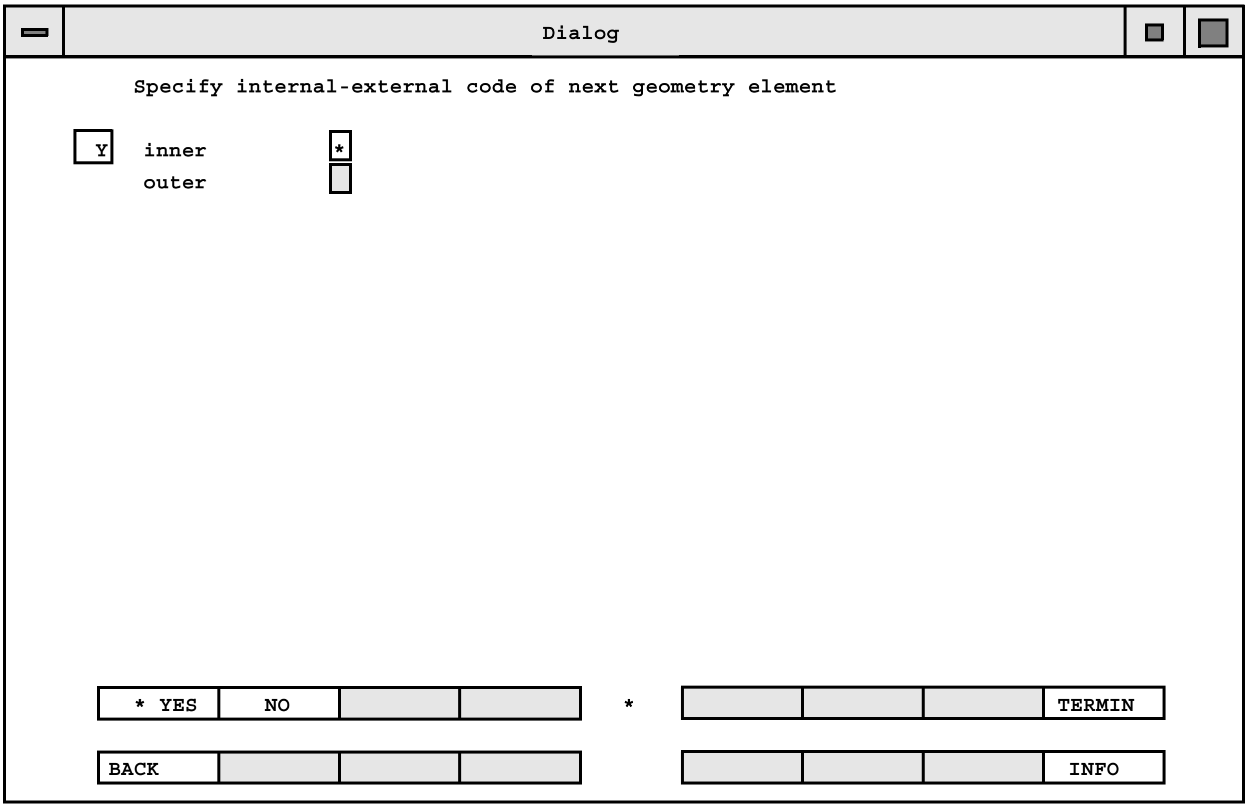
Entering the inner/outer code <DI 1179>

Application

You can coercively specify whether a subsequent geometric element (e.g. circle, ellipse, cone or cylinder) will be displayed as an outer element or an inner element.



DI	Pull-Down-Menu	Pictogram
1179		



POINT <DI 1101>

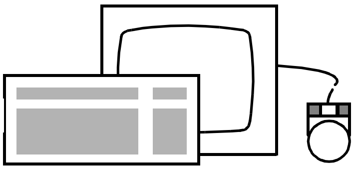
UMESS offers two ways to probe single points

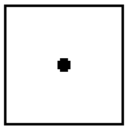
– **Without a previous program call**

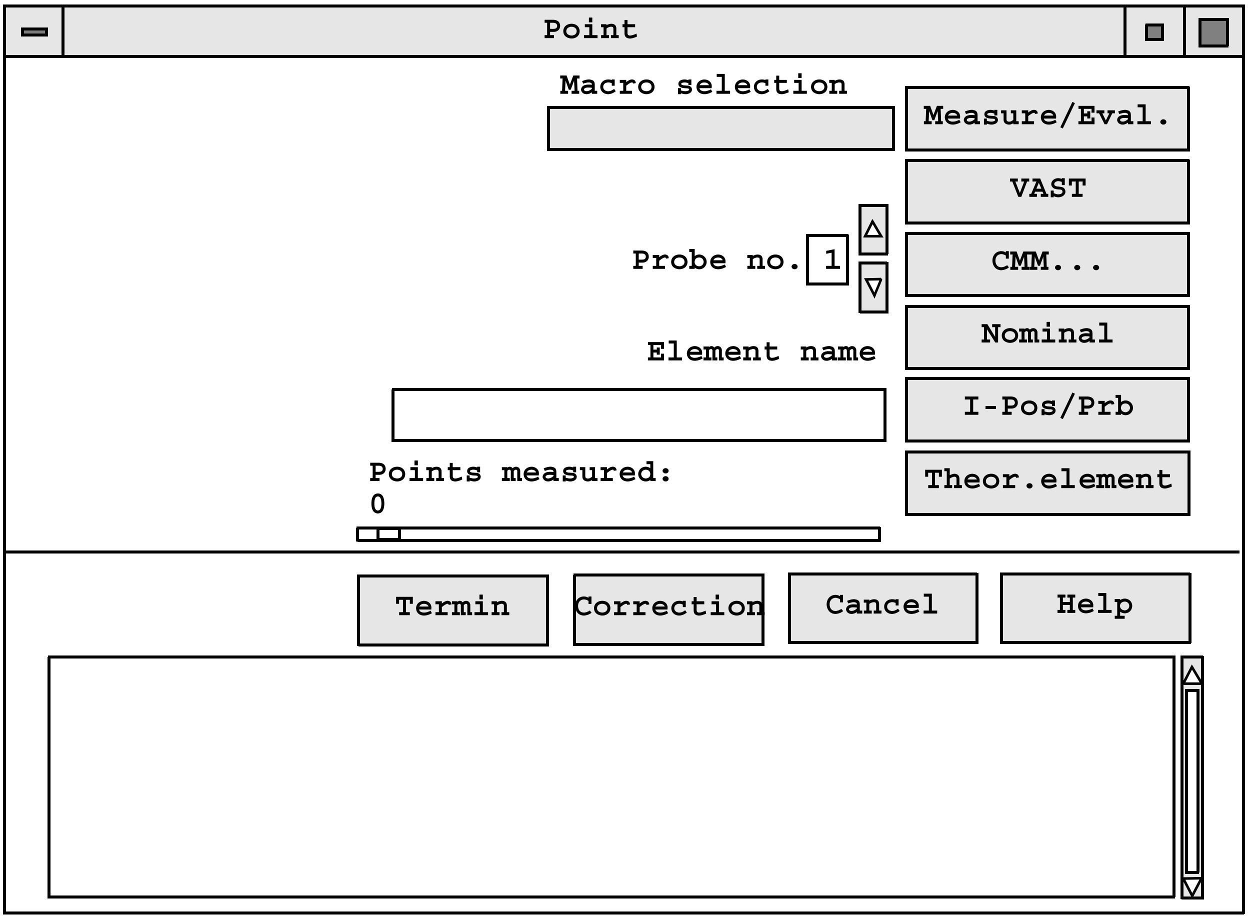
If a probing is performed without a previous program call, a **POINT** will be output as a result in the measurement record. The result is not assigned a result name.

– **Call of <DI 1101>**

You can edit the default name for the following point probing by calling the function **<DI 1101>**. If several points are probed while this function is activated, only the last point will be accepted.

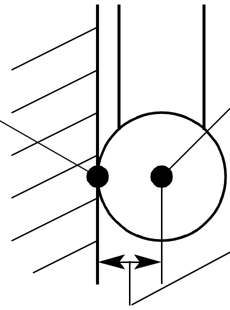


DI	Pull-Down-Menu	Pictogram
1101	Elements	
POINT	Special elements	
	Point...	



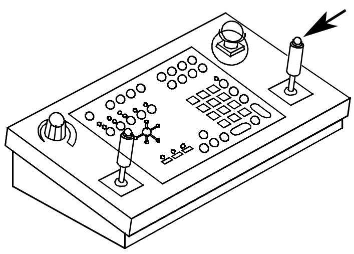
Probing correction

The calculated probe ball center point is corrected by the amount of the radius of the probe ball so that the actual contact point is output as the coordinate value:



NOTE

- The correction of the probing point occurs in the probing direction parallel to the workpiece coordinate system. The contact point and printed coordinate thus agree only if the probed surface runs parallel to the workpiece coordinate system.
- The angle of an inclined surface can be calculated if the surface is probed at two points with the probe moving in the same direction (➤***„Calculation of the rotation and tilt angle <DI 1204>“ on page 13-2***). The two points which are output do not coincide with the contact points in this case; however, the connecting line which passes through both points runs parallel to the geometric element..
- With the measuring probe system, more points can be acquired by probing with the probe in contact (with the workpiece). This can be done by simply pressing the "fire button" on the control panel.



Measurement record printout

```
POINT_5
     11      POINT     Z   13.6745
```

Coordinate value in probing direction (workpiece coordinates).

Probing direction; coordinate direction of the value output

Point probing

Address

Result name

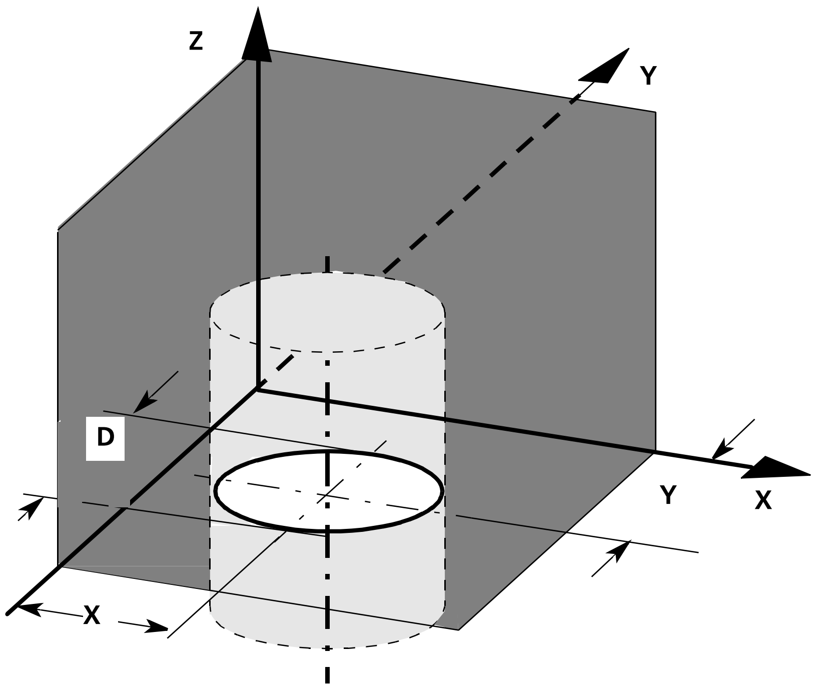
CIRCLE <DI 1104>

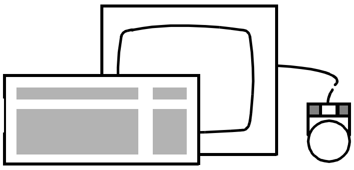
Measuring a circle manually

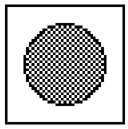
Application

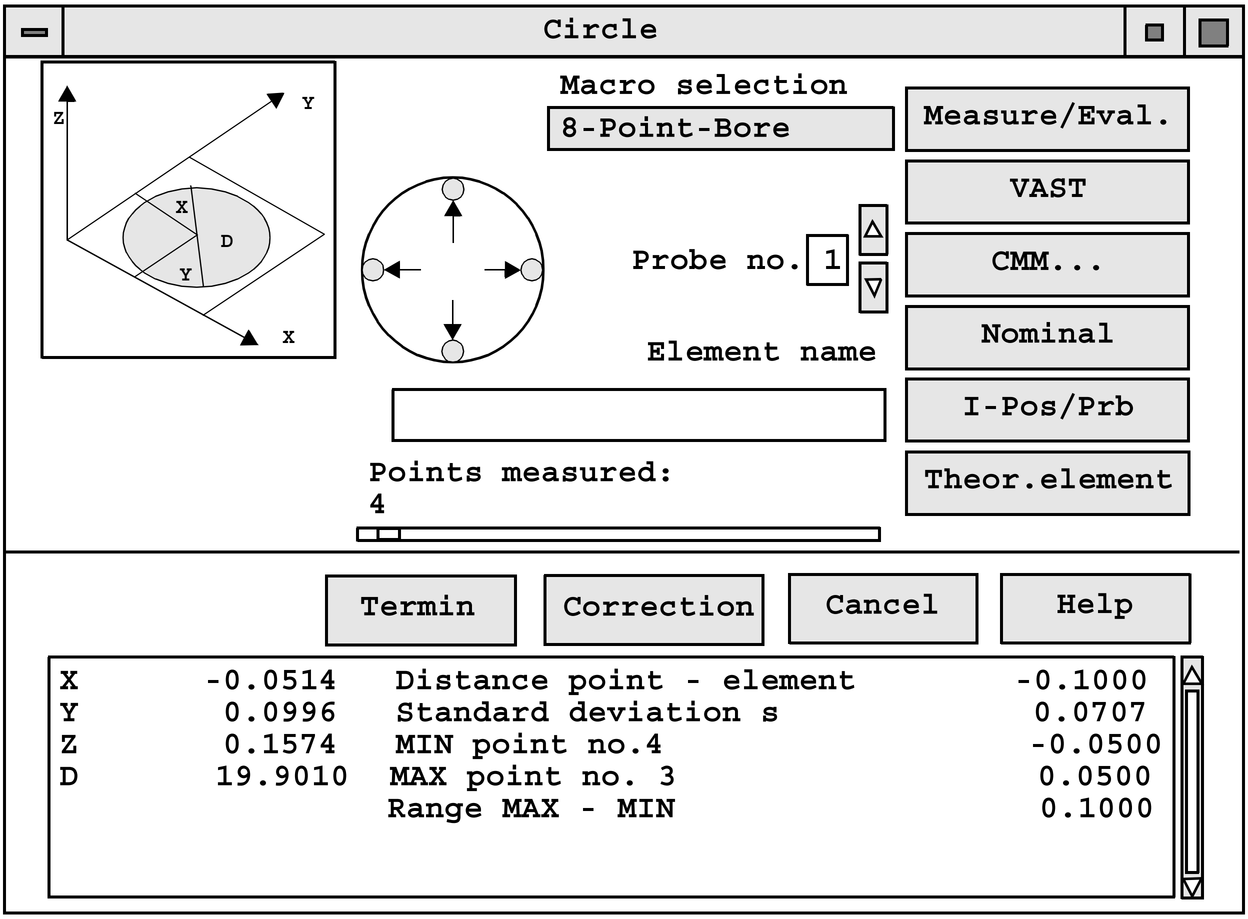
This program enables the measurement of bores and shafts with a negligible deviation in parallelism from the workpiece coordinates. The program automatically differentiates between inner and outer diameters. You can perform a measurement with different probes as long as they all have roughly the same radius. The probes used must all be assigned to the same probe combination.

Minimum number of probings: 3





DI	Pull-Down-Menu	Pictogram
1104	Elements	
CIRC	Geometric elements	
	Circle...	



Measurement record printout

```
CIRCLE_1
     11     CIRCLE I      X    13.1547
                          Y    14.9982
                          D    12.0036
        4P S/MIN/MAX       0.0006 (4)  -0.0003  (2)  .0003
```

Measuring a circle semiautomatically

Application

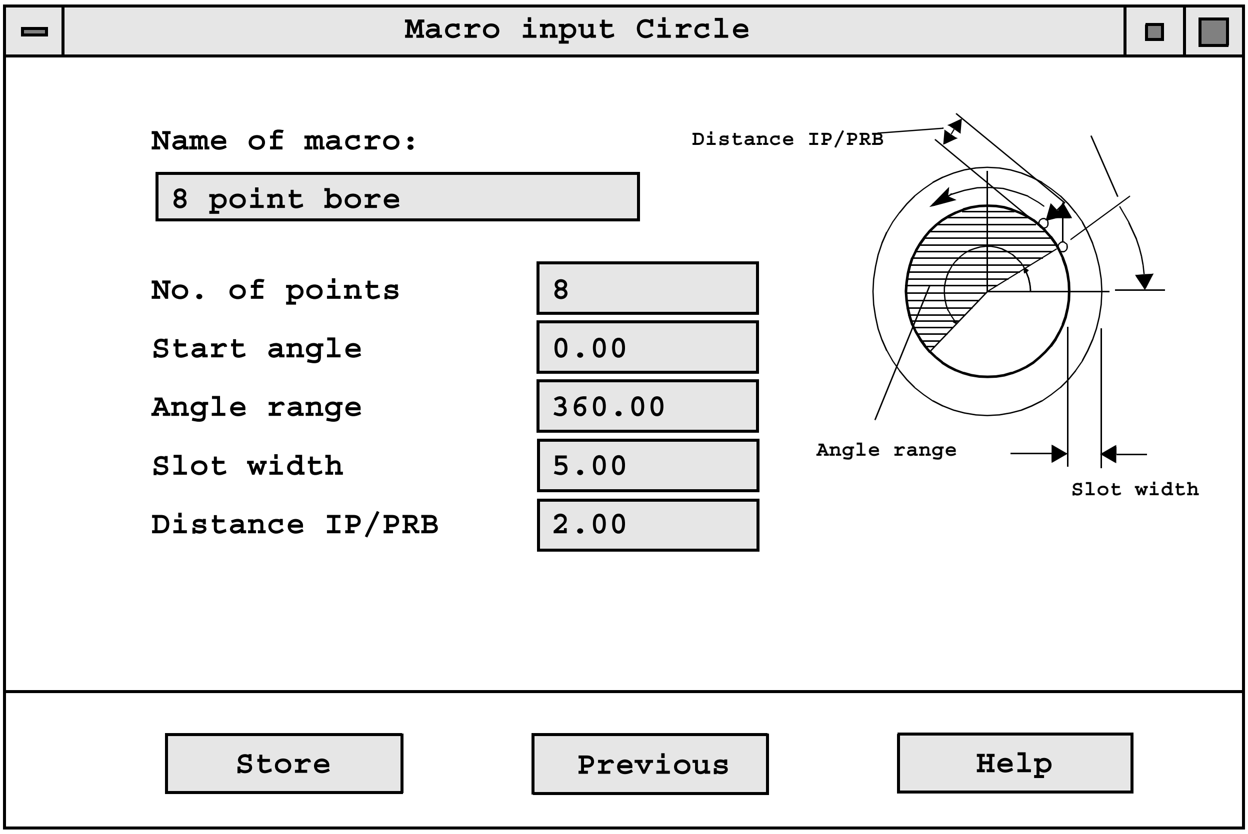
The following macro enables you to measure a circle semiautomatically via individual probings.

Function call

<CIRCLE>

<Macro selection>

<Input>



Data boxes

Name of macro

Enter any name.

No. of points

The number of points entered here will be distributed evenly over the selected angle range.

Start angle

The reference angle is the abscissa. This angle (which must be positive) applies when viewing the measuring plane from the positive direction of the third axis.

Angle range

Positive angle= counterclockwise travel, negative angle = clockwise travel.

Slot width

Width of the clearance zone which can be traversed by the probe without causing a collision. The slot width can be set to zero when measuring bores.

Distance IP/PRB

Distance between the intermediate position and the probing point. This value must be considerably less than the slot width.

Procedure

Start macro

The macro must be started before each measurement.

Intermediate position

A **clearance height** which can be traversed by the probe without causing a collision must be defined above the workpiece surface by setting an intermediate position.

Probe two points

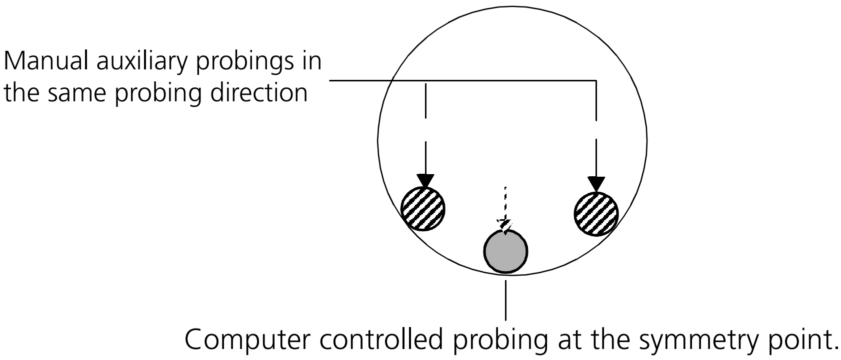
The measured element (part feature) must initially by obtained via **two manual auxiliary probings**. These two auxiliary points must lie in the same probing axis and be a certain distance apart.

Third auxiliary point

The control then performs another probing at the symmetry point of the two manual probings.

The geometry of the circle is calculated (i.e. reconstructed) from these three points and the macro is executed.

The control information is calculated from the data of the macro input and the three probings:



Scanning a circle with VAST

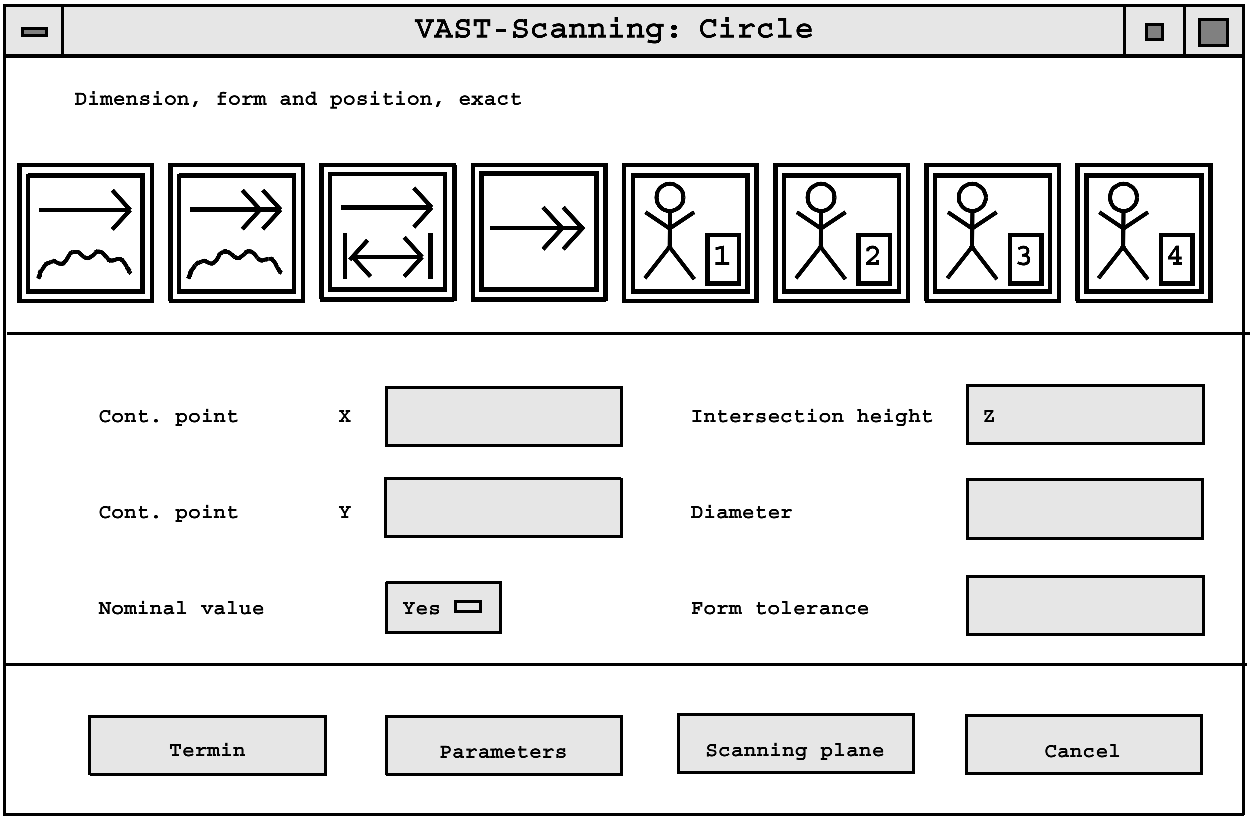
Application

In contrast to the conventional probing of individual points, VAST technology offers you fast multipoint measurement in a single scanning procedure.

You can optimize the measuring accuracy or speed of a measurement to meet the required measurement strategy.

Function call

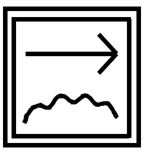
If the **<VAST>** function box is clicked on when you select the geometric element **CIRCLE**, the following window will be displayed to define the rest of the measuring run.



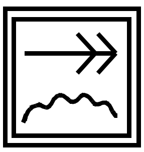
The remaining procedure is divided into three stages:

- Defining the VAST mode by clicking on one of the eight pictograms
- Input of the values for nominal geometry and form tolerance
- Optional: Change of the specified setting values.
- Start VAST measurement by clicking on the **<Termin>** function box

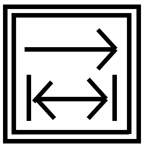
Description of the VAST icons



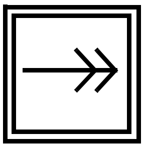
VAST level 1: Dimension, form and position, exact
VAST scanning with maximum accuracy for measuring form, dimension and position. The preset machine parameters are optimized for maximum accuracy.



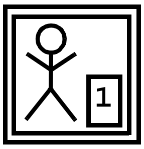
VAST level 2: Dimension, form and position, fast
VAST scanning with high dynamics for measuring form, dimension and position. The preset machine parameters are optimized for short measuring times with the accuracy defined for VAST level 2.



VAST level 3: Dimension and position, exact
VAST scanning with maximum accuracy for measuring dimension and position. The preset machine parameters are optimized for maximum measuring accuracy.



VAST level 4: Position, fast
VAST scanning with maximum dynamics for position measurement. The preset machine parameters are optimized to achieve short measuring times with the accuracy defined for VAST level 4.



VAST user mode 1 . . . 4
VAST scanning with preselectable, user-specific machine parameters. The required parameters can be entered individually in a window after clicking on the corresponding function box [setting values] and saved under a freely selectable number.

Function and data boxes

Cent. point X and Y

Data boxes for the center point coordinates of the circle to be measured.

Note: Axes other than **X** and **Y** may also be specified here. The respective input is adapted according to the current intersection plane, which results depending on the probe (start probe) selected.

Intersection height Z

Data box for the height position of the circle to be measured.

Diameter

Data box for the nominal diameter (in mm) of the circle to be measured

Form tolerance

Data box for the form tolerance (in mm) of the circle to be measured

Nominal value

This function box is changed by clicking on **<YES>** or **<NO>**. If confirmed with **<YES>,** the nominal window is automatically activated following the measurement.

Softkeys

Termin

The VAST measurement run is started with this function box.

Scanning plane

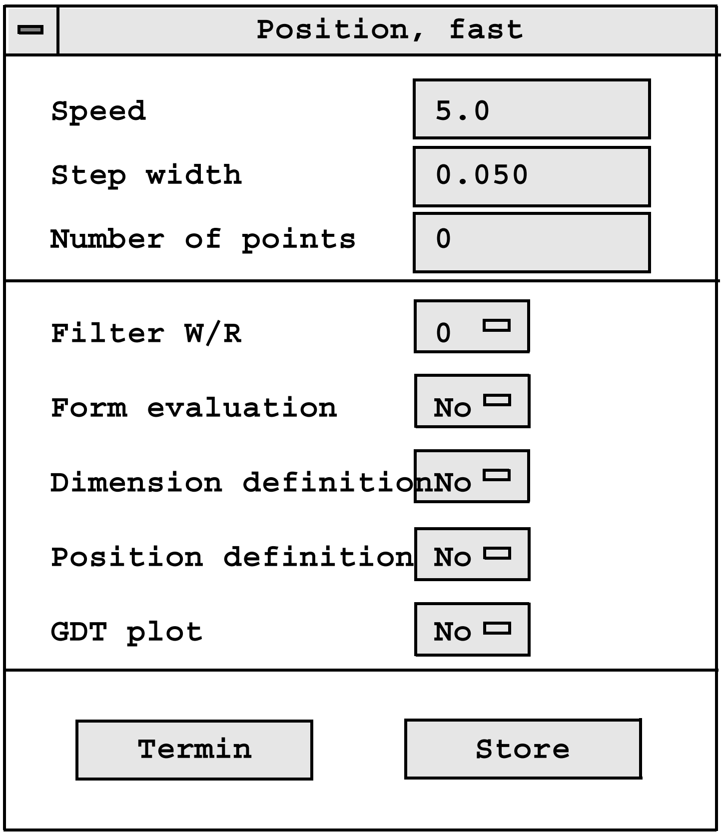
The plane in which scanning is to be performed can be changed here.

Cancel

Function box for cancelling the VAST measurement routine and return to the previous window of the **"Circle"** geometric element.

Parameters

Afterthis function box is selected, the parameters for an individual measurement run can be defined and stored (see below).



Preassignment The upper three data BOXes contain optimum default values which are dependent on the diameters of the circles and probe balls and can be modified if required or for special applications.

Note If this optimized default values are altered by the user, the accuracy specified by the manufacturer can not be guaranteed for the following measurements.

Description of the input and function boxes

Speed Input and display box for the scanning speed (in mm/s).

Step width Input and display box for the step width between points measured in the scanning mode (in mm).

Number of pointsicon Input and display box for the number of points measured during the scanning run. This value results from the diameter and step width inputs.

Filter W/R The measuring data is filtered according to the value preset here to separate the waviness profile from the surface roughness.

Form evaluation In addition to a calculation of the mean diameter (according to Gauss), a form evaluation according to Chebyshev (minimum circle) can also be performed (see UMESS Option 3).

– **<NO>**
  Normal Gauss calculation
– **<YES>**
  Additional evaluation or circle calculation according to Chebyshev.

Dimension definition

Possibility for additional calculation of the tangential surface (selection criteria for controling the nominal-actual comparison, see UMESS Option 3).

– **<NO>**
  Normal dimension calculation according to Gauss
– **<JA>**
  Additional calculation of the tangential element

Position definition

Possibility for additional calculation of the tangential surface (selection criteria for controling the nominal-actual comparison, see UMESS Option 3).

– **<NO>**
  Normal dimension calculation according to Gauss
– **<YES>**
  Additional calculation of the tangential element

GDT plot

Possibility of displaying a fast plot on the monitor. With the exception of the magnification (see UMESS Option 3) all of the parameters required are preset.

Softkeys

Termin

Function box for concluding this input routine and return to the VAST window. The parameters entered beforehand can then be used for the current measurement but are not stored.

Store

If this function box is clicked on, the parameters defined beforehand can be stored as an application-specific routine unter a VAST user pictogram(no.1 to no 4).

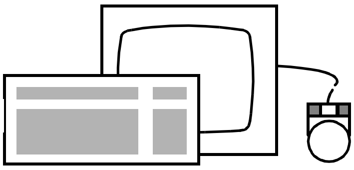
4-point circle <DI 1174>

Application

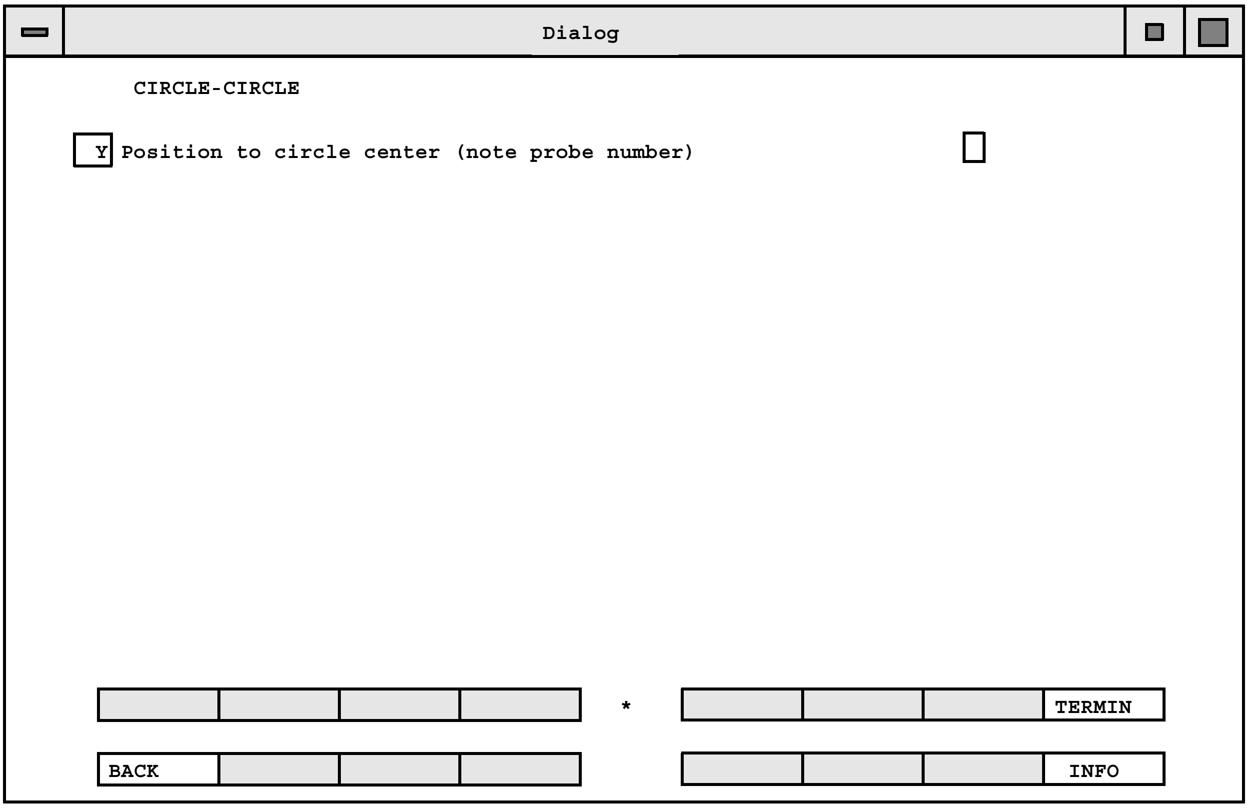
A full circle (bore) can easily be measured semiautomatically by probing 4 points.

Other names

The 4-point circle is also commonly called a "lazy man's circle".



DI	Pull-Down-Menu	Pictogram
1174	Elements	
	Macros	
	4Pt circle	



Procedure

Position the probe roughly in the center of the bore.

NOTE

Make sure that the correct probe has been selected on the control panel.

TERMIN

After you press the **<TERMIN>** key, the probe initially executes a search run until it finds a probing. Then it moves back to the center of the bore at high speed and executes another search run to locate the next probing.

Inclined bores

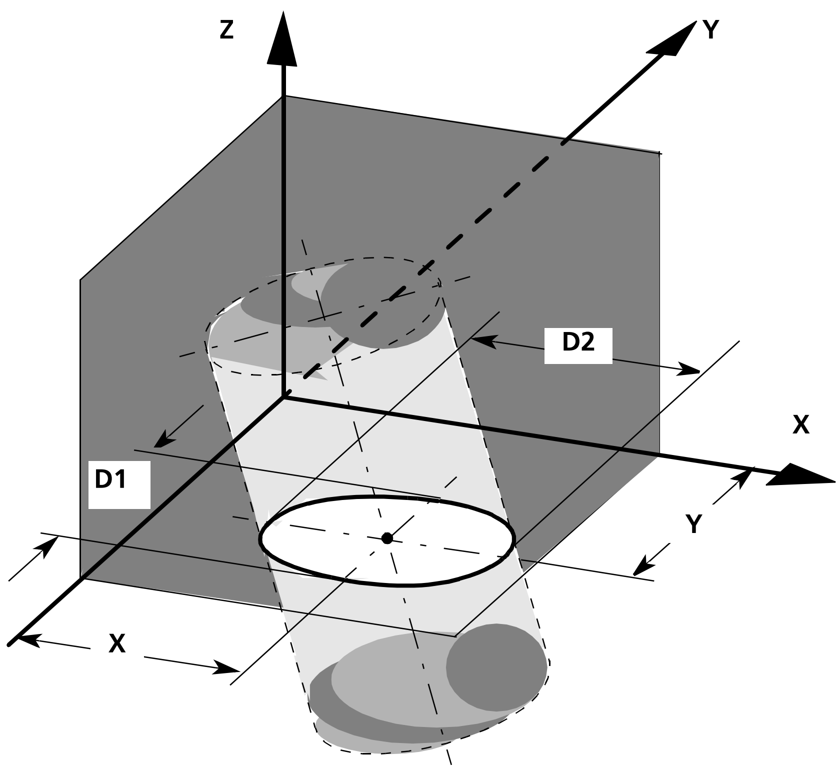
The 4-point circle function can also be used for inclined bores if the coordinate system has been correspondingly aligned and saved as a control coordinate system.

ELLIPSE <DI 1108>

Application

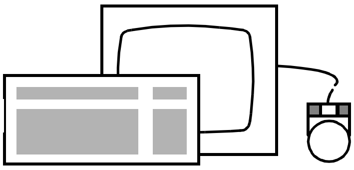
This program is used to probe geometric elements whose axes do not run parallel to the workpiece coordinate system. It is mainly suitable for determining the direction of geometric elements.

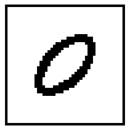
Minimum number of probings: 5

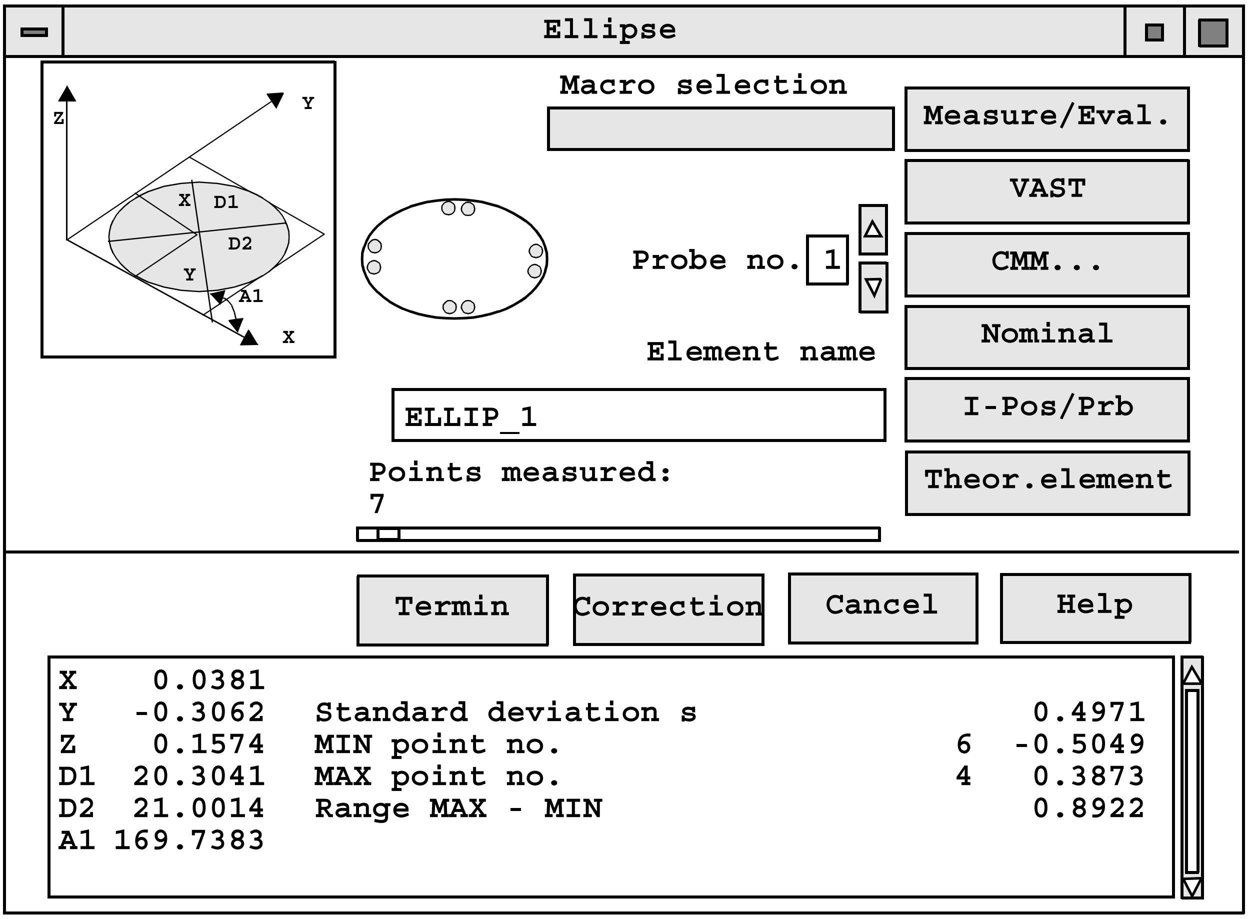


Application example

After measuring two ellipses, the coordinate system can be tilted parallel to the line connecting the centers of the ellipses by calling **<RO SPACE>**.



DI	Pull-Down-Menu	Pictogram
1108	Elements	
ELLIP	Geometric elements	
	Ellipse...	



Output in measured record

```
ELLIPSE_1
    11    ELLIP I       X     0.0381
                        Y    -0.3062
                        D1   20.3041
              Y/X       A1  169.7383
                        D2   21.0014
       6P S/MIN/MAX    .4971  (6) -.5049   (4)  .3873
```

NOTE

- All points must be probed in a single plane section. Therefore make sure that the probe does not travel in the 3rd coordinate.
- The ellipse is very sensitive regarding the position of the probing points if they are probed within a small sector (results are widely dispersed).
- **D1** is the small ellipse diameter, **D2** the large.
- **A1** is the angle between the reference axis and the small ellipse axis:

  Reference axis of XY plane = X axis

  Reference axis of YZ plane = Y axis

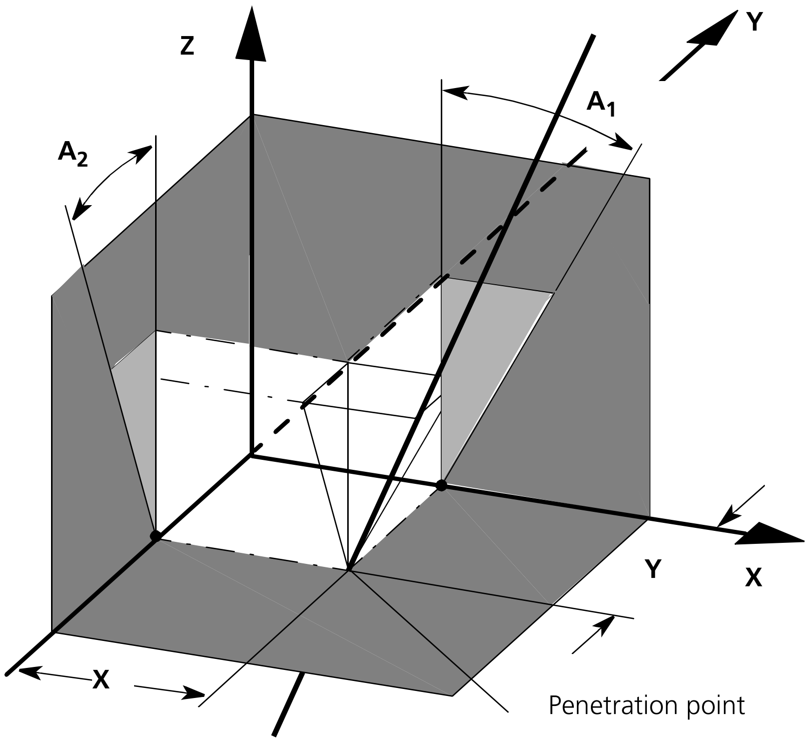
  Reference axis of ZX plane = Z axis
- A differentiation is automatically made between inner and outer ellipses.

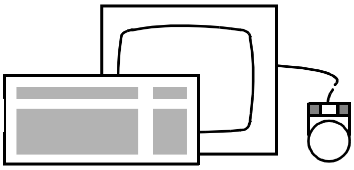
LINE <DI 1102>

Application

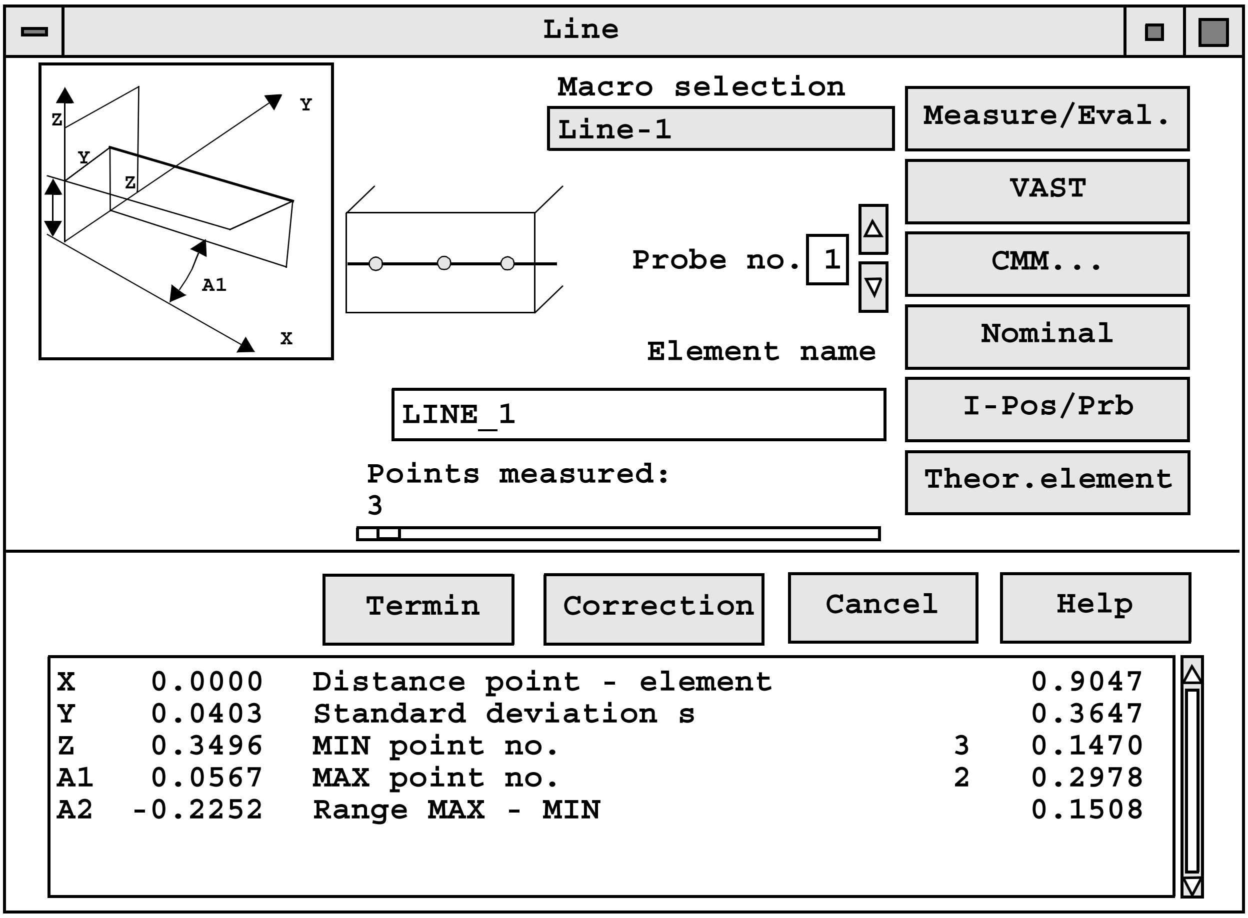
This measuring program places a compensating line through the points probed.

Minimum number of probings: 2





DI	Pull-Down-Menu	Pictogram
1102	Elements	
LINE	Geometric elements	
	Line...	



Measurement record printout

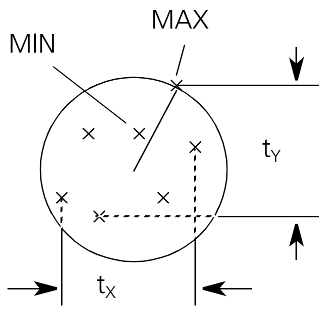
```
LINE_1
    11     LINE          Y     0.0403
                         Z     0.3496
               Y/X       A1    0.0567
               Z/X       A2    0.0567
         3P S/MIN/MAX     .3647  (3)  .1470   (2)  .2978
```

Application possibilities

- Defining the workpiece coordinate system (**<RO PLANE>**).
- Determining the direction of a V groove by self-centering probing (measuring probe system ➤***„Correction of probing errors“ on page 10-15***).
- Calculating the angle of rotation if the form deviation of the surface to be probed is too large. In this case, with a high number of points, a mean line is calculated which compensates for a possible angle error resulting from unfavorably placed probing points.
- Calculating an axis from circle centers located one behind the other.

NOTE

The **MIN** and **MAX** values from the line calculation are arranged radially to the best fit geometric element. For this reason, it is not possible to determine the straightness deviation by adding |**MIN**| + |**MAX**|. However the straightness deviation can be viewed in the individual planes instead.



Semiautomatic measurement

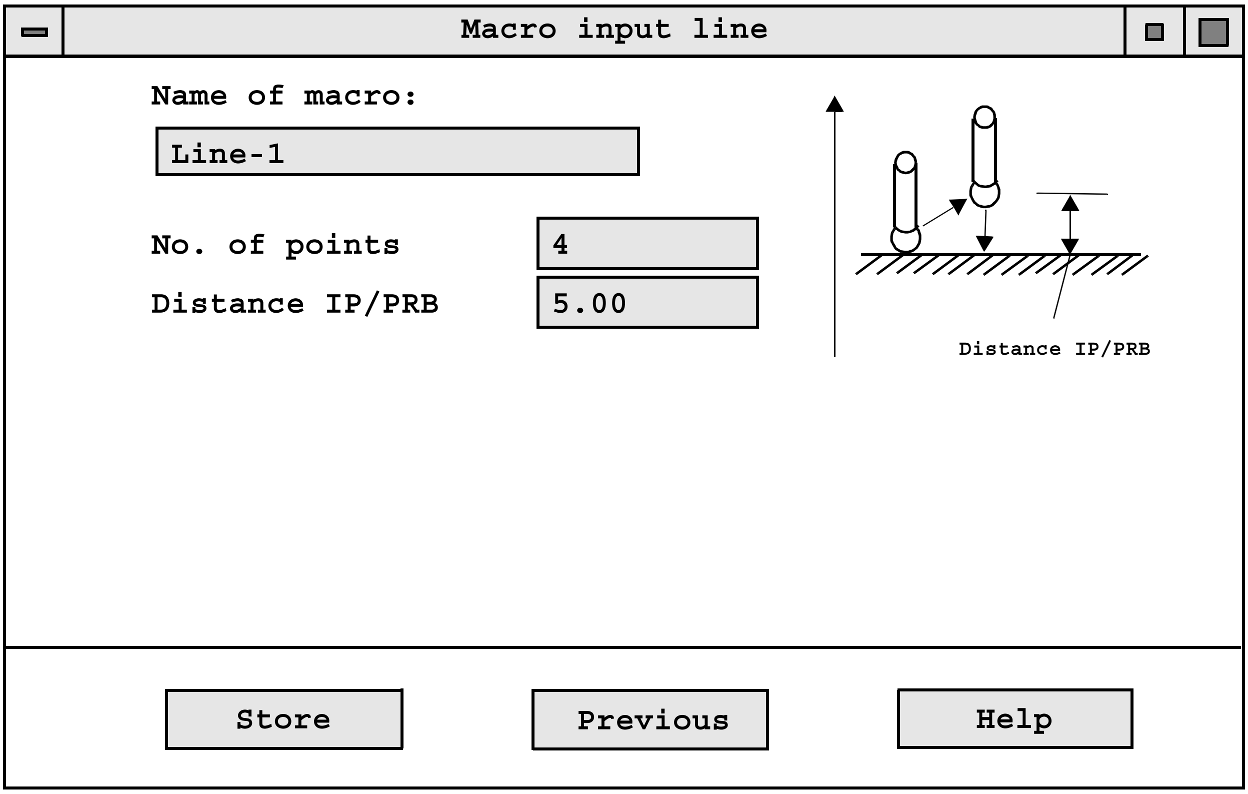
You can measure a line semiautomatically using the macro function.

Function call

<LINE>

<Macro selection>

<Input>



Data boxes

No. of points

The number of points entered is distributed uniformly between the two auxiliary probings.

Distance IP/PRB

The distance between the intermediate position and the probing point must be such that the intermediate position lies well below the clearance plane.

Procedure

Start macro

The macro must be started by entering its name before each measurement.

Intermediate position

A clearance height which can be traversed without collision must be defined above the workpiece surface by an intermiediate position.

Probe two points

The element (part feature) must then be defined by two manual auxiliary probings. They should designate the start and end point of the line to be probed. The control then executes the remaining probings based on the parameters thus specified.

NOTE

For measuring machines with a trigger probe head, a collision may be reported following the first probing during the macro run.
In this case, check to make sure that the probing parameters of **<DI 1661>** allow sufficient clearance between the preceding interme-

diate position and the probing point (➤ ***„Probing parameters <PROBE P>“ on page 6-11***).

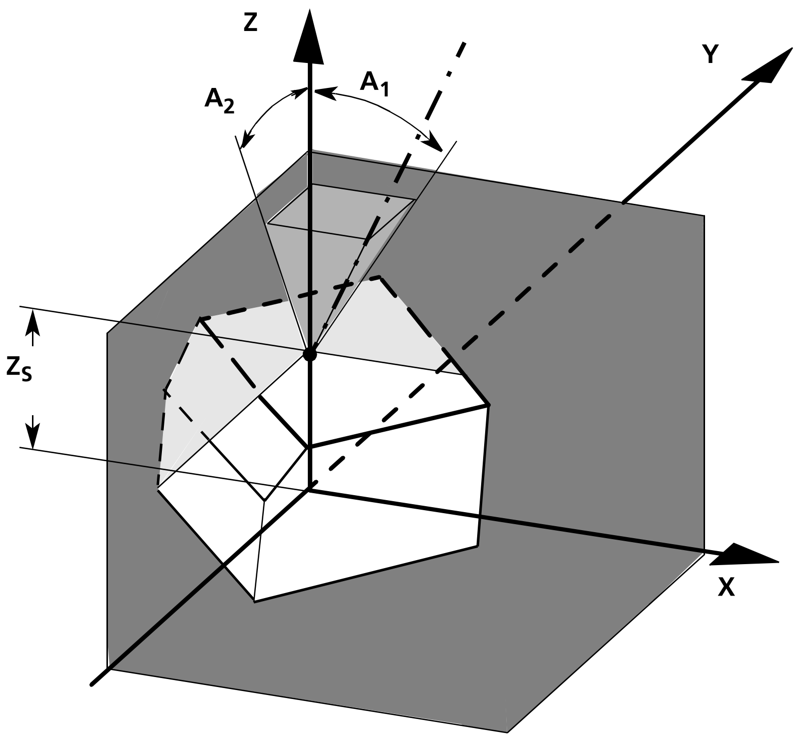
SURFACE <DI 1103>

Measuring a surface manually

Application

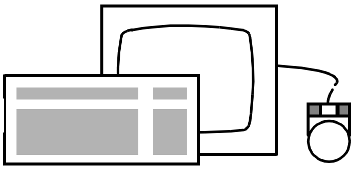
After this function call, a surface is calculated from the following points.

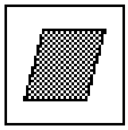
Minimum number of probings: 3

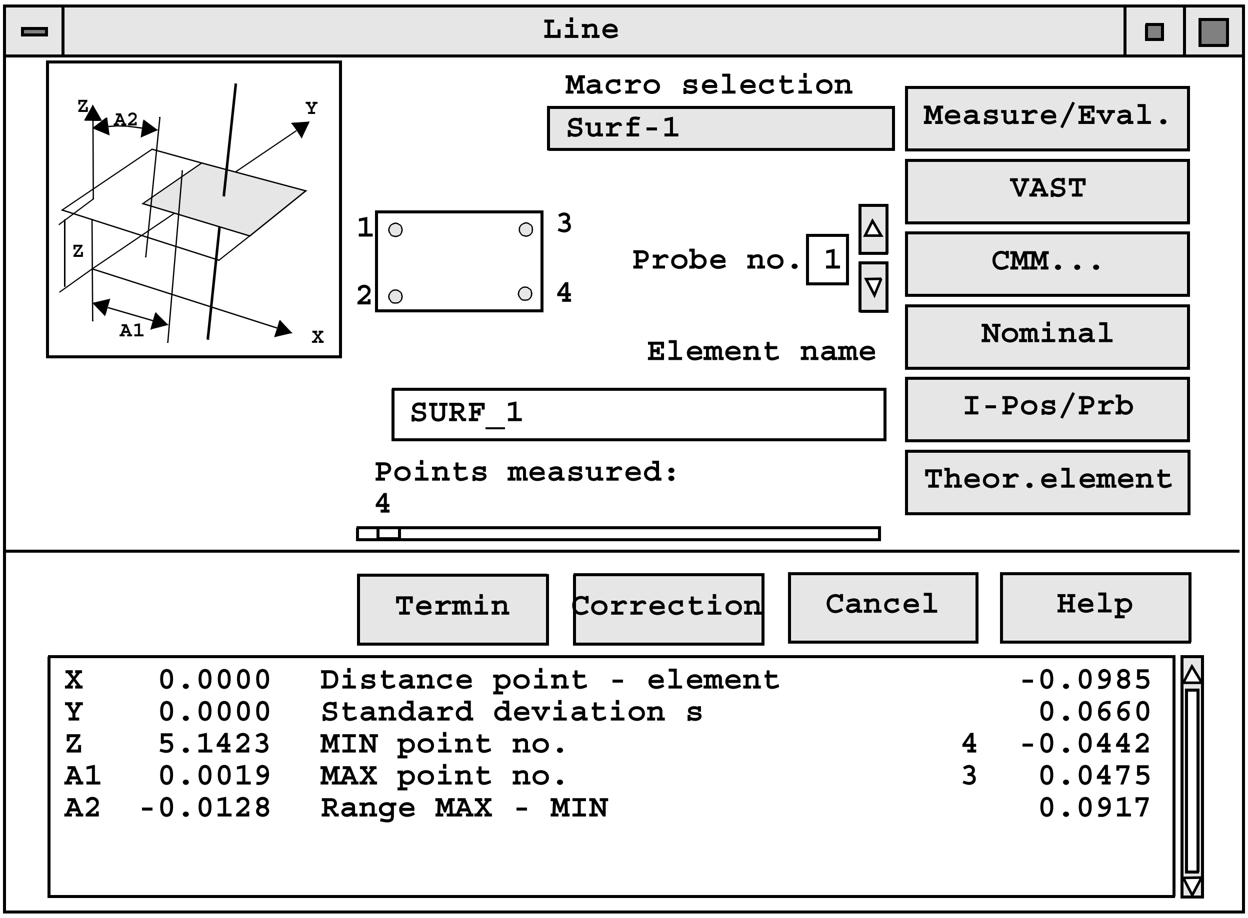


Explanations

- The output angles are referenced to the surface normal, which is a line located perpendicular to the surface.
- The reference axis for the projected angles is the coordinate axis which forms the smallest angle with the surface normal.
  Any coordinate axis can be specified as the reference axis with **<FIXED PLANE>** (➤ ***„Selecting the reference plane <DI 1680>" on page 10-50***).
- The coordinate value is output as the penetration point (in the example Z) where the reference axis penetrates the surface.



DI	Pull-Down-Menu	Pictogram
1103	Elements	
SURF	Geometrical elements	
	Surface...	



Measurement record printout

```
SURF_1
     11     SURFACE      Z     5.1423
                X/Z      A1    0.0019
                Y/Z      A2   -0.0128
        4P S/MIN/MAX    .0660  (4)  .0442   (3)  .0475
```

Measuring a surface semiautomatically

Application

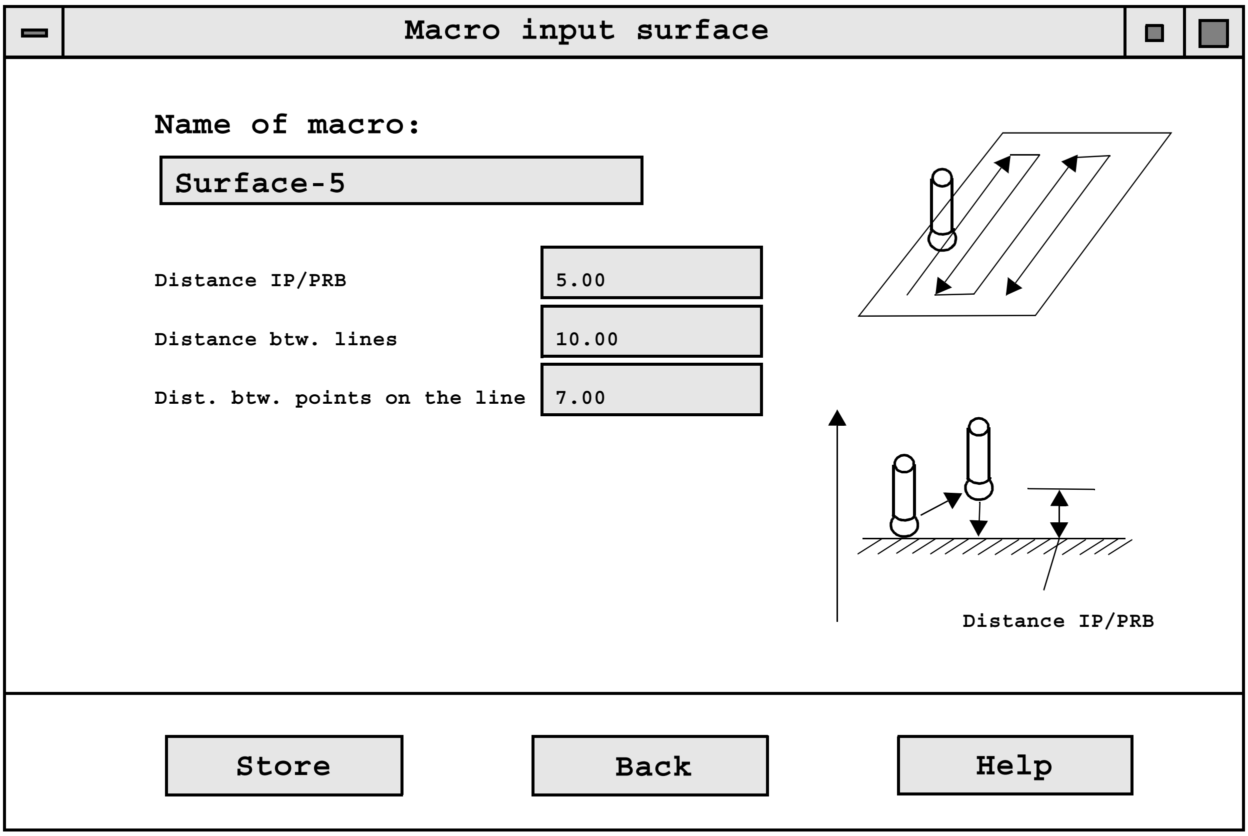
You can measure a surface semiautomatically using the macro function.

Function call

<SURFACE>

<Macro selection>

<Input>



Data boxes

Distance IP/PRB

The distance between the intermediate position and the probing point must be such that the intermediate position lies well below the clearance plane.

Distance btw. lines

Input of a dimension for the distance between grid lines located within the surface boundary.

Distance btw. points on the line

Input of the distance between points on a grid line. In connection with the point distance, the grid lines form the grid of the points measured within the surface boundary.

Procedure

Start macro

The macro must be started by entering its name before each measurement.

Intermediate position

A clearance height which can be traversed by the probe without a collision must be defined by setting an intermediate position above the workpiece surface.

Probe four points

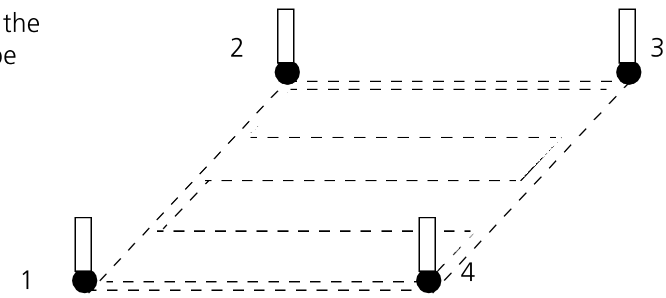
The measured element (part feature) must then be defined by four manual auxiliary probings. (See next page for probing strategy).

NOTE

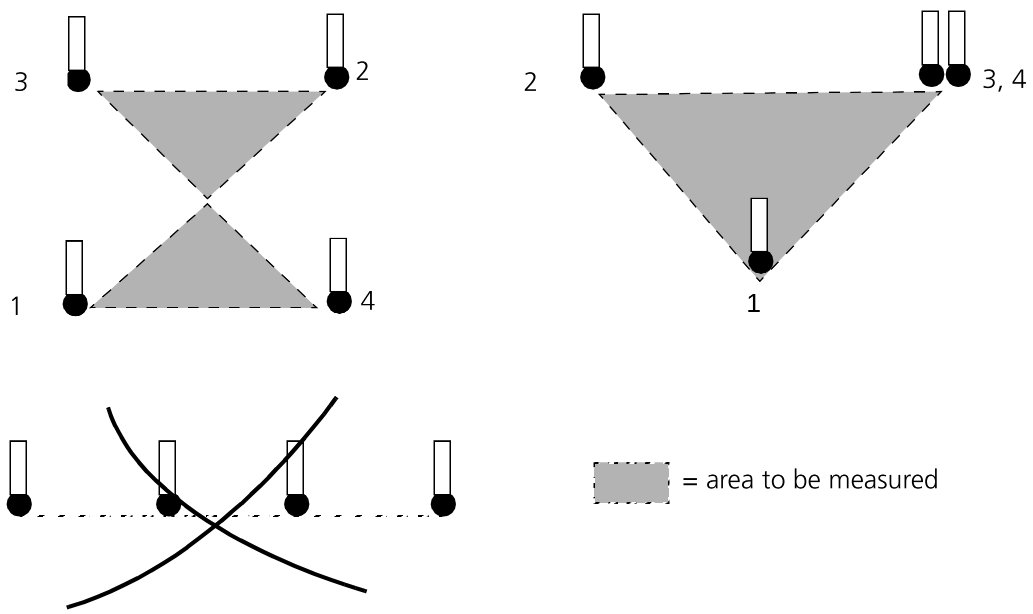
When the macro is executed, a collision may be reported after the first probing in measuring machines equipped with a trigger probe head.

In this case, check whether the probing parameters of **<DI 1661>** allow sufficient clearance between the preceding intermediate position and the probing point (➤***„Probing parameters <PROBE P>“ on page 6-11***).

The four auxiliary probings limit the area of the surface which is to be determined by the control.



Other possibilities



The maining probings will be executed by the control based on the parameters entered.

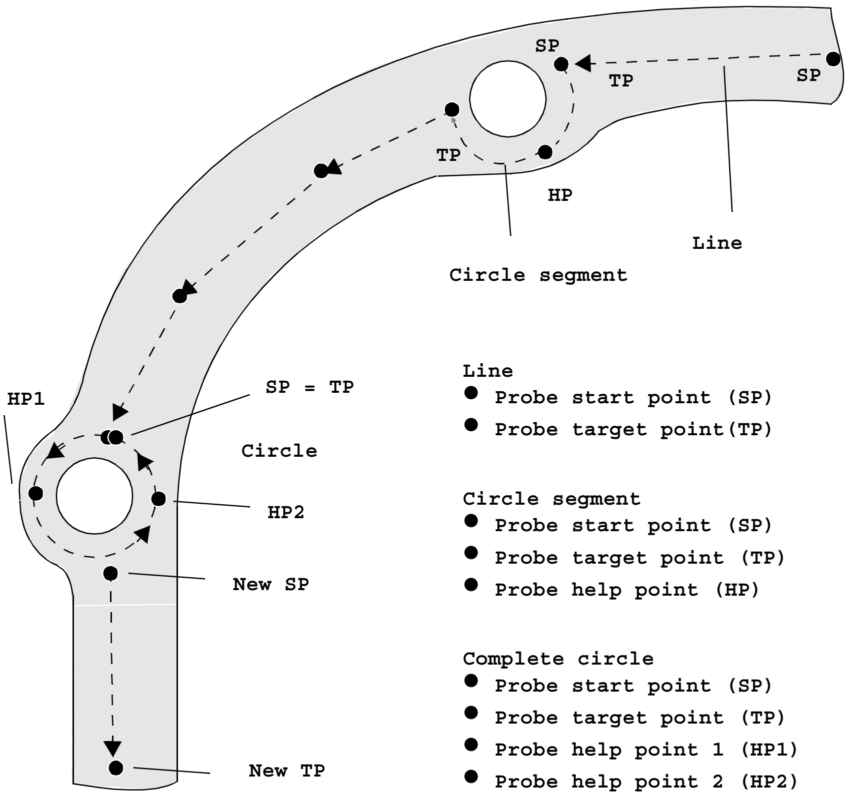
Scanning a surface with VAST

Application

Surfaces which are considerably segmented or broken can be scanned quite easily with VAST:

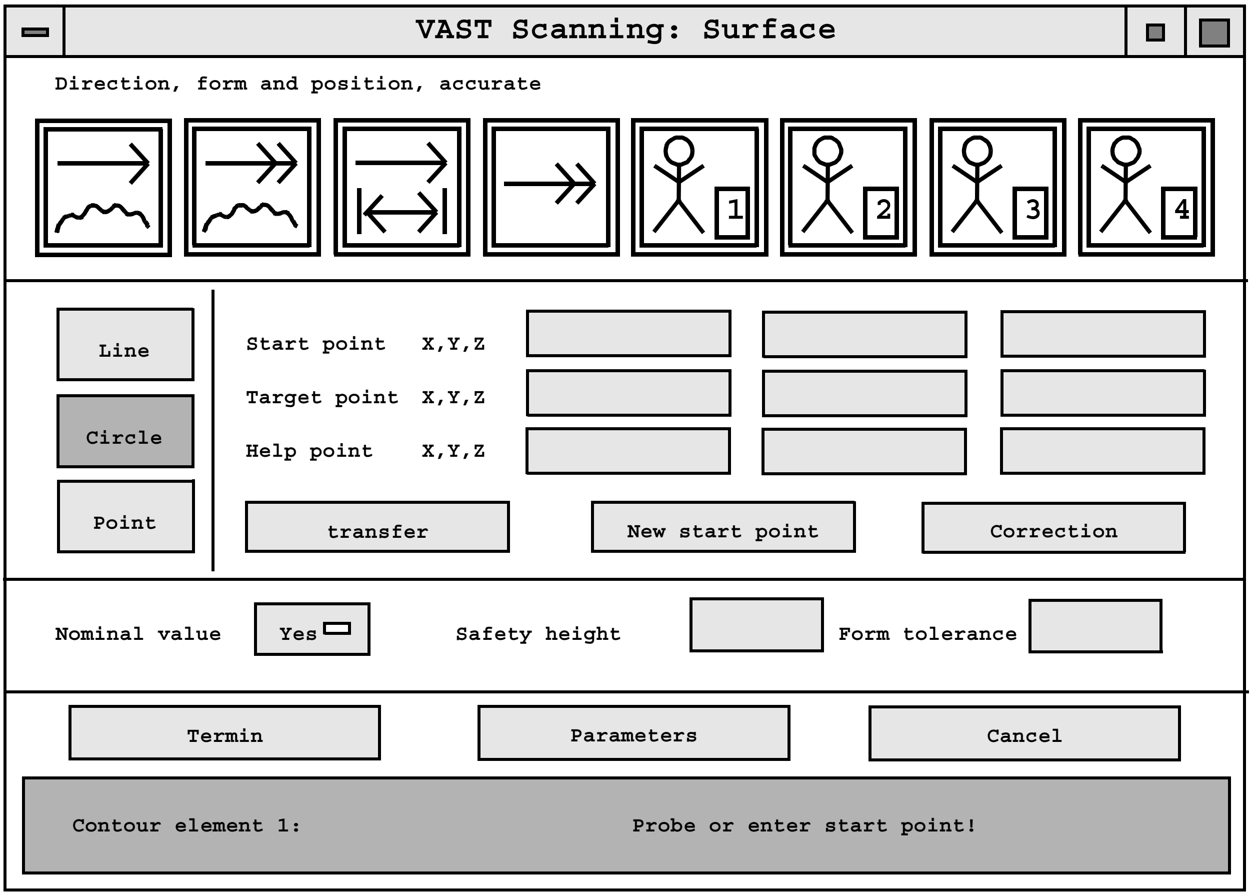
By probing individual geometric elements, you define the position and sequence of points, circles and lines. Together these elements result in the scanning path of the probe.

Alternatively, you can also specifiy the scanning path via the work-piece coordinates of the individual successive geometric elements. In this case, the probing direction is derived from the preselected probe. The number assignment of the probe specified here must correspond to the one indicated on the control panel.



Function call

If the **<VAST>** function box is clicked on when the geometric element **SURFACE** is entered, the following window for defining the remainder of the measuring run will open.



The following steps are required:

- Define the VAST mode by clicking on one of the eight pictograms (icons) (see CIRCLE).
- Enter the individual probing points and/or geometric elements for scanning.
- Enter the parameters for the nominal geometry and form tolerance.
- Optional: Change the default settings if necessary.
- Start the VAST measurement by clicking on the **<Termin>** function box.

Function and data boxes

When you click on a line, circle or point, the corresponding input field will be made available.

Once a geometric element has been selected, it remains active until it is deselected.

When the first geometric element (line or circle) has been entered, its target point automatically becomes the start point of the following geometric element.

Line

Start point X,Y,Z **Target point X,Y,Z**

The target point is transferred automatically as start point for a subsequent geometric element. If there are several lines which folow in succession: After the first line, only the target point has to be probed or entered.

Circle

Start point X,Y,Z **Target point X,Y,Z** **Help point X,Y,Z**

For a circle segment, the start and target point and subsequently a help point are probed or entered.

With a complete circle, the start and target point are identical. In addition, two help points must be probed or entered.

The target point becomes the start point of the following geometric element.

Point

Point X,Y,Z

The probe moves to the clearance height after each probing.

Nominal value

This function box is changed by clicking on either**<Yes>** or **<No>**. If you click on **<Yes>** the Nominal window will automatically be activated following the measurement.

Safety height

Distance of probe from probing point following the probing.

Form tolerance

Data box for form tolerance of surface to be measured (in mm).

Contour element 1: Probe or enter start point!

Display of current number of element, user prompt.

transfer

When entering data manually, you must transfer each individual travel path segment by pressing this function box. If you define the travel path by probing, this is done when accepting the target position.

New start point

If you have already defined a travel path element: The target point is offered automatically as the start point of a new element. If you do not want this, you can define a new start point using this function box.

Correction

By pressing this function box you retrieve the individual elements one after the other. The coordinates displayed can be corrected. If you want to mask out or delete a single element, then you have to set its coordinates to zero.

Termin

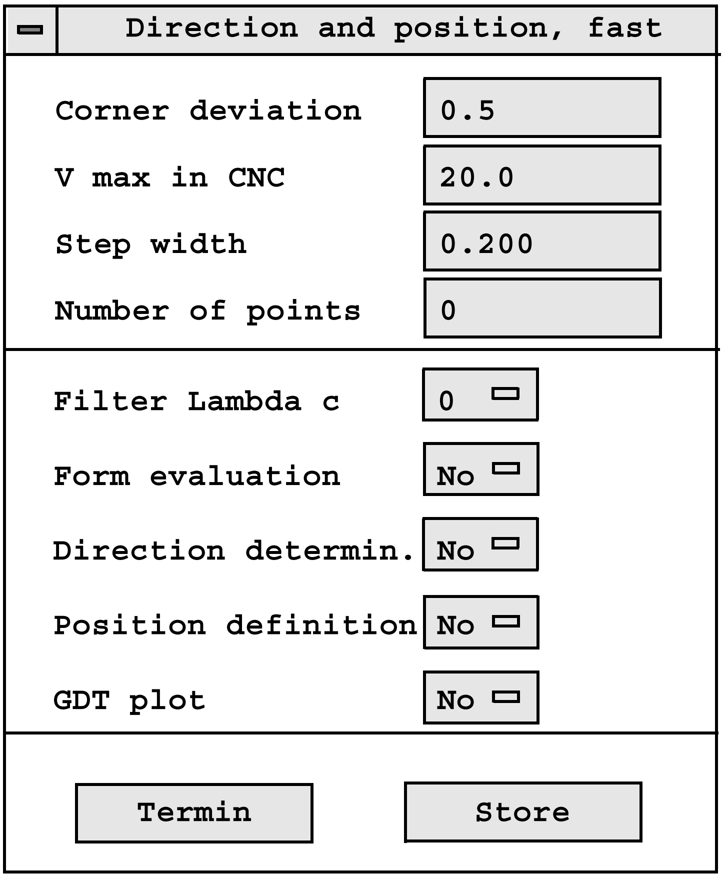
You start the VAST measuring run with this function box.

Cancel

Function box for canceling the VAST measurement routine and return to the previous dialog window of the **"SURFACE"** geometric element.

Parameters

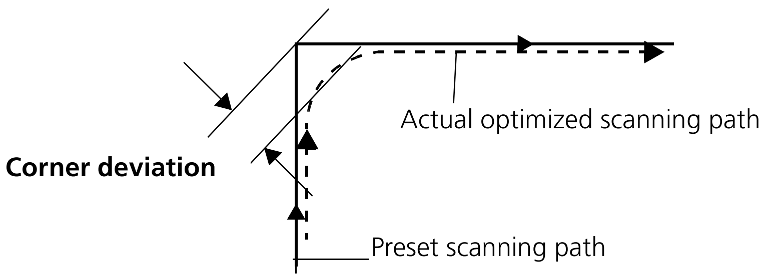
After selecting this function box you can define and store the parameters for an individual measuring run (see circle with VAST scanning).



Description of the input and function boxes

Corner deviation

During scanning runs, it is advantageous to change the scanning direction without bringing the measuring machine to a "standstill" stop. When the scanning direction is changed, a small path deviation results. The permissible value of this deviation is referred to as the "corner deviation". If in individual cases there is a risk of collision or the measuring surface can be missed, you can adapt the corner deviation to match the existing requirements.

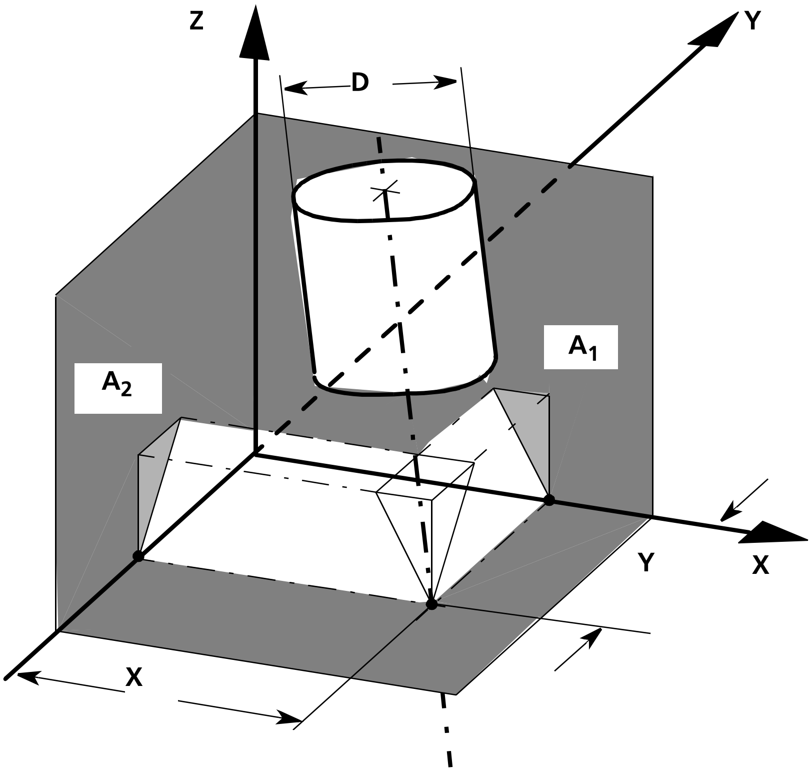


CYLINDER <DI 1106>

Application

This program calculates the diameter and position of bores or shafts.

Minimum number of probings: 5

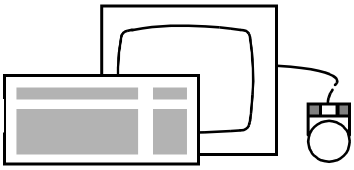


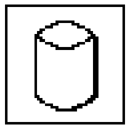
Probing strategy

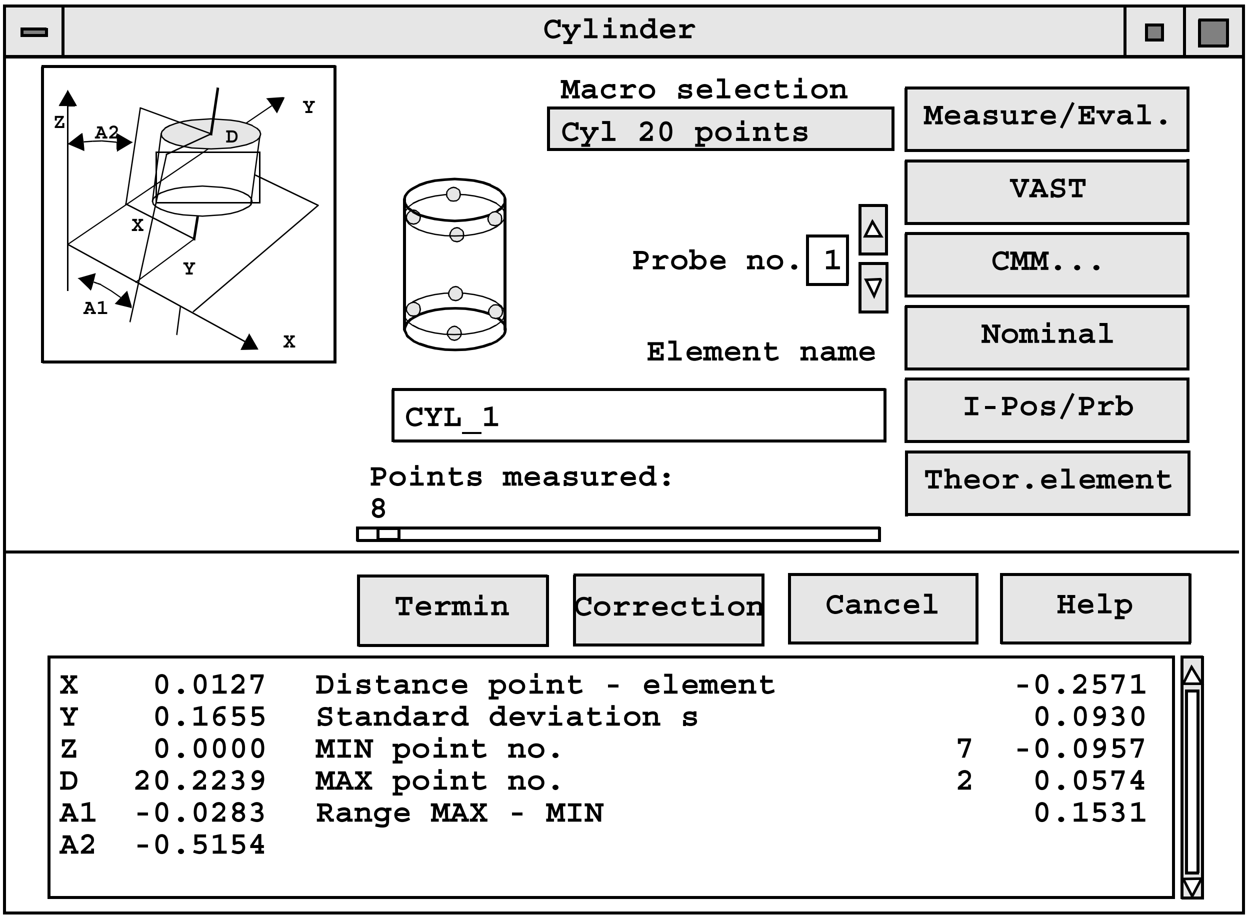
The first three probing contacts must be made in a single section which is roughly perpendicular to the axis. Based on this information, the program then determines the approximate direction of the cylinder axis for further calculation.

These probes must all be probed with the same probe. Other points may be probed with different probes if they all have approximately the same radius. The probes must all be assigned to the same combination.

During learn (i.e. part) programming these values are stored as control data for the subsequent accelerated evaluation.



DI	Pull-Down-Menu	Pictogram
1106 CYLIN	Elements Geometric elements Cylinder...	



Measurement record printout

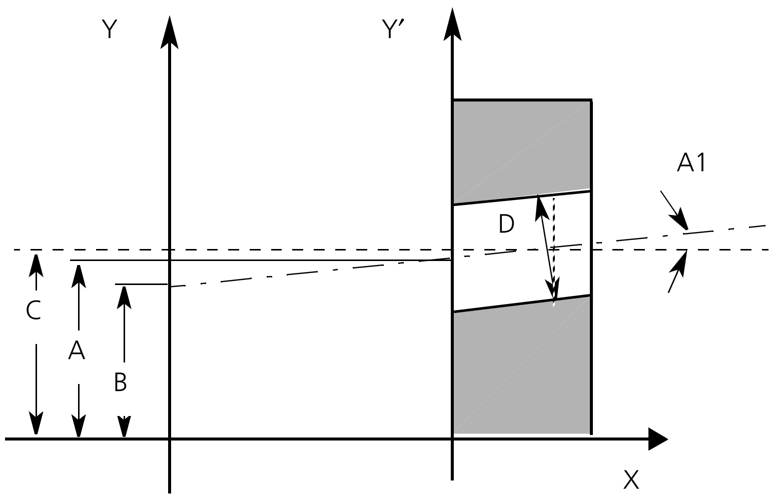
```
CYL_1
    11     CYL    I       X     0.0127
                          Y     0.1655
                          D    20.2239
              X/Z         A1   -0.0283
              Y/Z         A2   -0.5154
       8P S/MIN/MAX          .0930   (7) -.0957   (2)  .0574
```

Explanation of result output

- The angles outpout are referenced to the cylinder axis.
- The reference axis for the projected angles is the coordinate axis with which the cylinder axis forms the smallest angle.

  Any reference axis can be selected with **<FIXED PLANE>** (➤ ***„Selecting the reference plane <DI 1680>" on page 10-50***).
- The of the point are output as a penetration point where the cylinder axis penetrates the workpiece coordinate system.

The position of the penetration point is therefore dependent on the position of the workpiece coordinate system:



A This Y value results if the coordinate system is at Y'

B This Y value results if the coordinate system is at Y.

C This Y value results if the bore is measured as a circle or ellipse (independent of the position of the Y axis)

Semiautomatic measurement

Application

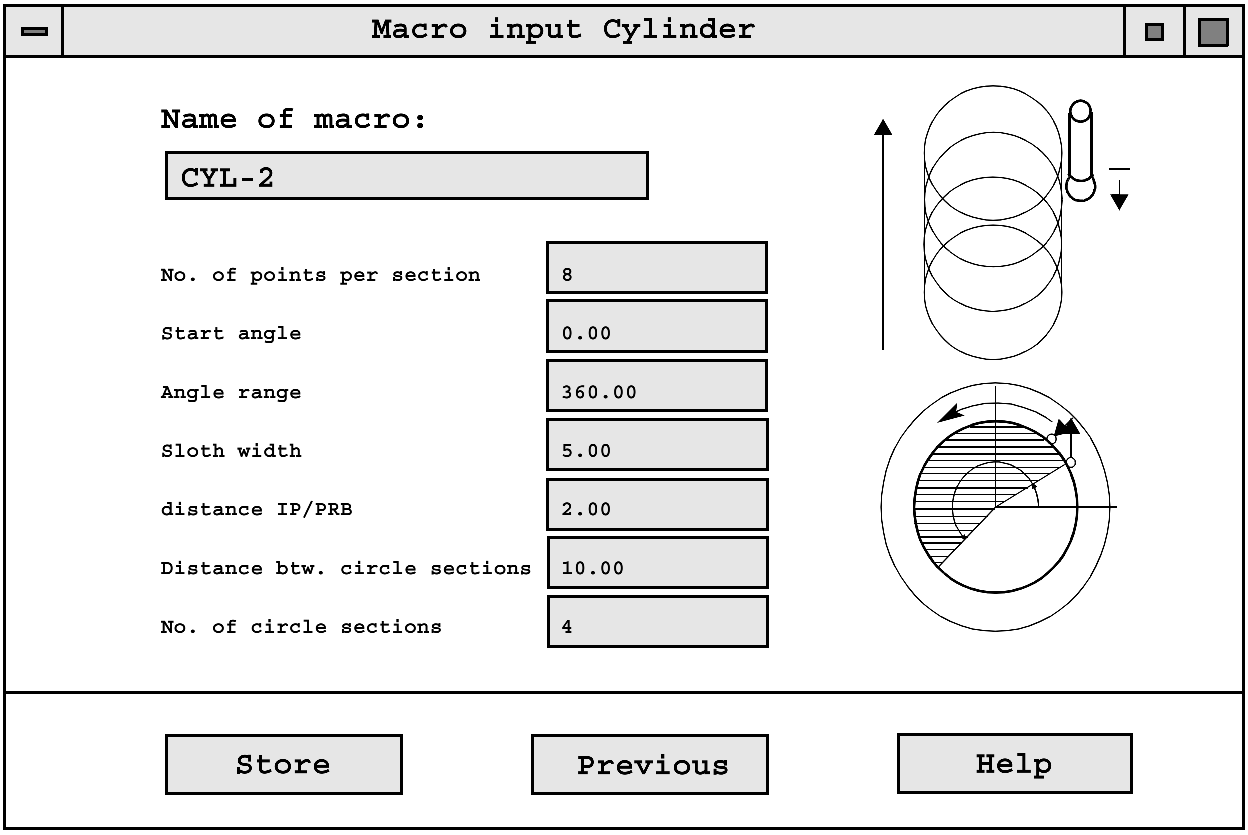
You can measure a cylinder semiautomatically using the macro function.

Function call

<CYLINDER>

<Macro selection>

<Input>



Data boxes

No. of points per section
The number of points entered is distributed evenly over the selected angle range.

Start angle
The angle (positive only) applies when viewing the measuring plane from the positive direction of the third axis.

Angle range
Positive angle = travel counterclockwise, negative angle = travel clockwise.

Slot width
Width of the clearance zone which can be traversed by the probe without causing a collision. The slot width can be set to zero when measuring bores.

Distance IP/PRB
Distance between the intermediate position and the probing point. This dimension must be considerably smaller than the slot width.

Distance btw./No. of circle sections
The reference for these inputs is the position of the auxiliary (help) points.

Procedure

Start the macro

The macro function must be started by entering its name before each measurement.

Intermediate position

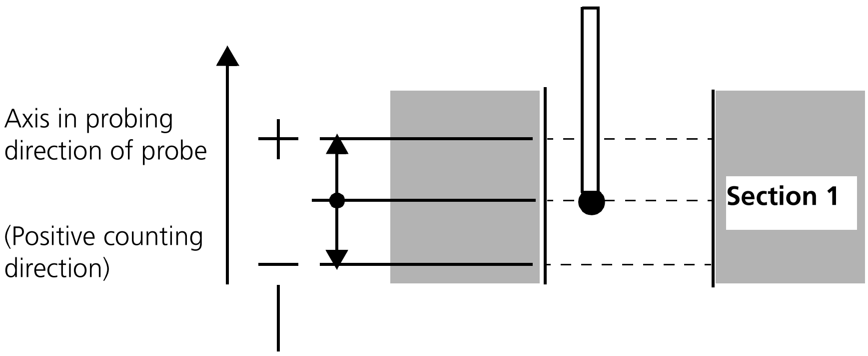
A **clearance height** which can be traversed by the probe without a collision must be defined by setting an intermediate position above the workpiece surface.

Probe two points

The measured element (part feature) must then be determined by **two manual auxiliary probings**. These auxiliary points must lie in the same probing direction and should be a certain distance apart.

Two further auxiliary points

The control then executes another two probings at the symmetry points of both manual probings. The second auxiliary point is located on the next section plane. The geometry of the cylinder is calculated from these four points and the macro is executed.



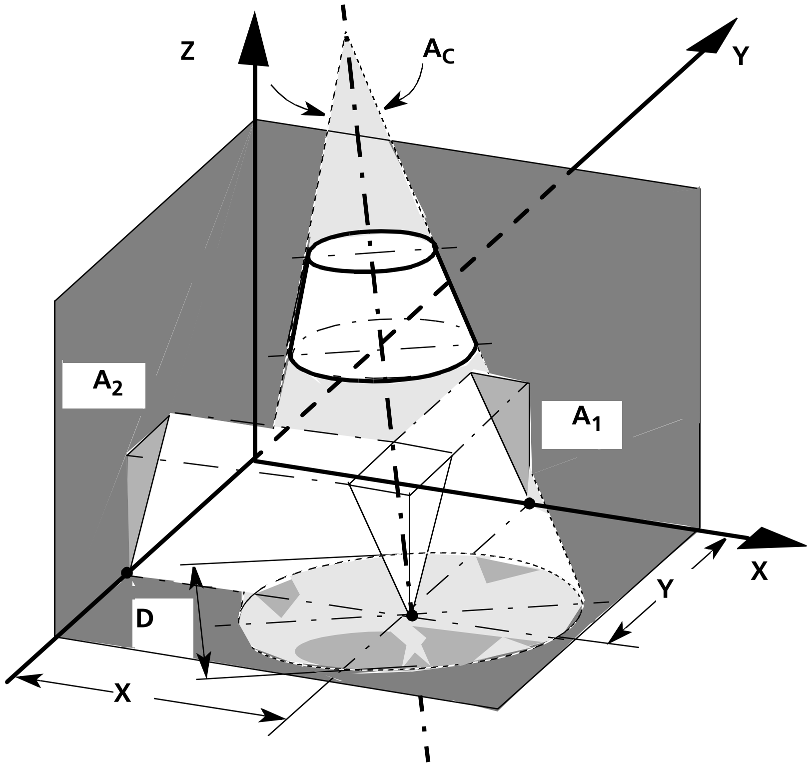
The positions of the following sections depend on the +/-sign for **Distance btw. circle sections**

CONE <DI 1107>

Application

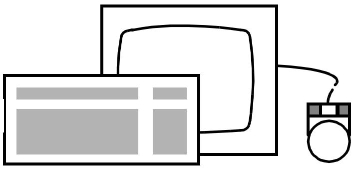
The program calculates the position and form or inner or outer cones.

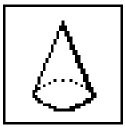
Minimum number of probings: 6

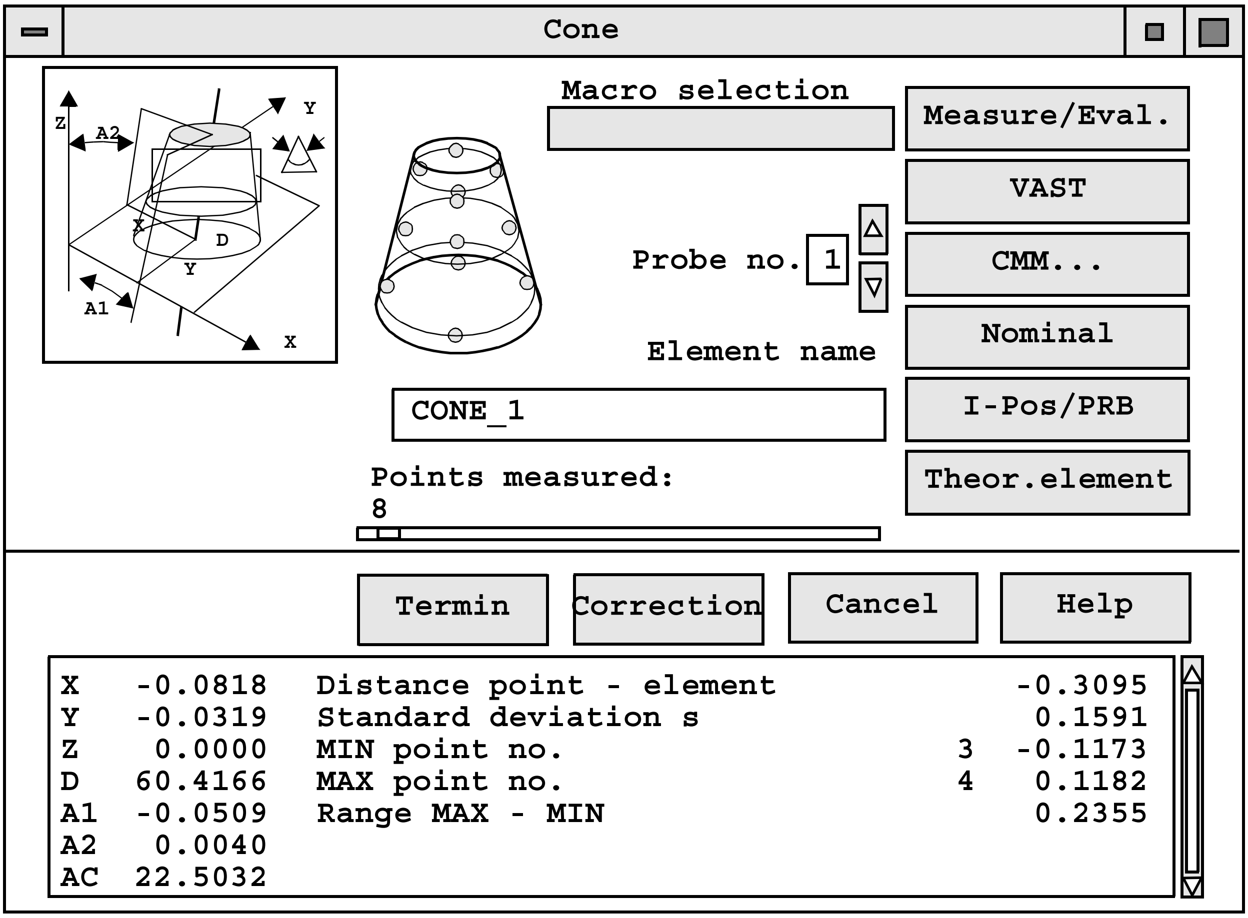


Recommended probing strategy

- The first three probings must lie in one section approximately perpendicular to the axis. The 4th point must be located in another section (based on this data, the program then calculates the approximate cone data for the subsequent operation. These points must all be probed with the same probe. Additional points can be probed with different probes if they have approx. the same radius. The probes must all be assigned to the same combination.
- Probe at least three sections with 4 points each.
- If the conditions are not favorable (e.g. cone sections), additional surface lines should be probed symmetrically.



DI	Pull-Down-Menu	Pictogram
1107 CYLIN	Elements Geometric elements Cone...	



Measurement record printout

```
   CONE_1
       11     CONE I        X    -0.0818
                            Y    -0.0319
                            D    60.4166
                  X/Z       A1   -0.0509
                  Y/Z       A2    0.0040
                            AC   22.5032
         8P  S/MIN/MAX        .1591  (3) -.1173  (4)  .1182
```

Explanation of the result output

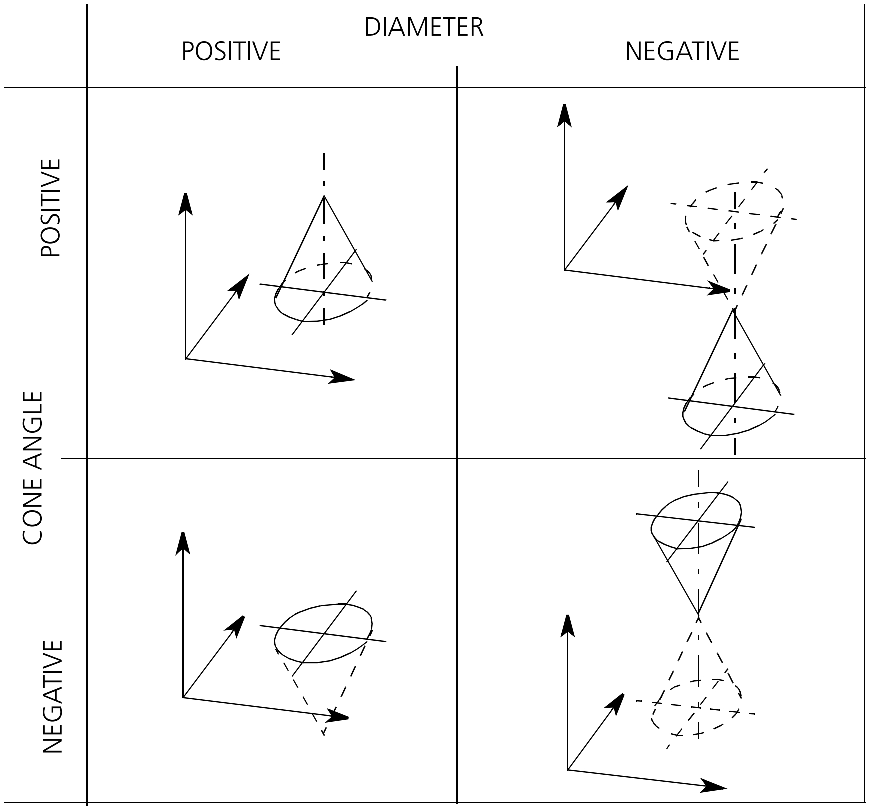
– Angles **A1** and **A2** refer to the cone axis.

– The reference axis for the projected angles is the coordinate axis with which the cone axis forms the smallest angle.
  Any reference axis can be selected with **<FIXED PLANE>**.

– The coordinates of the point where the cone axis penetrates the workpiece coordinate system are output as the penetration point.

– The (theoretical) cone diameter in the penetration point is output as the diameter.

– The position and direction of the cone should be interpreted based on the result as follows:



– Additional cone data can be calculated with **<DI 1243>** (➤***„Additional cone program <DI 1243>" on page 13-13***).

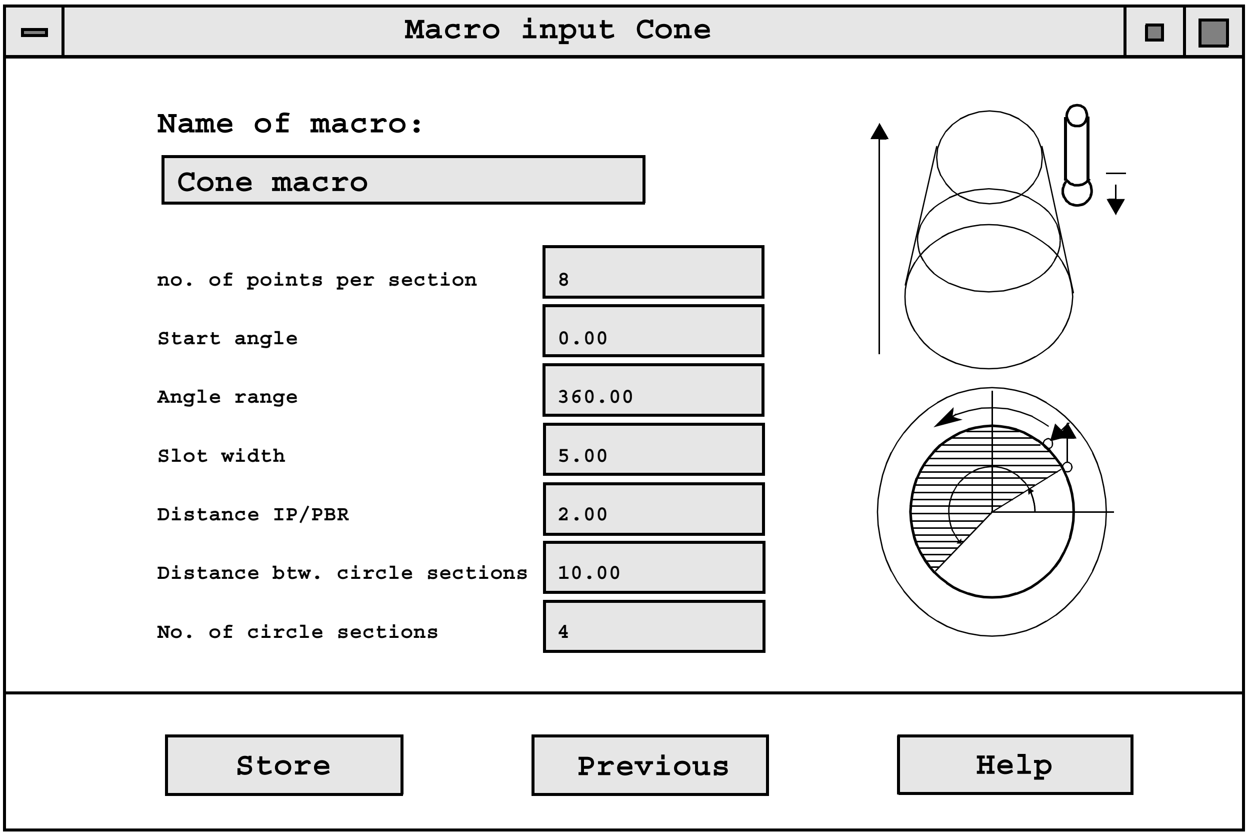
Semiautomatic measurement

Application You can measure a cone semiautomatically using the macro function.

Function call **<CONE>**

<Macro selection>

<Input>



Data boxes

No. of points per section
The number of points entered is distributed evenly over the selected angle range.

Start angle
The reference axis is the abscissa. The angle (positive only) applies when viewing the measuring plane from the positive direction of the third axis.

Angle range
Positive angle = counterclockwise travel, negative angle = clockwise travel.

Slot width
Width of the clearance zone which can be traversed by the probe without causing a collision. The slot width can be set to zero when measuring bores.

Distance IP/PRB
Distance between intermediate position and probing point. This dimension must be considerably smaller than the slot width.

Distance btw./No. of circle sections
The reference for these inputs is the position of the auxiliary points.

Procedure

Start macro
The macro function must be started by entering its name prior to each measurement.

Intermediate position

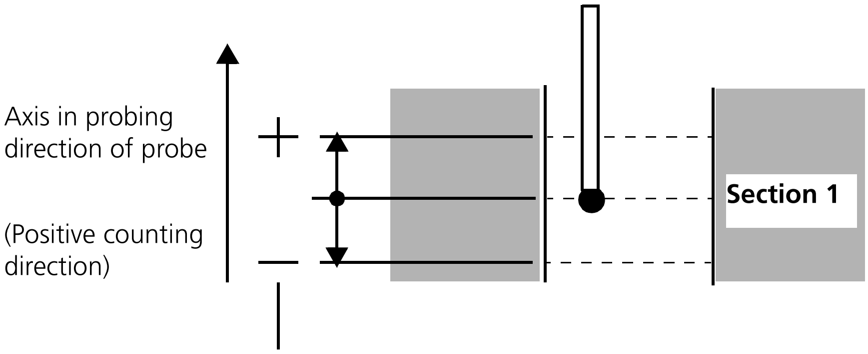
A **clearance height** above the workpiece surface which can be traversed by the probe without causing a collision must be defined by setting an intermediate position.

Probe two points

The measured element (or part feature) must then be determined by **two manual auxiliary probings**. These two auxiliary points must both lie in the same probing direction and should be a certain distance apart.

Two further auxiliary points

The control then performs another two probings at the symmetry point of the two manual probings. The second auxiliary point is located on the next section plane. The second auxiliary point is located on the next section plane. The geometry of the cone is calculated from these four points and the macro is executed.



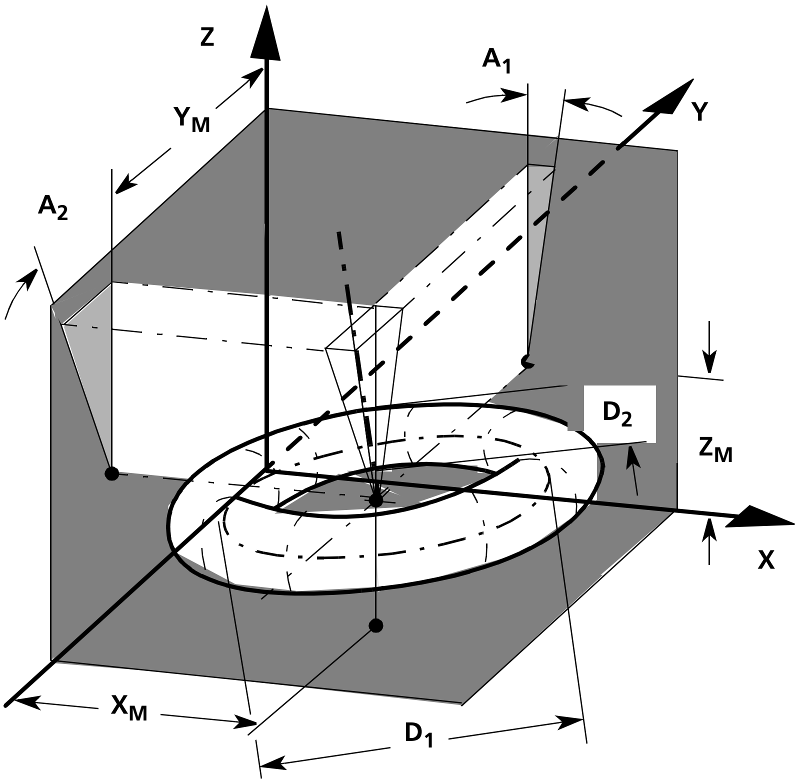
The position of the sections following depend on the +/-sign for **Distance btw. circle sections**

TORUS <DI 1109>

Application

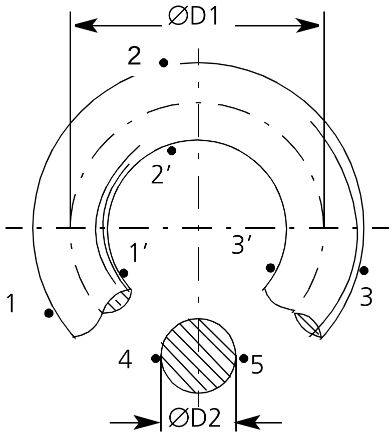
This program calculates the form and position of tori.

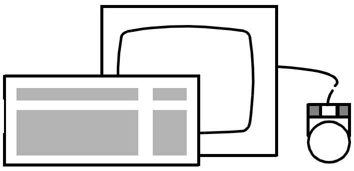
Minimum number of probings: 7

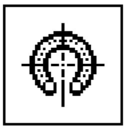


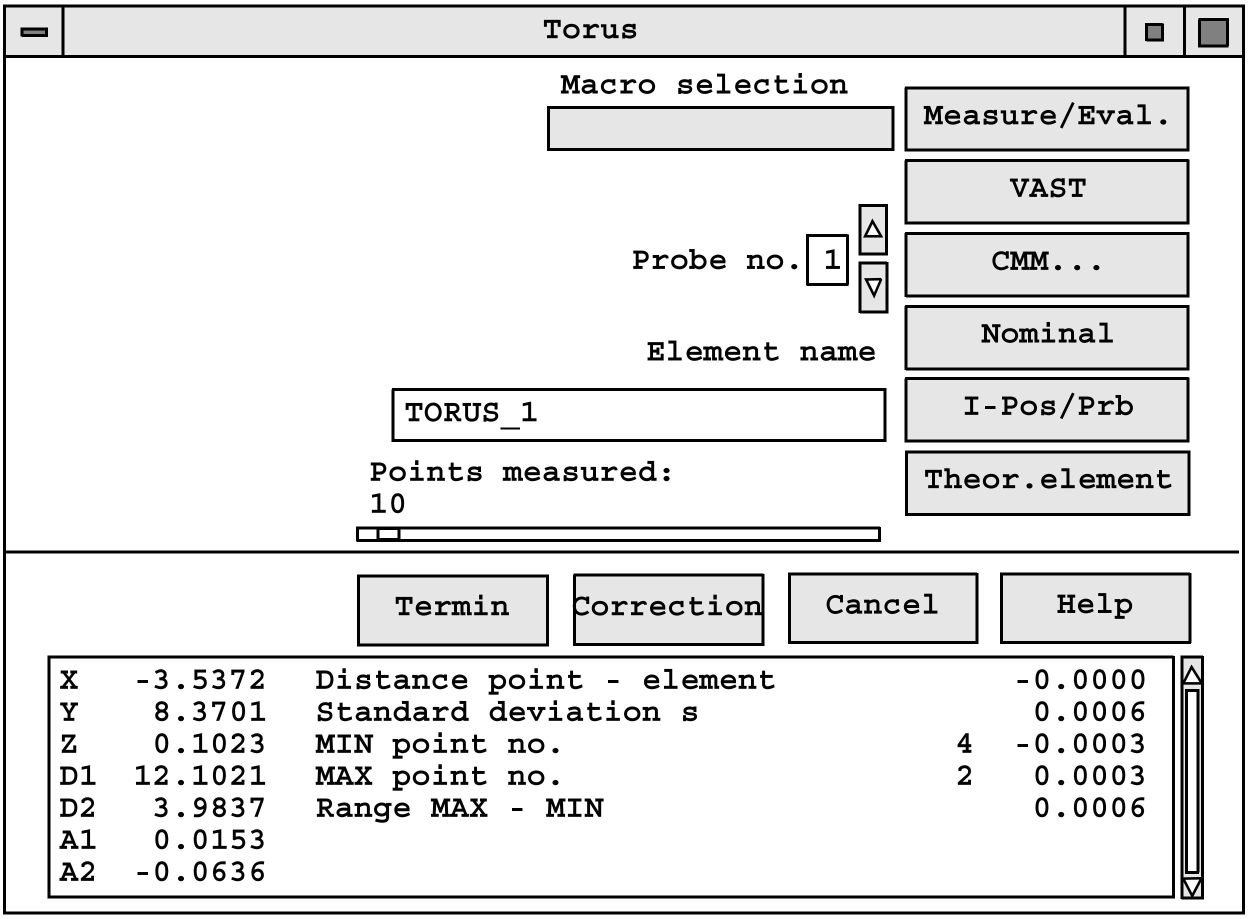
Probing strategy

- Minimum number of probings required: 7; at least 10 probings are recommended to compensate deviations.
- The first three probings must be located equally far away from the torus center point on one normal section (intersection plane perpendicular to the normal, e.g. points 1,2,3 or 1', 2', 3')
- Probings 4 and 5 must lie in a radial intersection plane with diameter D2 (see sketch).
- The remaining probings should be distributed over as large an area of the torus as possible.





DI	Pull-Down-Menu	Pictogram
1109	Elements	
TORUS	Geometric elements	
	Torus...	



Measurement record printout

```
TORUS_1
    11       TORUS      X    -3.5372
                        Y     8.3701
                        Z     0.1023
                        D1   12.1021
              X/Z       A1    0.0153
              Y/Z       A2   -0.0636
                        D2    3.9837
      10P S/MIN/MAX        .0006   (4)  -.0003   (2)  .0003
```

Further notes on application

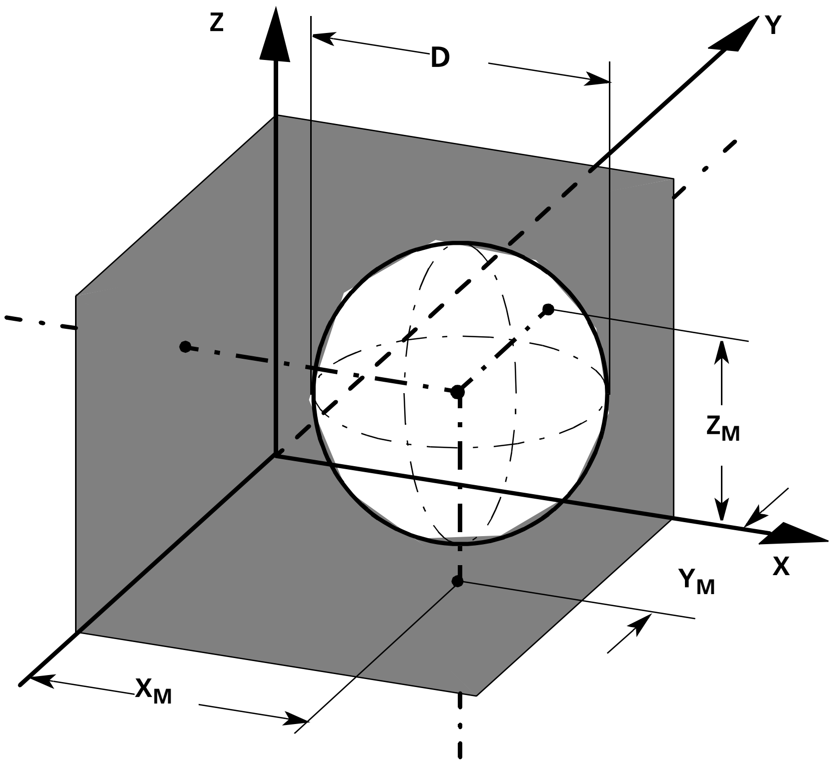
- Nominal input:
  - Enter large diameter **D1** under **D**
  - Enter small diameter **D2** under **AC**.
- Scanning: After the start the program will prompt you to perform the first 3 probings as described above.
- Recalls, combinations and coordinate transformations are possible.
- For maximum precision:
  - Distribute the probings over as large an area of the torus as possible.
  - Place the first three probings exactly in one plane intersecting the normal.
- The penetration point of the torus axis can be determined with **<DI 1217>** (➤ ***„Penetration point <DI 1217>“ on page 13-11***).

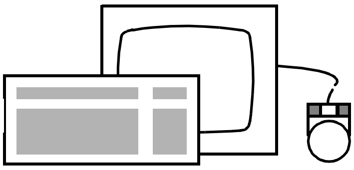
SPHERE <DI 1105>

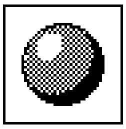
Application

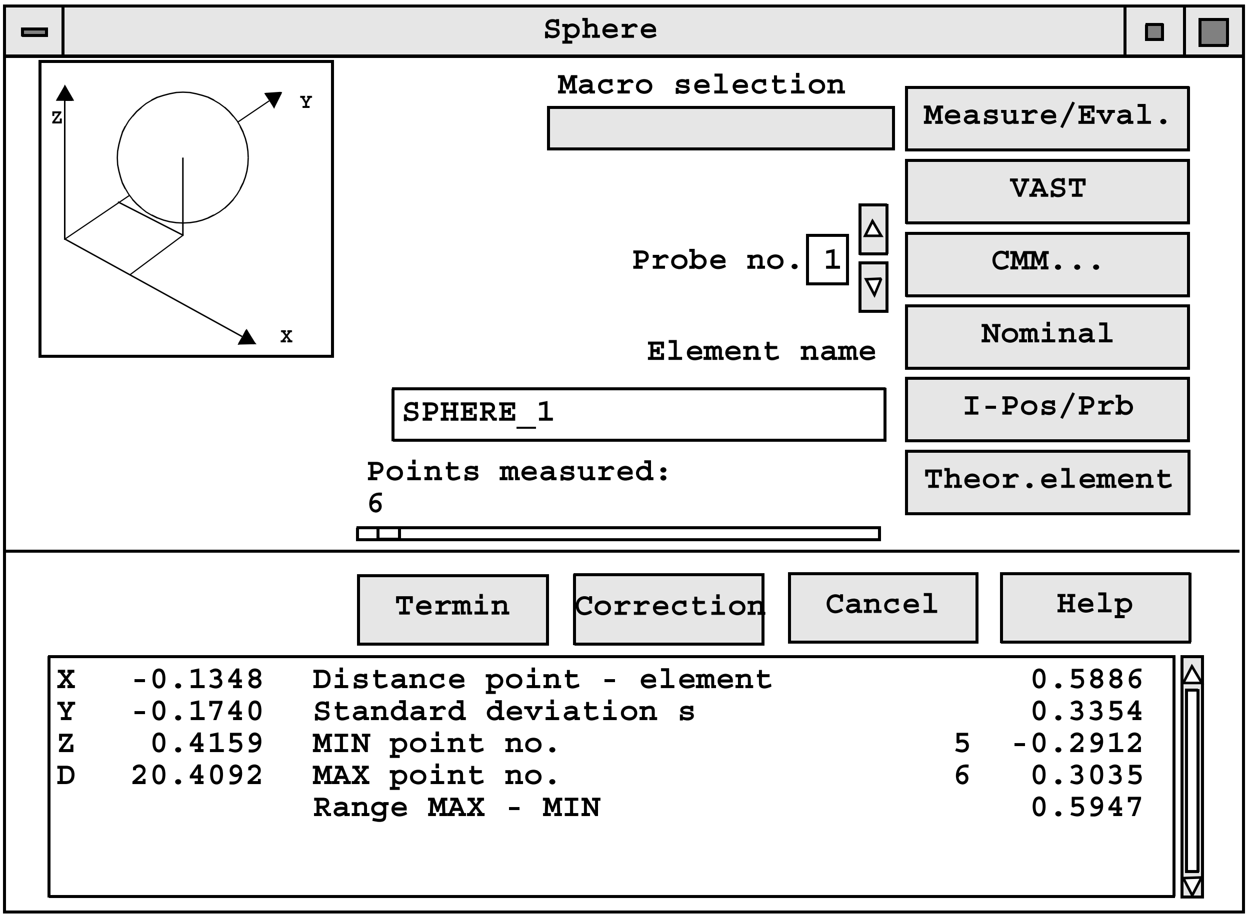
This program calculates the diameter and the center point of a sphere, spherical segment or spherical zone.

Minimum number of probings: 4





DI	Pull-Down-Menu	Pictogram
1105 SPHERE	Elements Geometric elements Sphere...	



Measurement record printout

```
SPHERE_1
     12     SPHERE I      X    -0.1348
                          Y    -0.1740
                          Z     0.4159
                          D    20.4092
          6P S/MIN/MAX      .3354 (5) -.2912  (6) .3035
```

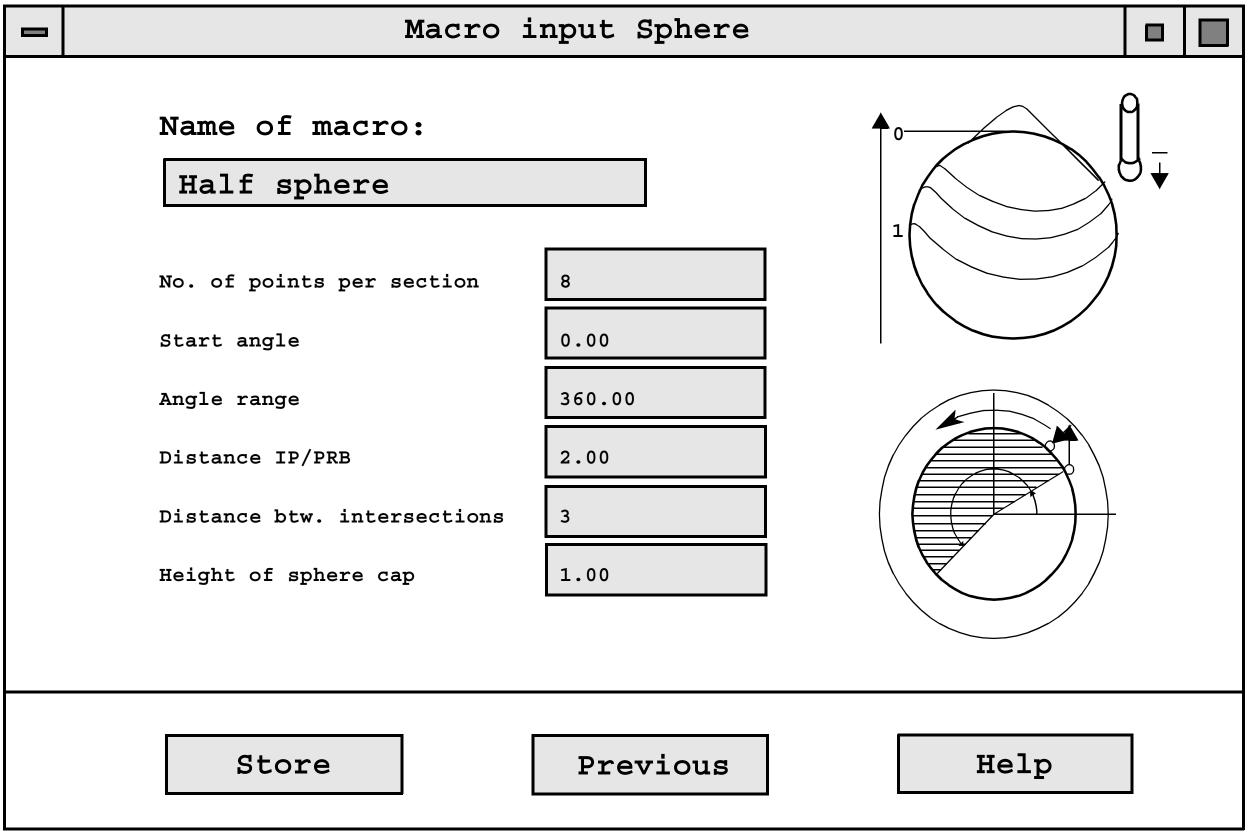
Semiautomatic measurement

Application You can measure the sphere semiautomatically using the macro function.

Function call **<SPHERE>**

<Macro selection>

<Input>



Data boxes

No. of points per section The number of points entered is distributed evenly over the selected angle range.

Start angle The reference axis is the abscissa. The angle (positive only) applies when viewing the measuring plane from the positive direction of the third axis.

Angle range Positive angle = counterclockwise travel, negative angle = clockwise travel.

Distance IP/PRB Distance between intermediate position and probing point.

Distance btw. intersections These intersection planes are automatically specified near the sphere cap.

Height of sphere cap
Area of the sphere which must be assigned with intersection planes. The height must be determined linearly by values between 0 (pole) and 1 (equator).

Procedure

Start macro
Prior to each measurement, the macro function must be started by entering the name of the macro.

Intermediate position
A **clearance height** above the workpiece surface which can be traversed by the probe without causing a collision must be defined by setting an intermediate position

Probe one point
At the start, the measured element (part feature) must be defined by performing a manual auxiliary probing near the pole.

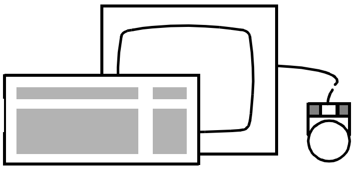
Three auxiliary points
Another three probings are performed automatically to calculate the control information. The geometry of the sphere is then calculated from these four points and the macro is executed.

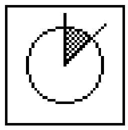
Circle segment <DI 1114>

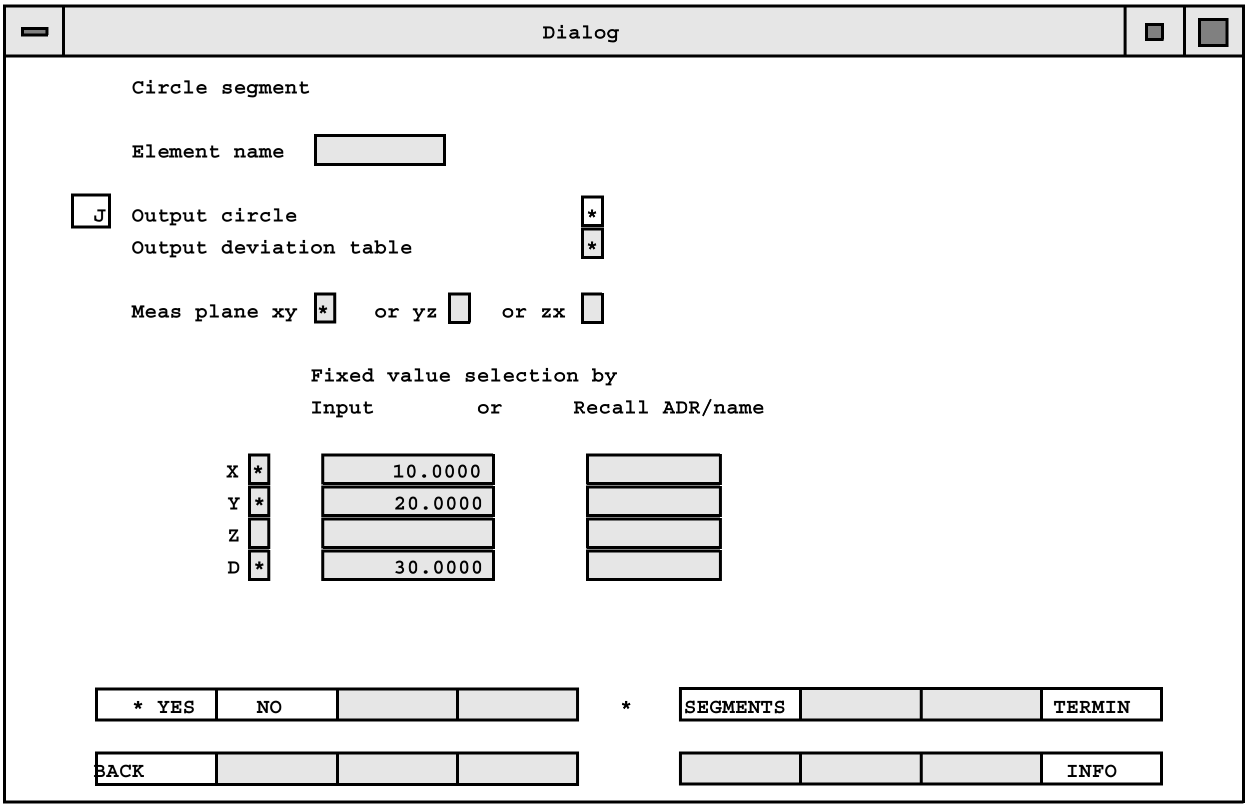
Application

The form and position deviation of circles for which only segments can be probed can best be evaluated with **<DI 1114>**.

Theoretical nominal values can be entered which are considered to be fixed values for the measured segment by the computer.

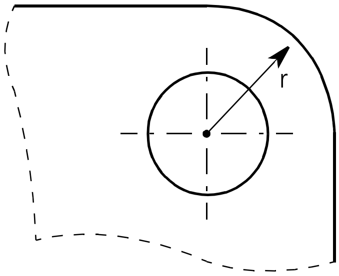


DI	Pull-Down-Menu	Pictogram
1114 CIRSEG	Elements Special elements	
a83	Circle segment...	



Example

The center of a bore is to be the center of the radius r at the same time.

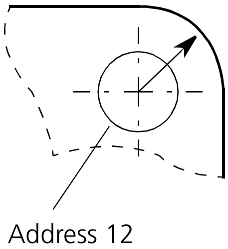


Procedure

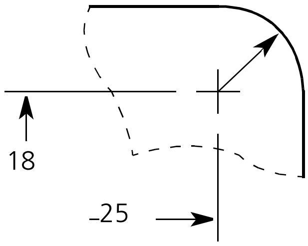
- Call **<DI 1114>** (circle segment).
- The center point of the bore is preset as the fixed value for the radius center point.
- The program calculates only the diameter of the circle segment from the subsequent probings on the radius.
- The specified fixed value as the center point, the calculated diameter and the standard deviation are all output in the result.

Fixed values

Entered numerical values or measurement results or result names can be specified as fixed values.



Measurement result as fixed value



Input numerical value as fixed value

Data boxes

Element name

The default name offered can be changed.

Output circle or deviation table

If the radii are to be used again, the inquiry **Output deviation table** must be answered with **<YES>**. Addresses will then be assigned to the **RADMES** radii.

Output circle	Output Deviation table	Output in the record
yes	yes	Result circle segment + probings
yes	no	Only result circle segment
no	yes	Only probings
no	no	Only result circle segment

Meas. plane

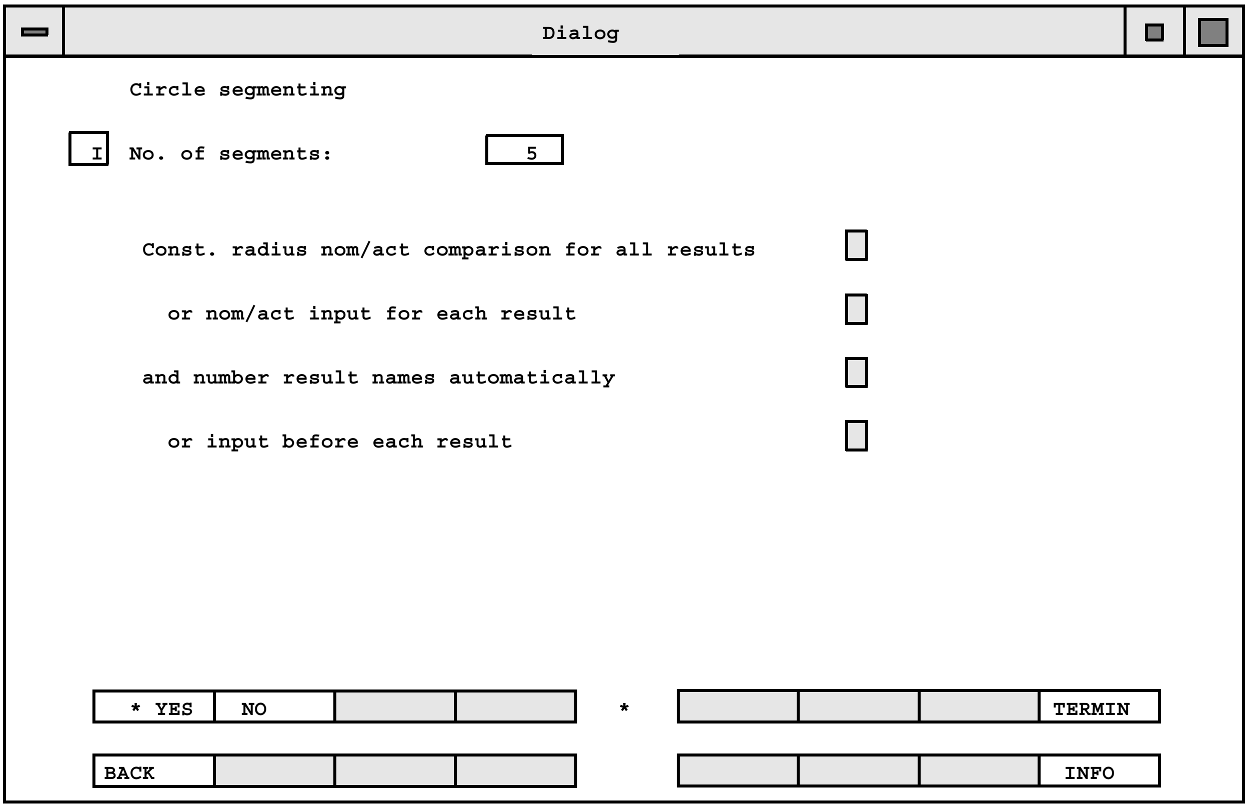
Plane in which the circle segment lies.

Fixed value selection by Input or Recall ADR/name

- Select the icon for which a fixed value is to be preset with **<YES>** / **<NO>**.
- If a numerical value is to be given as a fixed value for the icon, it must be entered in the **Input** column and confirmed with **<Enter>**.
- If a measuring result is to be preset as a fixed value, the address or name of the required result must be entered in the **Recall ADR/name** column.
- The dialog window is terminated with **<TERMIN>**. Then probing of the circle segment is requested.

SEGMENTS

This softkey is used for branching to the dialog window to enter circle segments.



Data boxes

No. of segments

The number of segments can be entered.

NOTE

– No result names can be given for the **RADMES** results.

– A recall of **RADMES** is output as **POLAR**.

Possible fixed value combinations

– If the center point and diameter are specified, no probings are necessary. The values specified are output as ideal circle.

– If the center point is specified, then at least 1 point must be probed. The diameter is calculated; ther other values remain as specified.

– The diameter can also be specified as a fixed value. The center point is calculated.

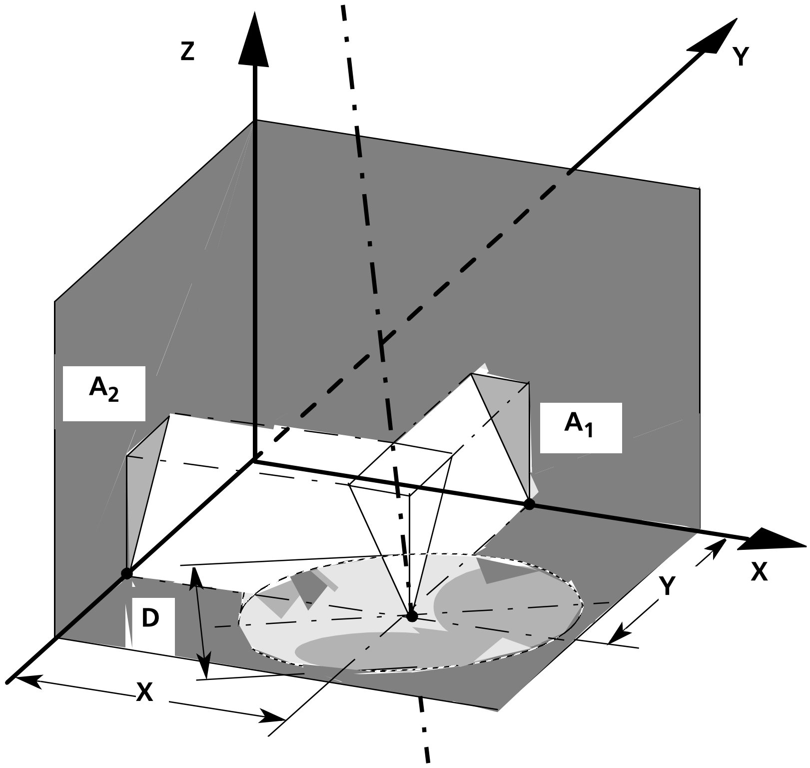
Measurement record printout

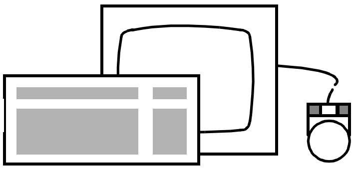
```
Fix value input: XY

CIRSEG_1
    2     KR-SE I      X     0.0000
                       Y     0.0000
                       D    39.8803
       2P S/MIN/MAX      .0705 (2) -.0499  (1) .0499

    3     RADMES       R    19.9999
              Y/X      A1    0.1574

    4     RADMES       R    19.8903
              Y/X      A1    5.3295
```

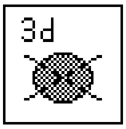
3D circle <DI 1154>

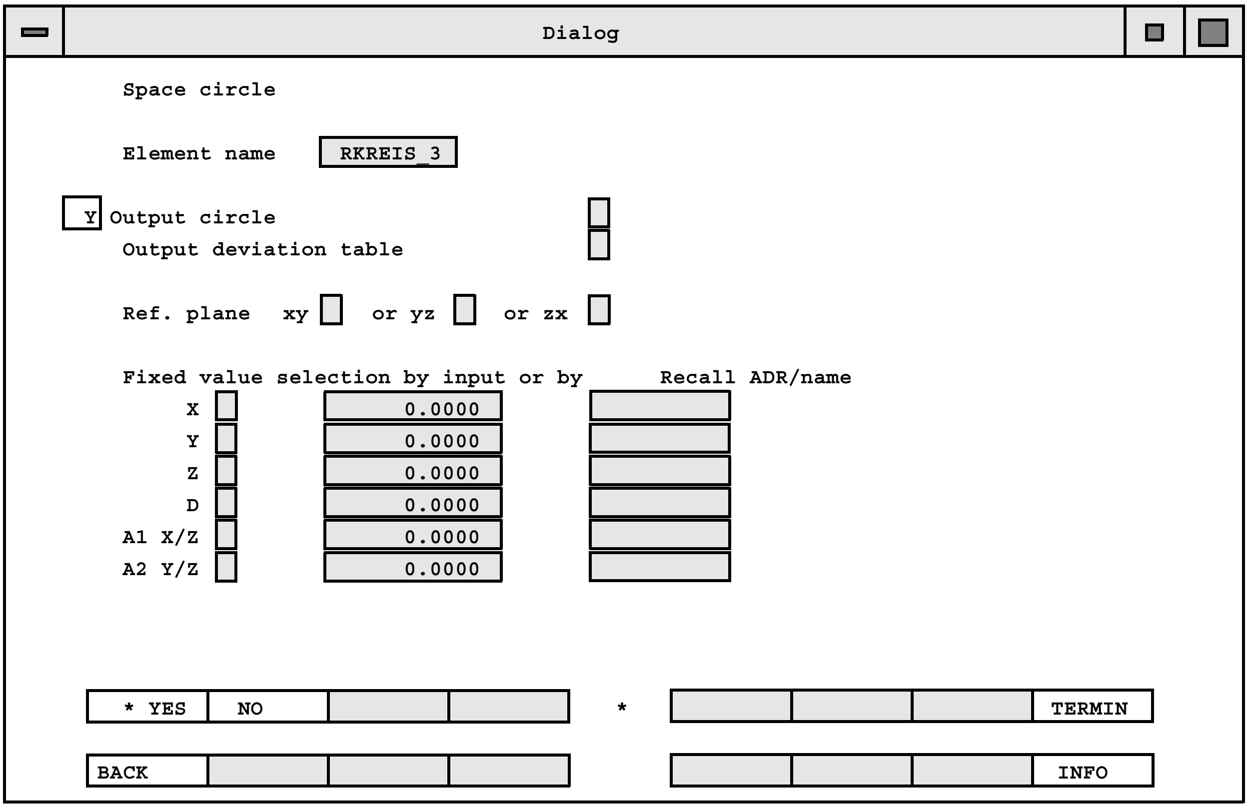
Application

With this program, circles and radii which lie inclined in space can be measured.





DI	Pull-Down-Menu	Pictogram
1154 3DCIRC a501		



Data boxes

Element name

The default name offered can be changed.

Output circle, Output deviation table

Not yet active.

Ref. plane

The plane in which the projection of the 3D circle lies.

Fixed value selection

- Select the icon for which a fixed value is to be specified with **<YES>** / **<NO>**.
- Either numerical values in the **Input** column or measurement results via address or result name in the **Recall ADR/name** column can be specified as fixed values.
- The dialog window is concluded with **<TERMIN>**. The circle is then requested for probing.

NOTE

Possible fixed value combinations

- If all fixed values are preset, no probings are necessary. The preset values will be output as an ideal space circle.
- If all fixed values except **D** are preset, at least 1 point must be probed. The diameter will be calculated and all other values remain as preset.
- At least three probings are necessary if fixed values are entered for **A1** and **A2**.

Measurement record printout

```
RCIRCLE_1
    11     R-KR I       X    13.1547
                        Y    14.9982
                        Z     0.0001
                        D    12.0036
           X/Z          A1   10.0000
           Y/Z          A2    5.0000
       6P S/MIN/MAX       0.0006 (4) -0.0003  (2) .0003
```

Theoretical elements

Application

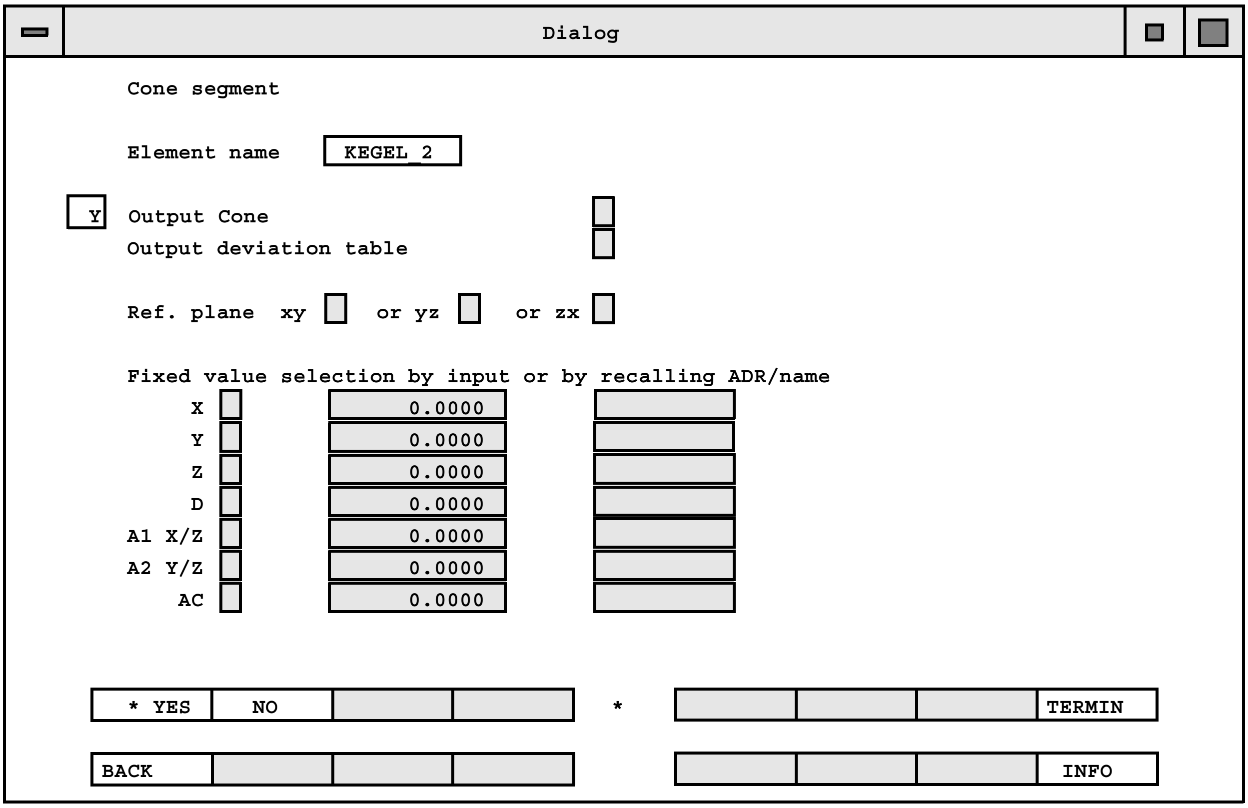
Sections or other constructions with theoretical planes or circles are occasionally required in technical drawings.

Theor.element

The respective theoretical element can be selected within a geometric element

Example

for the dialog window with the theoretical element cone



The data boxes in the dialog window may vary according to the element called.

Data boxes

Element name

The default name offered can be changed.

Output Cone, Output deviation table

Data boxes with no function.

Ref. plane

Enter plane in which cone segment lies.

Fixed value selection by input or by recalling ADR/name

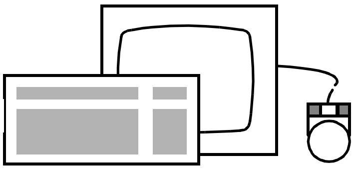
– Select the icon for which a fixed value is to be input with **<YES>** / **<NO>**.

- If a numerical value is to be entered as the fixed value for the icon,it must be entered in **Input** column and confirmed with **<Enter>**.
- If a measuring result is to be preset as a fixed value, the address or name of the desired result must be entered in the **Recall ADR/name** column.
- The dialog window is closed with **<TERMIN>** and the theoretical element is finished.

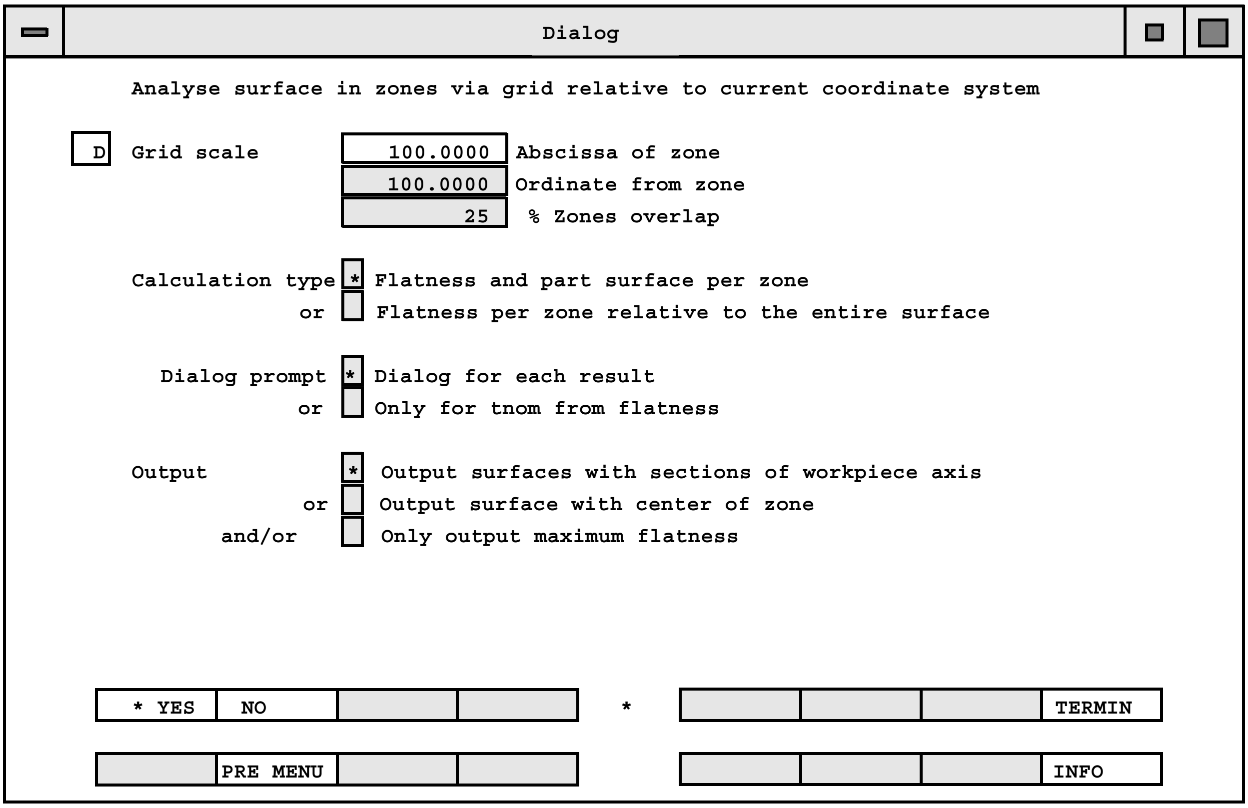
Flatness macro <DI 1169>

Application

A grid is placed over a surface. The surface and flatness are calculated for the grid points.



DI	Pull-Down-Menu	Pictogram
1169		



When you press the **<TERMIN>** key, the dialog branches to the surface element to record points.

Repetition

The evaluation can be repeated by pressing the **<REP EVAL>** softkey only with the correct coordinate system.

Chapter 12

Linking results

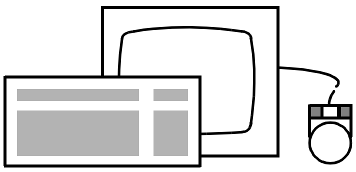
This chapter contains:

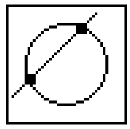
Intersections

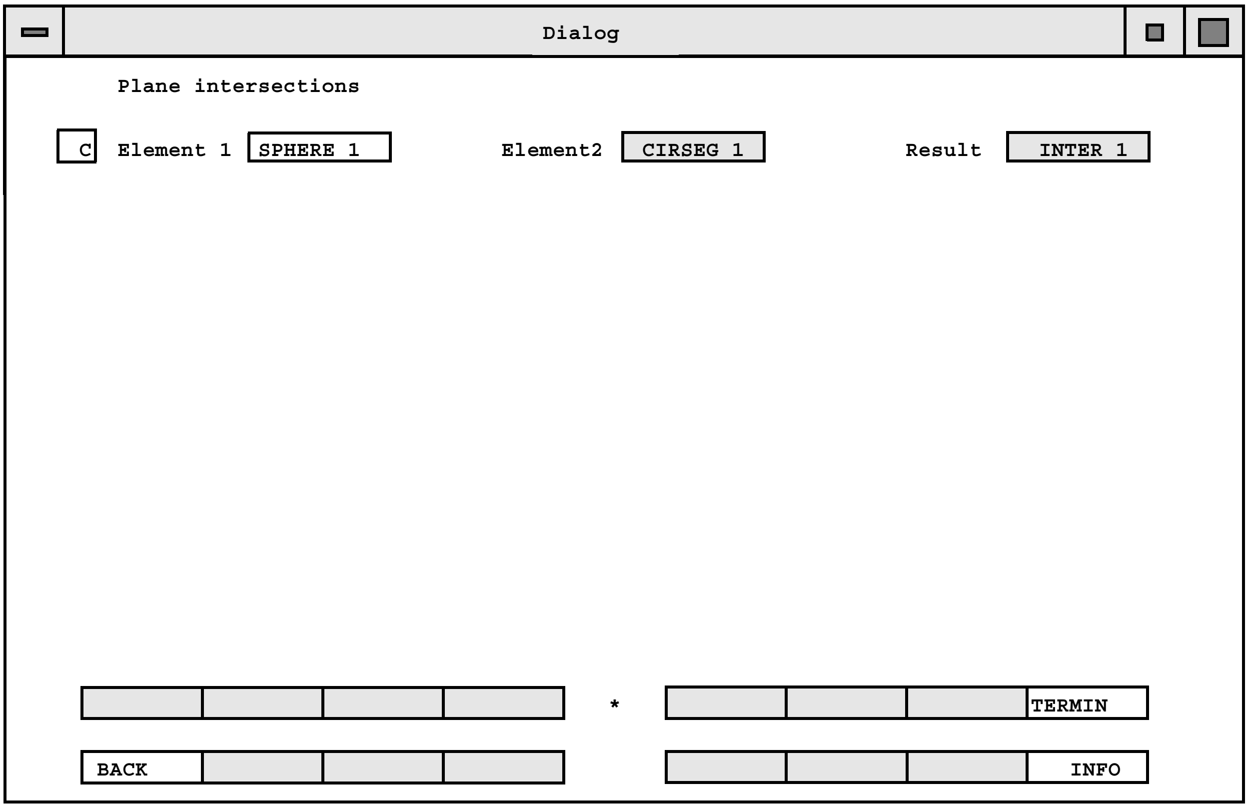
Plane intersections <DI 1218>

Application

Using the **<INTERSEC>** function, axes, circles, ellipses and surfaces can be intersected with each other.



DI	Pull-Down-Menu	Pictogram
1218 SECTPLA	Eval Inters. Inters.	



Procedure

Input address

Enter the names or address of the elements to be intersected in the **Element 1** and **Element 2** data boxes.

Result name

Enter the name you want to assign to the result in the **Result** box (Follow information in ➤***„Allocating names“ on page 5-9***).

Two intersection points

If two intersection points may result when the two elements are intersected, both intersection points will initially be displayed in the list and message window.

Inters. point no.: 1   X = -1.1803 Y = 14.9535

Inters. point no.: 2   X = 11.3661 Y = -9.7883

No intersection point is accepted with ’0’!

Select intersection point

The dialog asks which intersection point is to be accepted.

2 Inters. point(s) - Transfer inters. point no.:

End function

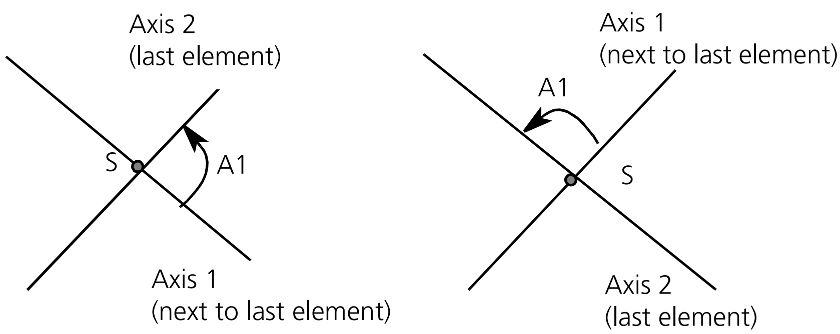
Enter the corresponding number and close the dialog window with **<TERMIN>**.

NOTE

- Differentiation between **Element 1** and **Element 2** is required only with the **AXIS/AXIS** combination to calculate the intersection angle.
- The first dialog window will not appear if the name allocation function is switched off (➤***„Allocating names“ on page 5-9***) In this case, the last element in the record is **Element 1** and the next to last element is **Element 2**.

This function can be applied to the following element combinations:

AXIS/AXIS



- The lines can lie in any workpiece plane.
- The intersection point output and the intersection angle are projected into the plane which is common to both lines.

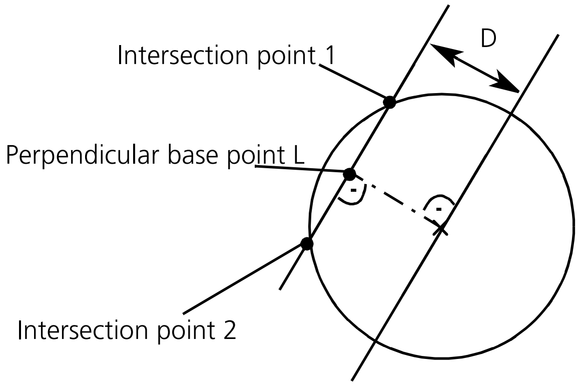
AXIS/CIRCLE (ELLIPSE)

Prerequisite

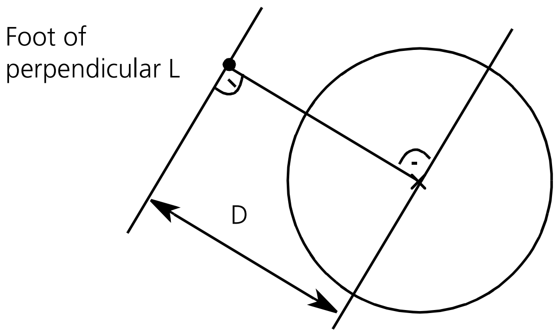
The penetration point of the axis output and the circle center point must not lie in the same measuring plane. The intersection point is projected into the plane which is common to both elements.

There are two possibilities:

– If **2 intersection points** exist, both of them will be displayed on the screen. The intersection point to be output in the measurement record must be defined in the dialog. The shortest distance (D) between the circle and the axis is also output.



– If **no intersection** point exists, the coordinates of the foot of the perpendicular and the shortest distance (D) between the circle and the axis are output.



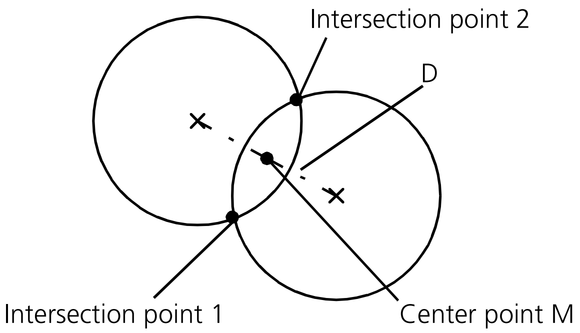
CIRCLE/CIRCLE (ELLIPSE)

Prerequisite

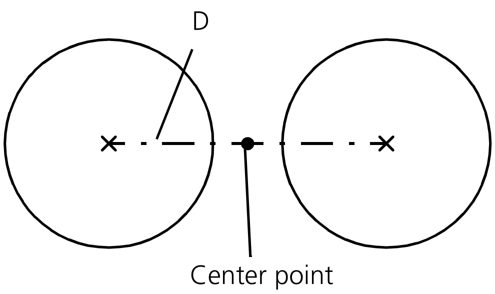
Both circles must lie in the same measuring plane.

Two cases must be differentiated:

– If **two** intersection points exist, both will be displayed on the screen.
  The intersection point to be output in the measurement record must be defined in the dialog The shortest distance (D) between the circle center points is also output.

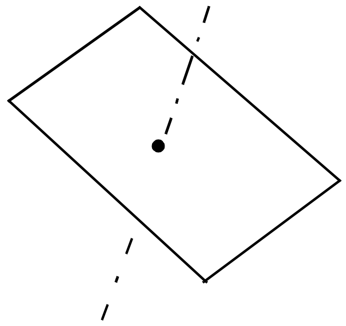


– If **no intersection point** exists, the distance between the circle center points and the center point of the connecting line will be ou tput.



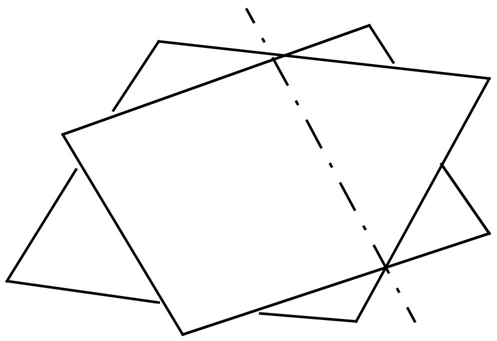
AXIS/SURFACE

The penetration point of the line through the surface is output in 3 coordinates (spatially defined point)



SURFACE/SURFACE

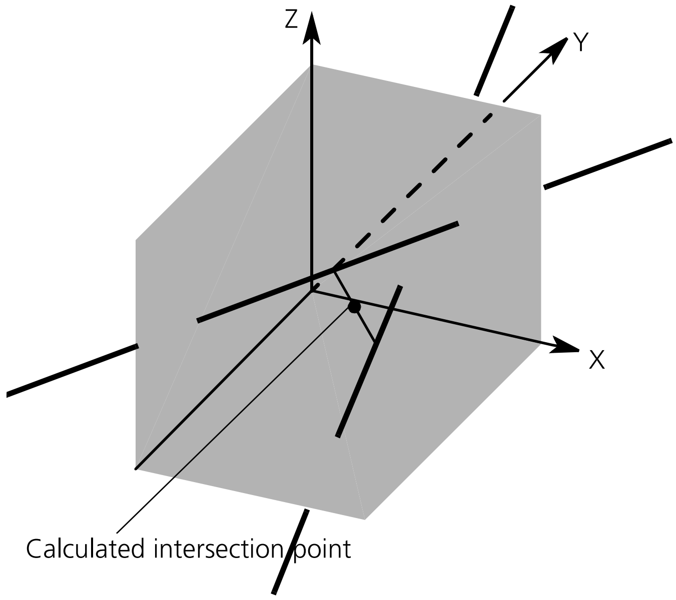
Result: spatially defined intersection line

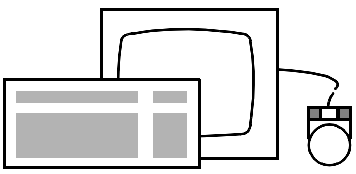


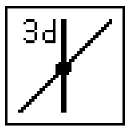
Intersection point of axes in space <DI 1215>

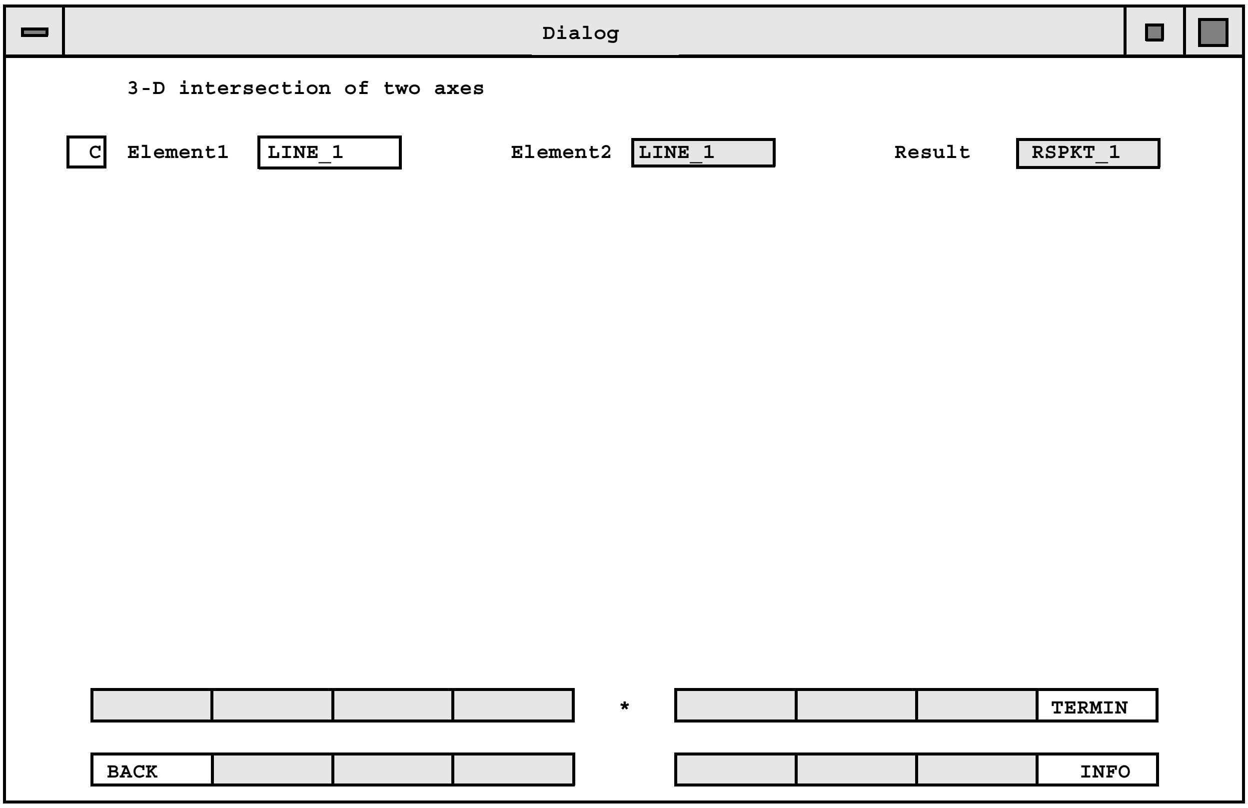
Application

This function calculates the intersection point between two axes in space. If the axes do not intersect, the point closest to both axes (center point of the perpendicular) will be output.





DI	Pull-Down-Menu	Pictogram
1215 SECT3D	Eval Inters. 2 Axis 3D	



Procedure

Enter address

Enter the names or address of the axes to be intersected in the **Element 1** and **Element 2** data boxes.

Result name

Enter the name you want to assign to the result in the **Result** box (see information in ➤***„Allocating names“ on page 5-9***).

End function

Close the dialog window with **<TERMIN>**.

NOTE

– No differentiation between **Element 1** and **Element 2** is required.

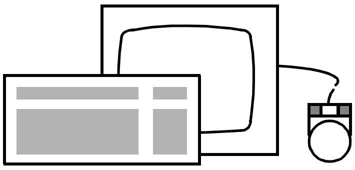
– If the name allocation is not activated (➤***„Allocating names“ on page 5-9***) the dialog window will not appear. The last two elements in the measurement record are then intersected.

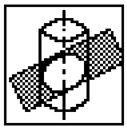
Surface sections <DI 1219>

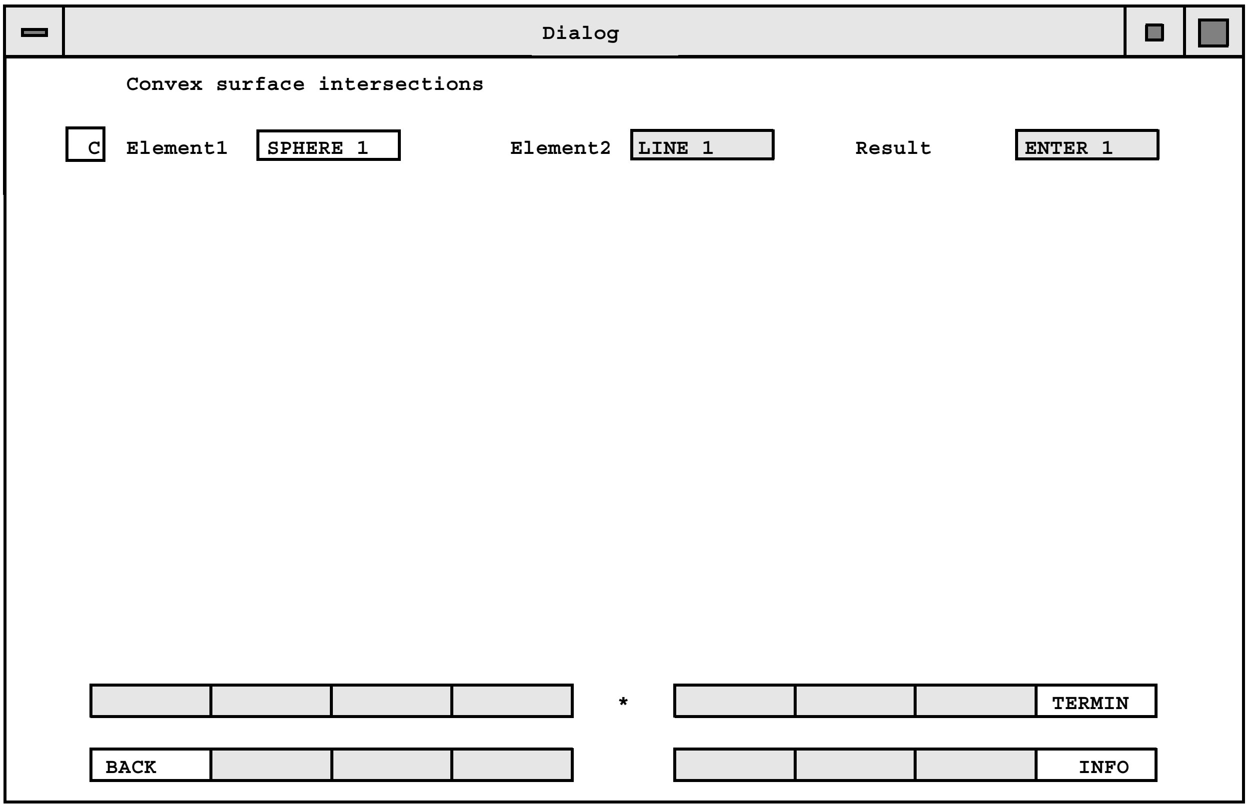
Application

With this function, the spatial elements **SPHERE** and **CYLINDER** can be intersected by an axis or a surface. A **TORUS** can be intersected with an axis. The following elements are permissible as an axis:

– Line
– Cylinder, cone or torus axis
– Calculated intersection lines



DI	Pull-Down-Menu	Pictogram
1219 SECTMAN	Eval Inters.	
a611	Convex surface intersections	



Procedure

Enter address

Enter the names or addresses of the elements which are to be intersected in the **Element 1** and **Element 2** data boxes.

Result name

Enter the name you want to assign to the result in the **Result** box (see information in ➤*„Allocating names“ on page 5-9*).

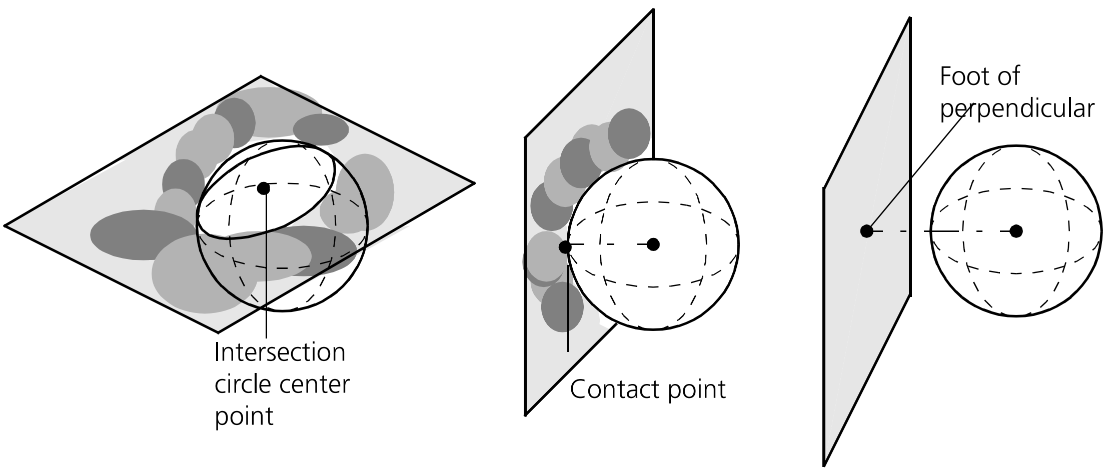
End function

Close the dialog window with **<TERMIN>**.

NOTE

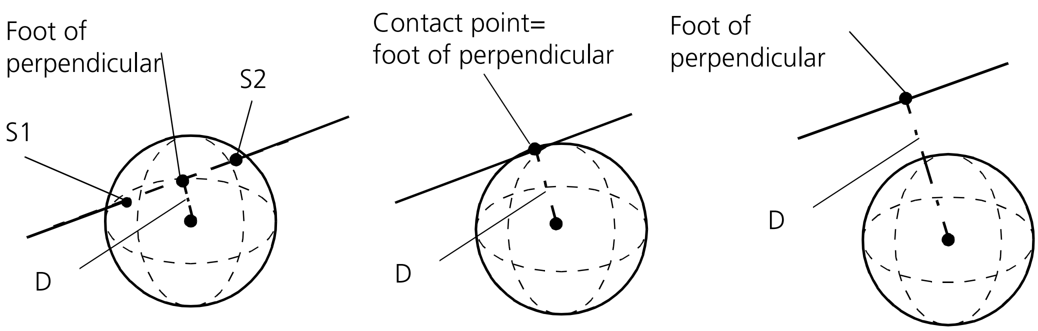
No differentiation between **Element 1** and **Element 2** is required. If the name allocation is not activated, the dialog window will not appear. The last two elements in the measurement record are intersected.

SPHERE/SURFACE



- Depending on the position of the sphere and the surface, the coordinates of the intersection circle center point, the contact point or the foot of the perpendicular will be output.
- The diameter of the intersection circle is output under D. If these two elements do not intersect, then D = 0.

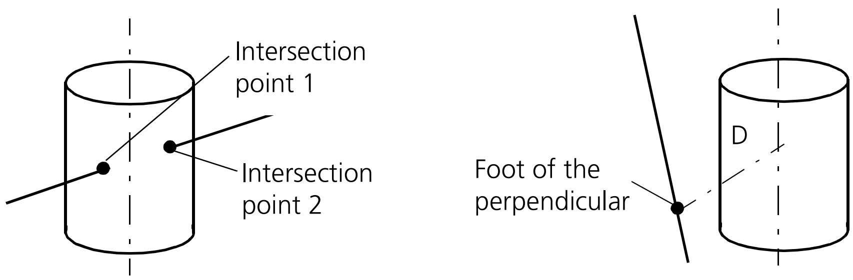
SPHERE/AXIS



- The shortest distance between the sphere center point and the axis (perpendicular) will be output under D in the measurement record.

– If 2 intersecting points exist, both of them will be displayed in the list and message window on the screen.
  Inters. pt no.: 1   X = -1.1803
  Y = 14.9535
  Inters. pt no.: 2   X = 11.3661
  Y = -9.7883
  The intersection point which is to be output in the measurement record must be determined in the dialog.
  Transfer from inters. point no: 1
  Select the required intersection point with **<YES>** / **<NO>**.
– If no intersection point exists, the coordinates of the foot of the perpendicular will be output.

CYLINDER/AXIS



Axis is Address: ..
Surface is Address: ..

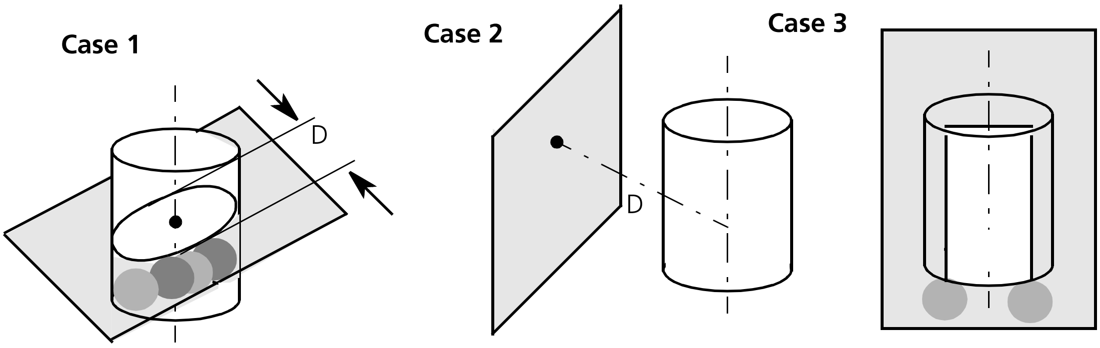
The inquiry appears only if a cylinder or torus axis has been chosen as the intersection axis. The element to be used as the axis and the element to be used as the surface must be entered here. Select **<YES>** to accept the default addresses or **<NO>** to replace them.

Transfer from inters. point no.: 1

If the axis intersects the cylinder, both intersection points will be displayed on the screen in the list and message window. The intersection point to be accepted for the measurement record is selected with **<YES>** / **<NO>**.

If no intersection point is present, the coordinates of the foot of the perpendicular and the shortest distance between the axis and the cylinder axis are output.

CYLINDER/SURFACE



Case 1

If the surface does not lie parallel to the cylinder axis, the center point and small diameter of the intersection ellipse will be output.

Special case: If the difference between the small and large ellipse diameter is smaller than the machine resolution, the result will be output as an intersection circle.

Case 2

If the surface does not intersect the cylinder, the coordinates of the foot of the perpendicular and the distance between the cylinder axis and the surface will be output.

Case 3

If the surface runs parallel to the cylinder and intersects it, the intersection lines will be calculated as the result.

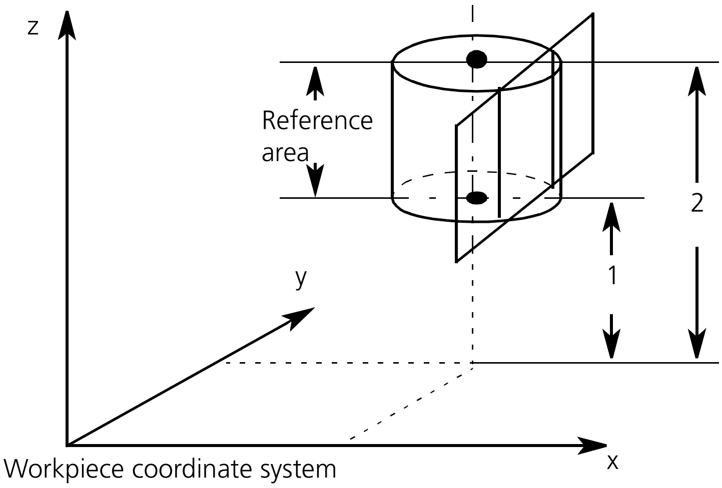
Intersection lines in the mathematical sense result only if the cylinder axis and the surface normal are exactly perpendicular to each other. This is generally not the case in metrology. The following dialog will appear if the parallelism deviation between the surface and the cylinder is less than **three degrees**:

max. parallelism dev. (perm. range 0 - 3 Deg)

Here you must enter the maximum parallelism deviation between the surface and the cylinder for which lines should be calculated as the result. If the actual deviation exceeds the value entered here, an intersection ellipse will be output as the result.

Ref. length 1
Ref. length 2

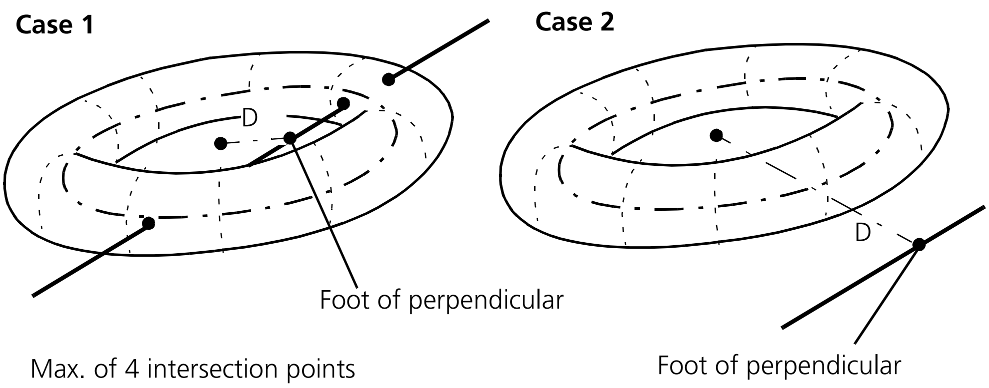
To minimize errors when calculating lines, a reference range must be specified to the computer. This reference range is limited by reference lengths 1 and 2. The reference lengths refer to the point where the cylinder axis penetrates the workpiece coordinate system.



Line no.: 1 - accept?

Both intersection lines are displayed on the screen. Line no. 1 is accepted with **<YES>** and line no. 2 with **<NO>**.

TORUS/AXIS



Case 1

If the axis intersects the torus, all intersection points will be displayed on the screen. The intersection point to be output in the measurement record must be defined in the dialog.

4 inters. points (s) - accept inters. point no.:

Enter the number of the intersection point to be output in the measurement record. If "0" is entered the coordinates of the foot of the perpendicular will be output.

Case 2

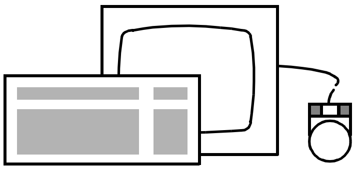
If no intersection point exists, the coordinates of the foot of the perpendicular and the shortest distance between the axis and teh torus center point will be output.

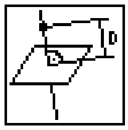
Perpendicular calculations

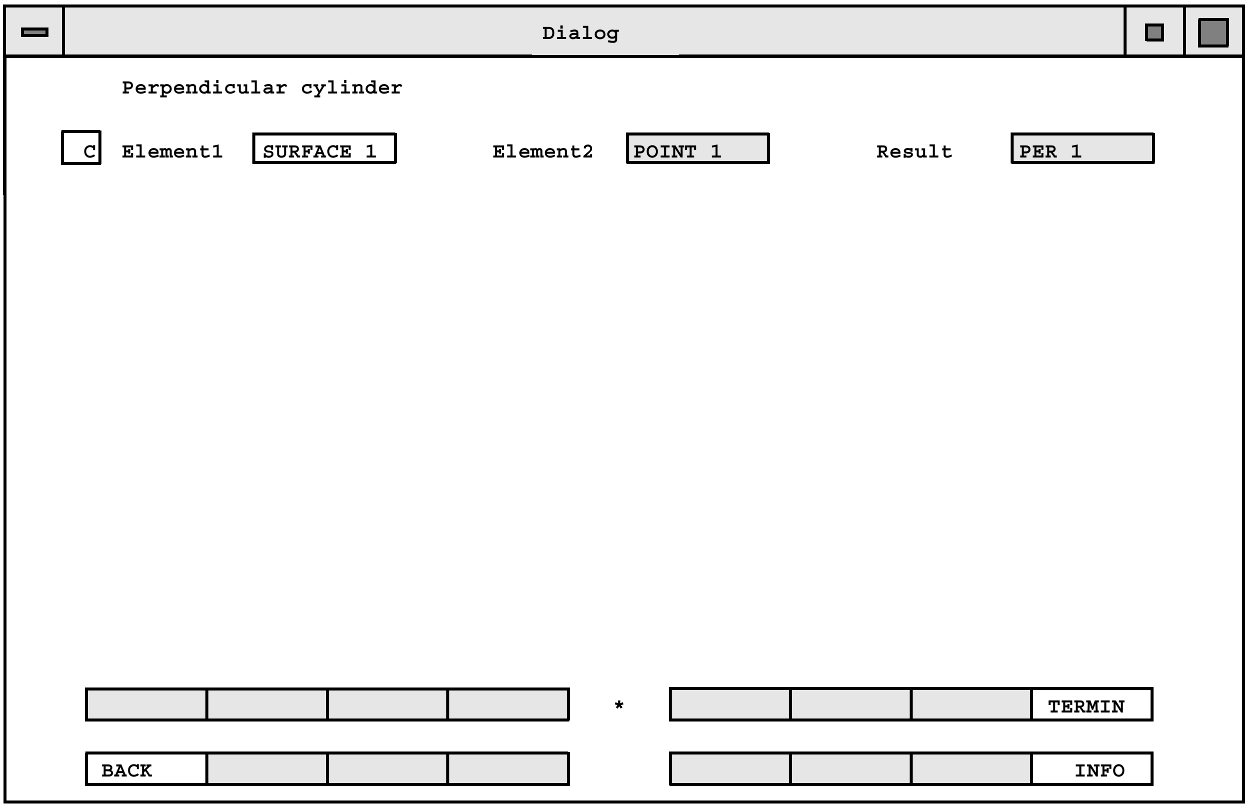
Perpendicular cylinder <DI 1285>

Application

Using the **<PERPEN>** program, you can measure the shortest distance between two geometric elements in space.



DI	Pull-Down-Menu	Pictogram
1285 SECTMAN	Eval Distance	
a85	Convex surface intersections	



NOTE

If the name allocation function is not activated (➤***„Allocating names“ on page 5-9***), the dialog window will not appear.
The perpendicular is formed between the last two elements in the record. One of them must be spatially defined.

Procedure

Enter address

Enter the names or addresses of the elements between which the perpendicular is to be calculated in the **Element 1** and **Element 2** data boxes.

Result name

Enter the name you want to assign to the result in the **Result** box (Follow instructions in ➤***„Allocating names“ on page 5-9***).

End function

Close the dialog window with **<TERMIN>**.

Result output

The **<PERPEN>** program supplies the same data as a cylinder measurement. The result is therefore output as **PERPCY**.

X, Y, Z: Coordinates of the perpendicular penetration point through the reference plane.

A1, A2: Projected angles of the perpendicular (➤***„Projected angles“ on page 10-53***)

D: Shortest distance between reference and measured elements.

Element 1

is the next to last element in the measurement record. It defines the ***location*** and ***length*** of the perpendicular. Any geometric element is permitted since only the coordinates of the element are used for the perpendicular calculation.

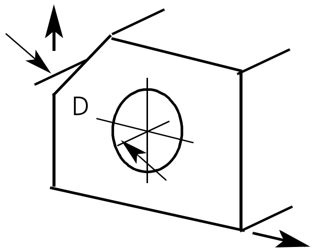
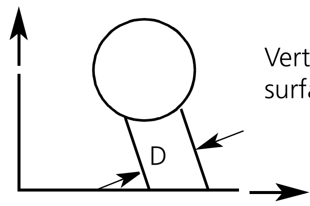
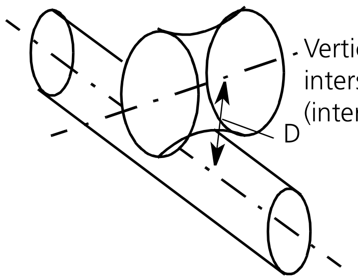
Element 1	**Coordinates used**
POINT probing	Coordinates of the probing point with probe radius correction in the direction of the surface normal
CIRCLE	Center point coordinates and average probing depth
AXIS	Coordinates of penetration point

An exception from the above is two intersecting axes (see example).

Element 2

is the last element in the measurement record. It defines the direction of the perpendicular (the perpendicular is at a right angle to element 2). A 3D definition is always required for this purpose (line, surface, cylinder, cone or torus axis).

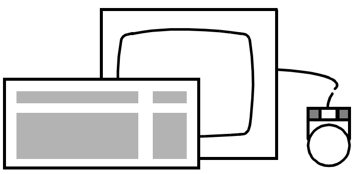
Application examples

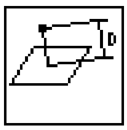
Measurement task		Element 1 / Element 2
	Vertical distance bore / inclined surface	Surface / Circle
	Vertical distance parallel surfacel	Surface / Point
	Vertical distance intersecting axes (intersecting angle> 0,1°)	Axis / Axis

Perpendicular distance <DI 1286>

Application

If only the shortest distance in space, but not the direction and penetration point of the perpendicular, is required for two geometric elements, this can also be determined with **<DI 1286>**.



DI	Pull-Down-Menu	Pictogram
1286 PERPDIS	Eval Distance Perpendicular	

Output

The length of the perpendicular, i.e. the shortest distance between the two elements, is output as the result under **D**.

Preassignment

The last two elements in the measuring record are always offered as the preassignments for Elements 1 and 2 with **<DI 1285>** i.e. each time **<DI 1285>** is called the preassignment changes for element 1.

If you call **<DI 1286>,** the same element will be offered as element 1 as was offered as element 2 (the last element in the record) the last time the function was called.

In this way, the values offered can simply be accepted with **<TERMIN>** if the perpendicular of the same spatially defined element is measured repeatedly.

Example

<SURFACE>

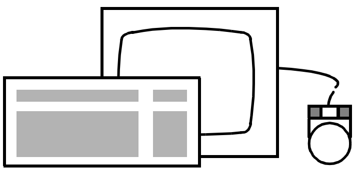
Probing point
<DI 1286>
Probing point
<DI 1286>
Probing point
<DI 1286>

Each time **<DI 1286>** is called the surface is offered as a Element 1 and the previous probing point as Element 2

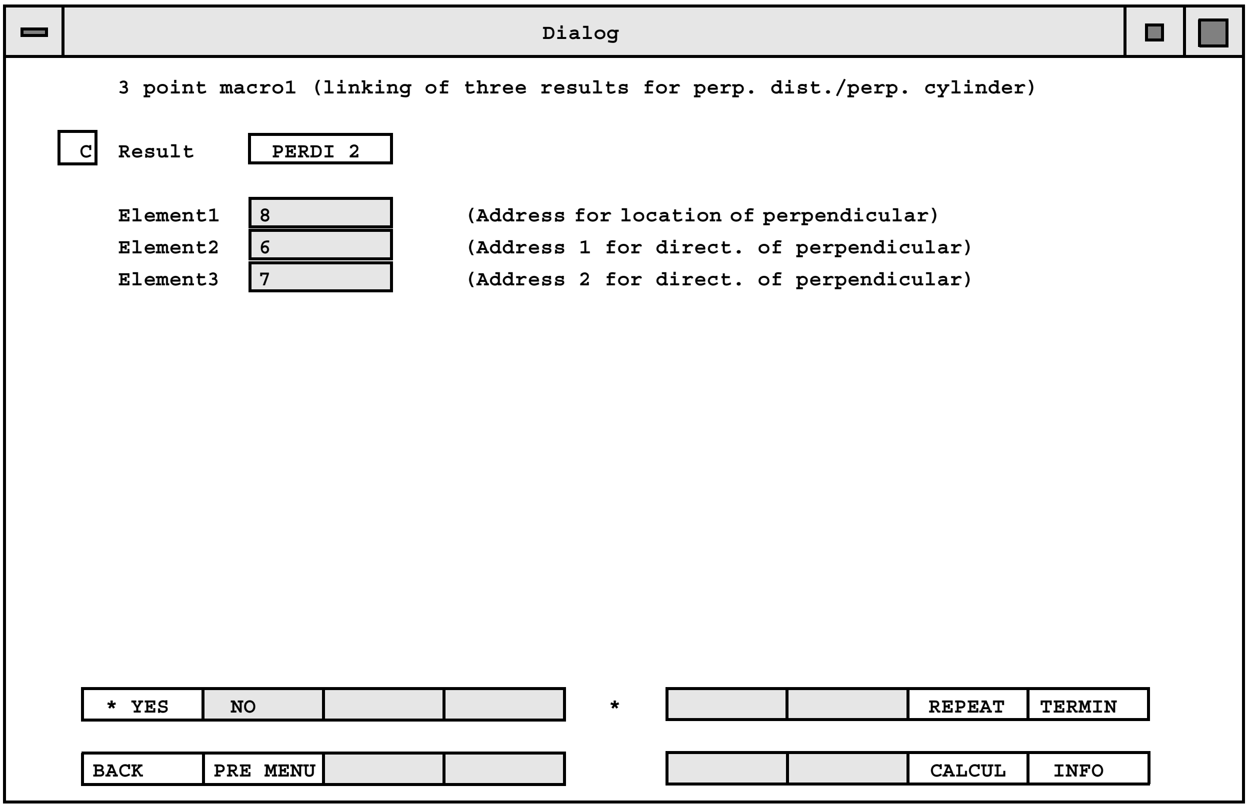
Perpendicular / Perpendicular distance <DI 1272>

Application

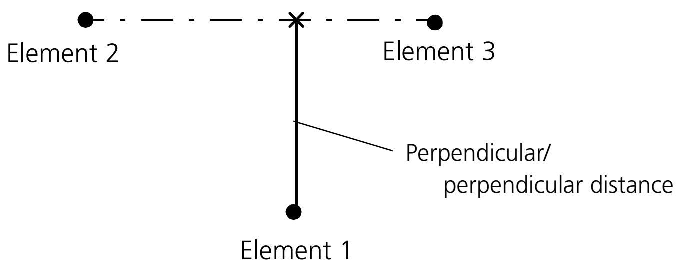
This function can be used if the perpendicular from a point to the perpendicular distance between two other points is required.



DI	Pull-Down-Menu	Pictogram
1272		



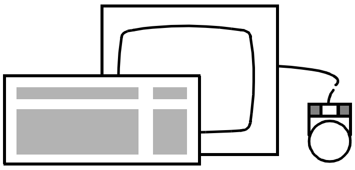
Beispiel

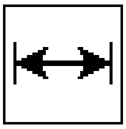


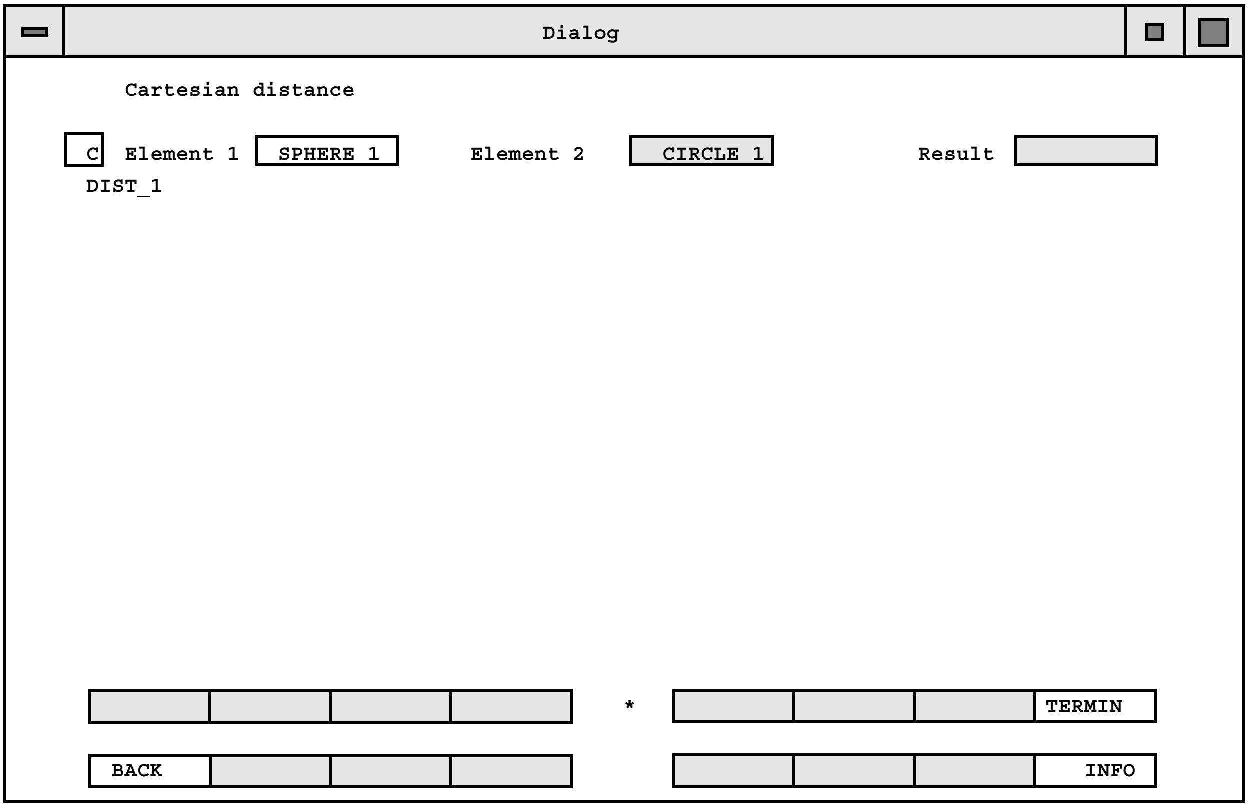
Distance in cartesian coordinates <DI 1202>

Application

The **<DISTANCE>** function calculates the distance between two elements in cartesian coordinates. The coordinates of the first element are subtracted from those of the second and the result is always output as positive.



DI	Pull-Down-Menu	Pictogram
1202 DIST	Eval Distance cartesian	



Procedure

Enter address

Enter the names or addresses of the elements between which the distance is to be calculated in the **Element 1** and **Element 2** data boxes.

Result name

Enter the name you want to assign to the result in the **Result** box (Follow instructions in ➤***„Allocating names“ on page 5-9***).

End function

Close dialog window with **<TERMIN>**.

NOTE

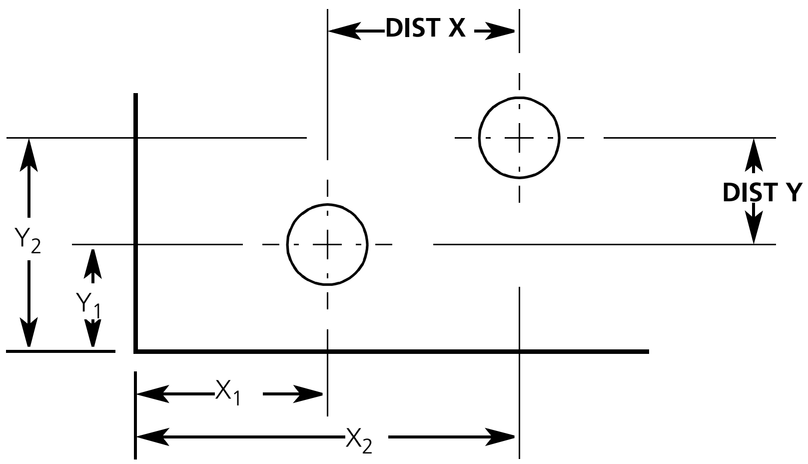
- The differentiation between element 1 and element 2 influences the angle output if the distance is subsequently converted to polar coordinates (**<DI 1203>** ➤***„Polar distance in one plane <DI 1203>“ on page 13-7***).
- If the name allocation is not activated (➤***„Allocating names“ on page 5-9***) the dialog window will not appear. In this case element 1 is the last element in the record and element 2 the next to last.
- Only one point from each element is used for the distance calculation. These points are:

Element	Point used
Circle, ellipse, sphere, torus	Center point
Cylinder, cone	Penetration point of the axis through the reference plane
Surface	Penetration point of the reference axis throught the surface

This means that for the **<DISTANCE>** between a surface and a cylinder the distance between the penetration points is determined.

Example

<DISTANCE> between two circles:



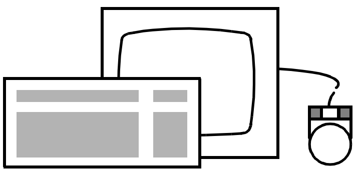
Symmetry elements <DI 1206>

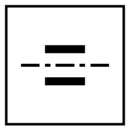
Application

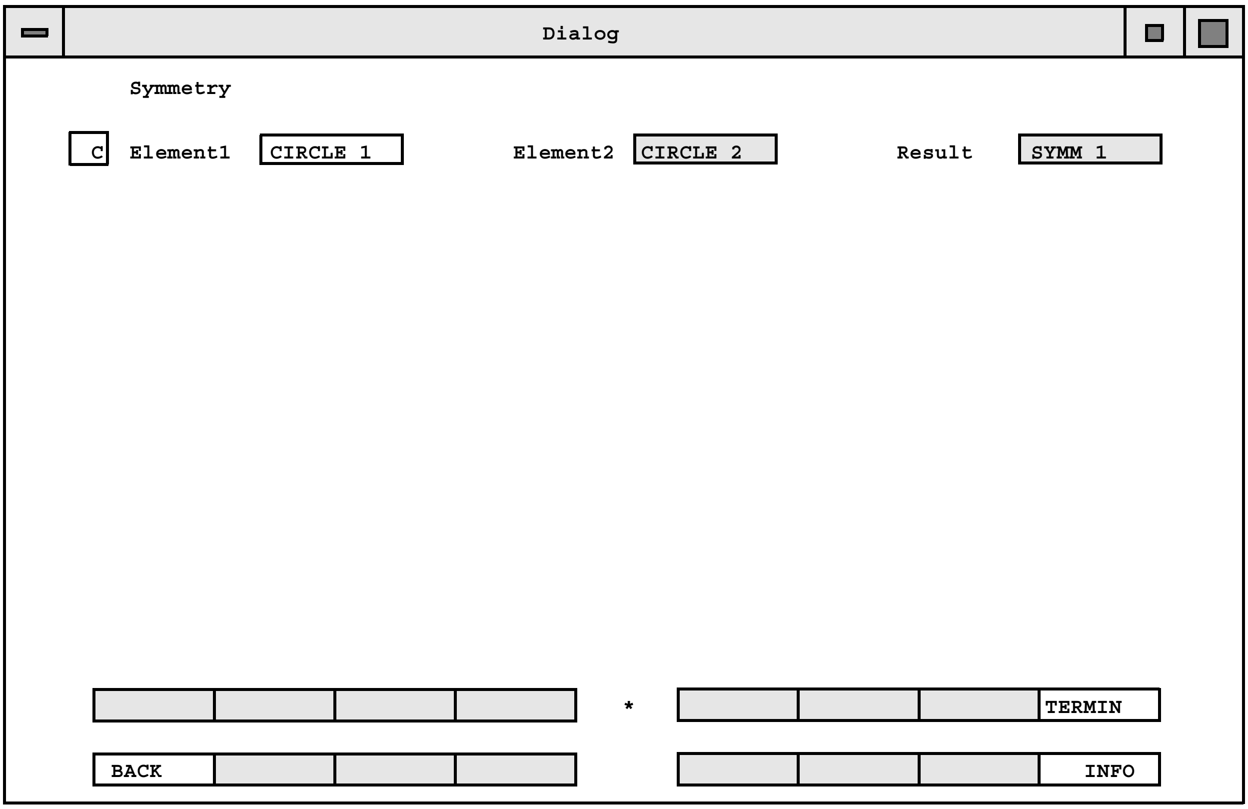
The program forms a symmetry element from two elements which have already been measured.

The calculation is performed for those coordinates which are common to both elements.

The symmetry element calculated can be used without restriction for further "linkings" or combinations.



DI	Pull-Down-Menu	Pictogram
1206 SYMM	Eval Symmetry element	



Procedure

Enter address

Enter the names or addresses of the elements from which a symmetry element is to be calculated in the **Element 1** and **Element 2** data boxes.

Result name

Enter the name you want to assign to the result in the **Result** box (follow instructions in ➤ ***„Allocating names" on page 5-9***).

End function

Close the dialog window with **<TERMIN>**.

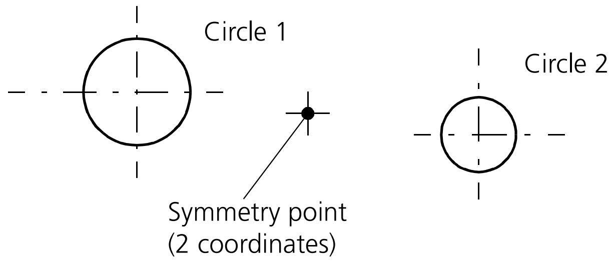
NOTE

– A differentiation between element 1 and element 2 is required only when calculating a symmetry surface from two intersecting surfaces.

– If the name allocation is not activated (➤ ***„Allocating names" on page 5-9***) the dialog window will not appear. In this case the last element in the record is element 1 and the next to last element 2.

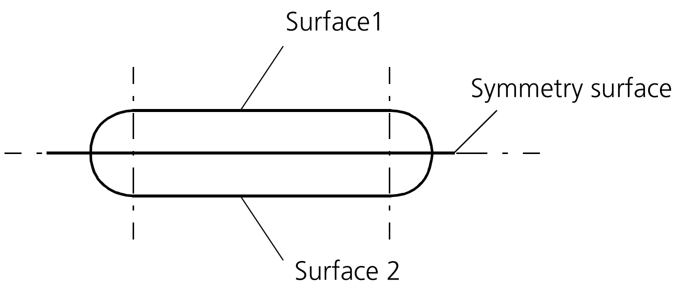
Application examples

Symmetry point

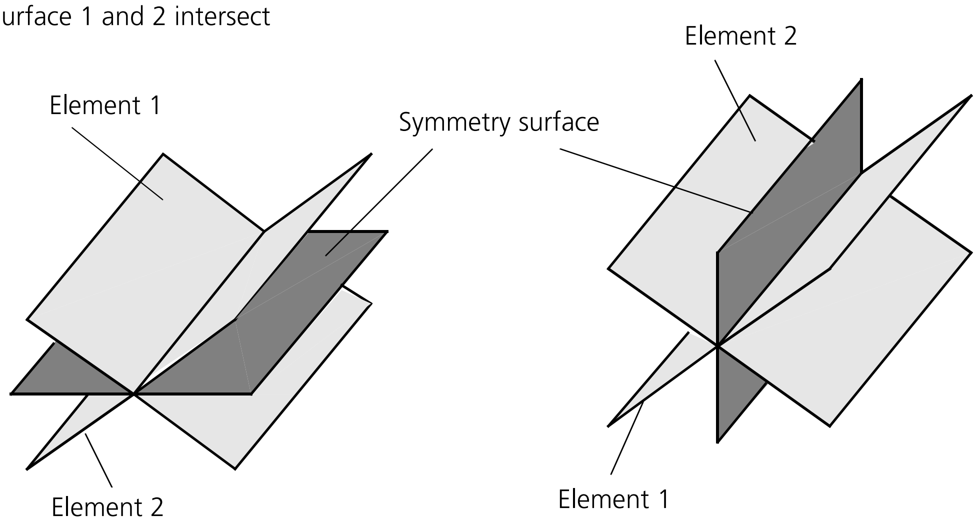


Symmetry surfaces

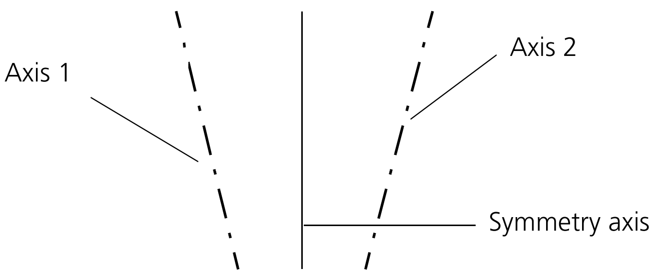
Surface 1 and 2 are approximately parallel (±0.5°)



Surface 1 and 2 intersect



Symmetry axis



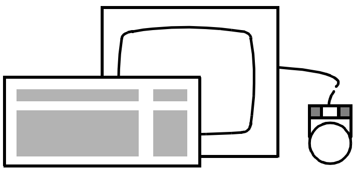
Mean value calculation <DI 1345>

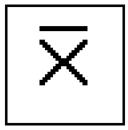
Application

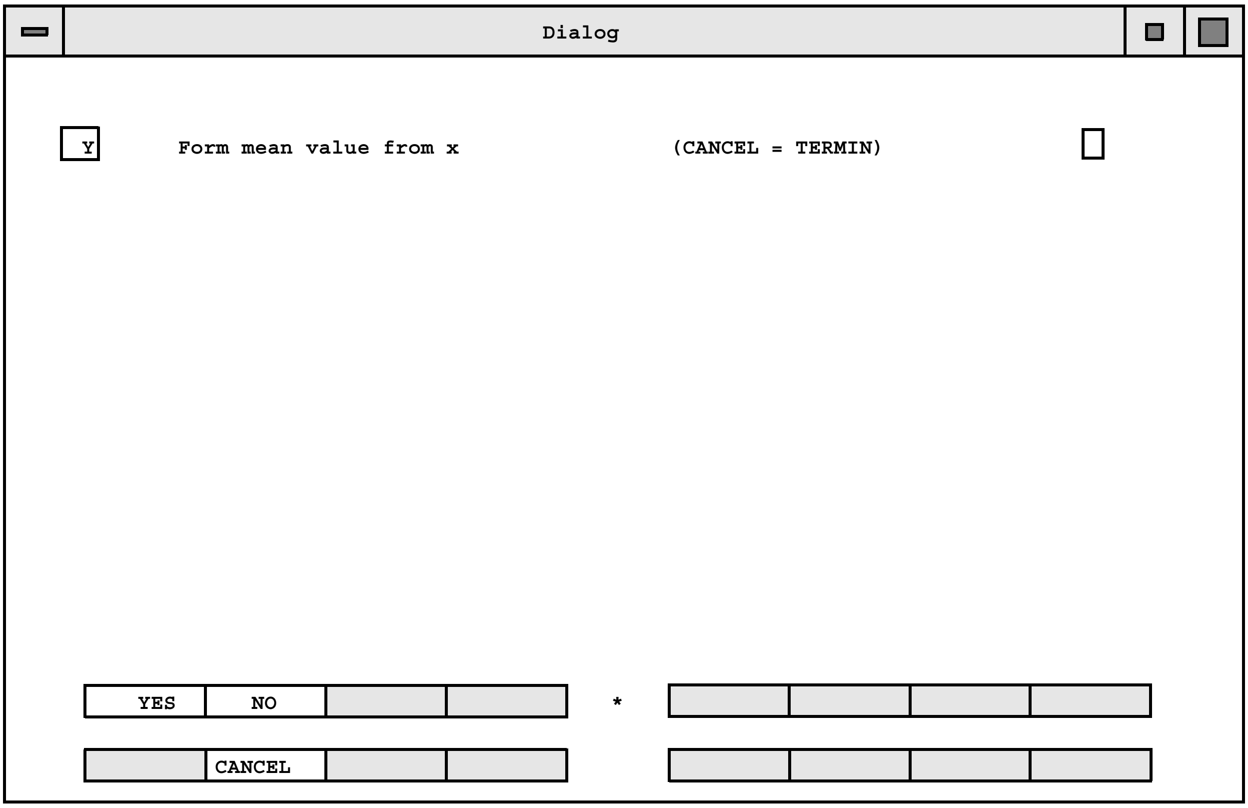
This program calculates the mean values of individual symbols from several record addresses.

Application example

For elements whose results are widely dispersed due to form error, you can perform repeat measurements and then calculate their mean value.



DI	Pull-Down-Menu	Pictogram
1345 MEANVAL a45	Eval Mean value...	



Explanation of dialog

Result name

An inquiry will appear only if the name allocation is activated. Enter the name you want to assign to the result (observe rules in ➤*„Allocating names“ on page 5-9*).

Form mean value from X? (CANCEL = TERMIN)

All symbols are offered in succession. Use **<YES>**/**<NO>** to select or reject each individual symbol for calculation of the mean value.

If you press **<CANCEL>** the symbols which have not yet been inquired on will be skipped and the dialog will be continued.

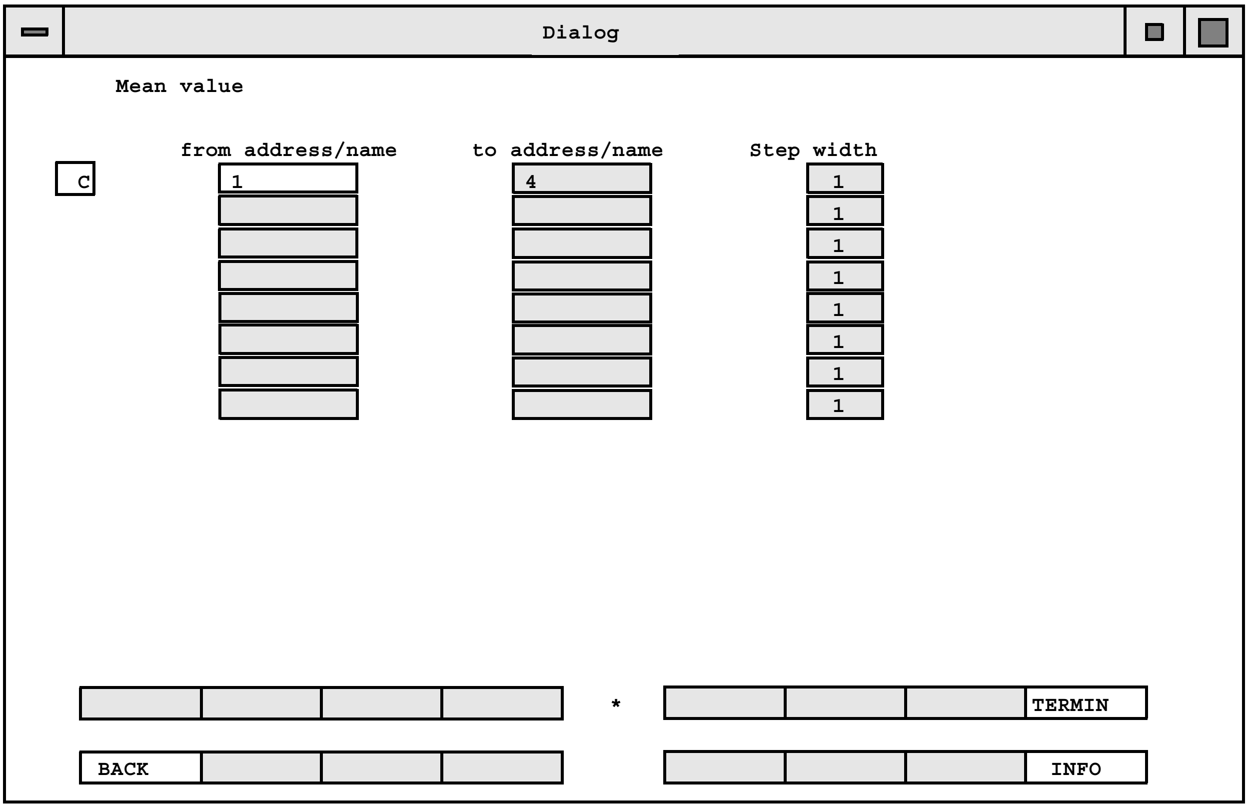
X Y D . . . o.k.?

Verification inquiry.

Enter addresses

Enter the addresses you want to link to one another for the mean value calculation in the **"Mean value"** dialog window.

Close the dialog window with **<TERMIN>**. The mean values of the selected symbols are output under a new address.



Data boxes

from address/name

Enter the name or address of the first element of an area to be recalled.

to address/name

Enter the name or address of the last element of an area to be recalled.

Step width

Distance between the elements required within an area.

NOTE

- Elements can be recalled from a maximum of eight areas.
- Relative addresses can also be used (➤***„Recall of an address <DI 1301>" on page 10-29***).

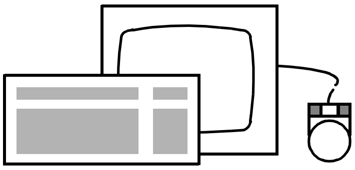
Formula calculation <DI 1379>

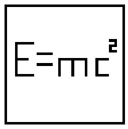
With this function:

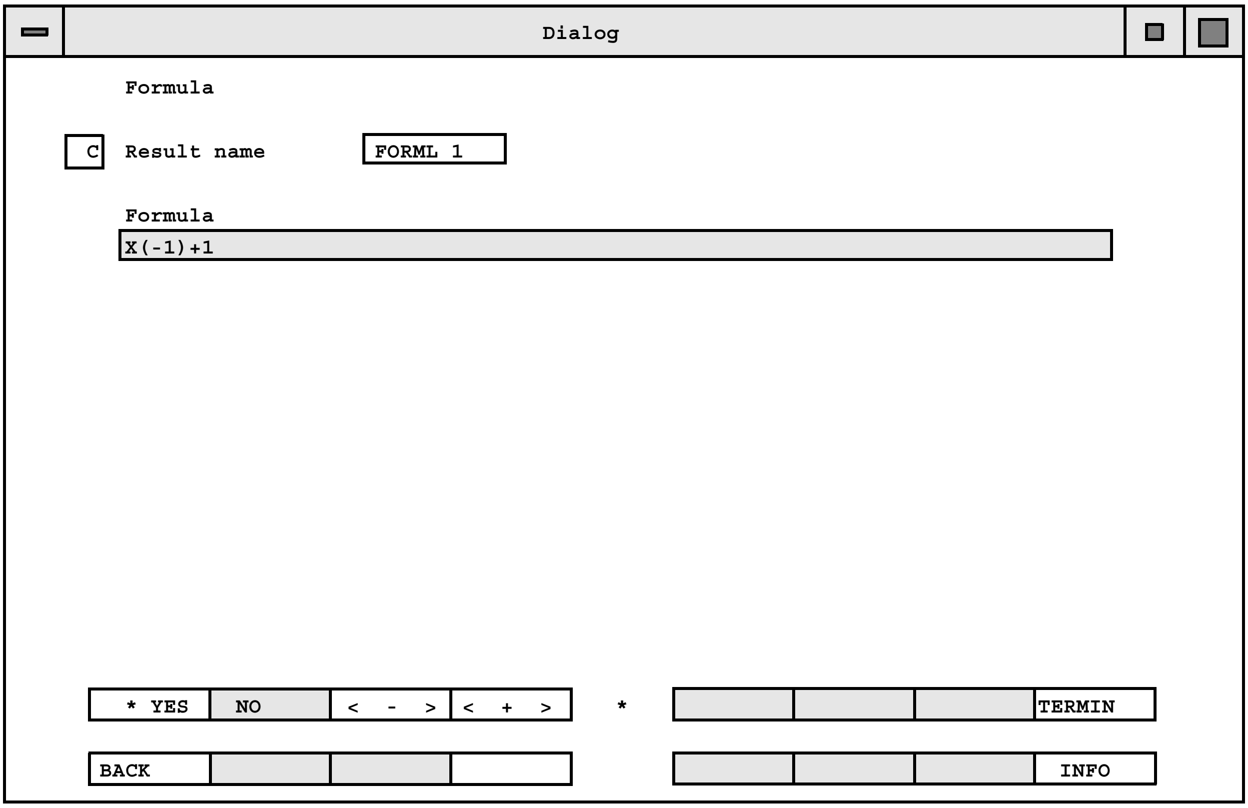
– function values can be calculated from measuring results (sine, root etc.)

– measuring results can be linked or combined with constants by operators

– multiple measuring results can be interlinked by operators.



DI	Pull-Down-Menu	Pictogram
1379 FORMULA a45	Eval Formula...	



Explanation

Result name

An inquiry will appear only if the name allocation is activated. Enter the name you want to assign to the result of the calculation (Observe the rules in ➤***„Allocating names“ on page 5-9***).

Formula

Enter formula and confirm with **<Enter>**.

Rules

- You can access measured values by entering the required symbol (X, Y, Z,...) with the address in brackets.

  Example: The X-axis measured value from record address 18 is required. Input: **X(18)**

  Relative addresses can also be used (➤ ***„Recall of an address <DI 1301>" on page 10-29***).

- Permissible **operators:**

+	(addition)	**-**	(subtraction)
*****	(multiplication)	**/**	(division)

- Permissible **functions:**

SIN	sine	**COS**	cosine
TAN	tangent	**SQR**	root
ASN	arc sine	**ACS**	arc cosine
ATN	arc tangent	**ABS**	amount
SGN	+/- sign		

- Each formula must contain ***at least one measured value.***
- Each formula may contain ***a maximum of three operators.***

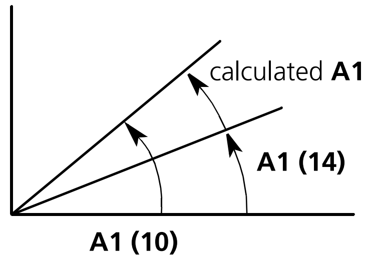
NOTE

When linking (combining) different symbols, the result is output with the symbol of the first measurement.

Application examples

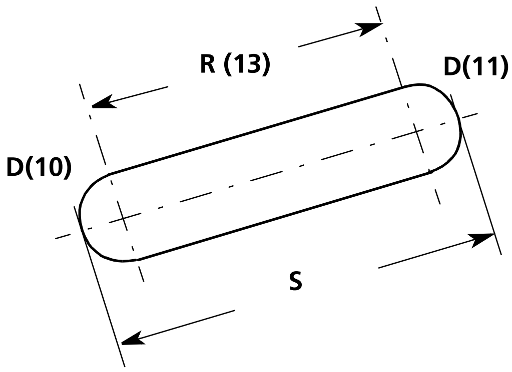
Difference of angle **A1** from address 10 and address 14:

FORMULA = A1(10) – A1(14)



Vertical length along a slot:

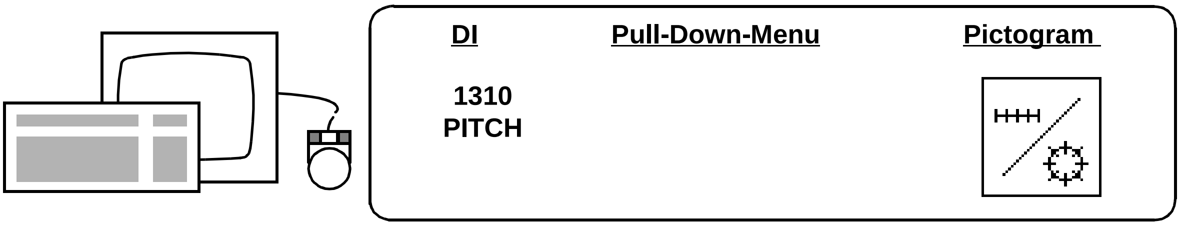
10 CIRCLE
11 CIRCLE
12 DISTANCE
13 POLAR
14 FORMULA <DI 1379>
D(10) / 2 + D(11) / 2
15 FORMULA <DI 1379>
D(14) + R(13)

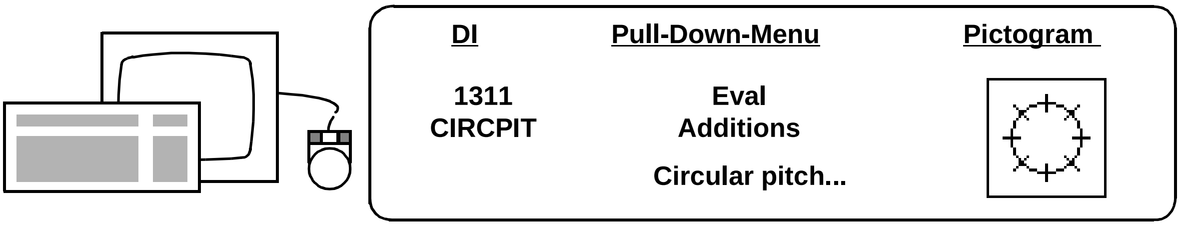


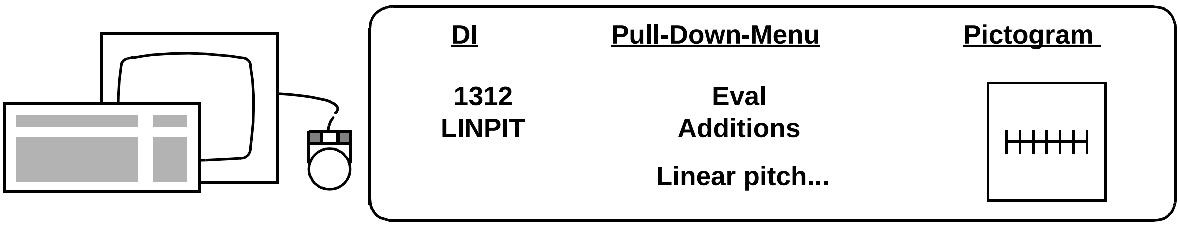
Pitch measurements <DI 1310>

Application

This program can be used to check circular pitch (e.g. of hole circles, gears) and linear pitch (e.g. of rows of holes, toothed racks). The position of the individual elements, individual and cumulative pitch error, pitch spread and radial deviation (with circular pitch) are calculated.



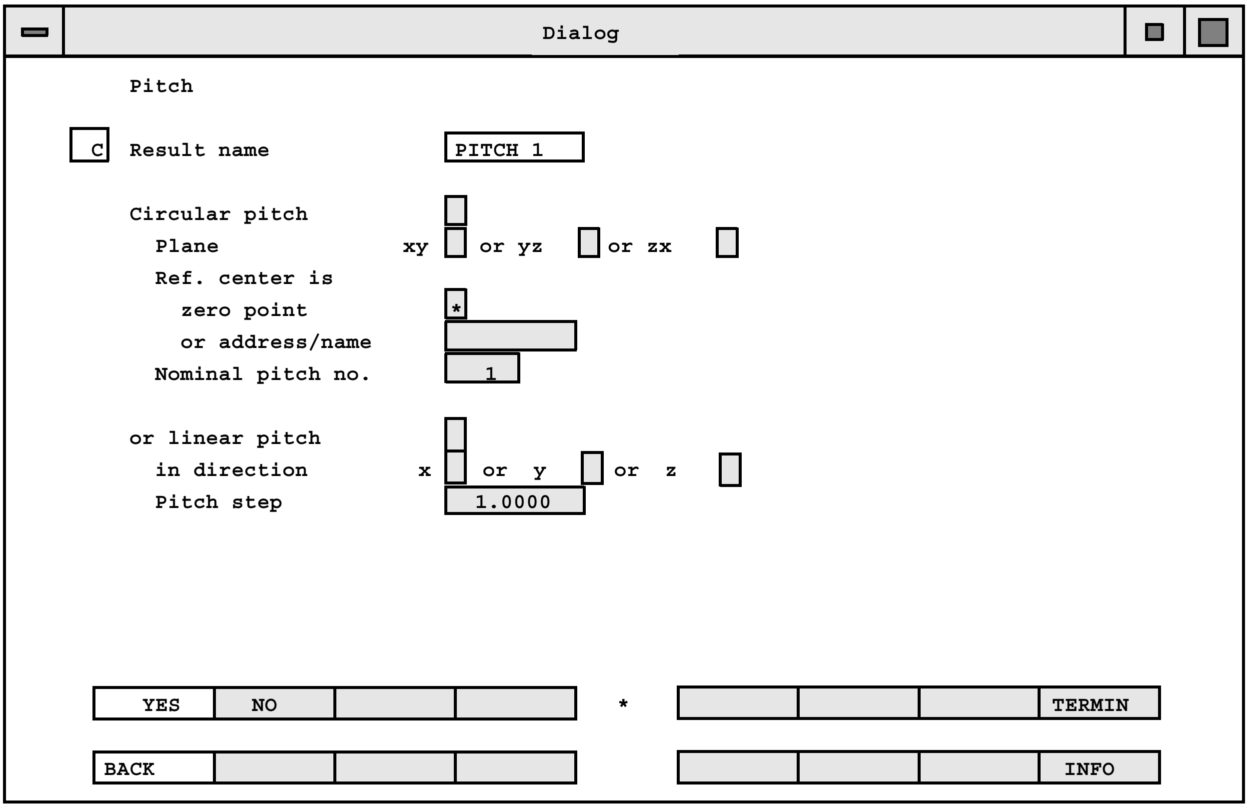




Differences between various direct inputs

<DI 1310> does not enter a preassignment in the dialog window.
<DI 1311> enters the preassignment **Circular pitch** = *****.
<DI 1312> enters the preassignment **Linear pitch** = *****.

The preassignments can be changed in the dialog window.



Softkeys

YES

NO

Used to accept/reject the **<YES>/<NO>** box currently highlighted.

TERMIN

Closes the dialog window and opens the "Recall of several elements" window to select the elements for the pitch measurement

BACK

Cancels the pitch measurement and returns the program to the main menu.

Data boxes

Result name

This box is activated only if the name allocation is on (➤ ***„Allocating names" on page 5-9***).

Circular pitch

Enter **<YES>** here to check the circular pitch.

Plane

Select the measuring plane in which the circular pitch is to be checked with **<YES>**/**<NO>**.

Reference center is Defines the reference center for the pitch measurement.

Options:

zero point = * The zero point of the workpiece coordinate system is the reference center for the pitch measurement.

address/name Enter the address or name which is to be the reference center for the pitch measurement.

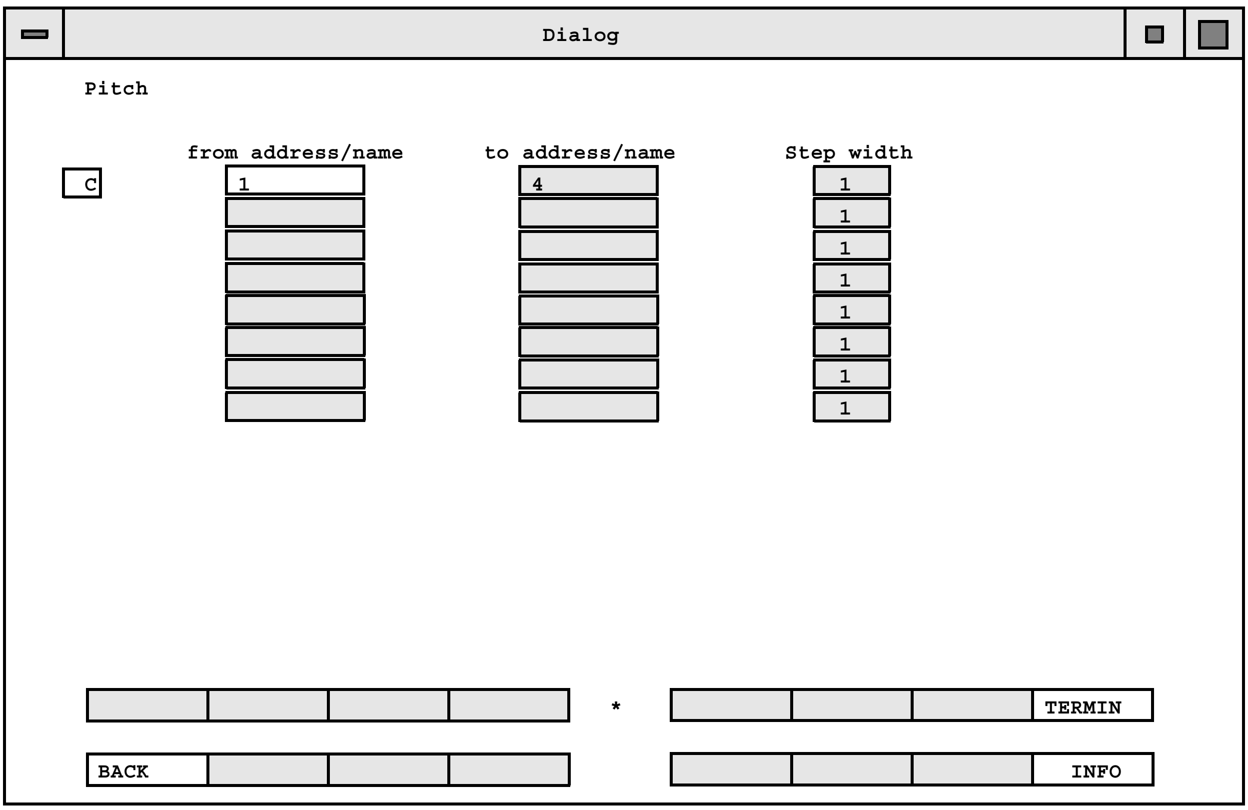
Nominal pitch no. Enter the theoretical number of elements which make up the pitch circle (see example).

linear pitch Enter **<YES>** here to check the linear pitches.

in direction Select the coordinate direction in which the pitch should be checked with **<YES>/<NO>**.

Pitch step Enter the nominal pitch step in mm. Make sure that the +/- sign is correct. (see example).

Procedure Fill in the data boxes for the circular or linear pitch and close the dialog window with **<TERMIN>**. The following dialog window will then appear. The elements for pitch measurement must be defined in this window.



Data boxes

from address/name
Enter the name or address of the first element of an area to be recalled.

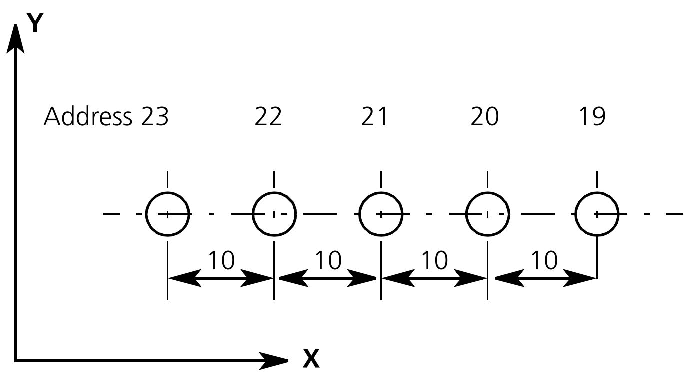
to address/name
Enter the name or address of the last element of an area to be recalled.

Step width
Distance between required elements within an area.

NOTE

- Elements can be recalled from a maximum of eight areas.
- Relative addresses can be used (➤ ***„Recall of an address <DI 1301>“ on page 10-29***).
- **Circular pitch:** The elements must be recalled with a mathematically positive direction of rotation (see example). The direction of rotation applies when looking at the measuring plane from the positive counting direction of the third axis.
- **Linear pitch:** The sequence of recalled elements must agree with the +/ signs for **Pitch step** (see example).

Example for input of row of holes (linear pitch)



Eingabe

- **Linear pitch in direction X ? = ***
- **Pitch step = 10**
- **From address 23 to address 19 step 1**

or

- **Linear pitch in direction X ? = ***
- **Pitch step = -10**
- **From address 19 to address 23 step 1**

Result output

```
                 PITCH MEASUREMENT (LINEAR PITCH)
                 =================================
           NOMINAL PITCH =    10.0000 MM IN X - DIRECTION
           FROM     23 TO   19   STEP   1
              NO           POS          p         pk        fp        Fp        fu
      28    23/22        15.0682    10.0842   10.0842     .0842     .0842
      29    22/21        25.1342    10.0660   20.1502     .0660     .1502    -.0182
      30    21/20        35.0039     9.8697   30.0199    -.1303     .0199    -.1963
      31    20/19        44.9638     9.9599   39.9798    -.0401    -.0202     .0902

                  EXTREME VALUES OF PITCH MEASUREMENT


    PITCH_1
      32          MIN          X      25.1342
                               Y      13.5023
                               Z       3.8612


    PITCH_2
      33          MAX          X      35.0039
                               Y      13.4865
                               Z       7.2385
         MIN PITCH STEP                9.8697

    PITCH_3
      34          MIN          X       4.9840
                               Y      13.5166
                               Z       7.6598
    PITCH_4
      35          MAX          X      15.0682
                               Y      13.5068
                               Z       9.0125
         MAX PITCH STEP               10.0842
```

Explanation

- An address is assigned to each pitch step (in examples 28 to 31).
- The **NO** column specifies the addresses of the elements to which the respective pitch step refers.
- Extreme values of the pitch measurement:
  The first (**MIN**) and second (**MAX**) element of the largest and smallest pitch step are output.

– The columns **POS**, **p** and **pk** contain the position of the individual elements:

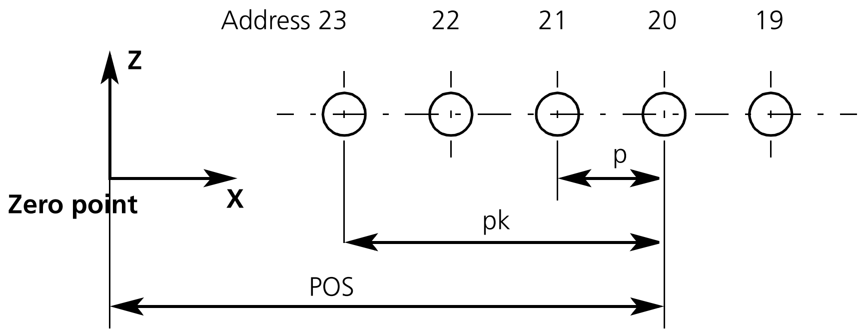
POS: Position of the 2nd element of a pitch step in the workpiece coordinate system.

p: Distance between the two elements of a pitch step

pk: Distance between the first element of the pitch measurement (in the example address 23) and the second element of the pitch step.

Example

Pitch step NO 21/20



– The columns **fp**, **Fp** and **fu** contain the pitch errors:

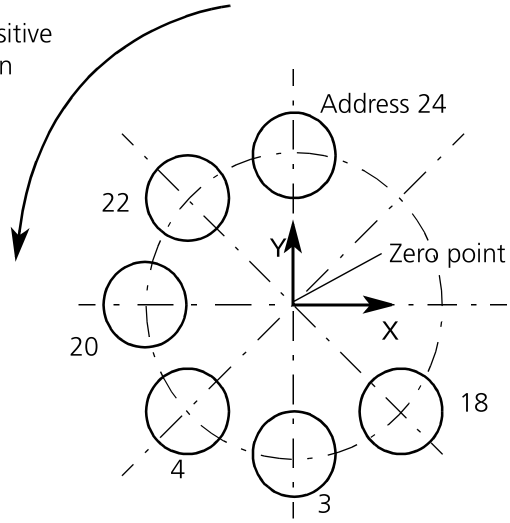
  – Adjacent pitch error
  fp = p - PITCH STEP
  (Difference between specified pitch step and actual distance between the two elements).

  – Cumulative pitch error
  Fp = Sfp = pk - n * PITCH STEP
  (Sum of adjacent pitch errors, difference between nominal and actual distance of and element from the first element of the pitch measurement).

  – Pitch spread (difference between adjacent pitches)
  fu = fpi - fpi-1
  (difference between the preceding and the current adjacent pitch error).

Example for input of circular pitch

Mathematically positive direction of rotation



Plane code no.= XY

Ref. center point is zero point = *

Nominal pitch no.= 8

from adr 24 to adr 20 step 2
from adr 4 to adr 3 step 1
from adr 18 to adr 18 step 1

Explanation

- An address is assigned to each pitch step (in examples 28 to 32).
- The **NO** column indicates the addresses of the elements to which the respective pitch step refers.
- The **POS**, **p** and **pk** columns contain the angular positions of the individual elements:

POS: Angle between the reference axis and the second element of the respective pitch step.

p: Angle between the two elements of a pitch step.

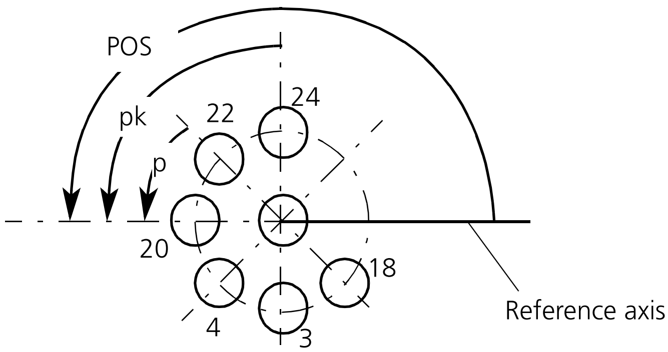
pk: Angle between the first element of the pitch measurement (in the example address 24) and the second element of the respective pitch step.

Circular pitch

```
             PITCH MEASUREMENT (CIRCULAR PITCH)
             ===============================
       REFERENCE: ZERO POINT
       NOMINAL PITCH =      8.0000
       FROM 24 TO   20 STEP 2
       FROM  4 TO    3 STEP 1
       FROM 18 TO   18 STEP 1
          NO          POS         p         pk        fp        Fp        fu       Fr
   28     24/22      135.0271   45.0271   45.0271   .0028     .0028               -.0204
   29     22/20      180.0354   45.0083   90.0354   .0013     .0041    -.0015      .0035
   30     20/4       225.0134   44.9780  135.0134  -.0023     .0018    -.0036      .0142
   31      4/3       269.9812   44.9678  179.9812  -.0034    -.0016    -.0011      .0216
   32      3/18      315.0065   45.0253  225.0065   .0011    -.0005     .0045     -.0143

              EXTREME VALUES OF PITCH MEASUREMENT

 PITCH_1
   33          MIN          X      -8.0146
                            Y        .0121
                            Z      25.3681

 PITCH_2
   34          MAX          X      -5.5746
                            Y      -5.6024
                            Z      27.3846
      MIN PITCH STEP               44.9678

 PITCH_3
   35          MIN          X        .0627
                            Y       8.0021
                            Z      19.2684
 PITCH_4
   36          MAX          X      -5.7562
                            Y       5.6624
                            Z      23.7516
      MAX PITCH STEP               45.0271
```

Example

Pitch step NO 22/20



Reference axis

The reference axis is always an axis of the workpiece coordinate system or an axis parallel to it. It is dependent on the measuring plane selected:

Measuring plane	Reference axis
ZY plane (1)	Y axis (or one parallel)
XZ plane (2)	Z axis (or one parallel)
YX plane(3)	X axis (or one parallel)

The **fp**, **Fp** and **fu** columns contain the pitch errors (in mm):

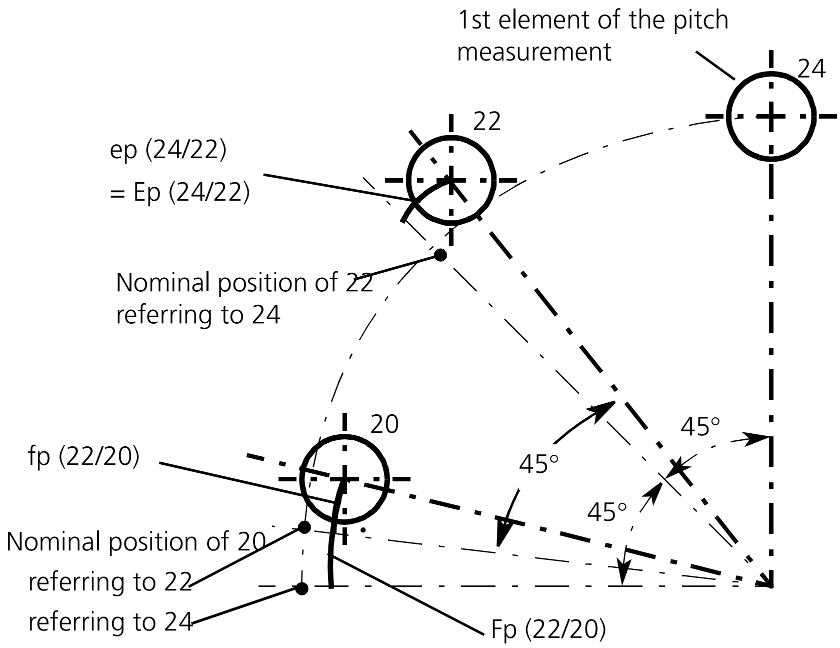
fp: Adjacent pitch error (difference between the nominal and actual arc length of an individual pitch step).

Fp: Cumulative pitch error (difference between the nominal and actual arc length between the first element of the pitch measurement and the second element of the respective pitch step). Sum of the adjacent pitch errors.

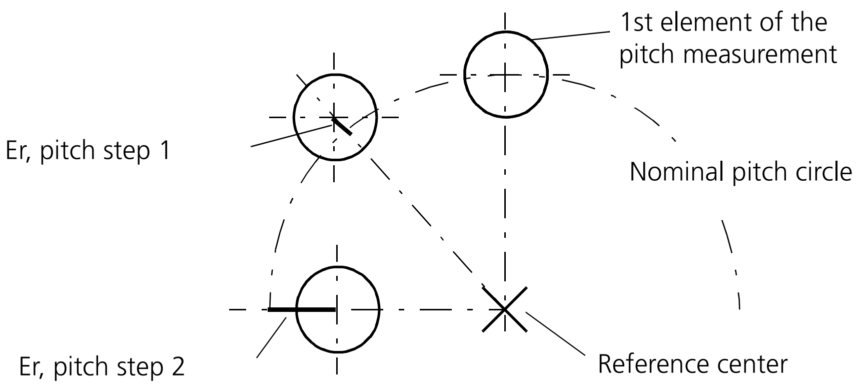
fu: Difference between adjacent pitches (Difference between the arc length of the previous and the current pitch step)

fu = fpi - fpi-1

Example



– The **Fr** column contains the radial runout of the second element of the respective pitch step. The radial runout is the radial deviation of the element from the nominal pitch circle. The nominal pitch circle is defined by the reference center and the first element of the pitch measurement.



– Extreme values of the pitch measurement:
  The first (**MIN**) and second (**MAX**) element of the largest and smallest pitch step are output.

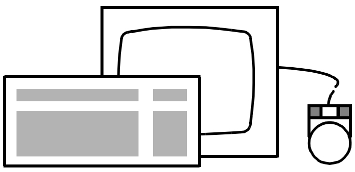
Determining the minimum and maximum of measurement results <DI 1341> <DI 1343>

Application

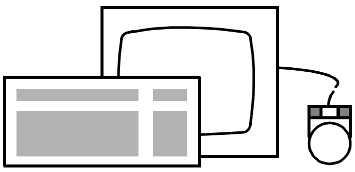
Using these functions you can determine the minimum or maximum for 1 symbol from the preselected measurement results.

NOMINAL/ACTUAL

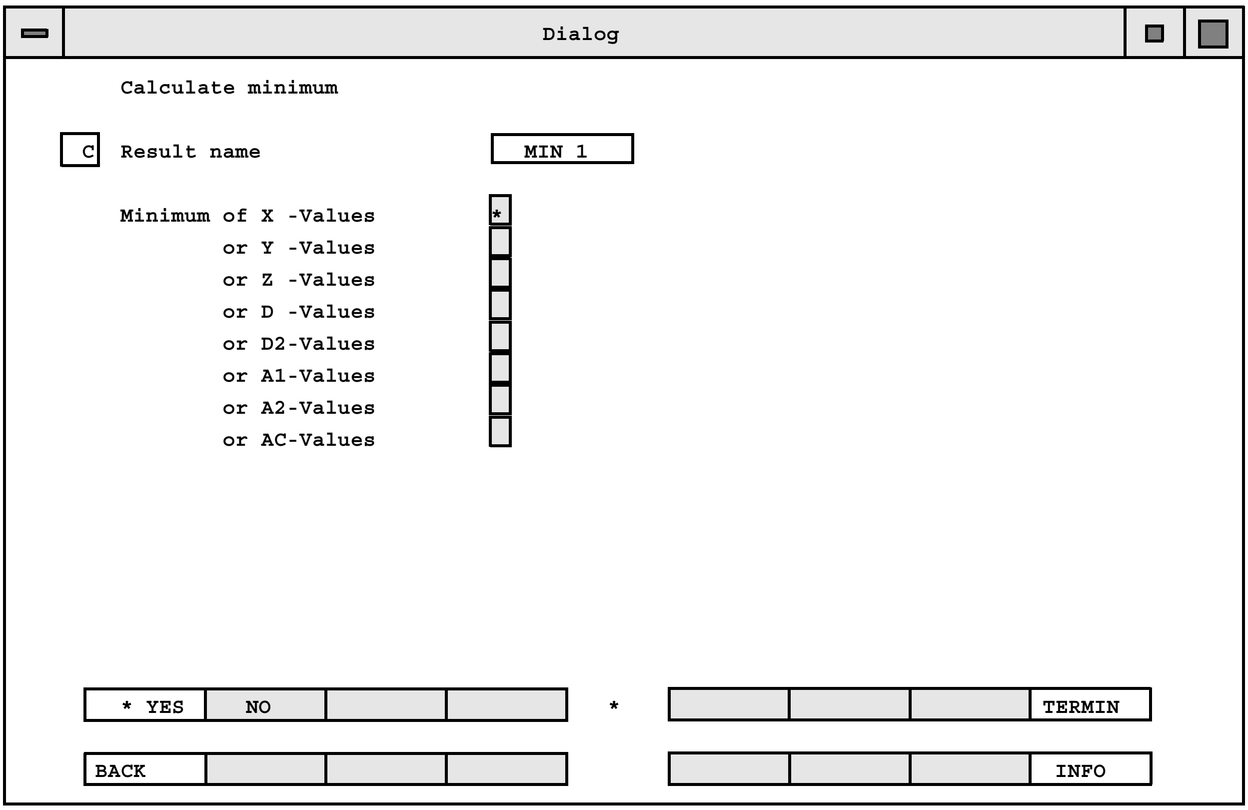
Enter the nominal value for the designed symbol immediately before calling **<DI 1341/1343>**.



DI	Pull-Down-Menu	Pictogram
1341	Elements Special elements Min calculation...	

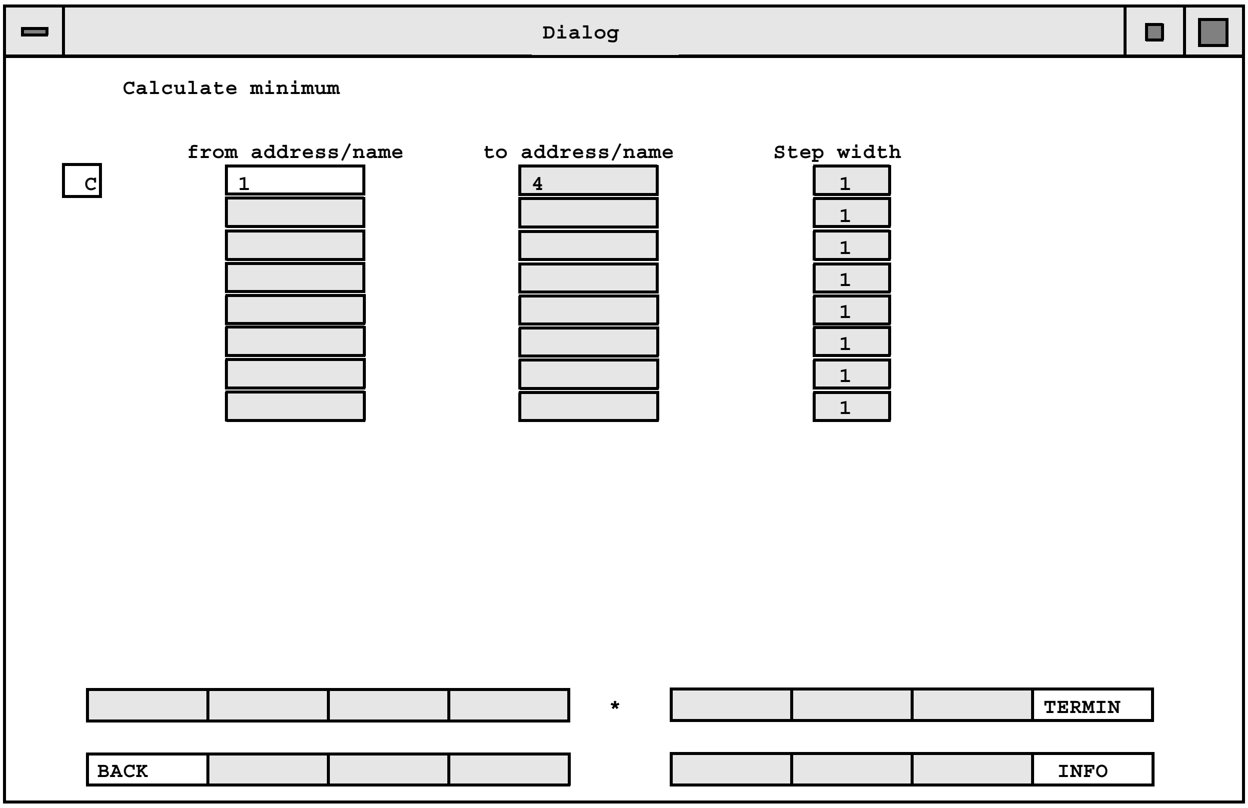


DI	Pull-Down-Menu	Pictogram
1343	Elements Special elements Max calculation...	



Procedure

Accept/reject the highlighted **<YES>/<NO>** BOX. Close the dialog window with **<TERMIN>**. The following dialog window then appears.



Data boxes

from address/name

Enter the name or address of the first element of an area to be recalled.

to address/name

Enter the name or address of the last element of an area to be recalled.

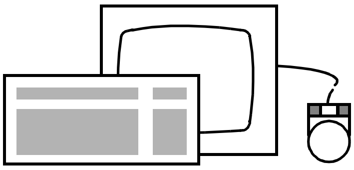
Step width

Distance of the elements required within an area.

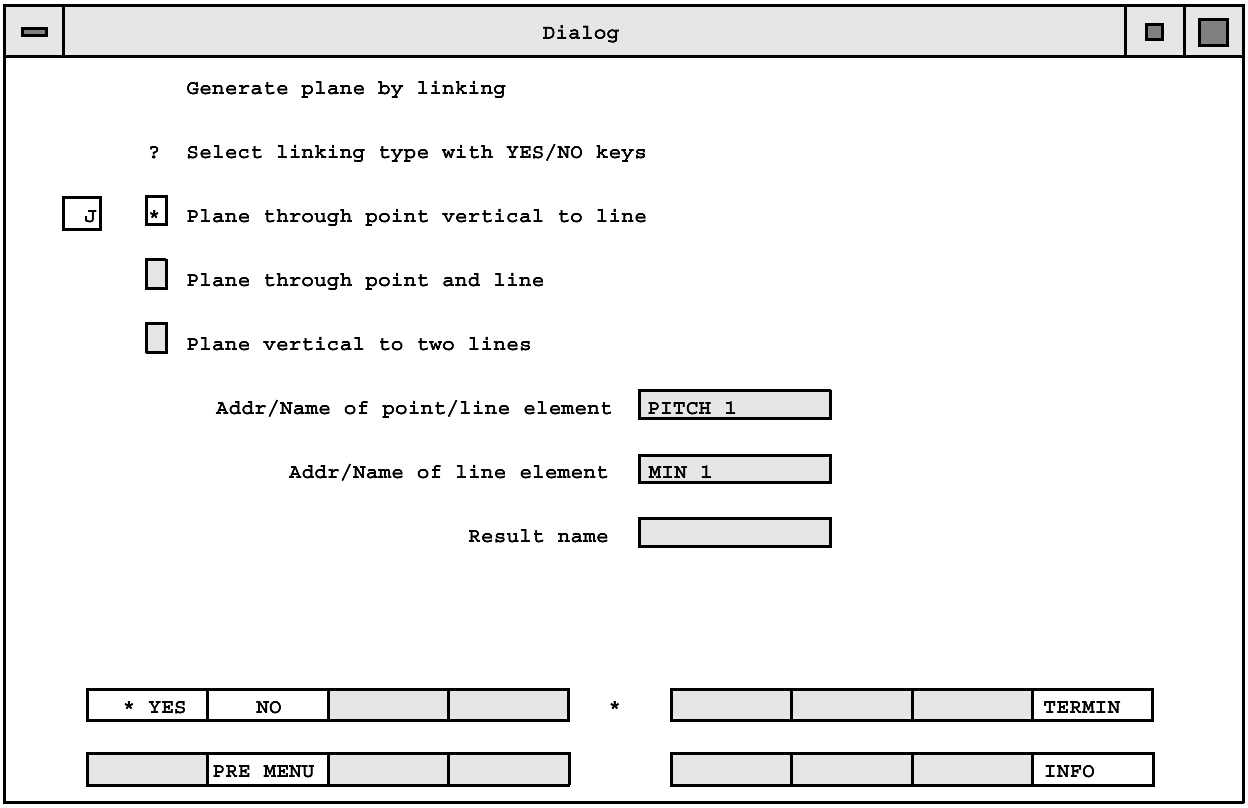
Generating a plane by linking <DI 1265>

Application

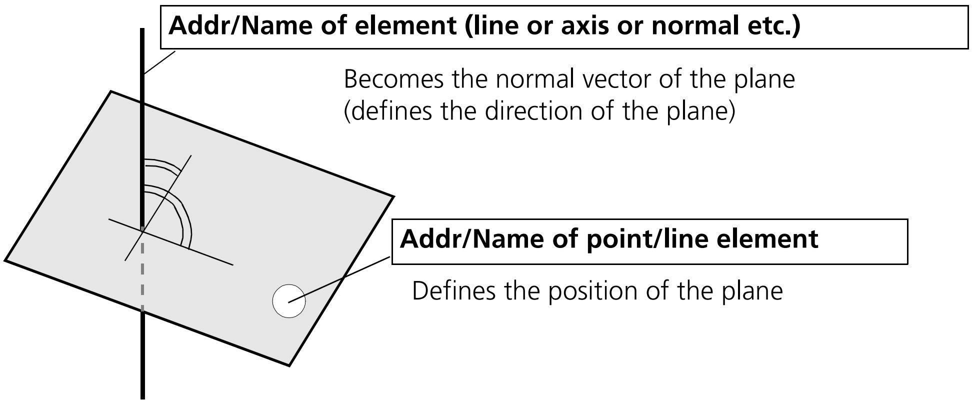
There are three ways of generating a plane by linking. However, you can choose only one of them at a time.



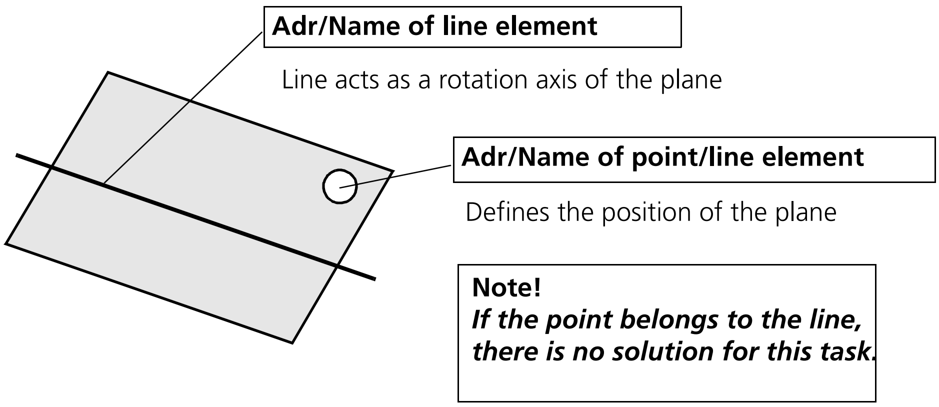
DI	Pull-Down-Menu	Pictogram
1265		



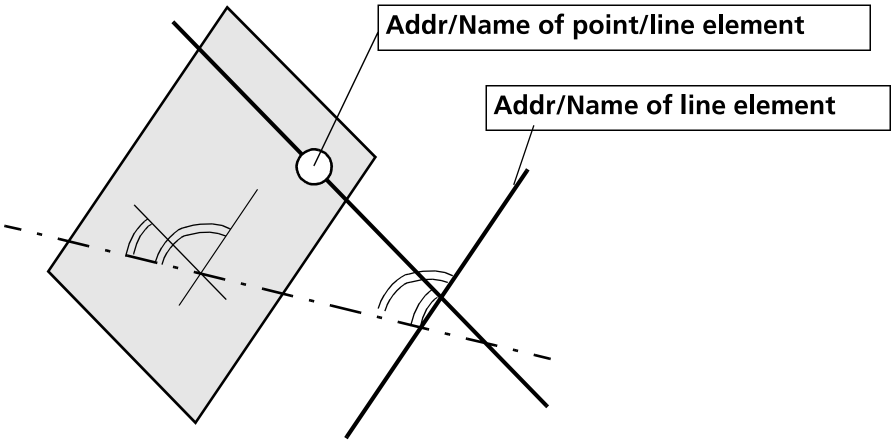
Plane through point vertical to line



Plane through point and line



Plane vertical to two lines



Explanation

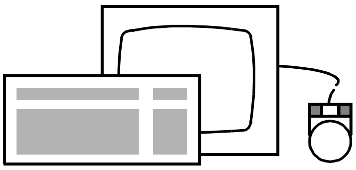
The normal vector of the plane is vertical to the two directions of the elements selected, whereby the selection of **Addr/Name of point/line element** specifies the position of the plane.

For deviations, the position of the plane can then be moved parallel to the first task **Plane through point vertical to line**.

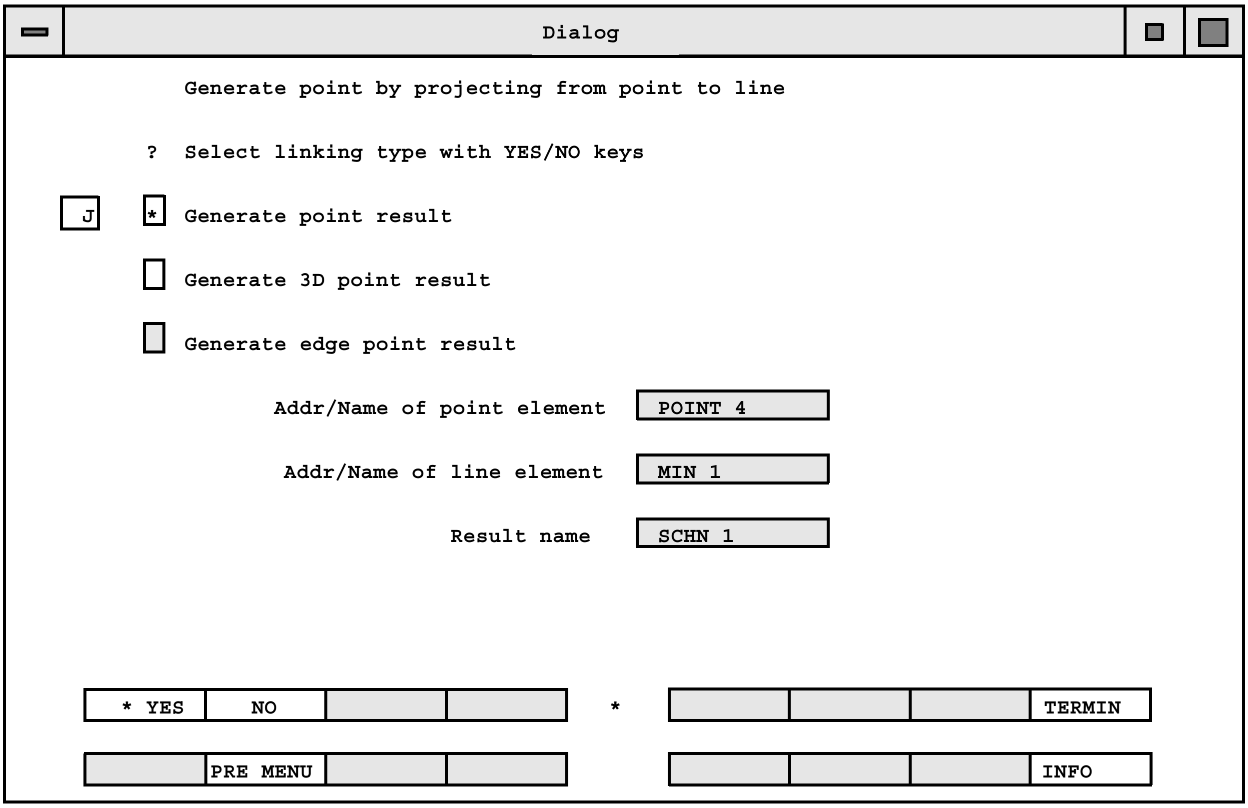
Generating a point by projecting from point to line <DI 1266>

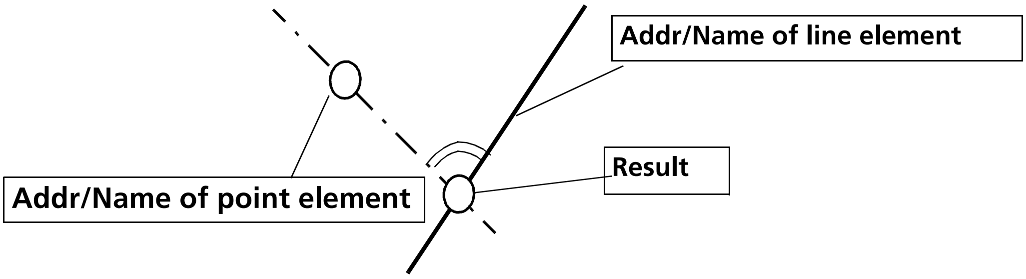
Application

You can choose one of three options, depending on the features the **Point** result should have.



DI	Pull-Down-Menu	Pictogram
1266		





Generate point result Only the XYZ coordinates are stored for the **Point** result. The distance of the point from the line is given with the point as **D** (diameter).

Generate 3D point result For the **3D point**, the direction of the perpendicular is provided to the 3D point as the normal vector. The distance of the point from the line is given with the 3D point as **D** (diameter).

Generate edge point result For the **Edge point** result, the direction of the line (axis) is included as the direction. The distance between the point and the line is given with the edge point as **D** (diameter).

Chapter 13

Conversion of results

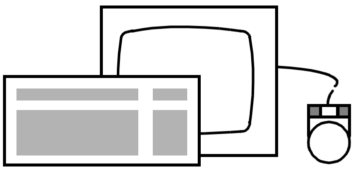
This chapter contains:

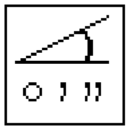
Conversion of results

Angle output in degrees, minutes and seconds <DI 1682>

Application

This function converts the decimal angle of the last record address into degrees/minutes/seconds.



DI	Pull-Down-Menu	Pictogram
1682 ANGDMS a53	Eval Angle Output Deg/Min/Sec	

The result is output under the same record address.

```
Record

LINE_1
 31        LINE        Y      36.4214
                       Z      55.9114
             X/Z       A1      1.5793
             Y/Z       A2    -39.8900

                       A1      1 DEG       34 MIN       45.30 SEC
                       A2    -39 DEG      -53 MIN      -24.10 SEC
```

Angle deviations can be output only in decimal degrees.

NOTE

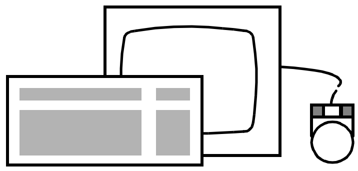
For the nominal input, nominals and tolerances for angles can also be entered in deg/min/sec. The numerical values must be separated by a slash. It is not necessary to call **<DI 1682>**.

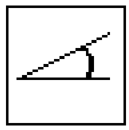
Calculation of the rotation and tilt angle <DI 1204>

Application

The **<ANGLE>** function converts the project angles of the last record address into rotational and tilting angles.

If the last record address contains no projected angles, the angle formed by the last two elements in the record and a reference axis will be calculated. In addition, the polar distance between the two elements will be output.



DI	Pull-Down-Menu	Pictogram
1204	Eval	
ANG	Angle	
	Angle	

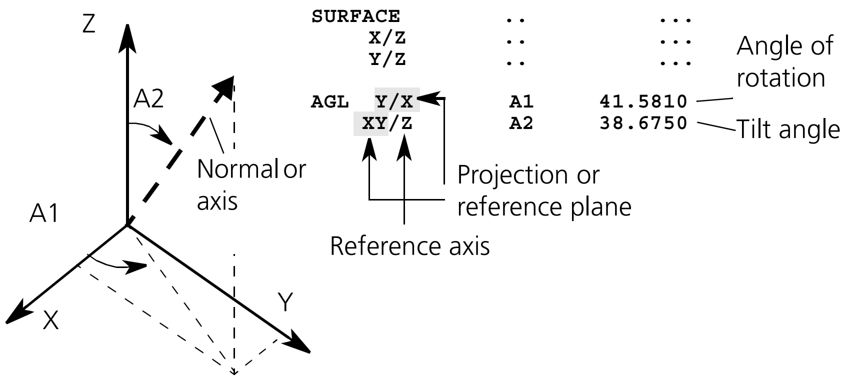
Reference axis

The reference axis is dependent on the measuring plane:

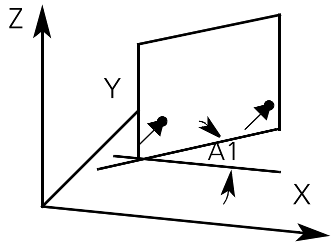
Measuring plane	Reference axis
YZ plane (1)	Y axis (or one parallel)
ZX plane (2)	Z axis (or one parallel)
XY plane (3)	X axis (or one parallel)

Result output

– The last record adress contains an axis or a normal:



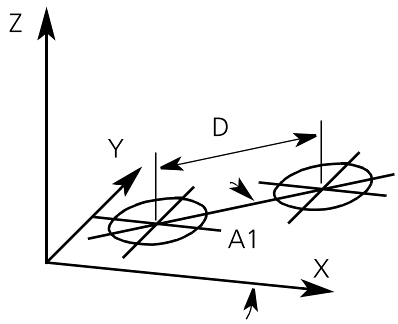
– If the last address contains no axis or normal:
  – The last two addresses each contain a point probing (**D** = Projected polar distance of both points):




```
POINT     Y     4.5132
POINT     Y    17.7539
ANG       D     9.7667
    Y/X   A1   40.5548
```

Reference axis

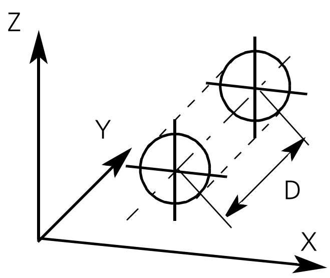
  – The last two addresses contain two centers in one plane (**D** = Projected polar distance between the centers):




```
CIRCLEI     X    55.5132
            Y    53.6750
            D    12.0265
CIRCLEI     X    12.5132
            Y    20.6750
            D    12.0120
ANG         D    73.9765
     Y/X    A1   40.5810
```

Reference axis

  – The last two addresses contain two centers along one axis (**D** = Spatial polar distance between the centers, **A1**, **A2** = Projected angle of connecting line, ➤ ***„Projected angles" on page 10-53***):



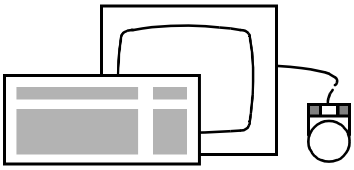

```
CIRCLEI     X    15.1021
            Z    20.0210
            D    10.0160
CIRCLEI     X    15.5132
            Z    20.1750
            D    10.0120
ANG         D    24.9765
     Z/Y    A1    0.1462
     X/Y    A2    0.2810
```

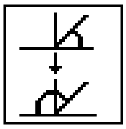
– The last two addresses contain two spatially defined points (sphere, penetration point, space point): The spatial polar distance (**D**) and a projected angle of the connecting line are output.

Changing the reference axis and direction of rotation <DI 1251>

Application

You can use this program to change the direction of rotation and the reference axis in results previously measured or calculated. In this way you can e.g. adapt measured angles to drawing data.



DI	Pull-Down-Menu	Pictogram
1251 CONVANG a51	Eval Angle Conversion...	

Explanation

Element ANGLE_1
Result ANGCONV_2

This inquiry will not appear if the name allocation is switched off (➤ ***„Allocating names“ on page 5-9***).

Conversion of A1?
Conversion of A2?

This inquiry will appear only if the reference element contains two projected angles. Select between A1 and A2 with **<YES>** / **<NO>**.

(+Z -Z +X -X) Ref. axis =

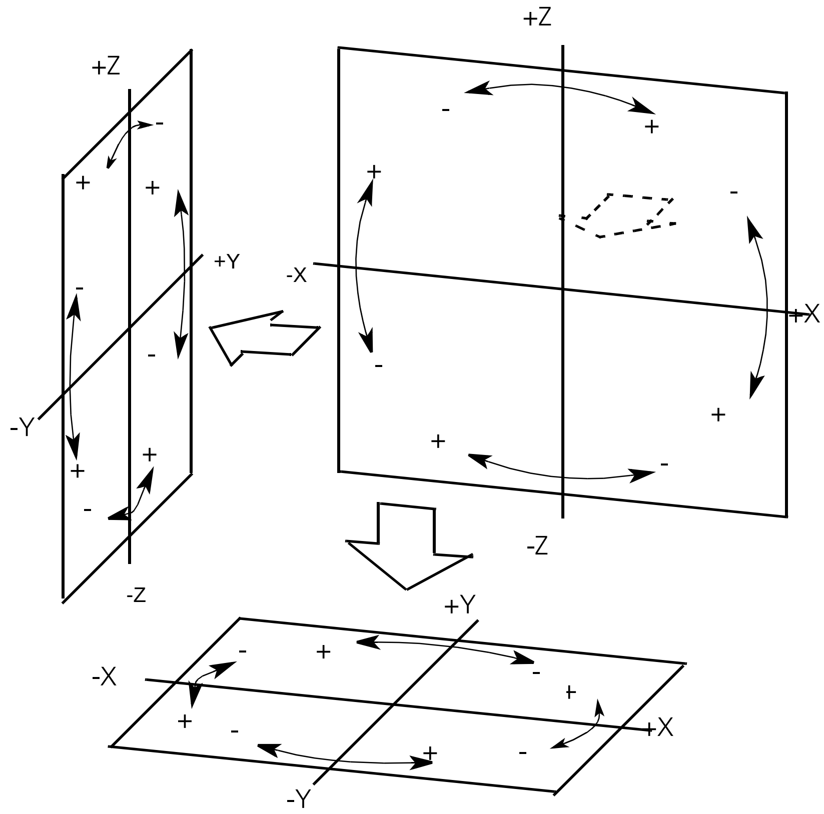
Enter the required angle reference angle and confirm with **<Enter>**.

The reference axis can be changed only within a measuring plane. The axes offered in brackets are allowed.

Clockwise rotation?

The direction of rotation applies when viewing the measuring plane from the positive counting direction of the 3rd axis.

– **<YES>**
  Mathematically negative direction of rotation (**-**)
– **<NO>**
  Mathematically positive direction of rotation (+)



Possibilities for representing an angle in the Y/X measuring plane

REFERENCE AXIS	ROTATION	RESULT
+ X – Y – X + Y	CLOCKWISE (NEGATIVE)	30° 300° 210° 120°
+ X – Y – X + Y	COUNTERCLOCKWISE (POSITIVE)	330° 60° 150° 240°

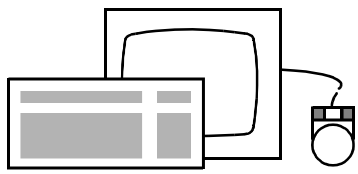
Calculation of polar distances

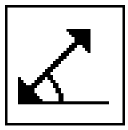
Polar distance in one plane <DI 1203>

Application

The **<POLAR>** function enables

- conversion of the cartesian coordinates of a geometric element to polar coordinates (polar distance from zero point)
- determination of the polar distance from the **<DISTANCE>** between two elements in a measuring plane.



DI	Pull-Down-Menu	Pictogram
1203 DISPOL2D	Eval Distance polar 2D	

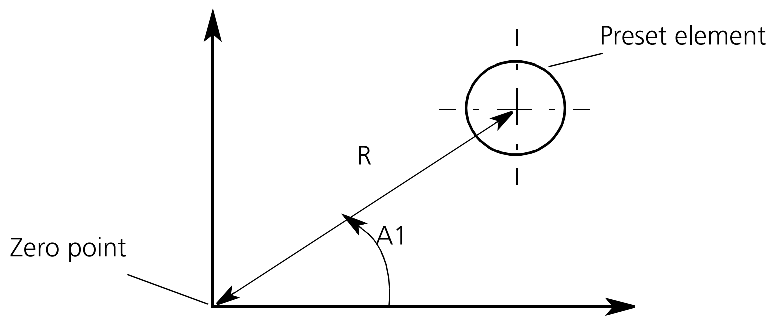
Name allocation

If the name allocation is activated (➤ ***„Setting the operating mode for the measuring probe head <DI 1502>“ on page 6-18***) a result name inquiry will appear.

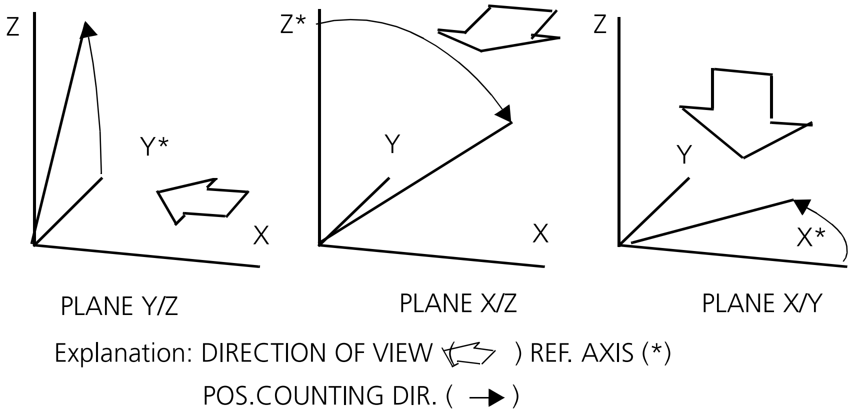
<DI 1203> will be used for the last element in the record.

NOTE

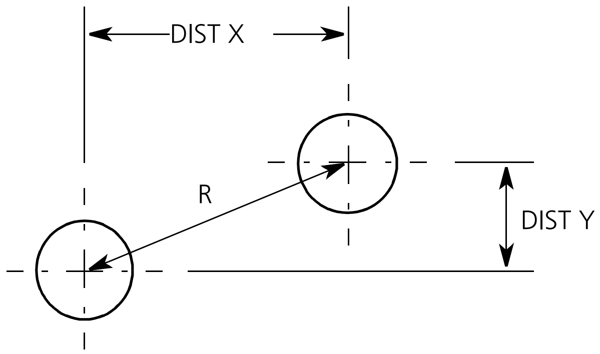
- The element entered must always contain a pair of coordinates.
- If a geometric element is preset, its polar distance from the zero point of the workpiece coordinate system will be calculated.



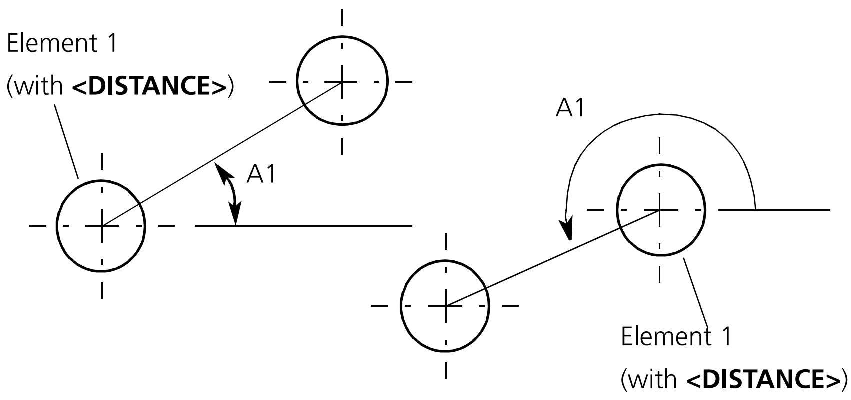
The reference axis of the angle output is dependent on the measuring plane:



If the element entered is the **<DISTANCE>** between two geometric elements, the polar distance of both elements is calculated.



The angle output is dependent on which element was element 1 with the calculation of **<DISTANCE>** :

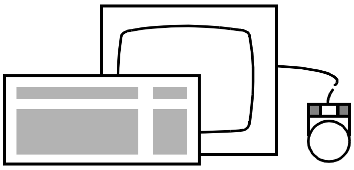


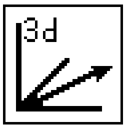
Space diagonal <DI 1261>

Application

The **<R POLAR>** function enables

- conversion of the cartesian coordinates of a geometric element to polar coordinates (polar distance from zero point)
- determination of the polar distance from the **<DISTANCE>** between two elements in the 3D coordinate system.



DI	Pull-Down-Menu	Pictogram
1261 DISPOL3D a61	Eval Distance polar 3D	

Result name

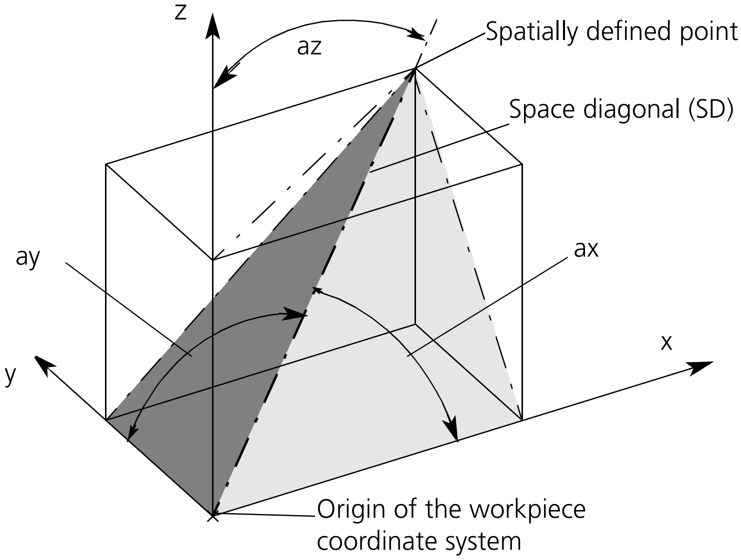
If the name allocation is activated (➤***„Setting the operating mode for the measuring probe head <DI 1502>“ on page 6-18***) an additional result name inquiry will appear.

NOTE

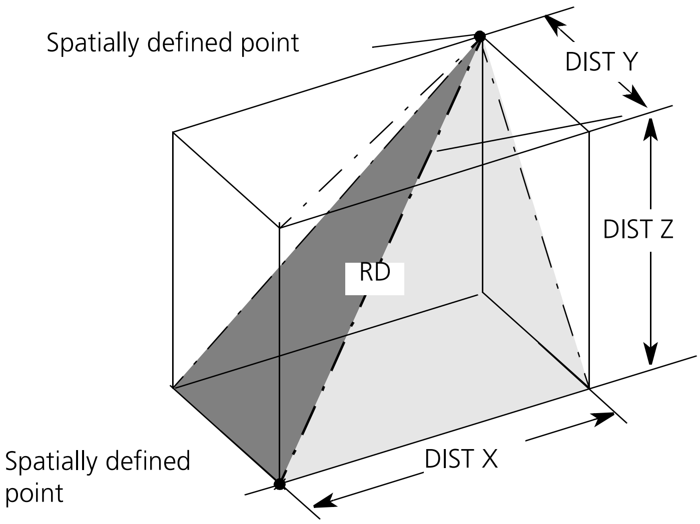
<DI 1261> is applied to the last element in the record.

- Interpretation of results:
  RD: Length of space diagonals **WX**, **WY**, **WZ**: Angle between space diagonal and coordinate axis.
- With a nom-act comparison, the nominal value for the space diagonal must be entered in the **R** input line.
- The element entered must be defined by three coordinates (X, Y and Z).
- If the specified element is a point defined by 3 coordinates (e.g. space point, sphere center, intersection point), its polar distance

will be calculated from the zero point of the workpiece coordinate system.



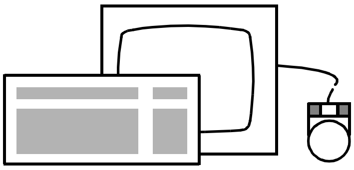
– If the element entered is the **<DISTANCE>** between two spatially defined elements, the polar distance between the two elements will be calculated.

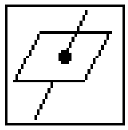


Penetration point <DI 1217>

Application

This function calculates the penetration point of an axis or normal through the reference plane.



DI	Pull-Down-Menu	Pictogram
1217 ROTPT	Eval Inters. Penetration S/A	

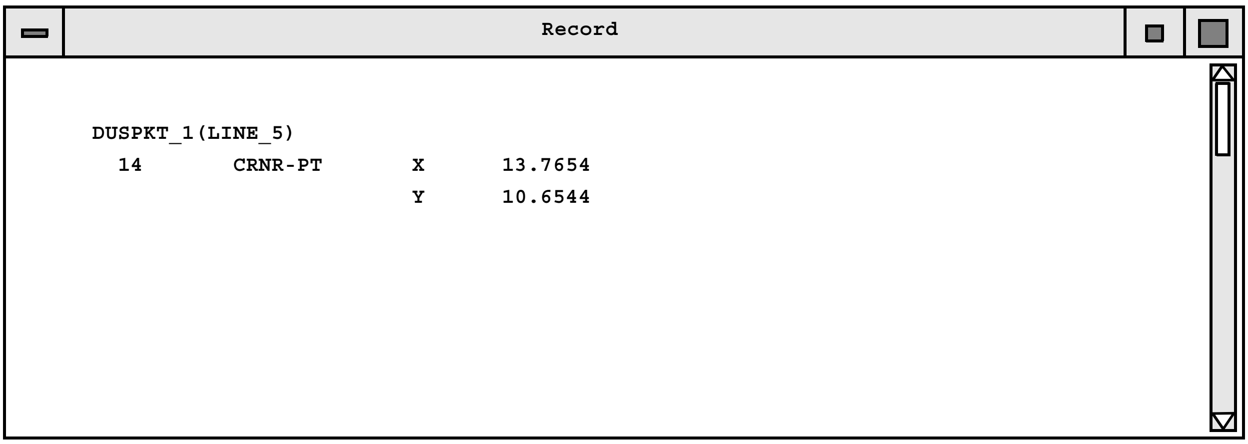
Result name

If the name allocation is activated (➤***„Setting the operating mode for the measuring probe head <DI 1502>" on page 6-18***), a result name inquiry will appear.

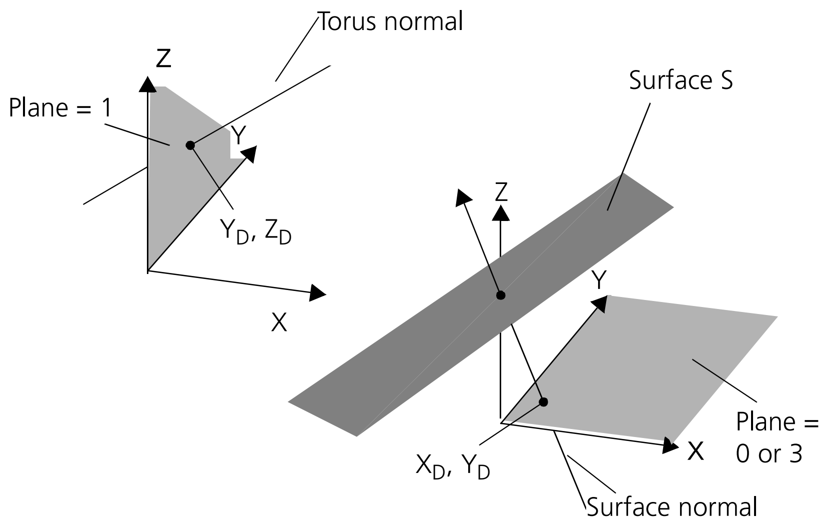
<DI 1217> is applied to the last element in the record.

Result

The result is output as an intersection point:



Examples



NOTE

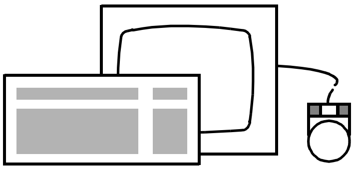
For a surface, the normal is placed at the point where the reference axis penetrates the surface. The point where the normal penetrates the reference surface is output.

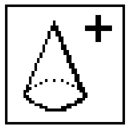
Additional cone program <DI 1243>

Application

The following data can be determined with **<DI 1243>**:

- The cone diameter at a defined point
- The center coordinates with a given cone diameter.



DI	Pull-Down-Menu	Pictogram
1243 ADDCONE a43	Eval Additions Additional cone...	

Result name

If the name allocation is activated (➤***„Setting the operating mode for the measuring probe head <DI 1502>" on page 6-18***) an additional result name inquiry will appear.

<DI 1243> is applied to the last element in the record, which must be a cone.

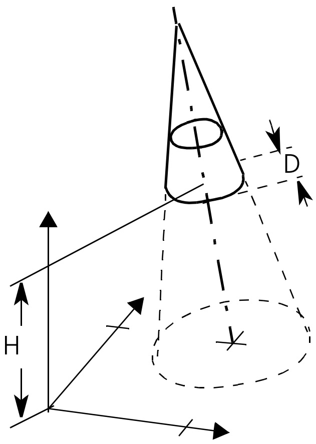
Explanation

Calculate diameter?

- **<YES>**
  The diameter of the cone is defined for a specified height.
- **<NO>**
  The coordinates of a specified diameter are defined.

Diameter calcul/height =

Enter height **H** where the diameter is to be defined (enter the correct +/- sign!).



Output:

ADDCONE_1(CONE_1)

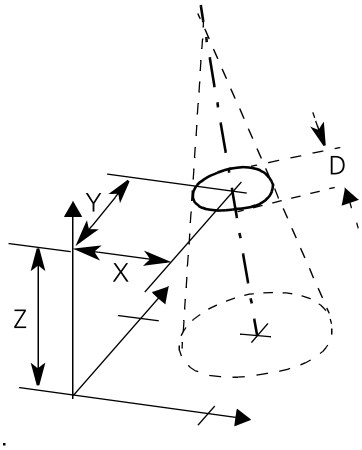
INTERS. HEIGHT 100.000

34 CON DIA D 53.136

If a negative cone diameter is output, the diameter is on the other side of the cone tip

Coord. determ./ diameter =

Enter diameter **D** for which the center point coordinates are to be calculated.



Output:

ADDCONE_2(CONE_1)

DIAMETER D 50.000

35 CON.CO X 53.136

Y 15.243

Z 5.542

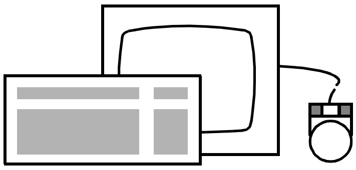
Height = 200.000 ok?
Diameter = 60.000 ok?

Verification inquiry depending on preceding input.

Cone angle correction <DI 1144>

Application

3D circle sections can not be measured by a CMM without deviations. These deviations (in the axis of the measured element) lead to considerable falsification of the measuring result for cones. The probings can be corrected via their distance from the calculated intersection plane of the circle and the cone angle.



DI	Pull-Down-Menu	Pictogram
1144	Elements Data acquisition Cone correction...	

Procedure

– Measure cone.

– Call **<DI 1144>**;
 the element window for CIRCLE then opens.

– Scan cone segment as circle.

NOTE

The program takes the cone angle of the cone evaluated last. The result of the cone measurement must be available as the last address (if necessary via recall).

<DI 1144> must be called individually for each section.

Chapter 14

Dimensional, form and position tolerances

This chapter contains:

Dimensional tolerances

Nominal-actual comparison

Measurements are subjected to a nominal-actual (variance) comparison by specifying nominal sizes. The degree of tolerance utilization or extent to which tolerances are exceeded is then output in the measurement record (printout).

Procedure

– Select the nominal-actual mode (➤***„Nominal-actual mode <DI 1454>“ on page 14-2***) **<DI 1454>**
– Specify the nominals and permissible tolerances (➤***„Nominal input <DI 1459> (old 1452)“ on page 14-8***) **<DI 1452>**
– Enter program for acquiring / converting the toleranced geometric element, e.g. **<CIRCLE>**
– A result which was previously printed out can be checked for its dimensional accuracy by calling **<NOM-ACT>** and then **<RECALL>**.
– If required, record output can be limited to results with nominals or where the tolerance has been exceeded. (➤***„Defining the scope of the record <DI 1665>“ on page 5-14***).
– Further application: The nominal-actual function can also be used ***without*** checking the nominals for the purpose of displaying the measuring results more clearly in the record (z ➤***„Nominal input <DI 1459> (old 1452)“ on page 14-8***; ➤***„Input of identifications“ on page 5-9***).

Nominal-actual mode <DI 1454>

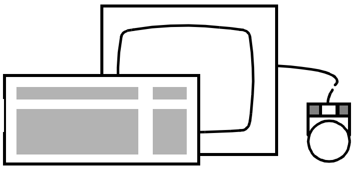
Application

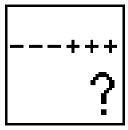
Four methods are available for calculating deviations for a nominal-actual (variance) comparison):

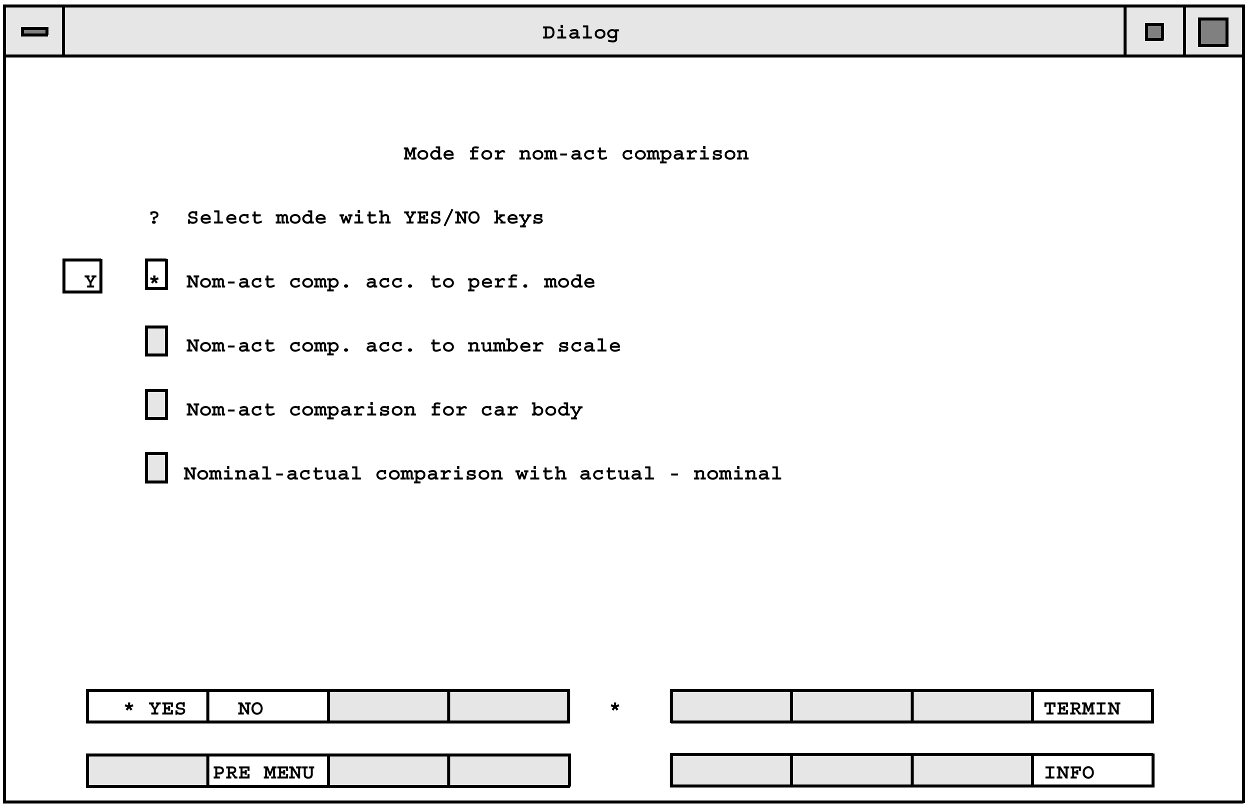
– Standard
– Number scale
– Car body
– Actual value - nominal value

NOTE

- The **STANDARD** nominal-actual mode is activated when the software is delivered. Another mode can be set with **<DI 1454>**.
- This mode setting remains the same until it is changed with **<DI 1454>**, even if UMESS is interrupted in the meantime (long-term mode).
- For CNC measuring runs, the nominal-actual mode must be defined by a learn (part) program, since it is not contained elsewhere in the control data.



DI	Pull-Down-Menu	Pictogram
1454 NAMODE a54	Record Mode Nominal/actual...	

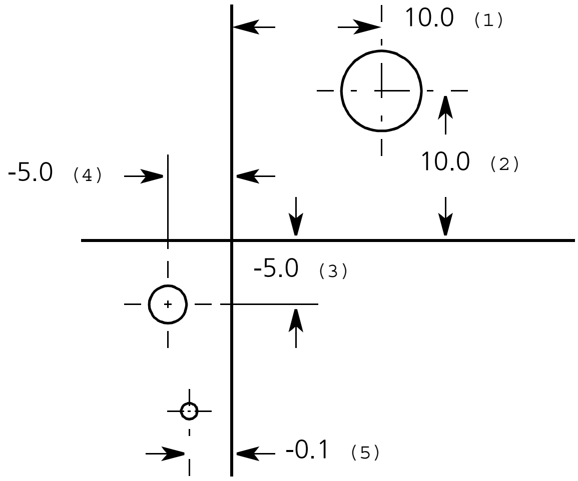


Procedure

Select the mode required with **<YES>**/**<NO>** and close the dialog window with **<TERMIN>**.

Standard mode

In the standard mode deviations are calculated according to the following rules:



	Enter nominal ***without*** +/-sign	Enter nominal ***with*** +/-sign
Deviation calculation	|ACT| – |NOM|	ACT– NOM
(1)	(10.1) - (10.0) = +0.1	(+10.1) - (+10.0) = +0.1
(2)	(9.7) - (10.0) = -0.3	(+9.7) - (+10.0) = -0.3
(3)	(5.1) - (5.0) = **+**0.1	(-5.1) - (-5.0) = **-**0.1
(4)	(4.9) - (5.0) = **-**0.1	(-4.9) - (-5.0) = **+**0.1
(5)	(0.1) - (0.1) = **0!!**	(+0.1) - (-0.1) = **+0.2**

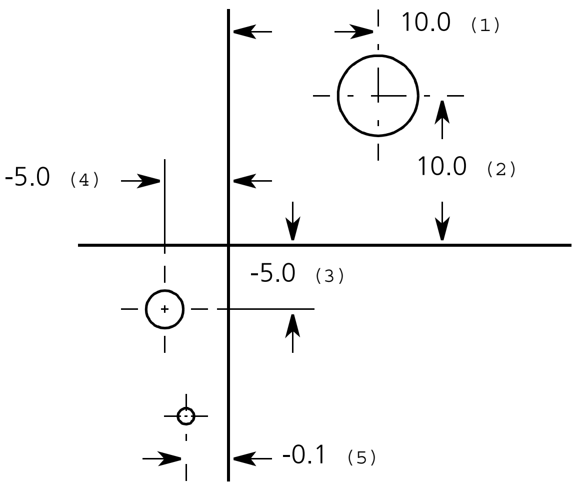
NOTE

- If the actual dimension is very close to the zero line (near the limit deviation), the +/- sign **must** be entered for the nominal size (cf. example 5).
- With negative actual dimensions, the +/- sign of the deviation depends on whether the nominal dimension was entered with or without a +/- sign (cf. examples 3 and 4).

Number scale mode

In NC production in particular it is advantageous to take the correction data for the machine tool directly from the measurement record. This is possible in the numer scale mode.

In the number scale mode, deviations between actual and nominal dimensions are calculated according to the following rules (compared with **Standard**, the deviation calculation is different when the actual values are negative):



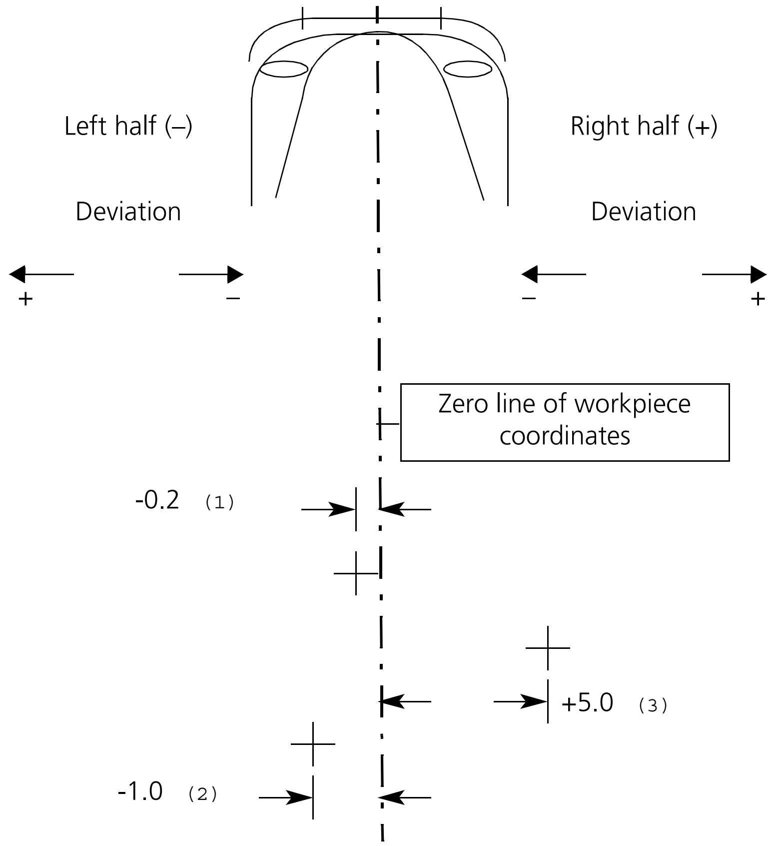
	Enter nominal **without** +/- sign	Enter nominal **with** +/- sign
Deviation Calculation	ACT – sgnACT × NOM	ACT– NOM
(1)	(+ 0.1) - (+) (10.0) = +0.1	(+10.1) - (+10.0) = +0.1
(2)	(+ 9.7) - (+) (10.0) = -0.3	(+ 9.7) - (+10.0) = -0.3
(3)	(- 5.1) - (-) (5.0) = -0.1	(- 5.1) - (- 5.0) = -0.1
(4)	(- 4.9) - (-) (5.0) = +0.1	(- 4.9) - (- 5.0) = +0.1
(5)	(+ 0.1) - (+) (0.1) = **0!!**	(+ 0.1) - (- 0.1) = **+0.2**
	sgn = +/- sign	

NOTE

If the actual dimension is very close to the zero line (near the limit deviation), the +/- sign ***must*** be entered for the nominal dimensions (cf. example 5).

Car body mode

The car body mode takes into account that the following applies to the +/- sign of the deviation:



	Enter nominal **without** +/- sign	Enter nominal **with** +/- sign
Deviation calulation	$\lvert IACT \rvert - \lvert NOM \rvert$	$sgnNOM \times ACT - \lvert NOM \rvert$
(1) (2) (3)	0.1 - 0.2 = **-0.1** 0.8 - 1.0 = -0.2 5.2 - 5.0 = +0.2	(-) (+0.1) - 0.2 = **-0.3** (-) (-0.8) - 1.0 = -0.2 (+) (+5.2) - 5.0 = +0.2 sgn = +/- sign

NOTE

If the actual dimensions lies very close to the zero line (near the limit deviation), the +/-sign ***must*** be entered for the nominal (cf. example 1).

Nom-act comparison with actual-nominal value

If you set this mode, the calculation of the nom-act (variance) comparison will always be performed from the actual to the nominal value.

NOTE

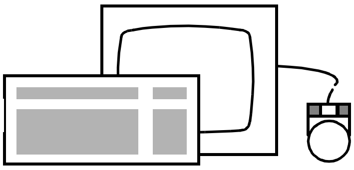
- The mode setting is displayed in the measurement record as follows by calling **<DI 1454>**:
  Nom-act comparison: CAR BODY MODE = 3
- A line is created with the corresponding code by calling **<DI 1454>** in the **Nominal** column of the control data list.

```
                                  Protokoll

  Nom-act comparison: CAR BODY MODE = 3

  ================================================================================
                        CONTROL DATA LIST    ZEISS  UMESS

  WORKPIECE NAME:   1454
  FILE NAME:  CNC________30B
  CONTORL DATA LINES:    11            NOMINAL LINES:    0
  ================================================================================
       X           Y           Z      | Function  | SC2 | SC1 | PCN |CCN  |ADR
  NO | ------------------------------ |           |     |     |     |     |
                Dialog                |           |     |     |     |     |
  NO |   Nominal    | U.Tol  | L.Tol  | Function  | SC2 | SC1 | PCN |CCN  |
  NO |        Identification          | Function  | SC2 | SC1 | PCN |CCN  |ADR
  ================================================================================
     1       3       0       0       0 NOM MOD          0     1  1454       0
     2 X    ABCDE       6   0   0   0   0 NOMINALS SN    0     2  1459       0
     3        50.0000   0.5000  -0.5000 LDL NOM V SN    1     0  9919       0
     4                  0   0   0   0   0 NOMINALS SN    0     2  1459       0
     5                   0.0000   0.0000 LDL NOM V SN    0     0  9919       0
```

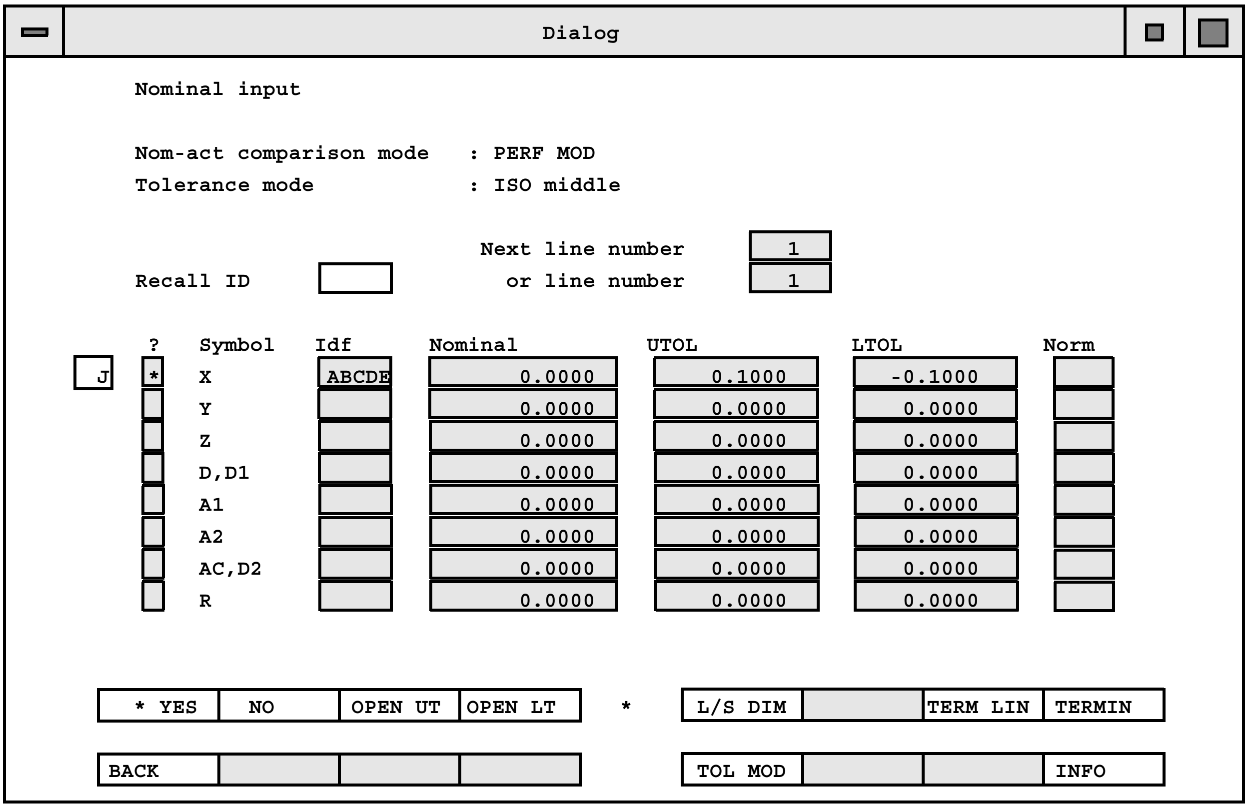
Nominal input <DI 1459> (old 1452)

Application

This function opens the **Nominal input** dialog window. Nominal dimensions and tolerances can be entered for elements to be checked for dimensional accuracy.



DI	Pull-Down-Menu	Pictogram
1459 (1452)	Record Nominal/actual	---+++
NOM	enter...	



Dialog

Nominal input

Nom-act comparison mode : PERF MOD
Tolerance mode : ISO middle

Next line number 1
Recall ID or line number 1

J	?	Symbol	Idf	Nominal	UTOL	LTOL	Norm
	*	X	ABCDE	0.0000	0.1000	-0.1000	
		Y		0.0000	0.0000	0.0000	
		Z		0.0000	0.0000	0.0000	
		D,D1		0.0000	0.0000	0.0000	
		A1		0.0000	0.0000	0.0000	
		A2		0.0000	0.0000	0.0000	
		AC,D2		0.0000	0.0000	0.0000	
		R		0.0000	0.0000	0.0000	

* YES | NO | OPEN UT | OPEN LT * L/S DIM | | TERM LIN | TERMIN

BACK | | | TOL MOD | | | INFO

NOTE

- Geometric elements can be concluded with **<NOMINAL>**. The boxes required for the nominal-actual comparison are preassigned with the rounded off measuring results (➤***„Switching on the intermediate result display <DI 1188>" on page 10-8***).
- For other functions, **<ACT-NOM>** must always be called immediately before the call with the toleranced dimensions.

– The values of the last nominal value input are stored and offered as the default values the next time the function is called.
– The active evaluation mode from the long-term file is displayed in the header of the dialog window (in the example: **STANDARD**).

Procedure with nominal input

First box

When the nominal window is called the cursor is initially positioned in the **?** column. Select the required line using the cursor keys **<∨>** and **<∧>** or by actuating **<NO>**.

Select line

Activate required line with **<YES>**. An asterisk (*****) then appears in the **?** column. This means that the nominal input line is activated and the values entered will be included in the nominal-actual (variance) comparison.

Move inside of a box with the **<>>** and **<<>** cursor keys.
Jump to the next box with the **<∨>** and **<∧>** cursor keys or **<Enter>.**

Identification

Depending on the setting of **<DI 1667>** you can enter a 5-digit or max. a 10-digit identification in the **Idf** column. Confirm your input with **<Enter>**.

Nominal

Nominal column**:** See rules for +/- sign in ➤***„Nominal-actual mode <DI 1454>“ on page 14-2***. Conclude input with **<Enter>**.

ISO fits (e.g. **25.6H7**) can also be entered in this column. After you confirm with **<Enter>** the tolerances will be entered automatically and the fit identification will be transferred to the **NORM** box.

Tolerances

UTOL and **LTOL** columns: Enter upper and lower tolerance and confirm each time with **<Enter>**.

Next line

After confirming the **LTOL** column with **<Enter>**, jump to the next line and fill it in as described above or skip it.

Termin input

When all of the data required has been entered, close the dialog window with **<TERMIN>**.

Inaccessible boxes

The **Next line number**, **Recall ID** and **Line number** boxes were previously used to enter the nominal blocks. These boxes are now inaccessible (disabled).

Softkeys

*** YES** — Selects the line required for the nominal-actual comparison.

NO — Skips one line.

OPEN-UT — **Upper tolerance open:** If you press this softkey, the number 1000 will be entered in the **UTOL** column and the cursor will then jump to the **LTOL** column.

OPEN-LT — **Lower tolerance open:** If you press this softkey, the number -1000 will be entered in the **LTOL** column and the cursor will then jump to the next line.

L/S DIM — **Largest/smallest dimension:** Enter the largest permissible dimension in the **Nominal** column and the smallest permissible dimension in the **UTOL** column and confirm each input with **<ENTER>**. If the **<L/S DIM>** softkey is actuated, the nominal as well as the upper and lower tolerance will automatically be calculated and entered in the corresponding column (symmetrical tolerance range). The cursor will then jump to the next line.

TERM LIN — **Line end:** Pressing this softkey terminates the line and accepts the values it contains. It does not matter which column a value was entered in. The whole line will automatically be accepted.

TERMIN — Accepts the values entered and closes the dialog window.

BACK — Cancels the function and returns the program to the previous menu.

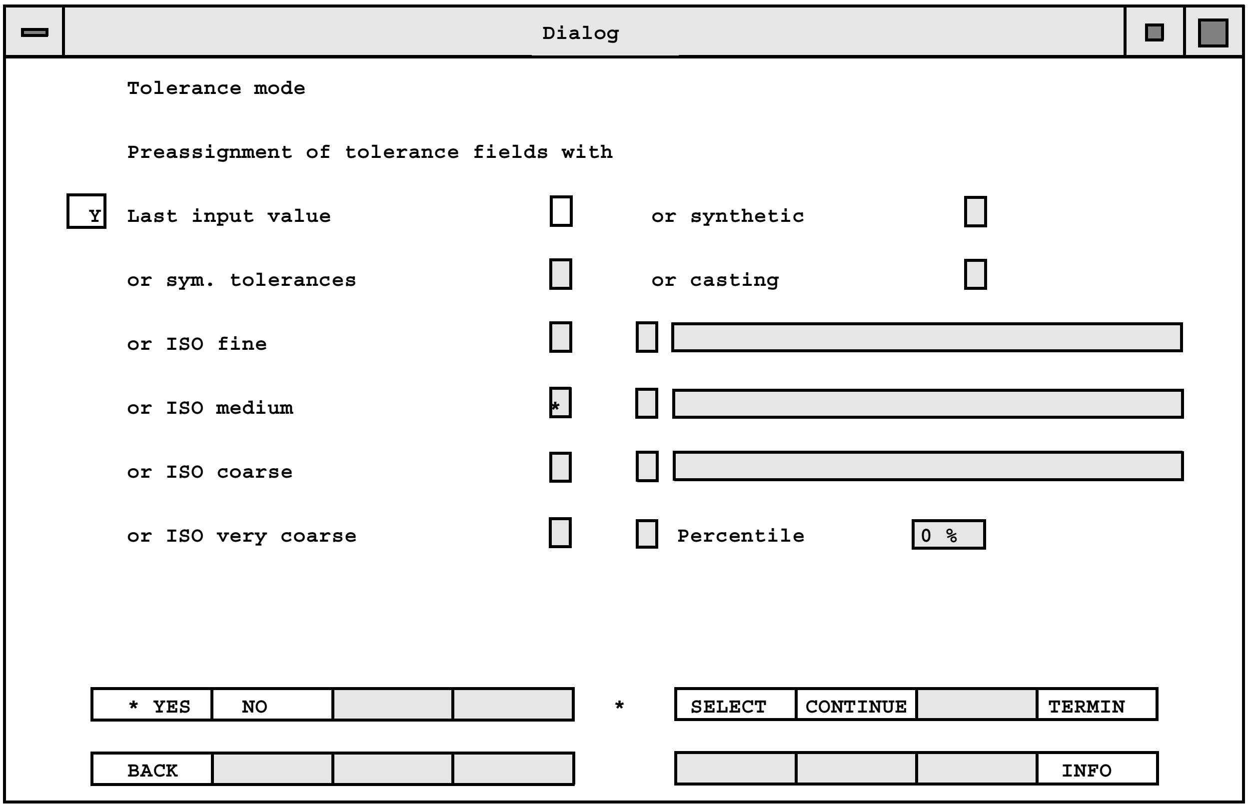
INFO — Initiates screen display of nominal input information. The program is returned to the dialog window with **<PRE MENU>**.

NOTE

For angles, the nominal dimension and tolerances may also be entered in the form **degrees/minutes/seconds**. Separation must be performed with a slash (/). When you press **<Enter>,** the values entered will be converted to decimal degrees.

TOL MOD

Tolerance mode:



*** YES** / **NO**

Selects the type of tolerance preassigned to the tolerance boxes. The tolerance mode defined is accepted and displayed in the **„Nominal input“** dialog window with **<TERMIN>**.

SELECT

Selection of the parameters stored for synthetic and casting toleran-ces.

CONTINUE

Preselects additional parameter lines for plastic or casting tolerances.

Data box

Percentile

Tolerance utilization in %.

General tolerances for cast parts made of light metal alloys:

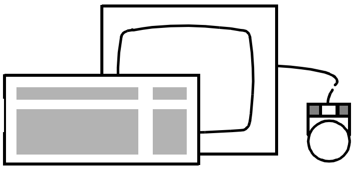
	3D diagonal range (3D)	Degree of accuracy	Mold depend.	Series of casting tolerances	Allowance	Highest nominal diameter		Lowest nominal diameter
GRAVITY DIE CAST		GTA 14/5	n. dep.	GTA 15	0 mm	over 1000 mm	up to 1250 mm	up to 18 mm
			dep.	GTA 14/5				
		GTA 15	n. dep.	GTA 15/5				
			dep.	GTA 15				
		GTA 15/5	n. dep.	GTA 16				
			dep.	GTA 15/5				
PRESSURE DIE CAST	over 500 mm	GTA 14	n. dep.	GTA 14	0.2 mm	over 1000 mm	up to 1250 mm	up to 18 mm
			dep.		0 mm			
		GTA 14/5	n. dep.	GTA 14/5	0.3 mm			
			dep.		0 mm			
	over 180 to 500 mm	GTA 13/5	n. dep.	GTA 13/5	0.15 mm	over 400 mm	up to 500 mm	
			dep.		0 mm			
		GTA 14	n. dep.	GTA 14	0.2 mm			
			dep.		0 mm			
		GTA 13	n. dep.	GTA 13	0.1 mm	over 120 mm	up to 180 mm	
	over 50 to 180 mm		dep.		0 mm			
		GTA 13/5	n. dep.	GTA 13/5	0.15 mm			
			dep.		0 mm			
		GTA 12/5	n. dep.	GTA 13	0 mm	over 30 mm	up to 50 mm	
			dep.					
	up to 50 mm	GTA 13	n. dep.	GTA 13	0.1 mm			
			dep.		0 mm			
SAND MOLD		GTA 15/5	n. dep.	GTA 16	0 mm	over 1000 mm	up to 1250 mm	up to 50 mm
			dep.	GTA 15/5				
		GTA 16/5	n. dep.	GTA 17				
			dep.	GTA 16/5				

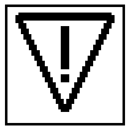
NOTE The adjustable parameters are based on DIN16901 for plastics and DIN1688, Parts 1, 3 and 4 for metal castings.

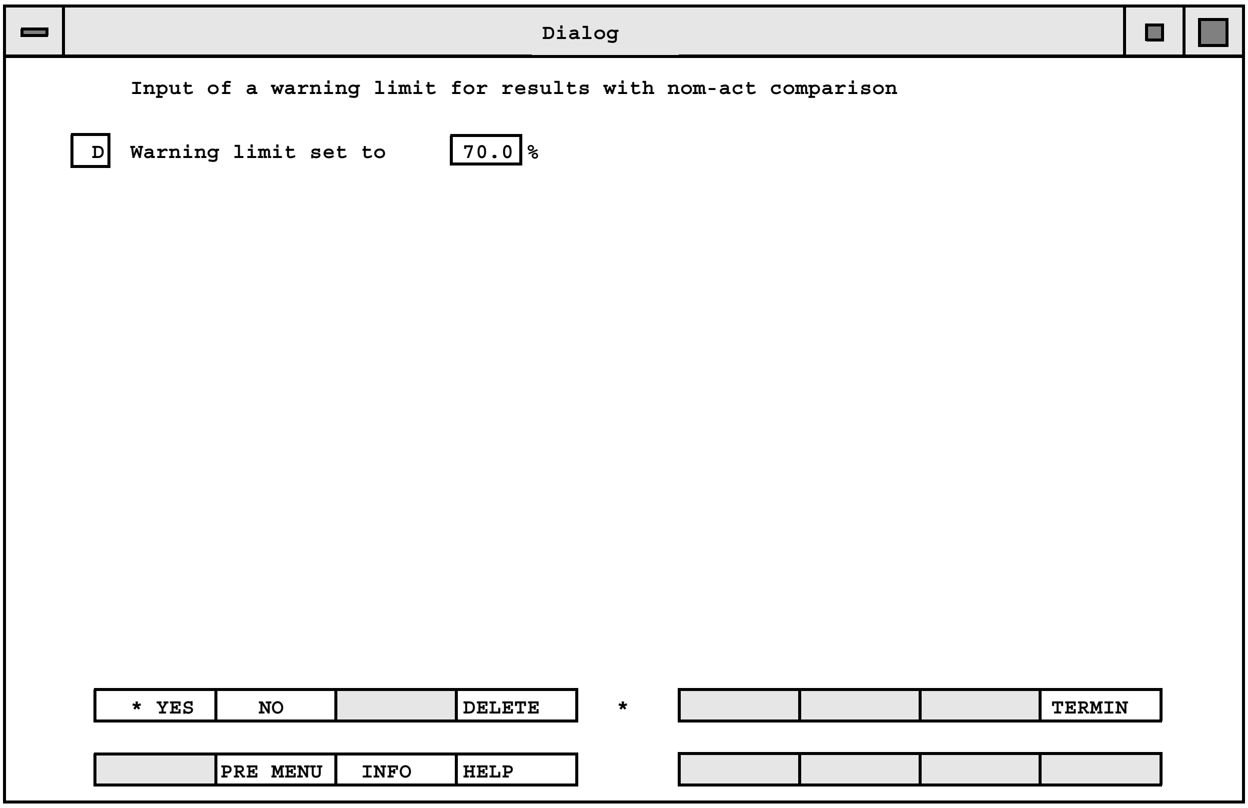
Setting a warning limit <DI 1664>

Application

A warning limit can be set with this function. This means that: If a measured value exceeds a preset degree of tolerance utilization, a corresponding message will be output to the measurement record.



DI	Pull-Down-Menu	Pictogram
1664 WARNLI	Record Mode Warning limit...	



Input values

The warning limit can be set to any value between 0 and 100%.

Softkeys

DELETE

Deactivates the warning limit check.

TERMIN

Terminates the dialog window, the value entered is accepted.

PRE MENU

Terminates the dialog window without accepting the entered or modified value.

Measurement record printout

If a measured value exceeds the warning limit, this is displayed in the measurement record by the exclamation marks in the **EXC** column.

Example (The warning limit has been set to 70% here)

```
Record
 ===============================================================================
  ADR|REC |TASK | IDF |SY | ACTUAL  | NOMINAL | U.TOL | L.TOL | DEV   | EXC
 ===============================================================================
 Warning limit set to      70.0 %

    2     CIRCLE I  Cir. 3 D     108.721   109.000   0.150   -0.150  -0.279  -0.129

    3     CIRCLE I  Cir. 3 D     108.860   109.000   0.150   -0.150  -0.140   !!!!

    4     CIRCLE I  Cir. 3 D     109.070   109.000   0.150   -0.150   0.070     ++
```

Interpretation of results

Example for the record output of a geometric element with toleranced dimensions

```
Record
 ===============================================================================
  ADR|REC |TASK | IDF |SY| ACTUAL  | NOMINAL | U.TOL | L.TOL | DEV   | EXC
 ===============================================================================

  22      CIRCLE I Cir.3  X   -10.130    10.000   0.100  -0.100   0.130   0.030
                   Cir.3  Y    20.050    20.000   0.100  -0.100   0.050   ++
                     12/45D   108.721   109.000   0.150  -0.150  -0.279  -0.129
```

The following columns concern the nominal input:

IDF Identification assigned by the user (if entered).

NOMINAL, U.TOL, L.TOL Values entered for nominal size, upper and lower limit deviations.

DEV Difference between actual and nominal sizes, calculated according to the rules explained in ➤***„Nominal-actual mode <DI 1454>“ on page 14-2***.

EXC

The histogram printed in this column gives you a quick overview of the dimensional accuracy of the measured values checked. If the deviations lie within the prescribed tolerance, this will be indicated by a corresponding number of +/- signs:
Deviations towards the upper limit deviation are indicated by plus signs.

Deviations towards the lower limit deviation are indicated by minus signs.

Histogram

Each plus or minus sign corresponds to a 25 % tolerance utilization starting from the center of the tolerance range:

Nominal size outside of the tolerance zone: **34.3** $^{-0.1}_{-0.5}$

%	DEV	EXC
75 - 100	-0.1	++++
50 - 75	-0.15	+++
25 - 50	-0.2	++
0 - 25	-0.25	+
0	-0.3	-+
0 - 25	-0.35	-
25 - 50	-0.4	--
50 - 75	-0.45	---
75 - 100	-0.5	----

Nominal inside of the tolerance zone: **12.0**±0.1

%	DEV	EXC
75 - 100	0.1	++++
50 - 75	0.075	+++
25 - 50	0.05	++
0 - 25	0.025	+
0	0	-+
0 - 25	-0.025	-
25 - 50	-0.05	--
50 - 75	-0.075	---
75 - 100	-0.1	----

NOTE

If a result is out of tolerance, the numerical value over or under the tolerance will be output. If a specified warning limit is exceeded, (➤***„Setting a warning limit <DI 1664>“ on page 14-13***) exclamation marks will be printed out.

The record output can be limited to results with a defined tolerance utilization (➤ ***„Defining the scope of the record <DI 1665>“ on page 5-14***).

Output of deviations referenced to the tolerance center

Description of the output mode

For a record printout, the value in the **DEV** (deviation) column should be output referenced to the tolerance center.

In the default mode, this value is output referenced to the nominal size.

Activating the output mode

Your system administrator can activate this output mode for you in the file **/home/zeiss/UC/MODLZBDRU__snB** (sn corresponds to the session number) with parameter **S59:1**.

Code for this output mode

In the output this mode can be recognized by the vertical line | located at the **DEV** value. Depending on the output medium, there may also be 2 small vertical lines.

Example 1

DEV value referring to nominal

```
Record
================================================================================
 ADR|REC |TASK| IDF |SY| ACTUAL | NOMINAL | U.TOL | L.TOL | DEV    | EXC
================================================================================

  1      CIRCLE I X__1  X    100.8000   100.0000  1.0000 -1.0000  0.8000   ++++
                  Y__1  Y    149.9000   150.0000  0.2000 -0.2000 -0.1000   --
                  D__1  D     49.9000    50.0000  0.1000 -0.1000 -0.1000   ----
       4P S/MIN/MAX              .0000        (3)   .0000     (1)   .0000

  2      CIRCLE I X__2  X    100.5000   100.0000  1.0000  0.0000  0.5000   +-
                  Y__2  Y    149.9000   150.0000  0.0000 -0.2000 -0.1000   +-
                  D__2  D     50.0500    50.0000  0.1000  0.0000  0.0500   +-
       4P S/MIN/MAX              .0000        (1)   .0000     (1)   .0000

  3      CIRCLE I X__3  X     99.5000   100.0000  3.0000 -1.0000 -0.5000   ---
                  Y__3  Y    150.0500   150.0000  0.2000 -0.1000  0.0500   +-
                  D__3  D     50.1500    50.0000  0.3000 -0.0500  0.1500   +
       4P S/MIN/MAX              .0000        (3)   .0000     (1)   .0000
```

Example 2 DEV value referring to tolerance center

```
Record

================================================================================
 ADR|REC  |TASK| IDF |SY| ACTUAL | NOMINAL | U.TOL | L.TOL | DEV    | EXC
================================================================================

  1       CIRCLE I X__1  X    100.8000   100.0000  1.0000 -1.0000   0.8000|  ++++
                   Y__1  Y    149.9000   150.0000  0.2000 -0.2000  -0.1000|  --
                   D__1  D     49.9000    50.0000  0.1000 -0.1000  -0.1000|  ----
       4P S/MIN/MAX              .0000        (3)   .0000     (1)    .0000

  2       CIRCLE I X__2  X    100.5000   100.0000  1.0000  0.0000   0.0000|  +-
                   Y__2  Y    149.9000   150.0000  0.0000 -0.2000   0.0000|  +-
                   D__2  D     50.0500    50.0000  0.1000  0.0000  -0.0000|  +-
       4P S/MIN/MAX              .0000        (1)   .0000     (1)    .0000

  3       CIRCLE I X__3  X     99.5000   100.0000  3.0000 -1.0000  -1.5000|  ---
                   Y__3  Y    150.0500   150.0000  0.2000 -0.1000  -0.0000|  +-
                   D__3  D     50.1500    50.0000  0.3000 -0.0500   0.0250|  +
       4P S/MIN/MAX              .0000        (3)   .0000     (1)    .0000
```

Form tolerances

Definition

Form tolerances limit the deviation of an individual element from its ideal geometric form.

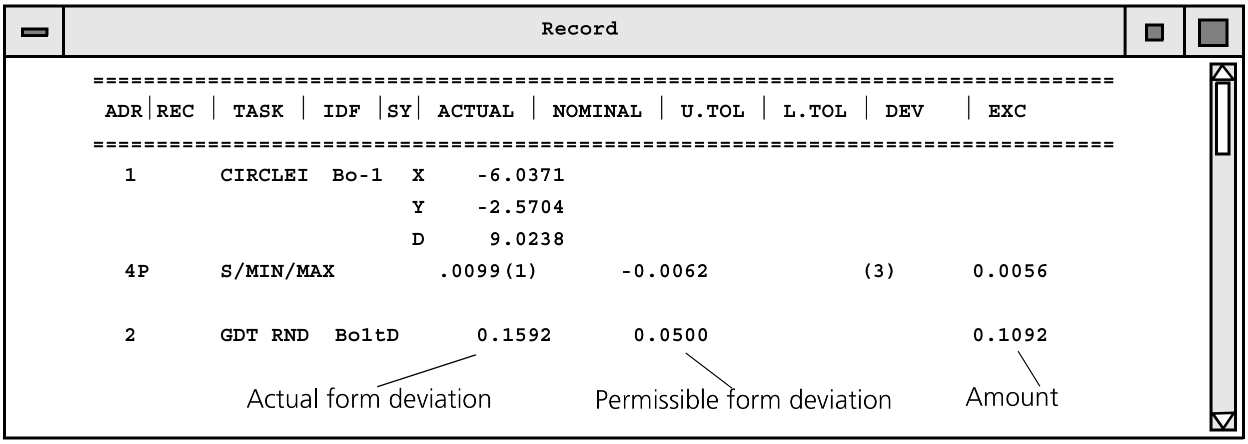
To calculate form deviations, geometric elements must be probed with a large number of points. The actual deviation is determined from the extreme, i.e. **MIN** and **MAX** values.

Ablauf

First
Measure geometric element with measuring program or **<RECALL>**

Subsequently
Call GDT 7184 with the corresponding symbol

Example



The following form deviations can be checked in UMESS:

– Straightness ➤ ***„Straightness <DI 1401>“ on page 14-19***

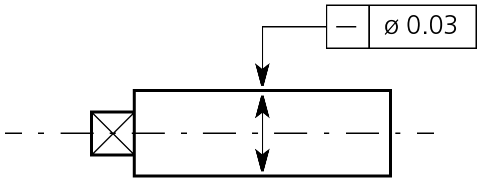
– Flatness ➤ ***„Flatness <DI 1402>, with reference length <DI 1472>“ on page 14-21***

– Roundness ➤ ***„Roundness <DI 1403>“ on page 14-26***

– Cylindricity ➤ ***„Cylindricity <DI 1404>“ on page 14-28***

Straightness <DI 1401>

Symbol

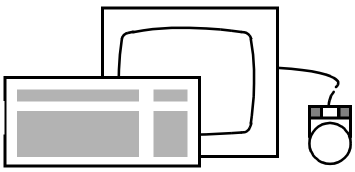


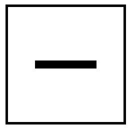
Application

The straightness of lines, cylinder axes and cone axes can be checked with this function.

Prerequisite

The element to be checked is the last address in the record (measured or placed via recall).



DI	Pull-Down-Menu	Pictogram
1401 GDTSTR	Eval Form Straightness...	

Data boxes

Result name

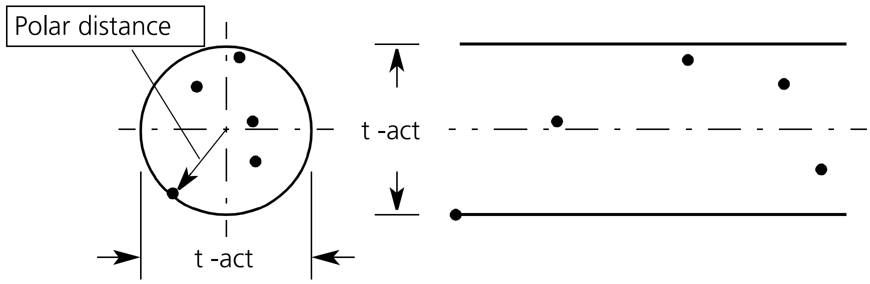
An inquiry appears only if the name allocation is activated (➤***„Setting the operating mode for the measuring probe head <DI 1502>“ on page 6-18***). Enter the result name and confirm with **<TERMIN>** (follow rules in ➤***„Allocating names“ on page 5-9***).

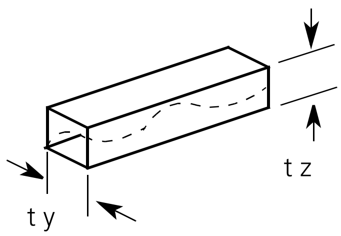
Tol.zone cyl.?

Define the form of the tolerance zone:

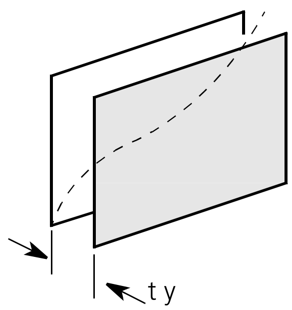
- **<YES>**
  Cylindrical tolerance zone
- **<NO>**
  Tolerance zone either cuboid or formed by two parallel planes.

With a **cylindrical** tolerance zone, the program calculates the polar distance between the calculated element and the most distant measuring point. The diameter of the actual tolerance cylinder is then obtained by doubling the polar distance.





If a **block-shaped** tolerance zone is specified, the program will calculate the vertical distance between the calculated element and the most distant measuring point.



If **two parallel planes** form the tolerence zone, the straightness deviation will be calculated in one direction only - perpendicular to the line.

Identific. t

An inquiry appears only if a cylindrical tolerance zone has been defined.

Enter the identification (max. 10 characters) and diameter of the tolerance zone and confirm each input with **<TERMIN>**.

Identific. tY
Identific. tZ

An inquiry appears only if **Tol.zone cyl.? = <NO>** has been set.

Enter the identification (max. 10 characters) and the cross section of the tolerance block (tx, ty, tz) and confirm with **<TERMIN>**.

If the tolerance zone is to be formed from two parallel planes, **tx < 0** must be entered for one coordinate direction.

Output examples

Record

```
================================================================================
 ADR|REC |  TASK  |  IDF  |SY|  ACTUAL  |  NOMINAL  |  U.TOL  |  L.TOL  |  DEV    |  EXC
================================================================================
  16       LINE E          Z      -0.123
                           X     -14.993
              Z/Y          W1      0.124
              X/Y          W2      0.042
       10P S/MIN/MAX                .056          (2)      .002      (5)     .084
```

Corresponds to radius of tolerance cylinder

2 x max

Cylindrical tolerance zone:

```
  17       GDT STR         t       0.168       0.200                                ++++
```

Block shaped tolerance zone:

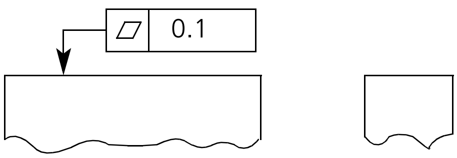
```
  18       GDT STR         tx      0.159       0.200                                ++++
                           tz      0.015       0.200                                +
```

Tolerance zone from two parallel planes:

```
  19       GDT STR         tx      0.159       0.200                                ++++
```

Flatness <DI 1402>, with reference length <DI 1472>

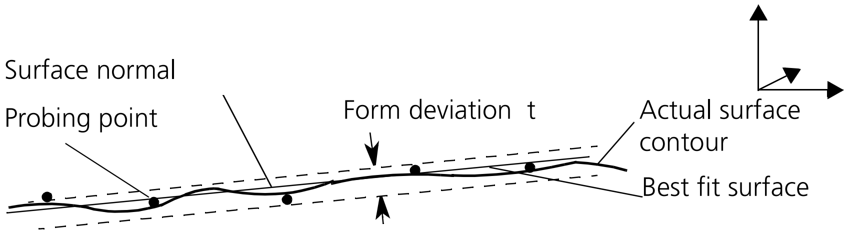
Symbol



Application

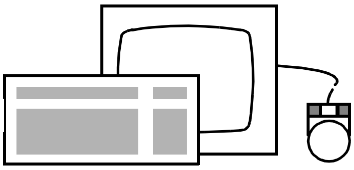
This function calculates the form deviation of the flatness of a surface.

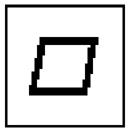
It determines the distance between two planes which are parallel to the best fit surface and enclose all measuring points.



Prerequisite

The **<SURFACE>** element or a result of the **<MIN FLAT>** or **<MAX FLAT>** function (➤***„Min-max flatness <DI 1110/1111/1140>“ on page 14-60***) is the last address in the record.



DI	Pull-Down-Menu	Pictogram
1402 GDTPLA	Eval Form Flatness...	

Data boxes

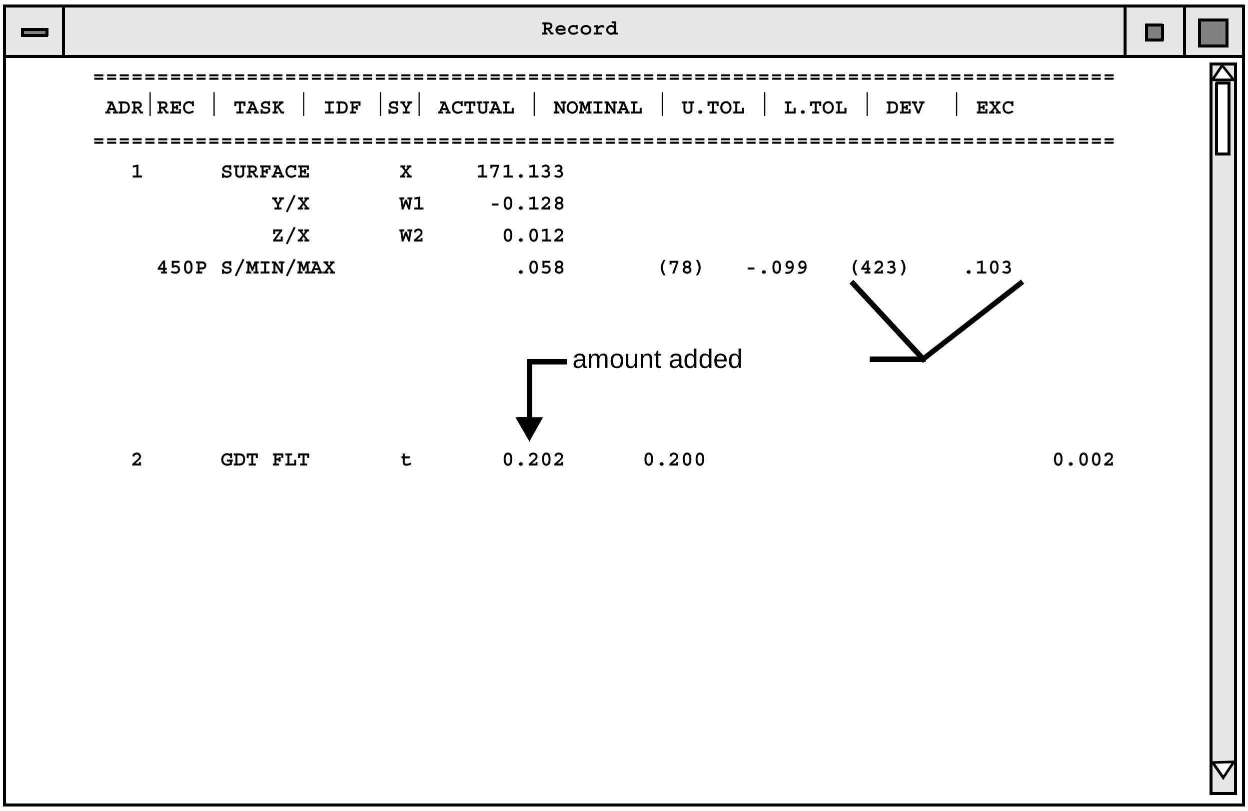
Result name

An inquiry appears only if the name allocation is activated (➤***„Setting the operating mode for the measuring probe head <DI 1502>“ on page 6-18***). Enter the result name and confirm with **<TERMIN>** (follow the rules in ➤***„Allocating names“ on page 5-9***).

Identific. t

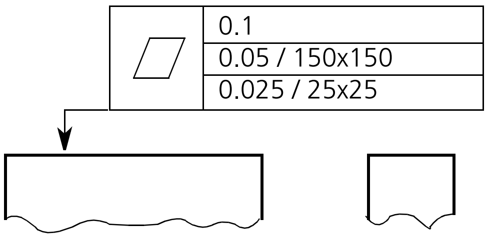
Enter the identification (max. 10 characters) and tolerance and confirm with **<TERMIN>**.

Output example



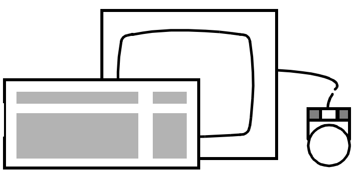
Flatness with reference length

Symbol



Prerequisite

The **<SURFACE>** element (comprising max. 5000 points) must be the last address in the record.

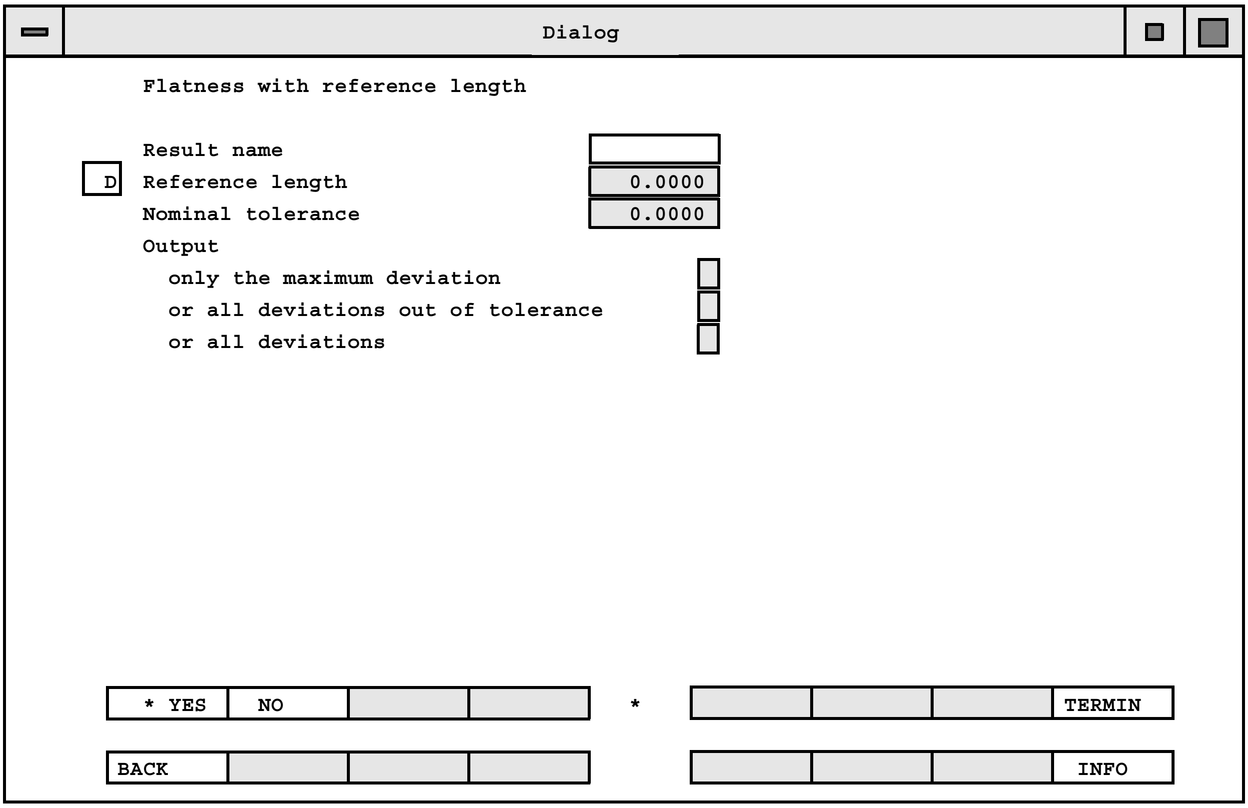


DI	Pull-Down-Menu	Pictogram
1472 GDTFLAPART	Eval Form Flatness/Length...	

Data boxes

Result name

This box will be assigned only if the name allocation is activated. Enter the result name for the first deviation. The names of all following deviations will then be incremented automatically.



Reference length

Edge length of the square part surface to which the flatness is referenced.

Nominal tolerance

Preset tolerance zone.

Output only the maximum deviation

– <YES>
Only the maximum deviation of the part surface will be output.

... or all deviations out of toelrance

– <YES>
All deviations of the part surface exceeding the nominal tolerance will be output.

... or all deviations

– <YES>
All deviations of the part surface will be outpout.

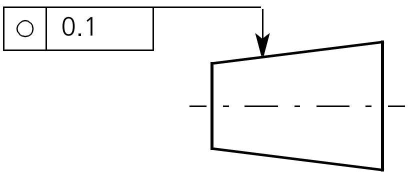
Output example

```
                                  Record
================================================================================
 ADR|REC  | TASK  | IDF  |SY| ACTUAL  | NOMINAL  | U.TOL  | L.TOL  | DEV   | EXC
================================================================================


   1      SURFACE        X      171.133
              Y/X        W1      -0.128
              Z/X        W2       0.012
     450P S/MIN/MAX                .058       (78)    -.099    (423)     .103

   2      GDT FLT        t        0.202      0.200                              0.002

GDT Flatness with reference length           50.000
Output: Only the maximum deviation
   3      GDT FLT        t        0.198      0.200                              ++++
                         X      172.587
                         Y     -266.142
                         Z      278.365
```

A result address is assigned to each deviation output. The deviation and the lower left-hand corner point of the corresponding part surface are output.

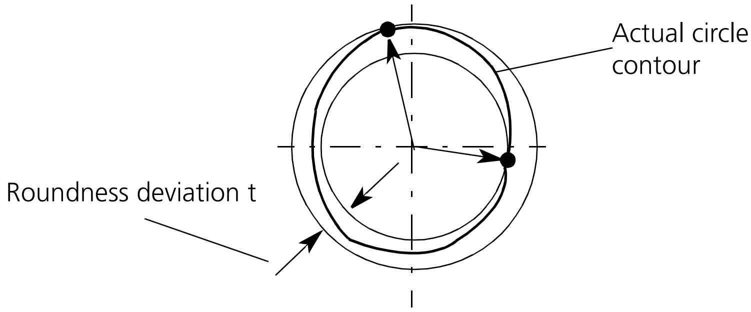
Roundness <DI 1403>

Symbol



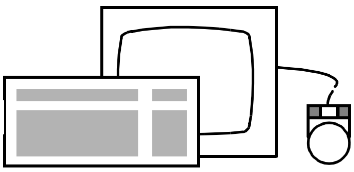
Application

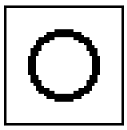
This function calculates the polar distances (radii) from the center point of the best fit circle to the nearest and furthest probing point. The difference between the two radii is the roundness deviation **t** of the circle.



Prerequisite

The **<CIRCLE>** element or a result of the **<MIN RUND>** or **<MAX RUND>** function (➤***„Min-max roundness <DI 1112/1113/1141>“ on page 14-62***) is the last address in the record.



DI	Pull-Down-Menu	Pictogram
1403 GDTROUN	Eval Form Roundness...	

Data boxes

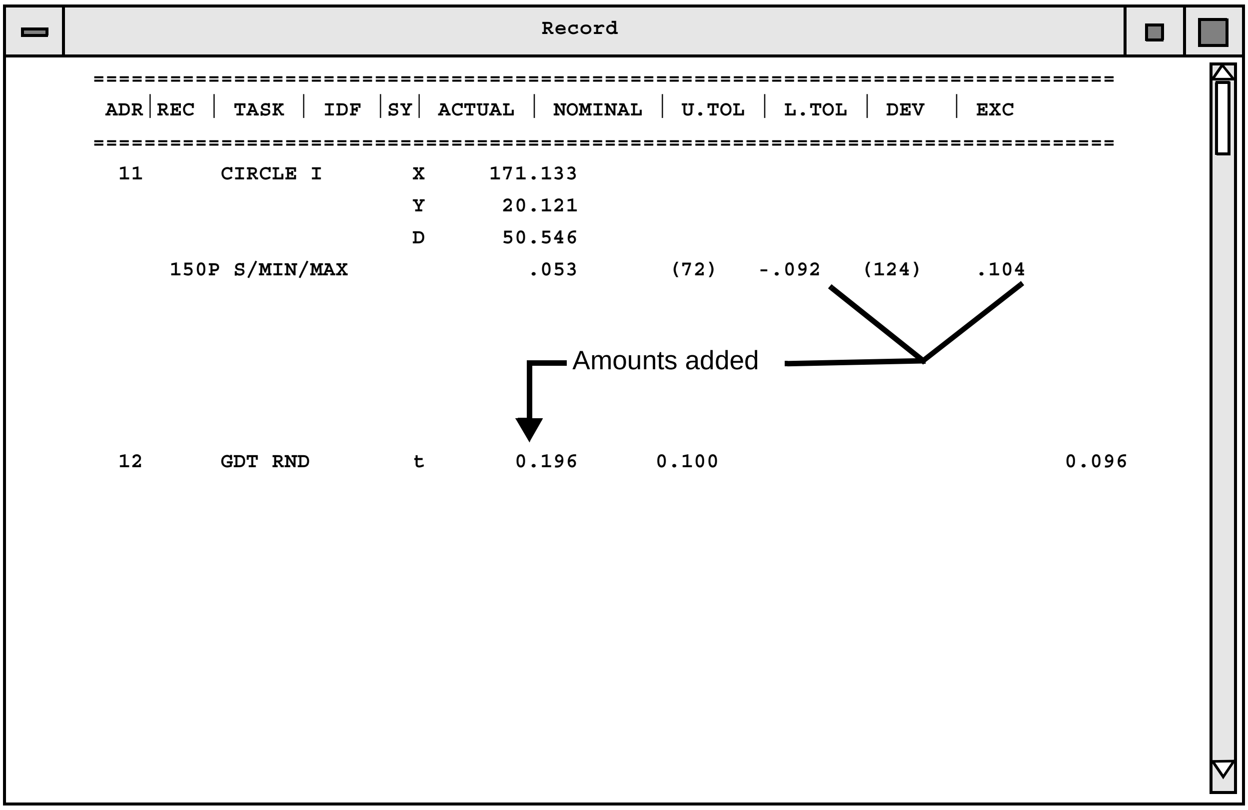
Result name

An inquiry appears only if the name allocation is activated (➤***„Setting the operating mode for the measuring probe head <DI 1502>“ on page 6-18***). Enter the result name and confirm with **<TERMIN>** (follow rules in ➤***„Allocating names“ on page 5-9***).

Identific. t

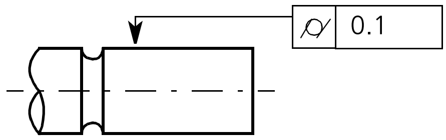
Enter the identification (max. 10 characters) and tolerance and confirm with **<TERMIN>**.

Output example



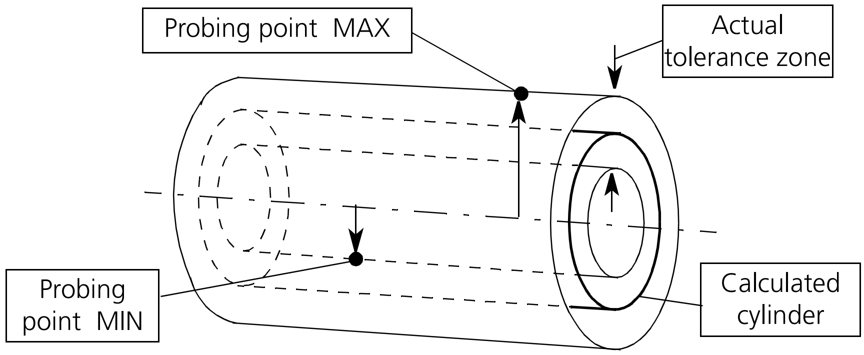
Cylindricity <DI 1404>

Symbol



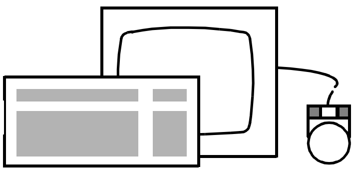
Application

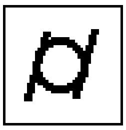
The program calculates the polar distance from the best fit cylinder axis to the nearest (MIN) and the furthest probing point (MAX). The difference between the two radii ist the form deviation of the cylinder.



Prerequisite

The **<CYLINDER>** element must be listed under the last record address (measured or placed via recall)



DI	Pull-Down-Menu	Pictogram
1404 GDTCYL	Eval Form Cylinder form...	

Data boxes

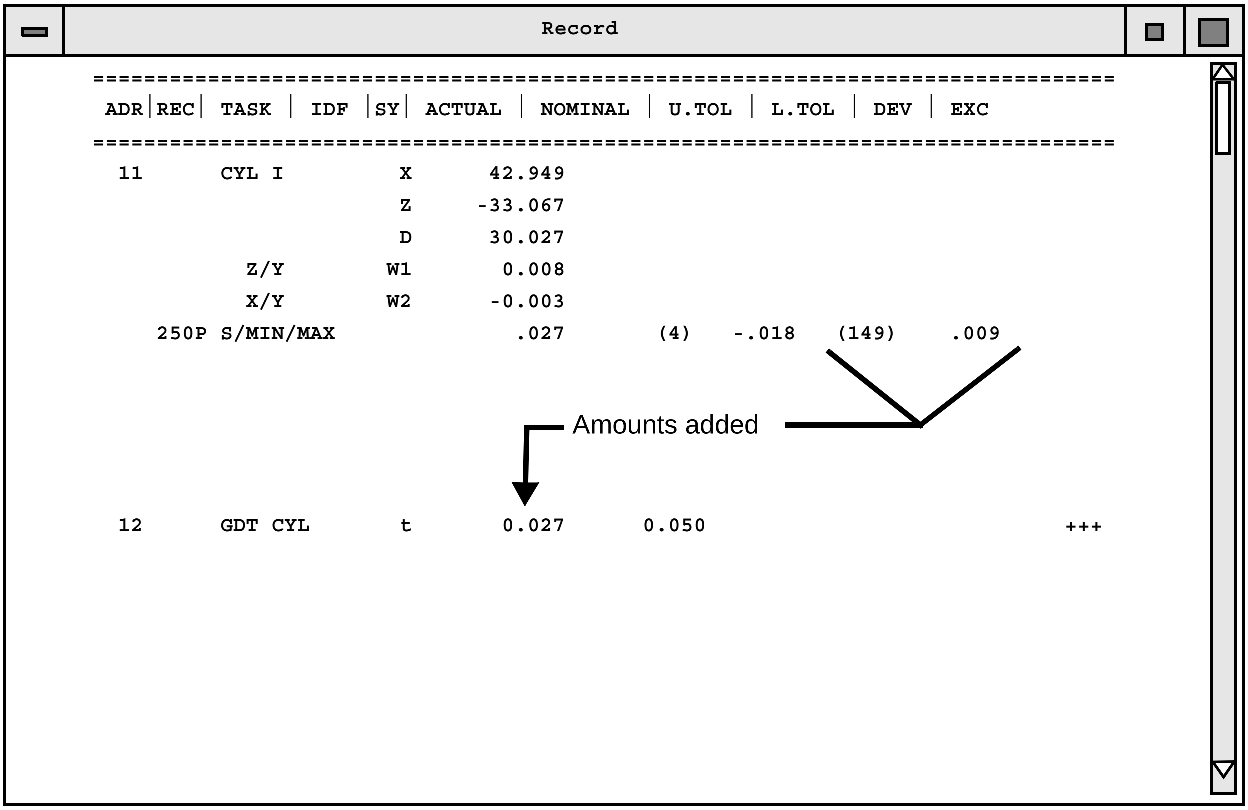
Result name

An inquiry appears only if the name allocation is activated (➤***„Setting the operating mode for the measuring probe head <DI 1502>" on page 6-18***). Enter the result name and confirm with **<TERMIN>.** (follow rules in ➤***„Allocating names" on page 5-9***).

Bezeichnung t

Enter the identification (max. 10 characters) and tolerance and confirm with **<TERMIN>**.

Output example



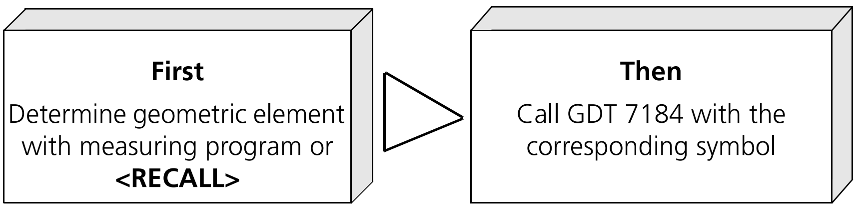
ADR	REC	TASK	IDF	SY	ACTUAL	NOMINAL	U.TOL	L.TOL	DEV	EXC
11		CYL I		X	42.949					
				Z	-33.067					
				D	30.027					
			Z/Y	W1	0.008					
			X/Y	W2	-0.003					
	250P	S/MIN/MAX			.027	(4)	-.018	(149)	.009	
12		GDT CYL		t	0.027	0.050				+++

Position tolerances

Definition

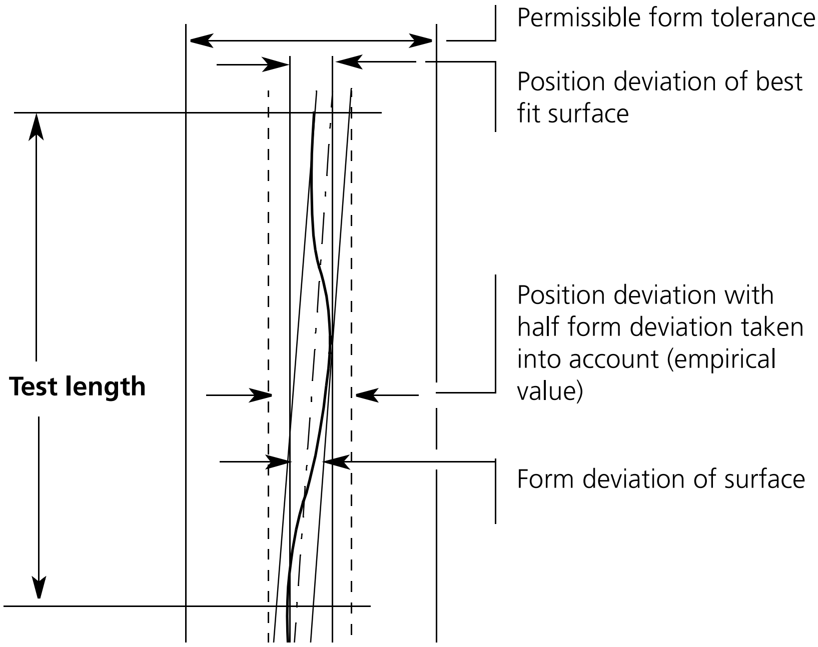
A form deviation is calculated by determining the 3D position of a **measured element** in relation to a **reference element**.

Procedure



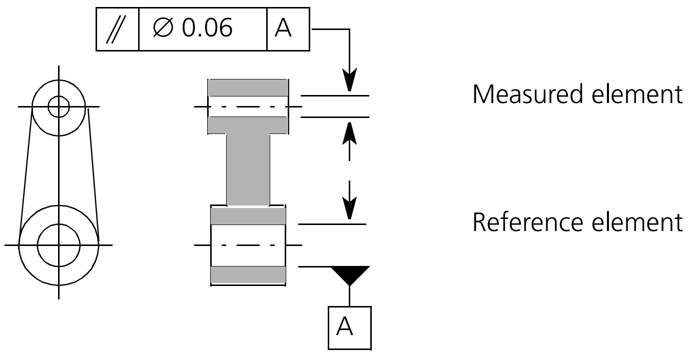
NOTE

- When checking the **PERPENDICULARITY**, **POSITION**, **CONCENTRICITY** and **COAXIALITY**, the maximum material condition (**MMC**) for the measured and the reference element can be included in the evaluation.
- When checking the **PARALLELISM**, **PERPENDICULARITY** und **ANGULARITY** (tilt), half of the form deviation is always included. Prerequisite: the measured element is a surface.



Parallelism <DI 1415>

Symbol



Application

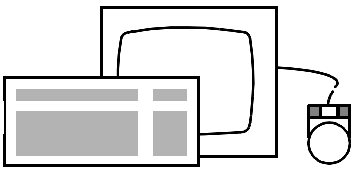
This program is used to determine the parallelism of surfaces and axes (cylinder axis, cone axis etc.).

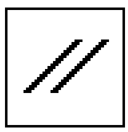
The following cases can appear:

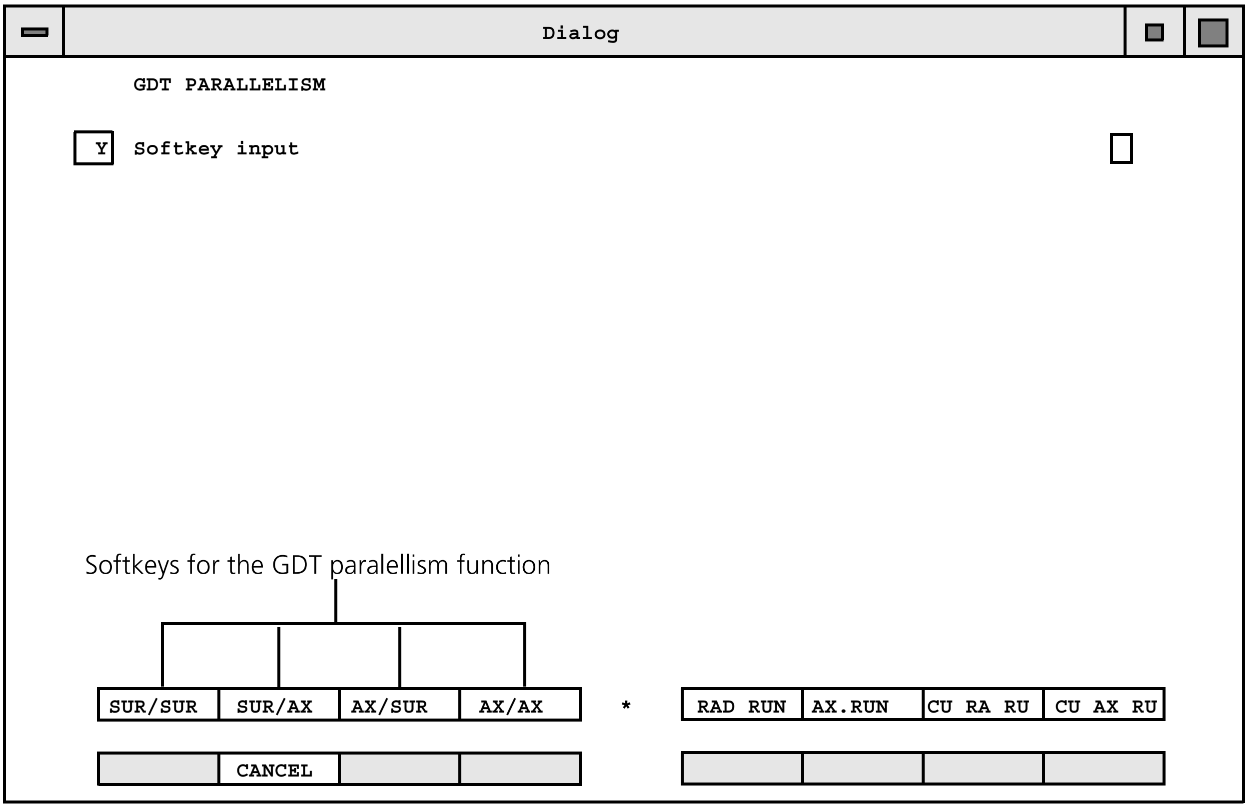
Measured element	Reference element
Surface	Surface
Surface	Axis
Axis	Surface
Axis	Axis

NOTE

- The measured element must be the last address in the record.
- The reference element is always the one which is spatially aligned, i.e. is always the element for which **<RO SPACE>** was last applied.
- If the measured element is a surface, half the form deviation is included in the calculation of the parallelism.



DI	Pull-Down-Menu	Pictogram
1415 GDTPAR	Eval Position Parallelism...	



SUR/AX

AX/SUR

The combination of measured element and reference element must be specified by softkey (**SUR** = surface, **AX** = axis)

The measured element is before the slash. The spatially aligned reference element is after the slash.

Case 1: Surface/surface parallelism

Data boxes

Result name

An inquiry appears only if the name allocation is activated (➤***„Setting the operating mode for the measuring probe head <DI 1502>“ on page 6-18***). Enter the result name and confirm with **<TERMIN>**. (Follow rules in ➤***„Allocating names“ on page 5-9***).

Identification t

Possibility of entering an identification with a maximum of 10 characters and specifying the permissible parallelism deviation (distance between two parallel planes).

REF LENGTH L = mm

The reference length is the length of the measured element to which permissible parallelism deviation **t** refers. If the measured element is a surface, the reference length is regarded as the length and width of this surface. The program thus calculates with a square surface having the lateral length L.

Calculation principle

tx = reference length x tan A1
ty = reference length x tan A2

Only the input of a test length is possible!

$\Rightarrow$ **t = $(tx^2+ty^2)^{1/2}$ + 1/2 *** Form deviation of the measured element

where t = distance between two parallel planes, parallel to the reference surface which includes the measured element.

Output example

```
Record

  1     SURFACE      Z    -443.1780
            X/Z      A1      0.0639                  Reference element
            Y/Z      A2     -0.0442
     4P S/MIN/MAX             .0051     (1)   -.0029   (2)    .0029

  2   ROTATE SPACE   A       0.0777   ABOUT SPACE AXIS Z

  3     SURFACE      Z     -10.0325
            X/Z      A1      0.0140                  Measured element
            Y/Z      A2     -0.0081
     4P S/MIN/MAX             .0011     (1)   -.0006   (2)    .0006

  4     GDT PAR      t       0.0147    0.0500   Test length 50      ++
                     L      50.0000
```

$$tx = 50 \times \tan 0.0140 = 0.0122$$
$$ty = 50 \times \tan 0.0081 = 0.0071$$
$$\Rightarrow t = (0.0122^2+0.0071^2)^{1/2} + {}^1/_2 * 0.0012 = 0.0147$$

Test length

The test length corresponds to the diameter of the measured surface under consideration (a circular surface or the diagonal of a square inscribed in a circle).

If the surface concerned is rectangular, an evaluation can also be performed with GDT rectangularity.

Case 2: Surface/axis parallelism

Data boxes

Result name

An inquiry appears only if the name allocation is activated (➤***„Setting the operating mode for the measuring probe head <DI 1502>“ on page 6-18***). Enter the result name and confirm with **<TERMIN>**. (Follow rules in ➤***„Allocating names“ on page 5-9***).

Meas plane X/Y?

A check for parallelism between axes and surfaces is limited to one plane. The correct measuring plane must be selected with **<YES>/<NO>**.

Identific. tZ

Possibility of entering an identification with a maximum of 10 characters and specifying the permissible parallelism deviation (distance between two parallel planes).

REF LENGTH L = mm

The reference length is the length of the measured element to which permissible parallelism deviation **t** refers.

If the measured element is a surface, the reference length will be regarded as the length and width of the surface. The program therefore calculates with a square surface having sides of length L.

Calculation principle

tz =ref. length x tan A1 +1/2 * Form deviation of the measured element

tx = ref. length x tan A2 +1/2 * Form deviation of the measured element

Output example

```
                                   Record
1     CYL I         X      443.9220
                    Y     -565.2997
                    D       30.0802
          X/Z       A1     -0.0971                  Reference element
          Y/Z       A2     -0.0371
    8P S/MIN/MAX              .0247     (7)   -.00196    (2)    .0210

2     ROTATE SPACE  A        0.1039   UM RAUM-ACHSE Z

3     SURFACE       Y      -32.0625
          Z/Y       A1       0.0233                     Measured element
          X/Y       A2      -5.3523
    4P S/MIN/MAX              .0006     (4)   -.0003    (3)    .0003

4     GDT PAR       tz       0.0207    0.0500   Test length 50        ++
                    L       50.0000

5     GDT PAR       tx       4.6847    0.0500   Test length 50     4.6347
                    L       50.0000
```

$$tz = 50 * \tan 0.0233 + {}^{1}/_{2} * 0.006 = 0.0207$$
$$tx = 50 * \tan 5.3523 + {}^{1}/_{2} * 0.006 = 4.6847$$

Measuring plane

The surface/axis parallelism can be checked in two measuring planes. Input of one test length per measuring plane is possible. However, it only makes sense to consider the parallelism in the Z/Y coordinate plane.

If **<RO PLANE>** is performed with the measured element before **GDT PAR** ⇒ **tx = 1/2** form deviation.

Case 3: Axis-surface parallelism

Data boxes

Result name

An inquiry appears only if the name allocation is activated (➤***„Setting the operating mode for the measuring probe head <DI 1502>" on page 6-18***). Enter the result name and confirm with **<TERMIN>** (follow rules in ➤***„Allocating names" on page 5-9***).

X/Y measuring plane?

The check for parallelism between axes and surfaces is limited to one plane. Select the correct plane with **<YES>/<NO>**.

Identific. tZ

Possibility for entering an identification with a maximum of 10 characters and specifying the permissible parallelism deviation.

REF. LENGTH L = mm

The reference length is the length of the measured element to which the permissible parallelism deviation **t** refers.

Calculation principle

tz = reference length x tan A1

tx = reference length x tan A2

Output example

```
                                   Record

    1      SURFACE       X     -443.1583
               X/Z       W1       0.0630                         Reference element
               Y/Z       W2      -0.0468
      8P   S/MIN/MAX               .0039        (7)    -.0023     (2)      .0023

    2      ROTATE SPACE  W        0.0785    ABOUT SPACE AXIS Z

    3      CYL I         Z      -32.0625
                         X       65.2997
                         D       30.0802
               Z/Y       W1       0.0037                         Measured element
               X/Y       W2      -5.3843
     10P   S/MIN/MAX               .0012        (5)    -.0011     (7)      .0020

    4      GDT PAR       tz       0.0032     0.0500   Test length 50       +
                         L       50.0000

    5      GDT PAR       tx       4.7125     0.0500   Test length 50     4.6625
                         L       50.0000

  tz = 50 * tan 0.0037 = 0.0032
  tx = 50 * tan 5.3843 = 4.7125
```

Measuring plane

The axis-surface parallelism can be checked in two measuring planes. Input of one test length per measuring plane is possible. However, only measurement of the parallelism in the Z/Y coordinate plane makes sense.

If **<RO PLANE>** is performed with the measured element before **GDT PAR** ⇒ **tx = 0.**

Case 4: Axis-axis parallelism

Data boxes

Result name

An inquiry appears only if the name allocation is activated (➤***„Setting the operating mode for the measuring probe head <DI 1502>" on page 6-18***). Enter the result name and confirm with **<TERMIN>** (follow rules in ➤***„Allocating names" on page 5-9***).

Tol.zone cyl.?

The form of the tolerance zone can be specified with the axis-axis combination:

– **<YES>**
  Cylindrical tolerance zone
– **<NO>**
  Block-shaped tolerance zone

Identific. td
Identific. tZ
Identific. tX

Possibility for entering an identification with a maximum of 10 characters and specifying the permissible parallelism deviation. With a block-shaped tolerance zone, the tolerance is specified in the direction of two coordinate axes. An identification can be entered for each direction.

REF LENGTH L = mm

The reference length is the length of the measured element to which the permissible parallelism deviation refers.

tx = test length x tan W1
ty = test length x tan W2
td = $(tX^2+tY^2)^{1/2}$

The axis-axis parallelism is checked in two measuring planes or a cylindrical tolerance zone!

Output example

```
Record

  1      CYL I          X    -443.1583
                        Y      65.2997
                        D      30.0802
             X/Z        A1      0.0437                        Reference element
             Y/Z        A2     -0.0021
       8P S/MIN/MAX              .0039        (7)   -.0023    (2)     .0023

  2      ROTATE SPACE   A       0.0438    ABOUT SPACE AXIS Z

  3      CYL I          Z     -32.0625
                        X      65.3587
                        D      30.0842
             X/Z        A1      0.0325                        Measured element
             Y/Z        A2     -0.0251
      10P S/MIN/MAX              .0025        (3)   -.0029    (4)     .0029

  4      GDT PAR        tx      0.0283    0.0500   Test length 50     +++
                        ty      0.0219    0.0500                         ++
                        L      50.0000

  5      GDT PAR        td      0.0358    0.0500   Test length 50     +++
                        L      50.0000
```

tx = 50 * tan 0.0325 = 0.0283
ty = 50 * tan 0.0251 = 0.0219

td = $(0.0283^2+0.0219^2)^{1/2}$ = 0.0358

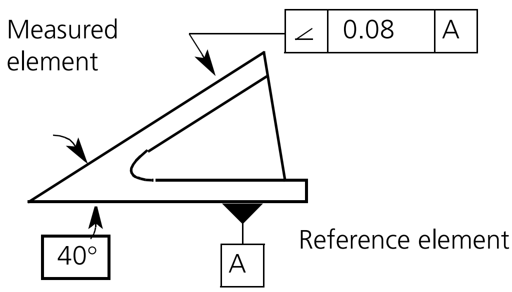
Measuring plane

Input of one test length per measuring plane is possible. One test length is required for the cylindrical tolerance zone.

<RO PLANE> must be executed together with another element to clearly define **tx** or **ty**.

Angularity (slope) <DI 1435>

Symbol

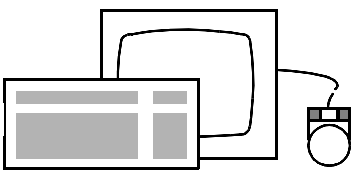


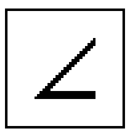
Application

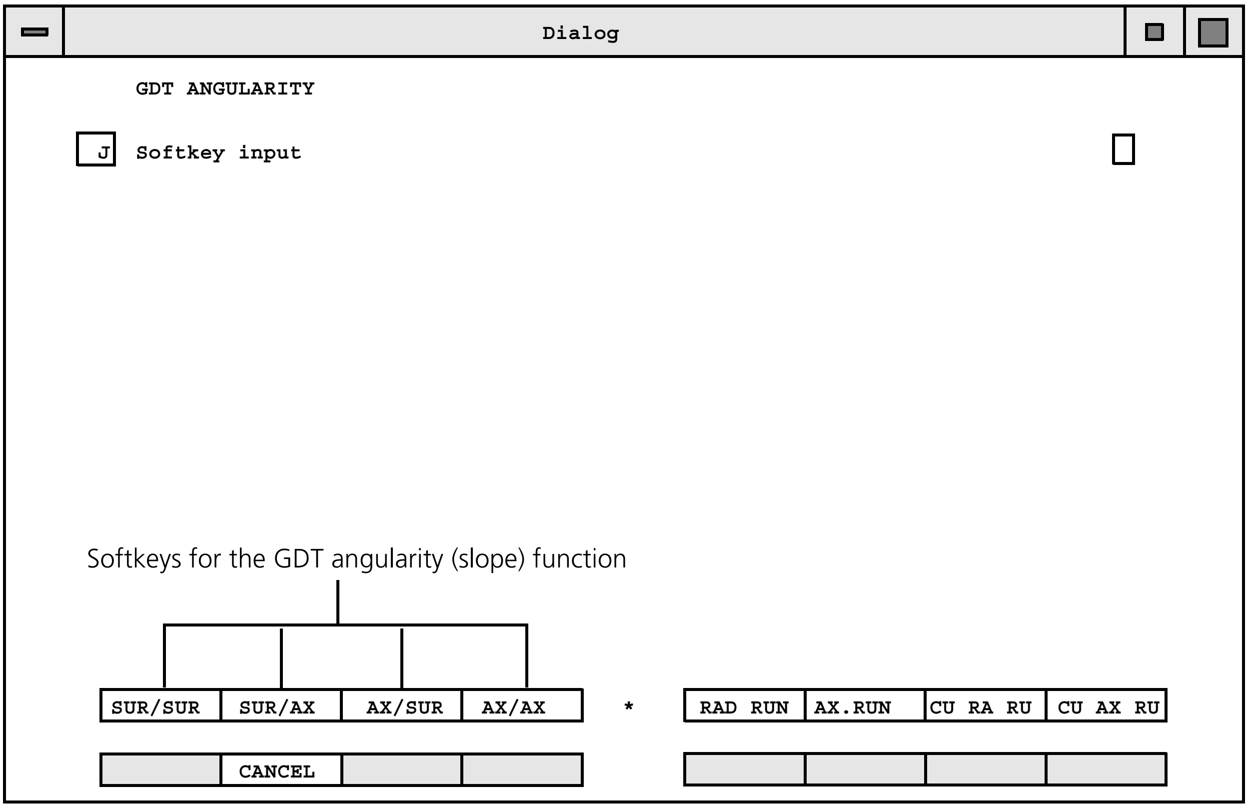
The program checks the slope of axes and surfaces in relation to one another.

NOTE

- The measured element must be the last address in the record (measured or placed via **<RECALL>**).
- The reference element is the spatially aligned element (to which **<RO SPACE>** was last applied).
- The tolerance zone is formed by 2 parallel planes which are located at distance **t** apart and inclined towards the reference element by the nominal angle.
- If the measured element is a surface, half the form deviation will be taken into consideration.



DI	Pull-Down-Menu	Pictogram
1435 GDTANG	Eval Position Angularity...	



SUR/AX The combination of measured element and reference element must be specified by the softkey. (**SUR** = surface, **AX** = axis)

AX/SUR The measured element is before the slash, the spatially aligned reference element after the slash.

Data boxes

Result name An inquiry appears only if the name allocation is activated (➤***„Setting the operating mode for the measuring probe head <DI 1502>“ on page 6-18***). Enter the result name and confirm with **<TERMIN>** (follow rules in ➤***„Allocating names“ on page 5-9***).

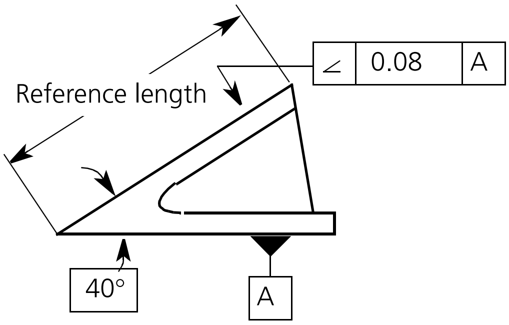
NOM ANGLE = Deg Enter nominal inclination angle. Confirm with **<Enter>**.

Meas plane X/Y? The inclination check is limited to one plane. The plane offered is accepted with **<YES>**, the alternative plane is selected with **<NO>**.

Identific. tX Possibility for entering an identification of max. 10 characters length and specifying the tolerance (distance between two parallel planes). Confirm all inputs with **<Enter>**.

REF LENGTH L = mm

Enter length of measured element to which tolerance refers.



If you press **<Enter>** the input will be terminated and the result will be output.

Calculation principle

tx = reference length x tan ($A1_{act}$ - A_{nom})+ 1/2 x form deviation

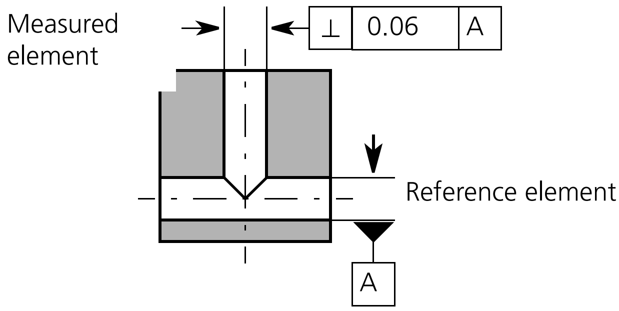
Output example

```
Record
==============================================================================
ADR|REC  | TASK  | IDF  |SY| ACTUAL  | NOMINAL  | U.TOL  | L.TOL  | DEV   | EXC
==============================================================================

   3      SUEFACE       Z     -28.3805
              X/Z       W1    -40.0781
              Y/Z       W2     -0.0948
       4P S/MIN/MAX              .0014        (4)    -.0008    (3)     .0008

   4      GDT ANG       tx      0.0689    0.0500                             0.0189
                        L      50.0000
                        W      20.0000
```

$tx = 50 * \tan(40.0781-40) + {}^{1}/_{2} * 0.0016 = 0.0689$

Perpendicularity with MMC <DI 1425>

Symbol



Application

This program makes it possible to check the perpendicularity of axes and surfaces in any combination.

NOTE

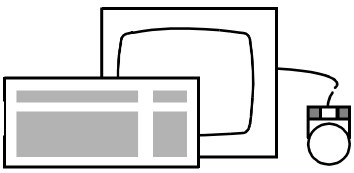
– The measured element must be the last address on the record.

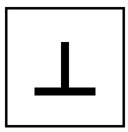
– The reference element must be spatially aligned (**<RO SPACE>**).

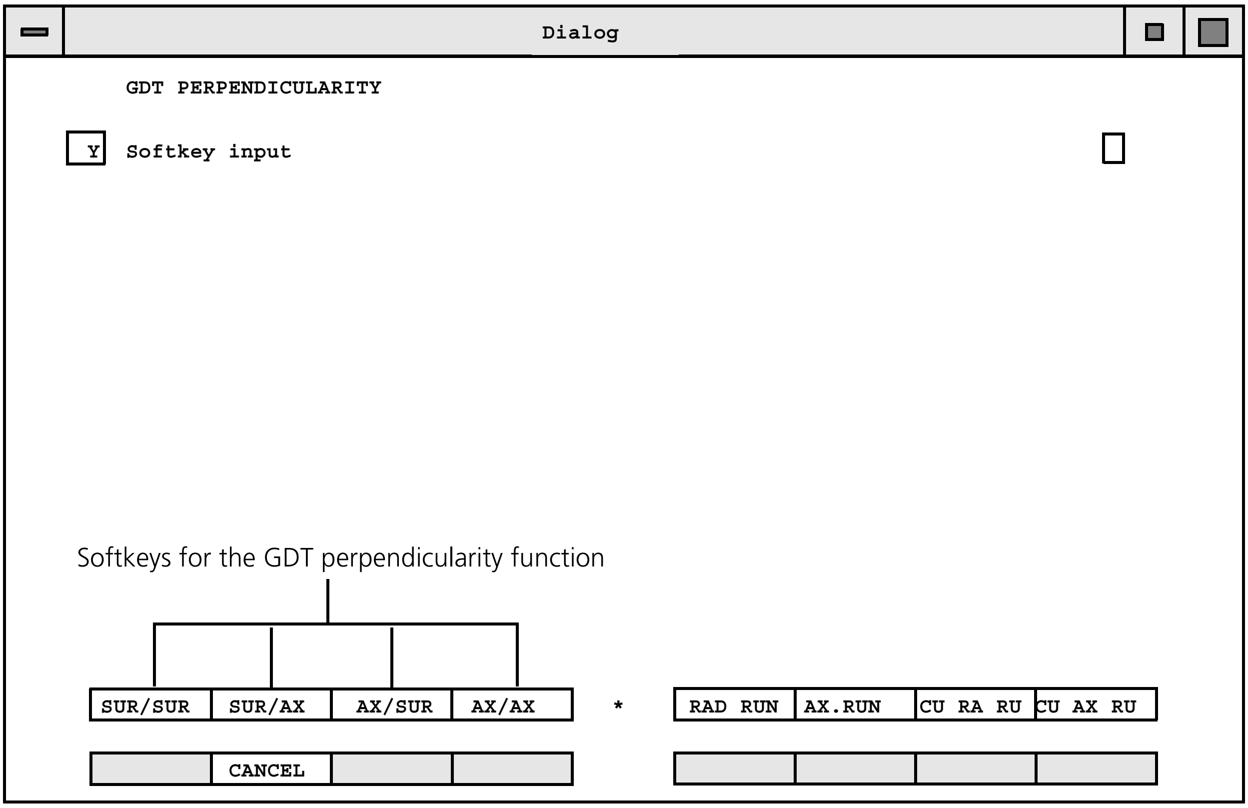
– If the toleranced element (together with the reference element) is not approximately parallel to a plane of the workpiece coordinate system, the measured element must be aligned mathematically. The following sequence results:
  - Determine measured element
  - **<RO PLANE>**
  - **<RECALL>** measured element
  - **<GDT PER>**

– If the measured element is a surface, half the form deviation is included in the calculation of the perpendicularity.

– If necessary, the maximum material condition (MMC) for the measured and reference element can be included in the program (this does ***not*** apply to surfaces!).



DI	Pull-Down-Menu	Pictogram
1425 GDTPERP	Eval Position Perpendicularity...	



SUR/AX

AX/SUR

The combination of measured element and reference element must be specified by softkey (**SUR** = surface, **AX** = axis)

The measured element is before the slash, the spatially aligned reference element after the slash.

Data boxes

Result name

An inquiry appears only if the name allocation is activated (➤***„Setting the operating mode for the measuring probe head <DI 1502>“ on page 6-18***). Enter the result name and confirm with **<TERMIN>** (Follow the rules in ➤***„Allocating names“ on page 5-9***).

GDT REC: d (M)? A (M)

The question mark shows which question is currently activated. The following must be entered:

(M)? A (M)

– **<YES>**
  The maximum material condition is applied to the measured element (offered only if the measured element is an axis).

(M) A? (M) Offered only if the reference element is an axis.

– **<YES>**
  The address of the reference element must be entered in the dialog.
– **<NO>**
  The reference element is the zero point of the workpiece coordinate system.

d (M) A (M)?

– **<YES>**
  The maximum material condition is applied to the reference element. (Permitted only if the reference element is an axis and not the zero point).

GDT REC:
d (M) A (M) o.k.?

The inputs are displayed once again for verification.

Identific. tY

Enter identification (max. 10 characters) and tolerance in succession and confirm each time with **<Enter>**. Only one inquiry appears for the cylindrical tolerance zone (diameter of tolerance cylinder **td**), and two inquiries for the block-shaped tolerance zone (cross section of tolerance cylinder **tx**, **ty** or **tz**).

REF ADDRESS =

An inquiry appears only if the zero point was not selected as the reference. Enter address of reference element and confirm with **<Enter>**. It is ***not*** permissible to enter relative addresses.

NOTE

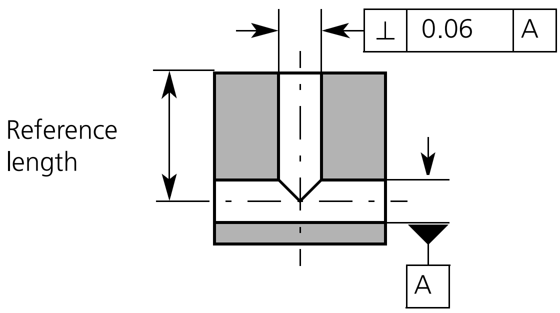
The reference element must be in the current coordinate system!

Idf Nominal
UTOL LTOL

Inquiry appears only if the maximum material condition was specified for the reference element. Enter identification, nominal diameter, upper and lower tolerance of element in succession and confirm with **<Enter>**.

REF LENGTH L = mm

Enter length of measured element to which specified tolerance refers.



If the measured element is a surface, the reference length must be specified in two coordinate directions (**Lx**, **Ly** or **Lz**).

Calculation principle for surface/surface

tx = ref. length1 x tan A1 + 1/2 x form deviation of the measured element

ty = ref. length2 x tan A2 +1/2 x form deviation of the measured element

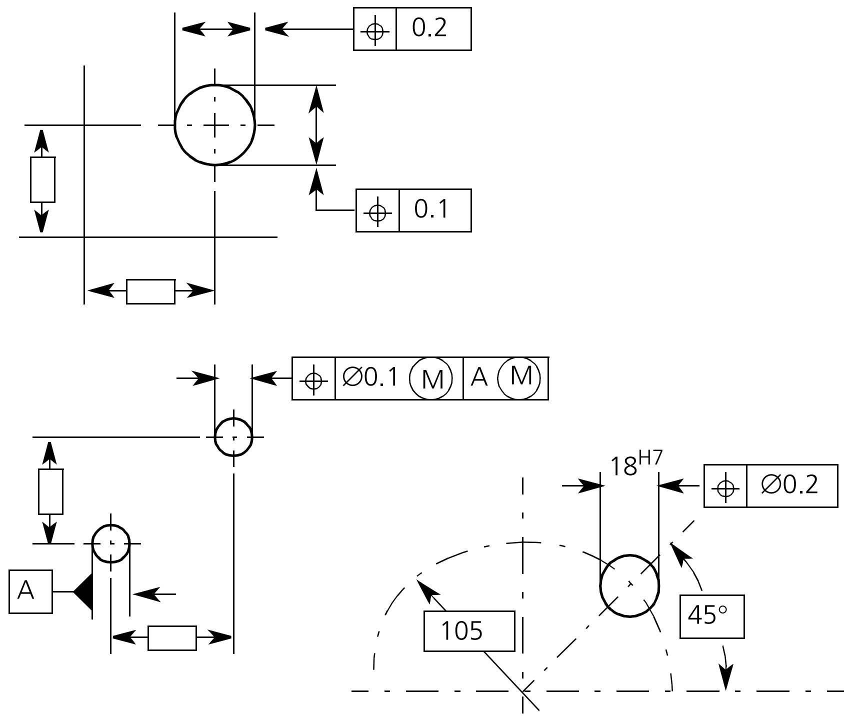
t = ref1. length x tan A1 + ref. length2 x tan A2 + 1/2 form.

Output example for surface/surface

```
                              Record

     1      SURFACE      Z    -443.1780
                X/Z      W1     -0.0021
                Y/Z      W2     -0.0199
         4P S/MIN/MAX              .0055       (1)   -.0032     (2)     .0031

     2      GDT PER      t        0.0050     0.0500                          +
                         L       50.0000

tx = 50 * tan 0.0021 + 1/2 * 0.0064 = 0.0050

     3      GDT PER      t        0.0205     0.0500                         ++
                         L       50.0000

ty = 50 * tan 0.0199 + 1/2 * 0.0064 = 0.0205

     4      GDT PER      t        0.0223     0.0500                         ++
                         L1      50.0000
                         L2      50.0000

t = 50 * tan 0.0021 + 50 * tan 0.0199 + 1/2 * 0.0064
  = 0.0223
```

Position with MMC <DI 1407>

Symbols



Application

This program can be used to check the position of geometric elements.

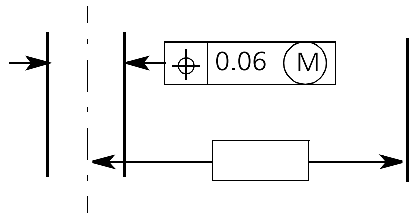
NOTE

- The reference element is either the zero point of the workpiece coordinate system or a previously measured element.
- The maximum material condition for the measured and reference element can be included in the evaluation if required.
- The measured element must be the last element in the measurement record.
- If MMC is to be applied to the reference element, the reference element must have a diameter.

  Exception:

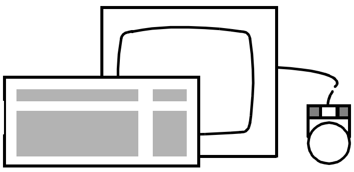
  If **GDT POS** with **MMC** is called following a record printout containing no diameter in its result, the last result printed will be used. This result must contain the **DISTANCE** from two probed points (if the **DISTANCE** is formed from "linkings" or combinations, no inside/outside identification results and the maximum material value can not be calculated).

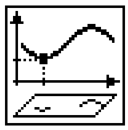
Example



Sequence for example shown:

POINT, **POINT**, **DISTANCE**, **SYMMETRY**, **GDTPOS** with **MMC**.



DI	Pull-Down-Menu	Pictogram
1407 **GDTPOS**	**Eval** **Position** **Position...**	

Data boxes

Result name

An inquiry appears only if the name allocation is activated (➤***„Setting the operating mode for the measuring probe head <DI 1502>" on page 6-18***). Enter the result name and confirm with **<TERMIN>** (follow rules in ➤***„Allocating names" on page 5-9***).

GDT POS: d? (M) A (M)

The question mark shows which question is currently activated. The following must be entered:

d? (M) A (M) Form (shape) of tolerance zone

– **<YES>**
  Cylindrical

– **<NO>**
  Cuboid

d (M)? A (M)

– **<YES>**
  The maximum material condition is applied to the ***measured element***.

d (M) A? (M)

– **<YES>**
  Address of reference element must be entered in dialog.

– **<NO>**
  The reference element is the zero point of the workpiece coordinate system.

d (M) A (M)?

– **<YES>**
  The maximum material condition is applied to the reference element. (allowed only if the reference element is ***not*** the zero point).

GDT POS: d (M) A (M) o.k.?

The inputs are displayed again for verification.

IDF.= / X =
IDF.= / tD =
IDF.= / Y =

Enter identifications for nominal values and for tolerance.

Identification

Maximum of 10 characters (printed out in measurement record).

Nominal position

Depending on how the measured element is output in the record, the nominal position must be specified in cartesian (X, Y or Z) or in polar coordinates (A, R). If the tolerance zone is cylindrical, changeover is possible using the **<POLAR>** / **<CARTES>** softkeys if **d ?** has been answered with **<YES>**.

Tolerance

With a circular or cylindrical tolerance zone, the diameter of the tolerance zone must be specified (one input). With a cuboid tolerance zone, the length of the sides must be specified (two inputs). If a negative value is entered for the tolerance zone, the corresponding coordinate will be omitted in the record.

REF ADDRESS =

An inquiry appears only if the zero point is not defined as a reference. Enter address of reference element and confirm with **<Enter>**.

The input of relative addresses is ***not*** allowed.

NOTE

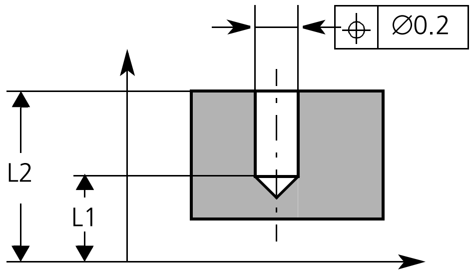
The reference element must be in the current coordinate system!

Idf Nominal
UTOL LTOL

An inquiry appears only if the maximum material condition was specified for the measured element. Enter the identification, nominal diameter, upper and lower tolerance of the element in succession and confirm with **<Enter>**.

REF LENGTH
L1 = mm
REF LENGTH
L2 = mm

An inquiry appears only if the measured element is a cylinder or a cone. In this case, the tolerance zone must be defined spatially. The area within which compliance with tolerance is checked must be defined by entering **L1** and **L2**.



Calculation principle for POSITION with maximum material condition

(See output example for numerical value)

$$\mathbf{tD_{Nom(MMC)} = tD_{Nom} + |Maximum\text{-}Materialcon_{Meas} - Actual\text{-}_{Meas}| + |Maximum\text{-}Materialcon_{Ref.} - Actual_{Ref.}|}$$

$$\mathbf{tD_{Nom(MMC)} = 0.2000 + |14.9000 - 14.9857| + |30.0000 - 30.0126|}$$

$$\mathbf{tD_{Nom(MMC)} = 0.2984}$$

The largest deviation of the axis of the measured element (ADR 19) from the reference element (ADR 18) is roughly Y = 100 mm. To simplify the calculation, it was performed with the reference element **<RO SPACE>** in this example.

$$\mathbf{X(Y=100) = sgn(W2)100 * tanW2 + X(Y=0)}$$

$$\mathbf{= +100 \times tan0.0120 + (-24.9969) = -24.9760}$$

$$\mathbf{Z(Y=100) = sgn(W1)100 * tanW1 + Z(Y=0)}$$

$$\mathbf{= +100 \times tan0.0259 + (-13.0002) = -12.9550}$$

Difference: $\mathbf{\Delta X = X_{Meas}(Y=100) - X_{Ref.}(Y=100)}$

$$\mathbf{= -24.9760 - (-25.0000) = 0.0240}$$

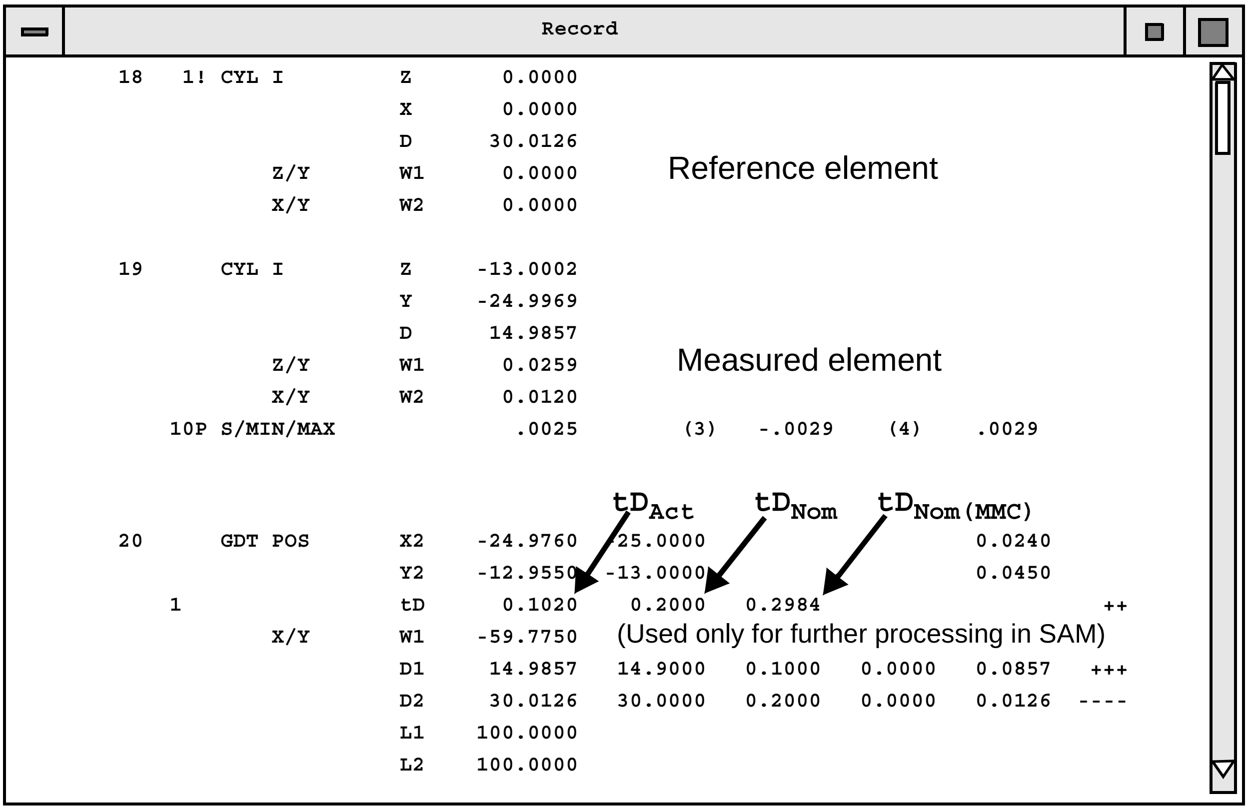
$$\mathbf{\Delta Z = Z_{Meas}(Y=100) - Z_{Ref.}(Y=100)}$$

$$\mathbf{= -12.9550 - (-13.0000) = 0.0450}$$

$$\mathbf{tD = 2 * (\Delta X2 + \Delta Z2)^{1/2}}$$

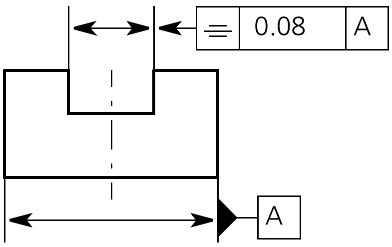
$$\mathbf{= 2 * (0.02402 + 0.04502)^{1/2} = 0.1020}$$

Output example



Symmetry <DI 1410>

Symbol



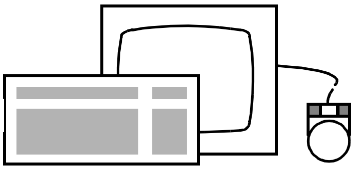
Application

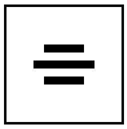
This program checks the position of the measured element with respect to a reference center plane.

The deviation from the reference point is doubled for the calculation of the actual tolerance. This value is then compared with t-nom.

NOTE

- The measured element must be the last address in the record.
- The reference element is either the next to last element in the record or a coordinate plane.



DI	Pull-Down-Menu	Pictogram
1410 GDTPOS	Eval Position Position...	

Data boxes

Result name

An inquiry appears only if the name allocation is activated (➤ ***„Setting the operating mode for the measuring probe head <DI 1502>" on page 6-18***). Enter the result name and confirm with **<TERMIN>** (follow rules in ➤ ***„Allocating names" on page 5-9***).

Ref. = 0?

Answer with **<YES>** or **<NO>**.

- **<YES>**
  The zero point of the workpiece coordinate system is the reference for the calculation.
- **<NO>**
  The evaluation program refers to the next to last element in the record. You therefore must make sure that the reference center plane is stored under this address.

Direction? X

This inquiry appears only if the reference and the measured element contain several coordinates. The coordinate direction offered is accepted with **<YES>**, the alternative direction is selected with **<NO>**.

Idenific. tX

Enter identification (max. 10 characters) and permissible deviation and confirm each time with **<Enter>**.

Calculation principle

tx = 2 x Actual

The deviation of the actual value (symmetry point) from the reference mean plane is calculated and doubled to obtain the actual tolerance.

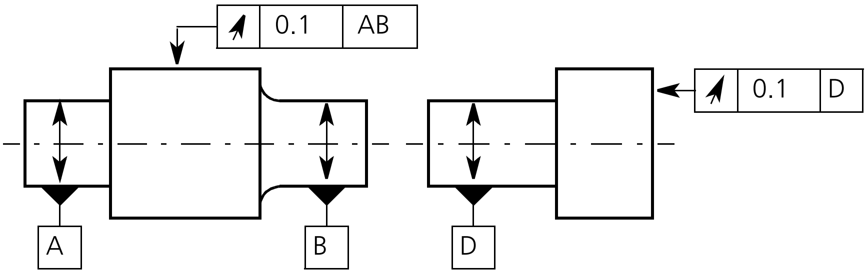
Output example

Record

ADR	REC	TASK	IDF	SY	ACTUAL	NOMINAL	U.TOL	L.TOL	DEV	EXC
21		POINT		X	20.0805					
22		POINT		X	-20.0776					
23		21 SY-P	22	X	0.0015					
24		GDT-SYM		tx	0.0030	0.0500				+

Runout <DI 1445>

Symbol

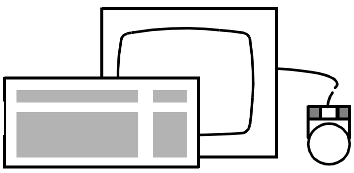


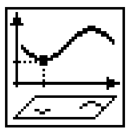
Application

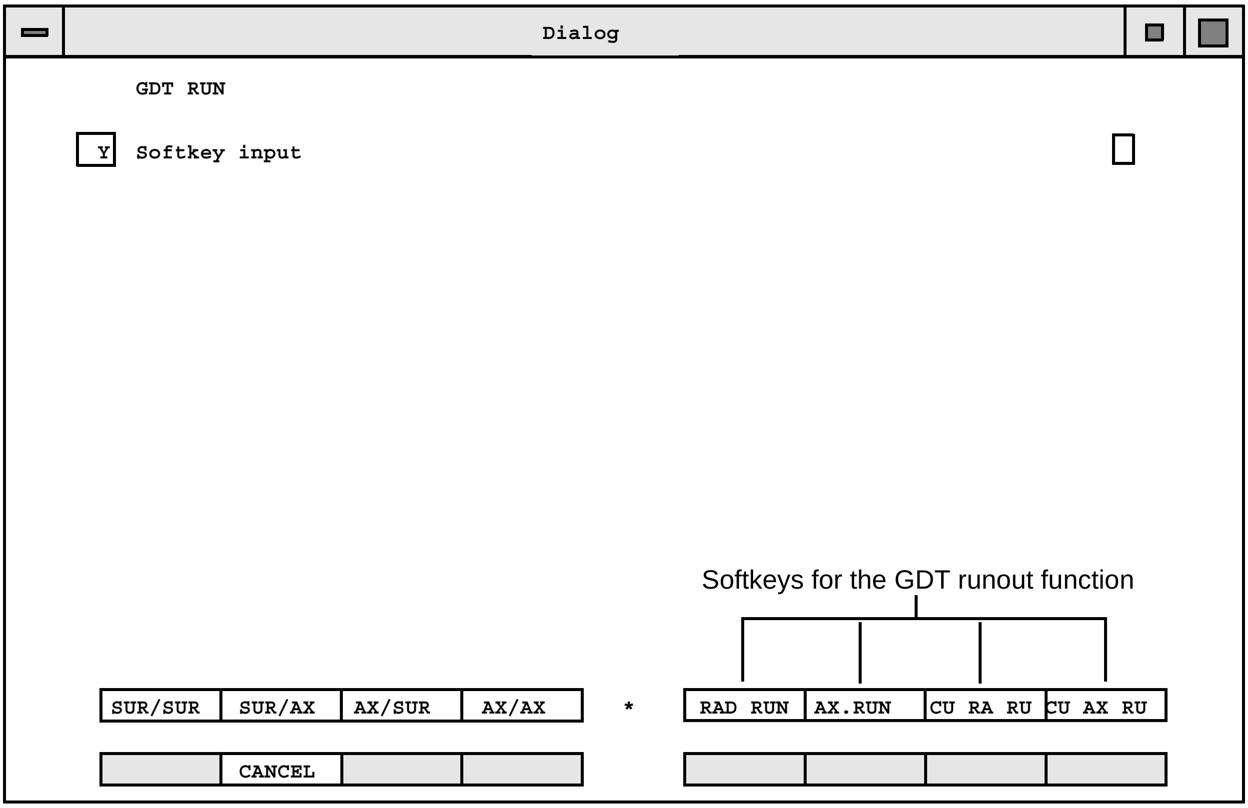
Elements of rotationally symmetrical parts can be checked with the help of runout tolerances. Cylindrical, conical or run-out surfaces are checked for deviations which would occur in the direction of the arrow(s) if the parts in question were rotated about the reference axis.

NOTE

- The measured element must be the last address in the record.
- The reference element depends on the task selected.
- Form errors of the toleranced surfaces may here be included in the runout deviation without being recognized as such.
- The reference element must always be spatially aligned.
- The **CIRCLE** and **SURFACE** programs are recommended for determining normal deviations of the **RADIAL RUNOUT** and **AXIAL RUNOUT** applications. The **MIN-MAX-ROUND** and **MIN-MAX-FLAT** programs must be used for larger form errors. (➤ ***„Superposition of form and position deviations“ on page 14-60***).
- The **CUMULATIVE RADIAL RUNOUT** and **CUMULATIVE AXIAL RUNOUT** routines require measurement of the entire element surface. The **MIN-MAX-ROUND** and **MIN-MAX-FLAT** programs must be used in such cases. (➤ ***„Superposition of form and position deviations“ on page 14-60***).



DI	Pull-Down-Menu	Pictogram
1445 GDTRUN	Eval Position Run...	



The required function can be selected via softkey here. The subsequent dialogs vary according to the function selected:

Data boxes

Result name

An inquiry appears only if the name allocation is activated (➤***„Setting the operating mode for the measuring probe head <DI 1502>“ on page 6-18***). Enter the result name and confirm with **<TERMIN>** (follow rules in ➤***„Allocating names“ on page 5-9***).

Ref. = 0?

An inquiry appears only for **RADIAL RUNOUT**:

– **<YES>**
  An axis of the workpiece coordinate system is the reference axis.

– **<NO>**
  The evaluation program refers to the next to last element in the record. It therefore must be guaranteed that the reference axis is stored under this address.

RADIUS R = mm

An inquiry appears only for **RADIAL RUNOUT**:

Enter radius of plane surface and confirm with **<Enter>**.

Identific. t

Enter the identification (max. 10 characters) and tolerance and confirm with **<TERMIN>** .

Calculation principle for radial runout

$$t = 2 \times (X^2+Y^2)^{1/2}$$

```
                                   Record
==============================================================================
 ADR|REC | TASK | IDF |SY| ACTUAL | NOMINAL | U.TOL | L.TOL | DEV | EXC
==============================================================================
  50     CIRCEL I       X    -0.0021
                        Y    -0.0013
                        D    30.0336
      8P S/MIN/MAX             .0011        (5)   -.0006    (2)    .0006

  51     GDT RARU       t    0.0049     0.0500                              +
```

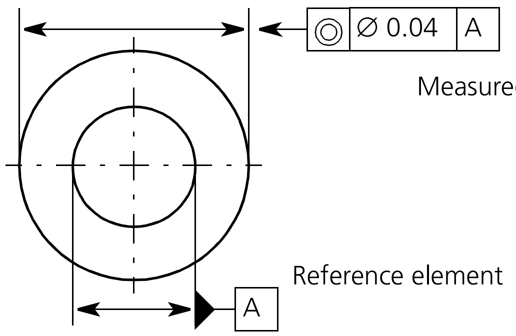
Calculation principle for axial runout

$$t = ((2 \times R \times \tan A1)^2+(2 \times R \times \tan A2)^2)^{1/2} + 1/2 \times \text{form deviation}$$

```
                                   Record
==============================================================================
 ADR|REC | TASK | IDF |SY| ACTUAL | NOMINAL | U.TOL | L.TOL | DEV | EXC
==============================================================================
  33     SURFACE       Z      -0.0007
             X/Z       W1     -0.0063
             Y/Z       W2      0.0175
     45P S/MIN/MAX              .0017        (9)   -.0056    (2)    .0046

  34     GDT AXRU      t       0.0161     0.0500                            ++
                       R      17.0000
```

Concentricity with MMC <DI 1408>

Symbol

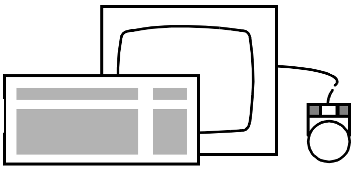


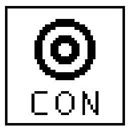
Application

This program determines the displacement of a circle center point in relation to a reference point.

NOTE

- The measured element must be the last address in the record (measured or placed via **<RECALL>**).
- The reference element is either the zero point of the workpiece coordinate system or a previously measured element.
- The tolerance zone is always circular.
- If required, the maximum material condition for the measured and reference elements can be included in the calculation.



DI	Pull-Down-Menu	Pictogram
1408 GDTCON	Eval Position Concentricity...	

Data boxes

Result name

An inquiry appears only if the name allocation is activated (➤***„Setting the operating mode for the measuring probe head <DI 1502>“ on page 6-18***). Enter the result name and confirm with **<TERMIN>** (follow rules in ➤***„Allocating names“ on page 5-9***).

GDT KON: d (M)? A (M)

The question mark shows which inquiry is currently activated. The following must be entered:

d (M)? A (M)

– **<YES>**
  The maximum material condition is applied to the ***measured element***.

d (M) A? (M)

– **<YES>**
  The address of the reference element must be entered in the dialog.

– **<NO>**
  The reference element is the zero point of the workpiece coordinate system.

d (M) A (M)?

– **<YES>**
  The maximum material condition is applied to the ***reference element***. (allowed only if the reference element is ***not*** the zero point).

d No inquiry is made on the shape of the tolerance zone. a circular tolerance zone is always computed.

GDT CON:
d (M) A (M) o.k.?

The inputs are displayed once again for verification.

Identific. td

Enter identification (max. 10 characters) and permissible deviation in succession and confirm each time with **<Enter>**.

REFERENCE ADDRESS =

Enter address of reference element and confirm with **<Enter>**.

The reference element must always be in the current coordinate system!

Idf Nominal
UTOL LTOL

The inquiry appears only if the maximum material condition was specified for one of the elements. Enter identification, nominal diameter, upper and lower tolerance of element and confirm with **<Enter>**.

Calculation principle for CONCENTRICITY with maximum material condition

(See output example for numerical value)

$$\mathbf{tD}_{\mathrm{Nom(MMC)}} = \mathbf{tD}_{\mathrm{Nom}} + \left| \mathbf{Maximum\text{-}Materialcon}_{\mathrm{Meas}} - \mathbf{Actual}_{\mathrm{Meas}} \right| + \left| \mathbf{Maximum\text{-}Materialcon}_{\mathrm{Ref}} - \mathbf{Actual}_{\mathrm{Ref}} \right|$$

$$\mathbf{tD}_{\mathrm{Nom(MMC)}} = \mathbf{0.0400} + \left|\mathbf{14.9000 - 14.9857}\right| + \left|\mathbf{30.0000 - 30.0126}\right|$$

$$\mathbf{tD}_{\mathrm{Nom(MMC)}} = \mathbf{0.1383}$$

Difference: $\Delta X = X_{\mathrm{Meas}} - X_{\mathrm{Ref}} = 42.0140 - 42.0065 = 0.0075$

$\Delta Z = Z_{\mathrm{Meas}} - Z_{\mathrm{Ref}} = -32.8820 - (- 32.8998) = 0.0178$

$$tD = 2 \times (\Delta X^2 + \Delta Z^2)^{1/2}$$

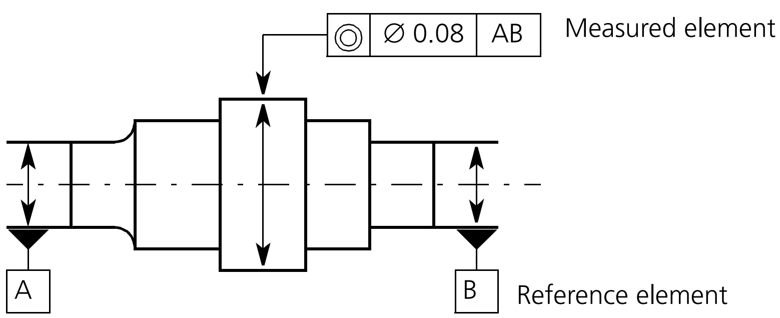
$$= 2 \times (0.0075^2 + 0.0178^2)^{1/2} = 0.0386$$

Output example

```
Record
==============================================================================
 ADR|REC | TASK | IDF |SY| ACTUAL | NOMINAL | U.TOL | L.TOL | DEV | EXC
==============================================================================
  18       CIRCLE I      Z     -32.8998
                         X      42.0065      Reference element
                         D      30.0126
       8P S/MIN/MAX               .0025     (3)    -.0029    (4)     .0029

  19       CIRCLE I      Z     -32.8820
                         X      42.0140      Measured element
                         D      14.9857
      10P S/MIN/MAX               .0032     (5)    -.0016    (4)     .0020

                                       tDAct      tDNom     tDNom(MMC)
  20       GDT CON       X       0.0075    0.0000                     0.0075
                         Z       0.0178    0.0000                     0.0178
      18                 tD      0.0386    0.0400    0.1383                    ++
               X/Y       A1    -59.4567  (Used only for processing in SAM)
                         D1     14.9857   14.9000    0.1000   0.0000  0.0857  +++
                         D2     30.0126   30.0000    0.2000   0.0000  0.0126  ----
```

Coaxiality with MMC <DI 1409>

Symbol

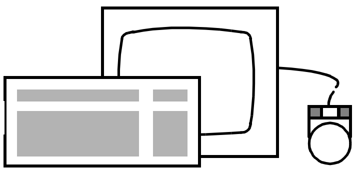


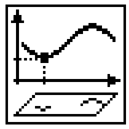
Application

This program determines the displacement of an axis (e.g. cylinder or cone axis) compared with a reference axis.

NOTE

- The measured element must be the last address in the record (measured or placed via **<RECALL>**).
- The reference element is either an axis of the workpiece coordinate system or a previously determined element.
- The tolerance zone is always cylindrical.
- If required the maximum material conditions for the measured and the reference element may be included in the calculation.



DI	Pull-Down-Menu	Pictogram
1409 GDTCOA	Eval Position Coaxiality...	

Data boxes

Result name

An inquiry appears only if the name allocation is activated (➤***„Setting the operating mode for the measuring probe head <DI 1502>“ on page 6-18***). Enter the result name and confirm with **<TERMIN>** (follow rules in ➤***„Allocating names“ on page 5-9***).

GDT KOA: d (M)? A (M)

The question mark shows which question is currently activated. The following entries must be made:

d (M)? A (M)

- **<YES>**
  The maximum material condition is applied to the measured element.

d (M) A? (M)

- **<YES>**
  Address of reference element must be entered in dialog.
- **<NO>**
  Reference element is zero point of workpiece coordinate system.

d (M) A (M)?

- **<YES>**
  The maximum material condition is applied to the ***reference element***. (allowed only if the reference element is ***not*** the zero point.

d No inquiry (concerning form of tolerance zone). The calculation is always performed with a cylindrical tolerance zone.

GDT KOA: d (M) A (M) o.k.?
The inputs are redisplayed for verification.

Identific. td
Enter identification (max. 10 characters) and permissible deviation in succession and confirm with **<Enter>**.

REF ADDRESS =
The inquiry appears only if the zero point was not defined as a reference. Enter the address of the reference element and confirm with **<Enter>**. The input of relative addresses is ***not*** allowed.

The reference element must be in the current coordinate system!

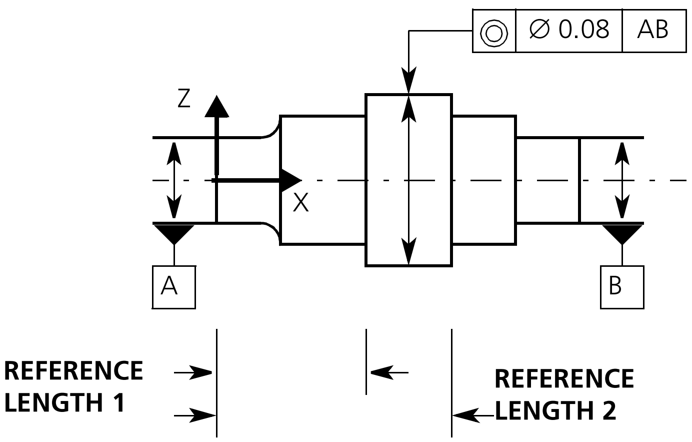
Idf Nominal OTOL UTOL
An inquiry appears only if the maximum material condition was specified. Enter the identification, nominal diameter, upper and lower tolerance of the element in succession and confirm with **<Enter>**.

REF LENGTH L1 = mm

REF LENGTH L2 = mm
Enter area to which tolerance entered refers.

L1 Start of test area,

L2 End of test area in reference to workpiece coordinate system.



Calculation principle

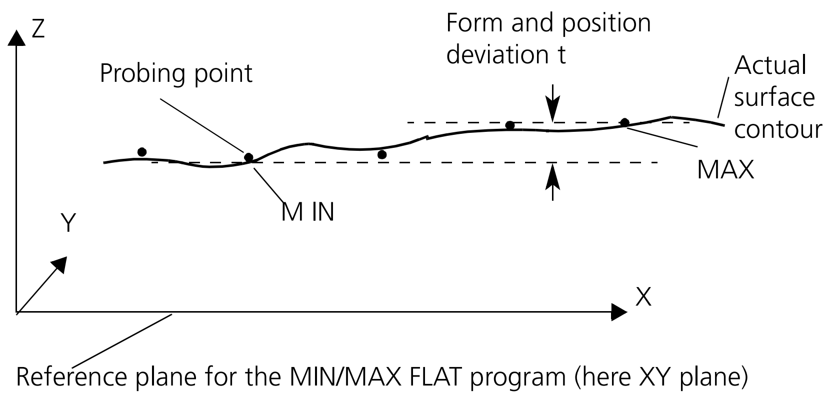
See example for GDT-POS (➤***„Position with MMC <DI 1407>“ on page 14-45***)

Superposition of form and position deviations

Min-max flatness <DI 1110/1111/1140>

Application

These programs calculate the superposition of the form and position deviation of a surface. The distance between two planes which are parallel to the workpiece coordinate system and enclose all measuring points between them is determined.



Difference

There are three programs which differ in result output:

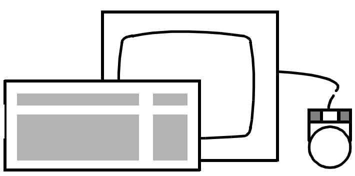
– Min flatness

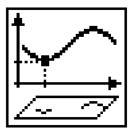
– Max flatness

– Min-max flatness

Min flatness

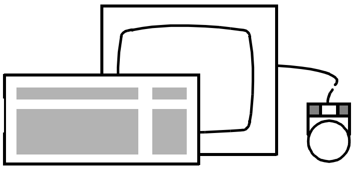
The coordinates of the lowest probing point (referenced to a plane of the workpiece coordinate system) and the distance between the highest and lowest probing point are output.

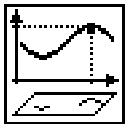


DI	Pull-Down-Menu	Pictogram
1110 MINPLA		

Max flatness

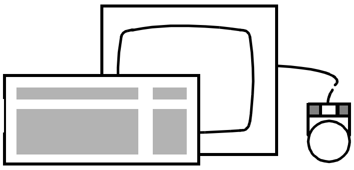
The coordinates of the highest probing point (referenced to a plane of the workpiece coordinate system) and the distance between the highest and lowest probing point are output.

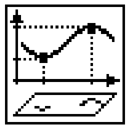


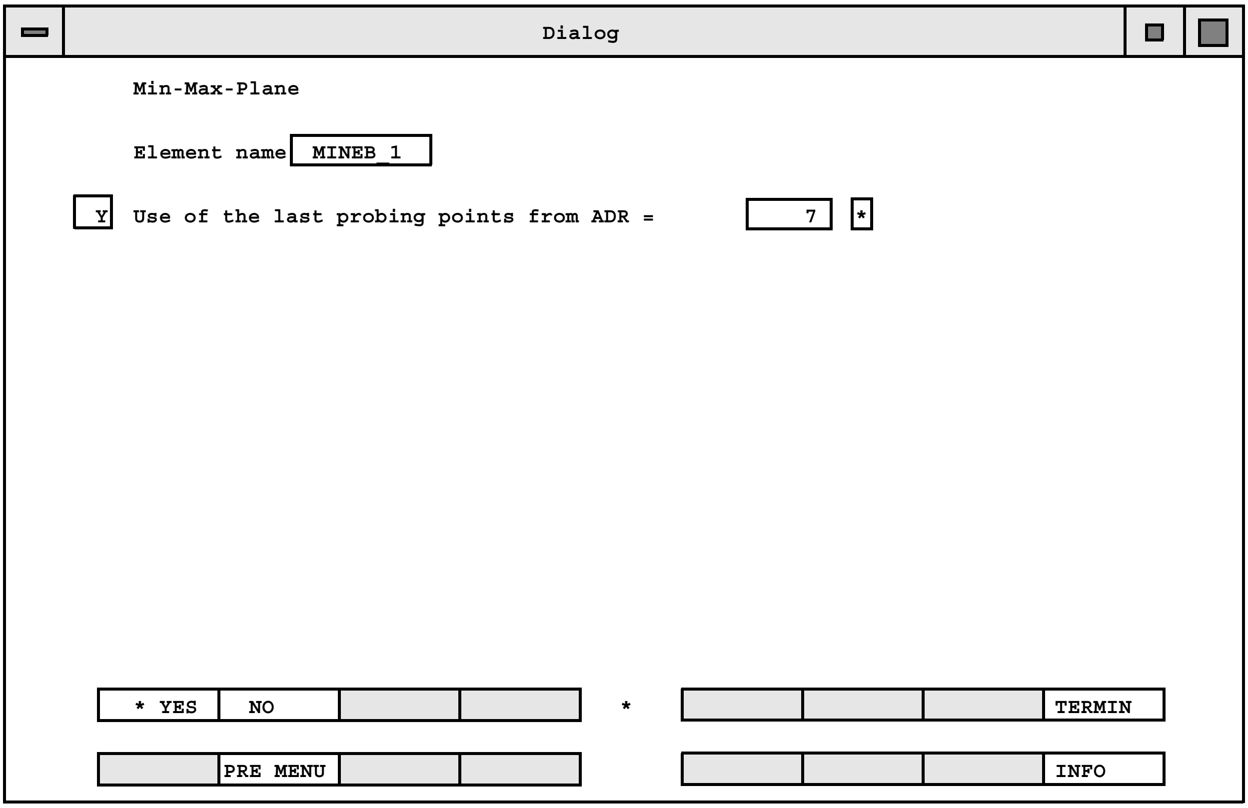
DI	Pull-Down-Menu	Pictogram
1111 MAXPLA		

Min-max flatness

The coordinates of the highest and the lowest probing point (referenced to a plane of the workpiece coordinate system) and the distance between the highest and lowest probing point are output



DI	Pull-Down-Menu	Pictogram
1140 EXTPLA a175	Elements Special elements Min/Max Flat...	



Data boxes

Element name

Enter the name to be assigned to the result here (follow rules in ➤*„Allocating names" on page 5-9*). Accept the name offered with **<Enter>** or type in another name and confirm it with **<Enter>**.

Use of the latest probing points from ADR = 7

– <YES>
  The computer checks whether the probing points of a surface, of a line or from min-max flatness are stored under the specified address. If they are, these probing points can be used to calculate the min-max flatness.

– <NO>
  The computer opens an element window and prompts you to probe the surface.

The last element in the measurement record is always offered as the **ADR**. It can not be changed.

NOTE

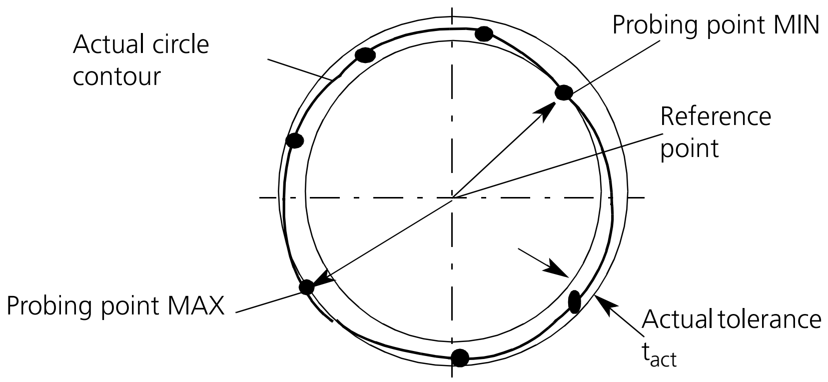
– The result can subsequently be used to check the **GDT PARALLELISM**, **GDT PERPENDICULARITY** or **GDT RUNOUT**.

– Nominal input (➤*„Nominal input <DI 1459> (old 1452)" on page 14-8*): Enter permissible deviation under A1 in the **NOMINAL** column, set **UTOL** and **LTOL** to zero.

Min-max roundness <DI 1112/1113/1141>

Application

These programs calculate the superposition of the form and position deviation for a circle measurement. The distance between two concentric circles (t_{act}) which enclose all probing points is determined. The center point of these circles is the reference point.



NOTE

Nominal input (➤*„Nominal input <DI 1459> (old 1452)“ on page 14-8*): Enter permissible deviation under **A1** in the **NOMINAL** column; set **UTOL** and **LTOL** to zero.

Difference

There are three programs which differ in the result output:

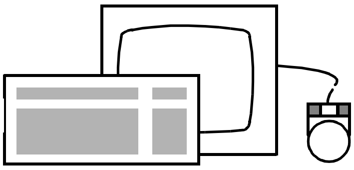
– Min roundness

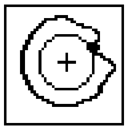
– Max roundness

– Min-max roundness

Min roundness

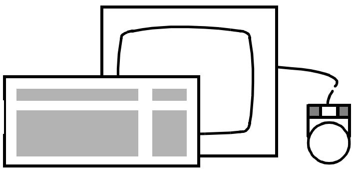
The coordinates of the probing point with the smallest radius and the distance between the concentric circles (t) are output.

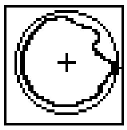


DI	Pull-Down-Menu	Pictogram
1112 MINROUN		

Max roundness

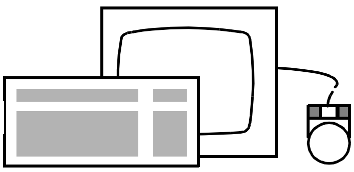
The coordinates of the probing point with the largest radius and the distance between the concentric circles are output.

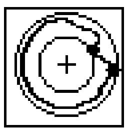


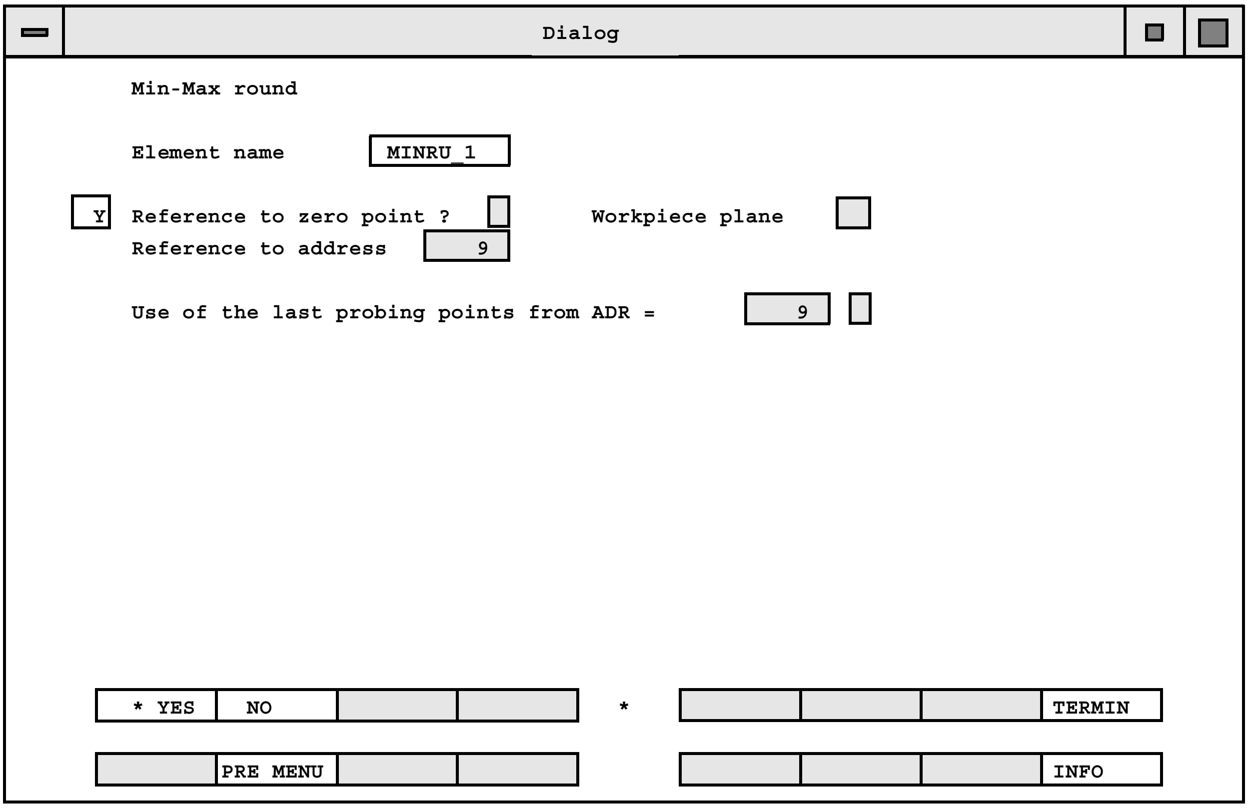
DI	Pull-Down-Menu	Pictogram
1113 MAXROUN		

Min-max roundness

The coordinates of the probing points with the smallest and the largest radius and the distance between the concentric circles are output under two addresses.



DI	Pull-Down-Menu	Pictogram
1141 EXTROUN a177	Elements Special elements Min/Max Round...	



Data boxes

Element name

Here you must specify the name which is to be assigned to the result (follow rules in ➤***„Allocating names“ on page 5-9***). Accept the name offered with **<Enter>** or type in another name and confirm with **<Enter>**.

Reference to zero point?

– **<YES>**
  The reference point for the calculation is the zero point of the workpiece coordinate system. It therefore must be ensured that the zero point is in the center of the circle to be checked.

– **<NO>**
  The reference point for the calculation is a previously determined element.

Workpiece plane

Input to this box will be prompted only if the zero point is the reference point. The workpiece plane in which the circle to be checked is located must be entered here.

Reference to address

Input to this box will be prompted only if you answer the question **Reference to zero point ?** with <NO>. The address of the element to be used as the reference element must be entered here.

Use of the last probing points from ADR = 9

– **<YES>**
  The computer checks whether the probing points of a circle or from min-max roundness are stored under the address specified. If this is the case, these probing points are used for the calculation of the min-max roundness.

– **<NO>**
  The computer opens an element window and prompts you to probe a circle.

The last element in the measuring record is always offered as **ADR**. It can not be changed.

Deleting outliers <DI 1181>

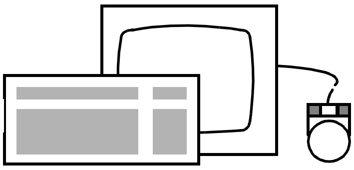
Application

Individual measuring points of the N point elements surface, line, circle and cylinder can be deleted as outliers if their distance to the best fit element exceeds a fixed threshold value.

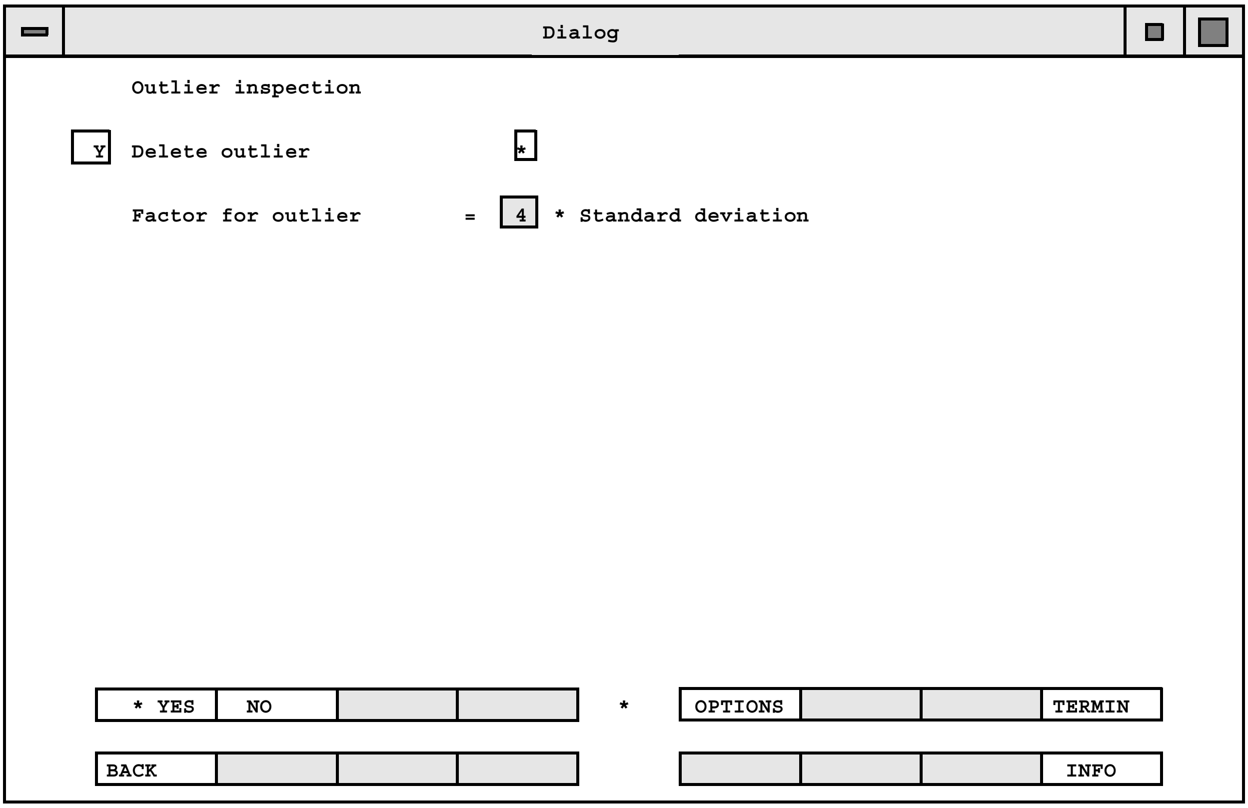
The threshold value is formed from:

Factor x standard deviation

Factor = integer from 0 - 20



DI	Pull-Down-Menu	Pictogram
1181 OUTLIER	**Elements Data acquisition**	
	Outlier elimination...	



Data boxes

Delete outlier?

<YES>/<NO> to activate/reject function.

Factor for outlier = ... * Standard deviation

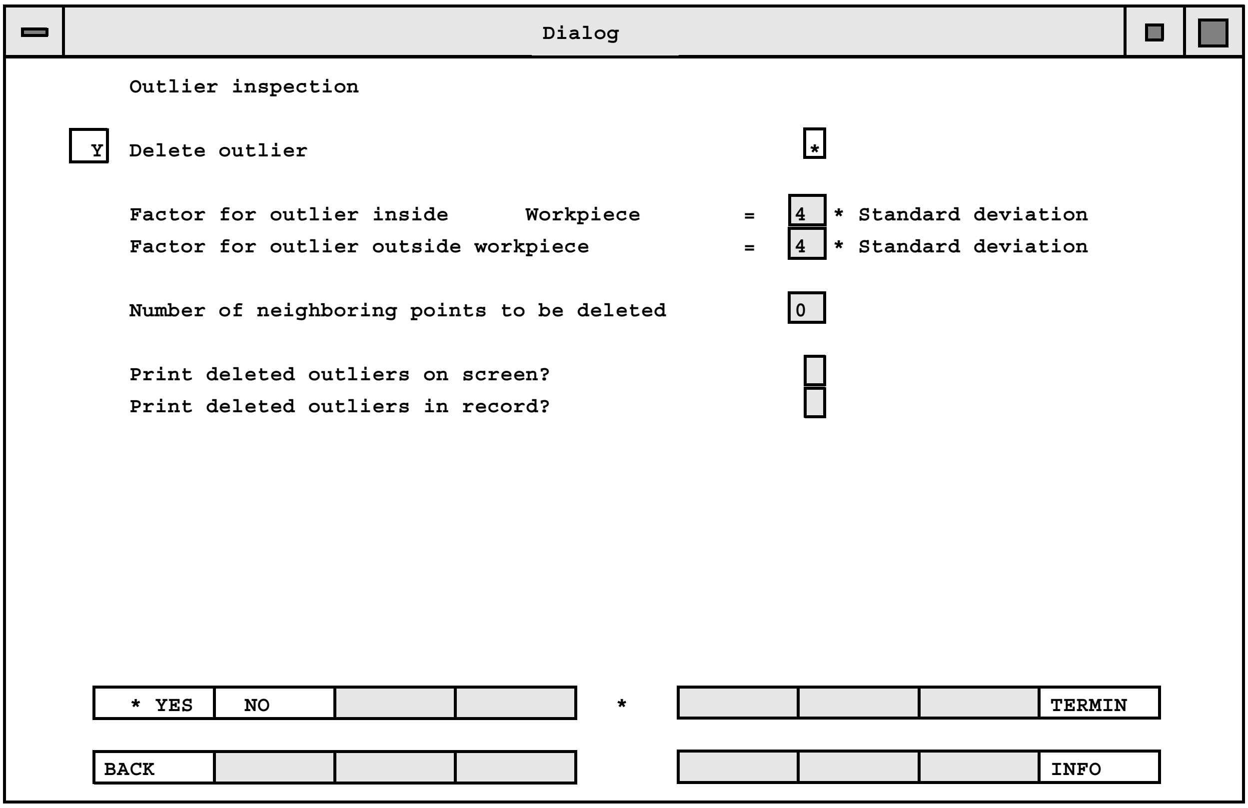
Input of an integer from 0 to 20 (empirical value).

Softkey

OPTIONS

Branching to the 2nd dialog window

2nd dialog window



Data boxes

Delete outlier?

<YES> activates the function.

Factor for outlier inside/outside workpiece = .. * Standard deviation

Input of an integer from 0 - 20 (empirical value). You can differentiate between outliers which show a depression (**within the workpiece**) and those which show an elevation (**outside of the workpiece**).

Number of neighboring points to be deleted

Input of the number of points (0 - 20) to be deleted before and after the outlier.

Print deleted outliers on screen/in record?

<YES> Outliers are output on the screen or printer.

NOTE

The function is reset by calling **<DI 1608>** (initial status), by calling **<DI 1610>** (recorder header) or by restarting the measuring system.

Filtering points <DI 1185>

Application

The filters described below isolate the waviness profile from the influences of roughness.

The filter type must be selected depending on the type of form tester to be simulated to ensure that the results of the measurements are comparable.

Type of filter	Mode of operation for form tester	Transfer at limiting wavelength
ISO TC57	digital	50%
2RC (ISO 4291)	analog	75%

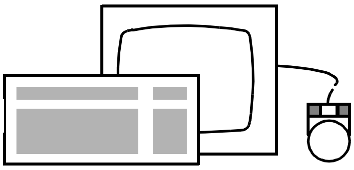
Definition

A mean line results from the profile filtration, which takes the waviness and other profile sections of longer wavelength into account. The surface roughness is suppressed in the process. The mean line results by evaluating the profile points within the same sections (= double wavelength): A weighted assessment is made of the points lying within each section. The best fit profile thus acquired forms the basis for calculating the waviness parameters.

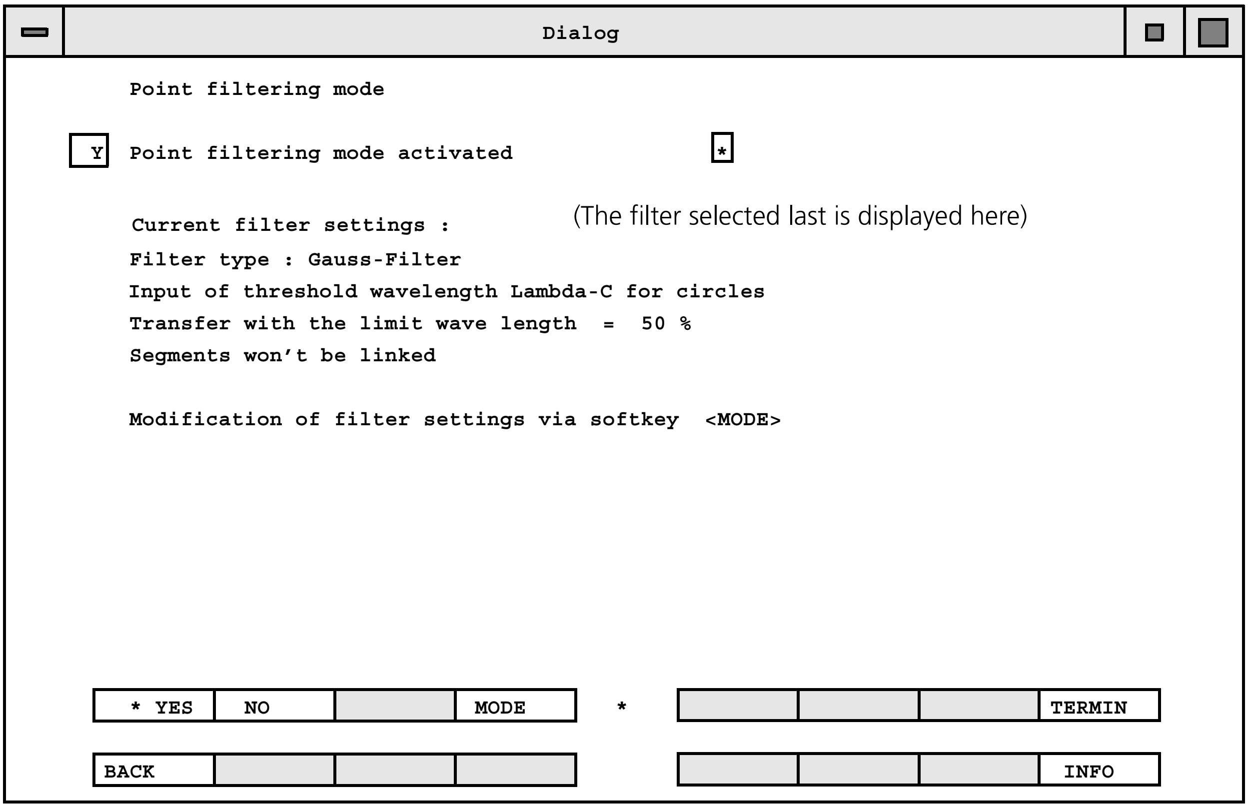
Profile filters are characterized by their limiting wavelength. This parameter specifies the wavelength at which the amplitude of a sinus curve still amounts to 50 or 75% after filtration.

Application

The filters can be used for the following scanned elements: Circle, circle section(s), line, surface, cylinder, sphere.



DI	Pull-Down-Menu	Pictogram
1185 FILTER	Elements Data acquisition Filter...	



Data box

Point filtering mode activated

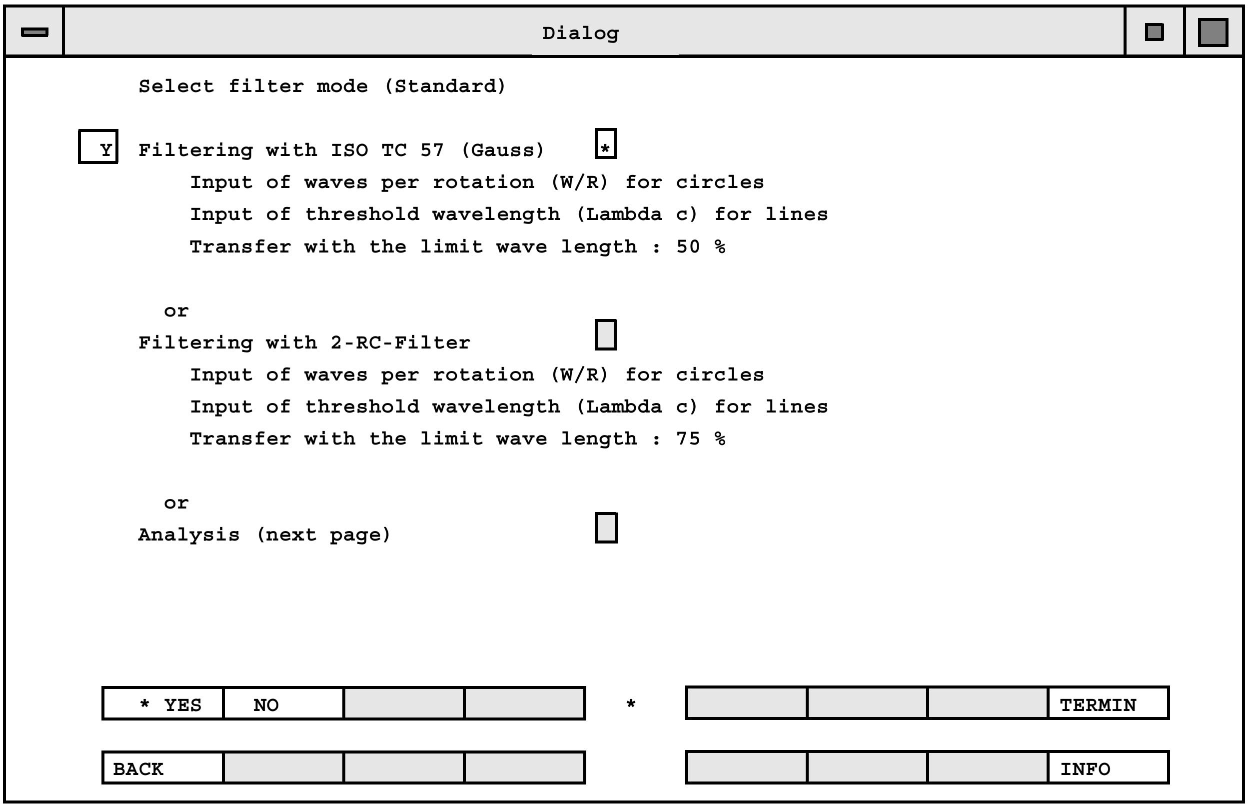
<YES>
Filter is activated.

<NO>
Filter is deactivated.

Softkey

MODE

Branching to the dialog window **Select filter mode**

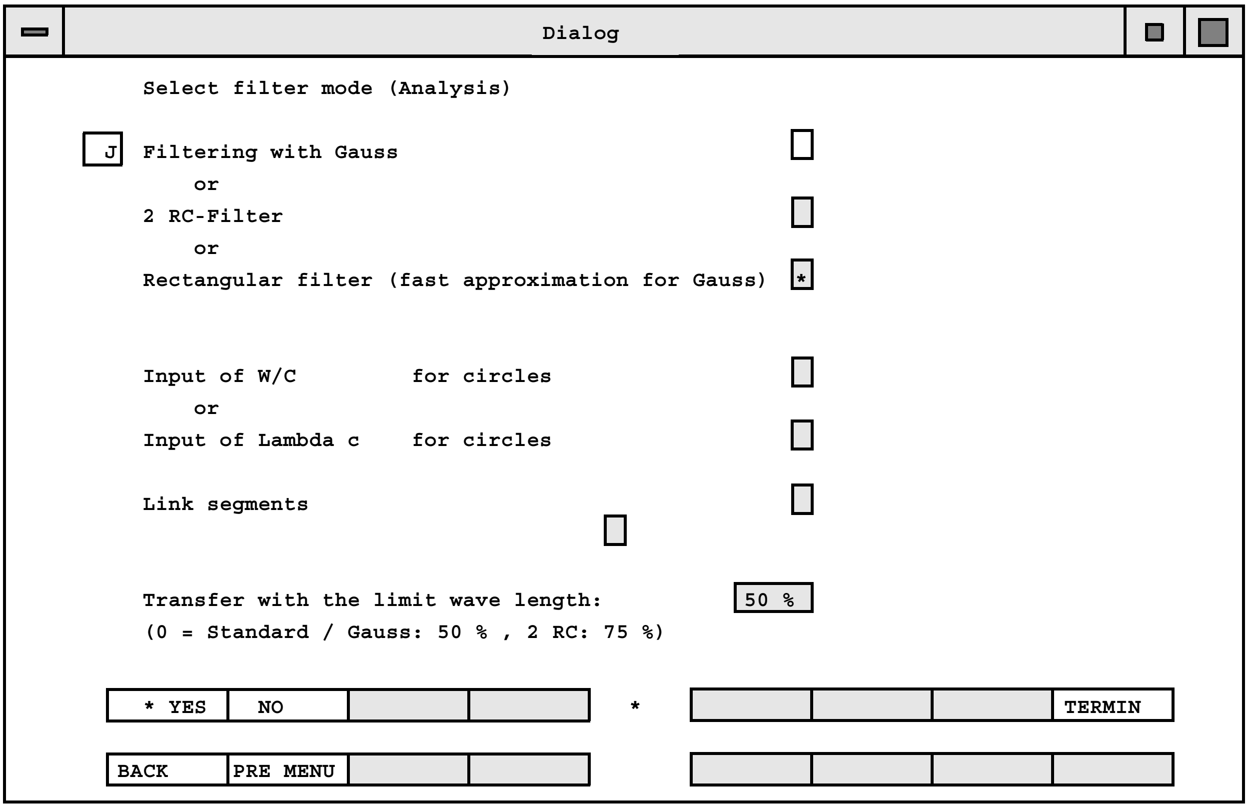


Data boxes

Filtering with ISO TC 57 (Gauss)
Filtering with 2-RC-Filter

Selection of a filter type.

Analysis (see next page) Select of filters which deviate from both standards.



Data boxes

Rectangular filter (fast approximation for Gauss)
Circle smoothing by forming mean value over neighboring probing points.

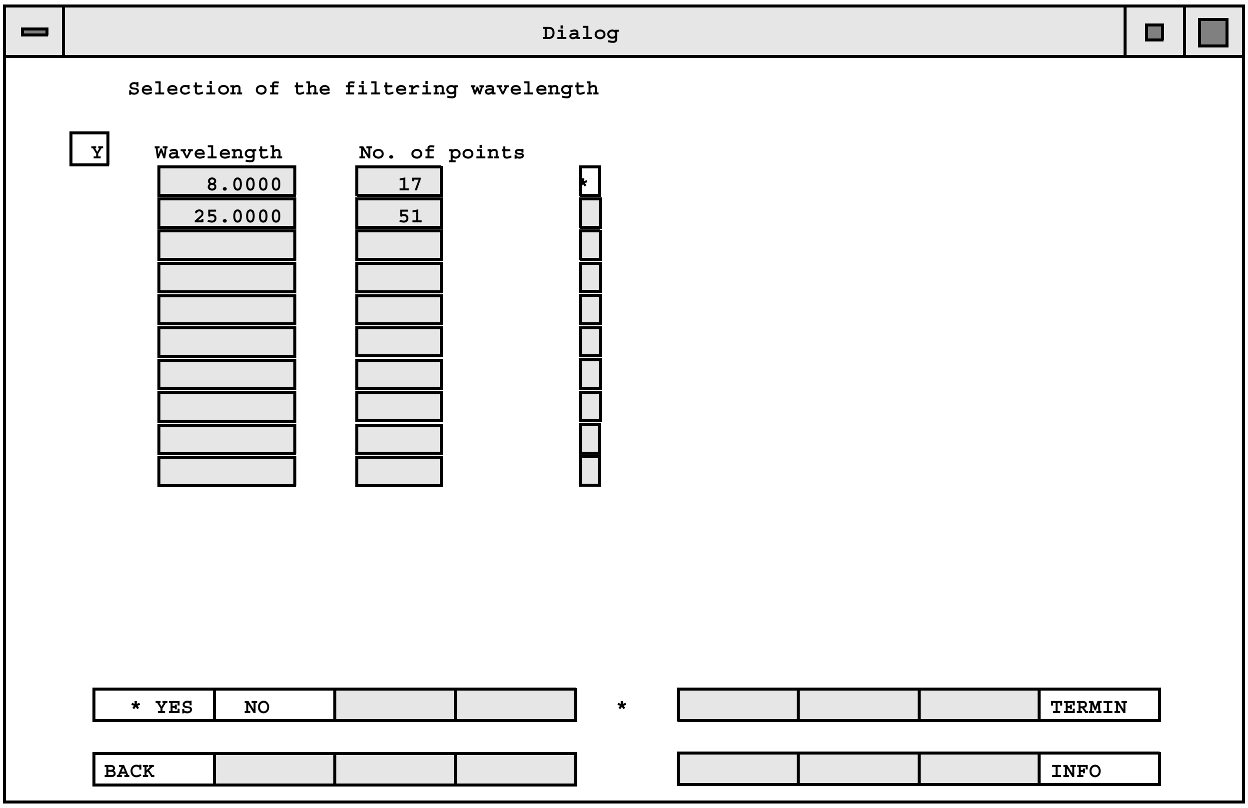
Input of W/C for circles or Input of Lambda c for circles
Selection whether old control data should be enabled for operation with the current program.

Link segments
To take as many points as possible into account, broken contours can be combined to form a continuous contour during filtering. a long wavelength can then be selected.

Transfer with the limit wave length
Any value between 0% (standard) and 99% can be selected.

Procedure

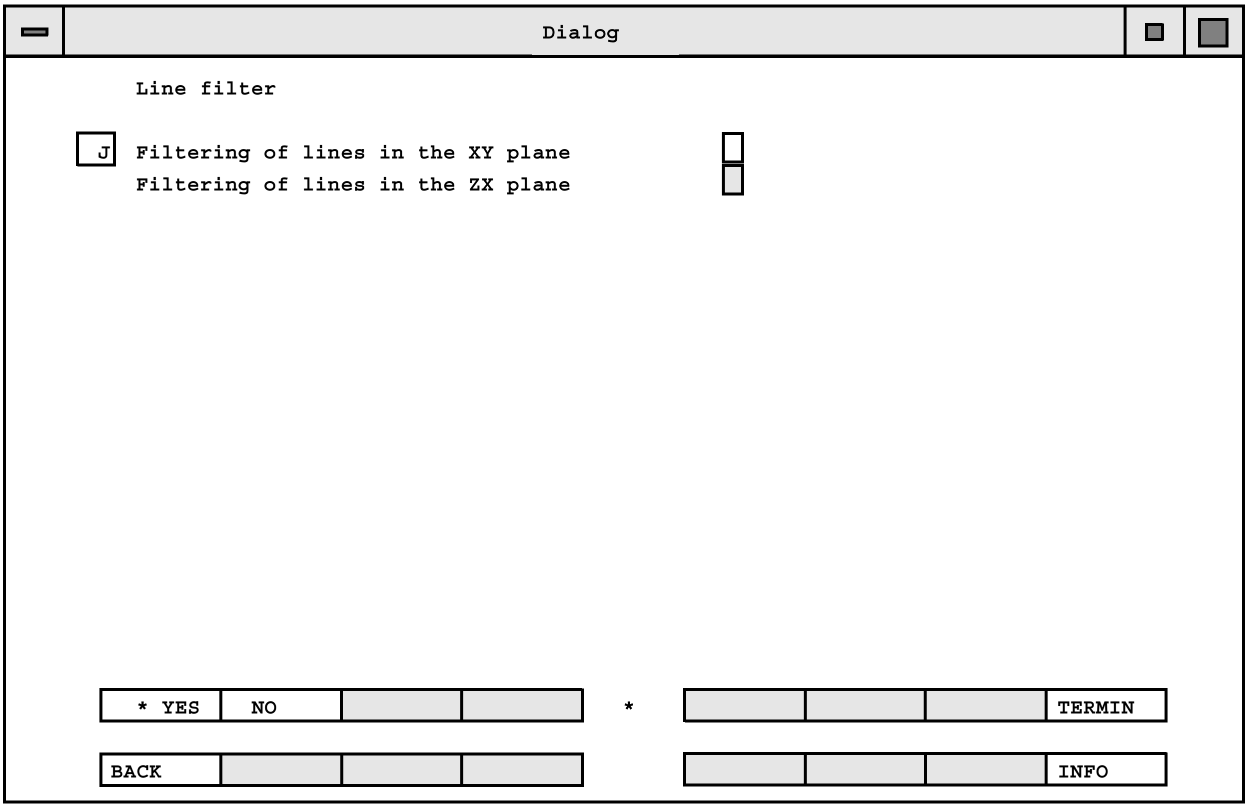
If a filter is activated, another dialog window for defining the filter will be displayed after you terminate an element:



Depending on the setting in the filter mode, input either of the **Wavelength** or of the **No. of points** will be requested.

Special feature

When scanning lines, the filter plane is offered for selection in an additional dialog window. One or two planes can be selected.



NOTE

The filter mode is deactivated by:

- -Calling **<DI 1185>**, **<NO>** again
- -Calling **<DI 1608>** - initial status
- -Calling **<DI 1610>** - record head
- -Restarting the measuring system

With λ_c you can choose between the values 0.8 and 2.5 as well as their decimal powers.

The smallest wavelength is selected so that values ≥ 3 points can be detected; the largest wavelength corresponds to ≤ half of the scanned path.

A comparison of measured results requires evaluations to be performed at the same limiting wavelength.

Chapter 15

Rotary table operation

This chapter contains:

Procedure for measuring with a computer controlled rotary table

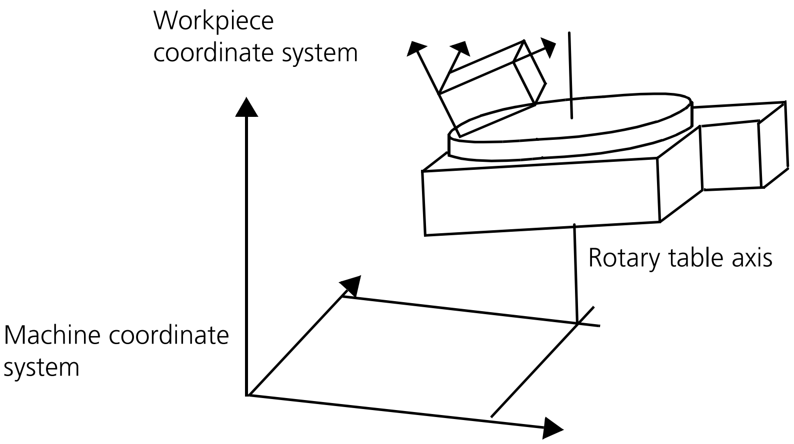
- Prepare rotary table ➤*„Preparations" on page 15-3*
- Position rotary table ➤*„Positioning commands" on page 15-4*
- Define rotary table axis ➤*„Defining the rotary table axis" on page 15-12* to ➤*„Displaying the rotary table axis" on page 15-16*
- Measurement:
  - Define workpiece and control coordinate system ➤*„Procedure" on page 15-11*
  - If necessary, uncouple workpiece/control coordinate system from rotary table ➤*„Coupled rotation/uncoupling of workpiece/control coordinate system <DI 1566> (<DI 1567>)" on page 15-19*
  - Position rotary table ➤*„Positioning commands" on page 15-4*
  - Measure ➤*„Procedure" on page 15-11*
- To end rotary table operation: Deactivate rotary table, initialize rotation axis ➤*„Procedure" on page 15-11*

Preparations

Prepare rotary table as per the relevant operating instructions:

– The clamping surface of the rotary table must point roughly in the direction of a machine axis.

– No mechanical alignment is required. The eccentricity error and wobble error are compensated mathematically.



Exception: E.g. clamping between centers with an alignment deviation between the rotary table and the workpiece axis of ≤ 0.1 mm requires mechanical prealignment, cf. relevant rotary table operating instructions.

– CNC run with rotary table: Make sure that the angular position (slope) of the workpiece is approximately the same as during learn (part) programming.

– Travel to rotary table reference point (absolute zero point) (this step is not mandatory): ➤***„Traveling to the rotary table reference point <DI 1570>“ on page 15-10***

Positioning commands

Positioning with the computer or joystick

Options

You can position (rotate) your rotary table

- with the left-hand joystick or
- via computer command.

Difference

During learn or part programming the control data accepts only rotary table positions which you have set via computer. Therefore in the learn program you must confirm each position which has been traveled to via joystick control via computer command **<DI 1521>**.

The following computer commands are available:

- Rotate to a defined angular position with display of the current position ➤ ***„Rotating the rotary table to an angular position <DI 1521>“ on page 15-4***
- Rotate by a defined angular step with display of the current position ➤ ***„Rotating the rotary table by an angular step <DI 1522>“ on page 15-7***
- Rotate by an angular pitch with display of the current position ➤ ***„Rotating the rotary table by a scale division <DI 1523>“ on page 15-8***
- Align to machine coordinates ➤ ***„Aligning the rotary table parallel to the machine coordinates <DI 1524>“ on page 15-9***
- Travel to reference point ➤ ***„Traveling to the rotary table reference point <DI 1570>“ on page 15-10***
- Set current position to 0° ➤ ***„Setting the rotary table position to zero <DI 1520>“ on page 15-10***

Joystick

The joystick can be protected against accidental actuation. Prerequisite: The left joystick is equipped with a pushbutton (like the one on the right joystick for programming intermediate positions).

- Press the left push button once after power-up.
- You must then press the left push button simultaneously in order to move the rotary table with the joystick.

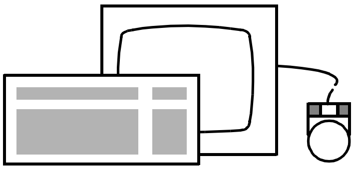
Rotating the rotary table to an angular position <DI 1521>

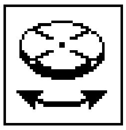
Application

You can use this function to read off the current position of the rotary table and/or travel to another angular position.

Please note

- Do not rotate the rotary table while defining the workpiece coordinate system.
- Learn programming with rotary table: You must program each position traveled to via joystick with this function.
- You can also use the function within a geometric element (cf. function call) under the following conditions:
  - The element is not used to define the workpiece coordinate system.
  - You have switched on **Rotate workpiece system too** (➤***„Coupled rotation/uncoupling of workpiece/control coordinate system <DI 1566> (<DI 1567>)“ on page 15-19***)



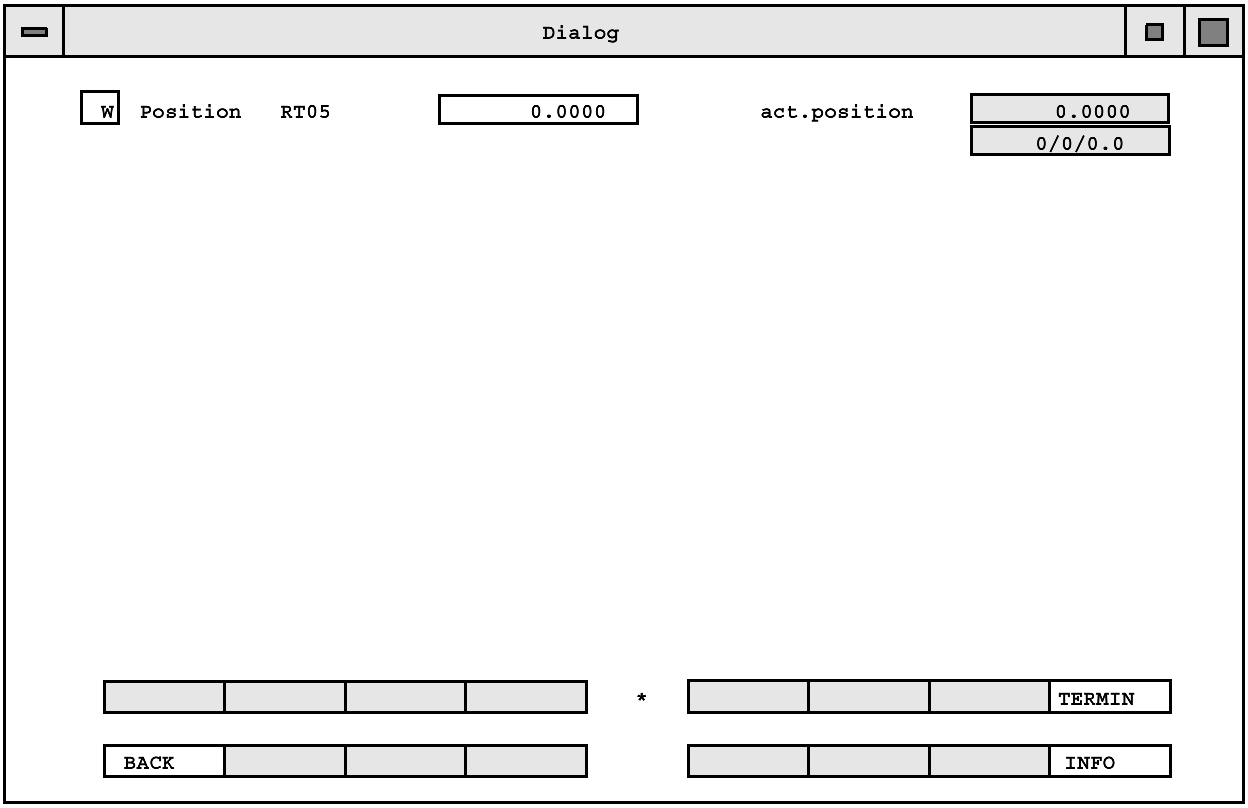
DI	Pull-Down-Menu	Pictogram
1521 RTPOS	CMM RT05 Position...	

Procedure

Enter the nominal position and close window with **<TERMIN>**. The new position is then logged and (during learn or part programming) written to the control data.

Important!
Make sure that the clamped parts can not cause a collision.

If you do not want to rotate the rotary table, exit the window with **<BACK>**.



Data boxes

Position RT 05
Enter nominal position in decimal degrees or in deg/min/sec (type with slash).

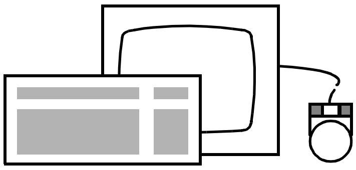
act.position
Display of actual position in decimal degrees and in deg/min/sec.

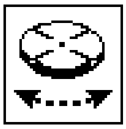
No input or editing is possible.

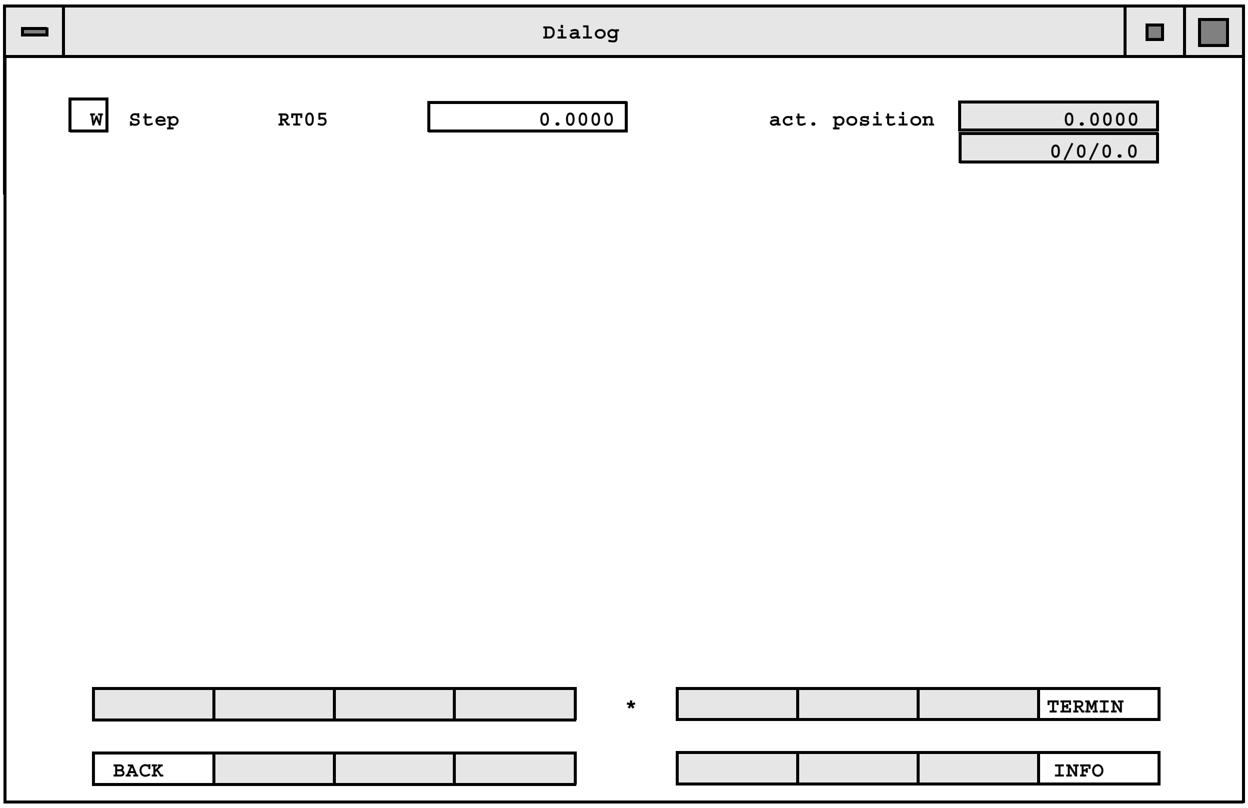
Rotating the rotary table by an angular step <DI 1522>

Application

You can use this function to read off the current rotary table position and/or move the rotary table by a defined angle.



DI	Pull-Down-Menu	Pictogram
1522 RTSTEP	CMM RT05 Step...	



Data boxes

Step RT 05

The value entered last is offered and can be accepted. New inputs must be decimal or in °/′/″ (type in with slashes). The direction of rotation is determined by the +/- sign entered: the positive sign denotes counterclockwise rotation and the negative sign stands for clockwise rotation (this direction of rotation applies when viewing the surface of the rotary table from the front and above).

act.position

Display of the actual position in decimal degrees and in deg/min/sec. Input or editing is not possible.

Procedure

Enter the nominal step and close the window with **<TERMIN>**. The new position will then be logged and (during learn or part programming) written to the control data.

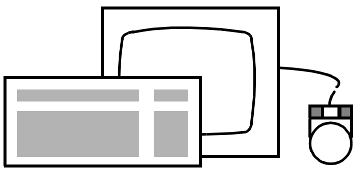
Important!
Make sure that the clamped parts can not cause a collision.

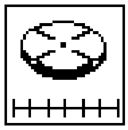
If you don't want the rotary table to rotate, close window with **<BACK>**.

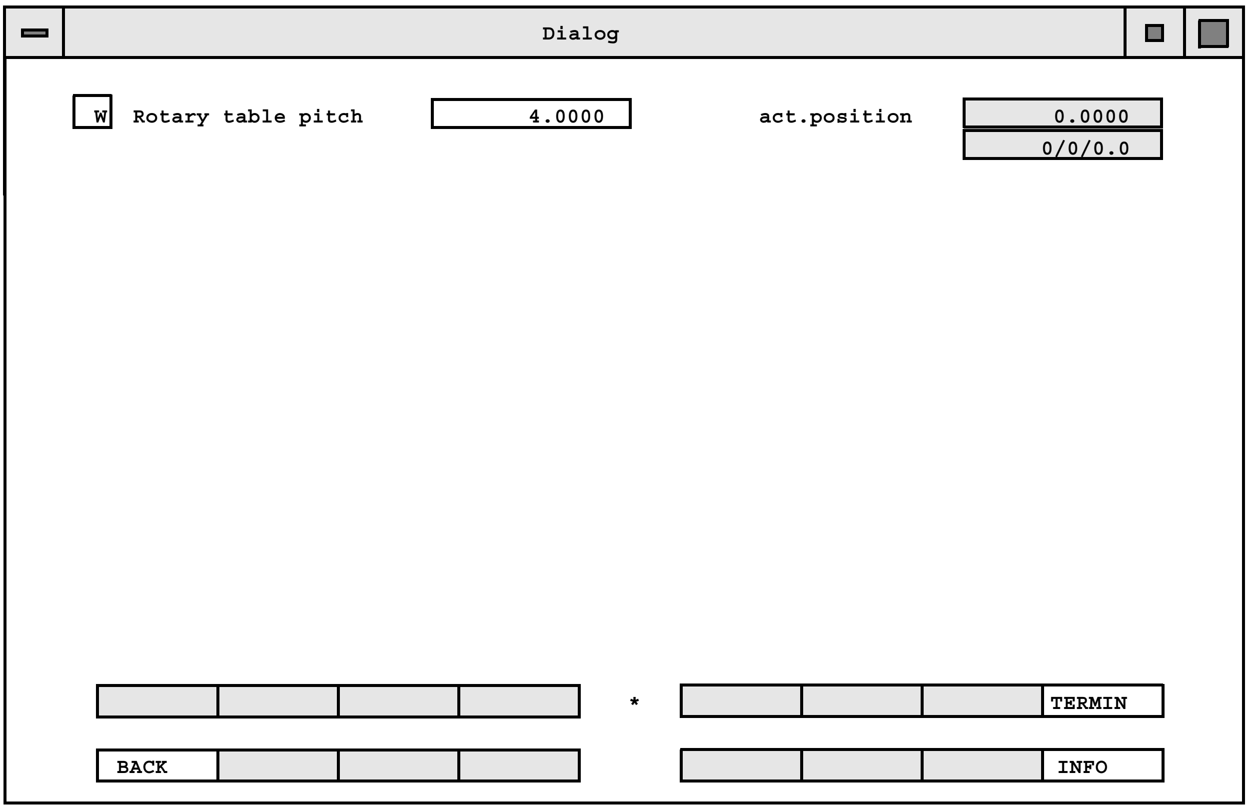
Rotating the rotary table by a scale division <DI 1523>

Application

You can use this function to read the current angular position and/or rotate the rotary table by an angle resulting from the scale division of a full revolution into steps of equal size. A function call is required for each step.



DI	Pull-Down-Menu	Pictogram
1523 RTPITCH	CMM RT 05 Pitch...	



Data boxes

Rotary table pitch

The "pitch" i.e. scale division last entered is offered for acceptance or overwriting. The direction of rotation is determined by the +/- sign: The positive sign denotes counterclockwise rotation and the negative sign clockwise rotation (this direction of rotation applies when viewing the surface of the rotary table from the front and above).

act.position

Display of the actual position in decimal degrees and in deg/min/sec.

Input or editing is not possible.

Procedure

Enter the pitch or scale division and close the window with **<TERMIN>**. The new position is logged and (for learn or part programming) written to the control data.

Important!
Make sure that the clamped parts can not cause a collision.

If the rotary table should not be rotated, quit the window with **<BACK>**.

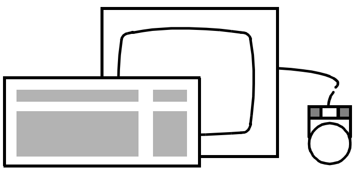
Aligning the rotary table parallel to the machine coordinates <DI 1524>

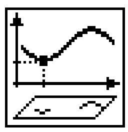
Application

You can use this function to align an element of the part clamped to the rotary table parallel with the machine coordinate system. The rotary table will rotate by the angle specified in the last record printout.

NOTE

You may call this function only after the following elements: **LINE, CYLINDER, SPHERE, SURFACE, POLAR**.
If 2 projected angles are printed, rotation will be performed by the angle of the rotary table's rotational plane.



DI	Pull-Down-Menu	Pictogram
1524 RTANG	CMM RT05 Angle	

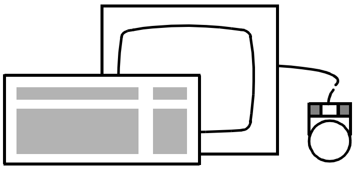
Traveling to the rotary table reference point <DI 1570>

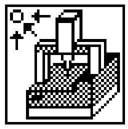
Application

With the reference point (rotary table zero point) mechanically aligned to the rotary table, you can repeat CNC programmed rotary movements and positions even if the machine has been switched off in the meantime. You can thus perform exact travel to an initial or home position referenced to this point even after a power failure.

To execute a reference point travel, call **<DI 1570>** (➤***„Reference point travel <DI 1570>“ on page 6-2***) or start UMESS (➤***„Prerequisites“ on page 2-3***).

Make sure that no fixtures or workpieces can cause a collision while rotating to the reference point. The rotary table counter will be reset to 0 at the reference point.



DI	Pull-Down-Menu	Pictogram
1570 RERPT	CMM Travel commands Reference point travel...	

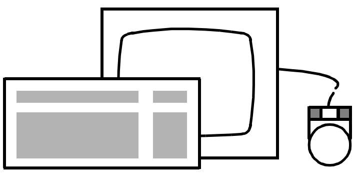
Procedure

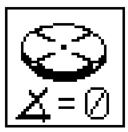
See ➤***„Reference point travel <DI 1570>“ on page 6-2***.

Setting the rotary table position to zero <DI 1520>

Application

With this function you can set the current rotary table position to 0°. Application e.g. to subsequently adjust the rotary table with **<RTPOS>** instead of with **<RT STEP>**.



DI	Pull-Down-Menu	Pictogram
1520 RTZEROP	CMM RT05 set to zero	

Rotary table measurement mode

Procedure

Alignment

Before you start measuring,

- define the rotary table axis (➤***„Defining the rotary table axis" on page 15-12***) and save with **<DI 1568>** (➤***„Storing, reading in and deactivating the rotary table axis <DI 1568>" on page 15-14***) or
- read in the rotary table axis with **<DI 1568>** (➤***„Storing, reading in and deactivating the rotary table axis <DI 1568>" on page 15-14***).

Measurement

- Define the workpiece coordinate system and W-position.

  Please note: Do **not** rotate the rotary table while performing element measurements and function calls to define the zero point of the workpiece coordinate system (➤***„Rotating the rotary table to an angular position <DI 1521>" on page 15-4***).
- Use **<DI 1566>** to determine whether and how you want to connect the workpiece coordinate system and/or the W-position with the rotary table.
  The following options are available (➤***„Coupled rotation/uncoupling of workpiece/control coordinate system <DI 1566> (<DI 1567>)" on page 15-19***):
  - coordinate system rotates along with table, eccentricity and wobble error compensated; this condition is automatically active following each UMESS start and after **<DI 1608>**, **<RECORD>;**
  - coordinate system does not rotate with table, but the eccentricity and wobble errors are compensated;
  - coordinate system does not rotate with table and eccentricity and wobble errors are not corrected.

Application examples and information ➤***„Coupled rotation/uncoupling of workpiece/control coordinate system <DI 1566> (<DI 1567>)" on page 15-19***.

Positioning the rotary table

- Computer controlled with positioning commands (➤***„Positioning with the computer or joystick" on page 15-4***);
- Manually via joysticks, during learn (part) programming with subsequent position acceptance via **<DI 1521>**. The intermediate position or probing does not store the rotary table position in the control data.

Once you have defined the workpiece coordinate system, you can also rotate the rotary table within an N point element (with the joystick or <RT POS>) if you have activated **Rotate workpiece system too** (➤***„Coupled rotation/uncoupling of workpiece/control coordinate system <DI 1566> (<DI 1567>)" on page 15-19***).

Correcting the rotary table axis

You must occasionally redefine the rotary table axis or correct it via an offset measurement (➤***„Defining the rotary table axis" on page 15-12***).

Deactivating the rotary table axis

If you measure parts afterwards or in-between without the rotary table: Deactivate the rotary table axis (➤***„Storing, reading in and deactivating the rotary table axis <DI 1568>" on page 15-14***). Otherwise you may inadvertently rotate (and therefore displace) your coordinate systems.

Defining the rotary table axis

Important!
It is generally advisable to redefine (recalibrate) the rotary table axis following each probe calibration.

The rotary table axis must be redefined and stored in the following cases:

– After assembling/moving a mobile rotary table.

– Following each UMESS start with reference point travel, i.e. if the control has been switched off in the meantime.

  Alternatively: Offset measurement (➤***„Linear offset correction <DI 1572>" on page 6-4***).

– After each reference point travel started with **<DI 1570>**.

  Alternatively: Offset measurement (➤***„Linear offset correction <DI 1572>" on page 6-4***).

– At intervals, If the rotary table axis can be expected to drift due to temperature influences during longer measurements.

  Explanation:

  The rotary table axis stored is referenced to the zero point of the machine coordinate system. Fluctuations in temperature may displace the actual rotary table axis in relation to the one stored. During longer measurements, this "drifting" will cause an eccentricity error if only the workpiece coordinate system is redefined after changing workpieces. Alternatively, you can correct this thermally induced displacement of the table axis by performing an offset measurement (➤***„Linear offset correction <DI 1572>" on page 6-4***).

– Following probe recalibration if there is no common reference probe. A common reference probe exists if the calibration standard has not been moved or recalibrated.

NOTE

Definition of the axis is not required in the following cases:

– After a UMESS start without a reference point travel, i.e. if the control cabinet remains on in the meantime. In this case the rotary table axis is automatically read from the hard disk.

– If an offset measurement is possible (➤***„Linear offset correction <DI 1572>“ on page 6-4***). The offset correction also detects the rotary table axis.

Procedure for defining the rotary table axis

Set to initial status

<DI 1608>

Set offset to zero

If an offset correction has been activated, it must be deactivated with **<DI 1572>** (➤***„Linear offset correction <DI 1572>“ on page 6-4***).

Define the rotary table axis

Be very careful when performing this operation. Calculation of the elements or features may be adversely affected by such factors as probe bend, form deviations and/or unfavorable position of the probing points.

The following options are available:

– If it is accessible, you can use the bore of the rotary table with a 180° reversal measurement for calibration:

  Measure the bore via

  <CYLINDER>, **<RT 05> <RT STEP> 180°**, **<CYLINDER>**, **<SYMMETRY>**

  or **<SURFACE>** (face), **<CIRCLE>**, **<DI 1285>** (perpendicular), **<RT 05> <RT STEP> 180°**, <**SURFACE>**, **<CIRCLE>**, **<DI 1285>**, **<SYMMETRY>**

– 180° reversal measurement of a cylinder with little form deviation fastened to the rotary table in a roughly upright position:

  <CYLINDER>, <RT 05> <RT STEP> 180°, <CYLINDER>, <SYMMETRY>

– Fasten sphere to rotary table. Measure after each **<RT STEP>**. (select **<RT STEP>** so that you can measure at least 6 spheres over as large an angular range as possible):

  <SPHERE>, **<RT 05> <RT STEP>** (e.g. 60°), **<SPHERE>**, ... , **<RECALL>** of the spheres to **<CIRCLE>**, **<RECALL> to <SURFACE>**, **<DI 1285>** (perpendicular);

- (with measuring probe head) Fasten triple ball to rotary table and perform self-centering probing of triple ball following each **<RT STEP>**:

  <POINT>, **<RT 05> <RT STEP>**, **<POINT>**, . . ., **<CIRCLE>** via **<RECALL>**, **<SURFACE>** via **<RECALL>**, **<DI 1285>** (perpendicular)
- Perform measurement on reversal on the actual workpiece.

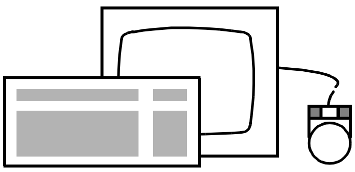
Store rotary table axis

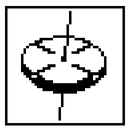
Use **<DI 1568>** (➤***„Storing, reading in and deactivating the rotary table axis <DI 1568>“ on page 15-14***).

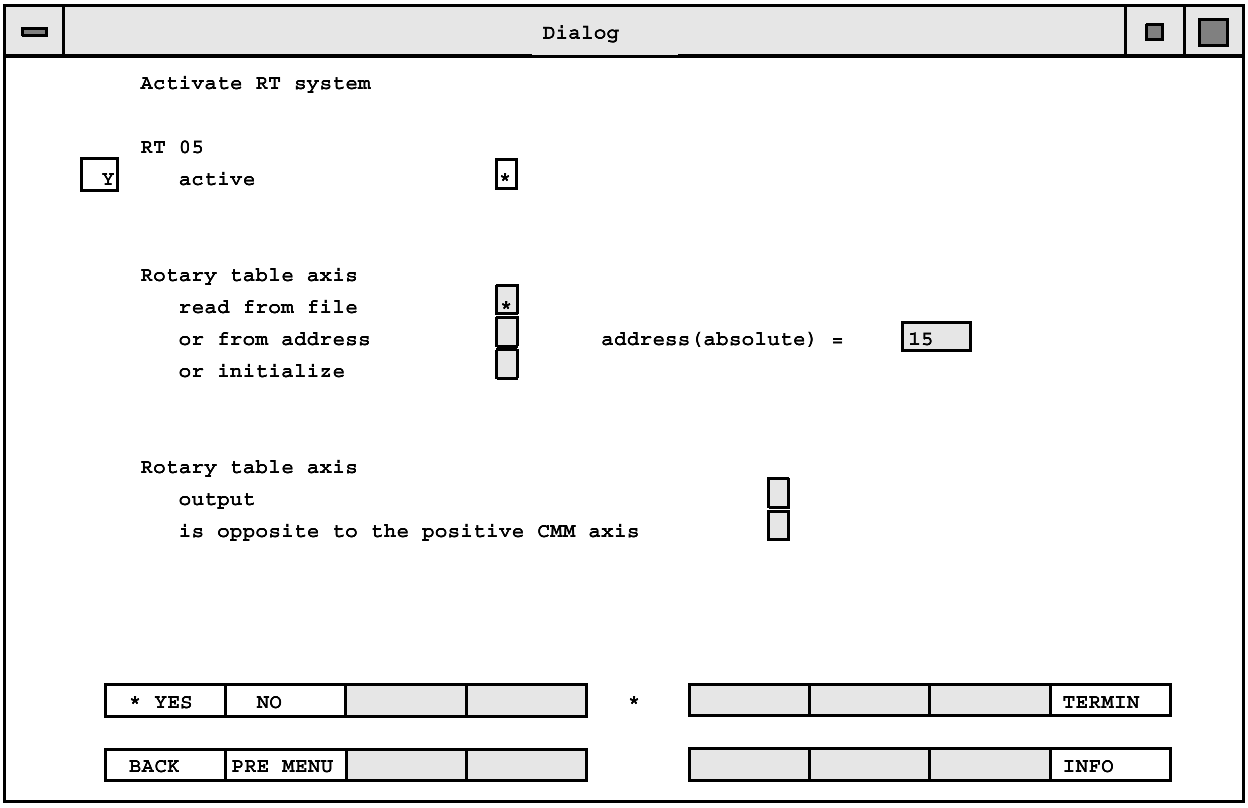
Storing, reading in and deactivating the rotary table axis <DI 1568>

This function features the following options:

- Storing of the rotary table axis defined according to ➤***„Defining the rotary table axis“ on page 15-12*** (last element in record).
- Read-in of the stored rotary table axis.
- Deactivation of the rotary table axis; if this is done, it doesn't matter if the rotary table is accidentally moved.
- Listing of the stored rotary table axis.
- Correction of the direction of the rotary table axis.



DI	Pull-Down-Menu	Pictogram
1568 RTCAL a75	CMM RT 05 Axis...	



Data boxes

RT 05 active

Must be accepted with **<* YES>**.

Rotary table axis: read from file

Required e.g. if you have in the meantime deactivated the rotary table axis with **Rotary table axis initialize**.

Rotary table axis: from address

Used to store the rotary table axis; the element which was printed last in the record and you should have determined by the method outlined in ➤ ***„Defining the rotary table axis“ on page 15-12*** is always stored. Its address can be obtained from the **address (absolute)** display box.

If you are using a mobile rotary table and it is clamped in -X or -Y, you should simultaneously select **Rotary table axis output** to check the axis direction and correct it if necessary.

Rotary table axis initialize

Used to deactivate the stored rotary table axis. The axis is deleted in the computer, but retained on the hard disk, from where it can be read in as required. In this way you can make sure that any accidental movement and/or deadjustment of the rotary table will have no influence on your coordinate systems, e.g. whenever you are not performing measurements on the rotary table.

Rotary table axis output

Used to call the **Rotary table axis** dialog window to check the axis direction (+/- sign) (➤***„Displaying the rotary table axis“ on page 15-16***). This is interesting especially if you are using a mobile rotary table and it is clamped in **-X** or **-Y** of the machine coordinates.

Rotary table is opposite to the positive CMM axis

This box must be selected if the rotary table is installed in **-X** or **-Y**.

Procedure

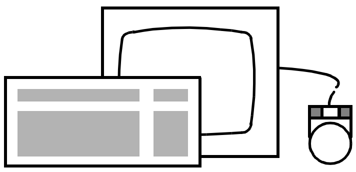
Select the option(s) required and close the window with **<TERMIN>**.

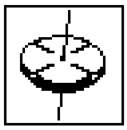
If you select **Rotary table axis output**, the **Rotary table axis** dialog window will then be displayed ➤***„Displaying the rotary table axis“ on page 15-16***.

Displaying the rotary table axis

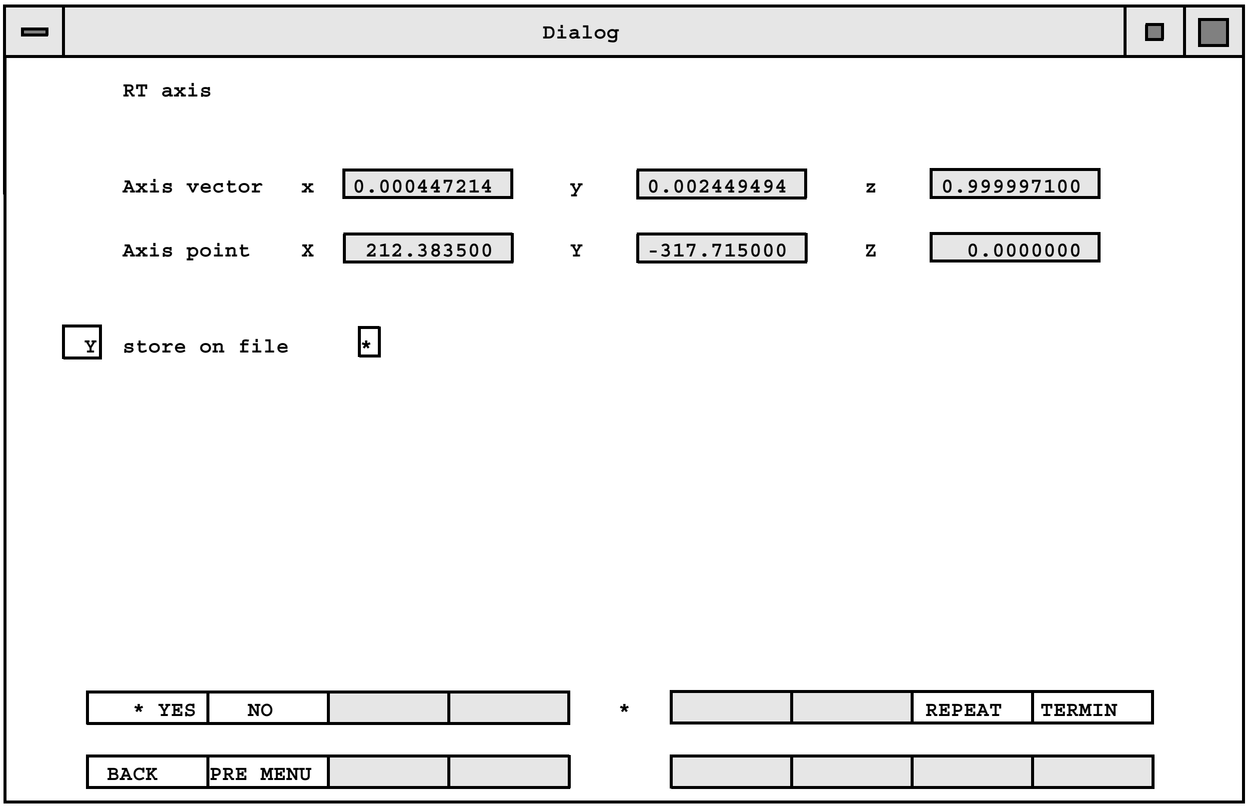
Application

If you are using a mobile rotary table and it is pointing in the **-X** or **-Y** direction of the machine coordinates, you might be determining the direction of the rotary table axis incorrectly by using the method explained in ➤***„Defining the rotary table axis“ on page 15-12***. You can list and check the current rotary table axis using the **Rotary table axis** dialog window.



DI	Pull-Down-Menu	Pictogram
1568	CMM	
RTCAL	RT 05	
a75	Axis...	

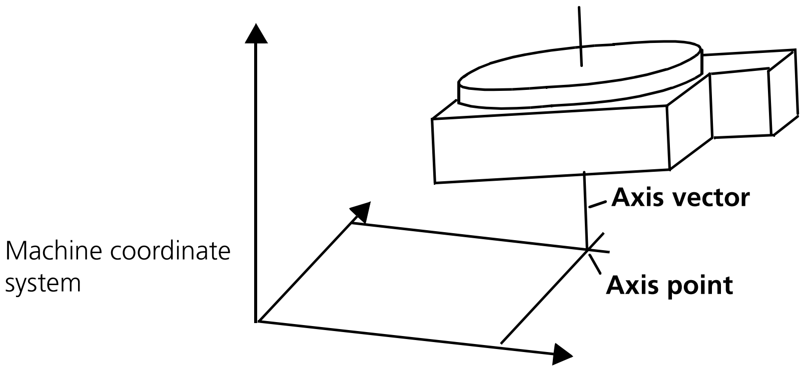
Rotary table axis output



Data boxes

Axis vector, Axis point

The dialog window lists the inclination of the RT axis (as direction cosine of its unit vector) and its penetration point through the zero plane of the machine coordinate system:



If your rotary table axis is pointing in the **-X** or **-Y** direction, a minus sign also must be assigned to the corresponding axis vector.

store on file

Two cases must be differentiated:

– After **Rotary table axis read from file** (➤***„Storing, reading in and deactivating the rotary table axis <DI 1568>“ on page 15-14***)

If you check this box, the rotary table axis will be stored to the hard disk with the displayed values after you press **<TERMIN>**. If it is not checked, the computer will only temporarily store the values entered when you press **<TERMIN>**. The previous status then remains stored on the hard disk (and can be reactivated from there).

– After **Rotary table axis from address** (➤***„Storing, reading in and deactivating the rotary table axis <DI 1568>“ on page 15-14***)

the rotary table axis will be stored in any case, i.e. either with the original or with the edited values.

Procedure

Check the +/- sign of the **Axis vector**. Then determine whether you want to store the displayed status in the computer only temporarily or save it permanently to the hard disk. Close the window with **<TERMIN>**.

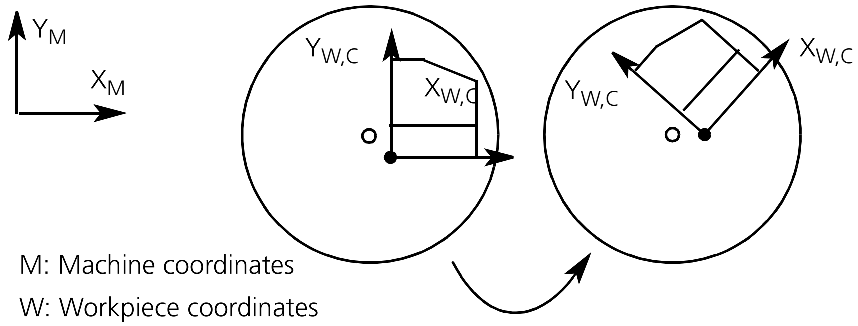
Coupled rotation/uncoupling of workpiece/control coordinate system <DI 1566> (<DI 1567>)

Application

With this function you can influence the coupling of the workpiece and control coordinate systems to the rotary table.

Standard case

The workpiece and control coordinate systems rotate along with the rotary table. The wobble error and eccentricity error are mathematically compensated if the rotary axis was defined (calibrated) beforehand.



M: Machine coordinates
W: Workpiece coordinates
C: Control coordinates

This coupling is automatically produced

– after UMESS start and
– after **<DI 1608>** or **<RECORD>**.

Therefore please note

You should always deactivate the rotary table axis whenever you are not performing measurements on the rotary table. Otherwise your coordinate systems will be rotated out of adjustment if you accidentally move the rotary table.

Options

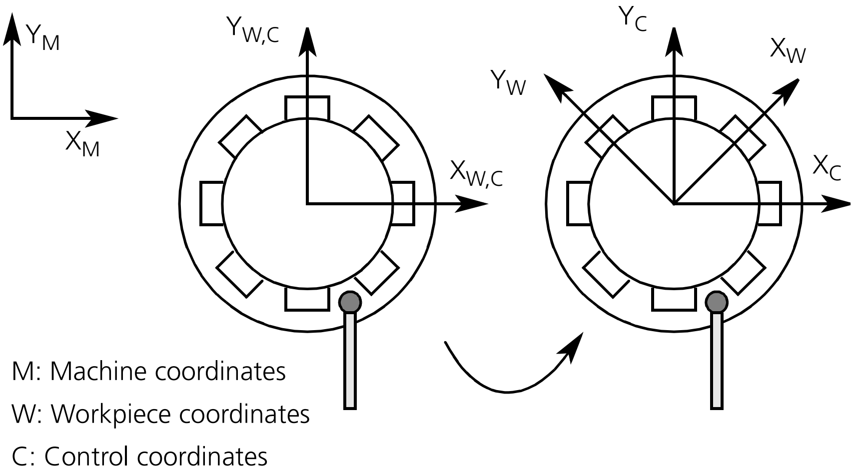
– Safety device on the control panel (button on left-hand joystick),
– **<DI 1568>**, **Rotary table intialize = YES**,
– **<DI 1568>**, **RT 05 active = NO**.

Special case

Even when you are performing measurements on the rotary table, it is not always advisable to rotate the coordinate systems as well:

Example 1

You should not rotate W-position with the rotary table if your CNC program measures elements or features which are repeated in a loop **<DI 1051>**:



Prerequisite

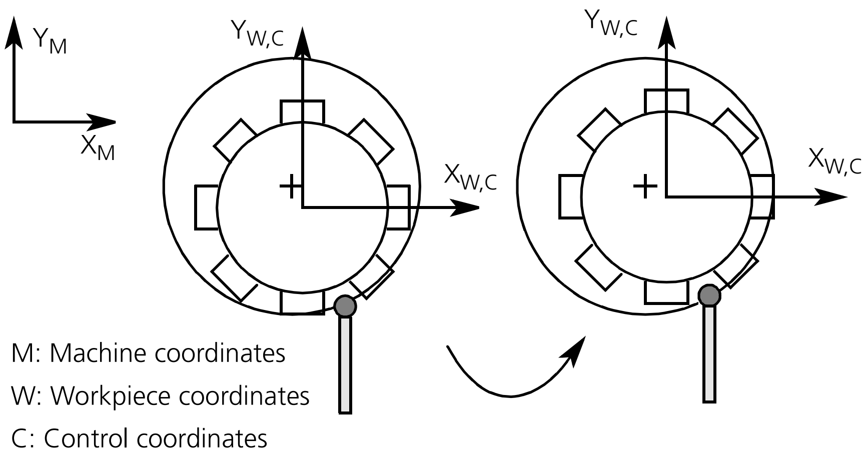
The workpiece is arranged central to the rotary table axis. Align exactly with critical probings (otherwise there is a danger of collision or probing errors) or by turning the zero point of the control coordinate system along with the rotary table, cf. example 3.

Example 2

The workpiece coordinate system should not be rotated along with the table if you want to measure the pitch or division of a part which is aligned to the rotary table axis. In this case you can omit the correction of the wobble and eccentricity errors; the residual alignment error will be entered in the measuring result. However, you must not adjust the rotary table during an N point program.

Example 3

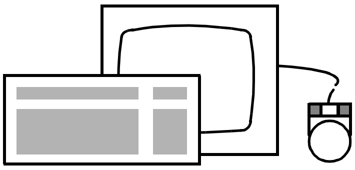
Correct only the wobble error and the eccentricity error:

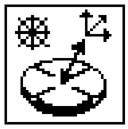


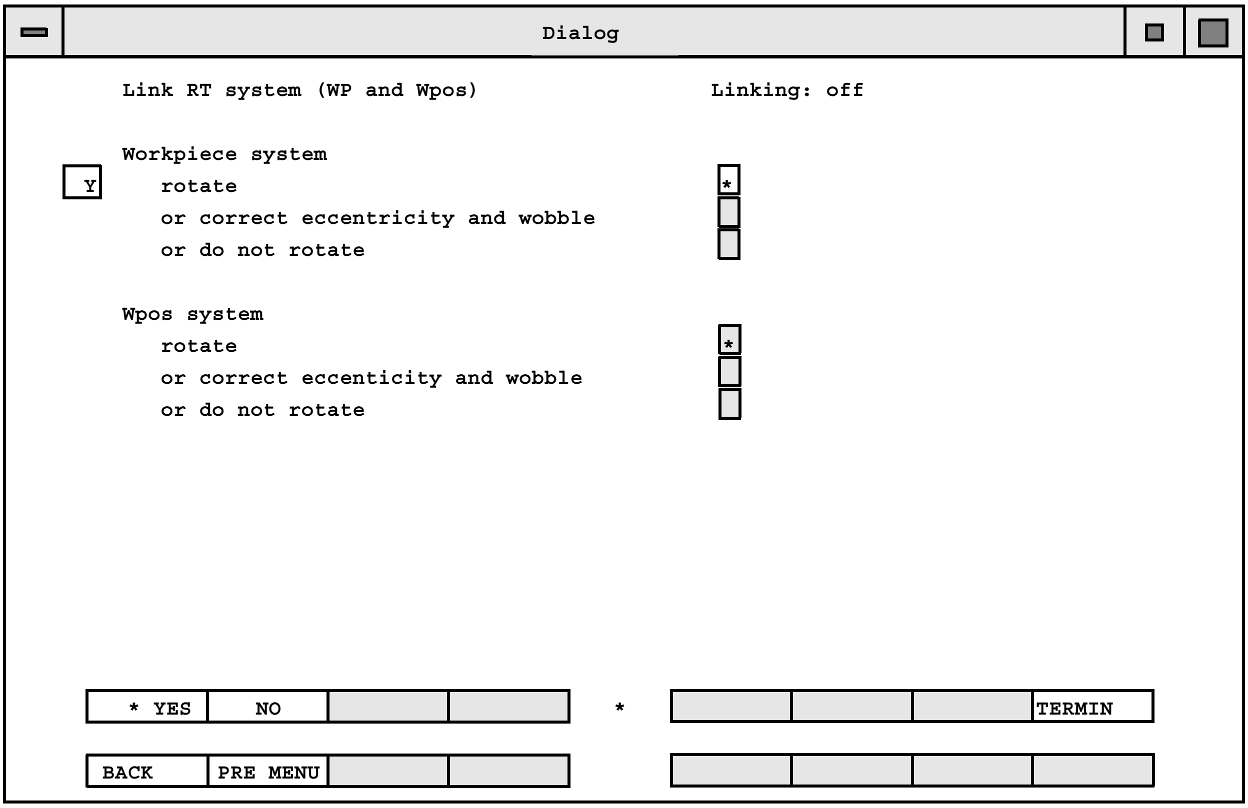
In this case you should rotate the zero point of the workpiece and/or the control coordinate system along with the RT, thus retaining the coordinate directions. This method should be used if the exact mechanical alignment required for examples 1 and 2 is too involved or the residual wobble and eccentric errors are not negligible.

Procedure

With the following function you can determine whether and how you want to rotate the workpiece coordinate system or W-position along with the rotary table.



DI	Pull-Down-Menu	Pictogram
1566/(1567)	CMM	
RTLINK	RT05	
a191	link/unlink...	



Data boxes

Workpiece system/ Wpos system rotate

Used to rotate the workpiece coordinate system and/or W-position along with the table, cf. explanation at the beginning of the chapter. You can also reach this status after a UMESS start and after **<DI 1608>/<RECORD>**.

Workpiece system/ Wpos system correct eccentricity and wobble

Used to rotate only the zero point of the workpiece and/or control coordinate system along with the rotary table and retain the coordinate directions. See the beginning of the chapter for application information and example.

This setting can be reversed (undone) by:

– calling the dialog window again and selecting **rotate**.

– or by setting the initial status **<DI 1608>**, **<RECORD>**

– or by restarting UMESS.

This setting is not eliminated by:

– initializing MASCH **<DI 1590>**,

– CNC start, CNC end.

Workpiece system/ Wpos system do not rotate

The workpiece and/or control coordinate system are retained and do not rotate along with the rotary table. The wobble and eccentric errors of the workpiece are not corrected. See the beginning of the chapter for application notes and example.

Reverse (undo) the setting as for **correct eccentricity and wobble.**

NOTE

Couple only if the workpiece coordinates and the and the W-pos have been defined (calibrated). **<DI 1566>** must be recalled following each change of the coordinate system.

Chapter 16

Learn programming

This chapter contains:

General

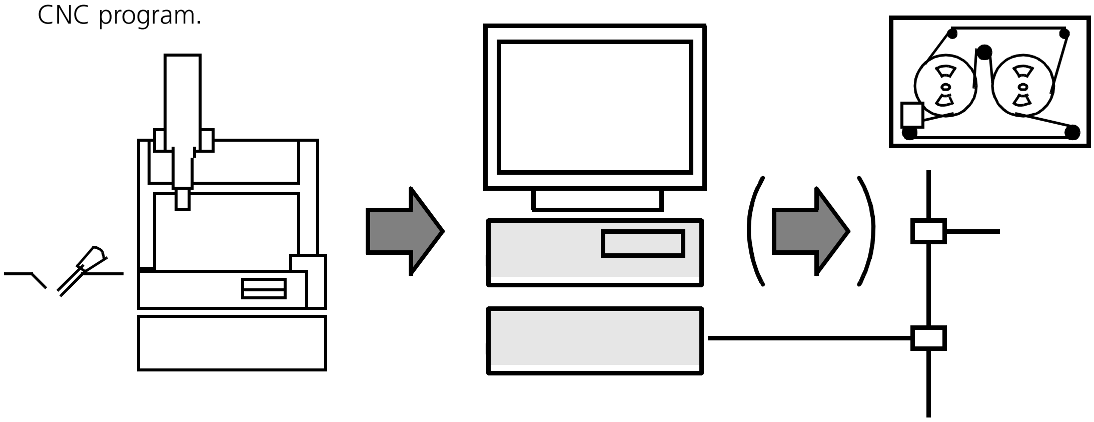
Application

With UMESS you can create CNC programs by learn (part) programming and run them as automatic measurements.

Learn programming:

Manual measurement of a workpiece with simultaneous storing of all codes and travel paths on the hard drive as a CNC program.

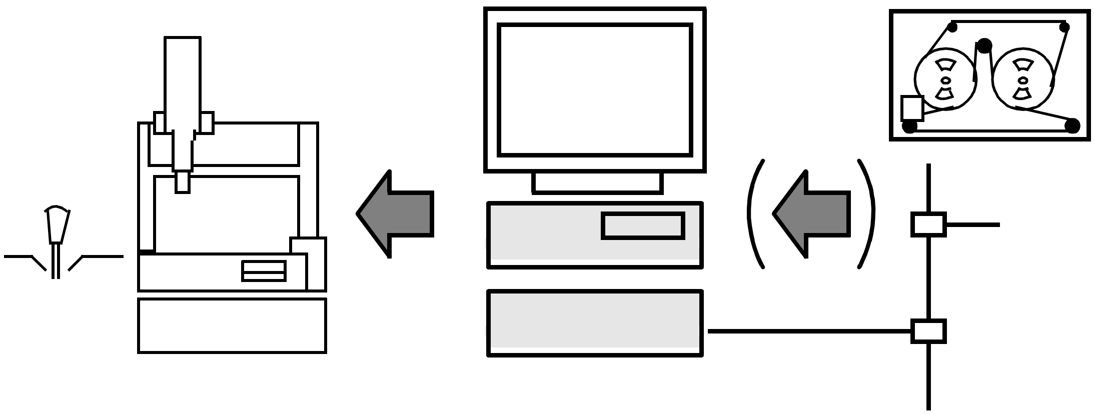
If necessary, store externally/save CNC programms to DAT or via LAN.



CNC run:

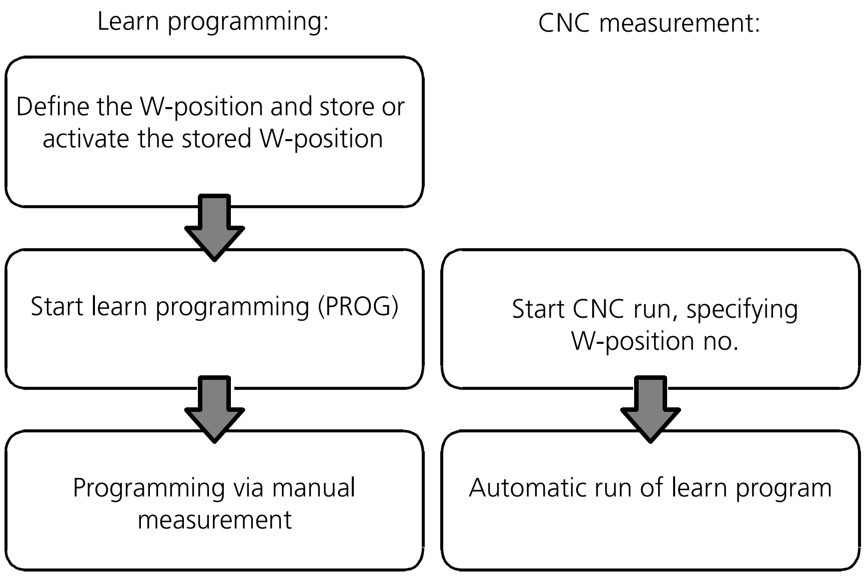
Decodes the control data of the CNC program and converts it into travel and computer commands which exactly reproduce the learn programmed run on a workpiece of the same type.

If necessary, retrieve CNC program from DAT or via LAN to the hard drive and enter it in the workpiece catalog.



Coordinate systems

The travel paths of the current probe always refer to a predefined coordinate system, the control coordinate system, during learn programming and later on during the CNC measuring run. Like the identically named command you use to save a control coordinate system, the term **W-pos** is also used for control coordinate systems.

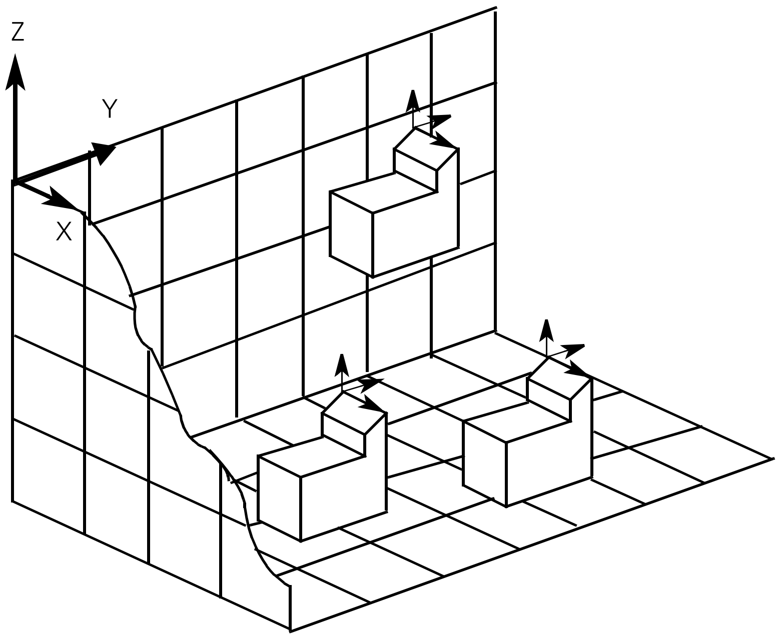


W-position

With the W-position you save the position of the control coordinate system and its angles relative to the machine coordinate system to the hard disk.

Control coordinate system

The control coordinate position (W-position) is defined relative to the workpiece. If the workpiece position changes, the W-position must be moved accordingly (e.g. CNC run at a position other than the one with learn programming).



Procedure for learn programming

Preparation

Preparations for learn programming: Clamp workpiece, calibrate probes (as for manual measurement).

Programming

Creating a new CNC program:

- Define and store control coordinate system or activate stored control system: ➤ ***„Control coordinate system“ on page 16-6***.
- Start learn programming: ➤ ***„Starting learn programming <DI 1639>“ on page 16-13***.
- Execute learn programming: ➤ ***„Execution of learn programming“ on page 16-16***.
- Terminate learn programming: ➤ ***„Terminating learn programming <DI 1632>“ on page 16-85***.
- If necessary, correct CNC program (see below).

Correction

Correcting or extending a CNC program:

- via learn programming: ➤ ***„Continuing the learn programming of an existing workpiece“ on page 16-14***,
- via control data correction: ➤ ***„Correcting control data <DI 1642>“ on page 17-31***,
- with CNC debugger: ➤ ***„CNC debugger <DI 1070>“ on page 18-17***.

Control coordinate system

Defining and storing the control coordinate system

Function calls

The following functions are used to store and activate a control coordinate system:

- **<DI 1708>** or **<WS->WPOS>** stores the current workpiece coordinate system as W-position (control coordinate system) in the computer (➤***„Storing the W-position in the computer <DI 1708>“ on page 16-9***).
- **<DI 1710>** or **<WPTCAT>** stores the current workpiece coordinate system as W-position (control coordinate system) (➤***„Storing the W-position/Deleting the W-position <DI 1710>“ on page 16-7***):
  - in the computer
  - and on a long-term W-position file under any name you specify.
- **<DI 1712>** or **<WPFCAT>** downloads one of the stored W-positions to the computer as the current W-position (➤***„Reading in the W-position <DI 1712>“ on page 16-10***).

Options for defining and storing a W-position

- Define workpiece coordinates fully (mathematical alignment) and then save them as a control coordinate system.
- This method is always recommended at the start of a CNC program in order to obtain an exact control coordinate system for each workpiece.
- After executing **<DI 1608>** probe one point each for **X**, **Y**, **Z** (with a prismatic workpiece) and reset to zero (**<ZERO PT>**). Then store as W-position.
- This method is recommended only in the manual mode where a roughly defined control coordinate system is sufficient, e.g. prior to learn programming or a CNC run. The exactly mathematically aligned control coordinate system must be defined in the CNC program (see previous section).
- Use the machine zero point without any manual probing: **<DI 1608>**, then store as W-position; this method is recommended during learn programming and CNC operation only if the workpiece is clamped in a fixture whose position in relation to the zero point remains constant.

Check

When in doubt you can check the position of the control coordinate system currently stored in the computer by positioning a probe as follows:

<DI 1608> Set initial status,

<DI 1713> Workpiece system same as W-position system,

<DI 1511> Position in workpiece system with **X=0**, **Y=0**, **Z=0**.

Important:
A risk of collision exists if the zero point is located on an edge of the workpiece. Enter a coordinate ≠ 0 if necessary!

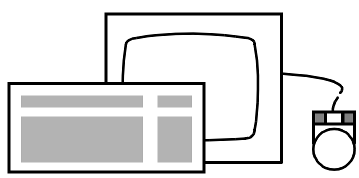
Please note This method does not work for a W-position stored during a CNC run with **<DI 1708>** (➤***„Storing the W-position in the computer <DI 1708>" on page 16-9***).

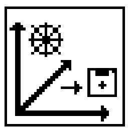
Rotary table The W-position and rotary table are automatically coupled after a UMESS start and after **<DI1608>/<RECORD>**. If necessary, uncouple the W-pos or secure the rotary table against deadjustment when not measuring on the rotary table (➤***„Coupled rotation/uncoupling of workpiece/control coordinate system <DI 1566> (<DI 1567>)" on page 15-19***).

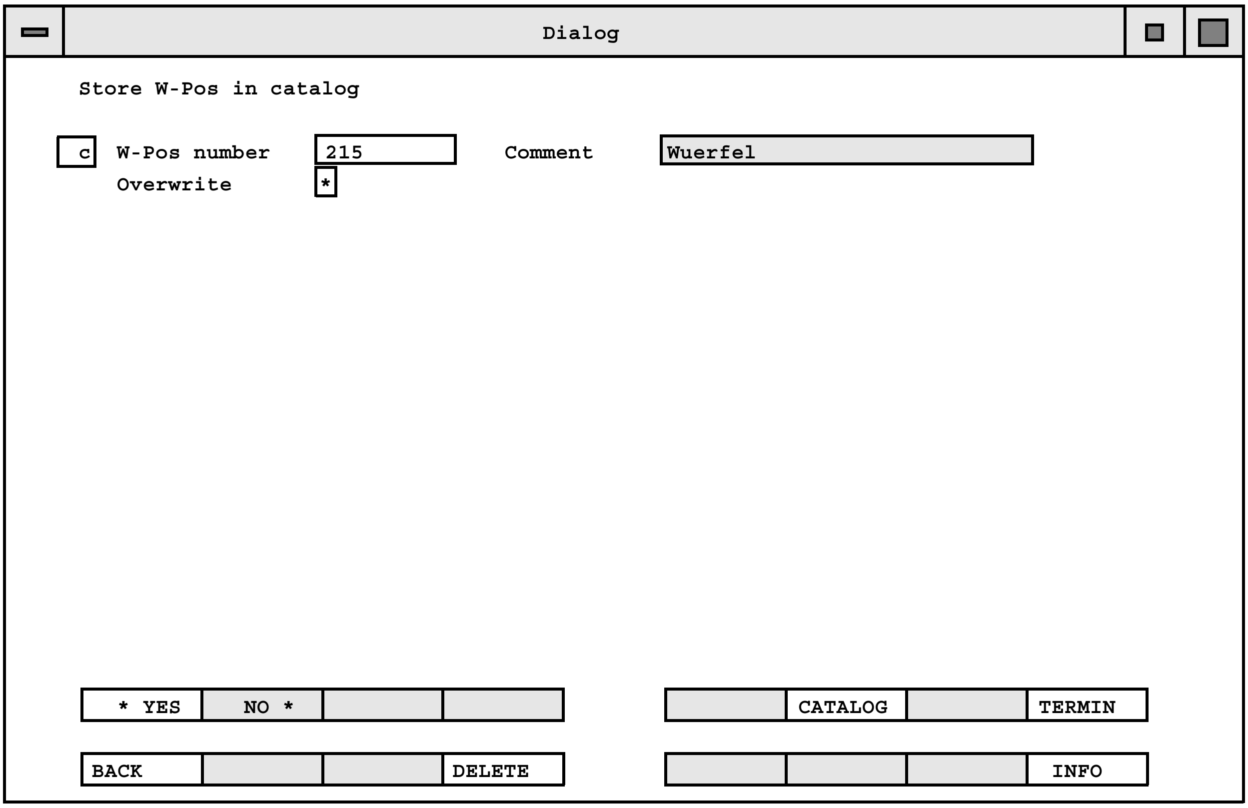
Storing the W-position/Deleting the W-position <DI 1710>

You can use this function call

- to store the current workpiece coordinate system as the control coordinate system in the computer and under a selectable W-pos number in the W-pos file.
- and/or to delete a W-pos in the catalog.



DI	Pull-Down-Menu	Pictogram
1710 WPTCAT	Coord Control system WPOS store as WP no....	



Softkeys

CATALOG

lists the W-pos file (➤ ***„W-position catalog" on page 16-11***).

DELETE

deletes the W-position specified for **W-Pos number** without inquiry.

Data boxes

W-Pos number

Enter the number under which you want to store the W-position. You can also make this entry with **<CATALOG>** (➤ ***„W-position catalog" on page 16-11***).

The W-position file can store a maximum of 32 000 W-positions.

Comment

Here you can enter a comment on the stored W-position comprising max. 30 characters. This comment will be displayed in the catalog (➤ ***„W-position catalog" on page 16-11***). It will not be stored in the control data.

Overwrite

Select this box if a W-position you want to overwrite is already stored under the specified **W-Pos number**. Otherwise the error message explained under "Procedure" will be displayed in the manual mode and during learn programming. There is no backup in the CNC run.

Procedure

Cursor keys

You can move between data boxes using the ∧ und ∨ keys.

Catalog

If you require information on existing W-positions (e.g. free numbers): change to the W-position file via **<CATALOG>** (➤***„W-position catalog“ on page 16-11***). From there you will automatically return to your starting part.

Storing

After entering the data in the window, close the window with **<TERMIN>**. A message confirming successful storing or deletion will then appear on the screen in the list and message window.

W-Pos ... stored in catalog

W-Pos ... deleted from catalog

If the message **W-Pos already exists** is displayed, you have specified the number of an existing W-position. In this case, specify a new number, select **Overwrite**, or delete the old W-position.

Storing the W-position in the computer <DI 1708>

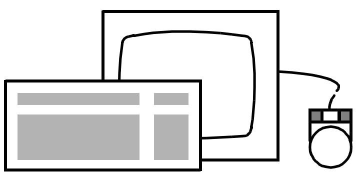
Application

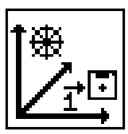
This function call stores the current workpiece coordinate system in the computer as the current control coordinate system. The W-position file previously stored is lost. The W-position file remains unchanged.

It is applied during a CNC program to define an exact control coordinate system without making use of the W-position file (➤***„Defining and storing the control coordinate system“ on page 16-6***).

Disadvantage

This W-position is not directly available to you for continuing learn programming or starting a CNC run in the middle of the program. You must either reconstruct it manually or let the CNC program run up to the program line concerned so that it can be downloaded to the computer.



DI	Pull-Down-Menu	Pictogram
1708 WS->WPOS	Coord Control system WPOS store as WP no.1...	

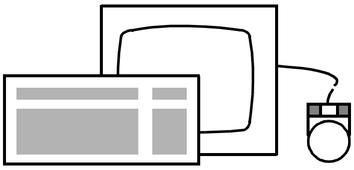
Message

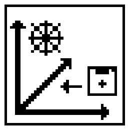
Successful storage is acknowledged by display of the message **W-POS** in the list and message window.

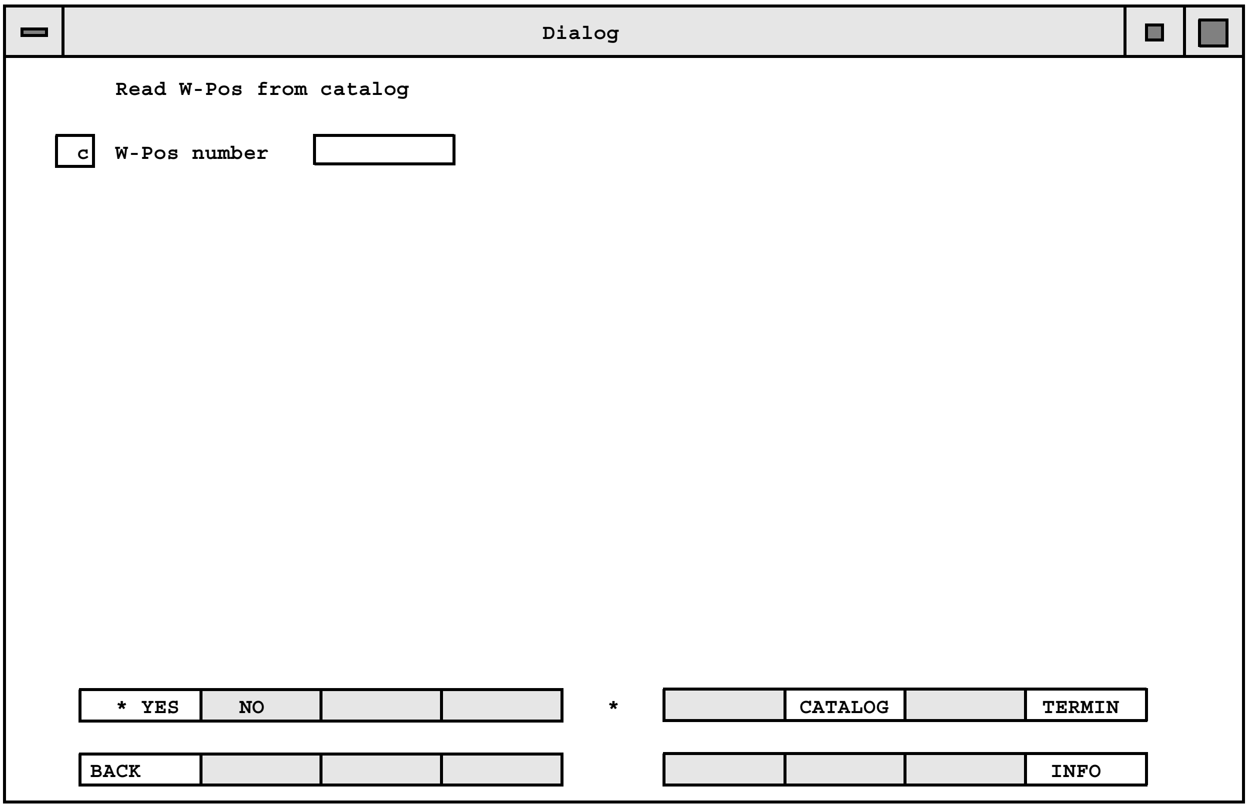
Reading in the W-position <DI 1712>

Application

This function downloads one of the W-positions from the W-position file to the computer (➤***„Defining and storing the control coordinate system“ on page 16-6***).



DI	Pull-Down-Menu	Pictogram
1712 WPFCAT a103	Coord Preparation Read in WPOS...	



Softkeys

CATALOG

Used to list the W-Pos file (➤***„W-position catalog“ on page 16-11***).

TERMIN

Closes the dialog window. The computer acknowledges your input with the message **W-Pos ... read from catalog**. Afterwards, if necessary, compare the W-position which was read in with the workpiece coordinate system with **<DI 1713>** (➤***„Forming a workpiece coordinate system from a control coordinate system <DI 1713>“ on page 9-31***).

Data boxes

W-Pos number

Enter the number of the required W-position. If you need information on the number stored: Change to the W-position file with **<CATA-LOG>** (➤***„W-position catalog“ on page 16-11***). From there you automatically return to the starting point.

Input of **0**: ➤***„W-position displacement <DI 1769, DI 1771>“ on page 16-66***

W-position catalog

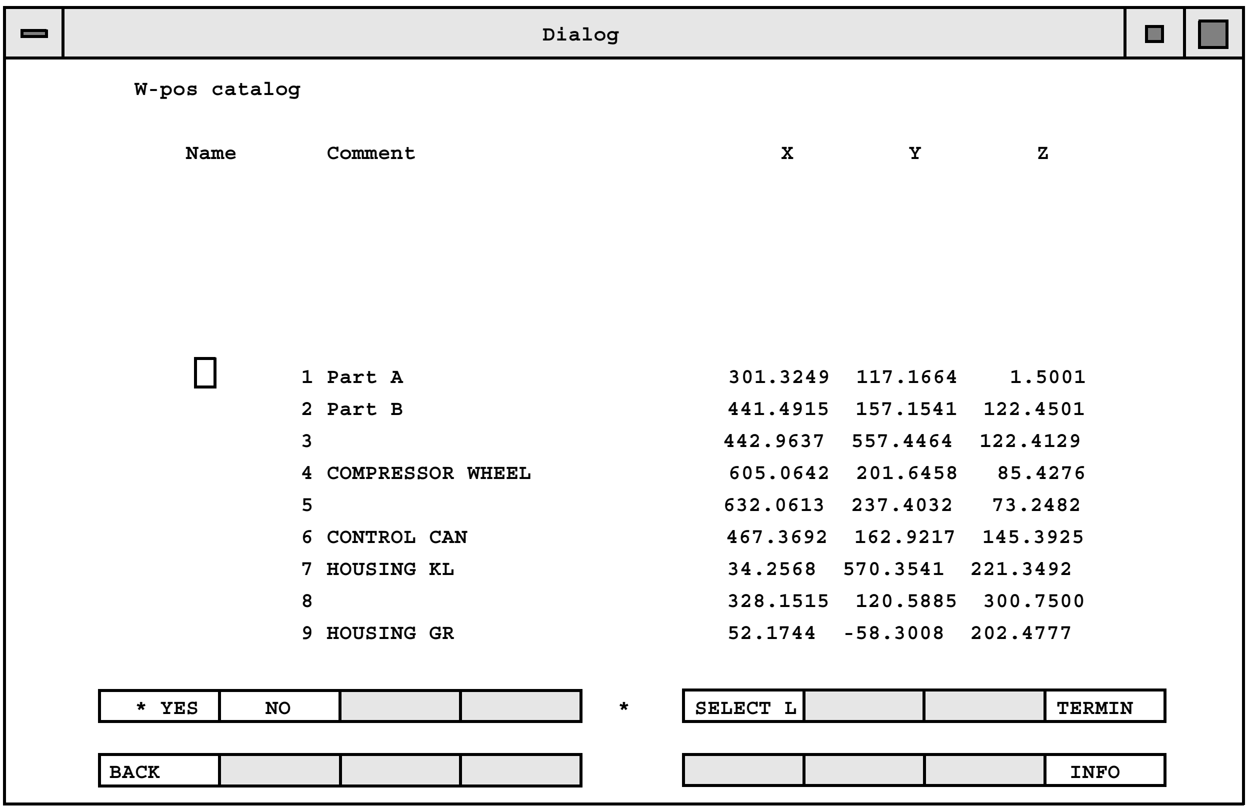
Application

The dialog windows **Store W-Pos in catalog** and **Read W-Pos from catalog** contain the **<CATALOG>** softkey. If you press this key, the W-position file will be listed in the dialog window. This is used e.g. to access information on the number of a W-position you want to read or unassigned W-position numbers. You can also transfer a W-position directly from the file to your dialog window.

Function call

➤***„Storing the W-position/Deleting the W-position <DI 1710>“ on page 16-7*** or ➤***„Reading in the W-position <DI 1712>“ on page 16-10***, then softkey **<CATALOG>** (without entering a W-pos no.).

Screen output



Procedure

Scrolling in the W-position file

– Use the **<Page Up>/<Page Down>** keys to scroll up/down one page at a time.

– Use **<NO>** or the ∨ cursor key to scroll down one line at a time

– Use **<SELECT L>**. to select a defined W-position/line.

Selection of a W-position

Accept the displayed W-position for entry to the calling dialog window with **<* YES>** or **<TERMIN>**. Otherwise return to the calling window with **<BACK>**.

Explanation of screen output

Name

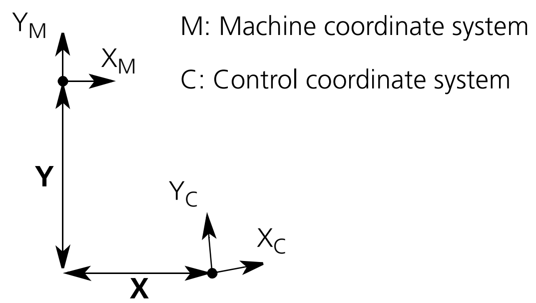
W-position number, entered with **<DI 1710>**.

Comment

Additional information on the W position, entered with **<DI 1710>**.

X, Y, Z

Distance from the origin of the control coordinate system to the machine zero point in the direction of the machine axes; this looks as follows in the XY plane:



Starting learn programming <DI 1639>

Learn programming a new workpiece

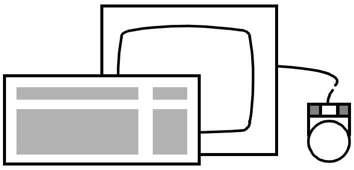
Preparations for learn programming

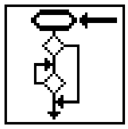
➤*„Procedure for learn programming“ on page 16-5*

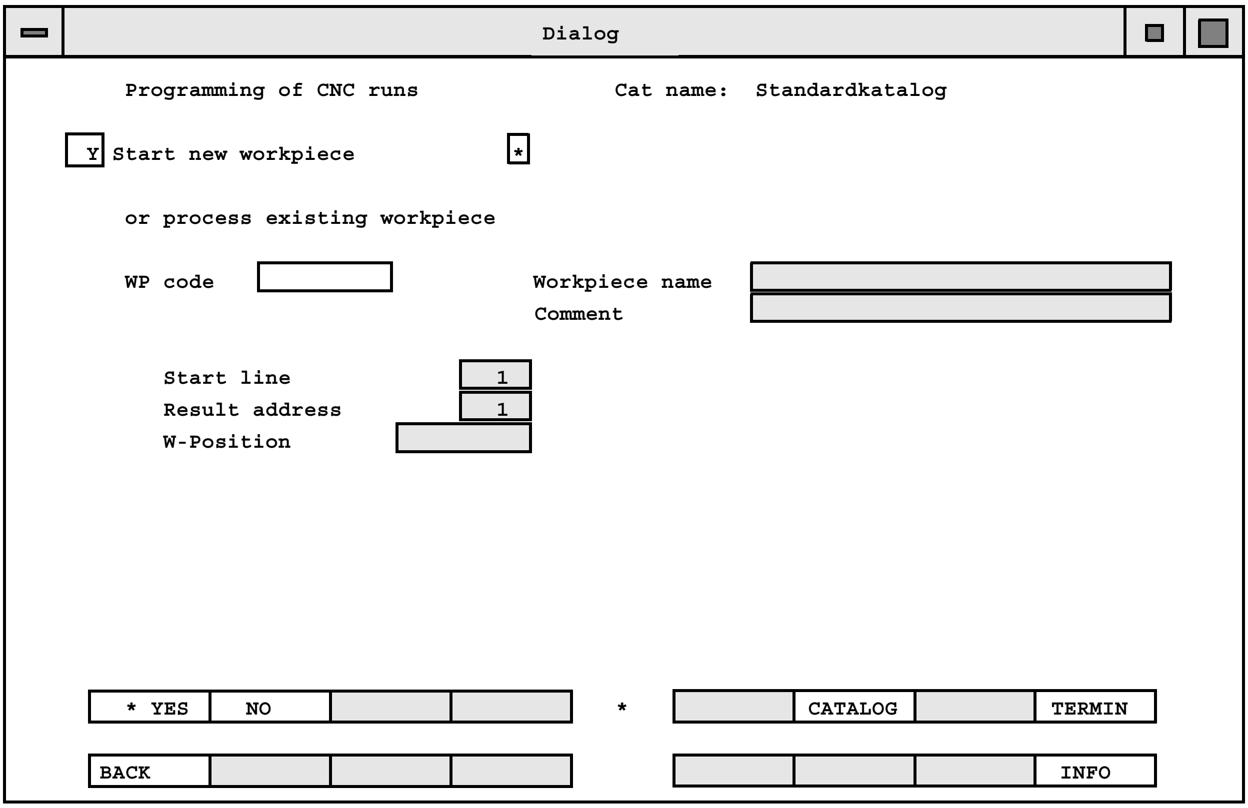
The following description applies if

– you are creating a completely new CNC program or

– you want to overwrite the control data of an existing CNC program completely.



DI	Pull-Down-Menu	Pictogram
1639 PROG	CNC PROG Start...	



NOTE

At the start of learn programming, all control coordinates are referenced to the W-position currently stored in the computer (➤***„Defining and storing the control coordinate system" on page 16-6***). If you want to start your learn program later as a CNC run, you must use this W-position again.

Softkeys

CATALOG To display the control data catalog

TERMIN To end the dialog window, learn programming is started.

Data boxes

Start new workpiece Press **<YES>** to start a new workpiece

or process existing workpiece

WS code A workpiece is selected after the workpiece code is selected with **<Enter>**.

Workpiece name Display of selected workpiece name.

Comment Comment on workpiece selected.

Start line Input of CNC run start line.

Result address Used to set the result address.

W-Position Number of the required W-position.

Continuing the learn programming of an existing workpiece

Procedure A finished CNC program can be overwritten section by section via learn programming or extended by adding new program steps ("patching").

The following conditions must be observed:

Coordinate system

– A CNC program will usually contain at least one call for defining the control coordinate system before the section to be newly programmed. You must activate this control coordinate system before continuing such a program via learn programming.

  Options:

  – It its position is known, determine it manually and store it.

  – If the W-position is present in the W-position file: Read it with **<DI 1712>**.

– Otherwise start the CNC run and stop at the point where the new learn programming is to be performed.

Continue programming by pressing **<PROG>** each time.

W-Position

– The workpiece must be aligned corresponding to the W- position entered.

Correct line

– If you continue programming at a random point, the following control data lines will be overwritten by the new programming steps. If you want to supplement a program without losing any existing control data, you must first enter the control data lines (➤ ***„Inserting additional control data lines with <INSERT>" on page 17-39***).

Another possibility: Append new control data lines to the end of the existing program, then move the control data lines appended to the correct position with **<CNC CORR>** and **<MOVE>** (➤ ***„Moving control data lines <MOVE>" on page 17-42***).

Continuing a learn program

If result addresses already exist, the address counter must be reset before the function call **<DI 1690>**. Otherwise the existing results will be overwritten by new ones and can no longer be recalled.

Inserting control lines

Adaptation with **<CNC CORR>** may result in a duplication of result addresses if the learn program is subsequently extended. This would cause complications in connection with recalls, formula applications or form and position tolerances.

Therefore:

– set the address counter with **<DI 1690>** so that all previously existing addresses are overwritten.

– Extend the learn program at the position required.

– Adapt addresses automatically by calling **<CNC CORR>**.

Alternative: Increase all existing addresses located behind the gap manually to prevent the creation of identical addresses.

Execution of learn programming

Procedure

Differences

Learn or teach-in programming basically differs from manual measurement in the following points:

– During learn programming the software stores all machine and travel commands (control data) specific to the workpiece. The workpiece catalog managers the individual workpieces (CNC programs). (➤***„Workpiece catalog“ on page 17-5***).

– You must define the travel paths with intermediate positions (➤***„Travel paths and intermediate positions“ on page 16-30***).

– Normally you should start each CNC program as follows:

  1. Define the control parameters: **<DI 1661>** (not necessarily required, cf. ➤***„Probing, probing parameters, machine parameters“ on page 16-20***).

  2. Set initial status: with **<DI 1608>** or **<REC HEAD>**.

  3. Align the workpiece mathematically and define the workpiece coordinate system.

  4. Define the W-position and store with **<DI 1710>** or **<DI 1708>**; do not use the number of the initial W-position with **<DI 1710>**, i.e. assign another number.

Then program the actual measuring run; use special generation programs if necessary (➤***„Generating programs“ on page 16-36***).

– For calling measuring and evaluation programs ➤***„Program calls“ on page 16-20***

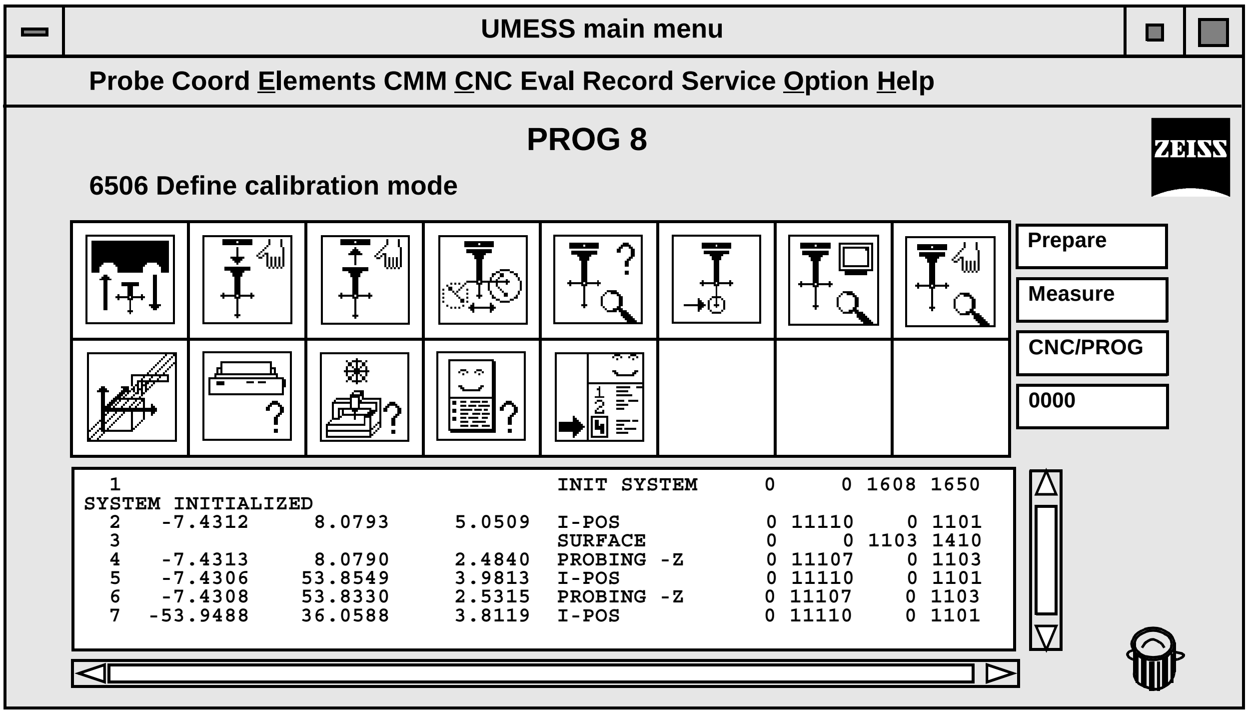
– Suitable programming strategies shorten the measuring time during the CNC run (➤***„Reserve address <DI 1456>“ on page 16-29***).

– Rotary table: Positions traveled to with the joystick during learn programming must be written to the control data with **<DI 1521>** (➤***„Positioning commands“ on page 15-4***).

Screen display during learn programming

Display

Your fully programmed control data lines are displayed for checking in the list and message window:



Example

The example shows the dialog window as it would appear after programming the first 7 control data lines. UMESS will then wait for programming step 8. For an explanation of the codes and abbreviations, please see ➤***„Interpretation of the control data“ on page 17-29***.

The number of program lines visible depends on the size of your list and message window (increase its size if necessary).

Correction during learn programming <DI 1032> and <DI 1694>

Application

Incorrect program calls, incorrectly set intermediate positions and other errors can be canceled (undone) during learn programming.

Alternative

Continue programming and quit learn program, afterwards clear errors via renewed learn programming (➤***„Continuing the learn programming of an existing workpiece“ on page 16-14***); control data correction (➤***„Correcting control data <DI 1642>“ on page 17-31***); delete incorrect control data lines (➤***„Deleting control data lines <DELETE>“ on page 17-43***).

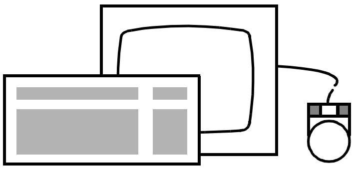
Options

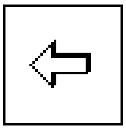
The following options exist to perform corrections during learn programming:

Delete a control data line

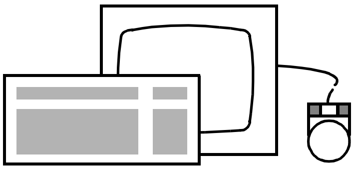
e.g. after an incorrectly set intermediate position or an incorrect probing.

The last control data line can always be deleted with **<DI 1032>**.

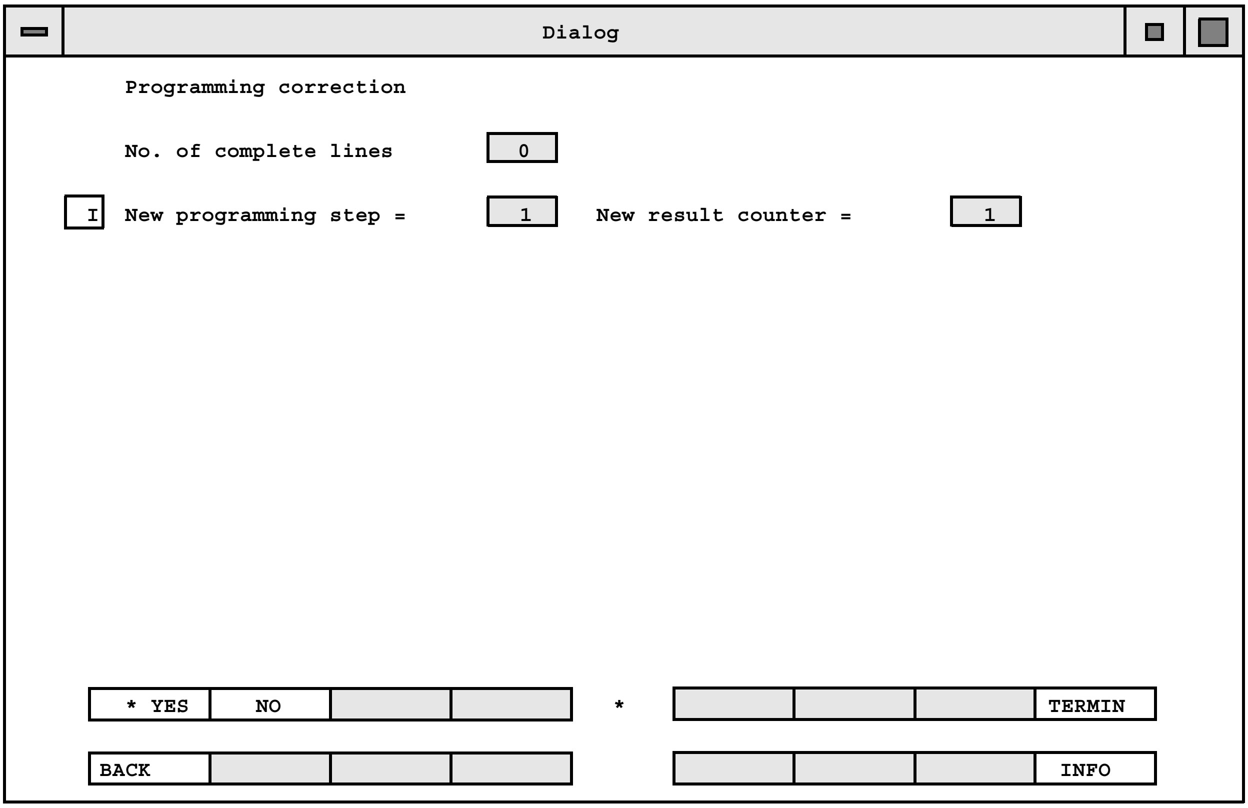


DI	Pull-Down-Menu	Pictogram
1032 CORRECT	CNC PROG Correction	

You can enter the number of control data lines to be deleted with **<DI 1694>**.



DI	Pull-Down-Menu	Pictogram
1694 PRGCORR		



Data boxes

No. of complete lines

Display only for orientation

New programming step =

Enter the program line from which the new program is supposed to start.

Limit 1 - Total number of lines.

New result counter =

Correct the result counter (address counter) if necessary, e.g. if you want to repeat the learn programming of several addresses.

NOTE

Function call of **<DI 1032>** and **<DI 1694>** is possible only outside of an N point program.

Correction possibility within an N point program:

– **<Correction>** key

– **<Cancel>** key

These correction calls clear all previous probings and intermediate positions performed within the N point program and the program call. The programming step counter is set to the line of the original program call.

- If functions have to be deleted which change the workpiece coordinate system, first restore the preceding coordinate system before performing the correction (e.g. **<RECALL>**).
- The control data editor can be called during programming with (**<DI 1642>** or **<CNC CORR>**).
- **<DI 1641>** or **<CNC LIST>** can be used to list the current program (the program call does not generate a control data line). You therefore have the possibility of gathering information on the programming steps required and the result addresses.

Program calls

Program calls

during learn programming are handled the same as in the manual mode:

- Activate point measurements via direct probing or with **<DI 1101>**.
- Call N point program as usual, conclude with **<TERMIN>** or **<NOMINAL>** (➤***„Computer controlled manually measured sections <DI 1077>“ on page 16-25***).
- If you press the **<PRE MENU>** or **<BACK>** key while programming a function, the program step counter will go to the first step of the function. You can then continue the learn programming (➤***„Correction during learn programming <DI 1032> and <DI 1694>“ on page 16-17***).

Fixed plane

If you use an incorrect fixed plane during learn programming, errors will occur in the subsequent CNC measuring run (the measuring plane of the geometric element is stored in the control data).

Nominal input

The options available for nominal input are explained in ➤***„Computer controlled manually measured sections <DI 1077>“ on page 16-25***.

Probing, probing parameters, machine parameters

Probing

The CNC program automatically accepts each probing during learn programming. The relevant control data line stores the following for each point probed:

- Center coordinates of the probe referenced to the control coordinate system at the moment it contacts the workpiece,
- Probe number,
- Probing direction.

Probing and machine parameters (<DI 1661> or <DI 1662>)

There are three options

– Always program the relevant functions as well (at the start of learn programming). Please note the restrictions when learn programming **<DI 1662>**.

  Advantage: This measure ensures that each measuring run is optimally tailored to the particular workpiece and measurement, even if the parameters have been changed in the meantime (e.g. by other users).

  If the program occasionally has to be executed with parameters other than the ones programmed, set the required values in the manual mode. Then, when the CNC mode is started, skip the programmed parameters by entering an appropriate start line.

– If the mode seldom changes: Do not define any parameters in the CNC program, but set the parameters before the CNC start instead.

– If the parameter data should or must be changed section by section within the CNC program (e.g. to measure critical elements): incorporate the parameter changes at a suitable point in the CNC program if the corresponding function is learn programmable.

Programmable stop <DI 1096>

Application

This function can be used to integrate stop functions in the measuring run during learn programming. The machine then stops at the programmed point during the CNC run. This is useful e.g. for the purpose of removing probes which would be in the way during the rest of the measuring run.

Function call

During the stop phase, you can call other UMESS functions, e.g. to edit probing or control parameters, modify the record output etc.

NOTE

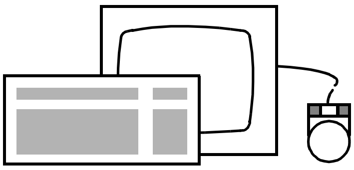
You can program a user comment with **<DI 1677>** immediately ***before*** the stop command which appears on the screen in the CNC run.

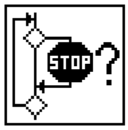
Not allowed

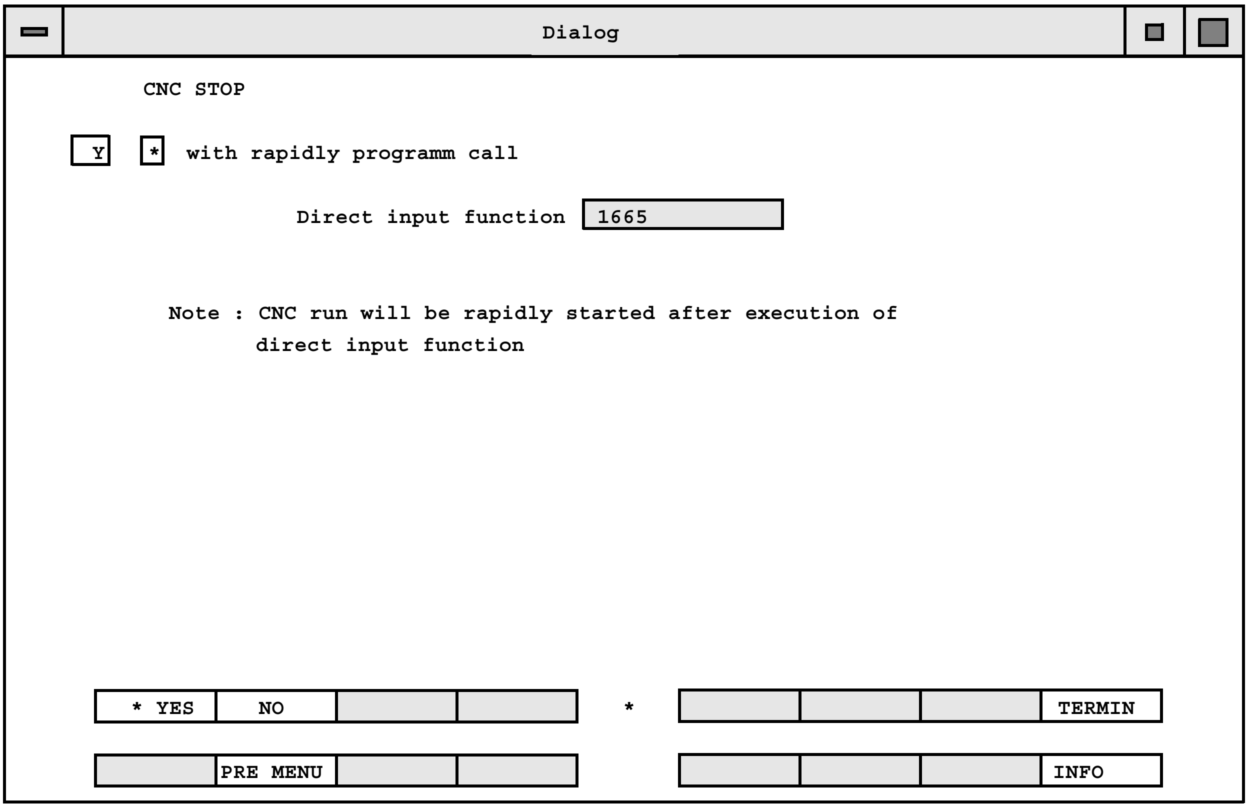
The following functions are not allowed during the stop:

<DI 1610, **1612**, **1613**, **1629**, **1632**, **1633**, **1634**, **1635**, **1636**, **1639**, **1640**, **1641**, **1642**, **1644**, **1649**, **1676**, **1677**, **1678>**.

Function call Possible only in **PROG**



DI	Pull-Down-Menu	Pictogram
1096 PRG STOP	CNC PROG	
a63	Stop with DI	

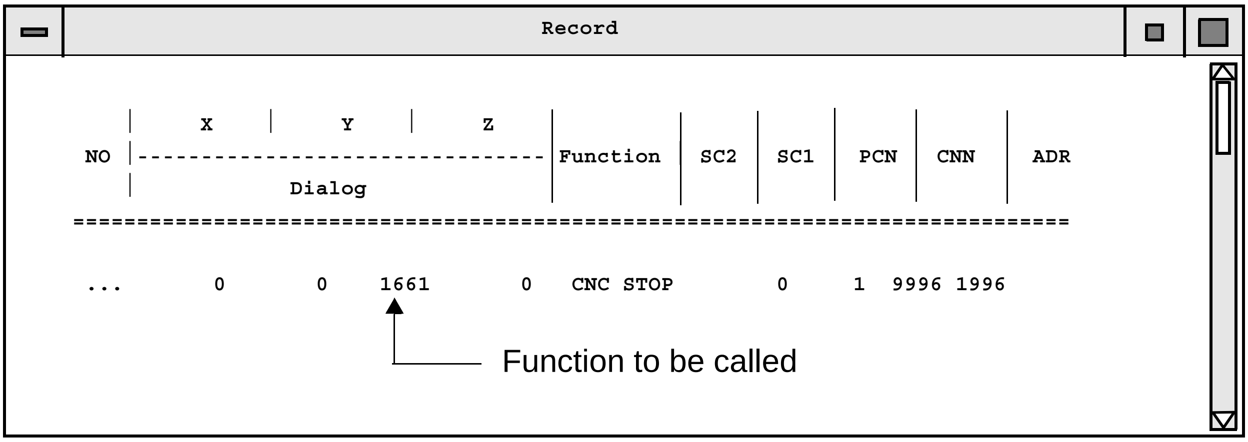


Data boxes

with rapidly program call

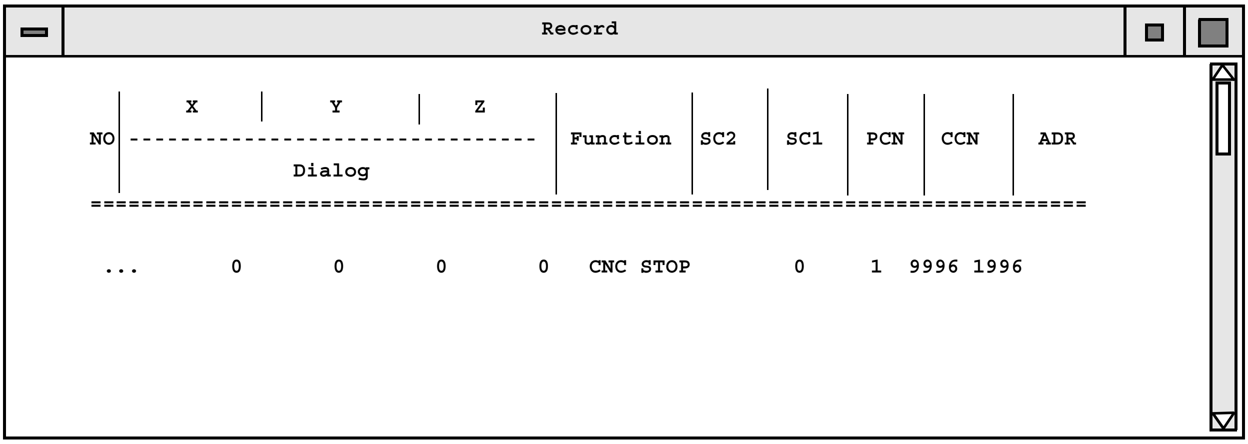
– <YES>
The CNC run automatically calls a specific function and/or opens its dialog window at the programmed stop. When the input has been concluded and the function has been executed, the CNC run will continue automatically, cf. comment in dialog window. You must enter the required function in the **Direct input function** box.

Generated control data line



– **<NO>**
  The CNC run stops and is resumed only after this is requested by the operator. Other functions can also be called up during the Stop phase, ➤ ***„Function call during the stop phase“ on page 18-13***

Generated control data line



Direct input function

If you have selected **with rapidly program call**, enter the function to be called automatically here. If you want to call several functions in succession automatically, program **<DI 1096>** the number of times required in succession.

Probe head mode <DI 1551>

Application

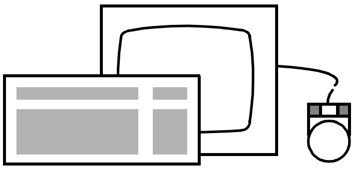
If you want to change the probe head mode during a CNC run, you must program every changeover with this function. This function is superfluous for manual measurement.

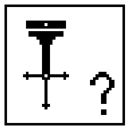
Application examples

- Changeover to the **MAN** operating mode for self-centerning probing contacts in CNC and return to the **AUTO** operating mode;
- Alteration of the measuring force during the CNC measuring run.

Please note

You must set an intermediate position with the probe in a non-contact position before executing the function call.



DI	Pull-Down-Menu	Pictogram
1551 PRBMOD	CMM Mode Probe head...	

Data box

Set operating mode, measuring forces and clamping at control panel

Prompt to enter settings on the control panel (in accordance with the control panel operating instructions). Please also note that:

- You must select at least one measuring force direction (= probing direction).
- Either no clamping or one clamping is allowed; two clampings correspond to the automatic mode.
- Measuring force and clamping in der gleichen Achse sind nicht erlaubt.

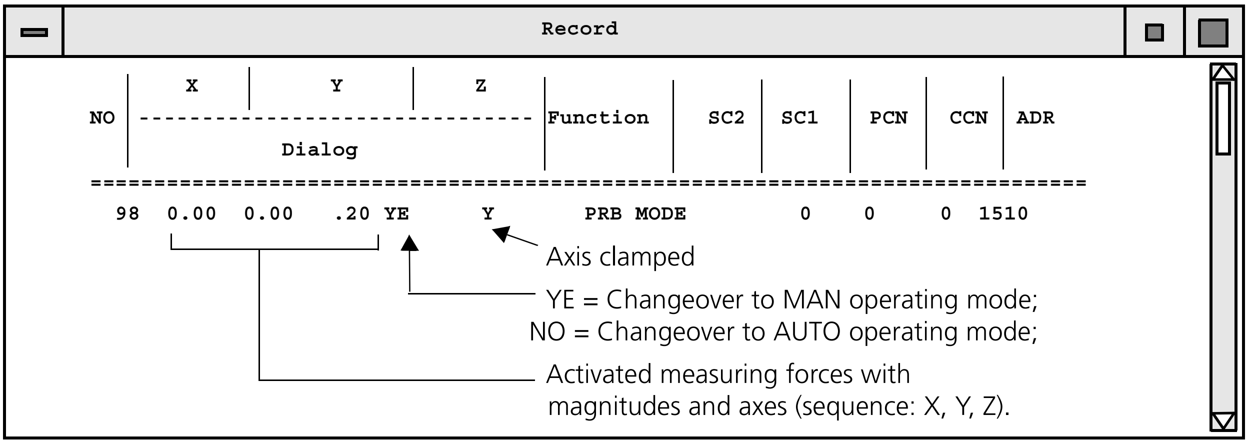
TERMIN

Press **<TERMIN>** as soon as you have set the probe head mode. Learn programming can now continue as long as the computer does not recognize the status set as illegal or need more information on the probing direction.

Prbg direction =

This inquiry will appear only if you have activated more than one measuring force direction. It therefore prompts the user to enter more information on the probing direction. You may specify only one axis in which the measuring force is activated as the probing direction.

Generated control data line



If a probing direction is requested as described above, it will not appear in this control data line. Instead it will appear in encoded form, i.e. under **SC1** for the following probing(s).

Computer controlled manually measured sections <DI 1077>

Application

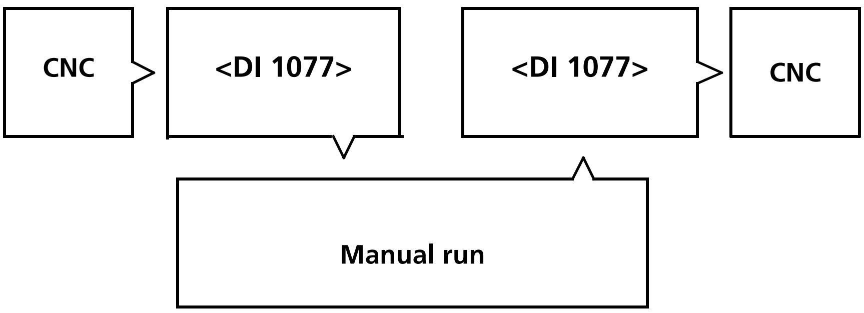
Manually measured sections can be integrated into CNC programs.

Application examples

- Used for manual probing where roughly toleranced parts (castings) could cause collisions.
- Used to define the W-position before the first travel movement at the start of a CNC program. As a result, the workpiece can be measured in any position regardless of the stored W-position.

Function

<DI 1077> programs the changeover between manually measured sections and CNC measurement.



NOTE

- Via learn programming of the manual section, a dialog results which is subsequently used to guide the operator: All probings stored in the control coordinate system will appear as a clearly interpretable user comment in the dialog window. (➤***„User guidance in manual sections“ on page 18-16***).
- This user guidance concerns only the probings (in the control coordinate system). All other functions, e.g. the start and termination of N point programs, alignment commands, recalls etc. are automatically initiated by the CNC run, even in the manual section
- The coordinate measuring machine travels to intermediate positions and probings in the workpiece coordinate system, even in the manual section.

NOTE

- The manual section ignores intermediate positions in the control coordinate section. You can therefore omit programming of the travel paths (intermediate positions) if it can be ensured that the section will always be performed manually. Normally, however, it should be possible to optionally execute the section concerned either manually or automatically. This can best be achieved by masking or demasking the control data lines relevant for changeover prior to the CNC start.
- **<DI 1096>** is ineffective in manual sections.

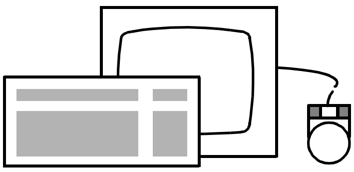
Overview

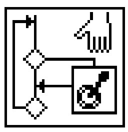
The following overview compares the individual steps performed during programming and during the CNC run:

<PROG>	<DI 1640>
Learn programming	Automatic measuring run
Call <DI 1077> before measuring the critical element (CNC => MAN)	Changeover to computer controlled measuring run
Learn programming the critical element as usual	The dialog window gives tips on measuring the element ➤ ***„User guidance in manual sections" on page 18-16***
Call <DI 1077> after measuring the critical element (MAN => CNC)	Changeover to CNC measuring run
Learn programming	Automatic measuring run

Function call

possible only in **PROG**



DI	Pull-Down-Menu	Pictogram
1077 MANCNC	CNC PROG	
a55	manual measuring section	

Data box

Activate operation mode 'MANCNC' ?

– **<YES>**
The manual mode is switched (or left) on.

– **<NO>**
The CNC mode is switched (or left) on.

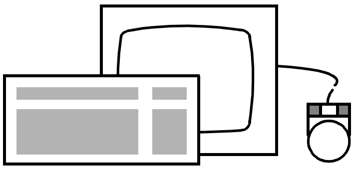
Comment line in the control data <DI 1679>

Application

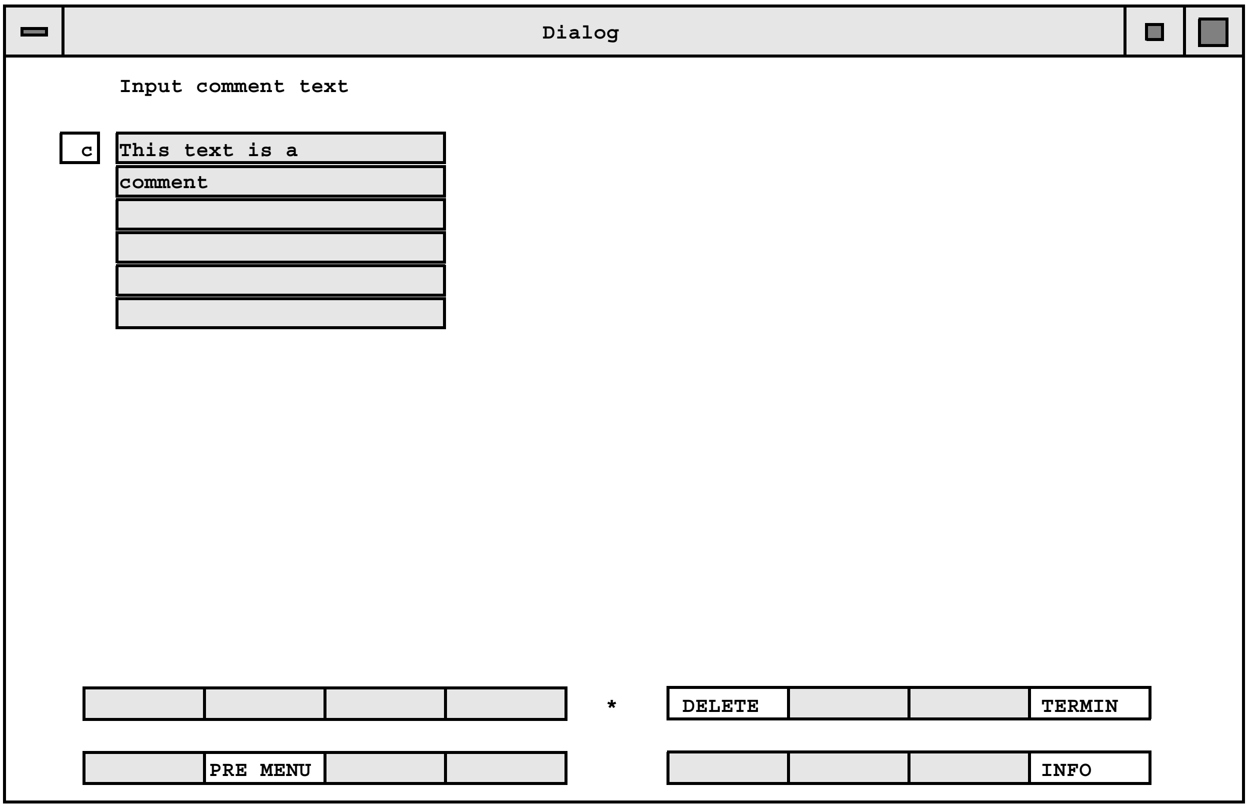
This function can be used to insert any text in the control data. These texts are not taken into consideration during the CNC run.

Function call

Possible only in **PROG**.



DI	Pull-Down-Menu	Pictogram
1679		



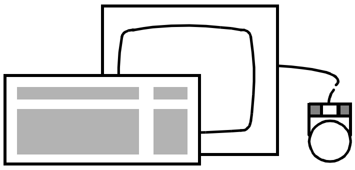
DELETE

All of the text in the data boxes is deleted.

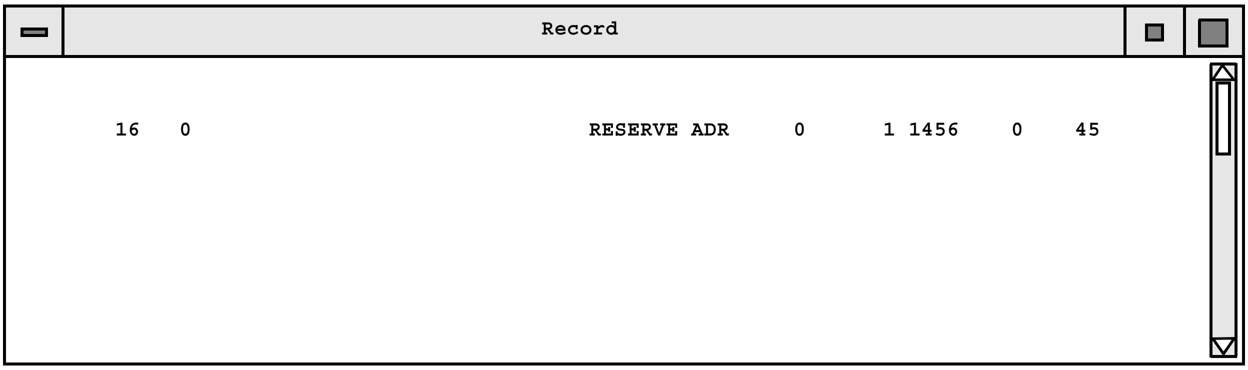
Reserve address <DI 1456>

Application

If you can not enter function calls right away during a learn program but nevertheless want the address flow to resume immediately afterward, you can reserve an address with **<DI 1456>**.



DI	Pull-Down-Menu	Pictogram
1456		



Control data

A line is reserved in the control data.

Strategies for time-optimized programs

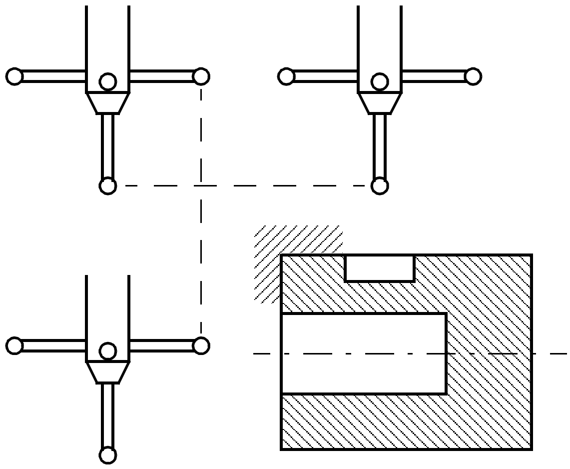
NOTE

For a time-optimized CNC program, please observe the following guidelines:

- The probe should travel around the workpiece only once and in one direction.
- Avoid probing elements repeatedly, i.e. use **<RECALL>** instead.
- Use intermediate positions sparingly (➤***„Travel paths and intermediate positions“ on page 16-30***).
- Utilize the possibilities for time optimization by adjusting the probing and machine parameters individually (section by section) (➤***„Probing, probing parameters, machine parameters“ on page 16-20***).
- If necessary, make sure that the program continues running following missing bores (➤***„Continuation after a missing bore <DI 1080>“ on page 16-32***).

Travel paths and intermediate positions

Overview



How this function works

In the CNC mode your measuring machine travels from one point to the next. You must specify all travel movements except for probings in the learn program by setting intermediate positions or entering travel commands. This is necessary:

– to be able to travel around the workpiece without collision by changing the direction of travel;

– to position the probe in relation to a new geometric element;

– to ensure that the probing direction is clearly recognized if and when it is changed;

– to enable collision-free travel to the next workpiece following a measuring run.

Positions

Options for programming intermediate positions and travel movements:

– Normal intermediate position in the ***W-position system*** defined via the correspondingly labeled control panel key or (if installed) the push-button in the right-hand joystick or in N point programs via softkey **<I-Pos/Prb>** (➤***„Intermediate position <I-Pos> in the W-position system“ on page 16-31***).

– Fine positioning in the ***workpiece coordinate system*** via the travel and positioning commands (➤***„Fine positioning in the workpiece coordinate system“ on page 16-31***). The fine position can be influenced by the standstill window using **<DI 1661>**.

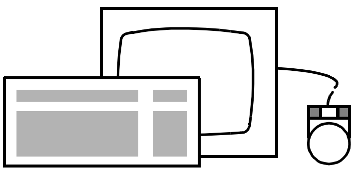
NOTE

- Use intermediate positions sparingly; as a rule of thumb when measuring an element: Set one intermediate position before the probing and none afterwards.
- As long as one of the axes is in a limit position, you can not program any intermediate positions.
- Before switching over to another probe: Set an intermediate position.
- To optimize travel paths: Observe ➤***„Comment line in the control data <DI 1679>“ on page 16-28***.

Intermediate position <I-Pos> in the W-position system

Application

If the intermediate position keys are pressed when the probe is not in contact, the coordinates of the preselected probe will be programmed as an intermediate position. The probe then travels to this position with an accuracy of several tenths of a millimeter ***in the W-position system*** (control coordinate system).



DI	Pull-Down-Menu	Pictogram
1510	CNC Intermediate position	

Probing

If the keys are pressed with the probe in contact (with a measuring probe head) a probing will be programmed.

Follow instructions in ➤***„Overview“ on page 16-30***.

Fine positioning in the workpiece coordinate system

With the travel functions

<POSITION>,

<STEP>,

<REF STEP>,

<POS-RES>,

<POSNORM>

you can program fine positions ***in the workpiece coordinate system*** based on the conditions defined with **<DI 1661>** (➤***„Travel commands“ on page 10-34***).

Advantage

Advantage of using the workpiece coordinate system: You can thus take the specific circumstances of each workpiece measured (e.g. due to manufacturing inaccuracies) into account. This is possible even in critical situations (e.g. when positioning in narrow bores, probing defined points, traveling or probing relative to the last probing, etc.).

Continuation after a missing bore <DI 1080>

Application

Sometimes bores may be missing or chips, burs etc.may obstruct the probe in a bore. For such cases, continuation of the CNC program can be ensured via the safety mode. This works for the following measuring programs:

- **<DI 1104>** (circle),
- **<DI 1106>** (cylinder),
- **<DI 1107>** (sphere),
- **<DI 1108>** (ellipse),
- **<DI 1112>** (min. round),
- **<DI 1113>** (max. round),
- **<DI 1114>** (circle segment).

Special cases

For complicated elements or part features (e.g. oblong holes) you may need other measuring programs, e.g. **<DI 1101>** (point). In such cases, it is advisable to use **<DI 1081>** as well (➤***„Bore element <DI 1081>“ on page 16-34***).

Additional condition

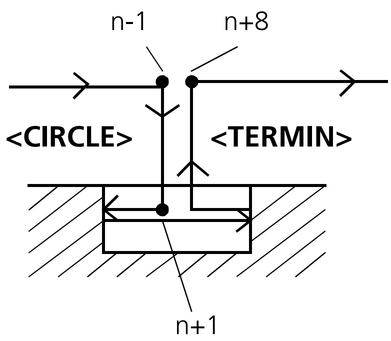
The bore must not be used for alignment or for defining the workpiece coordinate system (zero point).

Procedure

for learn programming the safety mode:

- Activate the safety mode with <**DI 1080>** at the start of the CNC program or before reaching critical bores.
- If you are using functions other than those mentioned above, program **<DI 1081>** as well (➤***„Bore element <DI 1081>“ on page 16-34***).
- Measure the bore or critical element using one of the programs specified above. When doing so, keep to the following sequence of intermediate positions and calls:
  - Set **I-POS** outside the bore,
  - Call function (e.g. **<CIRCLE>**) ,

- Set **I-POS** inside the bore (not too deep, otherwise collision will be too great),
- Measure the element as usual with probings and intermediate positions,
- **<TERMIN>**,
- Set the **I-POS** again outside the bore.



(● = I-POS)

Control data:

NO	Function	Note
	.	
	.	
m	YE MISSING BORE	Safety mode on
	.	
	.	
n-1	I POS	last I POS before element
n	CIRCLE	
n+1	I-POS	do not set too low
n+2	PROBING +Y	
n+3	PROBING -Y	
n+4	I POS	
n+5	PROBING +X	
n+6	PROBING -X	
n+7	N POINT TERM	
n+8	I-POS	I POS outside the element; here the CNC run continues if a collision occurs
	.	
	.	

- If necessary switch off **<DI 1080/1081>** again.

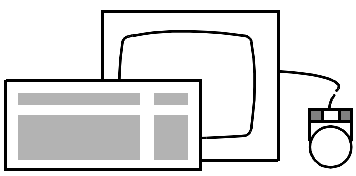
Function

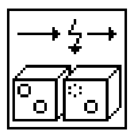
If a collision occurs in the CNC run between the first **I-POS** outside the bore and **N-POINT TERM**, the program will continue from the next **I-POS** after **N-POINT TERM**, cf sketch.

The screen displays the message: **Element cannot be calculated**; **NO RESULT** appears in the record(➤ ***„"No result" function“ on page 10-55***).

Function call

Possible only in **PROG**



DI	Pull-Down-Menu	Pictogram
1080 BOREMISS	CNC PROG Continue with problems...	

Data box

Activate operation mode 'Missing drill hole' ?

- **<YES>**
  Activates the safety mode.

– **<NO>**
  Deactivates the safety mode.

Bore element <DI 1081>

Application

You can not measure complicated elements such as for example oblong holes, rectangular holes, grooves, joints etc. via a single measuring program call. In many cases you must first perform the required probings as points or individual elements and then calculated the dimensions required by recalling and linking or combining individual elements.

Safety mode

In this case you can obtain a safety mode as for circle etc. To do this, you mark the point where an oblong bore begins and ends with **<DI 1081>** In this way the program recognizes where it must continue the CNC run if the oblong bore is missing or following a collision in the oblong bore (e.g. with burs or chips).

Procedure

– Activate the safety mode with **<DI 1080>** if this has not already been done (➤***„Continuation after a missing bore <DI 1080>“ on page 16-32***).

– As soon as you start the bore element: Mark the beginning of the bore element with **<DI 1081>**.

Control data:

NO	Function	Remark
	.	
	.	
m	YE MISSING BORE	Safety mode on
	.	
	.	
n-1	I POS	Last I POS outside element
n	BORE ELE ST	
n+1	I POS	Do not set too low
n+2	POINT	
n+3	PROBING -Y	
n+4	N POINT TERM	
n+5	I POS	
n+6	PROBING -X	
n+7	N POINT TERM	
n+8	BORE ELE END	I POS outside the element; here the CNC run continues if a collision occurs
n+9	I POS	
	.	
	.	

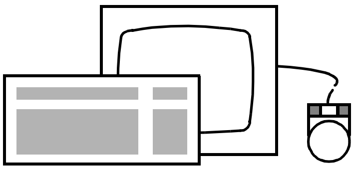
Bracketing for bore element

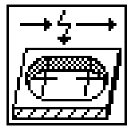
– Measure the bore element, e.g. with single-point measurements.

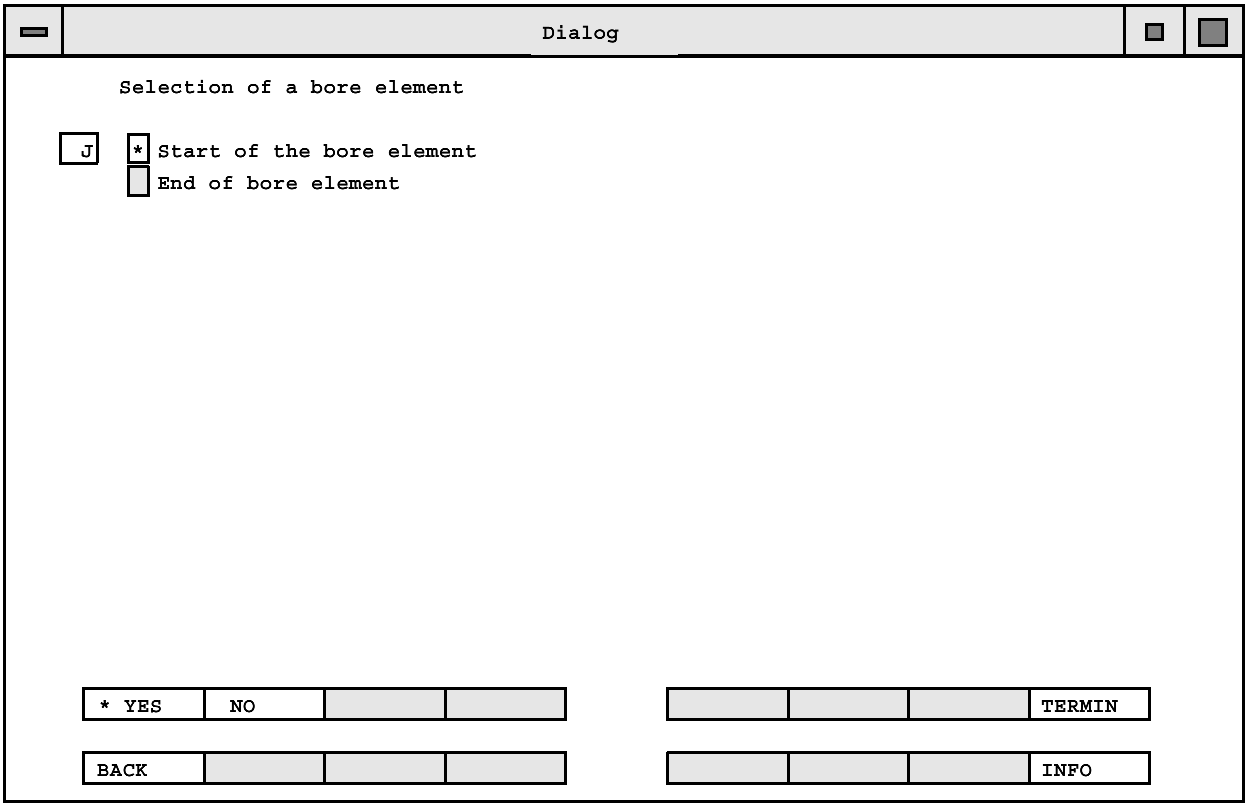
– Once you have all probings for your bore element: Mark the end of the bore element with **<DI 1081>**.

– Set the intermediate position outside the bore element from which the CNC run should be continued if the bore element is missing.

Function call Possible only in **PROG**



DI	Pull-Down-Menu	Pictogram
1081 HOLE	Elements Macros Bore element...	



Generating programs

Overview

Application

Generating programs can reduce your programming time when measuring regularly arranged elements, processing alternative program sections, repeating program steps etc.

The following generating programs are available

- Loops to repeat program steps. The number of repetitions is specified or dependent on conditions (➤***„Loops <DI 1051>" on page 16-36***).
- Branching to run alternative program steps depending on the given measuring results or branching within the program (➤***„Conditional branchings and jumps <DI 1050>" on page 16-44***).
- W-position displacement (➤***„W-position displacement <DI 1769, DI 1771>" on page 16-66***) for elements with a regular arrangement.
- **EXCALL** workpiece jump to load other CNC programs as subprograms or define a batch measurement (➤***„EXCALL workpiece jump" on page 16-71***).
- CNC macro for transferring previously created control data lines to a CNC program or taking them over into different CNC programs in unmodified or corrected form. (➤***„CNC macro mode" on page 16-77***).

Loops <DI 1051>

Application

Loops simplify programming if identical or similar elements are arranged in a regular pattern (e.g. hole circles, Bore patterns). Application example: ➤***„Application example for loops and branchings" on page 16-64***

Scope

A loop comprises all of the control data lines necessary to reach, measure and evaluate a recurring program section. You can either predefine a fixed number of repetitions (e.g. hole circle) or make this contingent on certain conditions (e.g. repeated measurement of an element with different probing parameters if the standard deviation exceeds a specific limiting value).

Programming loops

- Start the learn programming as usual.
- When you reach a measurement section which is to be measured by loops, open the **Loops** dialog window with **<DI 1051>**.

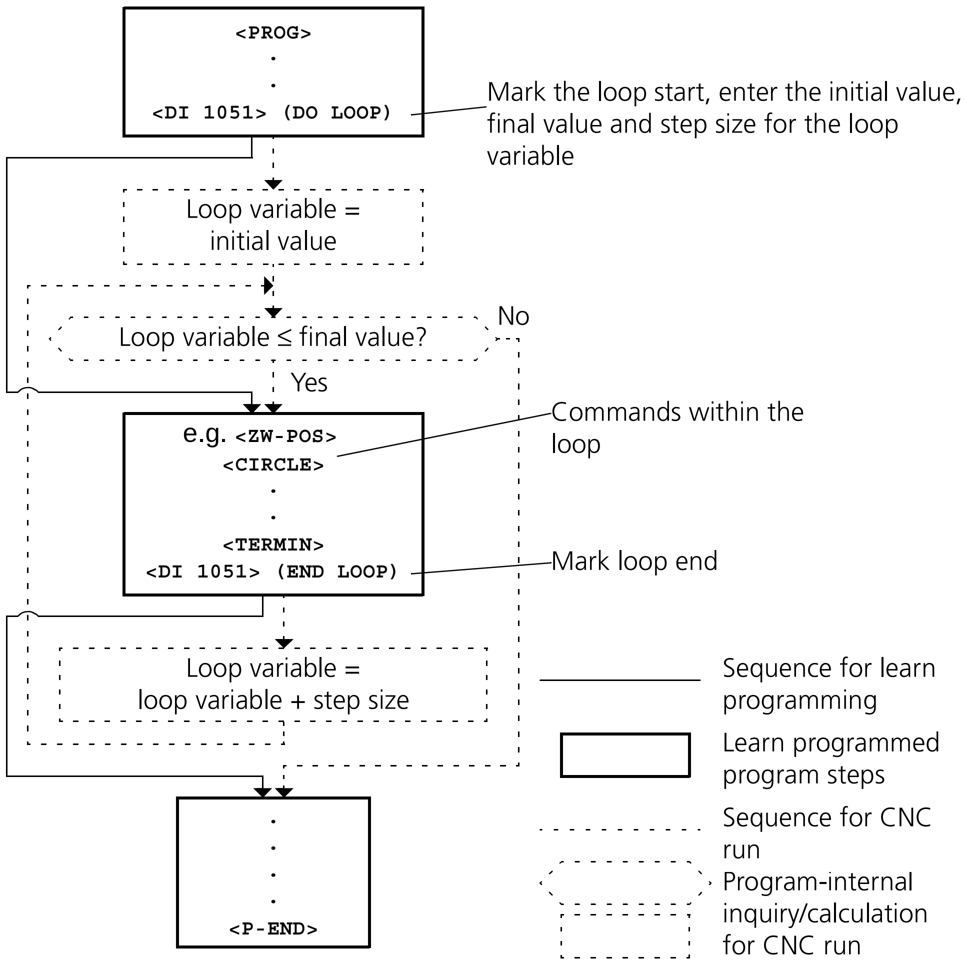
– Select the type of loop and mark its starting point, if necessary make other input(s): ➤***„Control data of loops and branchings“ on page 16-58***
– If a coordinate system is to be formed or changed within a loop, an offset with the coordinates X, Y, Z = 0.0000 must be programmed at the start of the loop.
– Learn program the first of the recurring measurement sections including the travel path to the next measurement section. Additional (nested) loops and/or branches are allowed within a loop (**maximum nesting depth: 10 levels**).
– Open the **Loops** dialog window with **<DI 1051>**, mark end of loop and make any other inputs which may be necessary. Control data line(s) generated: ➤***„Control data of loops and branchings“ on page 16-58***
– Continue learn programming as usual.

A distinction is made between the following loop types:

1. Loop without condition

You define the number of repetitions. The loop variable controls the repetitions in the program. Starting from an initial value, the loop variable changes by one preset step size with every run. The loop is then repeated as often as necessary until the loop variable no longer exceeds the specified final value.

Structure:

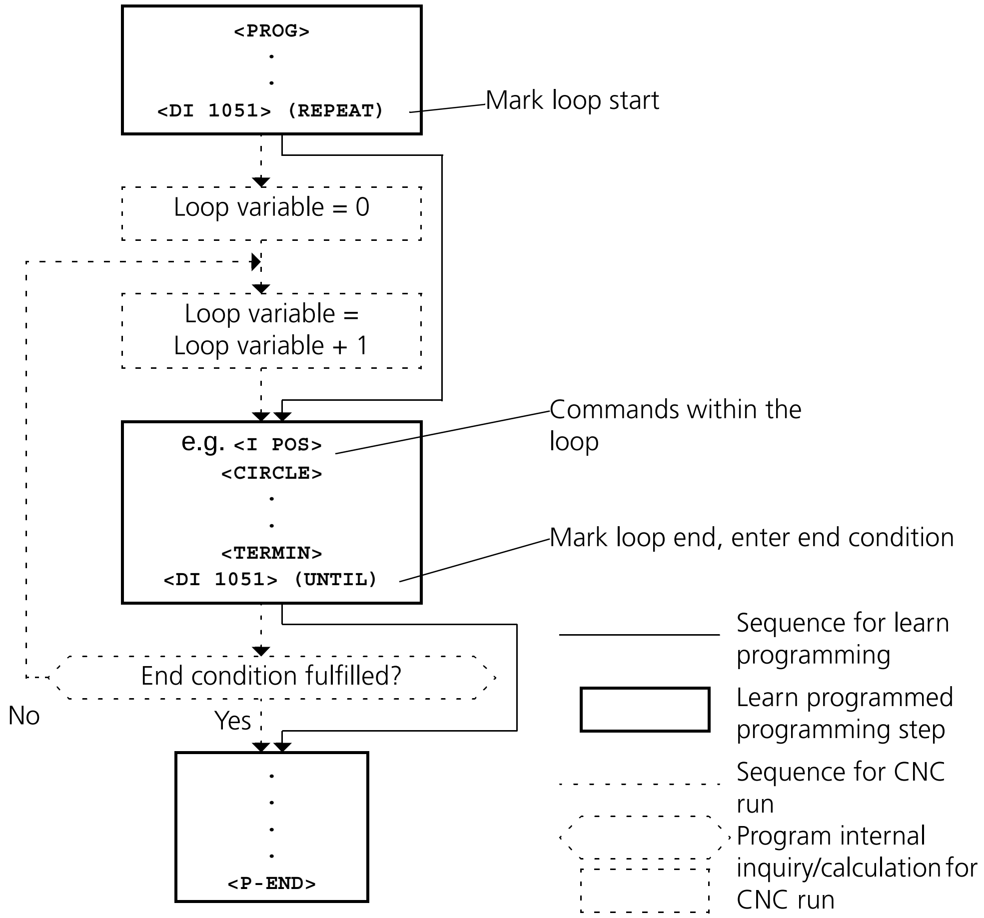


2. Loop with condition at the end

You specify a condition for the end of the loop, e.g. a certain measured value. The program checks whether the condition has been fulfilled after each cycle. The loop is then repeated as often as required until the specified condition has been met. Since the check is first made at the end of the loop, the CNC program must run through the complete loop at least once.

With this type of loop, the loop variable counts the number of loop cycles (cycle counter). You thus have the option of including the number of repetitions in the end condition e.g. to prevent closed loops.

Structure:

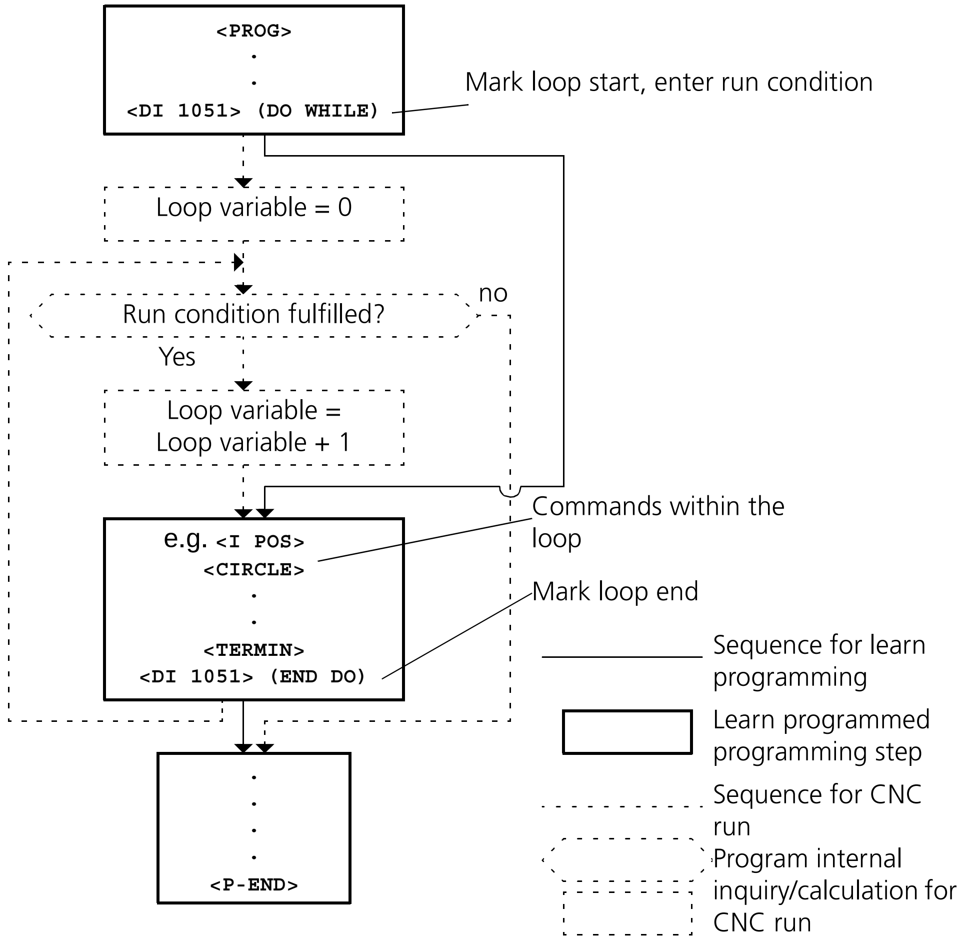


3. Loop with condition at the start

You specify a condition for cycling the loop, e.g. a certain measured value. The program then checks whether this condition has been fulfilled before each cycle. The loop is repeated as often as necessary until the condition has been met. Since this check takes place at its start, the loop cycle may be omitted completely.

With this type of loop, the loop variable internally counts the number of loop cycles (cycle counter). You thus have the option of including the number of repetitions in the end condition e.g. to prevent closed loops.

Struktur



Additional information

– When performing learn (part) programming, you measure each element or feature only once. The result name therefore appears in the record only once. However, during a CNC run such an element will usually be measured several times. All repeat measurements are therefore indexed to differentiate between them in the record:

Learn programming	CNC run
CIRCLE_5	CIRCLE_5 CIRCLE_5_1 CIRCLE_5_2...
LINE	LINE LINE_1 LINE_2...

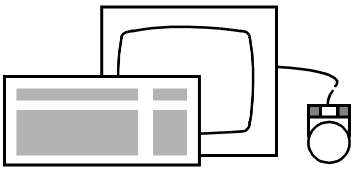
It is not possible to enter indexed result names, i.e. only the recall and linking of such names are allowed.

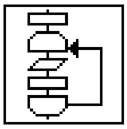
– When calculating the nesting depth, UMESS considers loops and branches with equality of access. **The max. nesting depth is 10**.

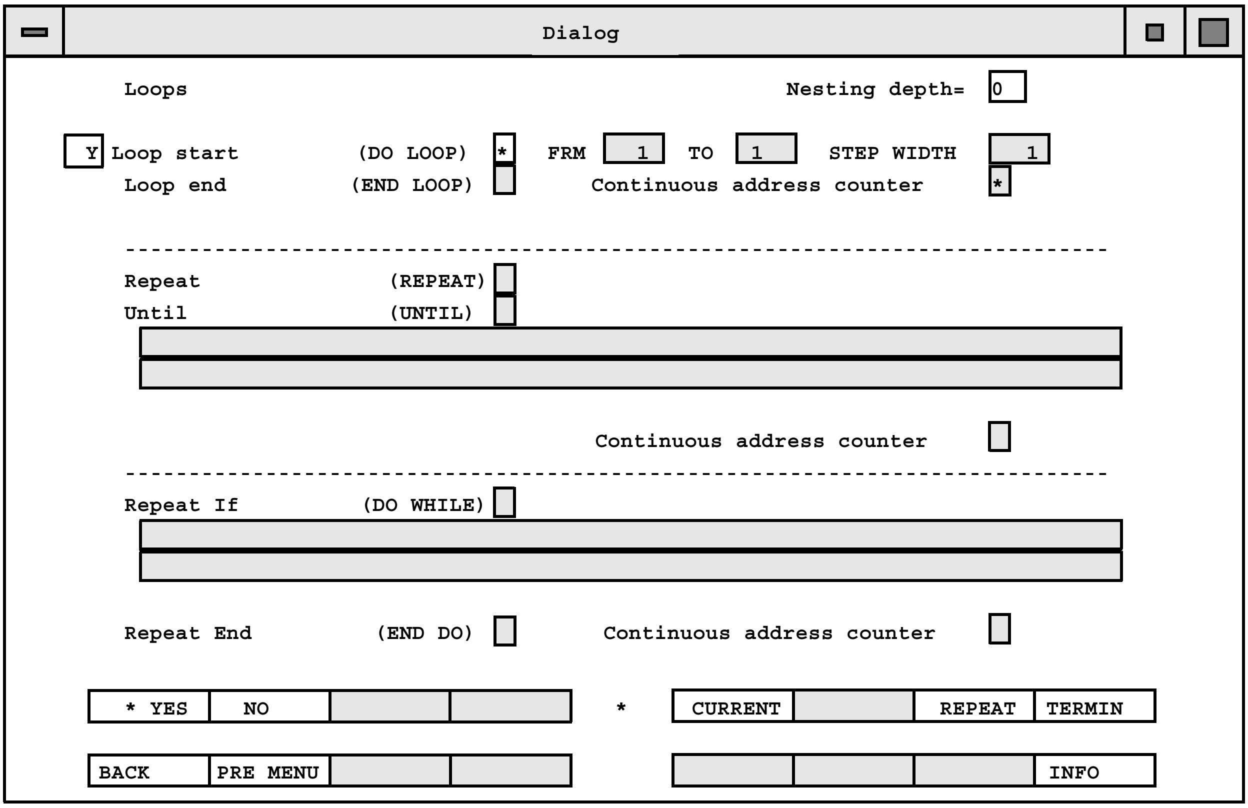
– Each loop which has been started must also be closed (the no. of "open" calls = the number of "close" calls).

– If you want to access any addresses or results determined in loops, proceed as follows when a loop has been completed:
  – End **PROG**.
  – Start CNC mode.
  – Continue learn programming

Function call Possible only in **PROG**.



DI	Pull-Down-Menu	Pictogram
1051 LOOPS	CNC PROG Loops...	



Softkeys

*** YES/NO**

Used to accept/reject the highlighted **<YES>/<NO>** box.

CURRENT

This softkey enters the current nesting depth in the dialog window. It should be used, for example, after jumping to an existing CNC program with **<PROG>** to correct or extend it via learn programming. Generally to be used if there is any doubt on the nesting depth displayed.

Alternative: Before **<PROG>**, execute a CNC run up to the line to be jumped to. In this case, the correct nesting depth will immediately appear in the dialog window and there is no need to press the softkey.

REPEAT

Used to cancel changes (entries reset to original status).

TERMIN

Used to close dialog window and program the control data lines corresponding to the entries.

Data boxes

Loop start (DO LOOP)

Used to start programming a loop of the type **"without condition"**. All subsequent control data lines will be assigned to this loop until it is concluded with **Loop end (END LOOP)**.

FRM

Initial value for loop variable; e.g. enter 2 if the bore pattern programmed with the loop should be measured starting with the 2nd bore.

TO

Final value for loop variable; e.g. enter 20 if the bore pattern programmed with the loop should be measured up to bore 20.

STEP WIDTH

Step size for the loop variable; the loop variable changes by this value with every loop cycle. For example, enter 3 if only every third bore of the bore pattern programmed with the loop is to be measured. Thus, with an initial value of 2, bores 2, 5, 8, ...

Loop end (END LOOP)

Used to terminate the programming of a loop of the type **without condition**. All control data lines since the last **Loop start (DO LOOP)** call are integrated in this loop.

Continuous address counter

– **<NO>**
  The same address is assigned to all elements measured within the loop. Therefore, only the values recorded last can be referenced in the CNC run (e.g. with **<RECALL>**).

– <YES>
  Continuous addressing; the addressing of the learn program and the CNC run do not agree. If the number of elements measured is decided individually for each CNC run due to the loop condition, the addressing will also vary accordingly. In such cases you should set the address counter behind the loop to the (maximum) value expected in the CNC run if recalls, SAM applications, etc. require unambiguous address assignment.

Repeat (REPEAT)

Used to start programming a loop of the type **condition at end**. All subsequent control data lines belong to this loop until it is terminated with **Until (UNTIL)**.

Until (UNTIL)

Used to end programming of a loop of the type **condition at end**. All control data lines since the last **Repeat (REPEAT)** call belong to this loop. Then enter the end condition in the two-line data box below (➤***„Formulating conditions for loops and branchings." on page 16-49***).

Please note: With this type of loop the condition may be based on results gained within the loop.

Repeat If (DO WHILE)

Used to start programming a loop of the type **condition at start**. All subsequent control data lines belong to this loop until it is terminated with **Repeat End (END DO)**. Then enter the end condition in the two-line data box below (➤***„Formulating conditions for loops and branchings." on page 16-49***).

Please note: The commands belonging to the loop are not yet learn programmed. Therefore with this type of loop the condition can not be based on results gained within the loop.

Exception: Loop variable I may be included (➤***„Formulating conditions for loops and branchings." on page 16-49***).

Repeat End (END DO)

Used to terminate programming of a loop of the type **condition at start**. All control data lines since the last **Repeat If (DO WHILE)** call belong to this loop.

Procedure

If necessary, update the nesting depth with **<CURRENT>**. Select the required loop type with **<YES>**/**<NO>** and mark whether you want to program at the start or end of the loop. Make any additional inputs necessary. Used to enter an end/repeat condition ➤***„Formulating conditions for loops and branchings." on page 16-49*** Individual boxes can be selecting with the ∨ and ∧ cursor keys. Close the dialog window with **<TERMIN>**. Control data line(s) generated: ➤***„Control data of loops and branchings" on page 16-58***

Conditional branchings and jumps <DI 1050>

Application

A branching or jump must be programmed if parts of a measuring run may only be executed under certain conditions. The CNC run will then skip certain parts of the program or branch to others.

You formulate the conditions during learn (part) programming and assign the respective program branches to them. The CNC run checks whether the conditions apply and then continues in the assigned program branch.

Example for condition

The diameter of the circle measured last falls below a defined limiting value.

"Intelligent" CNC programs

In this way you can make CNC programs "intelligent". Depending on the prevailing conditions (e.g. measuring results), the program executes alternative program steps, changes the probing parameters, repeats measurements, searches for measuring elements, etc.

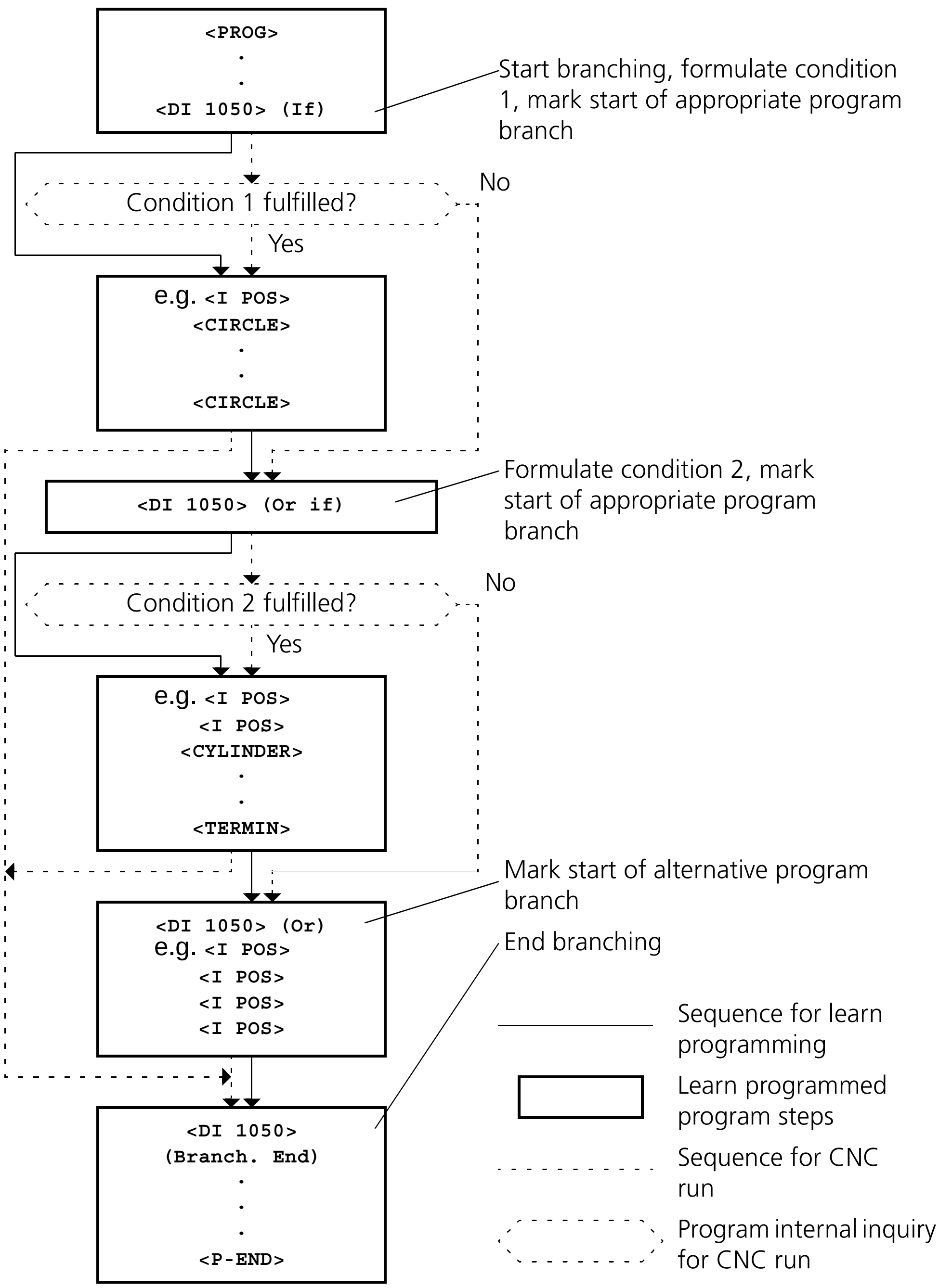
Another possibility

Measure different variations of a workpiece family with a single program which identifies the variation concerned based on a measured value or a missing measured element (part feature) and then branches to the appropriate program section(s).

Application example

➤ ***„Application example for loops and branchings“ on page 16-64***

Structure for (three-fold) branching



Programming branches

- Start learn (part) programming as usual.
- On reaching the point where the CNC program should branch, call the **Branching** dialog window with **<DI 1050>**.
- Start branching **(**mark **If (IF)**, cf. dialog window), enter condition 1 (➤***„Formulating conditions for loops and branchings." on page 16-49***) and close dialog window with **<TERMIN>**.
- Program the branch to be run if condition 1 applies.
- If alternative conditions should be checked (condition 2, 3, ...):
  - call the **Branching** dialog window with **<DI 1050>**,
  - mark **Or if (ELSE IF)**, enter condition 2,3, ... (➤***„Formulating conditions for loops and branchings." on page 16-49***),
  - Close dialog window with **<TERMIN>**,
  - program the branch to be run if condition 2, 3, ... is met.
- If a special branch should be run in case none of the conditions is met:
  - Call the **Branching** dialog window with **<DI 1050>**,
  - Mark **Or (ELSE)**,
  - Close the dialog window with **<TERMIN>**,
  - Program the branch which is to be run if none of the conditions are met.
- Terminate branching: Call the **Branching** dialog window with **<DI 1050>**, Mark **Branch. end (END IF)**, end dialog window with **<TERMIN>**.
- Continue learn programming as usual.

Control data lines generated

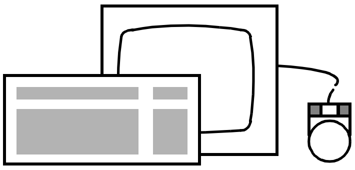
➤***„Control data of loops and branchings" on page 16-58***

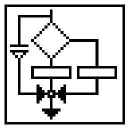
NOTE

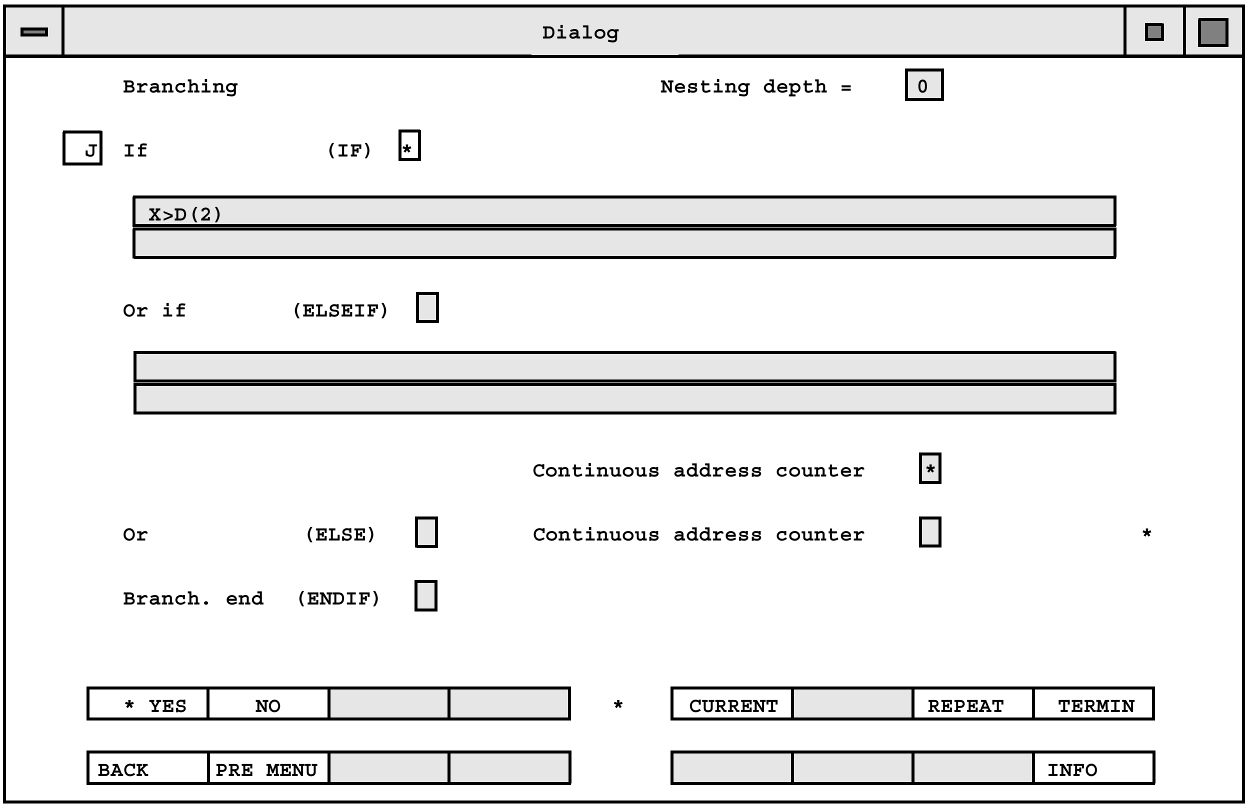
- **<DI 1050>** (**If**) must appear once per branching.
- **<DI 1050>** (**Or if**) may appear any number of times per branching or not appear at all (depending on whether and how many alternative conditions exist).
- **<DI 1050>** (**Or**) may appear only once per branching or not at all. In the latter case, the CNC run is continued and no branching is executed after **<DI 1050>** (**Branch. end**).
- **<DI 1050>** (**Branch. end**) must appear once per branching.
- New branches may be placed inside of a single branch (nesting). Loops are also permitted. The maximum nesting depth is 10 levels.

When calculating the nesting depth, UMESS considers loops and branches with equality of access.

Function Call Possible only in **PROG**.



DI	Pull-Down-Menu	Pictogram
1050 JUMPS	CNC PROG Jumps...	



Softkeys

*** YES/NO** Used to accept/decline the highlighted **<YES>/<NO>** box.

CURRENT This softkey enters the current nesting depth in the dialog window. It should be be used e.g. if an existing CNC program has been jumped to with **<PROG>** in order to correct or extend it with learn programming. Generally used if there is any doubt concerning the nesting depth displayed.

Alternative: Before **<PROG>**, execute a CNC run up to the line to be jumped to: in this case, the correct nesting depth is displayed immediately in the dialog window and there is no need to press the softkey.

REPEAT

Used to cancel changes (entries reset to original status)

TERMIN

Used to close dialog window and program the control data lines corresponding to the entries

Data boxes

If (IF)

Used to start programming a branching together with the together with the corresponding program branch. Then enter the branching condition (condition 1) in the two-line data box below (➤ ***„Formulating conditions for loops and branchings.“ on page 16-49***). All subsequent control data lines belong to this branching until it is closed with **Branch. end (ENDIF)**.

NOTE

You must select **If (IF)** once per branching.

Or if (ELSE IF)

Used to start programming an alternative condition together with the applicable program branch. Then enter the branching condition (condition 2, 3, ..) in the two-line data box below (➤ ***„Formulating conditions for loops and branchings.“ on page 16-49***).

NOTE

You can select **Or if (ELSEIF)** as often as required per branching or not at all.

Continuous address counter

After a branching, the CNC run always continues with the address which is valid after the longest branch has been run. I.e. there may be gaps in the address count if shorter branches are run.

The following applies to learn programming:

– **<NO>**

  During learn programming, the addressing is restarted for each branch. Each time this is done, the address counter is reset to the value it had after If (IF) for the first element.

– **<YES>**

  Continuous addressing; the addressing of the learn program and the CNC run do not coincide, since you run through each branch during programming. Adjust the address counter if recalls, SAM applications etc. require unambiguous address assignment.

Or (ELSE)

Used to start programming a branch which should be run if none of the conditions are met. Then program the appropriate program steps.

NOTE

Or (ELSE) may be selected once per branching or not at all.

Branch. end (ENDIF)

Used to conclude programming of a branching. All control data lines since the last **If (IF) = *** call belong to this branching.

NOTE

Branch. end (ENDIF) must be selected once per branching.

Procedure

If necessary, update the nesting depth with **<CURRENT>**. Select the applicable program branch or branching end with **<* YES>/<NO>**. Make any additional inputs required. For entering conditions ➤***„Formulating conditions for loops and branchings." on page 16-49*** Individual boxes can be selcted with the ∨ and ∧ cursor keys. Close the dialog window with **<TERMIN>**.

Formulating conditions for loops and branchings.

Applications

The **Loops** dialog window expects input of the end or repeat condition for **Until (UNTIL)** und **Repeat If (DO WHILE)**. The branching condition also must be entered for **If (IF)** and Or if **(ELSEIF)** in the **Branching** dialog window.

Structure

A loop or branching condition comprises::

- Variables: Symbol for a measured value which should be compared in the condition.
- Indices of variables: Address of the measured value to be compared.
- Constants.
- Relational operators.
- Logical operators.
- Brackets.

Example

for a condition: **Z(-2)<-.3MM.OR.I(1)>10.**

Application example: ➤***„Application example for loops and branchings" on page 16-64***

NOTE

A basic knowledge of programming logical expressions is very useful when formulating conditions.

Variable

The following overview shows which symbol you must use for which measurement result (e.g. **D** for the diameter of a cylinder).

I	Loop variable
X, Y, Z	Coordinates of the element or absolute distances
D	Diameter
D1	Diameter 1 with ellipse and torus

NX, NY, NZ	Normal standardized at space point
W	Angle (degrees)
W1	Angle 1 (projected angle, angle of rotation, polar angle)
W2	Angle2 (projected angle, tilt angle)
WK	Cone angle
WX, WY, WZ	Axis angle space diagonal (Distance polar 3D)
RD	Space diagonal; space point: deviation; ROM: space distance
DX	Distance in X axis (with +/- sign)
DY	Distance in Y axis (with +/- sign)
DZ	Distance in Z axis (with +/- sign)
V	Pipe measurement option: Rotation angle
B	Pipe measurement option: Bend. angle
RX, RY, RZ	Direction line with edge point
S	Standard deviation
KOORD_OD_ISTW	Coordinate or actual angle of pitch feature
EINZ_TEILUNG	Single pitch
SUM_TEILUNG	Total pitch
EINZ_TEI_FEHL	Single pitch error
SUM_TEI_FEHL	Total pitch error
TEI_SPRUNG	Difference between adjacent pitches
RUNDLAUFFEHL	Circular pitch: Radial runout
SCHRITT	Pitch step (recorded under **EXTREME VALUES OF PITCH MEASUREMENT**)

Form, position deviation with following abbreviations:			
TIST	**t**REAL		
TDIST	**TXIST**	**TYIST**	**TZIST**
TDMMC	**TXMMC**	**TYMMC**	**TZMMC**
not yet implemented			
TWISTTRIST	**TRIST**	**TWMMC**	**TRMMC**

Index

The address of the measured value to be compared is shown behind the variable as an index in round brackets (exception: loop variable `I`, see below).

The following are permitted:

– Absolute addresses; example: **X(10)** means coordinate **X** of the element with the address **10**.
– Relative addresses; example: **W1(-1)** means projected angle **1** of the next to last element.
– No address. Then the last element measured is always the one in question (equivalent to index **(0)**).

NOTE

Relative indexing therefore differs from indexing with recall. I.e. index **0** refers to the last element, index **-1** to the next to last element, etc.

Loop variable **I** has the nesting depth as index (i.e. must not exceed max. 10). You can also omit the index. In this case the program accepts the current nesting depth as the index. Please make sure that the nesting depth increases by 1 if you request the loop variable with an **IF**-clause within the loop. You will find an example in ➤***„Application example for loops and branchings“ on page 16-64***, line 31 or line 42. If you omitted the index at **I**, the program would would interpret **I(3)** at line 31 and **I(4)** at line 42.

Constants

Constant values must not exceed a maximum length of 18 digits before and 4 digits after the decimal point. Example: 34.1.

If constants are subject to mm-inch conversion, they must be labeled with **IN** or **MM** (append without a space). Examples: **1234.5678MM**; **1234IN**.

NOTE

The millimeter-inch conversion may require an additional control data line due to a differing number of decimal places (therefore max. 9 lines are available for the user since the 10th line is required for displacments, ➤***„Control data of loops and branchings“ on page 16-58***).

Relational operators

The following operators are allowed in order to compare variables with other variables within a condition:

Meaning	Symbol	Relational operation (Example)	Rule of precedence
less than	<	**S<0.1MM**	Standard deviation of the last address less than 0.1 mm
less than equal to	<=	**I<=I(1)**	Current loop variable less than or equal to loop variable nesting depth 1
equal to	=	**I=3**	Current loop variable equal to 3
greater than	>	**W(2)>45**	Angle of address 2 greater than 45°
greater than equal to	>=	**NX(-1)>=0.1**	S point normal from next to last address greater than or equal to 0.1
not equal to	<>	**I(1)<>I(3)**	Loop variable nesting depth 1 not equal to loop variable nesting depth 3

The value of a relational operation can only be **TRUE** or **FALSE**. Examples:

Result in measuring record	Relational operation (example)	Value of relational operation
S 0.034	**S<0.1MM**	TRUE
2 W 44.978	**W(2)>45**	FALSE
NX 20.166	**NX(-1)>=0.1**	TRUE
4 X 7.986 10 X -3.226	**X(4)<X(10)**	FALSE

In a relational operation there is always a relational operator between two variables or between a variable and a constant.

Arithmetic operations (+, -, ·, / etc.) must not be included in a comparison. They first must be executed under a separate address with **<DI 1379>** (formula). The condition can then refer to the result of the formula via the corresponding index.

Example for angle between two bores

```
Record

 52                      CIRCLE        0    0  1104  1410
                         .
                         .
 61                      N POINT TERM  3    2  1191  1420   29
 62  BORE16              LDL RESNAME   0    0  9919     0

 63                      CIRCLE        0    0  1104  1410
                         .
                         .
 72                      N POINT TERM  3    2  1191  1420   30
 73  BORE17              LDL RESNAME   0    0  9919     0

                         .
                         .
111                      POLAR         0    3  1203     0   57
113  BORE17              DL REFNAME    0    0  9911     0
114  POL2D_1             LDL RESNAME   0    0  9919     0
115                      POLAR         0    3  1203     0   58
116  BORE16              DL REFNAME    0    0  9911     0
117  POL2D_2             LDL RESNAME   0    0  9919     0
118  A1(58)-W1(57)       FORMULA 0   2  1379    0    59
119  FORMULA(20)         LDL RESNAME   0    0  9919     0
120  A1>90               IF            1    1  9951  1951
                         .
                         .
```

Logical operators

The following symbols may be used as logical operators in order to link or combine two or more relational operations or negate a comparison (logical operation):

Meaning	Symbol	Application	Rule of precedence
not (complement)	.NOT.	Negation	Highest status
and (logical product)	.AND.	Linking of relational operations	
or (logical total)	.OR.		
logically equal	.EQV.		
logically unequal	.NEQV.		Lowest status

A logical operator is always placed between two relational operations and/or the minus sign is placed in front of a relational operation, cf. the following examples. If a logical operation contains more than one such operator, the specified precedence applies, cf. the information at the end of the chapter.

Since relational operations can only be **TRUE** (applicable) or **FALSE** (nonapplicable), the value of a logical operation also must be **TRUE** or **FALSE**.

The following truth tables apply.

Truth table for logical operator .NOT.:

Value of relational operation	Value of logical operation
TRUE	FALSE
FALSE	TRUE

Sample results for .NOT.X(9)>0.5:

Result in measurement record	Logical operation	Value of operation
`9 X 0.034`	`.NOT.`$\underbrace{\texttt{X(9)>0.5}}_{\text{FALSE}}$	TRUE, i.e. the condition applies
`9 X 1.408`	`.NOT.`$\underbrace{\texttt{X(9)>0.5}}_{\text{TRUE}}$	FALSE, i.e. the condition does not apply

Truth table for logical operator .AND.:

Value of relational operation 1	Value of relational operation 2	Value of logical operation
TRUE	TRUE	TRUE
TRUE	FALSE	FALSE
FALSE	TRUE	FALSE
FALSE	FALSE	FALSE

Sample results for X(9)>0.5.AND.Y(9)>3.0:

Value in measurement record	Logical operation	Value of operation
9 X 0.034 Y 3.513	$\underbrace{\mathtt{X(9)>0.5}}_{\text{FALSE}}\mathtt{.AND.}\underbrace{\mathtt{Y(9)>3.0}}_{\text{TRUE}}$	FALSE, i.e. the condition does not apply
9 X -1.408 Y -3.513	$\underbrace{\mathtt{X(9)>0.5}}_{\text{FALSE}}\mathtt{.AND.}\underbrace{\mathtt{Y(9)>3.0}}_{\text{FALSE}}$	FALSE, i.e. the condition does not apply
9 X 1.408 Y 3.513	$\underbrace{\mathtt{X(9)>0.5}}_{\text{TRUE}}\mathtt{.AND.}\underbrace{\mathtt{Y(9)>3.0}}_{\text{TRUE}}$	TRUE, i.e. the condition applies

Truth table for logical operator .OR.:

Value of relational operation 1	Value of relational operation 2	Value of logical operation
TRUE	TRUE	TRUE
TRUE	FALSE	TRUE
FALSE	TRUE	TRUE
FALSE	FALSE	FALSE

Sample results for X(9)>0.5.OR.Y(9)>3.0:

Result in measuring record	Logical operation	Value of operation
9 X 0.034 Y 3.513	$\underbrace{\mathtt{X(9)>0.5}}_{\text{FALSE}}\mathtt{.OR.}\underbrace{\mathtt{Y(9)>3.0}}_{\text{TRUE}}$	TRUE, i.e. condition applies
9 X -1.408 Y -3.513	$\underbrace{\mathtt{X(9)>0.5}}_{\text{FALSE}}\mathtt{.OR.}\underbrace{\mathtt{Y(9)>3.0}}_{\text{FALSE}}$	FALSE, i.e. condition does not apply
9 X 1.408 Y 3.513	$\underbrace{\mathtt{X(9)>0.5}}_{\text{TRUE}}\mathtt{.OR.}\underbrace{\mathtt{Y(9)>3.0}}_{\text{TRUE}}$	TRUE, i.e. condition applies

Truth table for logical operator .EQV.:

Value of relational operation 1	Value of relational operation 2	Value of logical operation
TRUE	TRUE	TRUE
TRUE	FALSE	FALSE
FALSE	TRUE	FALSE
FALSE	FALSE	TRUE

Example results for X(9)>0.5.EQV.Y(9)>3.0:

Result in measurement record	Logical operation	Value of operation
9 X 0.034 Y 3.513	$\underbrace{\texttt{X(9)>0.5}}_{\text{FALSE}}\texttt{.EQV.}\underbrace{\texttt{Y(9)>3.0}}_{\text{TRUE}}$	FALSE, i.e. condition does not apply
9 X -1.408 Y -3.513	$\underbrace{\texttt{X(9)>0.5}}_{\text{FALSE}}\texttt{.EQV.}\underbrace{\texttt{Y(9)>3.0}}_{\text{FALSE}}$	TRUE, i.e. condition applies
9 X 1.408 Y 3.513	$\underbrace{\texttt{X(9)>0.5}}_{\text{TRUE}}\texttt{.EQV.}\underbrace{\texttt{Y(9)>3.0}}_{\text{TRUE}}$	TRUE, i.e. condition applies

Truth table for logical operator .NEQV.:

Value of relational operation 1	Value of relational operation 2	Value of operation
TRUE	TRUE	FALSE
TRUE	FALSE	TRUE
FALSE	TRUE	TRUE
FALSE	FALSE	FALSE

Example results for X(9)>0.5.NEQV.Y(9)>3.0:

Result in measurement record	Logical operation	Value of operation
9 X 0.034 Y 3.513	$\underbrace{X(9)>0.5}_{\text{FALSE}}.NEQV.\underbrace{Y(9)>3.0}_{\text{TRUE}}$	TRUE, i.e. condition applies
9 X -1.408 Y -3.513	$\underbrace{X(9)>0.5}_{\text{FALSE}}.NEQV.\underbrace{Y(9)>3.0}_{\text{FALSE}}$	FALSE, i.e. condition does not apply
9 X 1.408 Y 3.513	$\underbrace{X(9)>0.5}_{\text{TRUE}}.NEQV.\underbrace{Y(9)>3.0}_{\text{TRUE}}$	FALSE, i.e. condition does not apply

Rule of precedence and brackets

If an operation contains more than one logical linking (combinatorial) symbol, the following precedence applies when editing:

1st priority:	Relational sign (>, >=, <, <=, <>);
2nd priority:	NOT-operation;
3rd priority:	AND-operation;
4th priority:	OR-operation;
5th priority:	EQV-operation, NEQV-operation.

With several equivalent linking symbols, editing must be performed from left to right. With OR operations, checking is performed only until one of the linked relations applies.

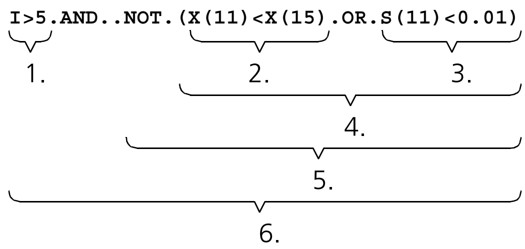
The rule of precedence for editing can be influenced with brackets. Expressions in brackets form a unit. In addition to the generally applicable rules for using brackets, please also note the following conditions:

- A maximum of 5 bracket levels is possible.
- Index brackets do not form a bracket level.
- 20 logical operations per bracket level are possible.

Examples

I>5.AND..NOT.(X(11)<X(15).OR.S(11)<0.01)

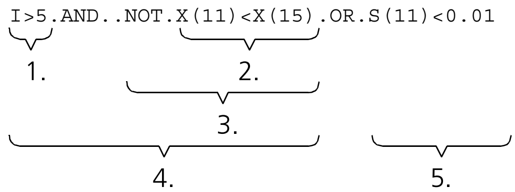
is edited in this order:



3rd bracket is checked only if 2nd does not apply

I>5.AND..NOT.X(11)<X(15).OR.S(11)<0.01

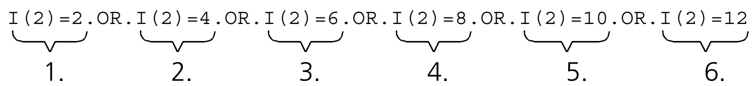
is edited in this order:



5th bracket is checked only if 4th does not apply

I(2)=2.OR.I(2)=4.OR.I(2)=6.OR.I(2)=8. OR.I(2)=10.OR.I(2)=12

is edited in this order (as soon as a comparison applies, the others are not taken into account):

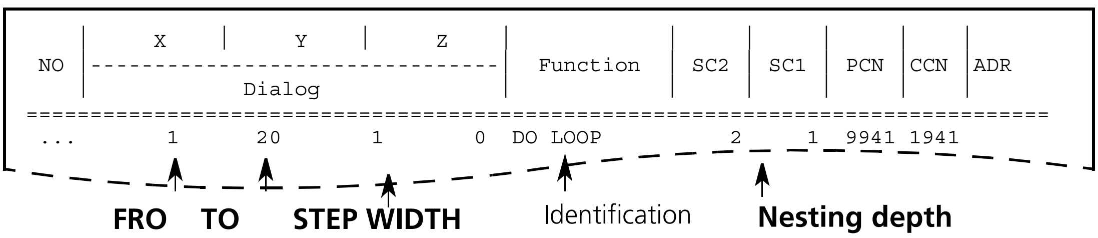


Control data of loops and branchings

Example 1

<DI 1051>, Loop start (DO LOOP) = *

(open loop with a fixed number of runs):



The code numbers not explained are the function-specific codes.

Example 2 **<DI 1051>, Loop end (END LOOP) = ***

(Close loop with a fixed number of runs):

```
NO  |      X    |     Y    |     Z     |  Function  |  SC2 |  SC1 |  PCN | CCN | ADR
    | -------------------------------- |
    |            Dialog                |
================================================================================
 ...          0                          END LOOP      1010      1  9949 1949
```

Identification

Nesting depth

10=Continuous address counter

- The code numbers not explained are the function-specific codes.
- If the address counter is not serial (continuous) only the nesting depth will appear under SC2:

```
NO  |      X    |     Y    |     Z     |  Function  |  SC2 |  SC1 |  PCN | CCN | ADR
    | -------------------------------- |
    |            Dialog                |
================================================================================
 ...          0                          END LOOP        10      1  9949 1949
```

Identification

Nesting depth

Example 3 **<DI 1051>, Repat (REPEAT) = ***

(Open loop with condition at end):

```
NO  |      X    |     Y    |     Z     |  Function  |  SC2 |  SC1 |  PCN | CCN | ADR
    | -------------------------------- |
    |            Dialog                |
================================================================================
 ...          0                          REPEAT           1      1  9943 1943
```

Identification

Nesting depth

The code numbers not explained are the function-specific codes.

Example 4 **<DI 1051>, Until (UNTIL) = ***

(Close loop with condition at end):

```
NO  |         X        |        Y        |        Z     |   Function    | SC2  | SC1  | PCN  | CCN  | ADR
    | ------------------------------------------------- |               |      |      |      |      |
    |                  Dialog                            |               |      |      |      |      |
==========================================================================================================
 ... I(2)=2.OR.I(2)=4.OR.I(2)             UNTIL          1002      2    9947 1947
 ... =8.OR.I(2)=10.OR.I(2)=12             DL COND           0      0    9911 1911
 ... .OR.I(2)=14                          LDL COND          0      0    9919 1919
```

End condition (max. 24 characters per control data line)

Identification(s)

10=Continuous address counter

Nesting depth

Number of data lines

- The code numbers not explained are the function-specific codes.
- The end condition requires 1 control data line per 24 characters. A maximum of 9 lines is possible (millimeter-inch conversion ➤***„Formulating conditions for loops and branchings." on page 16-49***). **SC1** codes the line number. The **DL COND** line is omitted with a scope of only two lines and repeated correspondingly often with 4 or more lines.
- If the address counter is not serial (continuous) only the nesting depth will appear under SC2:

```
NO  |         X        |        Y        |        Z     |   Function    | SC2  | SC1  | PCN  | CCN  | ADR
    | ------------------------------------------------- |               |      |      |      |      |
    |                  Dialog                            |               |      |      |      |      |
==========================================================================================================
 ... Z(-2)<-.3.OR.I>1                     UNTIL             2      1    9947 1947
```

End condition (max. 24 characters per control data line

Identification

Nesting depth (when address counter is not continuous)

Example 5 **<DI 1051>, Repeat If (DO WHILE) = ***

(Open loop with condition at start):

```
NO  |      X      |      Y      |      Z      |  Function       SC2    SC1    PCN   CCN   ADR
    |-------------------------------------------|
    |              Dialog                       |
===================================================================================
... I(2)=2.OR.I(2)=4.OR.I(2)           DO WHILE          2      2    9942 1942
... =8.OR.I(2)=10.OR.I(2)=12           DL  COND          0      0   9911 1911
... .OR.I(2)=14                        LDL  COND         0      0   9919 1919
```

Identifications

Nesting depth

Number of control data lines

– The code numbers not explained are the function-specific codes.

– The start conditionrequires 1 control data line per 24 characters. A maximum of 9 lines is possible (millimeter-inch conversion ➤***„Formulating conditions for loops and branchings.“ on page 16-49***, note on constants). **SC1** codes the line number. The **DL COND** line is omitted with a scope of only two lines and repeated correspondingly often with 4 or more lines. With a content of one line the **LDL COND** line is also omitted.

Example 6 **<DI 1051>, Repeat end (END DO) = ***

(Close loop with condition at start):

```
NO  |      X      |      Y      |      Z      |  Function       SC2    SC1    PCN   CCN   ADR
    |-------------------------------------------|
    |              Dialog                       |
===================================================================================
...                                    END DO           1002      1   9948 1948
```

identification

Nesting depth

10=Continuous address counter

The code numbers not explained are the function-specific codes. If the address counter is not serial (continuous) only the nesting depth will appear under **SC2**.

Example 7 **<DI 1050>, If (IF) = ***

(Open branching, input condition 1):

```
        |       X      |       Y      |       Z      |
  NO    |-------------------------------------------- |  Function    | SC2 | SC1 | PCN | CCN | ADR
        |               Dialog                         |
=================================================================================================

 ... I(2)=2.OR.I(2)=4.OR.I(2)               IF               4       3    9951 1951
 ... =8.OR.I(2)=10.OR.I(2)=12               DL  COND         0       0   9911 1911
 ... .OR.I(2)=14                            LDL  COND        0       0   9919 1919
```

Condition 1 (max. 24 characters per control data line)

Identification(s)

Nesting depth

Number of control data lines

– The code numbers not explained are the function-specific codes.

– The branching condition requires 1 control data line per 24 characters. A maximum of 9 lines is possible (millimeter-inch conversion ➤ ***„Formulating conditions for loops and branchings." on page 16-49***, note on constants). **SC1** codes the line number. The **DL COND** line is omitted with a scope of only two lines and repeated correspondingly often with 4 or more lines. With a content of one line the **LDL COND** line is also omitted.

Example 8 **<DI 1050>, Or if (ELSE IF) = ***

(Open branching 2, 3 ..., enter condition 2, 3, ...):

```
        |       X      |       Y      |       Z      |
  NO    |-------------------------------------------- |  Function    | SC2 | SC1 | PCN | CCN | ADR
        |               Dialog                         |
=================================================================================================

 ... I(2)=2.OR.I(2)=4.OR.I(2)               ELSE  IF        1004      3    9952 1952
 ... =8.OR.I(2)=10.OR.I(2)=12               DL  COND         0       0   9911 1911
 ... .OR.I(2)=14                            LDL  COND        0       0   9919 1919
```

Condition 2,3...(max. 24 characters per control data line)

Identification(s)

10=Continuous address counter

Nesting depth

Number of control data lines

– The code numbers not explained are the function-specific codes.

– The condition requires 1 control data line per 24 characters. A maximum of 9 lines is possible (millimeter-inch conversion ➤ ***„Formulating conditions for loops and branchings." on page***

16-49, note on constants). **SC1** codes the line number. The **DL COND** line is omitted with a scope of only two lines and repeated correspondingly often with 4 or more lines. With a content of one line the **LDL COND** line is also omitted.

– If the address counter is not serial (continuous) only the nesting depth will appear under SC2 (cf. control data for **<DI 1051>**, **Until (UNTIL) = ***).

Example 9 **<DI 1050>, Or (Else) = ***

(Open alternative branching):

```
     |    X    |    Y    |    Z    |
NO   |-----------------------------| Function  | SC2 | SC1 | PCN |CCN |ADR
     |          Dialog             |           |     |     |     |    |
===========================================================================
...                                 ELSE          1002     1  9953 1953
```

Identification

Nesting depth

10=continuous address counter

The code numbers not explained are the function-specific codes. If the address counter is not serial (continuous) only the nesting depth will appear under SC2.

Example 10 **<DI 1050>, Branch. end (END IF) ***

(End conditional branching):

```
     |    X    |    Y    |    Z    |
NO   |-----------------------------| Function  | SC2 | SC1 | PCN |CCN |ADR
     |          Dialog             |           |     |     |     |    |
===========================================================================

...                                 END IF           2     1  9959 1959
```

Identification

Nesting depth

The code numbers not explained are the function-specific codes.

Application example for loops and branchings

```
 1                                      INIT SYSTEM0     0   1608  1650
 2                                      WPOS TO WSYS     0      0  1713  1640     1
 3    -39.7934     61.3696      60.2426 I POS       0 11110      0  1101
 4    -64.0062     56.5006       5.0240 I POS       0 11110      0  1101
 5           0                          REPEAT           1      1  9943

 6                                      POINT       0      0  1101  1410
 7      0.0000      0.0000      -3.0000 STEP PRB -Z1 11107  1515  1153
 8                                  N POINT TERM    3      0  1191  1420     2

 9      1.0000      0.0000       3.0000 STEP IPOS   1 11110  1515  1151
10 Z<-.3MM.OR.I>=10                     UNTIL            1      1  9947
11 I(1)<10                              IF               1      1  9951
12      2.0000      0.0000      -6.0000 STEP IPOS   1 11110  1515  1151

13                                      CIRCLE      0      0  1104  1410
14     -1.0000      0.0000       0.0000 STEP PBR -X1 11109  1515  1153
15      8.0000      0.0000       0.0000 STEP PRB +X1 11111  1515  1153
16     -4.0000      0.0000       0.0000 STEP IPOS   1 11110  1515  1151
17      0.0000      4.0000       0.0000 STEP PRB +Y1 11112  1515  1153
18      0.0000     -8.0000       0.0000 STEP PRB -Y1 11108  1515  1153
19      0.0000      4.0000       0.0000 STEP I POS 1 11110  1515  1151
20                                  N POINT TERM    3      0  1191  1420     3

21                                      ZERO POINT 0      0  1701  1640     4
22          10                          W-POS       0      1  1710  1610
23     -0.5073      0.5175      -1.6034 I POS       0 11110      0  1101
24     -0.5081      0.5167      28.6204 I POS       0 11110      0  1101
25                                      ELSE        1      1  9953  1953
26    -42.0180     57.1904      19.5870 I POS       0 11110      0  1101
27    -20.7362     13.4242      34.3404 I POS       0 11110      0  1101
28           1          20         1          0 DO LOOP   2      1  9941  1941
29     27.5000    315.0000  24.00 3WPOS DIS POL     0      1  1769  1610
30    -40.0776     31.0584       5.3226 I POS       0 11110      0  1101
31 I(2)=2.OR.I(2)=4.OR.I(2)             IF          3      2  9951  1951
32 =8.OR.I(2)=12.OR.I(2)=20             LDL COND    0      0  9919  1919
33    -40.0776     31.0586      -1.7220 I POS       0 11110      0  1101

34                                      POINT       0      0  1101  1410
35    -40.0772     28.6089      -1.7587 PROBING -Y 0 11108      0  1103
36                                  N POINT TERM    3     0  1191  1420     3

37    -40.0768     32.3104      -1.7848 I POS       0 11110      0  1101

38                                      POINT 0     0  1101  1410
39    -43.6431     32.3093      -1.7838 PROBING -X 0 11109      0  1103
40                                      NPOINT TERM2     0  1191  1420     4

41    -40.4814     32.3108      -1.7826 I POS       0 11110      0  1101
42 I(2)<>4                              IF               4      1  9951

43                                      POINT       0      0  1101  1410
44    -40.4810     35.6482      -1.7814 PROBING +Y  0 11112      0  1103
45                                  N POINT TERM    2      0  1191  1420

46    -40.4802     32.6546      -1.7804 I POS       0 11110      0  1101
47           0                          END IF           4      1  9959
48 I(2)<>8                              IF               4      1  9951

49                                      POINT       0      0  1101  1410
50    -36.6271     32.6533      -1.7793 PROBING +X  0 11111      0  1103
51                                  N POINT TERM    2      0  1191  1420

52    -40.1088     32.6548      -1.7784 I POS       0 11110      0 1101
53           0                          END IF           4      1  9959
54    -40.1088     32.6548       4.0930 I POS       0 11110      0 1101
55           0                          END IF           3      1  9959
56           0                          END LOOP      1002      1  9949
57           0                          END IF           1      1  9959
58      0.0000      0.0000       0.0000 P-END       0      0  9999   999
```

1
2a
2b
3
4
5
6
Nesting depth= 1
Nesting depth= 2
Nesting depth= 3
Nesting depth= 4

1 Loop with end condition to initially identify the workpiece variant via a "sawtooth probing".

2 Branching with two subbranchings which are executed depending on the status when loop 1 is completed:

2a If the branching condition applies, a bore measurement with definition of the W-pos takes place, followed by a jump to the end of the program.

2b If the branching condition does not apply, the program runs through this branch. It contains:

3 Loop with fixed number of runs (20). It initially repeats a W-pos displacement. Subsequent branching(s) follow for certain values of the loop values:

4 For certain values of the loop variables, additional probings are performed which are programmed within this (single-branch) branching condition. The program should omit probings for loop variable values 4 and 8, since they are not worthwhile here:

5 Probing in +Y (omitted if the loop variable has the value 4).

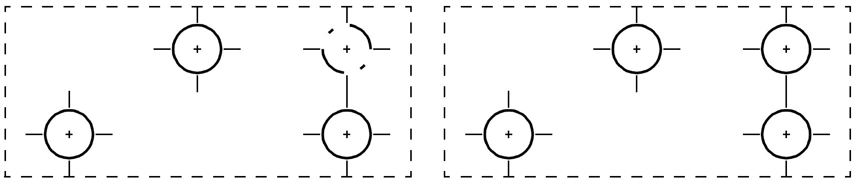
6 Probing in +X (omitted if the loop variable has the value 8).

Additional example ➤***„Batch measurement with <DI 1644>“ on page 18-8***

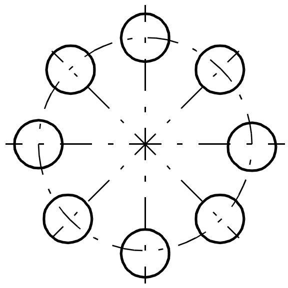
W-position displacement <DI 1769, DI 1771>

Application

Learn programming is easier if the elements to be measured recur regularly. For this purpose, you must program a polar **<DI 1769>** or a cartesian **<DI 1771>** W-pos displacement, depending on the arrangement of the measured elements:



Measurement with cartesian W-pos displacement



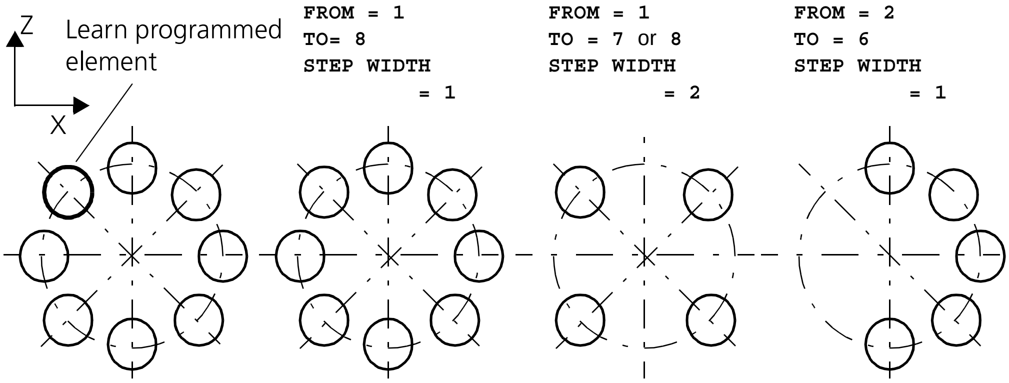
Measurement with polar W-pos displacement

All you have to do then is program the first element of the group.

Procedure

– Start learn programming as usual and define the W-position within the program.

– As soon as you reach the element group: Open the loop with **<DI 1051>**, **Loop start (DO LOOP) = ***. For entering data with **FROM**, **TO**, **STEP WIDTH** (examples for XZ plane):



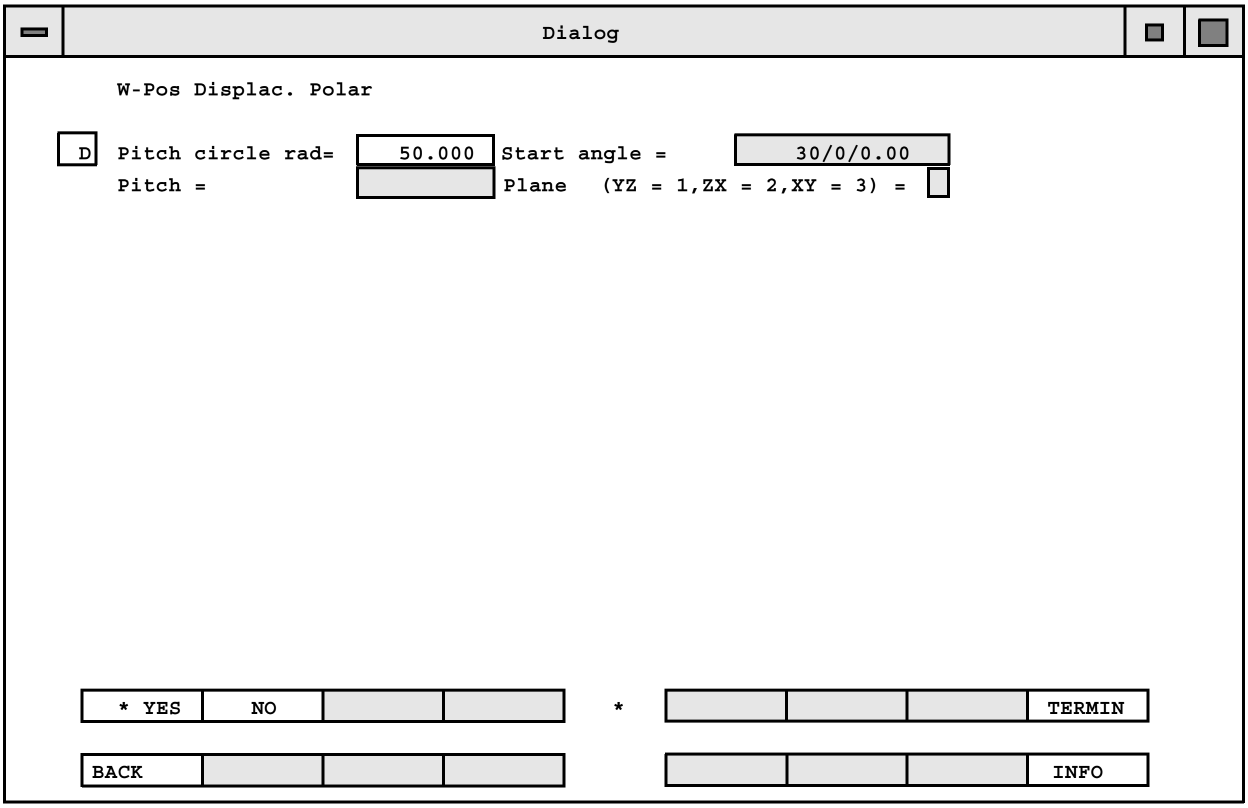
Programmed bore pattern

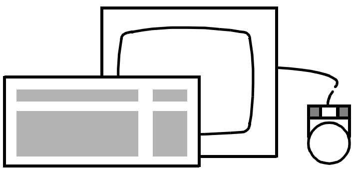
Examples of measurable variants (if necessary, adapt program by changing control data)

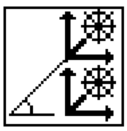
- Call **<DI 1769>** or **<DI 1771>** (depending on the type of W-position displacement).
- Enter the data requested by the displacement program in the dialog window. Above example: **Start angle = -45**, **Pitch = 8**, **Plane = 2**, cf. explanation of dialog.
- After closing the dialog window, set an intermediate position ***outside the first element*** of the group.
- Learn program (teach-in) the measurement of the first element of the group, completing the run by setting an intermediate position ***outside of this element***.
- Close the loop with **<DI 1051>**, **Loop end (END LOOP) = ***.
- If further programming is required after the element group, recall the original W-position.
  Options:
  - Read-in the original (home) W-pos with **<DI 1712>**:
  - You can also enter **0** to simplify operation. The W-position from the CNC start or from the last call of **<DI 1710>**. which took place within the program is then valid. It is of course also possible to enter the W-pos number. However, in this case you should make sure that the W-position concerned is stored this number for every CNC run.
  - **<RECALL>** of the corresponding coordinate system, then **<DI 1710>**.
  - **<DI 1713>**.
  - Option after polar displacement: Call **<DI 1769>** again, enter **0** for all values.
  - Option after cartesian displacement: call **<DI 1771>** again, enter accumulated values with the opposite sign.

– Learn program (teach-in) the remaining measurements ***after the element group***.

– Terminate learn programming.





DI	Pull-Down-Menu	Pictogram
1769 WPCDPOL	Coord Control system WPOS	
a69	Displacement polar...	

Function Call (for polar W-position displacement)

Softkeys

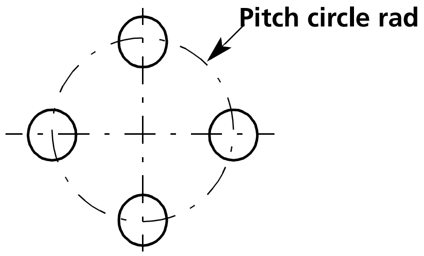
*** YES** accepts the value offered in the highlighted box.

TERMIN closes the dialog window, accepts the programming of the control data lines and returns you to the calling (starting) menu.

BACK returns to the menu used last without programming a control data line.

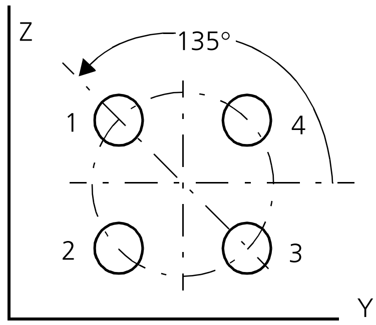
Data boxes

Pitch circle rad

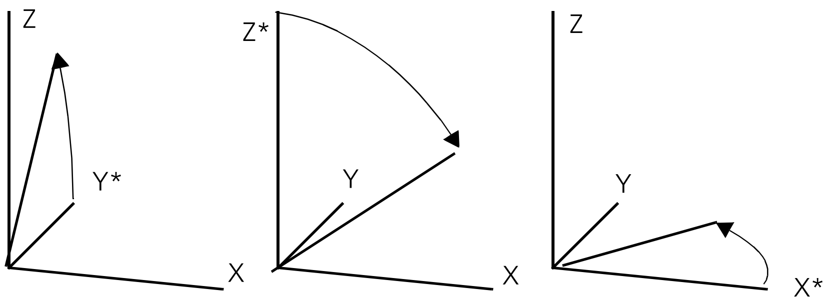


Start angle

The start angle must be specified for the first (learn programmed) element. The positive counting direction (counterclockwise) applies when viewing the measuring plane from the positive direction of the 3rd axis:



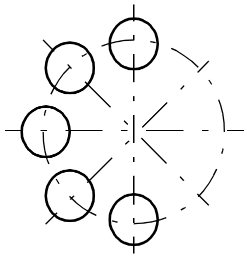
The following illustration shows the reference axis for the start angle of the respective measuring plane.



Cf. also example under "Procedure".

Pitch

Number of measured elements in the entire pitch circle:



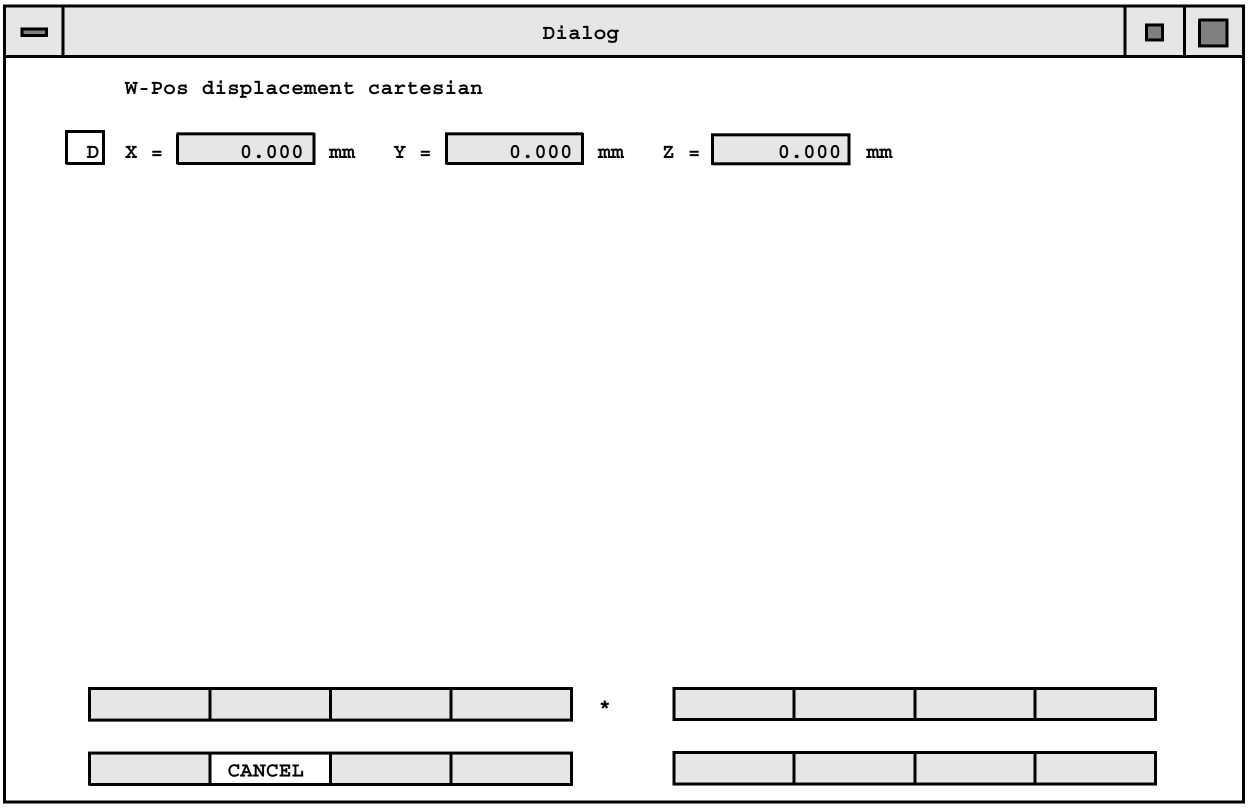
Pitch = 8

Cf. also example above under "Procedure".

Plane

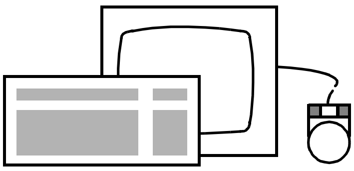
The program always offers plane 3 as the measuring plane in which the W-pos displacement is to be performed. This default value can be accepted with **<Enter>** or overwritten and confirmed with **<Enter>**.

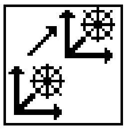
See also the example under "Procedure".



Function Call

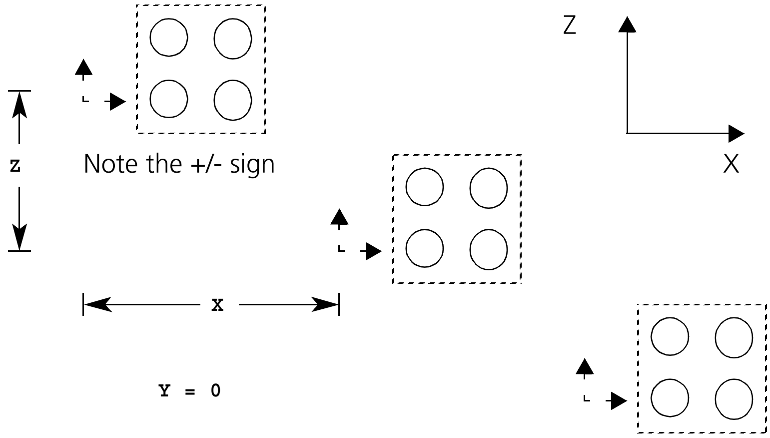
(for cartesian W-pos displacement)



DI	Pull-Down-Menu	Pictogram
1771	coord	
WPDCCAR	Control system WPOS	
a71	Displacement cartesian...	

Data boxes

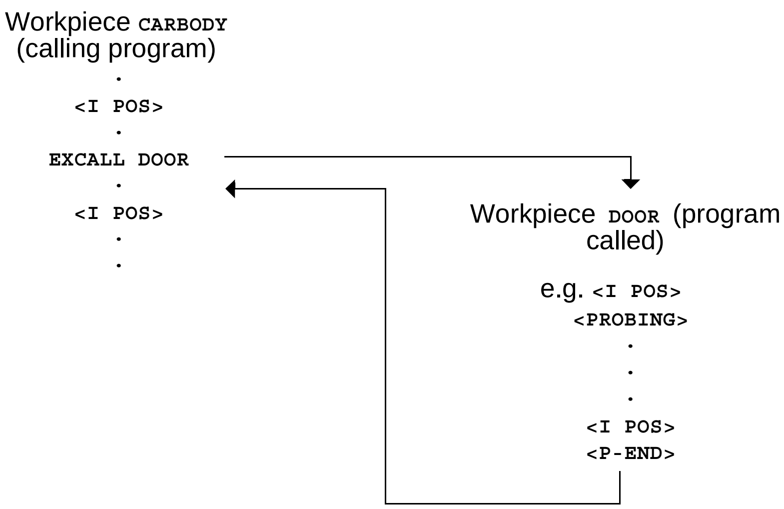
Example:



EXCALL workpiece jump

Application

Using the **EXCALL** function, you can jump from one CNC program to another and from the target location back to the calling program:



Application examples

Subprograms

You only have to program recurring elements once as a special CNC program. You can then call these subprograms from one or more main program(s). If necessary, you can make the call dependent on certain conditions or measuring results **<DI 1050>**.

Modules

You can put together a CNC measurement from several different individual (partial) runs.

Batch (serial) measurements

You can combine several different workpieces to form a continuous measuring run (➤***„Batch measurement with <DI 1644>" on page 18-8***). This option can be used as an alternative to **<DI 1644>** offering the advantage that you can define and store any number of series with **EXCALL**.

PCM

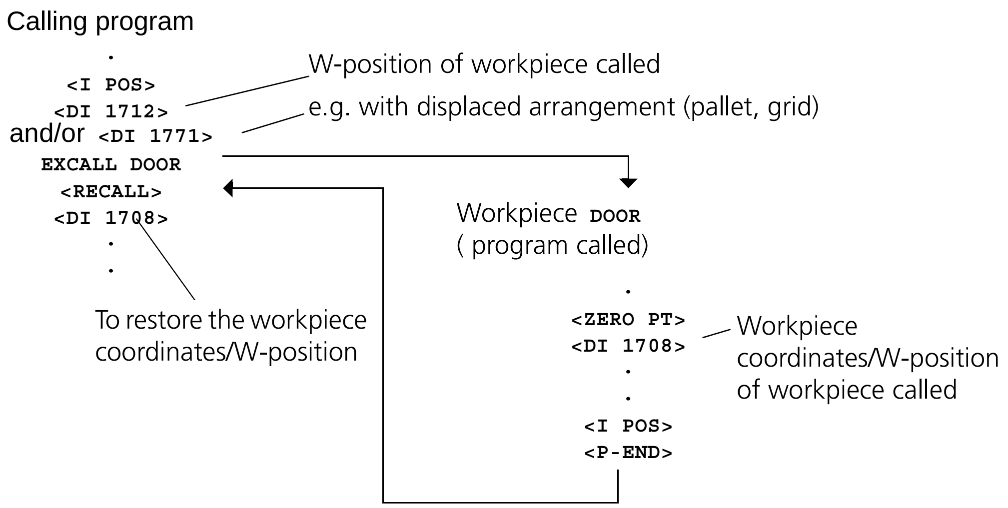
The application range of **EXCALL** is extended in connection with UMESS Opt.9 (PCM): Feature and element oriented measurement can be selected at the CNC start.

NOTE

- You can not learn program (teach-in) the workpiece jump, but only create it by correcting the control data correction. For more information, see "Procedure".
- The program called need not exist prior to the learn programming or control data correction.
- You can call additional programs (subprograms) from the program originally called if necessary. Nesting of up to 10 jumps (levels) is permissible.

Jump

In the CNC run, **EXCALL** jumps to the first line of the workpiece program called. At the end of this workpiece program, the CNC run continues with the next line of the calling program. For this reason you must make sure that the W-positions and workpiece coordinate systems of the linked (combined) workpieces are compatible, see also "Procedure" below:



Address counting

The CNC run sets the addresses which are in the control data. If you use EXCALL to call partial runs as in the example above, you will normally require continuous address counting and unambiguous address assignment (e.g. for recalls). You therefore must match the addresses of the calling program with those of the programs called (via control data correction, ➤***„Adjusting control data addresses <AUTO--ADR>, <MAN-ADR>“ on page 17-49***):

```
Learn program   Address adjustment
                ADR  ADR
      ..
N POINT TERM    49   49
      ..
N POINT TERM    50   50
EXCALL DOOR
      ..
N POINT TERM    51  101
      ..
N POINT TERM    52  102
      ..
      ..
      ..
      ..
      ..
      ..
      ..
N OINT TERM     87  137
EXCALL HOLM
      ..
N POINT TERM    88  201
      ..
N POINT TERM    89  202
      ..
P-END
```

```
Learn program   Address adjustment
                ADR  ADR
      ..
N POINT TERM      1   51
      ..
N POINT TERM      2   52
      ..
      ..
N POINT TERM     13   63
P-END
```

```
                ADR  ADR
      ..
N POINT TERM      1  151
      ..
N POINT TERM      2  152
      ..
      ..
N POINT TERM     27  177
P-END
```

How to structure addressing

The example shows how to structure the addressing and reserve the option of subsequent program extensions by selecting suitable start counters. Of course you can also directly learn program the addressing required.

Batch measurements

It is not usually necessary to change the addresses for batch measurements. Each workpiece starts again with address counter 1.

EXCALL address correction during a CNC run

In connection with PCM options UX9 or UX10, an **EXCALL** address correction is possible during the CNC run. It is not necessary to adapt the addresses of the programs called via control data correction. (➤***„Terminating learn programming <DI 1632>“ on page 16-85***, see UX 9 ➤***„Hardware“ on page 1-5***, "Partial runs").

Procedure

– Learn program the main (calling) program as usual. As soon as you reach a point where a jump to another workpiece is to take place:

- If necessary, program the W-position of the workpiece to be called (**<DI 1712>** or W-position displacement); this step can be omitted e.g. if the workpieces linked have been programmed with the same W-position or the calling workpiece contains **<DI 1712>** itself.
- Generate a blank line for the **EXCALL** workpiece jump. **<DI 1676>** "Comments in the measurement record" is useful for this purpose (➤***„Comments in the measurement record <DI 1676>" on page 5-33***). This enables you to record the name of the workpiece to be called immediately.
- If the workpiece to be called changes the W-position or the workpiece coordinate system, install the old systems (e.g. **<RECALL>** and **<DI 1708>**).
- If continuous address counting is required, adjust the address counter now, see above.
- You can of course also insert these steps later on via control data correction. You must use the control data correction to enter **EXCALL** anyway, see next step.

– Terminate learn programming and edit the main program with the control data correction, ➤***„Correcting control data <DI 1642>" on page 17-31***: **<DI 1642>**.

Select the line reserved for **EXCALL** with **<SELECT L>** (➤***„Selecting a control data line <SELECT L>" on page 17-35***), use search functions if necessary (➤***„Searching for control data lines < FUNCT ->, FUNCT <-, CHAR. ->, CHAR. <->" on page 17-51***), and request for editing with the **<MODIFY>** softkey (➤***„Modifying a control data line <MODIFY>" on page 17-35***).

The **Function** column is now highlighted. Type in **EXCALL** and transfer with **<Enter>**.

Enter 1 for one line in the **SC1** column.

NOTE

If your **EXCALL** call (command) is more than 24 characters long, you must set the number of lines to 2 in the **SC1** column. The entries in the following line will include **LDL EXCALL** in the **Function** column and the rest of the workpiece name.
The cursor will then jump to the front data box. Enter the name of the workpiece to be called here and confirm with **<Enter>**.

NOTE

If you are working with several CNC catalogs, it is advisable to enter the catalog code in brackets along with the workpiece name. This will ensure that the subprogram concerned is found even if it is located in another catalog.

Conclude the control data line with **<EXECUTE>**; see next page for the control data line generated:

Record

```
NO |     X     |     Y     |     Z     | Function | SC2 | SC1 | PCM | CCN | ADR
   ---------------------------------
              Dialog
==============================================================================

... DOOR                             EXCALL        0     1   9971  1971
```

Simple call of a workpiece

```
... DOOR(__)                         EXCALL        0     1   9971  1971
```

Call of a workpiece with catalog code

```
... Workpiece with a long na         EXCALL        0     2   9971  1971
... me(XY)                           LFZ EXCALL    0     0   9919     0
```

Call of a workpiece with a long name and catalog code

Insert additional jump commands in the same way if required.

– If continuous address counting is required, adapt the addresses, see above.

– Conclude control data correction (➤ ***„Copying control data lines from other workpieces <MIX>" on page 17-55***).

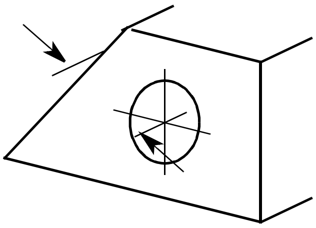
Example for batch (serial) measurement ➤ ***„Batch measurement with <DI 1644>" on page 18-8***

CNC macro mode

Application

CNC macros reduce the amount of programming required for control data occurring in unchanged or modified form in one or more CNC program(s), e.g. slots. To do this, you combine recurring control data in one special CNC program, the so-called CNC macro. Then, during learn programming, you call the corresponding macro whenever you require the control data.

Example:



You must repeatedly measure the vertical distance from bores to a surface (by perpendicular). You require different probe combinations for surfaces and bores. You then want to determine the penetration point of the perpendicular through the surface (by section).

Control data

In the CNC macro you must define whether you want to transfer control data and, if so, whether it should be transferred in modified or in unmodified form.

– Unmodified transfer means: The control data lines concerned are copied to the CNC program by the macro as a block. Therefore: This is useful for lines which can be transferred to the CNC program on a 1-to-1 basis (e.g. function calls, change to a defined probe combination).

– Correction-programmed transfer means: The control data concerned is transferred from its function line by line, but still has to be adapted. User guidance can be created for this purpose via correction programming. In this way, the learn programmer is told what to do next, e.g. to set an intermediate position.
  It thus follows that: Correction-programmed transfer is ideal for variable data, e.g. when probing bores with varying arrangements and diameters.

Procedure

1. Create a CNC macro (➤***„Creating a CNC macro“ on page 16-78***).

2. Incorporate macro during learn programming (➤***„Copying a macro to a learn program <DI 1079>“ on page 16-81***).

Creating a CNC macro

Basic principles and overview

➤*„CNC macro mode“ on page 16-77*

Procedure for generating a macro

Learn program (teach-in) the recurring control data lines or copy them from an existing CNC program.

NOTE

- Assign a logical name to the workpiece.
- Normally you can omit the alignment and W-position functions unless you want to transfer original coordinate values to your CNC program.
- Start the address counter at 1; addresses will be added to the current value after they are transferred to the CNC program.

Example

The following CNC program results for our example from ➤*„CNC macro mode“ on page 16-77* (initially without highlighted control data lines):

```
WORKPIECE NAME: MACRO
FILE NAME:  0038                 CONTROL DATA CARRIER: UB = LUCRT( 2)
CONT. DATA LINES: 44             NOM VAL LINES:     2
PROGRAM PACKAGE REQUIRED:        UMESS
================================================================================
   |    X    |     Y     |    Z    |         |      |    |     |     |
 NO| ----------------------------------- Function SC2 |SC1 |  PCN |  CCN |ADR
   |           Dialog             |         |      |    |     |     |
================================================================================
   1                                 DEBUG ON       0     1  9970  1970
   2 PROG 5                          DEBUGGER       0     1  9978     0
  3        1       1       1      0  PRB-COMB CHA   0     1  9978     0
   4   -45.4314     19.8866     35.1621 I POS       0 11110     0  1101
   5 STEP                            DEBUGGER       0     1  9978     0
   6                                 SURFACE     0     0  1103  1410
   7 PROG 15                         DEBUGGER       0     1  9978     0
   8   -21.5336     23.7614      7.8107 I POS       0 11110     0  1101
   9   -21.6217     23.8805      2.4950 PROBING -Z  0 11107     0  1103
  10   -39.4108     51.9681      6.4969 I POS       0 11110     0  1101
  11   -40.5145     54.6050      2.4945 PROBING -Z  0 11107     0  1103
  12   -59.1392     19.1776      6.9025 I POS       0 11110     0  1101
  13   -59.1434     19.1853      2.4931 PROBING -Z  0 11107     0  1103
  14   -59.1395     19.1786      6.0439 I POS       0 11110     0  1101
  15 CONT 17                         DEBUGGER       0     1  9978     0
  16                             N POINT TERM   0     1  9978     0   1
  17 PROG 21                         DEBUGGER       0     1  9978     0
  18        1       1        1      0  PRB-COMB CHA   0     1  9978     0
  19   -48.2945     28.3960      6.0490 I POS       0 11110     0  1101
  20   -48.3069     30.2341     -1.8208 I POS       0 11110     0  1101
  21 STEP                            DEBUGGER       0     1  9978     0
  22                                 CIRCLE      0     0  1104  1410
  23 PROG 31                         DEBUGGER       0     1  9978     0
  24   -52.3068     30.2147     -1.8144 PROBING -X  0 11109     0  1103
  25   -27.4574     30.3538     -1.8212 PROBING +X  0 11111     0  1103
  26   -42.6768     30.2648     -1.8218 I POS       0 11110     0  1101
  27   -42.6198     19.6020     -1.8264 PROBING -Y  0 11108     0  1103
  28   -39.3580     44.3868     -1.8060 PROBING +Y  0 11112     0  1103
  29   -39.2836     31.7323     -1.8215 I POS       0 11110     0  1101
  30   -39.2803     31.7224      9.9111 I POS       0 11110     0  1101
  31 2 STEP                          DEBUGGER       0     1  9978     0
  32                             N POINT TERM   3     0  1191 1420  2
  33 Switch to current           BTEXT          0     2  1677     0
  34 probe                       LDL TEXT       0     0  9919     0
  35 PROG                            DEBUGGER       0     1  9978     0
  36   1       1        1       0    PRB-COMB CHA   0     1  1601 1521
  37 2 STEP                          DEBUGGER       0     1  9978     0
  38                                 PERPENDIC   0     1  1769  1610     3
  39     -3                          RECALL 1 ADR    0     1  1301     0     4
  40 PROG                            DEBUGGER       0     1  9978     0
  41 D                               NOM VALUES 1     1  1452     0
    1  UMESS-NOMINAL D1  D                    0.0000    0.0000    0.0000
  42 CONT                            DEBUGGER       0     1  9978     0
  43       0.0000      0.0000      0.0000 INTERSEC    3     1  1218     0     5
  44       0.0000      0.0000      0.0000 P-END       0     0  9999   999
```

- Request this CNC program for control data correction with **<DI 1642>** and create the highlighted control data lines as described below.
- Insert 1 blank line at the start, request modification and enter the words **DEBUG ON** in the function column, **<Enter>**. In this way the file is marked as a CNC macro.

- Insert 1 blank line in front of the first control data lines to be transferred, request modification and enter the word **DEBUGGER** in the **Function** column, enter a 1 in the **SC1** column.
- The **Dialog** column is now highlighted. Here you must specify how you want to transfer which of the following macro lines to the CNC programs.

3 options

PROG XXX

Correction-programming of the control data from the next line to line xxx-1 on a line by line basis (lines 3 to 4 or 8 to 14 in the example given). If you do not specify a line, you can only correction-program the next function (line 36 or 41 in the example given).

Restriction: You can perform correction programming only on the following functions:

  - Intermediate positions in the W-position system.
  - Probings in the W-position system.
  - Changing the probe combination with **<DI 1552>**.
  - Nominal input **<DI 1459>**
  - Relative recall of single result (**<DI 1301>**, absolute recall is illegal).

CONT xxx

Edit the control data from the following line to line xxx-1 and copy it (line 16 in the example). If you do not specify a line, this applies to the rest of the macro (starting with line 43 in the example).

xxx STEP

Edit the accept the next xxx functions (not lines!) (lines 32 to 34 or 38 to 39 in the example). If you do not specify a number, this applies only to the next function (line 21 in the example).

Note: Text lines are executed, but not transferred to the control data of the CNC program during learn programming (lines 33 to 34 in the example).

Conclude with **<Enter>**.

- Insert a blank line in front of the control data line xxx 1 and mark it as a debugger line: **DEBUGGER**, **SC1 = 1**, **PROG**, **CONT** or **STEP**.
- In this way you can use the debugger functions to determine whether each line/function should be executed and programmed (copied) or transferred via correction programming. Note that
  - the line specified must contain the next debugger function and
  - when setting the function, the next function (xxx+1) must be the debugger function.
    Please refer to the example.
- After inserting all debugger lines, conclude the control data correction as usual.

– Copy the macro to a learn program ➤ ***„Copying a macro to a learn program <DI 1079>“ on page 16-81***

Copying a macro to a learn program <DI 1079>

Basic principles and overview

➤ ***„CNC macro mode“ on page 16-77***

➤ ***„Creating a CNC macro“ on page 16-78***

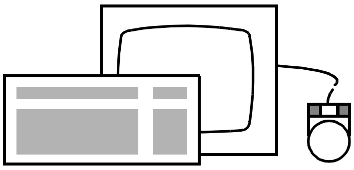
Procedure for copying macros to a learn program:

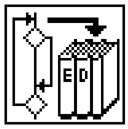
– Store the required macros in the workpiece catalog and note their numbers and names (unless of course this has already been done).

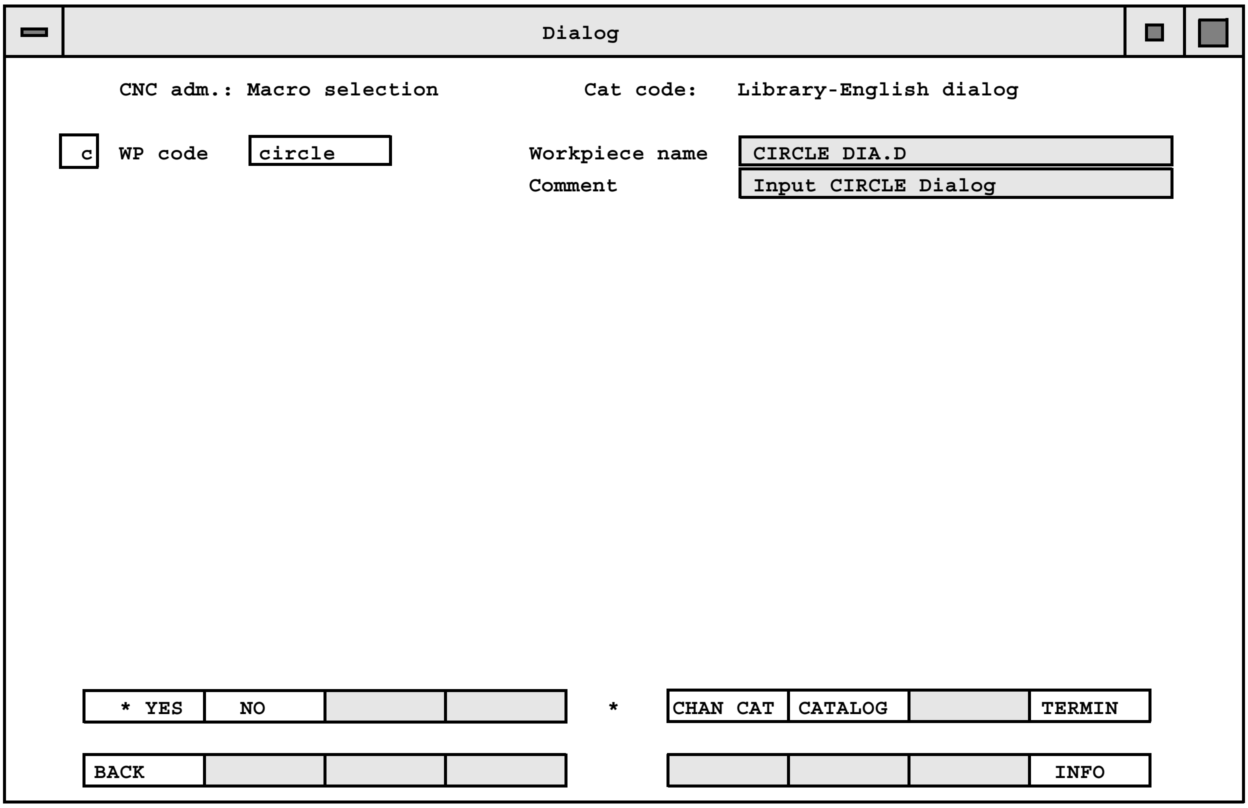
– Start learn programming as usual.

– As soon as you reach a section you want to copy from a macro: Call **<DI 1079>**.

Function call (for learn programming only)



DI	Pull-Down-Menu	Pictogram
1079 EXCALL	Elements Transfer macro...	



Data boxes

WP code Workpiece code of macro.

Workpiece name, Comment Displayed for checking purposes.

Procedure

Enter the macro required or select the macro concerned using the **<CATALOG>** softkey.

Close window with **<TERMIN>**. The macro will then be loaded:

- The learn program processes the control data to be copied (marked by debugger lines with **CONT** or **STEP**, ➤***„Creating a CNC macro“ on page 16-78***) like a normal CNC run and writes them to the control data. See example below.

  Cancellation is possible and resets the programming step to the status prior to the macro start. System changes made by the canceled macro are, however, retained (e.g. W-position).

  If you inadvertently call a normal CNC program instead of a macro, this will have no effect.
- The control data provided for correction programming (marked by debugger lines with PROG, ➤***„Creating a CNC macro“ on page 16-78***) prompt the learn programmer to:
  - make inputs (combination changes, nominal sizes, recalls); in these cases the usual dialog is displayed;
  - travel to the intermediate positions in the W-position system and confirm by pressing the key specified;
  - execute probings in the W-position system for which the probing direction and probe number can be selected.

  See example below.

To cancel the correction programming: never recall all probings of an N point element by correction, i.e. always probe at least one point. Otherwise the system will get hung up.

If you probe too few points for an N point element: The calculation will be canceled and the macro will continue.

The macro from ➤**„Creating a CNC macro“ on page 16-78** generates the following control data lines:

```
WORKPIECE NAME:   ....
FILE NAME:  0040                  CONTROL DATA CARRIER:  UB = LUCRT( 2)
CONT: DATA LINES:   388           NOM VALUES:     ...
PROGRAM PACKAGE REQUIRED:         UMESS
===============================================================================
        X          Y          Z
NO  ----------------------------------- | Function | SC2 | SC1 | PCN |CCN | ADR
           Dialog
===============================================================================
   1 Programmed with macro          RECORD HEAD    0      6  1610  1650
   2                                    DL R HEAD  0      0  9911     0
   3                                DL R HEAD      0      0  9911     0
                                          .
                                          .
                                          .

  63       1       3       1       0  PRB-COMB CHA    0     1  1601  1521
  64  -135.4314    69.8866   35.1621 I POS          0 11110     0  1101
  65                                SURFACE        0     0  1103  1410
  66  -117.5336    73.7614    7.8107 I POS          0 11110     0  1101
  67  -118.6217    73.8805    2.4950 PROBING -Z   0 11107     0  1103
  68  -128.4108   101.9681    6.4969 I POS          0 11110     0  1101
  69  -131.5145   104.6050    2.4945 PROBING -Z   0 11107     0  1103
  70  -148.1392    69.1776    6.9025 I POS          0 11110     0  1101
  71  -148.1434    69.1853    2.4931 PROBING -Z   0 11107     0  1103
  72  -151.1395    69.1786    6.0439 I POS          0 11110     0  1101
  73                             N POINT TERM   3     0  1191  1420
  74       1       2       1       0  PRB-COMB CHA    0     1  1601  1521
  75  -140.2945    78.3960    6.0490 I POS          0 11110     0  1101
  76  -140.3069    80.2341   -1.8208 I POS          0 11110     0  1101
  77                                CIRCLE         0     0  1104  1410
  78  -141.3068    80.2147   -1.8144 PROBING -X   0 11109     0  1103
  79  -118.4574    80.3538   -1.8212 PROBING +X   0 11111     0  1103
  80  -131.6768    79.2648   -1.8218 I POS          0 11110     0  1101
  81  -131.6198    68.6020   -1.8264 PROBING -Y   0 11108     0  1103
  82  -128.3580    93.3868   -1.8060 PROBING +Y   0 11112     0  1103
  83  -127.2836    80.7323   -1.8215 I POS          0 11110     0  1101
  84  -128.2803    80.7224    9.9111 I POS          0 11110     0  1101
  85                             N POINT TERM   3     0  1191  1420     18
  86       1       1       1       0  PRB-COMB CHA    0     1  1601  1521
  87                                PERPENDIC      0     1  1769  1610     19
  88     -3                         RECALL 1 ADR   0     1  1301     0     20
  89 D                                NOMINALS       1     1  1452     0
   1  UMESS-NOMINAL                   D1      D         0.0000    0.0000    0.0000
  90     0.0000     0.0000     0.0000 INTERSEC       3     1  1218     0     21
                                          .
                                          .
                                          .

 388     0.0000     0.0000     0.0000 P-END          0     0   9999  999
```

Terminating learn programming <DI 1632>

Application

This call terminates the learn programming function. The computer then transfers all of the remaining program data to the storage unit. An end label is set there. This ensures that additional storage space will be made available for the next CNC program.

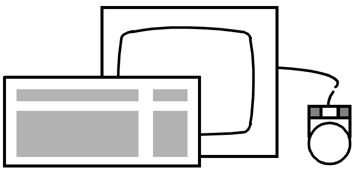
Please differentiate between the following cases:

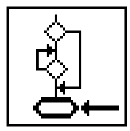
– Terminating learn programming of a new workpiece: The function call sets an end label and terminates the learn programming.

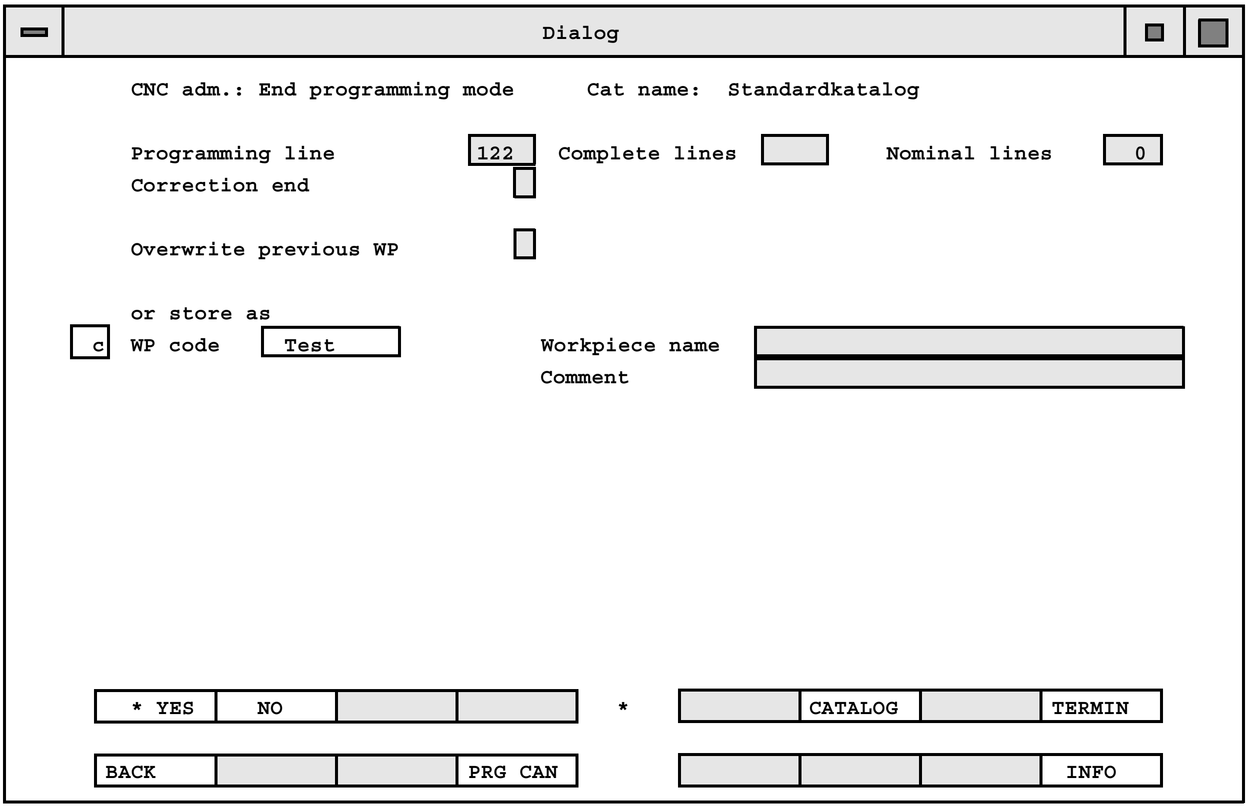
– Terminating learn programming after a program correction:

If the number of the last programming step of the correction is higher than that of the last program step of the original CNC program: The function call will set the end label.

If the number of the last programming step of the correction is lower than that of the last program step of the original CNC program: A dialog window will appear inquiring whether the remaining lines of the workpiece should be overwritten or saved.



DI	Pull-Down-Menu	Pictogram
1632 P-END	CNC PROG End...	



Softkeys

PRG CAN Programming is cancelled without the modifications being stored.

Data boxes

Programming line Display of last program line modified.

Complete lines Display of total number of program lines for the workpiece.

Nominal lines Display of number of nominal lines (applies only to old CNC runs with old nominal records).

Correction end

– **<YES>**
  Modified lines are stored, lines not modified are kept.

Overwrite previous WP

– **<YES>**
  The program will be terminated after the program line displayed.
  All following lines will be deleted!

– **<NO>**
  The previous workpiece will remain unchanged. The part of the program up to the program line displayed will be stored under another name (see below).

or store as WP code
Workpiece name
Comment

A new code, workpiece name or comment can be entered here if the previous dialog was answered with **<NO>**.

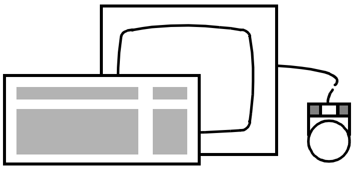
Chapter 17

Control data modification and management

This chapter contains:

Definition

Control data are the encoded commands of a CNC program (➤ ***„General" on page 16-2***). All CNC programs are listed in the workpiece catalog. The term **workpiece** is also used to refer to CNC programs.



DI	Pull-Down-Menu	Pictogram
1630 CNCADM	CNC Workpiece administration Catalog...	

Data boxes

WP code

Max. 10 characters

Workpiece name

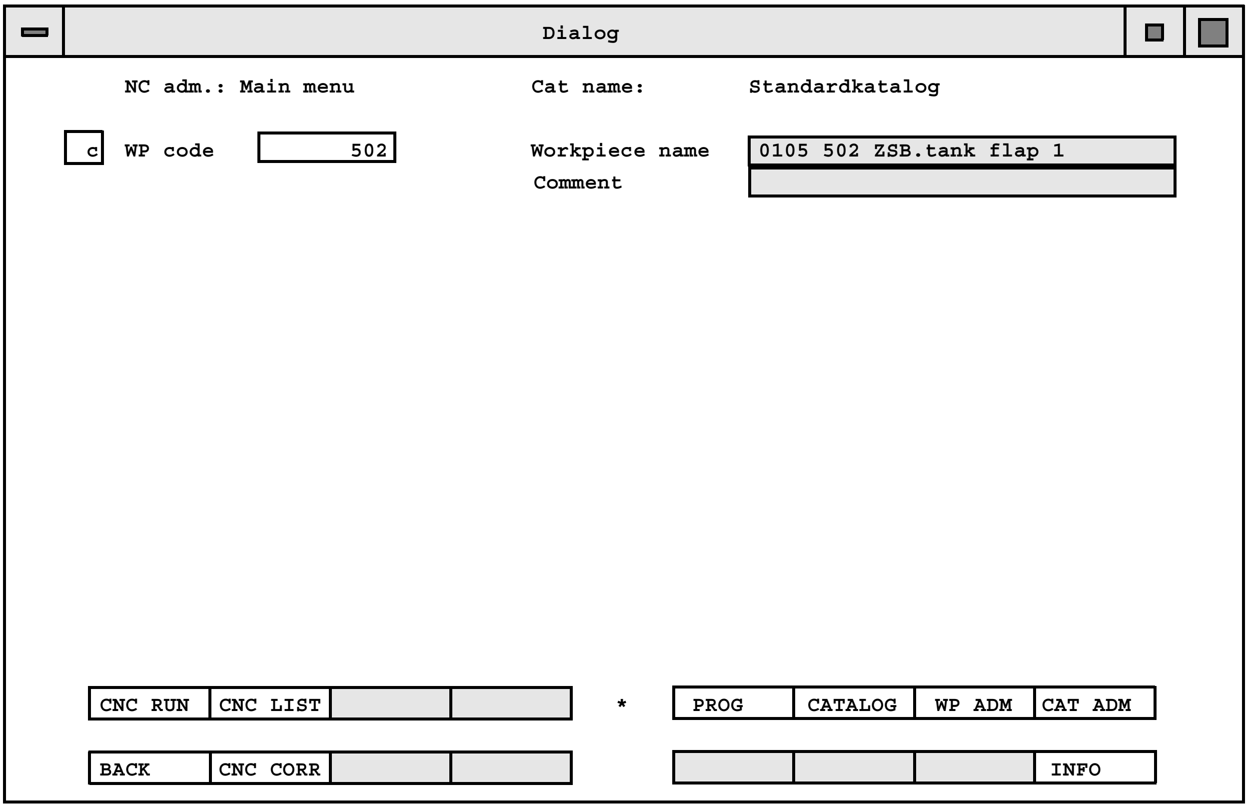
Max. 30 characters

Comment

Max. 30 characters

To select a workpiece, you must enter the corresponding workpiece identification or workpiece name. Your input will be checked immediately. If the workpiece identification or name entered is not listed in the current control data catalog, an error message will be displayed.

Using the **<CATALOG>** softkey, you can list the available workpieces in a dialog window and select the desired workpiece there. The workpiece identification, workpiece name and comment will be transferred to the dialog window.



Softkeys

CNC RUN — Start the CNC run **<DI 1640>** (➤***„Starting a CNC run for a single workpiece <DI 1640>" on page 18-3***).

CNC LIST — List the control data on screen / printer **<DI 1641>** (➤***„Adjusting control data addresses <AUTO-ADR>, <MAN-ADR>" on page 17-49***).

PROG — Program CNC runs **<DI 1639>** (➤***„Starting learn programming <DI 1639>" on page 16-13***).

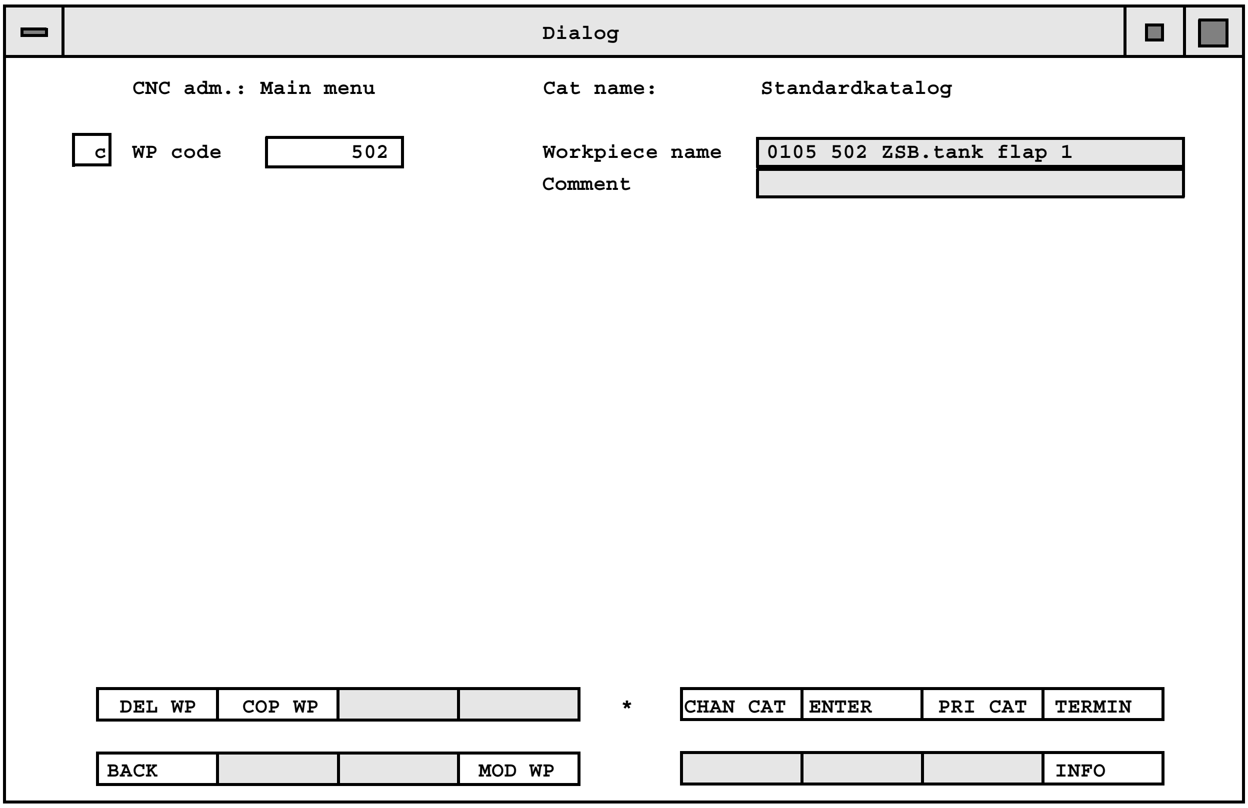
CATALOG — List the workpiece catalog on screen (➤***„Creating a new control data catalog" on page 17-25***).

WP ADM — Used for workpiece administration. See next page.

CAT ADM — Catalog administration (➤***„Managing workpiece catalogs <DI 1630>" on page 17-19***)

CNC CORR

Modify/correct control data **<DI 1642>** (➤*„Correcting control data <DI 1642>“ on page 17-31*).



Softkeys

DEL WP

Delete workpiece **<DI 1635>** (➤*„Deleting workpieces <DI 1635>“ on page 17-12*).

COP WP

Copy workpiece **<DI 1643>** (➤*„Copying workpieces <DI 1643>“ on page 17-18*).

CHAN CAT

Change Catalog (➤*„Changing the control data catalog“ on page 17-23*).

ENTER

Enter workpiece in catalog **<DI 1634>** (➤*„Entering a workpiece in the workpiece catalog <DI 1634>“ on page 17-10*).

PRI CAT

List workpiece catalog **<DI 1650>** (➤*„Listing the workpiece catalog <DI 1630, 1650>“ on page 17-5*).

MOD WP

Modify workpieces **<DI 1645>** (➤*„Modifying workpiece attributes <DI 1645>“ on page 17-17*).

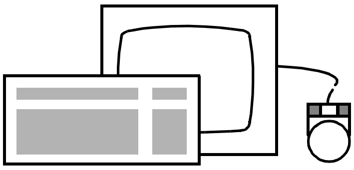
Workpiece catalog

Listing the workpiece catalog <DI 1630, 1650>

Application

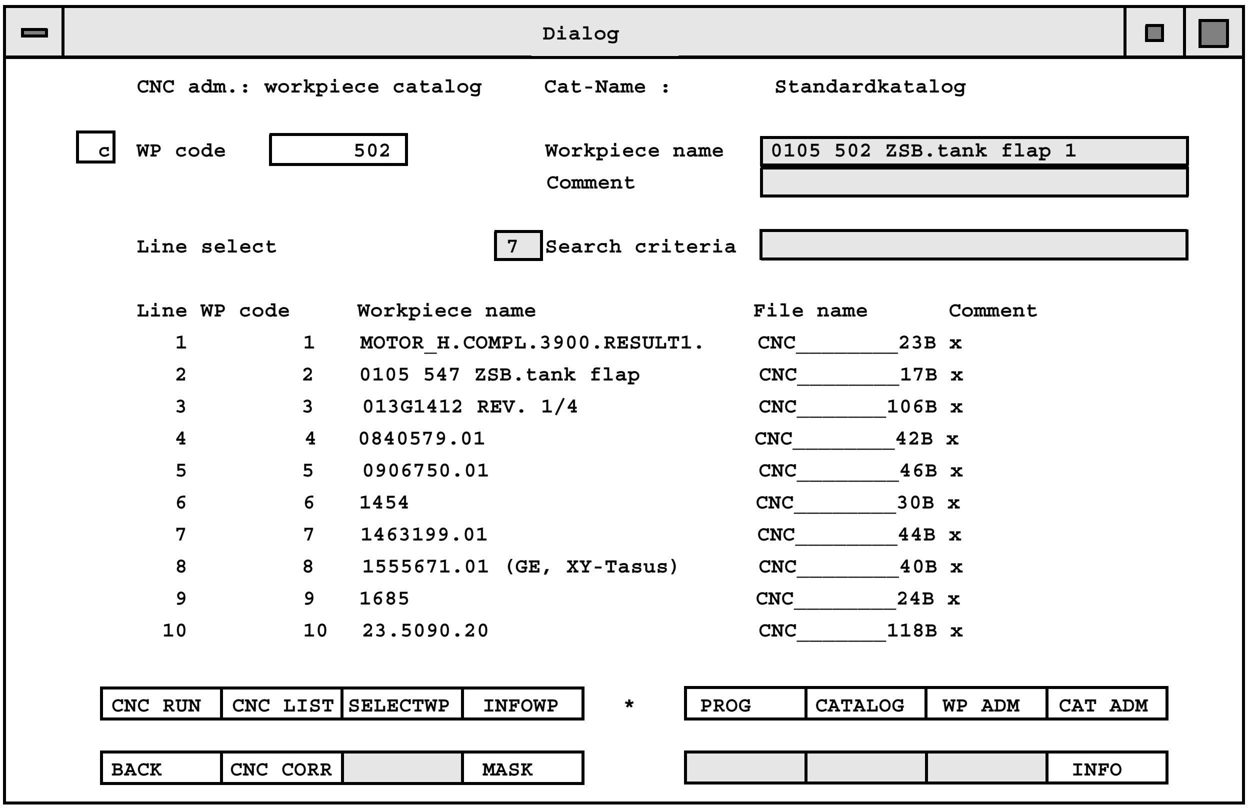
All programs in the workpiece catalog can be listed on the screen or printer. The list gives you information on workpiece codes, workpiece names and file names.

Output on screen



DI	Pull-Down-Menu	Pictogram
1630 ADM	CNC Workpiece administration. Catalog... <CATALOG>	

Screen output



Softkeys

CNC RUN	Start a CNC run.
CNC LIST	Output the control data of a workpiece.
SELECT WP	Enter the workpiece required in the **Line select** box. If this softkey is pressed, the WP code, workpiece name and comment will be transferred to the data boxes.
INFO WP	Display information on the current workpiece.
PROG	Start learn programming.
CATALOG	Softkey without function in this dialog window.
WP ADM	Call workpiece administration.
CAT ADM	Call catalog administration.
CNC CORR	Edit the control data of a workpiece.
MASK	This function activates a window for selective display of the catalog.

In the default setting, an "*" is entered in the **WP code, Workpiece name** and **Comment** data boxes so that all workpieces are displayed. If you enter a character string in one of the data boxes, only workpieces corresponding to the character string entered will be displayed. A character string can be combined with an "*". The window function is activated after pressing **<TERMIN>** .

Example: **WP code** = ***, Workpiece name** = **K*, Comment = ***; all workpieces starting with the letter K will be displayed.

Data boxes

WP code

The required workpiece can be selected with **<Enter>** after typing in the workpiece code.

Workpiece name

Display of the workpiece name selected or input of the workpiece name to be selected.

Comment

Display of the comment on the workpiece selected.

Line select.

Input of the catalog line in which the required workpiece is entered. See "Procedure" for more information.

Search criteria

The workpiece names of the catalog are searched through based on the character string entered here. The cursor points to the first workpiece name found. See "Procedure" for more information.

Procedure

Up to 10 programs (catalog lines) are displayed on the screen. The following possibilities exist for scrolling or searching through larger catalogs:

– Scroll up / down with **<SHIFT> <↑>/<SHIFT> <↓>**

– Page up / down with **<Page Up>** / **<Page Down>**.

– Enter the line (first columns of display) in the **Line select.** data box and accept with **<Enter>**. The required workpiece then moves to the center of the dialog window.

– Enter character string in **Search criteria** data box and accept with **<Enter>**. A typical character string would be e.g. the workpiece identification and the full or partial workpiece name.

  When you press **<Enter>,** the program will search starting from the current line (cursor position). If you want to browse through the entire catalog, you must initially select the 1st catalog line.

  After a successful search, the corresponding workpiece will move to the center of the dialog window.

You can jump between **Line select.** and **Search criteria** with the ↑ and ↓ cursor keys.

Conclude with **<BACK>** or **<TERMIN>**.

Explanation of the information listed

WP code

Workpiece code listed in the workpiece catalog, 10 characters in length.

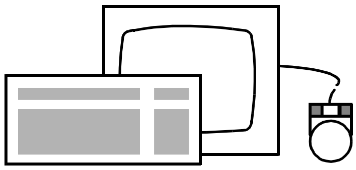
Workpiece name

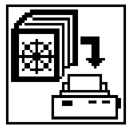
You must assign a name to the workpiece at the end of programming (➤ ***„Learn programming a new workpiece“ on page 16-13***). This name will automatically be entered in the workpiece catalog.

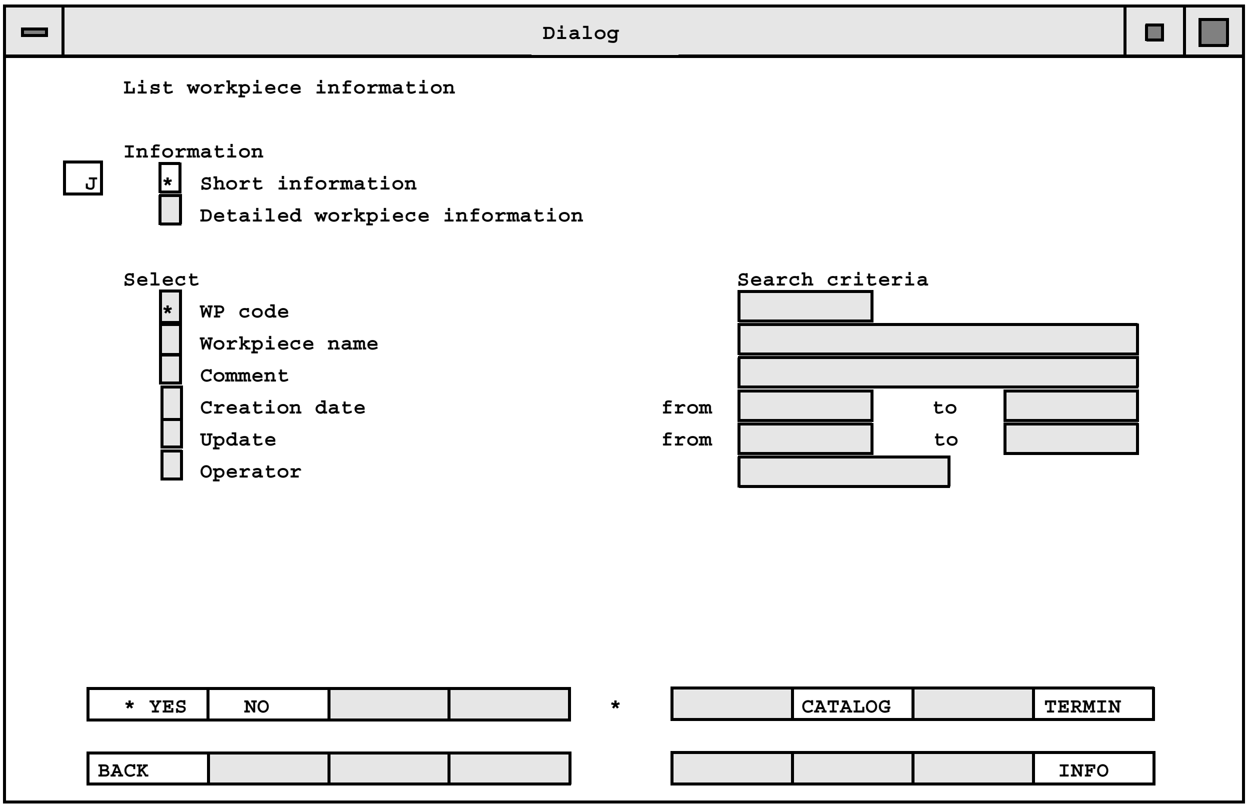
File name

The system stores the workpiece under this name. UMESS automatically assigns this name following learn programming. In specially cases, you may also do this yourself. For more information on file names, see ➤*„Entering a workpiece in the workpiece catalog <DI 1634>“ on page 17-10*

Output to the printer and/or record window



DI	Pull-Down-Menu	Pictogram
1650 LISCAT	CNC Workpiece administration Catalog on printer...	



Output

In its structure the listed catalog (printer, record window) corresponds to the output in the dialog window, see above.

CATALOG

Softkey without function

Data boxes

Information
Short information
Detailed workpiece information

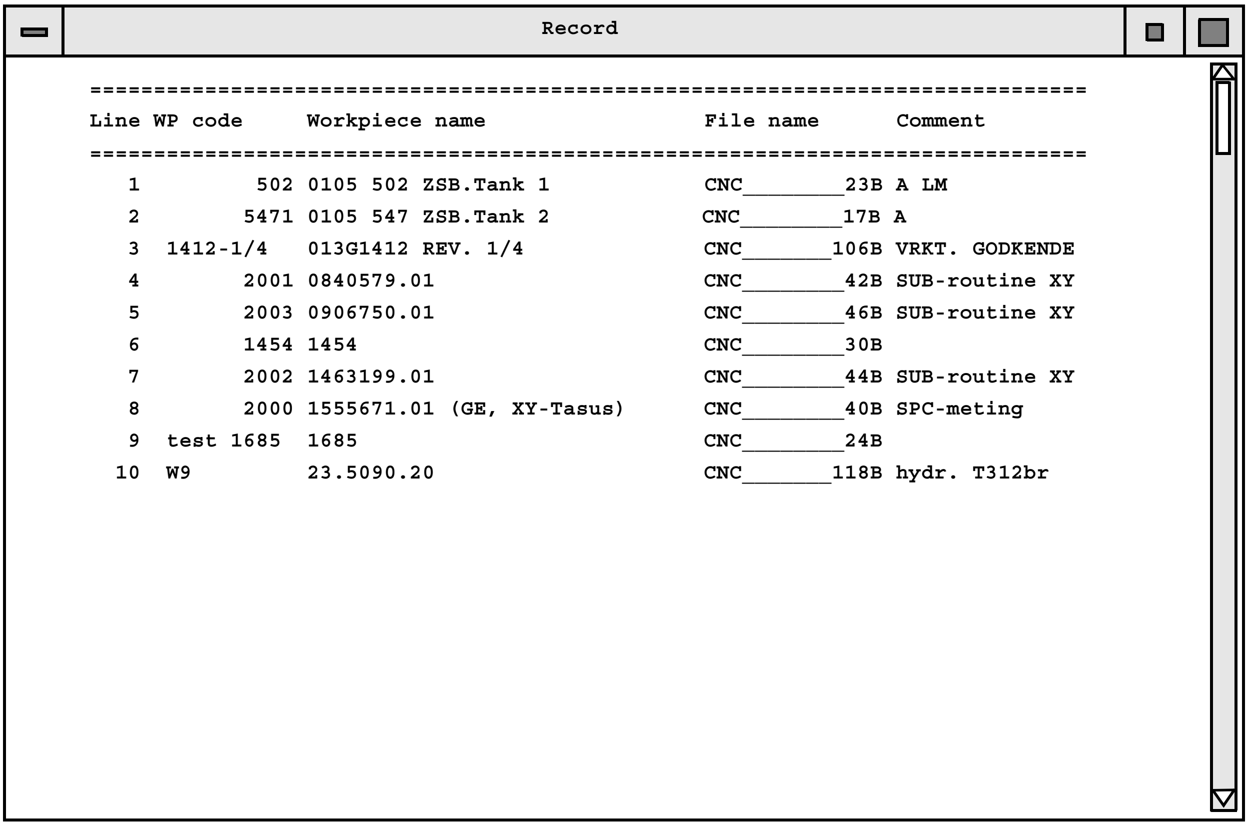
Short information: Output of the dialog window catalog display to the record window and/or to the printer.

Detailed workpiece information: Output of all catalog information to the record window and/or to the printer.

Selection

Workpiece output can be limited based on the selection criteria: **WP code**, **Workpiece name**, **Comment**, **Creation data**, **Update (Modification data)** and **Operator**. Selection can be made based on several criteria or only one. The wildcard character is an * (asterisk).

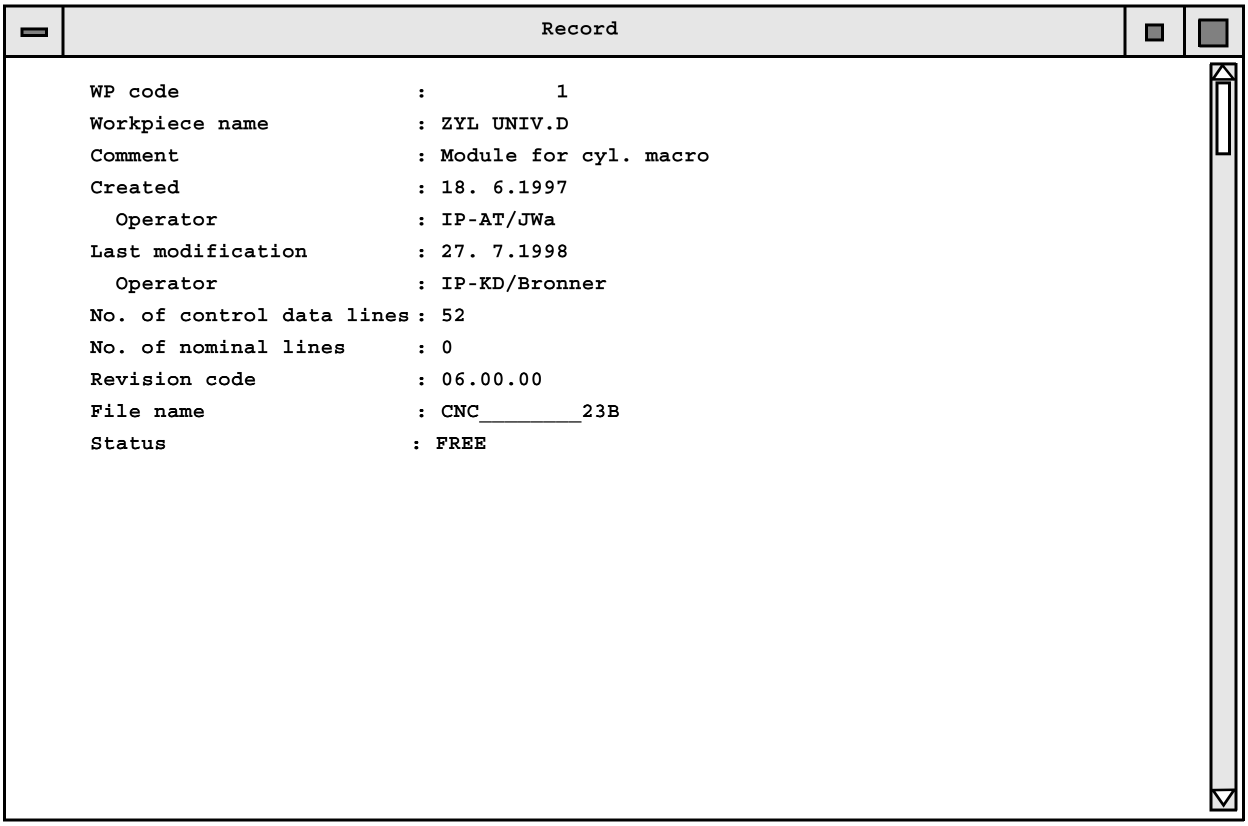
Example of short information



Record

Line	WP code	Workpiece name	File name	Comment
1	502	0105 502 ZSB.Tank 1	CNC_________23B	A LM
2	5471	0105 547 ZSB.Tank 2	CNC_________17B	A
3	1412-1/4	013G1412 REV. 1/4	CNC________106B	VRKT. GODKENDE
4	2001	0840579.01	CNC_________42B	SUB-routine XY
5	2003	0906750.01	CNC_________46B	SUB-routine XY
6	1454	1454	CNC_________30B	
7	2002	1463199.01	CNC_________44B	SUB-routine XY
8	2000	1555671.01 (GE, XY-Tasus)	CNC_________40B	SPC-meting
9	test 1685	1685	CNC_________24B	
10	W9	23.5090.20	CNC________118B	hydr. T312br

Example of detailed workpiece information



Entering a workpiece in the workpiece catalog <DI 1634>

Application

If a workpiece exists only in the memory of the computer, you must enter it in the workpiece catalog with this function. Otherwise UMESS will not be able to access the workpiece.

Application

Copying a workpiece from an external data carrier to the system with a UNIX command.

<DI 3500>

No entry is required if you have stored a workpiece with **<DI 3500>** or **<DI 3460>**.

Prerequisites

Any workpiece entered must meet the following requirements (➤ ***„Managing workpiece catalogs <DI 1630>“ on page 17-19***):

– Its workpiece file must be stored in the **/home/zeiss/UB** directory.

– Its complete file name must be **CNC__XXXXXXXXB**, where **XXXXXXXX** here stands for an eight-digit combination. The length of the file name must be 14 characters where the first three characters must be **CNC** and the last one must be **B**.

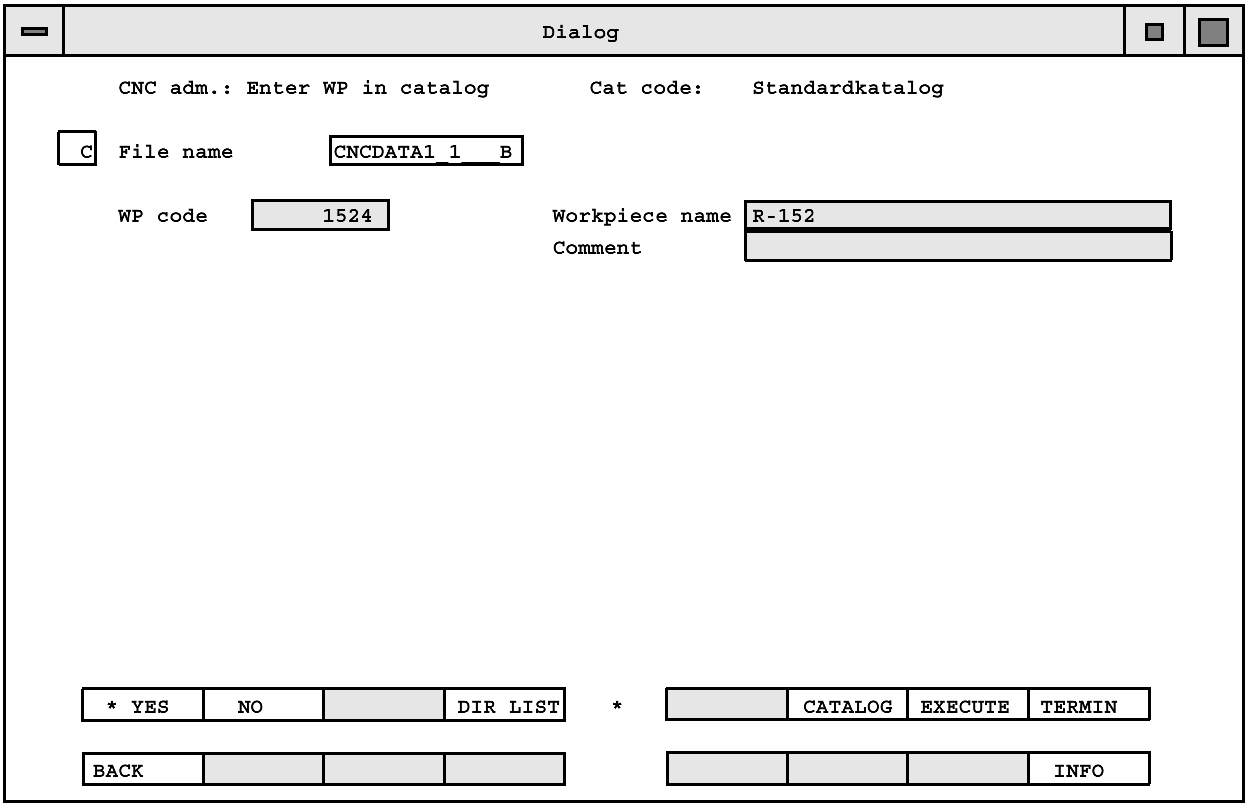
UMESS automatically assigns this file name corresponding to the catalog code during learn programming.

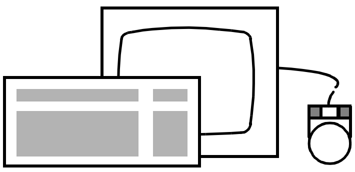
Example: file name = **12345678**. The full name of the file is then **CNC__12345678B**.

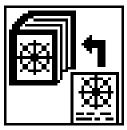
The workpiece catalog also lists the file names of the workpieces entered (for screen output, ➤***„Listing the workpiece catalog <DI 1630, 1650>" on page 17-5***).

When copying via a UNIX command, you must assign the file name manually.

– Rights: group **ikd1**, owner **kd1**.





DI	Pull-Down-Menu	Pictogram
1634	CNC Workpiece administration enter...	

Softkeys

DIR LIST

List all files on the directory **/home/zeiss/UB,** function not yet implemented.

CATALOG

List the workpiece catalog; e.g. check which workpiece number or file names are still free. Use and operation as for **<CATALOG>**,
➤ ***„Listing the workpiece catalog <DI 1630, 1650>" on page 17-5***

EXECUTE

Input the file with the filename entered in the catalog.

Data boxes

File name Name under which the file to be entered is stored in the **/home/zeiss/UB** directory.

WP code Code under which the workpiece is entered in the catalog.

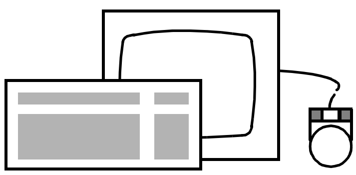
Workpiece name Enter name of workpiece, max. 30 (random) characters.

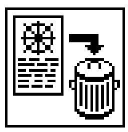
Comment Enter a comment on this workpiece.

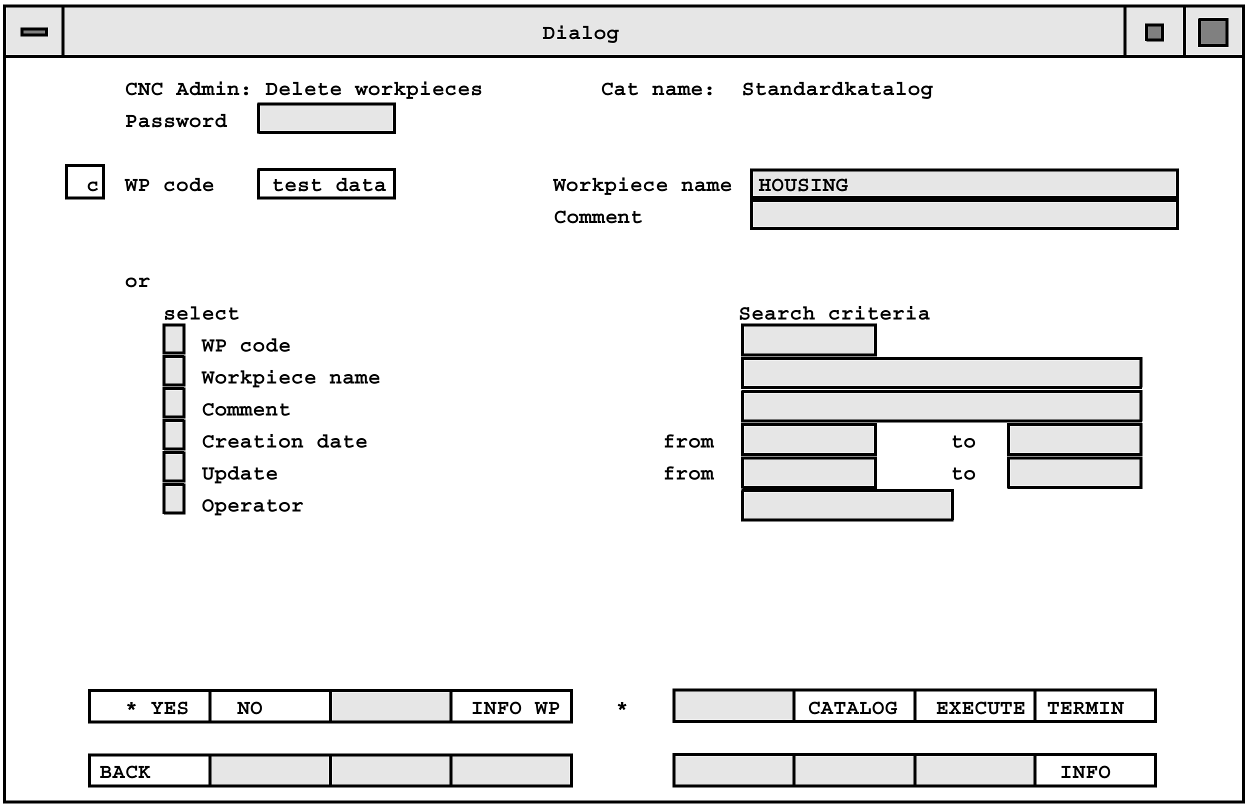
Deleting workpieces <DI 1635>

Application You can use this function to delete workpieces from the catalog and from the hard disk.

Important!
Workpieces will be irrevocably erased if they are deleted from the catalog! They can then be recovered only by restoring a previous data backup.



DI	Pull-Down-Menu	Pictogram
1635 DELETECNC	CNC Workpiece administration delete...	



Softkeys

INFO WP

Shows additional information on the workpiece.

CATALOG

Used to the workpiece catalog, e.g.select workpieces. Use and operation as for **<CATALOG>**, ➤***„Listing the workpiece catalog <DI 1630, 1650>“ on page 17-5***. You return to this screen page from the display of the workpiece catalog.

EXECUTE

Deletes the file with the workpiece code entered and the corresponding workpiece name in the catalog and in the memory.

NOTE

A verification inquiry is made beforehand:

Do you really want to delete workpiece xxxxxxx ?

TERMIN

Used to close the dialog window.

Data boxes

Password

An input is required only if a password has been entered in the catalog function.

WP code

Code of the workpiece in the catalog.

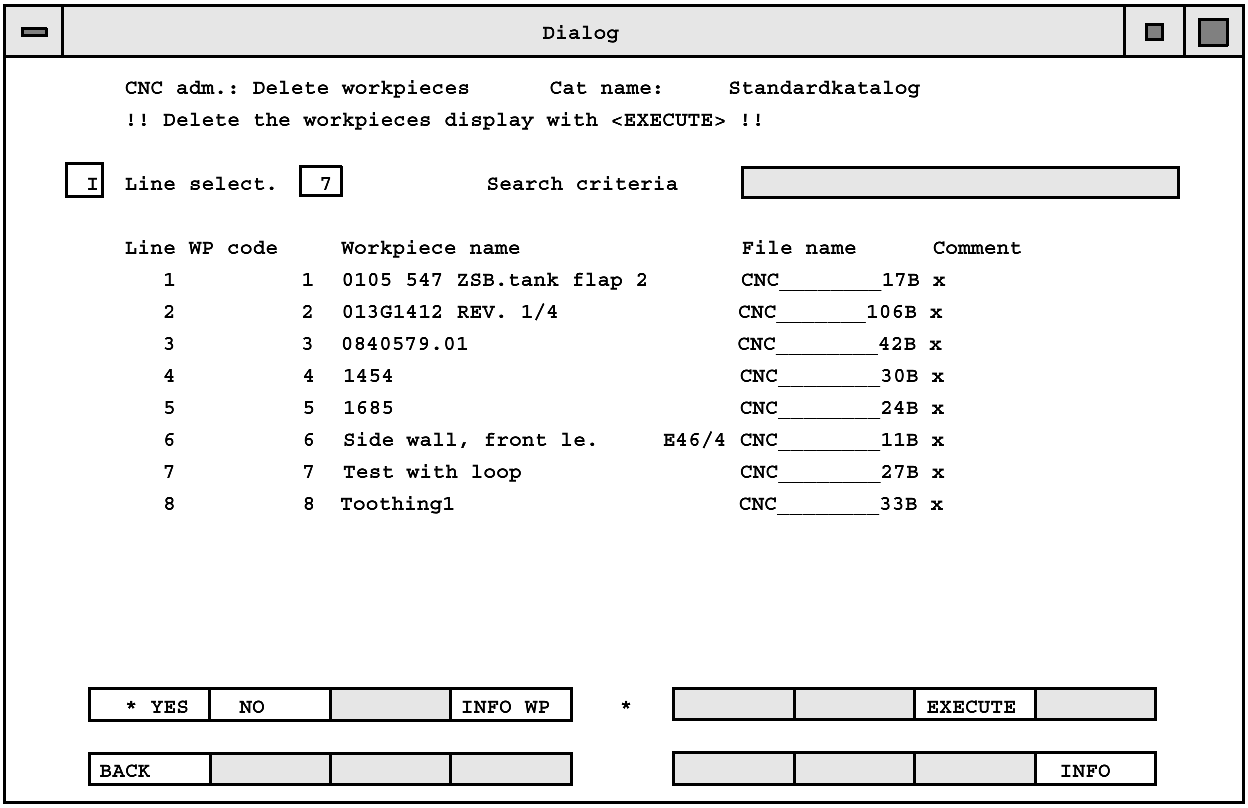
Workpiece name Name of workpiece, max. 30 (random) characters in length.

Comment Comment on this workpiece.

Select/Search criteria Workpieces are distinguished by a number of features in the catalog entry. When deleting workpieces, you can define these distinguishing features as search criteria: First select the required search criterion. Then define the character string for the search criterion. Multiple search criteria are possible.

You can terminate the character string of a search criterion with an asterisk (*). In this case any character string may follow. Example: "**WOR***" as search criterion deletes **WORKPIECE A, WORKPIECE B, ...**

Using **<EXECUTE>** you can display a list of **all workpieces marked for deletion**.



You can display this list section by section using the **<Page Up>** / **<Page Down>** keys.

All of the workpieces remaining in this list will be deleted when you press <EXECUTE>.

Workpiece information

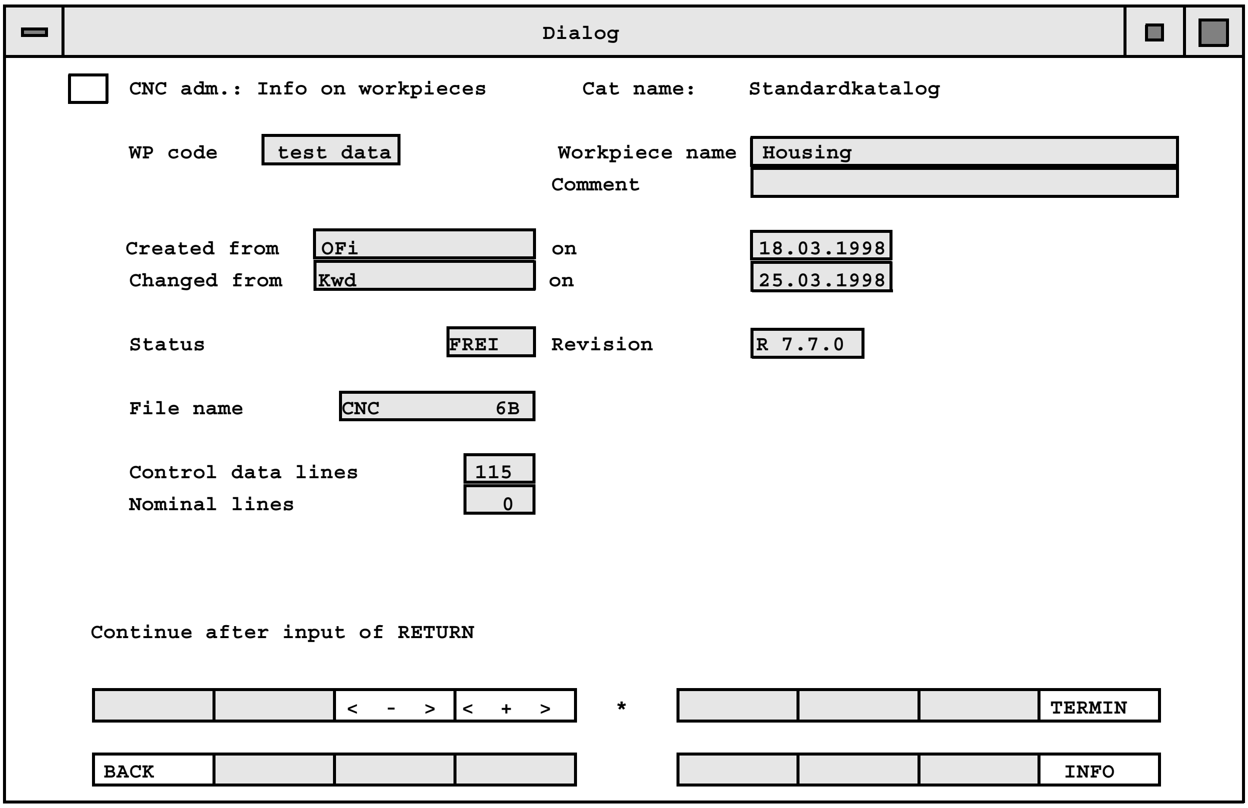
Application

This function displays workpiece information on the screen. You can edit the data displayed with **<DI 1645>** (➤***„Modifying workpiece attributes <DI 1645>“ on page 17-17***).

Function call

INFO WP

This function can be called from different dialog windows in the workpiece administration.



Softkeys

< - >

Move back one catalog position and display the corresponding workpiece information.

< + >

Move forward one catalog position and display the corresponding workpiece information.

Data boxes

WP code

Workpiece code of selected workpiece.

Workpiece name

Name of selected workpiece.

Comment

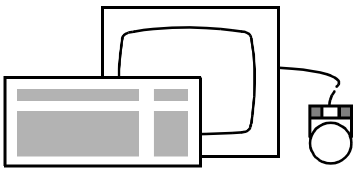
Comment on current workpiece name.

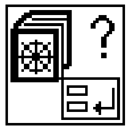
Created from/on	Operator and date of creation.
Changed from/on	Operator and date of last change.
Status	Status of workpiece.
Revision	Software revision used.
File name	Name of file stored in the /home/zeiss/UB directory.
Control data lines	Number of control data lines.
Nominal lines	Number of nominal value lines (only for old control data predating revision ➤***„Selecting a control data line <SELECT L>“ on page 17-35***).

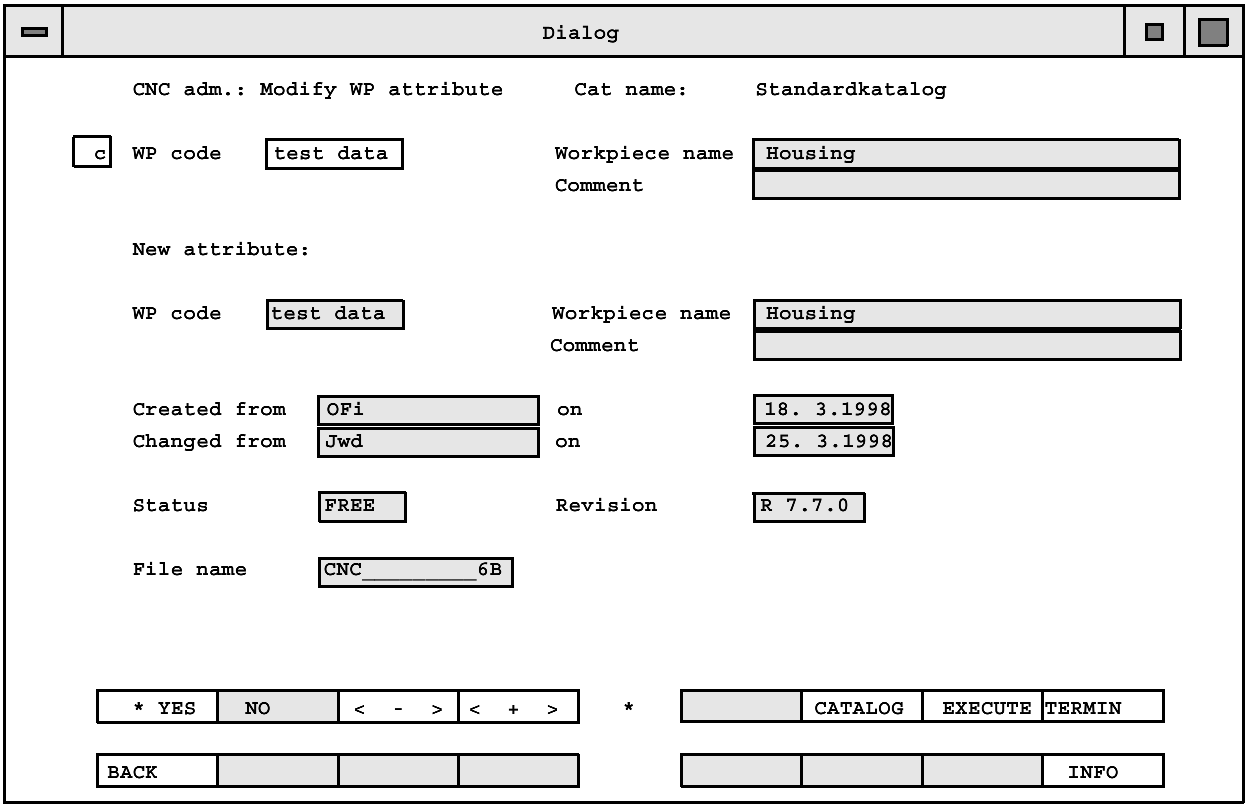
Modifying workpiece attributes <DI 1645>

Application

You can use this function to edit workpiece attributes. When it is called, a workpiece which has a **DISABLED** status due to incorrect application will automatically be set to the **FREE** status.



DI	Pull-Down-Menu	Pictogram
1645 CNCMOD	CNC Workpiece administration Modify catalog...	



Softkeys

< - >

Select the workpiece located in front of the workpiece displayed in the current catalog.

< + >

Select the workpiece located after the workpiece displayed in the current catalog.

CATALOG

List the workpiece catalog, to check for example which workpiece codes or file names are still free. Use and operation as for **<CATALOG>**, ➤ ***„Listing the workpiece catalog <DI 1630, 1650>“ on page 17-5***. You return to this point from the workpiece catalog.

EXECUTE

Store the data modified in the catalog.

Data boxes

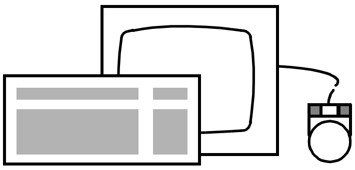
WP code, Workpiece name, Comment

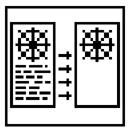
Selection of the required workpiece.

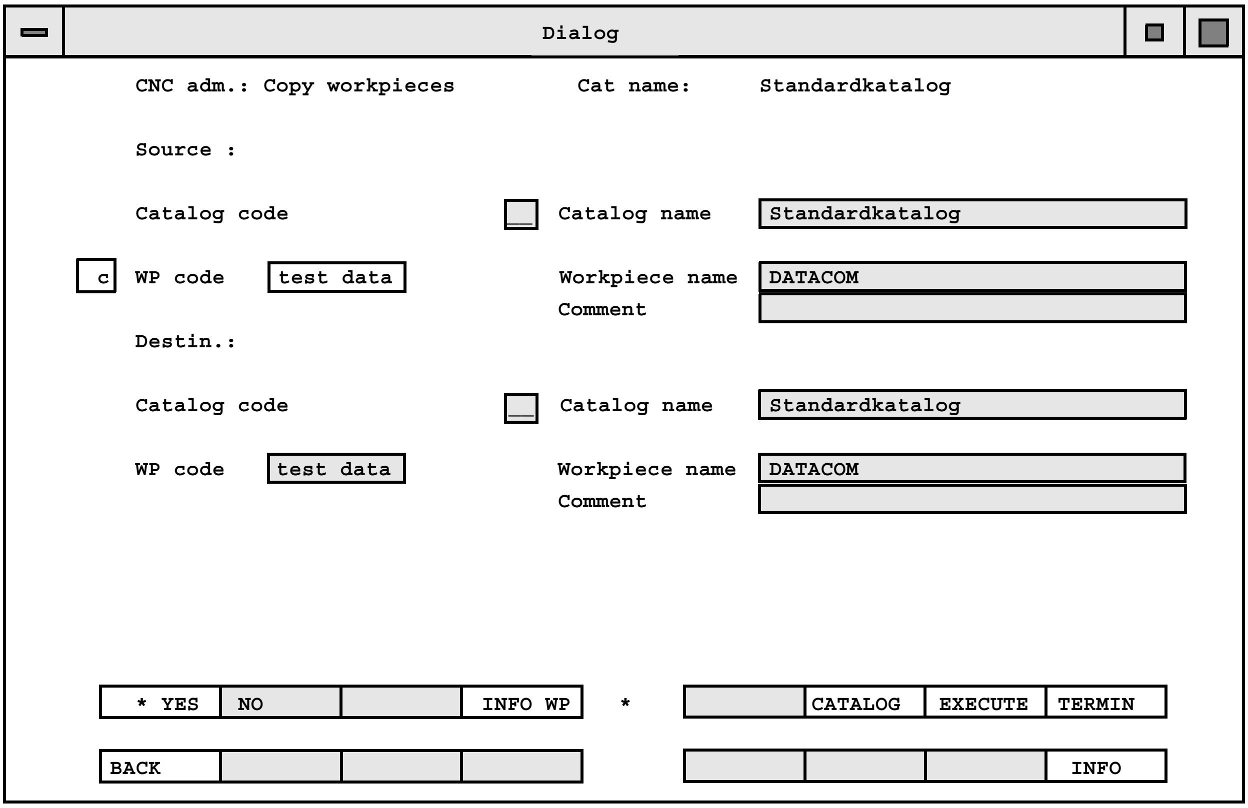
New attribute

Here you can edit the attributes of the selected workpiece. This new data can then be stored with the workpiece in the workpiece catalog by pressing **<EXECUTE>**.

Copying workpieces <DI 1643>



DI	Pull-Down-Menu	Pictogram
1643 CNCLIN	CNC Workpiece administration copy...	



Softkeys

INFO WP

Information on the workpiece data in the catalog.

CATALOG

To list the workpiece catalog; e.e. to check which workpiece codes or file names are still free. Effect and operation as for **<CATALOG>**, ➤***„Listing the workpiece catalog <DI 1630, 1650>“ on page 17-5***. You return to this point from the workpiece catalog.

EXECUTE

To execute the copy command corresponding to the data entered.

Data boxes

Source/Destin.

Source = entries for the original workpiece, Destination = entries for the copied workpiece.

The copied workpiece must be assigned a different **WP code** and **Workpiece name** than the original workpiece.

Reason: It must be possible to distinguish between these two features if they are located in the same catalog.

Catalog code

Catalog code (2 characters). Work with up to 400 catalogs is possible.

WP code

Code of selected workpiece.

Workpiece name

Name of selected workpiece.

Comment

Comment on current workpiece name.

Managing workpiece catalogs <DI 1630>

Application

This function features the catalog functions you need to manage multiple control data catalogs.

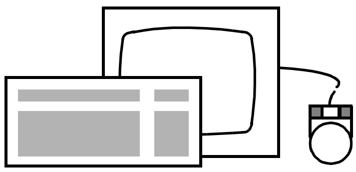
Catalog structure of control data management

Level 1	**Control data management catalog**				
Level 2	Control data catalog 1	Control data catalog 2	Control data catalog 3	• • •	Control data catalog n
Level 3	Workpieces for 1	Workpieces for 2	Workpieces for 3	• • •	Workpieces for n

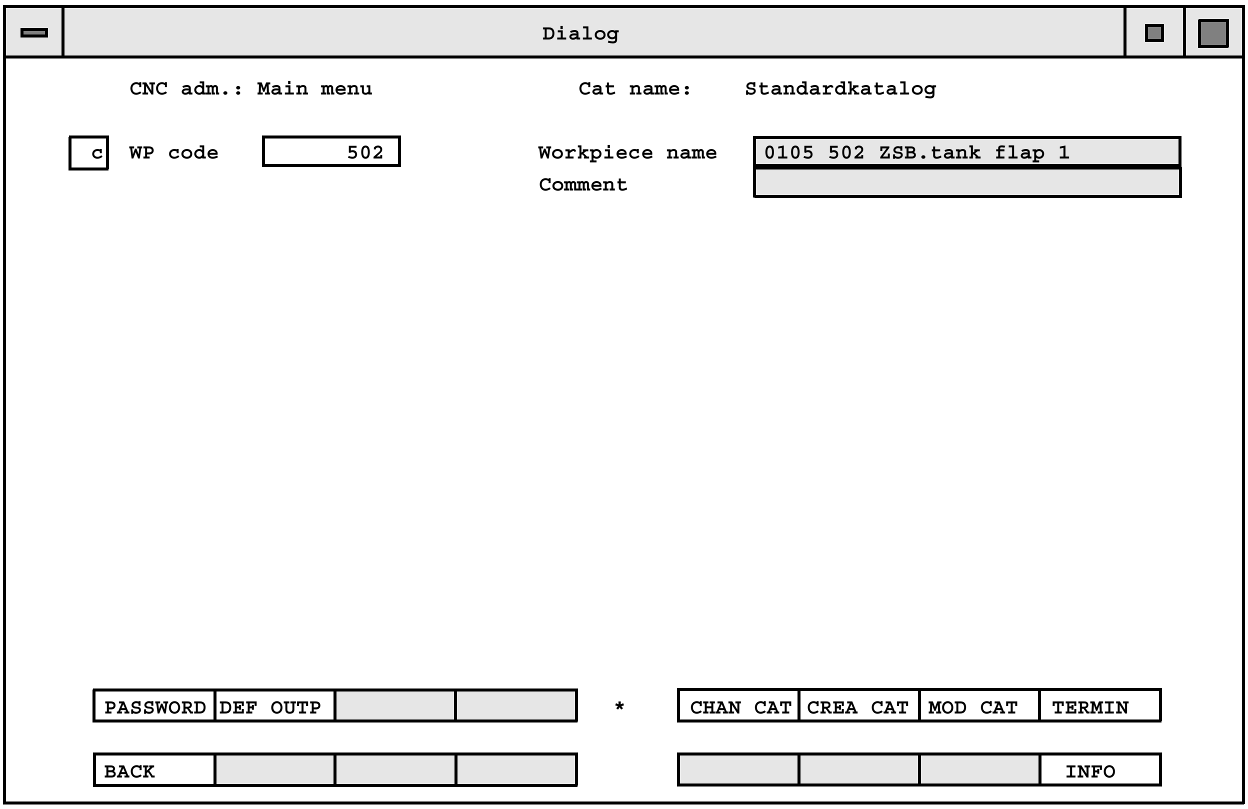
Control data catalog management involves the following responsibilities

1. Creation of new control data catalogs
2. Changeover between control data catalogs
3. Change or deletion of a password for a control data catalog
4. Edit or delete the control data catalogs
5. Defining an output

You can call the catalog functions from the UMESS main menu:



DI	Pull-Down-Menu	Pictogram
1630 CNCADM	CNC Workpiece administration Catalog... <CAT ADM>	



Softkeys

Use the **<CAT ADM>** softkey to call the main menu of the control data catalog. You can then use the softkeys in the menu to execute various control data catalog administration program functions.

PASSWORD Change or delete a passward, ➤ *„Changing or deleting a password in the workpiece catalog“ on page 17-21*

DEFR OUTP Define the output, ➤ *„Defining the output columns of the catalog“ on page 17-22*

CHAN CAT Change the control data catalog, ➤ *„Changing the control data catalog“ on page 17-23*

CREA CAT Create a new control data catalog, ➤ *„Creating a new control data catalog“ on page 17-25*

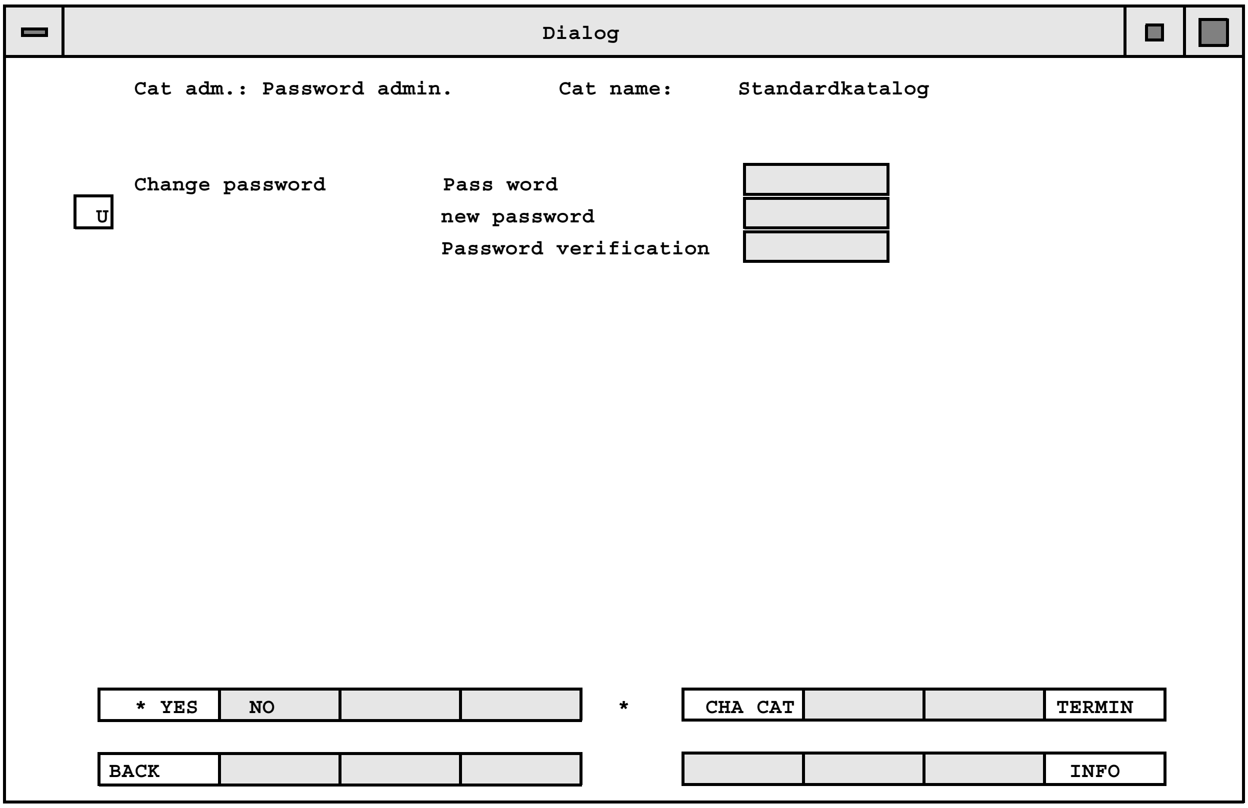
MOD CAT Modify or delete a control data catalog, ➤ *„Modifying or deleting a control data catalog“ on page 17-26*

Changing or deleting a password in the workpiece catalog

Application

You can use the **<PASSWORD>** program function in the catalog administration of **<DI 1630>** to change or delete the password of a control data catalog. Choose a password which all users with access rights can easily remember and is easy to write.

You do not necessarily have to assign a password to every control data catalog, see **Deleting passwords**



Data boxes

Pass word Enter the old password which was valid until now.

new password Enter the new password (max. 10 characters).

Password verification Enter the new password again for verification. If the two passwords are not identical, the message **'Passwords do not match. Please repeat entry'** will appear.

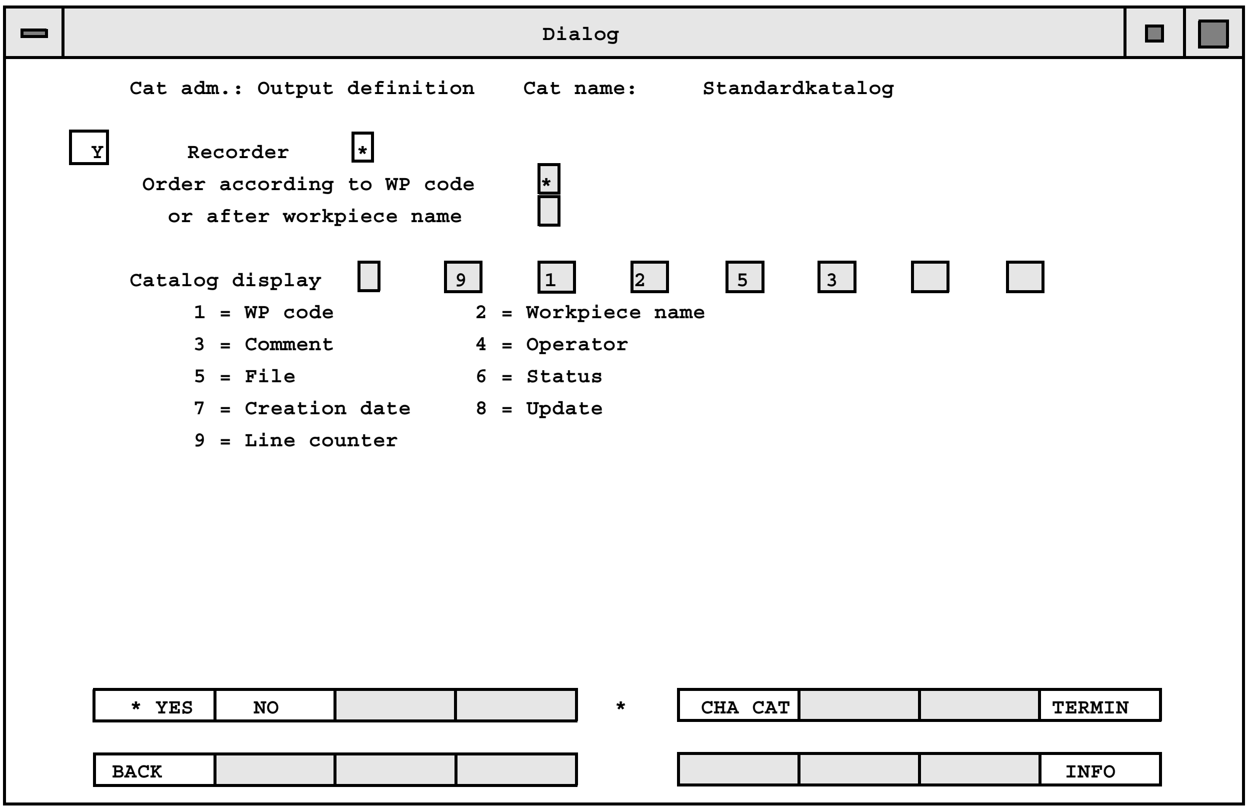
If you entered the same password both times, it will become effective as soon as you close the dialog window with **<TERMIN>**.

Deleting passwords You do not necessarily have to assign a password to each control data catalog.

To delete a password, just press <Enter> for **new password** and for **Password verification**. The password protection of the correspon-ding control data catalog will then be deleted as soon as you close the dialog window with **<TERMIN>**.

Defining the output columns of the catalog

Application Using the **<DEF OUTP>** program function in the catalog administra-tion of **<DI 1630>**, you can define which information will be output for individual workpieces and in which order this will be done in the control data catalog.



Data boxes

Reorder

<YES>
Here you can select output of the control data sorted alphabetically either by workpiece code or by workpiece name.

Catalog display

Here you can define which information will be output and in what order. Enter the code numbers concerned in the data boxes in the required order (see dialog window for code numbers).

Softkey

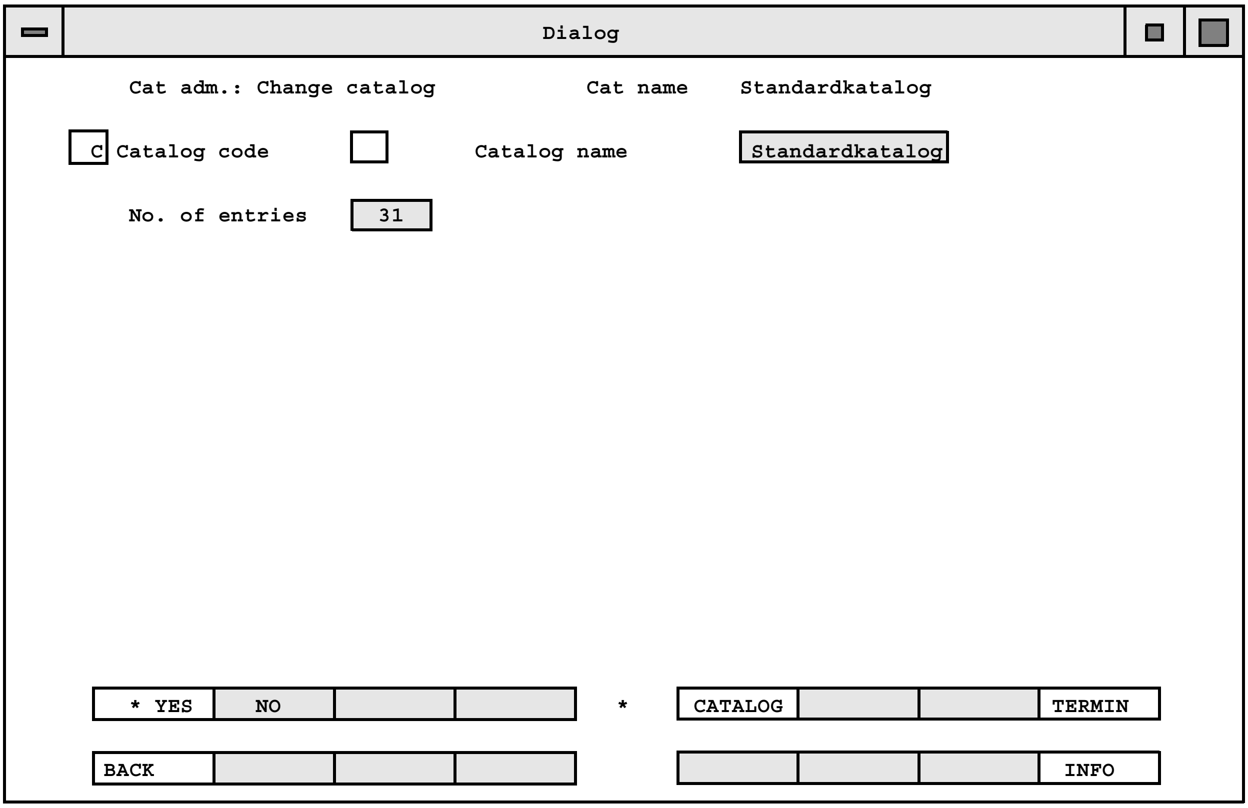
CHA CAT

Changes the control data catalog, ➤***„Changing the control data catalog" on page 17-23***

Changing the control data catalog

Application

You can change control data catalogs using the **<CHAN CAT>** program function in the catalog administration of **<DI 1630>**.



Data boxes

Catalog code

To select a control data catalog, you must enter its identification. Your input will be checked immediately. If the identification entered does not exist in the catalog of control data catalogs, the message **Control data catalog does not exist** will be displayed.

With the **<CATALOG>** softkey, you can list the existing control data catalogs present in the catalog and select the one you require. The identification and name of the selected control data catalog and the number of entries will then be copied to the dialog window.

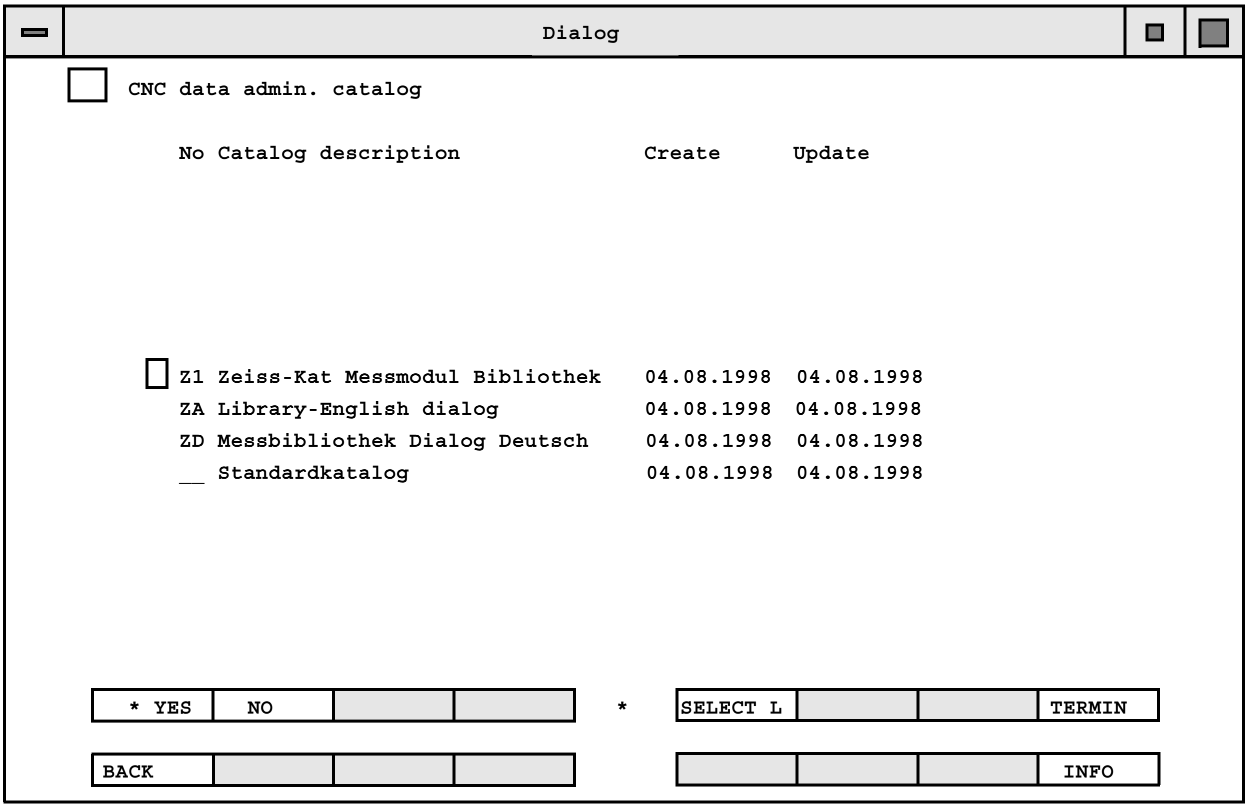
No. of entries

User information only: The number of workpieces entered in the current control data catalog is then displayed.

Softkey

CATALOG

All existing control data catalogs are displayed in the catalog of control data catalogs.



Softkeys

* YES

Select a control data catalog. The identification of the control data catalog, the name of the control data catalog and the number of entries will then be copied to the dialog window.

NO Jump to the next line in the catalog of the control data catalogs.

SELECT L Select a control data catalog by specifying a line in the catalog of the control data catalogs.

Line

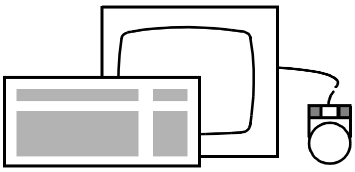
In order to select a control data catalog, you must enter the appropriate identification of the control data catalog (e.g. 3) in the catalog of control data lines.

Creating a new control data catalog

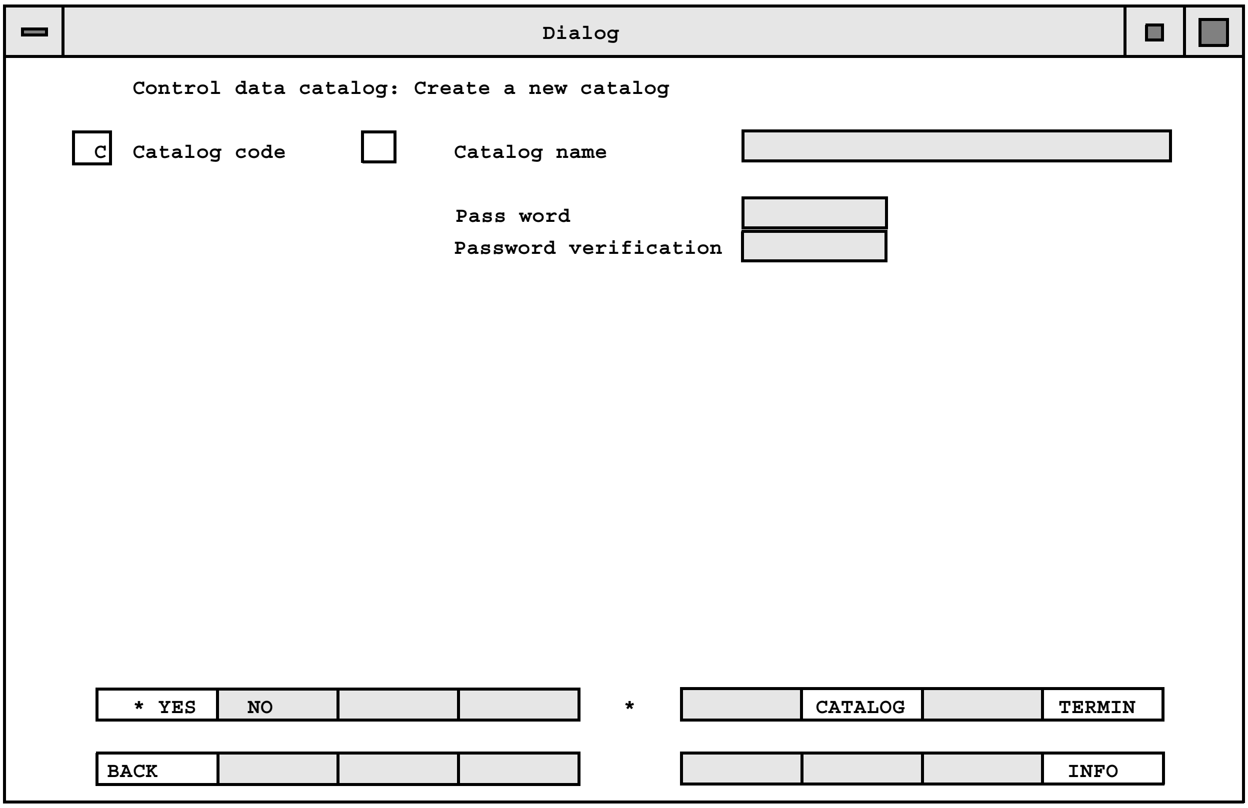
Application

You can create new control data catalogs with the **<CREA CAT>** program function in the catalog administration of **<DI 1630>**.

Alternative function call



DI	Pull-Down-Menu	Pictogram
1631		



Data boxes

Catalog code

Each control data catalog has a code comprising two characters. Enter the new code. Your input will be checked immediately. If the identification of the control data catalog entered already exists in the catalog of the control data catalogs, the following message will be displayed: **Catalog already exists**.

Catalog name

You must enter a text (catalog name) comprising at least 5 characters.

Pass word and Password verification

You can protect your new control data catalog with a password, ➤***„Changing or deleting a password in the workpiece catalog“ on page 17-21***. It is not, however, necessary to assign a password. If you do not want to assign a password, leave the data boxes empty and skip them with **<Enter>**.

Softkey

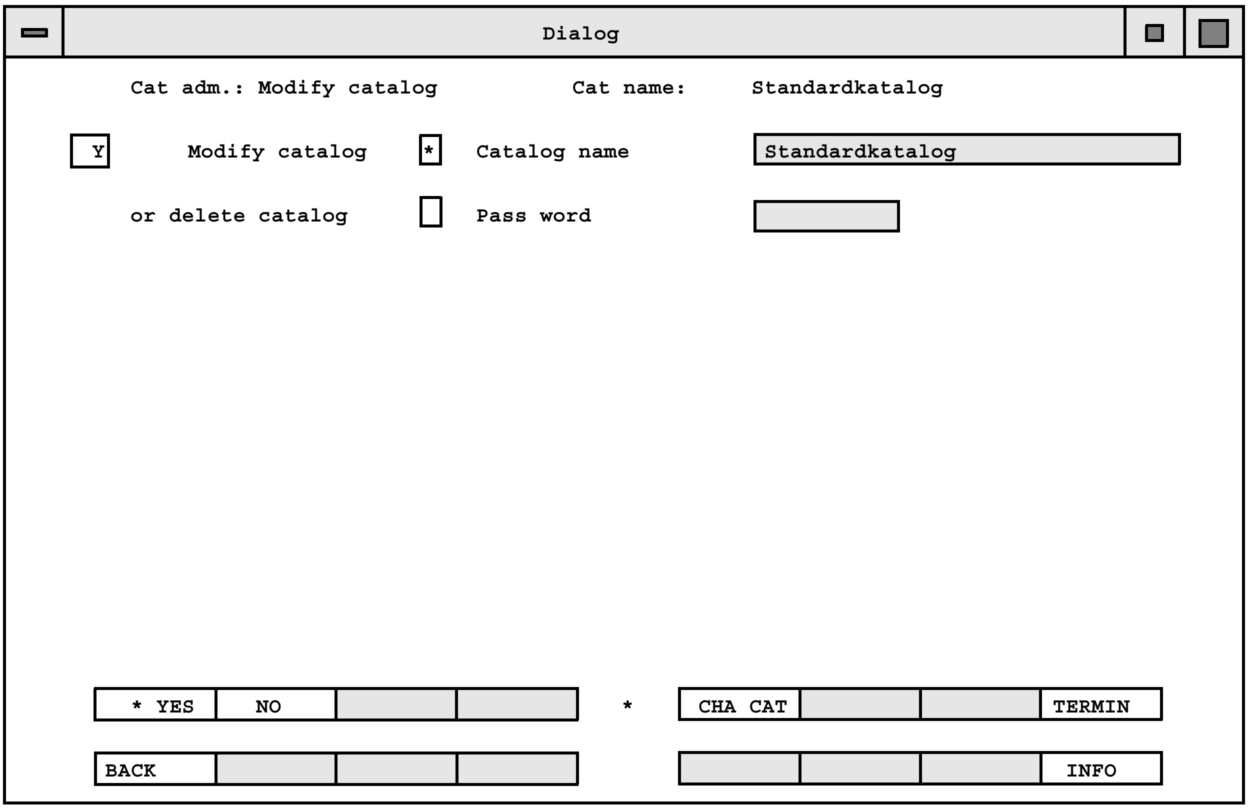
CATALOG

Displays the catalog of the control data catalogs, ➤***„Changing the control data catalog“ on page 17-23***

Modifying or deleting a control data catalog

Application

With the **<MOD CAT>** function in the catalog administration of **<DI 1630>** you can change or delete the control data catalogs.



Softkey

CHA CAT

Changes the control data catalog, ➤*„Changing the control data catalog" on page 17-23*

Data boxes

Modify catalog

<YES>
You can give the selected control data catalog another name.

or delete catalog

<YES>
You can delete the selected control data catalog if it is empty and you know the corresponding password.

Pass word

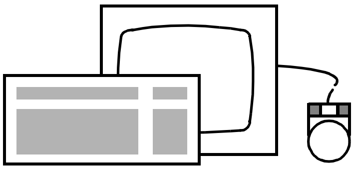
➤*„Changing or deleting a password in the workpiece catalog" on page 17-21*

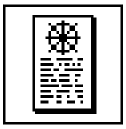
Editing control data

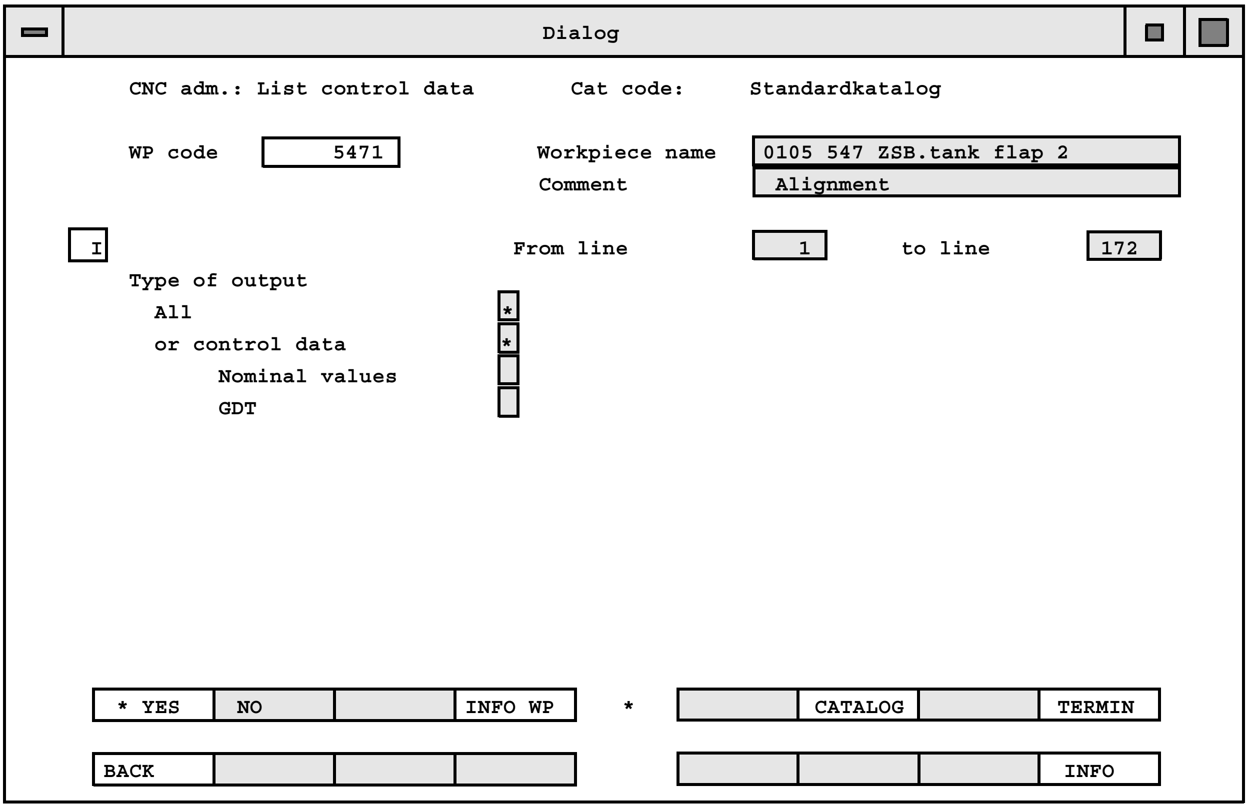
Listing control data <DI 1641>

Application

This function can be used to print the control data of a CNC program either in full or section by section.



DI	Pull-Down-Menu	Pictogram
1641 CNCLIST	CNC Control data list...	



Softkeys

INFO WP

Information on the workpiece data in the catalog (➤*„Workpiece information“ on page 17-15*).

CATALOG

Lists the workpiece catalog; e.g. in order to check which workpiece codes or file names are unassigned. Use and operation as for **<CATALOG>**, (➤*„Listing the workpiece catalog <DI 1630, 1650>“ on page 17-5*). You return to this point from the workpiece catalog.

WP code Code of selected workpiece.

Workpiece name Name of selected workpiece.

Comment Comment on current workpiece name.

From line, to line Start and end line of the control data to be output. The default values are the first line and the last line of the program.

Type of output Extent of the control data to be output.

All Output of all information contained in the control data.

or control data Nominal values, GDT This is an older function used only with UMESS revisions predating Rev. 7.5.4. The output selects the nominal values from the control data.

Example Control data list, requested with **<ALL>**:

```
Protokoll

================================================================================

                      CONTROL DATA LIST ZEISS  UMESS

WORKPIECE NAME :   0105 547 ZSB.tank flap 2
FILE NAME :  CNC________17B
CONTROL DATA LINES :   172              NOMINAL LINES:     0
================================================================================
    |     X     |      Y    |      Z     ||            ||    ||    ||     |
 NO |--------------------------------|  Function     SC2    SC1   PCN   CCN   ADR
    |            Dialog
 NO |   NOMINAL     |  U.Tol  |  L.Tol   Function     SC2    SC1   PCN  CCN
 NO |          Identification            Function     SC2    SC1   PCN  CCN   ADR
================================================================================
   1  1001    3    0      0.000    1.000 P_PARAM        2      7      0  1500
   2  2001    3    0      0.000    0.000  DL P_PARAM    2      0      0  1911
   3  1020    3    0      0.000    0.020  DL F_PARAM    1      0      0  1911
   4  2000    3    0      0.005    0.000  MEAS FORCE    3      0      0  1911
   5  1004    3    0      0.000    3.500  DL F_PARAM    1      0      0  1911
   6  1001    3    0      0.000   70.000  DL F_PARAM    1      0      0  1911
   7  1014    3    0      0.000  125.000 LDL F_PARAM    1      0      0  1919
   8                                     PRINTER ON    0      0  1614      0
   9     1    3    0 0    0.000    0.000 REC DEF       0      1  1665      0
  10     2    1    1 10   0.000    0.000 REC DEF       0      1  1665      0
  11     1    3    0 0    0.000    0.000 REC DEF       0      1  MMMM   MMMM
```

Interpretation of the control data

Key to column headings and codes used:

NO Consecutive number of learn program.

X | Y | Z Coordinates of probings or intermediate positions.

Function Short description of coded function.

SC2

For **fine positioning** (e.g. step, position, scanning): Address of the valid workpiece system.

For **N POINT TERM:** Plane code.

For **RECALL:** Number of addresses.

SC1

For **probing** and **intermediate position** from left to right: Column number, probe combination, probe number and probing direction.

For **fixed plane <DI 1680>:** Plane code.

For **data lines:** Number of continuous control data lines.

PCN

Program code for masking, program code, program-specific select code (from left to right).

- **MMMM** denotes masked control data lines which are not taken into account in the CNC run.
- Program codes:
  11 = N point programs,
  12 = Linking (binder) program,
  13 = Recall program,
  14 = Evaluation program,
  15 = Machine control program,
  16 = Control function,
  17 = Coordinate transformation.
- Program-specific select code.

CCN

Control code for masking, column number, select code for control modes, select code (from left to right):

- **MMMM** denotes masked control data lines which are not taken into account in the CNC run.
- Column number: Normally 1, for multi-column machines 2, 3, 4 (depending on column number).
- Select code for control modes:
  1 Positioning columns,
  2 Positioning the rotary table,
  3 Scanning,
  4 Geometric information,
  5 Technological information,
  6 Coordinate system information,
  7 Special control functions,
  8
  9 CNC program run information.

– Special select code:
  01 Intermediate position,
  03 Probing within an N-point element,
  10 N-point element call and workpiece position operations,
  11 Fine position in workpiece system without probing,
  13 Fine position in workpiece system with probing,
  20 N-point element terminated,
  40 Workpiece coordinate system manipulations,
  43 Position to normal vector,
  51 Step in workpiece system without probing,
  53 Step in workpiece system with probing.

ADR Consecutive addresses of the measurement results in the record.

Dialog Data entered by the operator, e.g. texts from the record header, recall addresses, coordinate system, **YES**, **NO**, scanning information, etc.

Nominal Value of the nominal.

U.Tol Upper tolerance referenced to the nominal size.

L.Tol Lower tolerance referenced to the nominal size.

Identification Identification of nominal size entered.

additional explanation Where necessary, the operating instructions will provide information on deviating control data codes in the respective program description.

NOTE Complex program functions call for considerable experience in order to interpret the codes correctly. Errors can often be corrected faster and more effectively by repeating the learn programming of the lines concerned.

Correcting control data <DI 1642>

Application Control data correction enables you to adapt a CNC program to changed conditions without repeating the learn programming procedure. This is useful for eliminating errors, adding new program steps, etc.

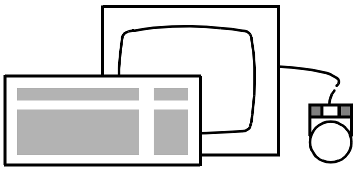
Preparations

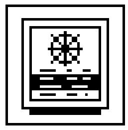
– If you have not already done so, switch to printer output with **<DI 1614>**; you will then receive an error record with references to lines which you should check again after the control data correction.

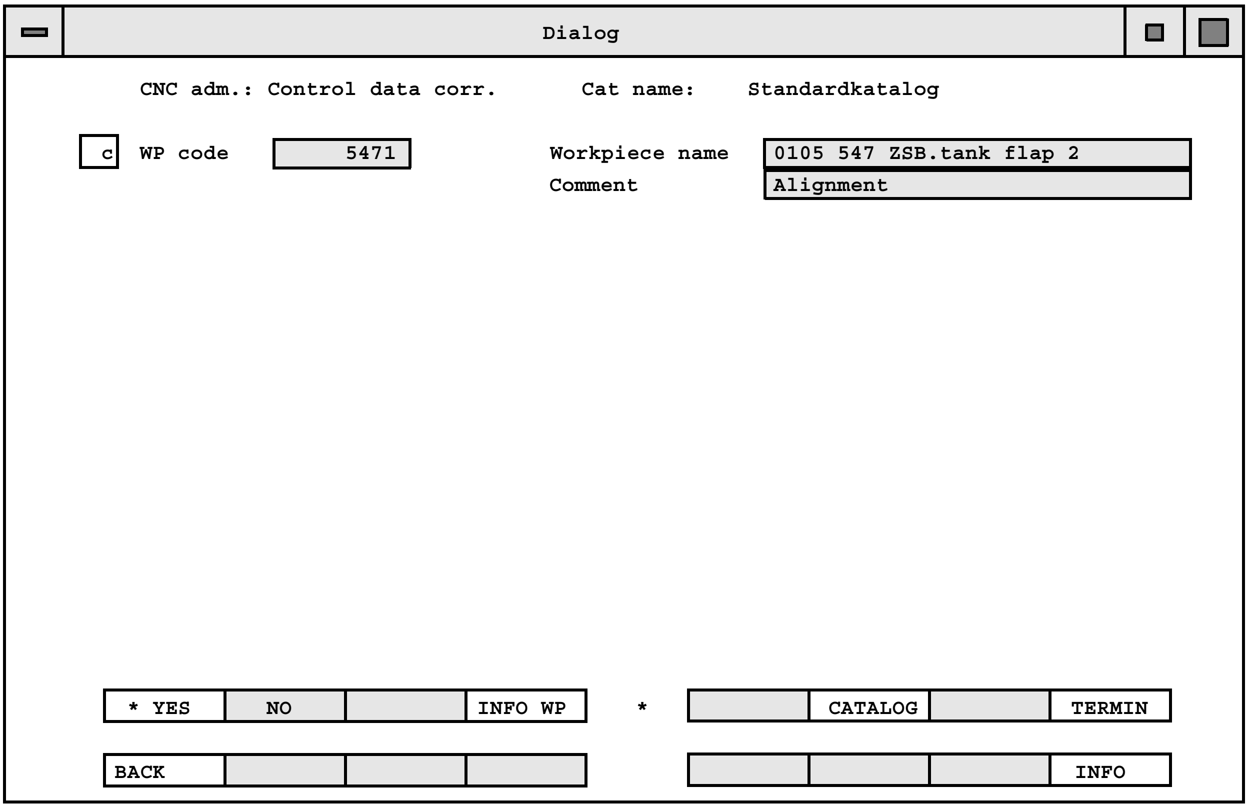
– After finishing the correction, you must decide whether you want to overwrite the original status or retain it alongside the corrected version (➤ ***„Copying control data lines from other workpieces <MIX>“ on page 17-55***). In the latter case, you should list the current workpiece catalog before performing the correction. This will make it easier for you to reach a decision on a suitable file name..

For users of Option 9 (PCM):

If you want to correct parameterized control data, the PCM edit mode must be activated via **<DI 1666>**.



DI	Pull-Down-Menu	Pictogram
1642 CNCCOLL	CNC Control data correct...	



Softkeys

INFO WP

Information on the workpiece data in the catalog (➤*„Workpiece information“ on page 17-15*).

CATALOG

Lists the workpiece catalog; e.g. in order to check which workpiece codes or file names are unassigned. Use and operation as for **<CATALOG>**, (➤*„Listing the workpiece catalog <DI 1630, 1650>“ on page 17-5*). You return to this point from the workpiece catalog.

Procedure

Enter workpiece code or select workpiece in question using **<CATA-LOG>** and end dialog window with **<TERMIN>**.

```
                                   Dialog
     Select control data line

  I          Line      1
     ============================================================================
      L-No        X         Y         Z      Function     SC2  SC1  PCN  CCN  ADR
     ============================================================================

        1  1001    3   0       0.000    1.000 P_PARAM      2     7         0 1500
        2  2001    3   0       0.000    0.000  DL P_PARAM  2     0         0 1911
        3  1020    3   0       0.000    0.020  DL F_PARAM  1     0         0 1911
        4  2000    3   0       0.005    0.000 MEAS FORCE    3     0         0 1911
        5  1004    3   0       0.000    3.500  DL F_PARAM  1     0         0 1911
        6  1001    3   0       0.000   70.000  DL F_PARAM  1     0         0 1911

 MODIFY   SELECT L  UNDO      DEMASK     *   INSERT   COPY     EXECUTE   TERMIN
 BACK     SPEC FCT  RESTART   MASK           DELETE   MOVE     CONVERS   INFO
```

Softkeys

MODIFY

Modifies variable data (➤*„Modifying a control data line <MODIFY>" on page 17-35*).

SELECT L

Jumps to any control data line of the program being processed (➤*„Selecting a control data line <SELECT L>" on page 17-35*).

UNDO

Reverses the last change made. The control data will then be restored to the status it had prior to the last action. This function must be performed immediately after **<Execute>**.

DEMASK

Demasks control data lines (➤*„Unmasking a control data line with <DEMASK>" on page 17-38*).

INSERT

Inserts masked control data lines above the current line (➤*„Inserting additional control data lines with <INSERT>" on page 17-39*).

COPY

Copies data lines (➤*„Copying control data lines with <COPY>" on page 17-40*).

EXECUTE

This softkey executes the correction just requested (e.g. insert, modify etc.). The dialog window will tell you when to press this softkey. It can be canceled immediately afterwards by pressing **<UNDO>**.

TERMIN

Terminates control data correction (➤***„Copying control data lines from other workpieces <MIX>“ on page 17-55***).

BACK

Returns you to the calling menu without implementing the modifications selected.

SPEC FCT

Calls other softkeys assigned with special functions (➤***„Softkeys for special functions <SPEC FCT>“ on page 17-48***).

RESTART

This softkey cancels all changes made during the current correction run. The control data list appears in its original state.

MASK

Masks control data lines (➤***„Masking a control data line <MASK>“ on page 17-37***).

DELETE

Deletes control data lines (➤***„Deleting control data lines <DELETE>“ on page 17-43***).

MOVE

Moves control data lines to another position in the program (➤***„Moving control data lines <MOVE>“ on page 17-42***).

CONVERS

Control data transformation (➤***„Converting control data <CONVERS>“ on page 17-44***).

INFO

More information.

Procedure

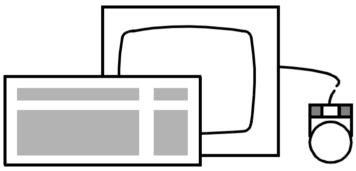
- Options for scrolling in control data:
  - Jump to a specific control data line: Enter the line number in the **Line** data box, if necessary activate the data box with the **<SELECT L>** softkey (➤***„Selecting a control data line <SELECT L>“ on page 17-35***).
  - back 1 line (scroll down): **<Shift>** + **< >** (press simultaneously).
  - forward 1 line (scroll up): **<Shift>** + **< >** (press simultaneously).
  - back 1 page (11 lines): **<Page down>**.
  - forward 1 page (11 lines): **<Page up>**.
  - Used to search for control data lines with certain functions or character strings: ➤***„Searching for control data lines < FUNCT ->, FUNCT <-, CHAR. ->, CHAR. <->“ on page 17-51***.
- Enter the type of the modification required or conclude it by pressing a softkey.

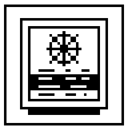
– Used to interpret the control data ➤***„Interpretation of the control data“ on page 17-29***.

Selecting a control data line <SELECT L>

Application

This function enables you to jump to any line of the control data being processed. For other ways to scroll through control data, see ➤***„Correcting control data <DI 1642>“ on page 17-31***.



DI	Pull-Down-Menu	Pictogram
1642 CNCCORR	CNC Control data correct... <SELECT L>	

Dialog

Select control data line

Line ...

Explanation of dialog

Enter the required line number. Confirm with **<Enter>**.

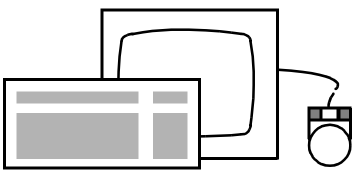
The requested control data line will appear in the center of the displayed control data block. You can then enter another line number to jump to it in the same way, select a new change function by pressing a softkey, or terminate the control data correction mode.

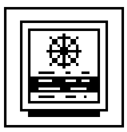
Modifying a control data line <MODIFY>

Application

With this function you select editing of the current control data line.

Procedure for modifying (editing) a control data line (handling of lines for subsequent input of nominal size ➤***„Computer controlled manually measured sections <DI 1077>“ on page 16-25***):



DI	Pull-Down-Menu	Pictogram
1642 CNCCORR	CNC Control data correct... <MODIFY>	

– Jump to the control data line you want to modify (➤***„Selecting a control data line <SELECT L>“ on page 17-35***).

– Press the **<MODIFY>** softkey.

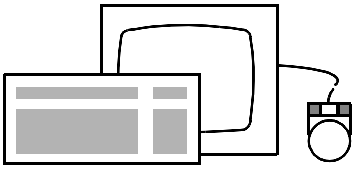
- The box available for editing is then highlighted. The input (sequence of changes, protection of fixed values) is program controlled.
  - Change or accept the data displayed in the highlighted box.
  - **<Enter>** accepts the contents of the box and executes a jump to the next editable box. After going through all editable boxes, this key causes a jump to the next line.

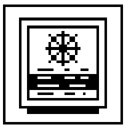
    If you do not want to go through all boxes: Press **<EXECUTE>** to end the line modification mode and jump to the next line.
  - Control data interpretation ➤***„Interpretation of the control data" on page 17-29***.
- Modify the next line, select new edit function or terminate control data correction with the softkey.

Masking a control data line <MASK>

Application

Parts of a CNC measuring run can be (temporarily) masked by masking the corresponding control data lines and reactivated by unmasking them. (➤*„Unmasking a control data line with <DEMASK>“ on page 17-38*).



DI	Pull-Down-Menu	Pictogram
1642 CNCCORR	CNC Control data correct... <MASK>	

```
Dialog

Control data block MASK

[I] From line        [   8]     To line        [   8]
============================================================================
 L-No        X         Y         Z       Function     SC2  SC1  PCN  CCN  ADR
============================================================================
    3  1020   3   0       0.000   0.020  DL F_PARAM  1     0         0 1911
    4  2000   3   0       0.005   0.000 MEAS FORCE     3     0         0 1911
    5  1004   3   0       0.000   3.500  DL F_PARAM  1     0         0 1911
    6  1001   3   0       0.000  70.000  DL F_PARAM  1     0         0 1911
    7  1014   3   0       0.000 125.000 LDL F_PARAM  1     0         0 1919
[ ] 8                                   PRINTER ON  0     0     1614     0
    9     1   3   0 0     0.000   0.000 REC DEF     0     1     1665     0
   10     2   1   1 10    0.000   0.000 REC DEF     0     1     1665     0
   11     1   3   0 0     0.000   0.000 REC DEF     0     1     MMMM MMMM
   12     2   1   1 10    0.000   0.000 REC DEF     0     1     MMMM MMMM
   13       1       1       5       0  PRB-COM-CHAN 0     1     1552 1520
   14  4654 364 GDA tank flap         RECORD HEAD     0     8 1610 1650

MODIFY | SELECT L | UNDO    | DEMASK   *   INSERT | COPY | EXECUTE | TERMIN
BACK   | SPEC FCT | RESTART | MASK         DELETE | MOVE | CONVERS | INFO
```

Softkeys

As for ➤*„Correcting control data <DI 1642>“ on page 17-31*.

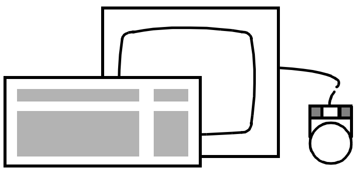
Procedure

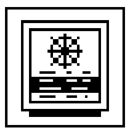
- Enter first (or last) line of the area to be masked behind **From line**. **<Enter>** first selects the requested line and then offers the default value to be accepted or overwritten, unless this has already been done. Jump to the end line box by pressing **<Enter>** or the ∨ cursor key.
- Enter the last (or first) line of the area to be masked behind **To line**. **<Enter>** first selects the requested line and then offers the default value to be accepted or overwritten, unless this has already been done. If necessary, return to the **From line** data box with the ∧ cursor key.
- Mask the selected area by pressing **<EXECUTE>**. The masked lines will be marked by **MMMM** in the **PCN** and **CCN** columns. The dialog window illustrated above shows the masking of lines 11 and 12 as examples.
- Mask another block of lines in the same way, select another editing function, or terminate control data correction with the softkey.

Unmasking a control data line with <DEMASK>

Application

This function is used to reenable masked control data lines. The **MMMM** characters in the **PCN** and **CCN** columns are then replaced by the original values (originally displayed prior to masking).



DI	Pull-Down-Menu	Pictogram
1642 CNCCORR	CNC Control data correct... <DEMASK>	

The execution and operation of this function are the same as for masking (➤ ***„Masking a control data line <MASK>“ on page 17-37***).

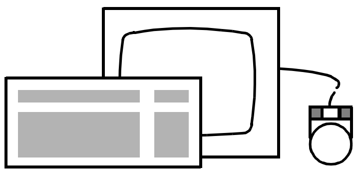
Inserting additional control data lines with <INSERT>

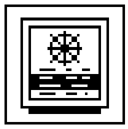
Application

Using this function you can insert blank lines in an existing CNC program for additional programming steps.

NOTE

- The control data lines inserted are masked. They can be overwritten via learn programming or control data correction.
- Blank lines which have not been overwritten are treated as masked lines, i.e. ignored during the CNC run.



DI	Pull-Down-Menu	Pictogram
1642 CNCCORR	CNC Control data correct... <INSERT>	

Procedure

- Enter the line number before which the blank line(s) should be inserted in the **Before Line** box. **<Enter>** first selects the requested line and then offers the default value to be accepted or overwritten, unless this has already been done. Jump to the **Number lines** box by pressing **<Enter>** again or using the ∨ cursor key.
- Enter the number of control data lines which must be inserted in the **Number Lines** box. If necessary, return to the **Bef Line** data box with the ∧ cursor key.
- Insert by pressing the **<EXECUTE>** softkey. The dialog window illustrated shows an inserted control data line as an example.
- Insert additional line(s) in the same way, select another edit function, or terminate control data correction by pressing the corresponding softkey.

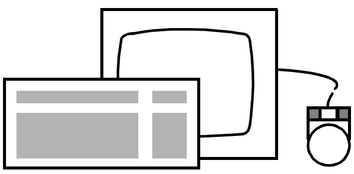
```
Dialog

    Control data line INSERT

[I] Bef Line            [    8] Number Lines        [    1]
    ===============================================================================
     L-No       X         Y         Z       Function      SC2  SC1  PCN   CCN  ADR
    ===============================================================================
       3   1020   3   0      0.000   0.020  P_PARAM     1     0          0  1911
       4   2000   3   0      0.005   0.000 DL P_PARAM   3     0          0  1911
       5   1004   3   0      0.000   3.500  DL F_PARAM  1     0          0  1911
       6   1001   3   0      0.000  70.000  MEAS FORCE  1     0          0  1911
       7   1014   3   0      0.000 125.000 LDL F_PARAM  1     0          0  1919
[ ]    8                               BLANK       0     0       MMMM  MMMM
       9                               Printer on  0     0       1614     0
      10                               RECORD HEAD 0     1       1665     0
      11      2   1   1 10   0.000   0.000 DL R HEAD   0     1       1665     0
      12      1   3   0 0    0.000   0.000 DL R HEAD   0     1       MMMM  MMMM
      13      2   1   1 10   0.000   0.000 DL R HEAD   0     1       MMMM  MMMM
      14        1       1       5       0 DL R HEAD    0     1       1552  1520

 | MODIFY | SELECT L | UNDO | DEMASK |  *  | INSERT | COPY | EXECUTE | TERMIN |
 | BACK | SPEC FCT | NEUSTART | MASK |       | DELETE | MOVE | CONVERS | INFO |
```

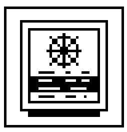
Copying control data lines with <COPY>

Application

This function copies one or more control data line(s) to another position in the program.

It may be necessary to check the addresses afterwards (➤ ***„Adjusting control data addresses <AUTO-ADR>, <MAN-ADR>“ on page 17-49***).



DI	Pull-Down-Menu	Pictogram
1642 **CNCCORR**	**CNC** **Control data correct...** **<COPY>**	

```
Dialog

Control data block COPY

[I] From line        [ 8]  To line        [ 8]  Bef Line       [ 8]
==============================================================================
 L-No       X         Y         Z       Function     SC2  SC1  PCN   CCN  ADR
==============================================================================
   3  1020   3   0      0.000   0.020  P_PARAM     1      0          0  1911
   4  2000   3   0      0.005   0.000  DL P_PARAM   3      0          0  1911
   5  1004   3   0      0.000   3.500  DL F_PARAM   1      0          0  1911
   6  1001   3   0      0.000  70.000  DL F_PARAM   1      0          0  1911
   7  1014   3   0      0.000 125.000 LDL F_PARAM   1      0          0  1919
[ ] 8                                  BLANK        0      0       1614     0
   9                                   PRINTER ON   0      1       1665     0
  10                                   RECORD HEAD  0      1       1665     0
  11     1   3   0 0    0.000   0.000 DL R HEAD     0      1       MMMM MMMM
  12     2   1   1 10   0.000   0.000 DL R HEAD     0      1       MMMM MMMM
  13       1       1        5       0  PRB-COM-CHAN 0      1       1552 1520
  14  4654 364 GDA tank flap         RECORD HEAD     0      8 1610 1650

MODIFY | SELECT L | UNDO    | DEMASK  *  INSERT | COPY | EXECUTE | TERMIN
BACK   | SPEC FCT | RESTART | MASK       DELETE | MOVE | CONVERS | INFO
```

Procedure

- Enter the first (or last) line of the area to be copied in the **From line** box. **<Enter>** first selects the requested line and then offers the value to be accepted or overwritten, if this has not already been done. Jump to the end line box by pressing **<Enter>** again or the ∨ cursor key.
- Enter the last (or first) line of the area to be copied in the **To line** box. **<Enter>** first selects the requested line and then offers the value to be accepted or overwritten, if this has not already been done. Then jump to the next box by pressing **<Enter>** again or the ∧ cursor key. If necessary, return to the **From line** data box with the ∨ cursor key.
- Enter the number of the line above which the copied line(s) should be inserted in the **Bef Line** box. **<Enter>** first selects the requested line and then offers the value to be accepted or overwritten, if this has not already been done. If necessary, return to the other data boxes with the ∧ cursor key.
- Copy by pressing the **<EXECUTE>** softkey. The copied lines then appear in the position required.

– Copy another block of lines in the same way, select another editing function, or terminate the control data correction function.

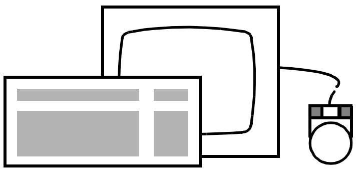
– Check the addresses if necessary (➤ ***„Adjusting control data addresses <AUTO-ADR>, <MAN-ADR>“ on page 17-49***).

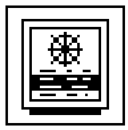
Moving control data lines <MOVE>

Application

This function moves one or more control data line(s) to another position in the program.

It may be necessary to check the addresses afterwards (➤ ***„Adjusting control data addresses <AUTO-ADR>, <MAN-ADR>“ on page 17-49***).



DI	Pull-Down-Menu	Pictogram
1642 CNCCORR	CNC Control data correct... <MOVE>	

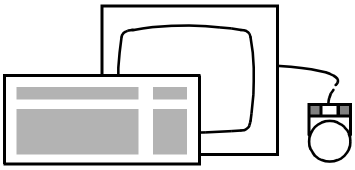
Dialog window

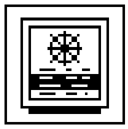
Structure and data as for the **Control data block COPY** dialog window (➤ ***„Copying control data lines with <COPY>“ on page 17-40***) except that the selected control data lines are not duplicated, but transferred instead.

Deleting control data lines <DELETE>

Application

Function for deleting control data lines.



DI	Pull-Down-Menu	Pictogram
1642 CNCCORR	CNC Control data correct... <DELETE>	

```
Dialog

      Control data block DELETE

 I    From line          8  To line            8
      ==============================================================================
       Z-No      X         Y         Z       Function     SC2  SC1  PCN  CCN   ADR
      ==============================================================================
         1  1020    3   0      0.000    0.020   P_PARAM     1     0         0  1911
         2  2000    3   0      0.005    0.000 DL P_PARAM    3     0         0  1911
         3  1004    3   0      0.000    3.500  DL F_PARAM   1     0         0  1911
         4  1001    3   0      0.000   70.000  MEAS FORCE   1     0         0  1911
         5  1014    3   0      0.000  125.000 DL F_PARAM    1     0         0  1919
         6                                     BLANK        0     0      MMMM  MMMM
         7                                     PRINTER ON   0     0      1614     0
         8  OP-30  MES                         RECORD HEAD  0     1      1665     0
         9  2       1   1 10   0.000    0.000 DL R HEAD     0     1      1665     0
        10  1       3   0 0    0.000    0.000 DL R HEAD     0     1      MMMM  MMMM
        11  2       1   1 10   0.000    0.000 DL R HEAD     0     1      MMMM  MMMM
        12  1       1       5        0  PRB-COM-CHAN 0      1       1552  1520

  MODIFY | SELECT L | UNDO    | DEMASK   *   INSERT | COPY | EXECUTE | TERMIN
  BACK   | SPEC FCT | RESTART | MASK         DELETE | MOVE | CONVERS | INFO
```

Procedure

- Enter first (or last) line of the area to be deleted in the **From line** box. **<Enter>** first selects the requested line and then offers the value to be accepted or overwritten, if this has not already been done. Jump to the end line box by pressing **<Enter>** again or the ∨ cursor key.
- Enter the last (or first) line of the area to be deleted in the **To line** box. **<Enter>** first selects the requested line and then offers the value to be accepted or overwritten, if this has not already been done. If necessary, return to the **From line** data box with the ∧ cursor key.
- Delete by pressing the **<EXECUTE>** softkey.

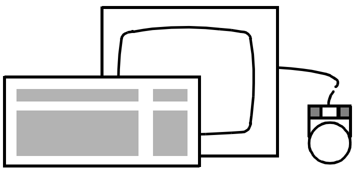
– Delete another line block in the same way, select another edit function or terminate control data correction with the softkey.
– Check the addresses if necessary (➤ ***„Adjusting control data addresses <AUTO-ADR>, <MAN-ADR>“ on page 17-49***).

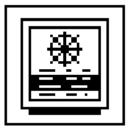
Converting control data <CONVERS>

Application

This function changes the softkey assignment so that you can perform the following transformations during control data correction:

– Exchange of the X and Y coordinates,
– Exchange of the Y and Z coordinates,
– Exchange of the Z and Xcoordinates,
– Rotation of the coordinate systems: XYZ to YZX or XYZ to ZXY,
– Mirroring of the X, Y or Z coordinates.



DI	Pull-Down-Menu	Pictogram
1642 CNCCORR	CNC Contol data correct... <CONVERS>	

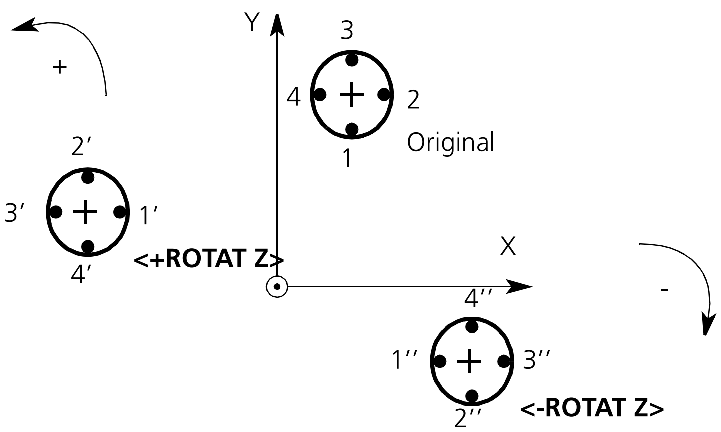
```
Dialog

=============================================================================
 L-No       X         Y         Z       Function      SC2  SC1    PCN   CCN  ADR
=============================================================================
   1 1001    3    0      0.000   0.5000 P_PARAM        2    6      0    1500
   2 2001    3    0      0.000   0.0000 DL P_PARAM     3    0      0    1911
   3 1020    3    0      0.000   0.0000 DL F_PARAM     1    0      0    1911
   4 2000    3    0      0.200   0.0000 MEAS FORCE     3    0      0    1911
   5 1004    3    0      0.000  15.0000 DL F_PARAM     1    0      0    1911
   6 1001    3    0      0.000  100.000 LDL F_PARAM    1    0      0    1919
   7                                    BLANK          0    0   MMMM    MMMM
   8                                    PRINTER ON     0    0   1614       0
   9                                    RECORD HEAD    0    8   1610    1650
  10 97 GH-6090-CC                      DL R HEAD      0    0   9911       0
  11 145-14578                          DL R HEAD      0    0   9911       0
  12 xyz                                DL R HEAD      0    0   9911       0

 +ROTAT Z | UNDO     | +ROTAT X | +ROTAT Y  *  XYZ->YZX | XYZ->ZXY | EXECUTE  | TERMIN
 -ROTAT Z | PRE MENU | -ROTAT X | -ROTAT Y     MIRROR X | MIRROR Y | MIRROR Z | INFO
```

Softkeys

± ROTAT Z
± ROTAT X
± ROTAT Y

These softkeys are used to exchange control data coordinates; as seen from the positive direction of the specified axis, the coordinates of the other two axes are rotated 90° in the direction of the sign (+ = CCW and - = CW).

Example for a bore with four probings in the XY plane:



UNDO

This softkey cancels the last change made. The status of the control data prior to the last action is thus restored. This function must be performed immediately after pressing **<EXECUTE>** .

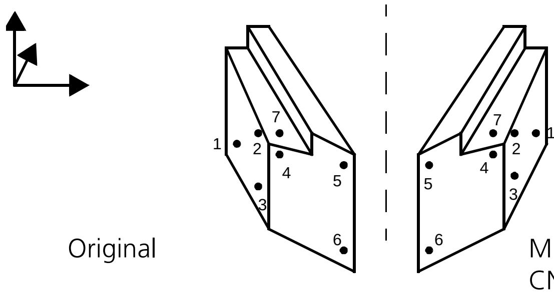
XYZ->YZX
XYZ->ZXY

These keys rotate control data coordinate systems; the coordinate values are exchanged as labeled on the softkey.

MIRROR X
MIRROR Y
MIRROR Z

These softkeys mirror control data coordinates on the respective axis.

Example:



Original

Mirrored
CNC run

EXECUTE

Pressing this softkey executes the conversion just requested. The **Change of probe arrangement** dialog window may be displayed, see below under procedure. Cancellation is possible by pressing **<UNDO>** immediately afterwards.

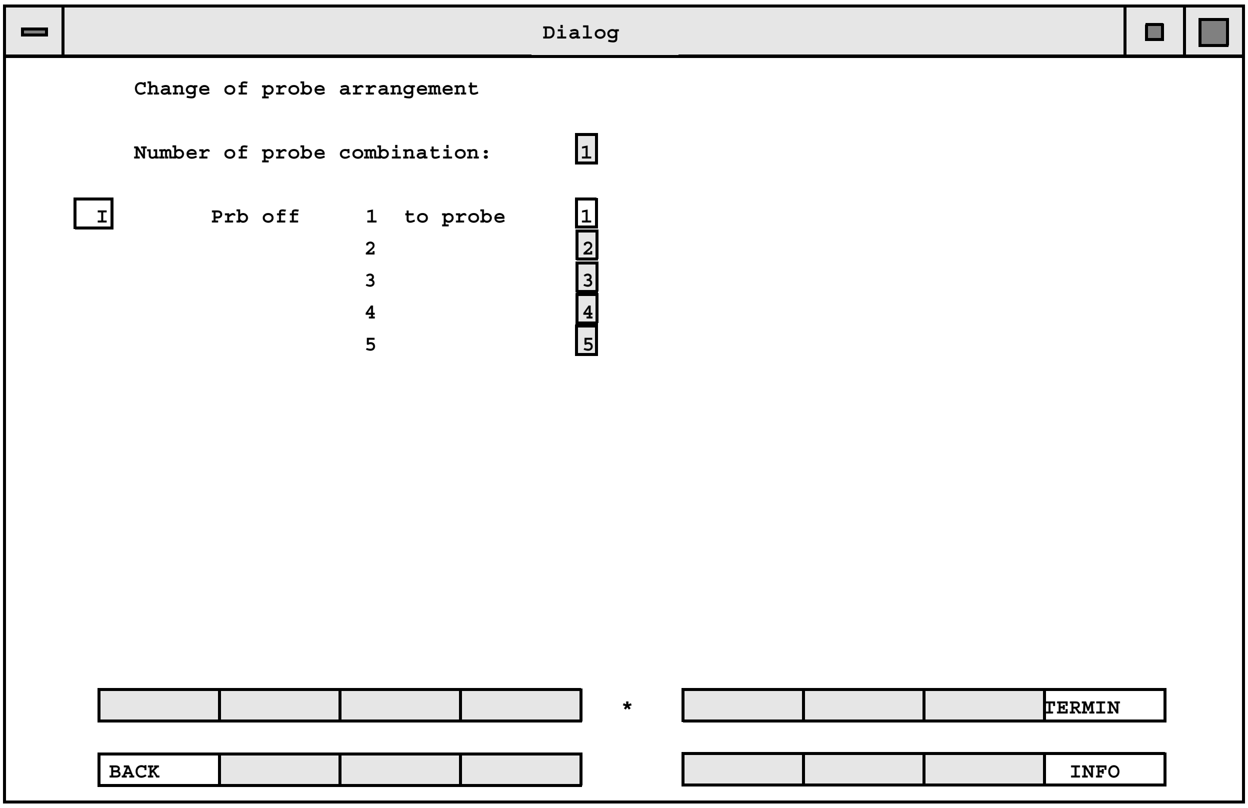
TERMIN

To terminate conversion, return to the calling softkey assignment.

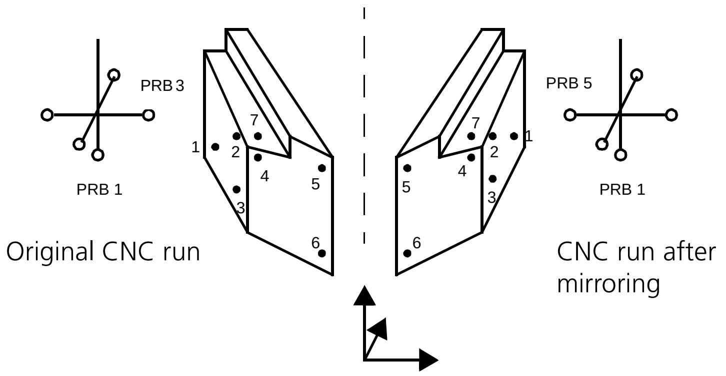
Procedure

– Select the type of conversion required with the softkey. The heading changes depending on the transformation selected. The line range to be converted must also be specified by making entries in the **From line =** and **To line =** data boxes; operation as for masking ➤***„Masking a control data line <MASK>“ on page 17-37***.

– Perform change with the **<EXECUTE>** softkey. The program then changes to the **Change of probe arrangement** input mask.



In this window you must adapt the probes to the transformation. Example for **<MIRROR X>**:



The numbers must match the proposed assignment on the control panel. Terminate with **<TERMIN>**.

The dialog window will not be displayed if the transformation does not affect the probe configuration.

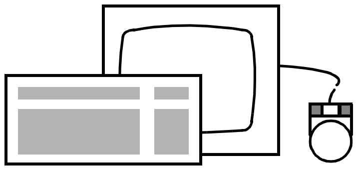
– Reverse process with **<UNDO>** if necessary.

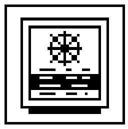
– Close dialog window with **<TERMIN>**, return to control data change, final termination there with **<TERMIN>**.

Softkeys for special functions <SPEC FCT>

Application

The **<SPEC FCT>** softkey can be used to assign auxiliary functions to the softkeys which facilitate changing the control data.



DI	Pull-Down-Menu	Pictogram
1642 CNCCORR	CNC Control data correct... <SPEC FCN>	

```
Dialog

=============================================================================
 L-No        X         Y         Z       Function     SC2  SC1  PCN   CCN   ADR
=============================================================================
   1  1001   3    0       0.0000  0.5000  P_PARAM     2     6     0  1500
   2  2001   3    0       0.0000  0.0000  DL P_PARAM  2     0     0  1911
   3  1020   3    0       0.0000  0.0000  DL F_PARAM  1     0     0  1911
   4  2000   3    0       0.2000 0.0000   MEAS FORCE  3     0     0  1911
   5  1004   3    0       0.0000 15.0000  DL F_PARAM  1     0     0  1911
   6  1001   3    0       0.0000 100.000  LDL F_PARAM 1     0     0  1919
   7                              BLANK               0     0  MMMM  MMMM
   8                              PRINTER ON          0     0  1614     0
   9  OP-30 MES                   RECORD HEAD         0     8  1610  1650
  10  97 GH-6090-CC               DL R HEAD           0     0  9911     0
  11  145-14578                   DL R HEAD           0     0  9911     0
  12  xyz                         DL R HEAD           0     0  9911     0

 MODIFY | UNDO | FUNCT -> | CHAR. ->   *   AUTO-ADR | FORMULA  | EXECUTE | TERMIN
 BACK   |      | FUNCT <- | CHAR. <-       MAN-ADR  | NOM CONV | MIX     | INFO
```

MODIFY

As in the calling menu, ➤ *„Correcting control data <DI 1642>“ on page 17-31*.

UNDO

As in the calling menu, ➤ *„Correcting control data <DI 1642>“ on page 17-31*.

FUNCT ->

FUNCT <-

Search for control data lines with a defined function and /or before the current line, ➤ *„Searching for control data lines < FUNCT ->, FUNCT <-, CHAR. ->, CHAR. <->“ on page 17-51*.

CHAR. ->
CHAR. <-

Search for control data lines with a defined character or digit string and /or before the current line,➤***„Searching for control data lines < FUNCT ->, FUNCT <-, CHAR. ->, CHAR. <->“ on page 17-51***.

AUTO-ADR

Automatic address adjustment for all control data lines, beginning with address counter 1,➤***„Adjusting control data addresses <AUTO-ADR>, <MAN-ADR>“ on page 17-49***.

FORMULA

Changes control coordinates systematically by a defined value, ➤***„Systematically changing control data coordinates <FOR-MULA>“ on page 17-53***.

EXECUTE

Executes an address adjustment requested with **<AUTO-ADR>** or **<MAN-ADR>**. The prompt to activate this softkey appears in the dialog window. Reversal possible immediately afterwards with **<UNDO>**.

MAN-ADR

Address adjustment with optional start counter for a defined line range, ➤***„Adjusting control data addresses <AUTO-ADR>, <MAN-ADR>“ on page 17-49***.

NOM CONV

Automatic nominal adjustment, ➤***„Automatic nominal value adjustment <NOM CONV>“ on page 17-54***.

MIX

Copies control data lines from another CNC program to the workpiece being edited, ➤***„Copying control data lines from other workpieces <MIX>“ on page 17-55***.

Adjusting control data addresses <AUTO-ADR>, <MAN-ADR>

Application

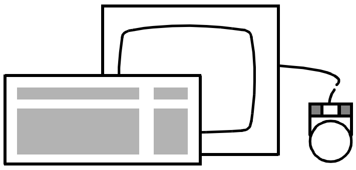
Correction of the control data may confuse the control data address counter. In this case, the numbering in the **ADR** column of the control data list will no longer be consecutive or reference addresses, e.g. for recalls, will be incorrect. For this reason, you should update the control data addresses by calling this function after making major changes.

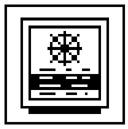
Differentiation

There are two types of address adjustment:

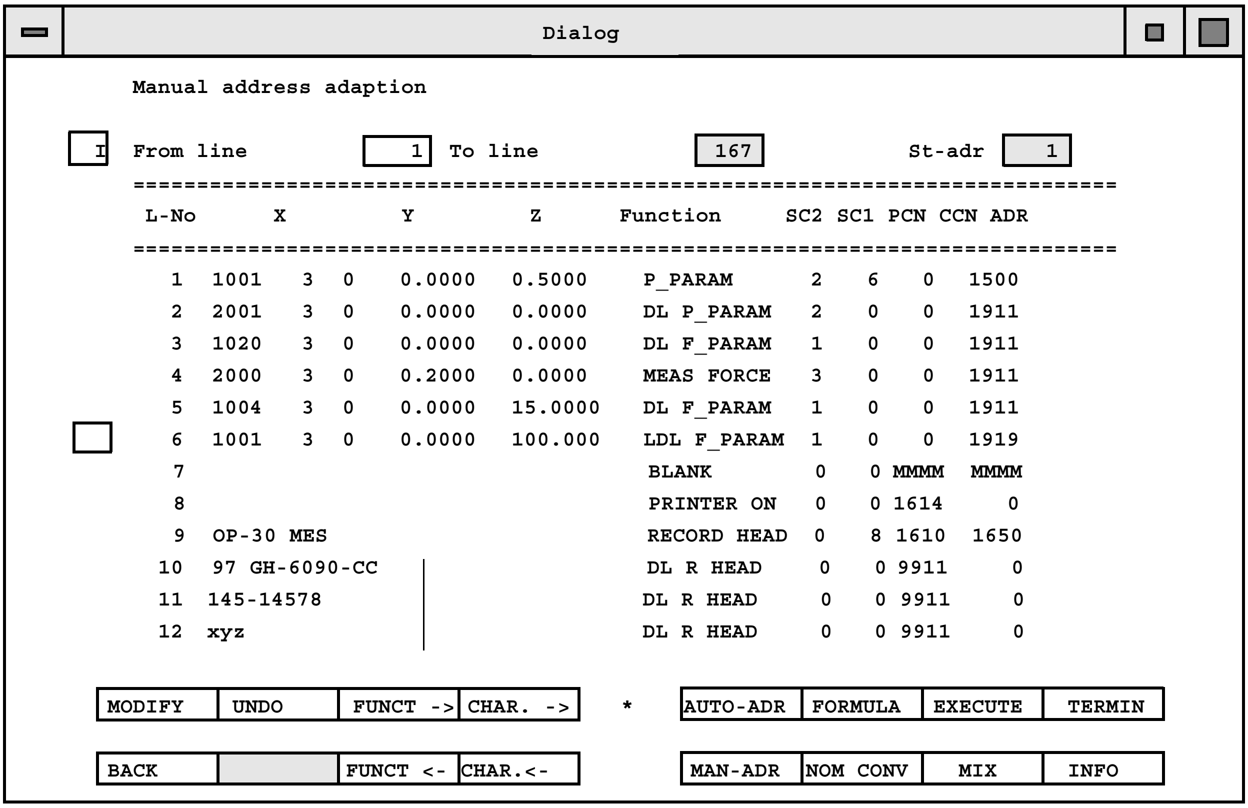
1. Automatic adjustment (**<AUTO-ADR>** softkey). This method continuously increments the addresses including the reference address in the entire control data file starting with address 1.
2. Manual address adjustment (**<MAN-ADR>** softkey). This method continually increments the addresses including the reference address in a selected range based on your inputs, which include selection of the start value. If available, reference addresses can also be adjusted outside of the range specified.

NOTE If your program contains an address change with **<DI 1690>**, this will also be taken into account.



DI	Pull-Down-Menu	Pictogram
1642 CNCCORR	CNC Control data correct... <SPEC FCT>	

Dialog window (illustrated for the manual address adjustment)



Procedure

– Automatic adjustment:
  No data boxes are displayed in this case. Start address adjustment with **<EXECUTE>**.

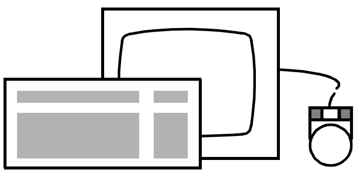
– Manual adjustment:
  Enter the first and last line of the range to be edited and the start value for address counting. Operation the same as for other editing functions, e.g. **<COPY>** (➤***„Copying control data lines with <COPY>“ on page 17-40***).

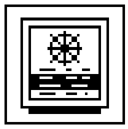
– Return to the softkey menu for control data correction with **<TER-MIN>**.

Searching for control data lines < FUNCT ->, FUNCT <-, CHAR. ->, CHAR. <->

Application

These functions make it easier to search for control data lines which encode a certain function or contain a particular character or digit string.



DI	Pull-Down-Menu	Pictogram
1642 CNCCORR	CNC Control data correct... <SELECT L>	

FUNCT ->

FUNCT <-

CHAR.->

CHAR. <-

The arrow indicates the searching direction.

– Forwards: Search starts in the lines following the current control data line.

– Reverse: Search starts in the lines before the current control data lines.

Regardless of the direction selected, the entire program will be taken into account: As soon as the last or first control data line has been reached, the search will continue in the other section ("wrap mode").

Data boxes

Function

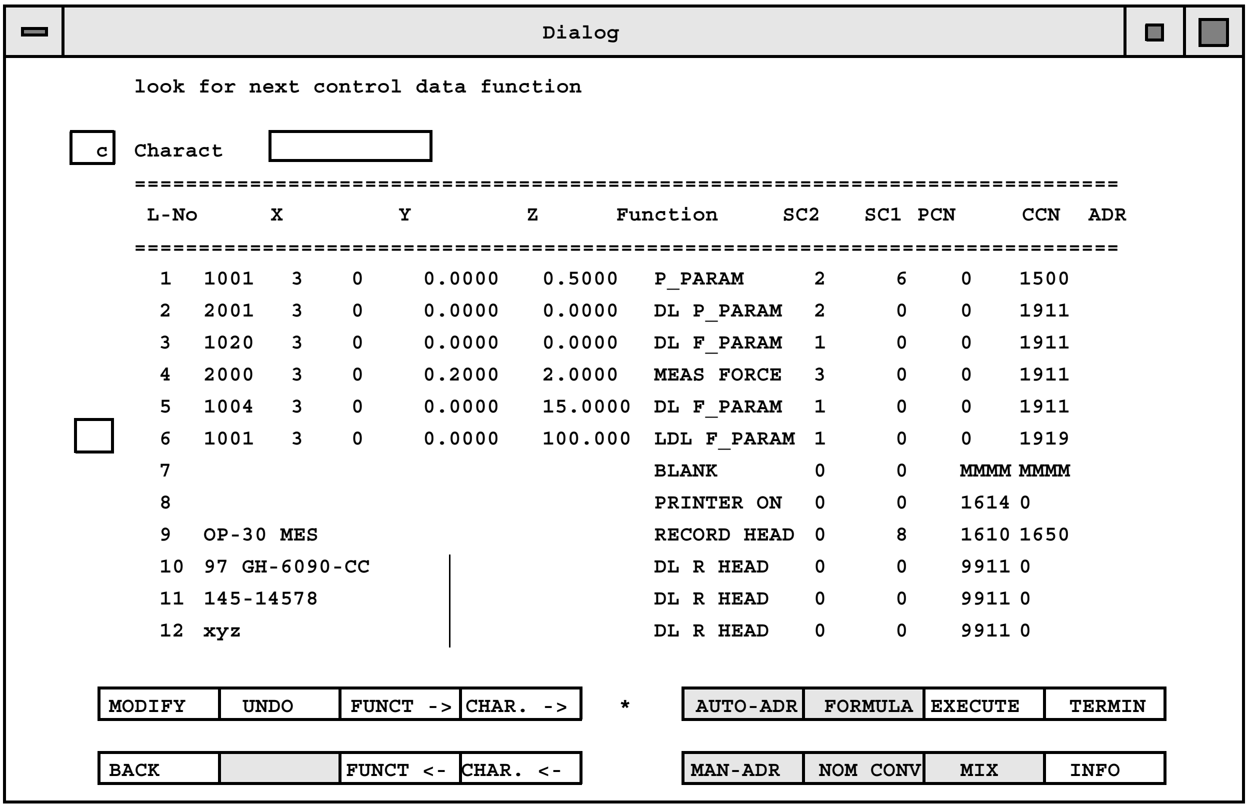
Here you can enter:

– the DI number of the function being looked for or

– its abbreviation as it appears in the **Function** column of the control data list. The exact and complete notation is required, e.g. **RECALL 1 ADR.**

Charact

Specify the character or digit string to be searched for here (max. 12 positions), e.g. **RECALL** or **-77**. or **11108**.



Procedure

Type in the function or character string to be searched for and confirm with **<Enter>**. If the search is successful, the corresponding control data block will be moved to the correction window with the line searched for in the center. You can then select editing of this line (**<MODIFY>** softkey), continue searching or select another editing function with a softkey.

Failed search

If the search has failed, the program outputs a corresponding message.

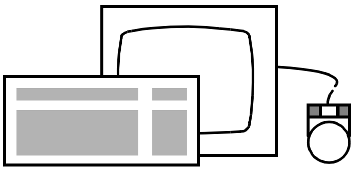
Systematically changing control data coordinates <FORMULA>

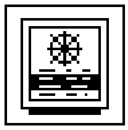
Application

You can systematically change the X, Y, Z control coordinates by a defined value or factor.

Application example

The bore depth in the +X direction has been increased by 5 mm, cf. explanation. This may be restricted to certain control data lines.



DI	Pull-Down-Menu	Pictogram
1642 CNCCORR	CNC Control data correct... <SELECT L>	

```
                                   Dialog

      Formula operat.:

 [C]  Coordinate(s)        [X]   Operation        [+]      val    [  5.000  ]
      ==============================================================================
       L-No        X          Y          Z        Function     SC2  SC1   PCN     CCN    ADR
      ==============================================================================
         1  1001    3    0    0.0000    0.5000   P_PARAM       2    6        0    1500
         2  2001    3    0    0.0000    0.0000   DL P_PARAM    2    0        0    1911
         3  1020    3    0    0.0000    0.0000   DL F_PARAM    1    0        0    1911
         4  2000    3    0    0.2000    0.0000   MEAS FORCE    3    0        0    1911
         5  1004    3    0    0.0000   15.0000   DL F_PARAM    1    0        0    1911
 [ ]     6  1001    3    0    0.0000  100.000    LDL F_PARAM   1    0        0    1919
         7                                       BLANK         0    0    MMMM MMMM
         8                                       PRINTER ON    0    0    1614 0
         9  OP-30 MES                            RECORD HEAD   0    8    1610 1650
        10 97 GH-6090-CC                         DL R HEAD     0    0    9911 0
        11 145-14578                             DL R HEAD     0    0    9911 0
        12 xyz                                   DL R HEAD     0    0    9911 0

   | MODIFY | UNDO  | FUNCT -> | CHAR. -> |  *  | AUTO-ADR | FORMULA  | EXECUTE | TERMIN |

   | BACK   |       | FUNCT <- | CHAR. <- |     | MAN-ADR  | NOM CONV | MIX     | INFO   |
```

Explanation

Formula operat.:

Specify coordinate change; permissible input values:

Coordinate(s)	**X**, **Y**, **Z**	If applicable, you can change 2 or 3 coordinates simultaneously. X would have to be entered for the above example.
Operation	**+**, **-**, *****, **/**, **=**	You would have to enter + in our example.
val	Numerical value (mm, inch);	Our example requires an input of 5.

Formula operat.: (X) + 5.000
From line To line

Specify the line range to which the change should apply. Operation as for ➤*„Masking a control data line <MASK>“ on page 17-37*.

Automatic nominal value adjustment <NOM CONV>

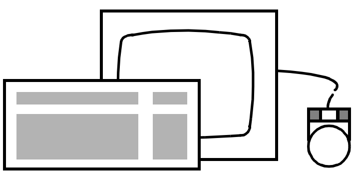
Application

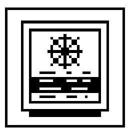
Due to the further development of the UMESS software, the structure of nominal values in the control data has changed. Existing CNC programs can still be run without converting the nominal values. The control data must be converted if existing control data is to be supplemented or changed.

UMESS 300

CNC runs which have been converted from UMESS 300 to UMESS should also be edited with this function.

The following may be affected by the conversion: DIN nominals, UMESS nominals, nominals for 2D best fit, nominals for 3D best fit and parameterized nominals. Reserved nominal lines are deleted.



DI	Pull-Down-Menu	Pictogram
		

NOM CONV

Convert old nominals to new

The change is executed by pressing the**<EXECUTE>** softkey.

Copying control data lines from other workpieces <MIX>

Application

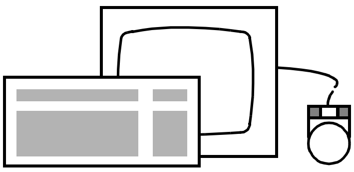
You can use this function to copy individual or all control data lines from another CNC program to the one currently being edited.

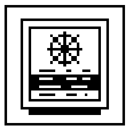
Preparations

- Note the last address of the workpiece to which you want to copy (workpiece 1).
- Create a copy of the workpiece from which you want to copy (workpiece 2). ➤***„Copying workpieces <DI 1643>“ on page 17-18***. You can delete the copy later on.
- Adapt the address of workpiece 2: **<MAN-ADR>**, **St-adr** = last address of workpiece 1 or higher (➤***„Adjusting control data addresses <AUTO-ADR>, <MAN-ADR>“ on page 17-49***).
- Request workpiece 1 for control data correction and copy workpiece 2 to it.

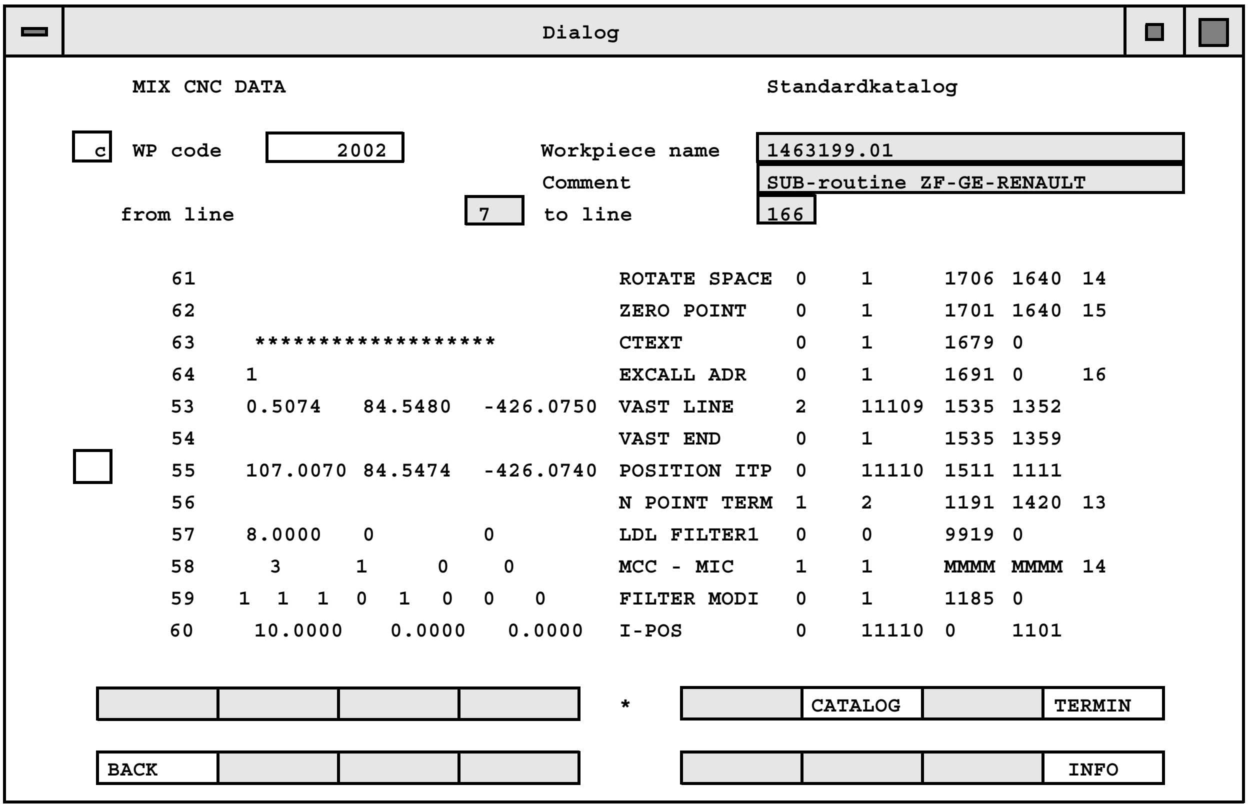
NOTE

Please note that this is purely an editor function. The program does not check whether the control data lines you have copied together are operable. Make sure e.g. that you do not copy to N point programs, loops, continuation lines, etc. Also make sure that both programs have been created with software of the same revision status.



DI	Pull-Down-Menu	Pictogram
1642 CNCCORR	CNC Control data correct... <SPEC FCT>	

MIX



Procedure

– Specify the name or number of the CNC program from which you want to copy. The program to be copied then appears on the screen.

– Enter the first (or last) line of the block to be copied in the **from line** box. **<Enter>** first selects the requested line and then offers the value to be accepted or overwritten, if this has not already been done. Jump to the end line box by pressing **<Enter>** again or the ∨ cursor key.

– Enter the last (or first) line of the area to be deleted in the **To line** box. **<Enter>** first selects the requested line and then offers the value to be accepted or overwritten, if this has not already been done. If necessary, return to the **From line** data box with the ∧ cursor key.

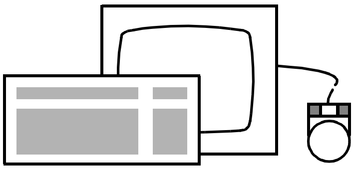
– Press **<TERMIN>**; the control data lines of the program to which you want to copy now appear again with the **Bef. line** inquiry. Enter the number of the line in front of which the line(s) copied should be placed. **<Enter>** first selects the requested line and then offers the value to be accepted or overwritten, if this has not already been done.

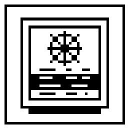
– Perform copy process with **<EXECUTE>**. The lines copied appear at the position requested.

– Copy the same line block again to another position, copy another line block in the same way, select another editing function with a softkey or terminate the control data correction process.

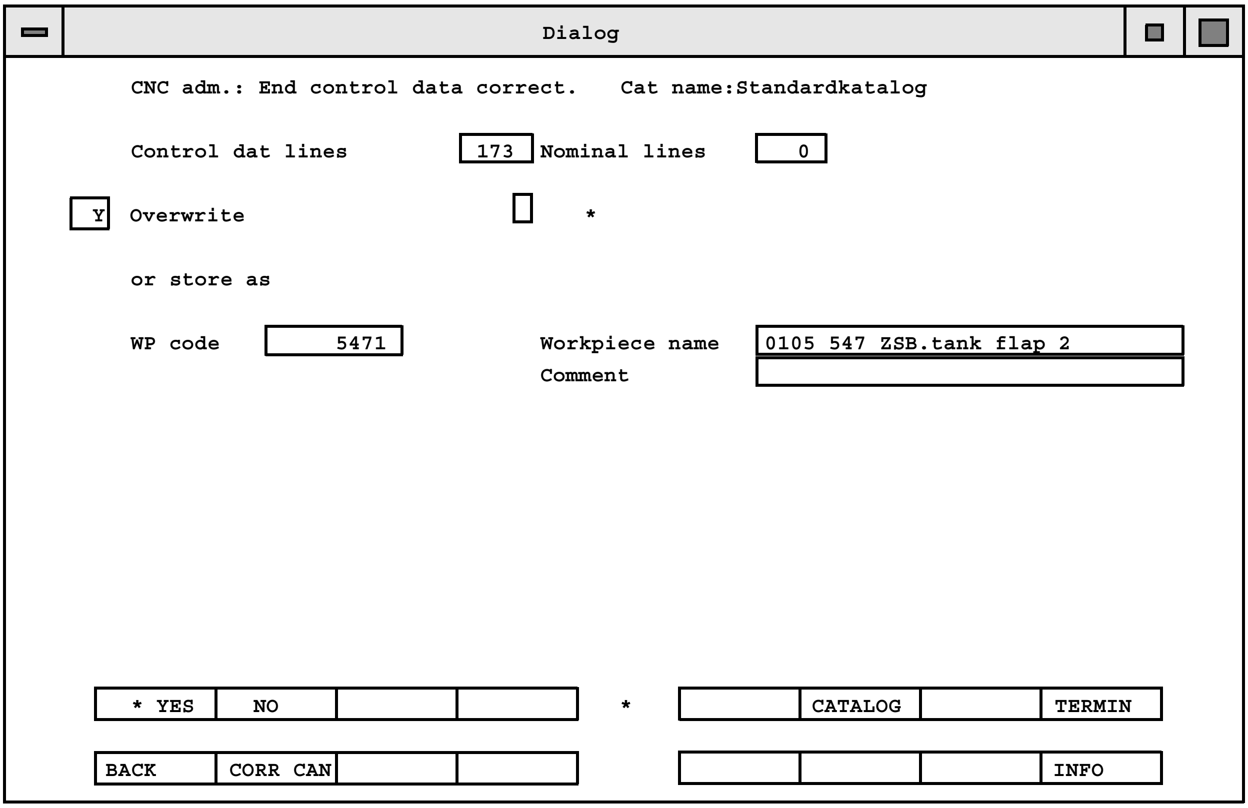
– Check the addresses of workpiece 1 if necessary (➤***„Adjusting control data addresses <AUTO-ADR>, <MAN-ADR>“ on page 17-49***) and delete workpiece 2.

Terminating the control data correction <TERMIN>



DI	Pull-Down-Menu	Pictogram
1642 CNCCORR	CNC Control data correct...	

TERMIN



Softkeys

CORR CAN

The control data correction is canceled. All changes which have been made are lost. The CNC run remains in its original state.

Data boxes

Control data lines, Nominal lines

Display of scope.

Overwrite

– **<YES>**
  The original file will be overwritten. The control data modifications will be transferred to the original control data file.

– **<NO>**
  The original file will be retained. The modified control data will be stored in a new file.

or store as WP code ...

Enter the identification of the new file. If you enter a file name which already exists in the control data catalog, a corresponding message will prompt you to make another input. If you then would like to find out which file names have already been assigned, you can list the control data catalog on the screen beforehand. (➤***„Listing the workpiece catalog <DI 1630, 1650>“ on page 17-5***).

NOTE

Please follow the instructions on identification (➤***„Entering a workpiece in the workpiece catalog <DI 1634>“ on page 17-10***) to prevent complications when deleting or entering workpieces.

Chapter 18

CNC run

During a CNC run, the coordinate measuring machine automatically performs a measurement with the help of a previously created CNC program. The computer processes the programmed control data in chronological order. Computing and travel commands result which reproduce the programmed run exactly.

This chapter contains:

Procedure

Clamping

Clamp the workpiece(s) with the same orientation as for learn programming.

Probes (styli)

Use the same probe configuration as for learn programming (the same physical arrangement of the probes and the same allocation of the probe numbers).

W-position

If the control coordinate system with which the CNC program was generated is not (no longer) stored: Redefine the W-position (➤***„Control coordinate system“ on page 16-6***).

Parameters

If necessary/required: Set/modify the probing and machine parameters (➤***„Probing, probing parameters, machine parameters“ on page 16-20***).

Start position

Position the probe head so that the first probing or intermediate position of the CNC program can be reached without a collision.

CNC start

Start the CNC measurement; UMESS features the following options for starting automatic measuring runs:

- CNC start of a single workpiece (➤***„Starting a CNC run for a single workpiece <DI 1640>“ on page 18-3***);
- CNC start of several identical or different workpieces (➤***„Starting a CNC run for multiple workpieces“ on page 18-5***).

Interruption

Interruption of a CNC measurement and its continuation following interruption (➤***„Interrupting and continuing a CNC run“ on page 18-11***).

Repetition record

If necessary, call up the repetition record after ending the measurement (➤***„Repetition record <DI 1613>“ on page 5-40***).

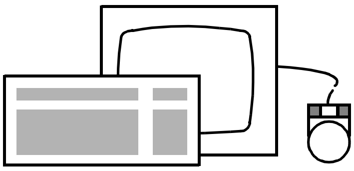
CNC debugger

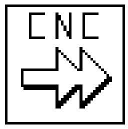
If necessary, check and correct with the CNC debugger (➤***„CNC debugger <DI 1070>“ on page 18-17***).

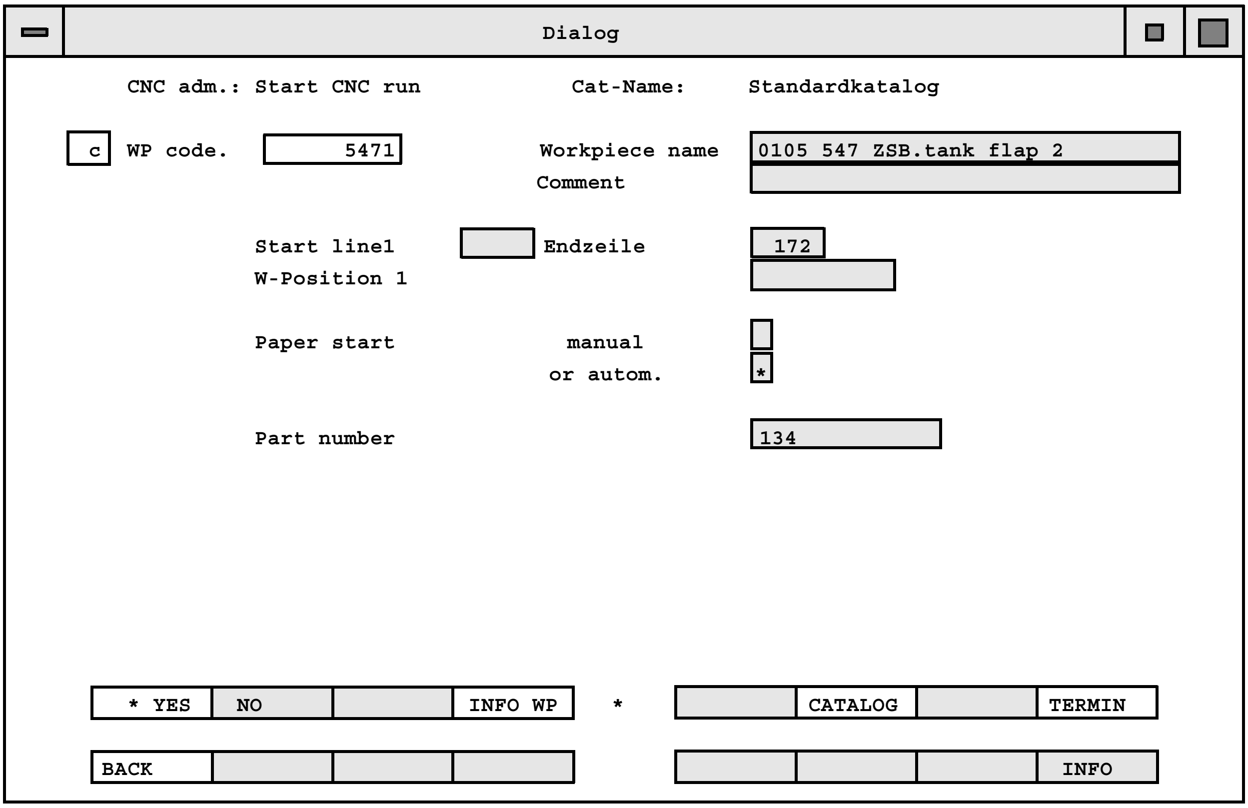
Starting a CNC run for a single workpiece <DI 1640>

Preparations

See ➤ ***„Procedure“ on page 18-2***.



DI	Pull-Down-Menu	Pictogram
1640 CNC	CNC Start CNC CNC run...	



Softkeys

INFO WP Displays information on the current workpiece.

CATALOG Displays the workpieces in the current catalog.

TERMIN Closes dialog window

Data boxes

WP code
Code of the CNC run.

Workpiece name
Name of the CNC run.

Comment
Comment on this CNC run.

Start line / End line
Start line enables the program to be entered at any point. If program sections which generate results are skipped, the following conditions must be met:

- The CNC run must be started with the W-position valid at the entry point.
- The workpiece coordinate system valid at the entry point must be defined.
- The address counter must be set to the next record address.
- All of the measuring results required for a recall must be available.
- The **<FIXED PLANE>** or **<PRB MODE>** which may be required for the next measuring run must be specified.
- The probe must be located in a starting position which enables collision-free travel to the first intermediate position.
- The probe combination must have been selected correctly.

End line makes it possible to set the end point anywhere within the program.

W-Position
Enter the number of the required W-position.

Paper start manual or autom.
Used to select automatic or manually loading of paper.

Part number
Input of the part number.

Starting a CNC run for multiple workpieces

Overview

With the methods described here you can

- combine multiple CNC programs in any sequence to form a continuous measuring run;
- start a program several times in succession.

Batch

A CNC run extending over multiple workpieces is generally referred to in UMESS as a batch or series.

Methods for creating a batch

Combine several different CNC program runs with

- Workpiece jump **EXCALL** (➤***„Compiling a batch measurement with EXCALL“ on page 18-6***)

or

- with **<DI 1644>** (➤***„Batch measurement with <DI 1644>“ on page 18-8***).

Preparations for measuring multiple workpieces by batch

Clamping

Clamp the workpiece(s) with the same orientation as for learn programming.

Probes

Use the same probe configuration as for learn programming (the same physical arrangement of the probes and the same allocation of probe numbers); all of the measuring elements included in the batch must be accessible with a single probe configuration or a probe changer must be available.

Starting position

The starting position must be selected so as to ensure collision-free travel to the first intermediate position or probing.

Travel paths

Ensure collision-free travel between workpieces.

Catalog function

Make sure that all the measuring runs required are stored in the workpiece catalog.

W-position

If the control coordinate systems with which the CNC programs were generated are not (no longer) stored: Redefine the W-positions (➤***„Control coordinate system“ on page 16-6***).

Parameters

If necessary: Set/modify the CNC probing and machine parameters (cf. ➤***„Probing, probing parameters, machine parameters“ on page 16-20***).

Batch

Define or start batch

according to the preceding method of combining with **EXCALL** (➤***„Compiling a batch measurement with EXCALL" on page 18-6***) or with **<DI 1644>** and **<CNC RUN>** (➤***„Batch measurement with <DI 1644>" on page 18-8***).

Compiling a batch measurement with EXCALL

Application

If you want to keep several batches ready for call, you must link the applicable CNC programs via the **EXCALL** workpiece jump, ➤***„EXCALL workpiece jump" on page 16-71***.

You can generate a batch by appending the **EXCALL** control data lines the lines needed to update the coordinate system

- to the end of the first workpiece or
- or by combining them to form a special CNC program containing only these control data lines.

Correction option

Using the control data correction feature, you can quickly modify the sequence and number of workpieces linked or generate a new batch..

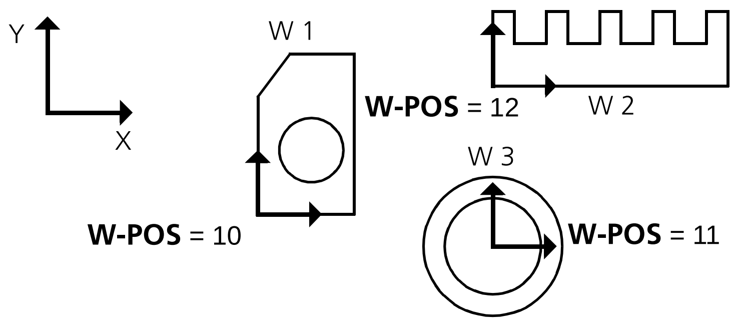
Batch start

Start the batch with **<DI 1640>** and with the W-position of the first workpiece.

Preparations for starting multiple workpieces ➤***„Overview" on page 18-5***.

Example 1

You want to measure three different workpieces in succession:

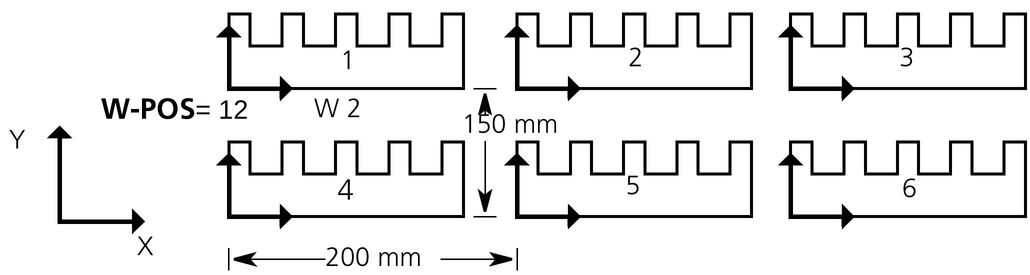


Control data list for the batch measurement:

```
Record
===============================================================================
    |     X      |      Y      |      Z      |        |    |    |     |     |
 NO  --------------------------------------- Function  SC2  SC1   PCN   CCN   ADR
                 Dialog
 NO |  Nominal   | U.Tol   | L.Tol          Function  SC2  SC1   PCN   CCN
 NO |       Identification                  Function  SC2  SC1   PCN   CCN   ADR
===============================================================================
   1 Three workpieces                       TEXT             0     0  1676     0
   2 in succession                          TEXT             0     0  1676     0
   3            10                          WPOS F DISK      0     1  1712  1610
   4 W1                                     EXCALL           0     1  9971  1971
   5            12                          WPOS F DISK      0     1  1712  1610
   6 W2                                     EXCALL           0     1  9971  1971
   7            11                          WPOS F DISK      0     1  1712  1610
   8 W3                                     EXCALL           0     1  9971  1971
   9     0.0000       0.0000       0.0000 P-END              0     0  9999  1999
```

Example 2

You would like to measure 6 uniform parts as a batch, the parts are arranged symmetrically on the measuring machine:



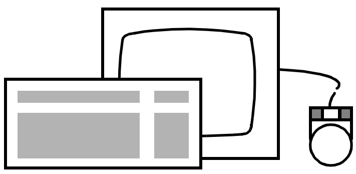
Control data list for the batch measurement:

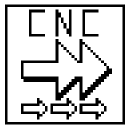
```
Record
===============================================================================
    |     X      |      Y      |      Z      |          |     |    |    |     |
 NO  ---------------------------------------   Function   SC2  SC1  PCN  CCN   ADR
                 Dialog
 NO |  Nominal   | U.Tol   | L.Tol            Function   SC2  SC1  PCN  CCN
 NO |       Identification                     Function   SC2  SC1  PCN  CCN   ADR
===============================================================================
   1 Six parts in                          TEXT             0     0  1676     0
   2 batch                                 TEXT             0     0  1676     0
   3       1         2         1        0  DO LOOP          1     1  9941  1941
   4       1         3         1        0  DO LOOP          2     1  9941  1941
   5 W2                                    EXCALL           0     1  9971  1971
   6   200.0000      0.0000      0.0000 WPOS DIS CAR        0     1  1771  1610
   7                                       END LOOP      1002     1  9949  1949
   8  -600.0000   -150.0000      0.0000 WPOS DIS CAR        0     1  1771  1610
   9                                       END LOOP      1001     1  9949  1949
  10     0.0000      0.0000      0.0000 P-END               0     0  9999  1999
```

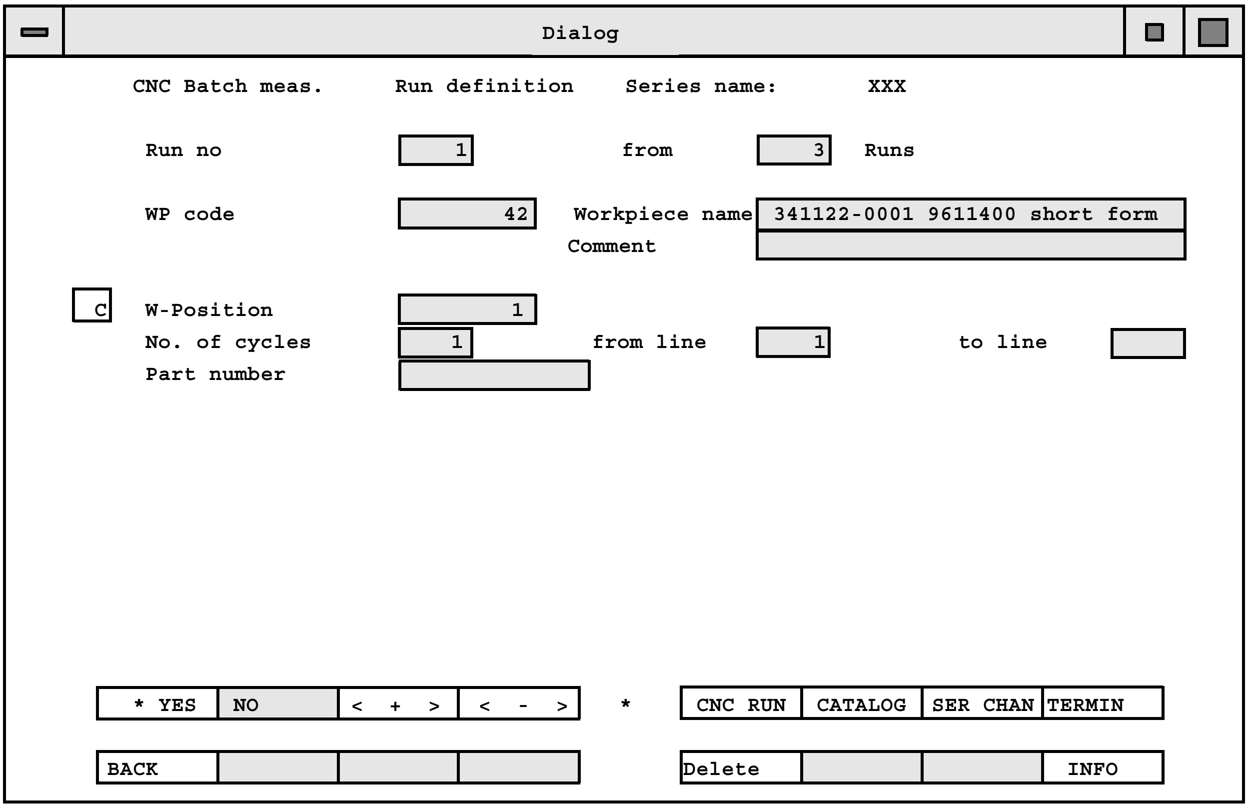
Batch measurement with <DI 1644>

Sequence of steps required

- Define record header with **<DI 1612>**.
- Call batch measurement with **<DI 1644>**.
- Select define batch name with **<SER CHAN>**.
- Further inputs using the Run definition dialog window.
- Start the batch measurement with **<CNC RUN>**



DI	Pull-Down-Menu	Pictogram
1644	CNC Start CNC Run macro...	



Softkeys

< + >
< - >

Store the individual run currently displayed, move to the next/previous run in the batch.

CNC RUN

Start the batch selected.

CATALOG

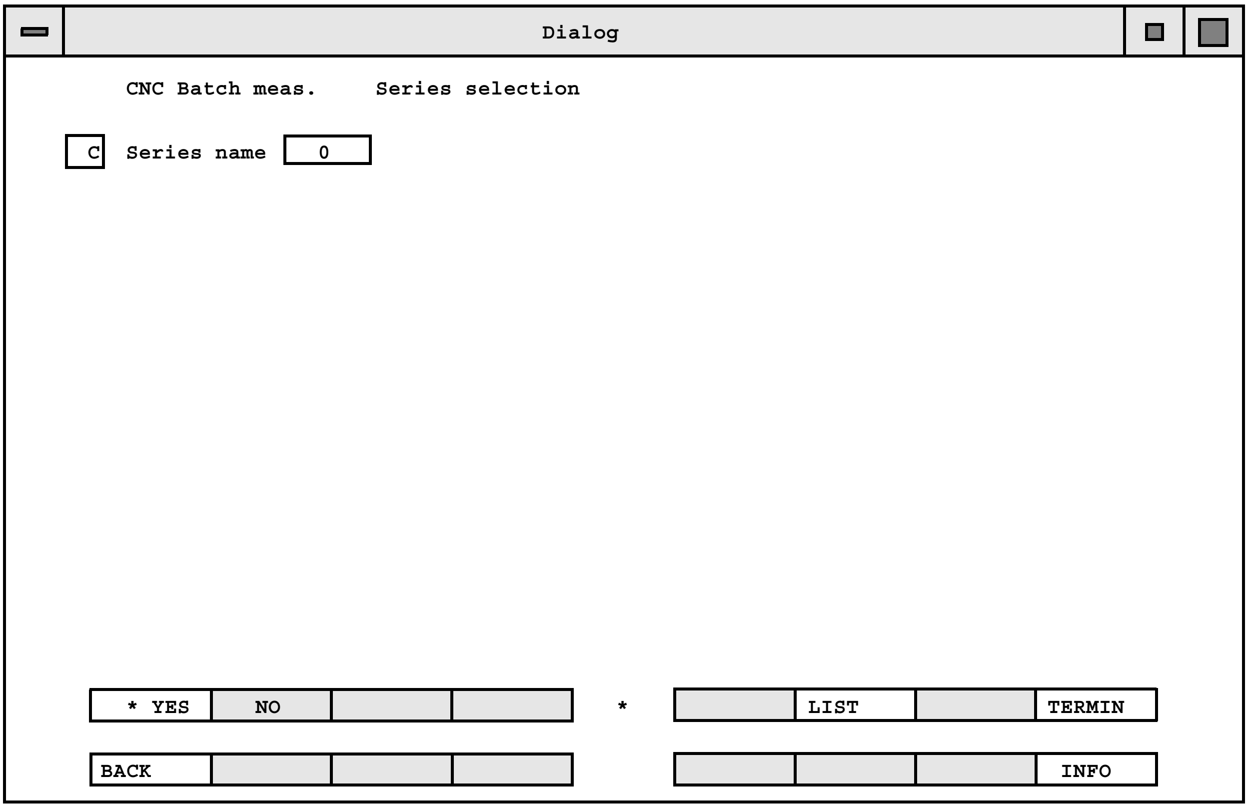
Call the workpiece catalog to select a workpiece.

TERMIN

Store the page currently displayed, exit the dialog window.

SER CHAN

Select the **Series selection** dialog window.



LIST

Display of the existing batch names.

Data boxes

Series name:	The name of the batch is defined in the **Series selection** window. Select using **<SER CHAN>**. Acknowledge with **<TERMIN>**.
Run no. .. from .. Runs	Display of the current run (number) and the total number of runs planned for the current batch.
WP code	Input of the workpiece code. The required workpiece code can also be entered via the **<CATALOG>** function.
Workpiece name/ Comment	Display boxes for the workpiece currently selected.
W-Position	Input of the W-position stored for the batch run.
No. of cycles	Input for the individual measuring run.
from line / to line	Input for partial run.
Part number	Input of the part number for the record header. Further inputs for the record header will then be prompted if the identification of the record header input column begins with an "*" (asterisk) ➤***„Modification of variable header I <DI 1612>“ on page 5-22***.

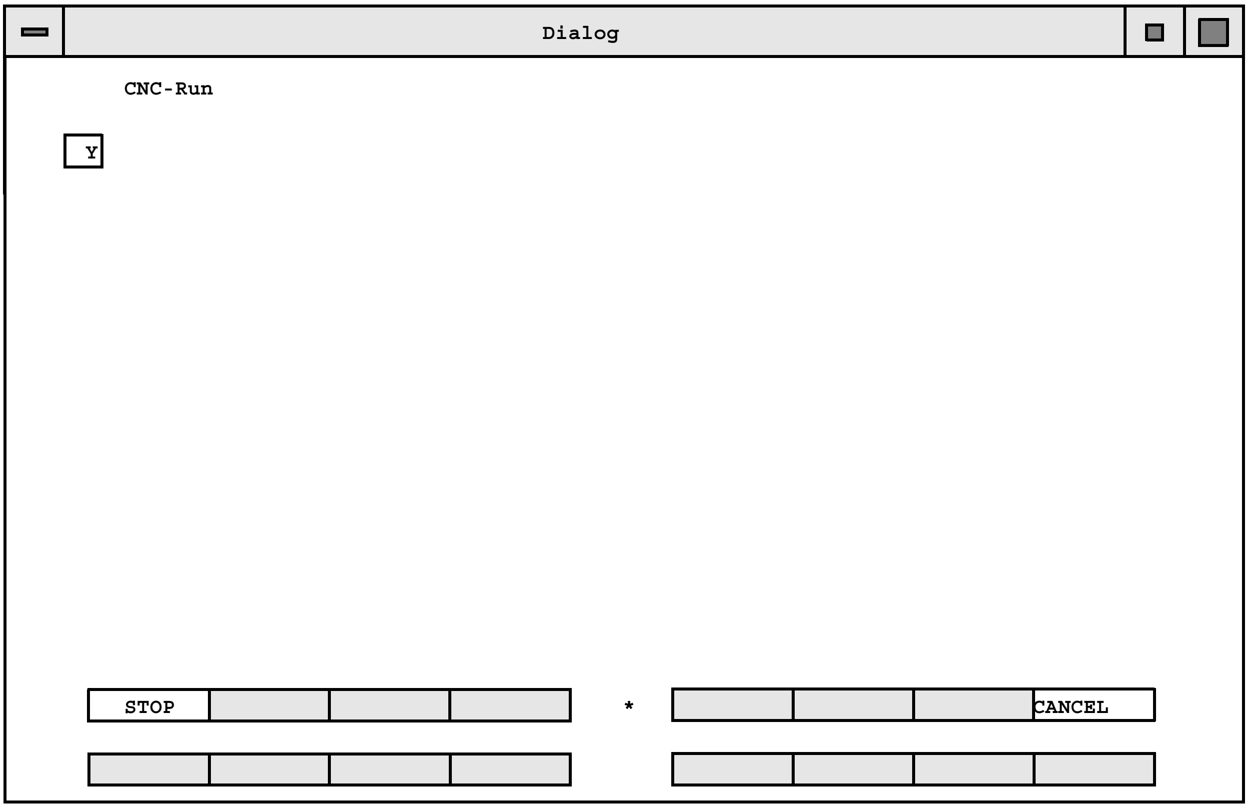
Interrupting and continuing a CNC run

The CNC run is interrupted:

intentionally	through intervention by the operator or a stop command ➤ ***„Interruption by the operator“ on page 18-11***
unintentionally	by a collision or some other malfunction ➤ ***„Interruption due to malfunction“ on page 18-14***
if manually guided	measurement sections are programmed ➤ ***„User guidance in manual sections“ on page 18-16***

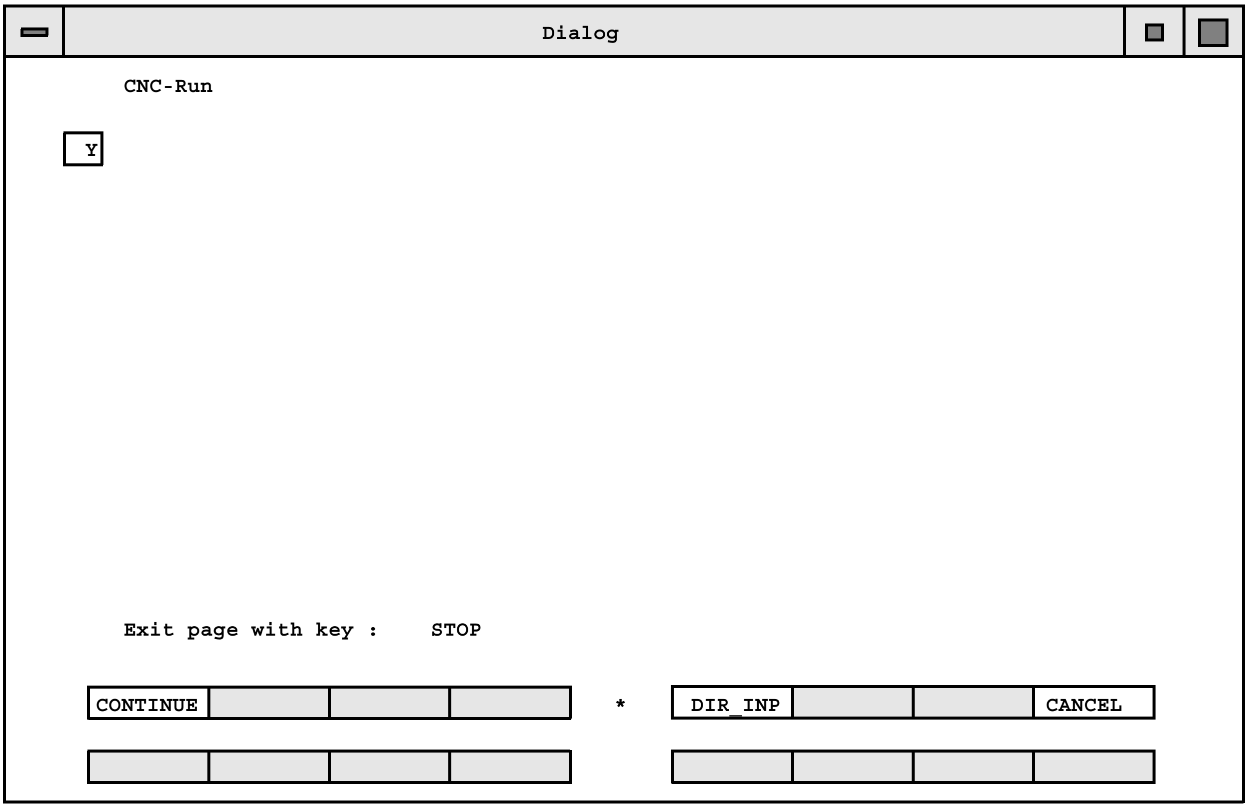
Interruption by the operator

Softkey assignment during the CNC run:



CANCEL Cancels the CNC run at any point (takes a few seconds).

STOP The CNC run is stopped and you have the following options:



CONTINUE Continues the CNC run.

DIR_INP Calls a function during the stop phase or switches to the CNC debugger, ➤ ***„Function call during the stop phase“ on page 18-13***.

CANCEL Cancels the CNC run.

Programmed stop

Following a programmed stop via **<DI 1096>** the CNC run is automatically interrupted. The following then appear:

– The same softkey assignment as for after **<STOP>**, if you have not selected **with rapidly program call**; operation ➤ ***„Function call during the stop phase“ on page 18-13***;

– The dialog window of the requested function, if you selected **with rapidly program call**. Fill in and accept the dialog window; the

CNC run will continue automatically after the function has been executed.

Function call during the stop phase

DIR_INP

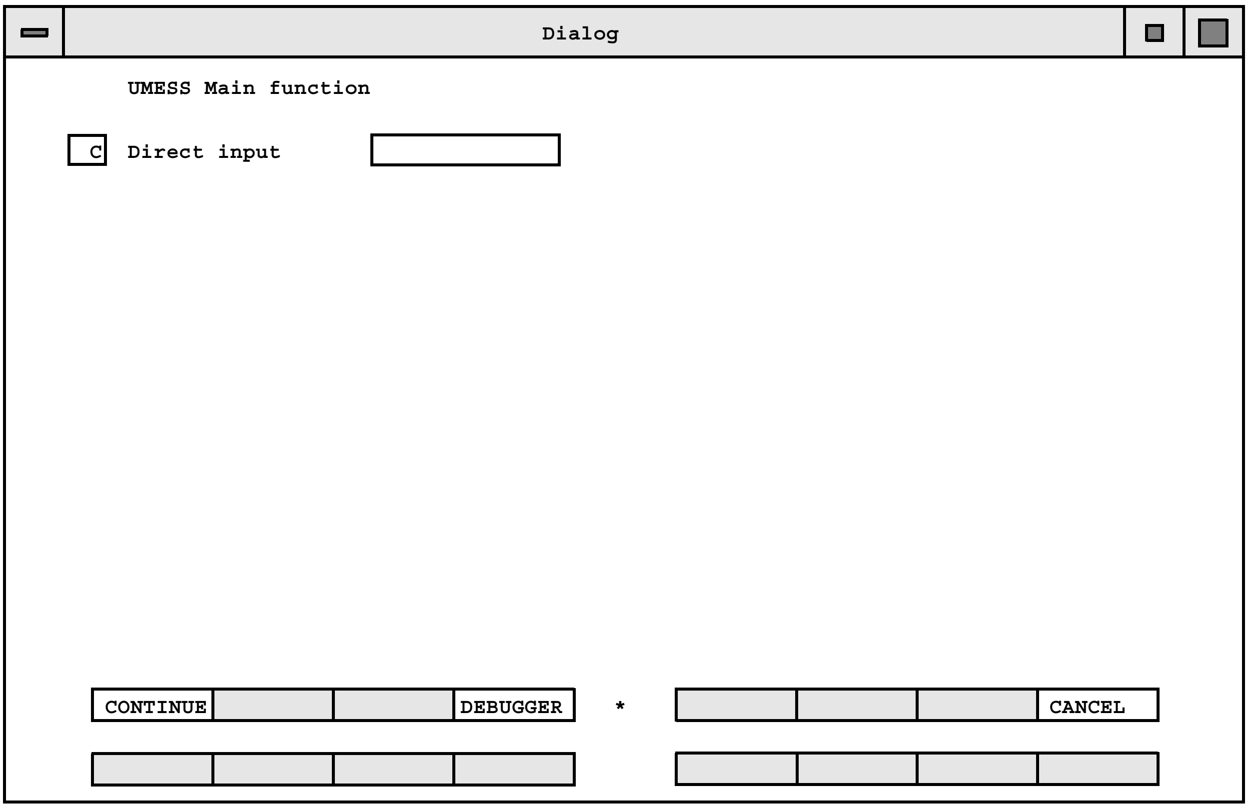
During the stop phase of a CNC run

- any function selection is allowed (with the exceptions mentioned below) and/or
- you can switch to the Debugger mode.

Prerequisite

The CNC run has been interrupted manually with **<STOP>** (➤***„Interruption by the operator“ on page 18-11***) or contains a stop command which was programmed with **<DI 1096>**, **with rapidly program call = NO** (➤***„Programmable stop <DI 1096>“ on page 16-21***).

The following dialog window appears for command input:



Softkeys

CONTINUE

Continue the CNC run.

DEBUGGER Start the CNC debugger (➤***„CNC debugger <DI 1070>" on page 18-17***).

CANCEL Cancel the CNC run.

Data boxes

Direct input

Any UMESS function is allowed with the following exceptions: **<DI 1610**, **1612**, **1613**, **1629**, **1632**, **1633**, **1634**, **1635**, **1636**, **1639**, **1640**, **1641**, **1642**, **1644**, **1649>**.

Procedure

Select the required function/softkey. After the selected softkey function has been terminated, the stop dialog window is displayed again.

Interruption due to malfunction

Application

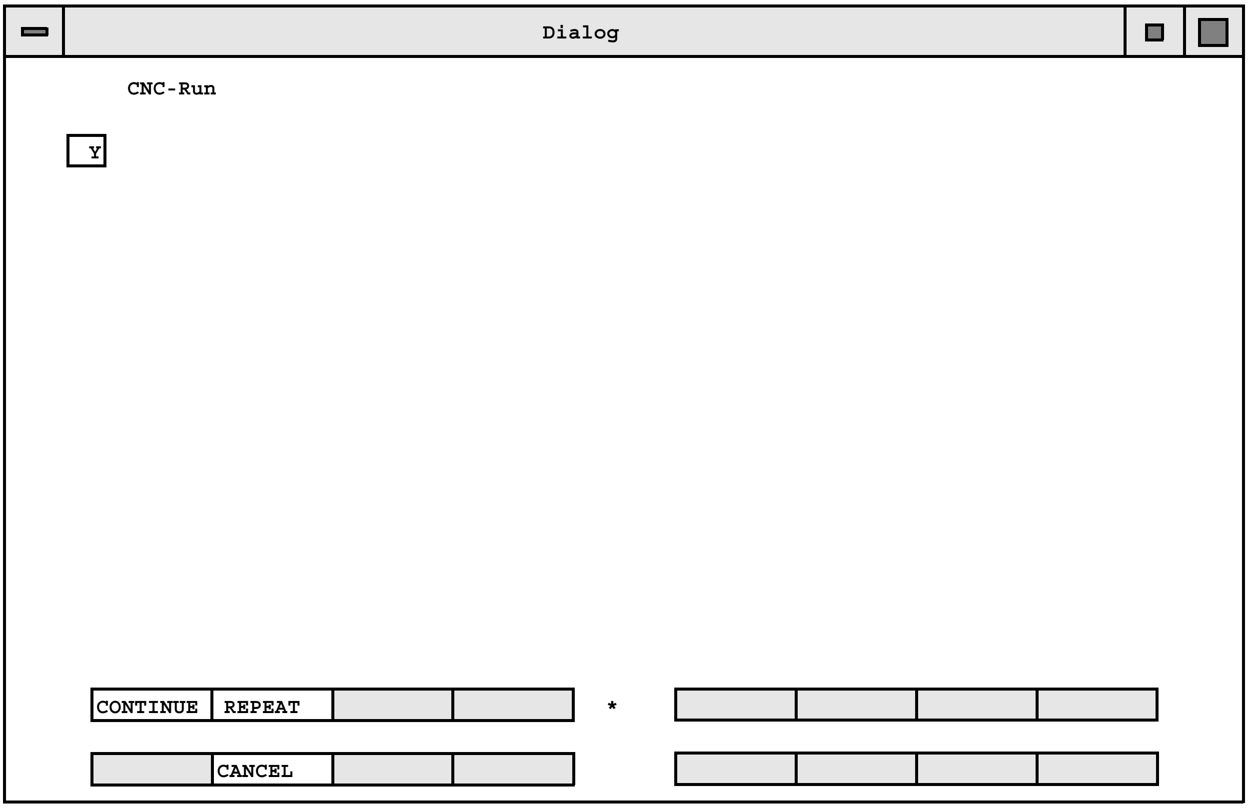
Collision, overtravel of the clamping (measuring probe head), insufficient weight balancing (measuring probe head), reaching the limit stop etc. may cause interruption of a CNC run.

NOTE

If necessary, the run safety can be improved by programming the Safety mode (➤***„Continuation after a missing bore <DI 1080>" on page 16-32***).

Display message

In case of an interruption due to a malfunction, the dialog window will output a corresponding message on the cause of the error and the possible remedy. At the same time, the following softkey assignment will also be displayed:



Softkeys

CONTINUE

To continue thh CNC run from the next intermediate position/probing.

REPEAT

To continue the CNC run from the last intermediate position/probing.

CANCEL

To cancel the CNC run.

Procedure

Proceed as prompted on the screen and continue/cancel the CNC run with the corresponding softkey.

If necessary, reset UMESS with the **<Break>** key (➤***„Switching on the measuring machine and computer“ on page 2-4***). Then look for the programming error e.g. with the CNC debugger (➤***„CNC debugger <DI 1070>“ on page 18-17***).

User guidance in manual sections

Application

If the CNC program contains computer prompted manual measuring sections (**<DI 1077>**, ➤***„Comment line in the control data <DI 1679>" on page 16-28***), The CNC run will stop at the first probing located inside of the manual section. The operator must then perform all subsequent probings in the manual section.

User prompting

The following instructions are displayed in the list and message window:

8 Point

MAN CNC STEP

14 PRBD -Z NOM CO: X= -64.0668

Y= 57.6859 Z= 6.8818

An additional reading is displayed on the Dynalog control panel:

Point number

3 Probe no. 1 DIFF: X= -4.0688

Y= 0.9906 Z= -1.2424

Explanation

MAN CNC STEP

Control step CNC run.

PRBD

Probing direction; the probing will always be calculated with this direction even if you have used another probing direction contrary to instructions.

NOM CO

Nominal coordinates of the probing in the control coordinate system (as in the control data).

Point number

Consecutive number of the point of an element to be probed.

Probe no.

Display of the probe with which programming was performed; this probe is also displayed on the control panel. The probing will always be calculated based on this probe, even if you select another probe on the control panel and probe with it.

DIFF

Current difference between the nominal and actual coordinates of the probe to facilitate control.

CNC debugger <DI 1070>

Application

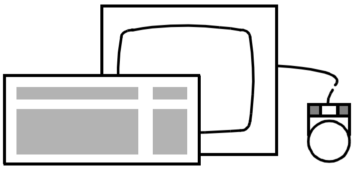
You can use the CNC debugger to test and improve a CNC program. The debugger edits a CNC program step by step. The control data is displayed in the dialog window.

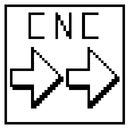
Procedure

In the debugger mode you must determine when the CNC program should start and how far it should run. I.e. you cause the program to stop at the next function (editable control data line), at a certain control data line or at so-called break points. There you can check the control data and edit it if necessary. The program will continue on to the next function, control data line, break point or the end of the program only after you have entered the corresponding command. In this way travel paths and probings can be optimized.

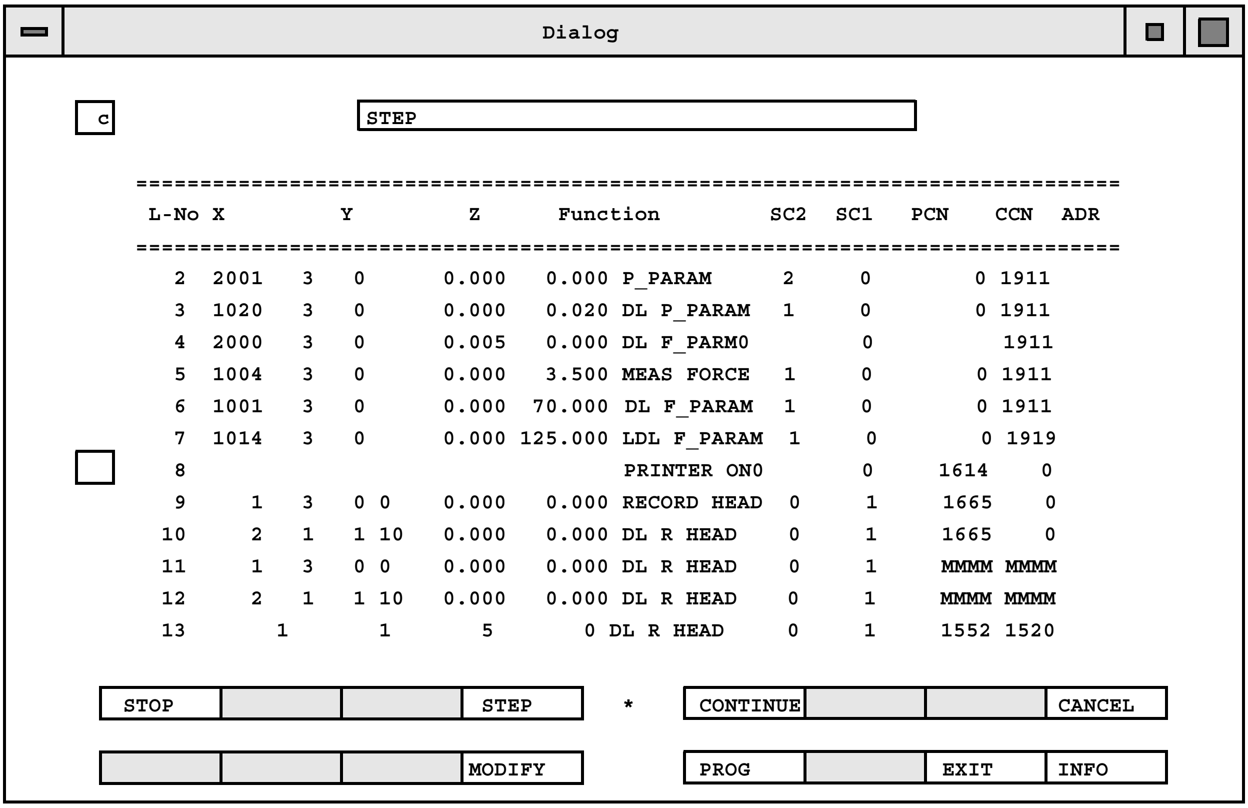
Function call

You can activate the debugger with **<DI 1070>** before starting a workpiece (program) of afterwards with the **<STOP>** softkey, cf. function call.
When you call **<DI 1070>** the CNC run will automatically be activated.



DI	Pull-Down-Menu	Pictogram
1070 **CNC DEBUG**	**CNC** **Start CNC** **STEP mode...**	

First dialog window as for normal CNC start (➤***„Starting a CNC run for a single workpiece <DI 1640>“ on page 18-3***)



Softkeys

STOP

Is activated during the CNC phase, e.g. **STEP** during probe change.

STEP

The program continues running up to the next function (editable control data line).

If you want to execute several functions in succession or execute the run up to a certain function, you must specify this in the data box, see below under "**Data box**".

CONTINUE

The program then continues on to the next break point or (if no break point has been set) to the end of the program.

If you want the program to run through several breakpoints or up to a certain break point, you must specify this in the data box, see below under "**Data box**". This also explains how breakpoints are set.

CANCEL

Cancels the CNC run/debugger. Any changes you have made with **<MODIFY>** or **<PROG>** will be lost.

MODIFY

Requests control data for editing; the softkey has the same effect as the function call for correcting control data **<DI 1642>**:

– Make corrections as described in ➤***„Correcting control data <DI 1642>" on page 17-31***. Be careful when modifying control data lines which have already been edited.

– After you terminate the corrections with **<TERMIN>** the CNC debugger will continue at the control data line where you requested the modification.

– At the end of a CNC run edited with **<MODIFY>** you must decide whether you want to accept the modifications. The dialog window explained in ➤***„Copying control data lines from other workpieces <MIX>" on page 17-55*** will appear, see operation there.

PROG

Used to edit the current control data line via learn programming. The CNC debugger then continues with the next control data line.

At the end of a CNC run edited with **<PROG>** you must decide whether you want to accept the modifications you have made. The dialog window described in ➤***„Copying control data lines from other workpieces <MIX>" on page 17-55*** will be displayed, see operation there.

EXIT

Terminates the debugger. The CNC run will continue and run to the end of the program as always.

Input box

You can enter more debugger commands in the input box below the softkeys: (**N** = whole number)

– Instead of pressing the softkey, type in its text and activate the corresponding task with **<Enter>**. The text from the softkey pressed last will automatically be displayed in the input box.

– **BREAKPOINT,N**: Set the break point to control data line n. As a result, you mark the stop points which can be selected with **<CONTINUE>** or **N,CONTINUE**, see corresponding explanation.

  The break points are valid only for the current debugger. You must make a note of where you have set them, since the program does not list this information.

– Extend the softkey commands to include the following options:

  – **N,STEP**: Used to execute the next n functions and then stop (usually the next editable control data lines including the continuation lines).

  – **CONTINUE,N**: Used to run up to the control data line and stop there.

  - **N,CONTINUE**: Used to run up to the nth break point. Useful e.g. for testing a loop in which a break point has been set. This loop is then run n-1 times until before the CNC run stops again.
- To list control data, type in one of the following commands:
  - **VIEW**: Control data starting with the current line.
  - **VIEW,BACK**: Control data preceding the current line.
  - **VIEW,N**: Control data starting with line n.

Notes on input

- You do not have to type in the commands in full. An unambiguous character string will do,
  for example **M** or **MOD** for **MODIFY**.
- You can also enter one or more blanks instead of a comma,
  e.g. **VIEW BACK** or **B 123**.

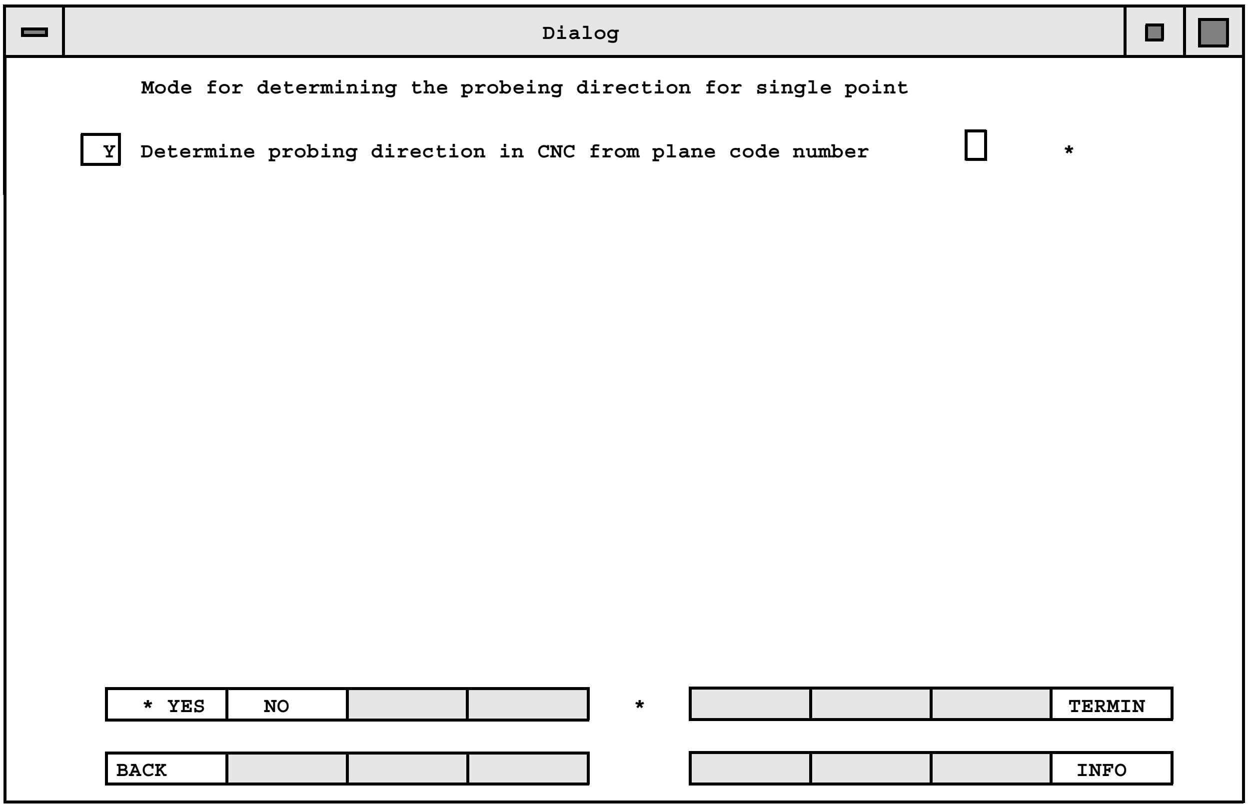
Determining the probing direction for single points of a CNC run <DI 1178>

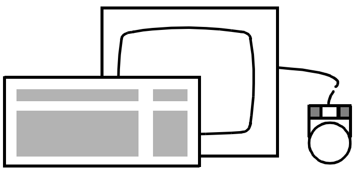
Application

In borderline cases (e.g. less than 45°) the probing direction may change sporadically. You can then determine the probing direction for a single point of the CNC run. This is done by determining the probing direction based on the plane code number.

Duration of function

The probing direction determination mode remains activated during the CNC run until you deactivate it or reset the CNC program to its initial state. This mode is always deactivated in the manual mode (MAN) and during learn programming (PROG).





DI	Pull-Down-Menu	Pictogram
1178		

Chapter 19

Scanning

This chapter contains:

General

Scanning method

The scanning method which should be selected depends on the specified measuring task, the existing workpiece geometry data and the measuring machine used. In individual cases you can choose from several different scanning methods.

The following criteria must be considered

Measuring task

– UMESS (circle, cylinder, line, surface)
– KUM (generate KUM nominals, measure)
– HOLOS (generate, measure HOLOS surface data)

Measuring machine

– Type of probe system (MT, VAST, ST, LTP, OTM)
– CMM operating mode (manual, CNC)

Geometry data

– The nominal values of the geometry to be scanned are known (scanning known contours)
– The nominal values of the geometry to be scanned are not known (scanning unknown contours)

Preparations

Selecting the scanning method

Probe systems

Measuring machines can be equipped with different types of probing systems.

The type of probing system determines its use during scanning. The following types are differentiated:

– Measuring probe system with high-speed scanning, can be unclamped for scanning (MT with HSS)

– VAST measuring probe system

– Measuring probe system, not unclampable for scanning (MT without HSS)

– Trigger probe systems such as RST, ST2 (ST)

– Laser probes (LTP, OTM)

First find out which scanning methods your measuring machine can perform:

Scanning method **1st dialog window**	**MT with HSS, VAST**	**MT with- out HSS**	**ST, RST**	**LTP**	**OTM**
Known contour (The coordinates are entered in the dialog window)	**X**				
Unknown contour (The start and end point are entered at the measuring machine)	**X**			**X**	**X**
Unknown contour, clamped (Only for ST/RST: The coordinates can be entered in the dialog window or the start and end point at the measuring machine)	**X**	**X**	**X**	**X**	**X**
Unknown contour, manual (The section plane and intersection height are entered in the dialog window)					**X**
Form line (only for CADLINK, manual point transfer)					**X**

Then select the scanning mode based on the scanning method possible and the measuring task:

Scanning method	Measuring task / **Scanning mode** CIRCLE	CYLINDER	LINE	SURFACE
Known contour	**Circle**	**Circle** or **Any inters. plane** (surface line)	**Any inters. plane**	**Any inters. plane** or **Plane on circle path**
Unknown contour	**Inters. plane in WP**	**Inters. plane in WP**	**Any inters. plane** or **Inters. plane in WP**	**Any inters. plane** or **Inters. plane in WP**
Unknown contour, clamped	**Plane in WP system**	**Plane in WS-System** or **Line in WP system** (surface line)	**Line in WP system**	**Line in WP system** or **Circle path**
Unknown contour, manual			**Any inters. plane and inters. plane in WP system possible**	

UMESS scanning functions are also available in KUM and CADLINK:

Scanning method	Measuring task / **Scanning mode** KUM nominal data	CADLINK
Known contour	**Nominals**	
Unknown contour	**Any inters. plane**	**Any inters. plane**
Unknown contour, clamped	**Scanning acc. to nominals** or **measuremant acc. to nominals**	
Unknown contour, manual	**Any inters. plane**	
Form lines		**only for DSE with OTM probe**

Preparations for measuring probe heads

Application

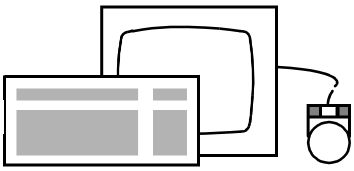
For measuring probe heads, the operating mode, probe calibration and probe bend must be considered depending on the scanning method selected and based on the following table:

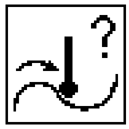
Procedure	**Scanning method known contour unknown contour**	**Scanning method unknown contour, clamped**
Set operating mode of probe head	**<DI 1502>** Vectorial probing **ON** ➤***„Setting the operating mode for the measuring probe head <DI 1502>“ on page 6-18***	**<DI 1502>** Vectorial probing is **OFF** ➤***„Setting the operating mode for the measuring probe head <DI 1502>“ on page 6-18***
Determine probes	**<DI 6528>** ➤***„Semiautomatic probe calibration with <DI 15228> (tensor calibration)“ on page 7-19***	**<DI 6501 / 6502>** ➤***„Semiautomatic probe calibration with <DI 6501>“ on page 7-17*** / ➤***„Manual probe calibration <DI 6502>“ on page 7-29***
Determine probe bend	Contained in **<DI 6528>** for extreme speeds **<DI 1184>** ➤***„Determining bend parameters for unclamped scanning <DI 1184>“ on page 7-46***	**<DI 6520>** ➤***„Determining bend parameters for the "clamped" probe head mode <DI 6520>“ on page 7-36***
probe bend taken into account in UMESS	Automatically taken into account when calibrating with **<DI 6528>** Call **<DI 1186>** ➤***„Measuring with compensation of the probe bend <DI 1186>“ on page 7-47*** required when scanning with **<DI 1184>**	**<DI 1186>** ➤***„Probe bend compensation“ on page 7-34***
Adapt probing behavior with probe radius < 1 mm	**<DI 1574>** ➤***„Adapting the probing behavior <DI 1574>“ on page 6-20***	---

Defining the scanning mode <DI 1530>

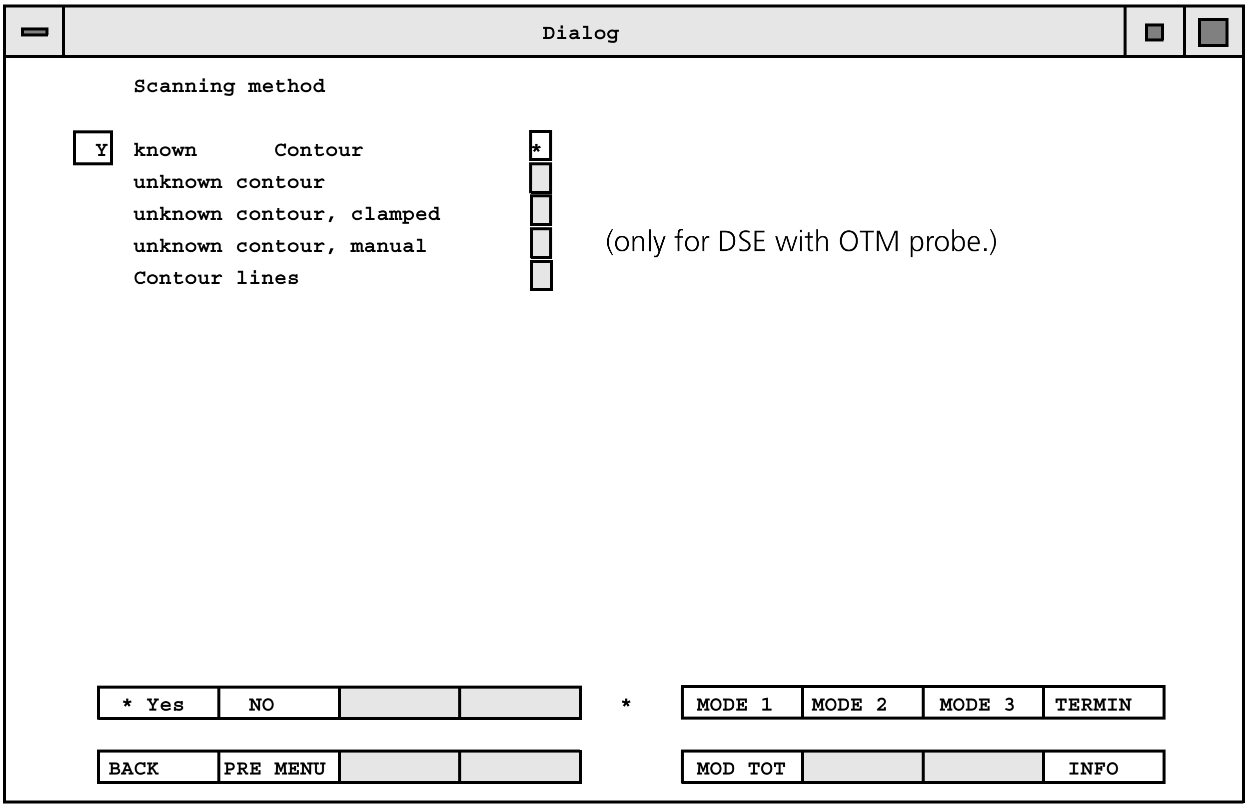
Application

Using the scanning mode you can define and store the parameters required for scanning.



DI	Pull-Down-Menu	Pictogram
1530 SCAN MOD	within a geometric element: Scanning mode	

You must define the scanning mode in several different dialog windows depending on the measuring task planned.



NOTE

Depending on the probe system connected, the **Scanning method** menu is supplemented with special menu options.

Softkeys

MODE X

Selects long-term mode 1,2 or 3 for setting or editing. Your selection can then be stored under any number as a long-term or short-term mode.

TERMIN

Fetch the short-term mode currently valid for editing. It can then be stored under any number either as a short-term mode or as a long-term mode.

BACK

Return to the calling menu. The mode currently valid becomes/remains the short-term mode.

MOD TOT

Lists the long-term modes currently stored.

Data boxes

known contour

<YES>
Control travels according to nominal data, explanations ➤***„Scanning in the known contour mode“ on page 19-16***

unknown contour

<YES>
The control probes along the contour. See additional dialog window, explanations ➤***„Scanning in the unknown contour mode“ on page 19-19***

unknown contour, clamped

<YES>
Scanning with the measuring probe head, the trigger probe head and optical probe heads (OTM), explanations ➤***„Scanning in the known contour clamped mode“ on page 19-21***

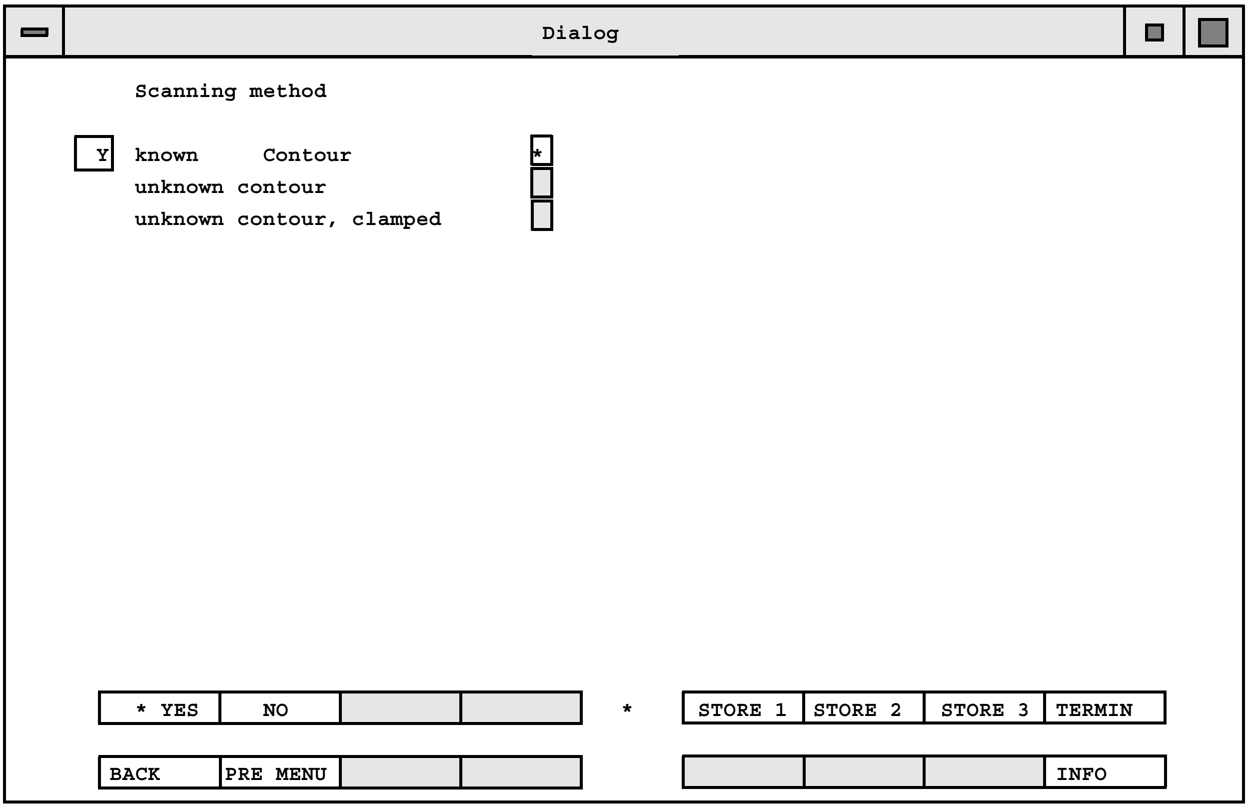
NOTE

- Three different scanning modes can be set and retained for call at any time (long-term modes). A fourth mode can be set temporarily (short-term mode).
- The last mode used is always the one which is currently valid .

Transferring the scanning mode

Application

If you close the dialog window with **<TERMIN>,** a softkey assignment will appear via which you must specify how you want to store the set mode.



Softkeys

STORE x

Stores the mode currently valid as long-term mode 1,2 or 3 (and at the same time as the new short-term mode).

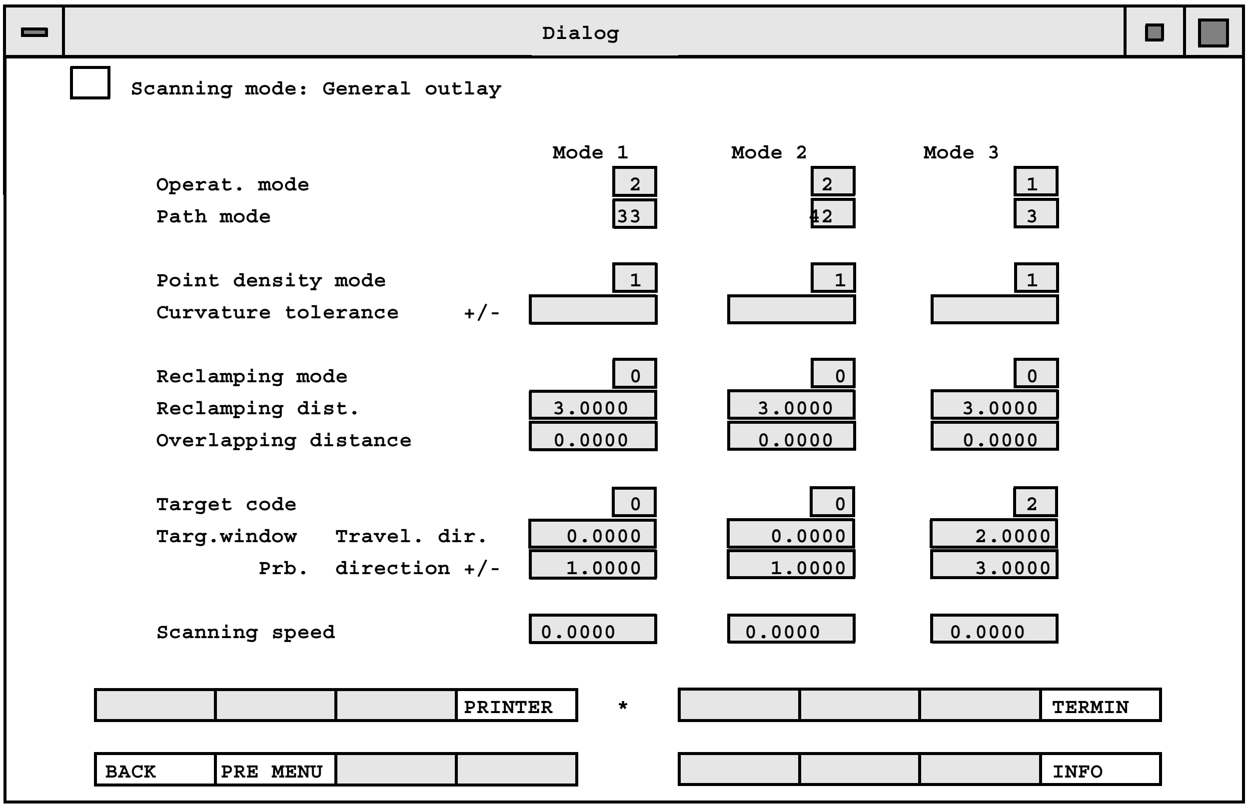
TERMIN

Stores the mode currently valid as short-term mode and returns to the calling menu.

Listing the scanning modes <MOD TOT>

MOD TOT

The **<MOD TOT>** softkey lists the long-term modes set on the screen. Other infos can also be called up or printed.



Softkeys

PRINTER

Printout of the entire overview.

TERMIN

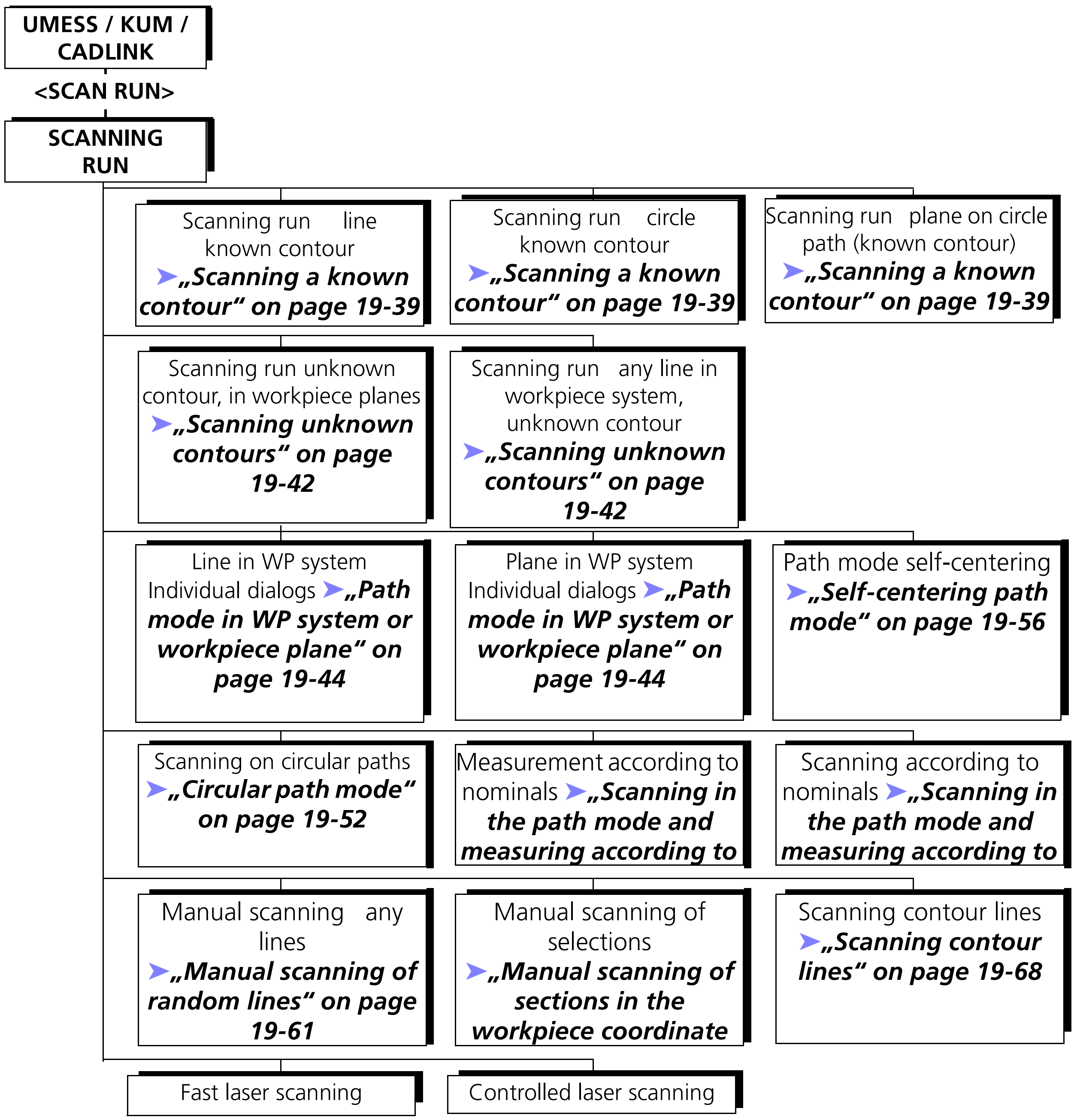
Return to the **Scanning method** dialog window.

Scanning measuring run

Branching of dialog windows

Overview

The following overview shows how the dialogs/dialog windows branch following the start of the scanning run:



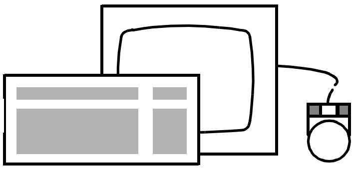
Scanning with UMESS

Preparations

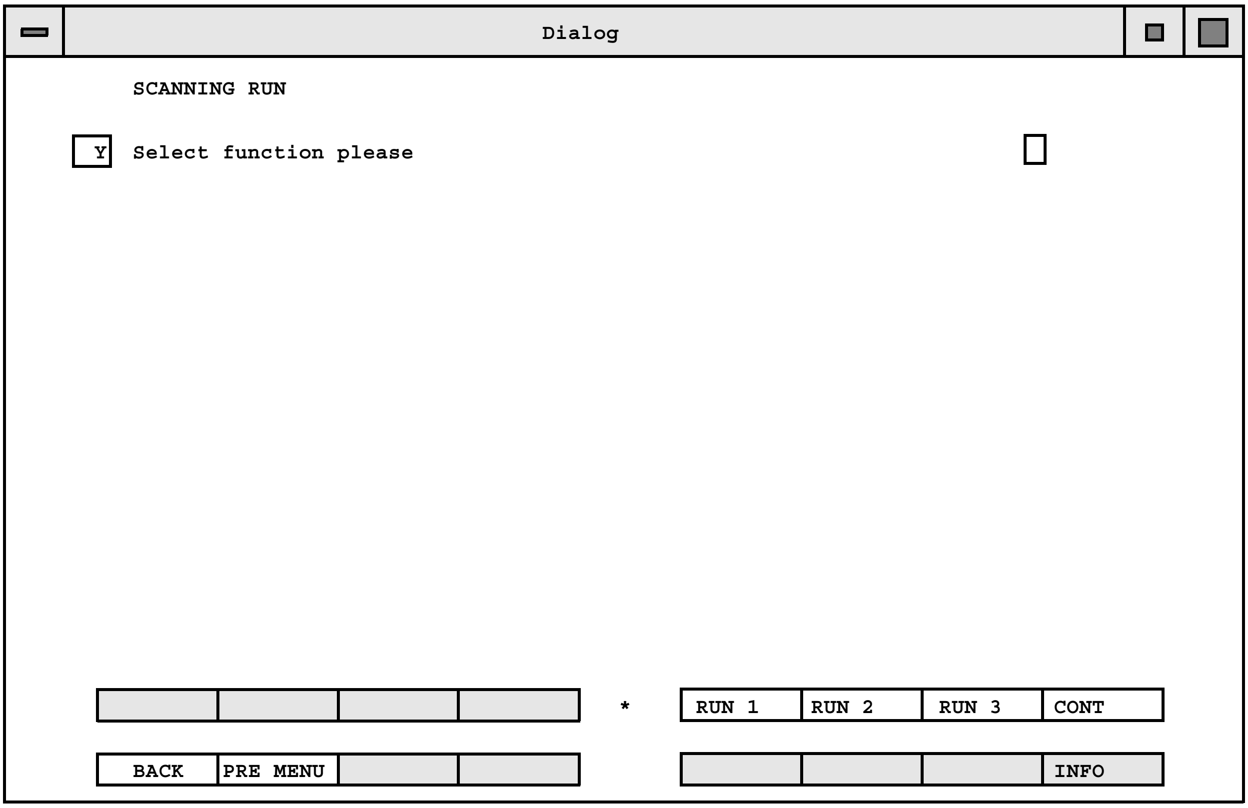
- If necessary, set the scanning mode (the mode used last is always the one currently valid and therefore the short-term mode).
- Define the workpiece coordinate system if this has not already been done.
- For scanning a known contour: If you have not already done so, you can activate the filter with **<DI 1185>** and the outlier elimination with **<DI 1181>**.
- For scanning in the workpiece plane: If you have not already done so, align the workpiece coordinate system parallel to the planned scanning plane.

NOTE

The scanning run automatically terminates when 32,000 per element have been scanned.



DI	Pull-Down-Menu	Pictogram
	Within a geometric element Measure/Eval...	
	Scanning run	



Softkeys

RUN X

Scanning with the parameters from long-term mode x (stored in the Scanning mode with **<STORE x > , x** = 1,2,3).
During learn programming, the control data accepts the long-term mode after error free scanning. I.e. this mode no longer needs to be stored at the CNC start.

CONT

Scanning with the mode currently valid.
The control data does not accept this mode during learn programming. I.e. this mode must be programmed with **<SCAN MOD>** or available at the CNC start as the mode currently valid.

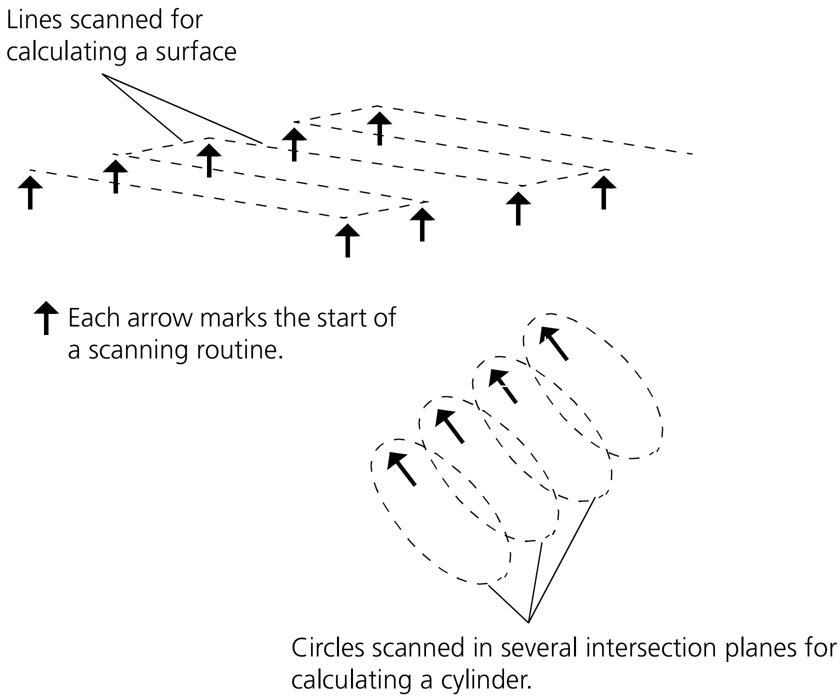
If **<RUN x>** or **<CONT>** is called, more dialog windows for entering the parameters required will follow.

NOTE

- Special features of learn programming/CNC run: ➤***„Learn programming“ on page 19-70***
- If desired: Subsequent graphic evaluation (see Option 2 operating instructions).
- A surface usually must be scanned in multiple paths. This also applies to elements such as cylinders or cones, which must be scanned in multiple sections and/or surface lines.

<SCAN RUN> must be called for each line/surface line and for each workpiece plane to be scanned .

Examples:



Scanning with KUM

Application

In KUM you can measure existing nominal values or generate new ones via scanning with the help of a master part:

Measuring with existing nominals

Step	Program call
Call measuring run	**KUM** **<MEASURE>**
Define the scanning mode	**<SCAN MOD>** **Scanning known contour** **Nominals**
Start the scanning run	**<SCAN RUN>**
End program	**<TERMIN>**

To generate nominals

Step	Program call
Call measuring run	**KUM** **<MEASURE>**
Define scanning mode	**<SCAN MOD>** **Scanning unknown contour** **Intersection plane in WP**
Start the scanning run	**<SCAN RUN>**
End the program	**<TERMIN>**

Scanning with HOLOS

Restriction

In HOLOS, scanning functions can be activated only for measuring machines equipped with both a measuring probe head and a laser probe head:

Scanning with HOLOS (digitization)

Step	Program call
Define scanning area by lofting a surface	**Digitize** **Scan area**

Scanning with HOLOS (measurement)

Step	Program call
Define scanning area by clicking on a line	**Measure** **Define measuring run** **Scan line**
Start scanning run	**Start run**

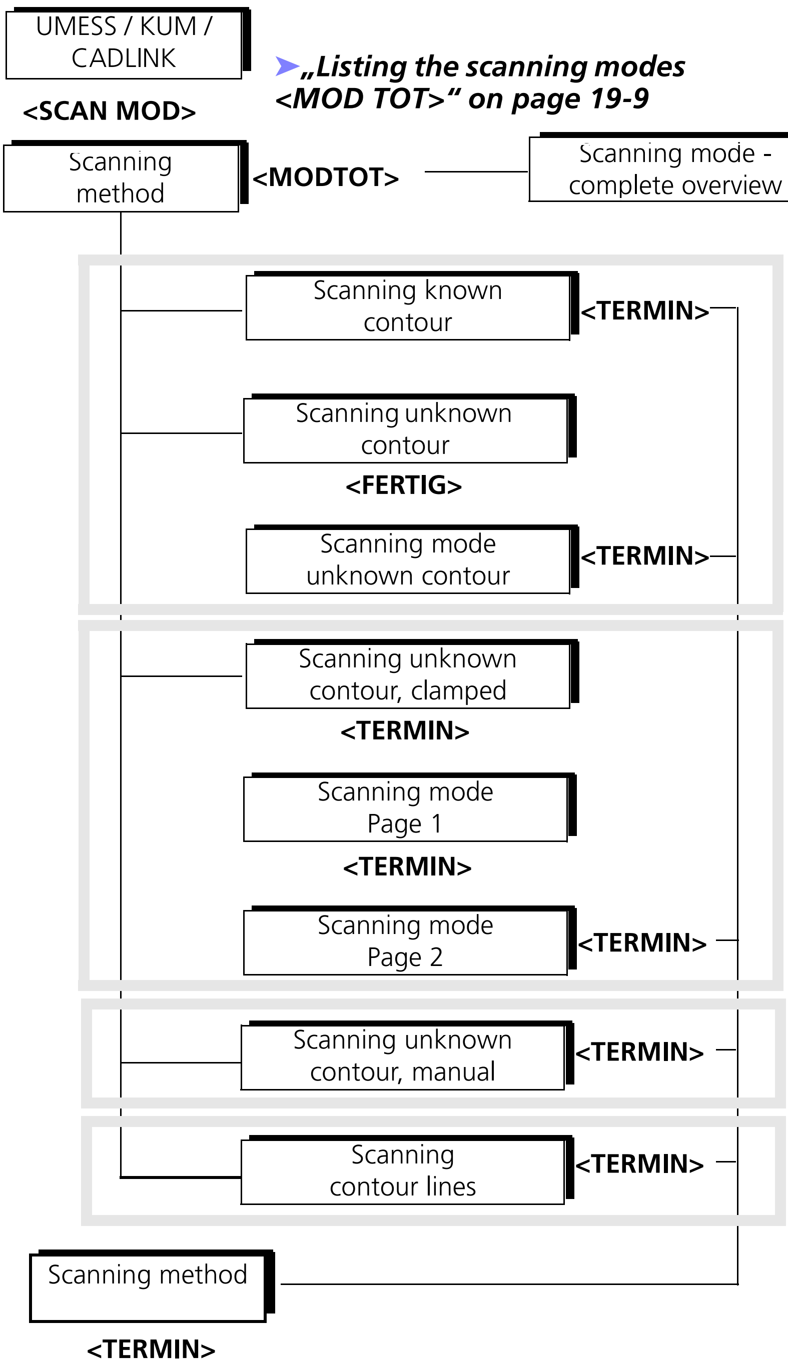
Step	Program call
Define scanning area by clicking on four corner points	**Measure** **Define measuring run** **Scan area**
Start scanning run	**Start run**

Details on the scanning mode

Branching of dialog windows

Overview

The following overview shows how dialogs / dialog windows branch when defining the scanning mode:



➤ *„Listing the scanning modes <MOD TOT>“ on page 19-9*

➤ *„Listing the scanning modes <MOD TOT>“ on*

➤ *„Scanning in the known contour mode“ on page 19-16*

➤ *„Scanning in the unknown contour mode“ on page 19-19*

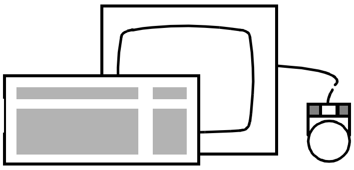
➤ *„Scanning in the known contour clamped mode“ on page 19-21*

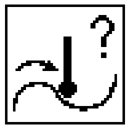
➤ *„Scanning an unknown contour manually“ on page*

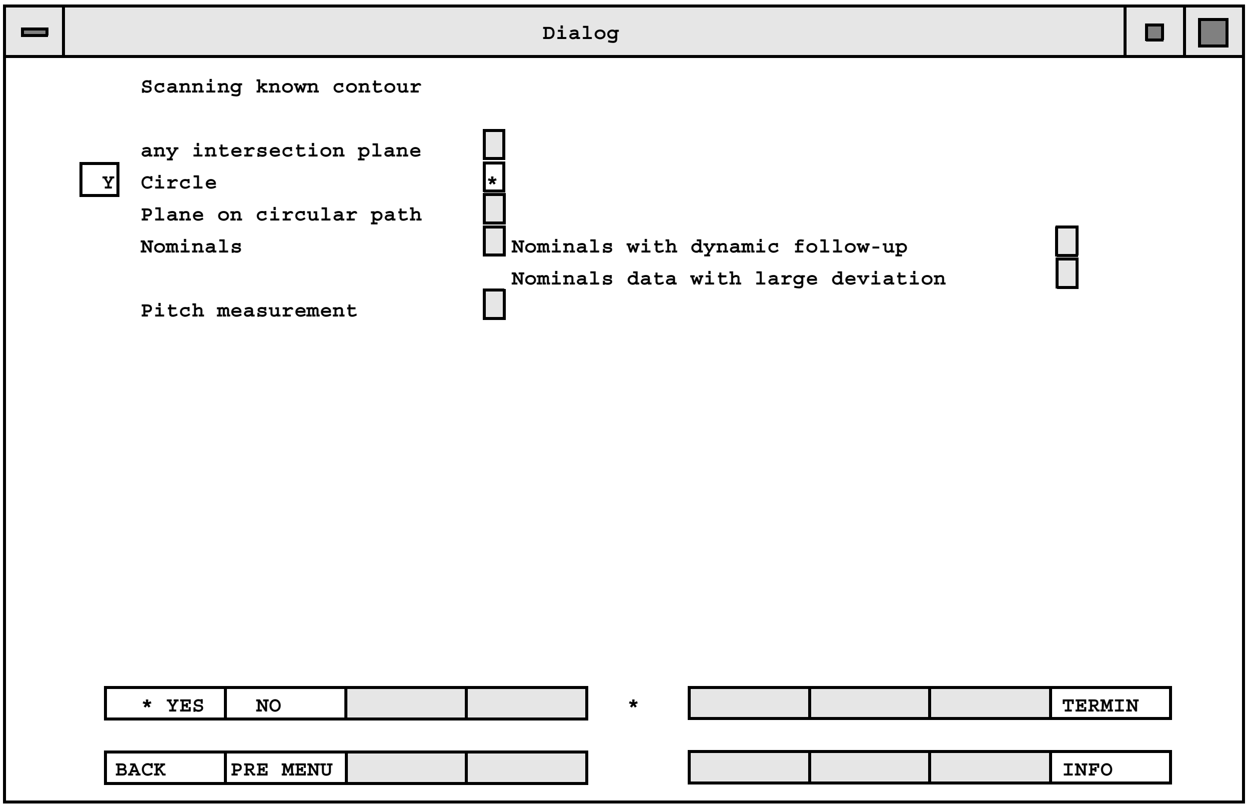
➤ *„Scanning contour lines“ on page 19-68*

Scanning in the known contour mode

Function call



DI	Pull-Down-Menu	Pictogram
1530	<SCAN MOD> known contour <YES> <TERMIN>	



Data boxes

any intersection plane

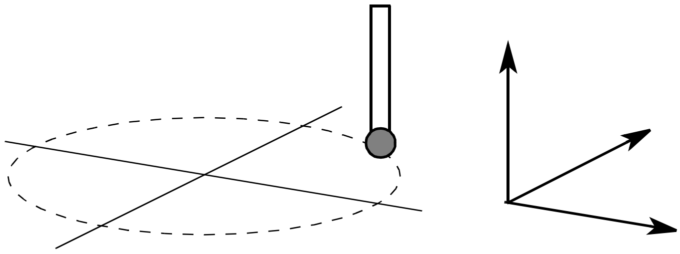
<YES>
Scanning of a line in any intersection plane. The intersection plane is defined by the start point and target point of the line as well as by the probing direction.

Circle

<YES>
Scanning of a circle in the workpiece coordinate system.

Plane on circular path

<YES>
Circular scanning of a plane in the workpiece coordinate system.



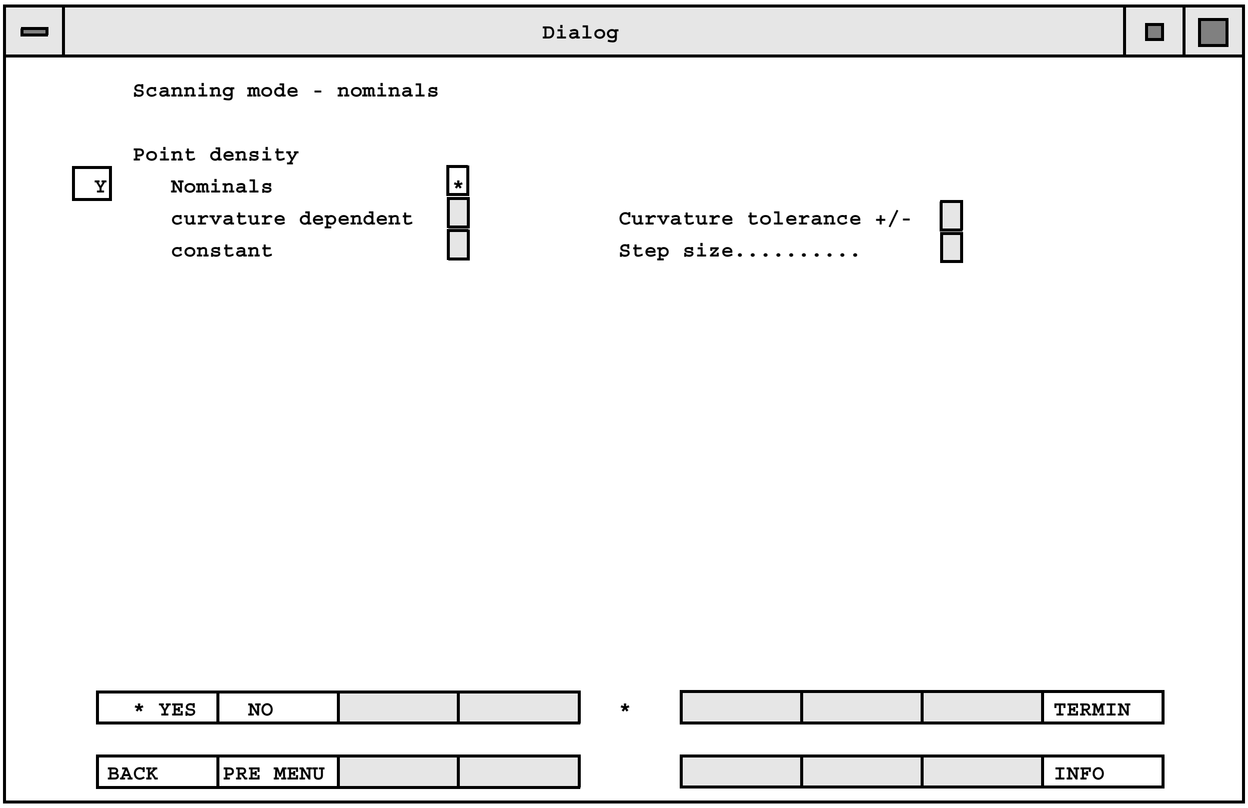
Nominals (nominal data)

<YES>
Scanning based on KUM nominals in the workpiece coordinate system.

Nominals with dynamic follow-up

Measurement according to nominals; for larger deviations, insertion depth > 0.1 mm

<YES>,
the dialog window follows

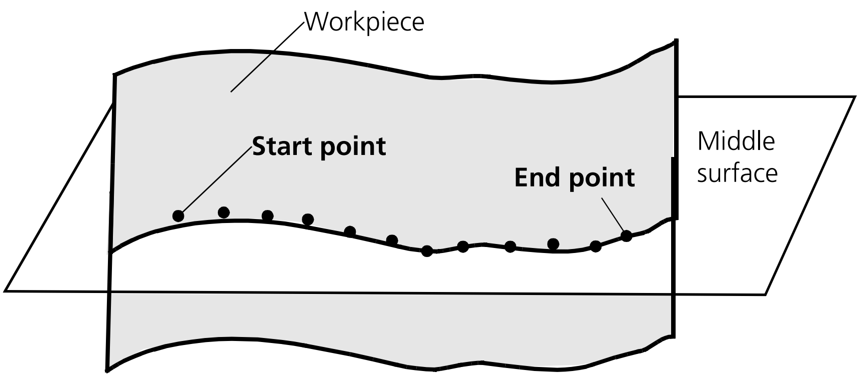


Nominal data with large deviation

Measurement according to "unknown" contour, point acquisition between support points, input of start point and target point. The program calculates a "middle surface" between these points.

Please note: The nominals must lie in the same plane.

<YES>
The dialog window is displayed as shown above



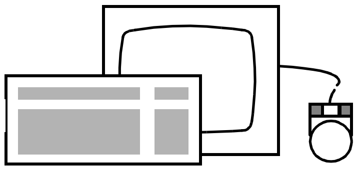
Pitch measurement

A pitch measurement can only be executed with a rotary table.

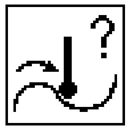
<YES>
A special menu will follow if a rotary table is installed.

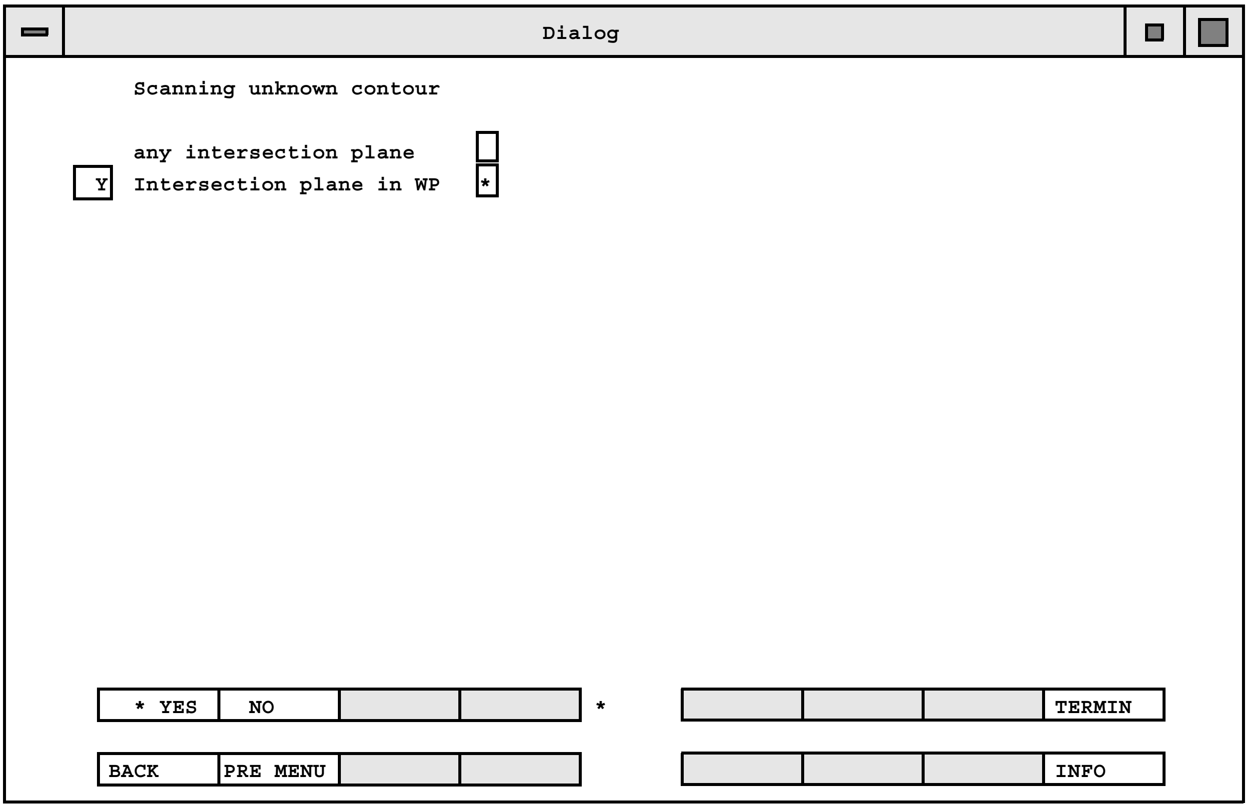
Scanning in the unknown contour mode

Function call



DI	Pull-Down-Menu	Pictogram
1530	<SCAN MOD>	
	unknown contour <YES>	
	<TERMIN>	





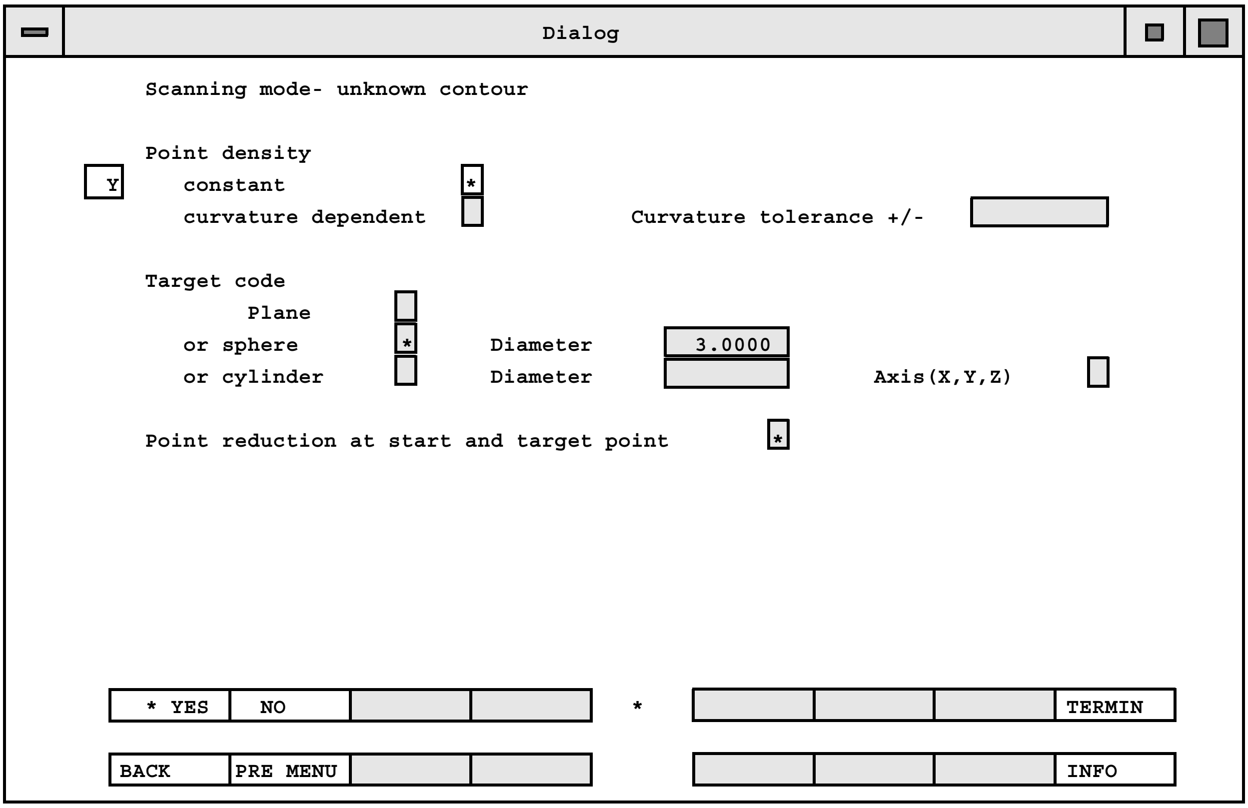
Data boxes

any intersection plane

<YES>
Scanning of a line in any intersection plane. The intersection plane is defined by the start point and target point of the line as well as the probing direction.

Intersection plane in WP

<YES>
Scanning in a plane of the workpiece coordinate system.



Point density constant — Default setting

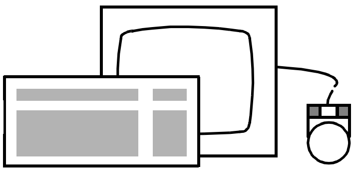
curvature dependent
Curvature tolerance +/- — Function not yet supported.

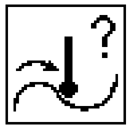
NOTE

At speeds of < 1 mm/s, the measuring machinemay first move in the direction opposite to the one required (approx. 0.1 mm at 0.1 mm/s). This is unavoidable due to the system.

Scanning in the known contour clamped mode

Function call



Di	Pull-Down-Menu	Pictogram
1530	<SCAN MOD>	
	unknown contour, clamped <YES>	
	<TERMIN>	

1st dialog window

```
Dialog

SCANNING

[I] Operat.mode  [1]     1 = computer-guided
                         2 = Cabinet control
                         3 = Joystick   free
                         4 = Joystick   WP Plane

    Path mode    [2]     2 = Line in WP system
                         3 = Plane in WP system
                         4 = self centering
                         9 = Cylinder surface
                        12 = Circ.path
                        21 = measurement according to nominals
                        22 = Scanning according to nominals
                        98 = controlled laser scanning
                        99 = rapid laser scanning

| * YES | NO       |  |  |   *   |  |  |  | TERMIN |
| BACK  | PRE MENU |  |  |       |  |  |  |        |
```

Softkey

TERMIN

Call of dialog window 2.

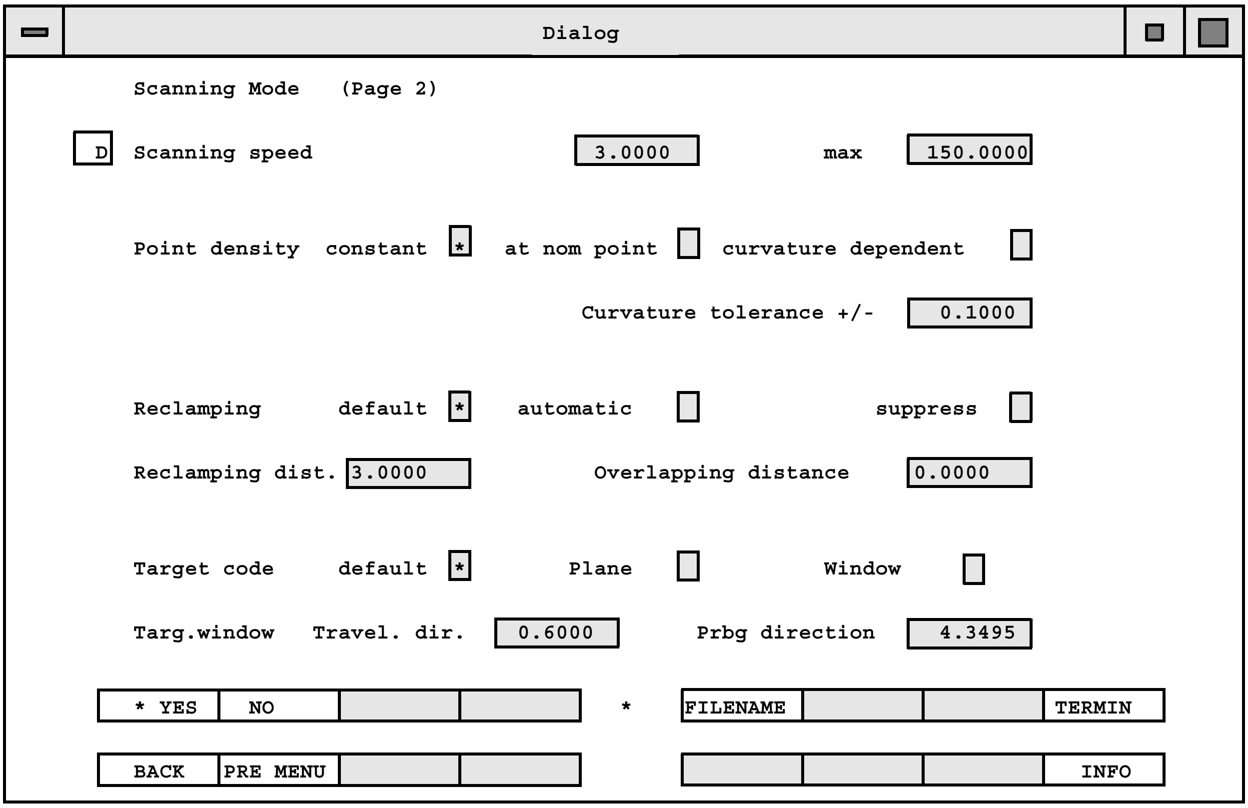
Data boxes

Operat.mode ➤*„Mode of operation“ on page 19-25*

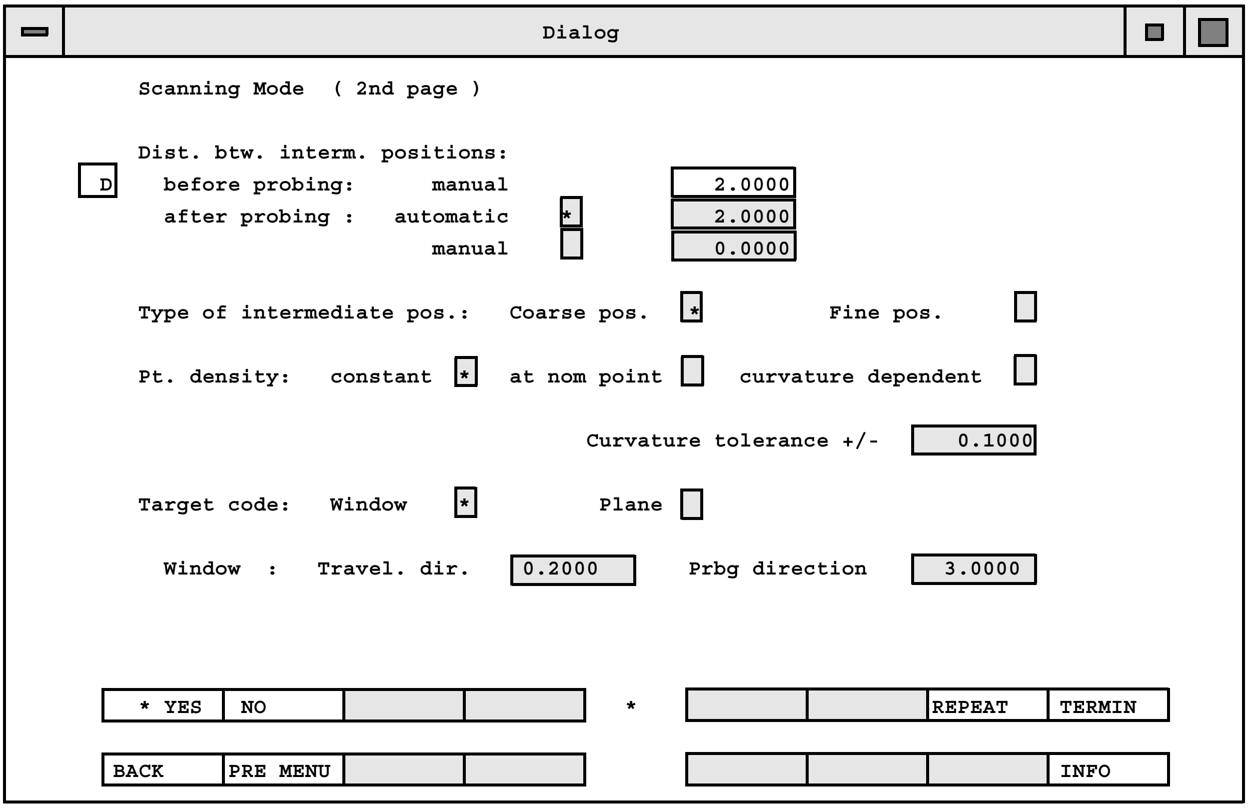
Path mode ➤*„Path modes“ on page 19-25*

Procedure If you do not want to change anything, jump to page 2 with **<TERMIN>**. Otherwise enter codes and accept with **<Enter>**. Use the ∨ and ∧ keys to move between boxes. Terminate with **<TERMIN>**.

2nd dialog window for measuring probe head (not applicable if **Path mode = measurement according to nominals**)



2nd dialog window for trigger probe head (also for measuring probe head if **Path mode = measurement according to nominals**)



Softkeys

REPEAT Resets all window contents to the status they had prior to the call of the dialog window (cancels entries made since call).

TERMIN The status set becomes the current mode, change-over to **SCANNING MODE** menu (➤*„Listing the scanning modes <MOD TOT>“ on page 19-9*). From there final storage with **<STORE x>** or **<TERMIN>**.

Data boxes

Scanning speed ➤*„Scanning speed“ on page 19-28*

Dist. btw. interm. positions ➤*„Intermediate position during scanning“ on page 19-28*

Point density ➤*„Point density“ on page 19-30*

Reclamping ➤*„Reclamping“ on page 19-33*

Target code ➤*„Target code/target window“ on page 19-35*

Targ.window ➤*„Target code/target window“ on page 19-35*

Procedure

The program highlights the box where an input is required.

– Boxes where values must be entered: Accept current data or type in new data, terminate with **<Enter>**.

– **<YES/NO>**-boxes: accept or reject with **<* YES>/<NO>**.

– Select individual boxes or browse step by step with the ∨ and ∧ cursor keys.

– Close dialog window with **<TERMIN>**, continue ➤***„Listing the scanning modes <MOD TOT>“ on page 19-9***

Explanation of the scanning parameters

Definition

The parameters explained in this chapter refer to **Scanning unknown contour, clamped**.

Mode of operation

Definition

The mode of operation or operating mode indicates who or what controls the coordinate measuring machine during scanning.

Possible operating modes

computer-guided

Controlled by the computer.

Cabinet control

Controlled by the CMM control, at present only for the path mode **Plane in WP system**.

Joystick free

Only with measuring probe head; The operator controls the probe manually with the joysticks. The measured element can be scanned independently of a workpiece plane, i.e. free in space.

Joystick WP Plane

Only with measuring probe head; the operator controls the probe manually with the joysticks. Scanning takes place here in a predefined section plane which lies parallel to the workpiece plane. The measuring machine is controlled so that the measured points lie in the section plane. You control the scanning speed by altering the deflection of the joysticks.

Path modes

Definition

Measuring probe head

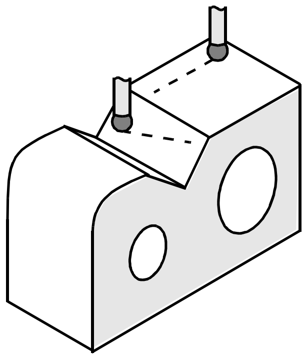
The measuring probe head travels along the scanning path with the probe in contact. Its control behavior corresponds to the selected path (path mode).

Trigger probe head

The trigger probe head must back away prior to each data transfer (probing). The scanning path is thus comprised of a series of probings with two intermediate positions set in-between in each case. These positions are generated by the program according to the required path mode.

Possible path modes:

Path mode 2



Line in WP system

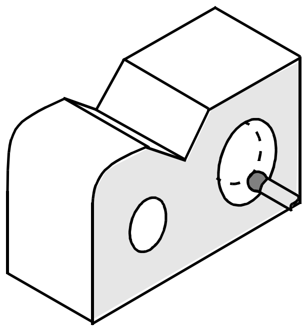
All lines located within the workpiece coordinate system can be scanned, regardless of the direction.

Application: Fast scanning of lines

Control response of the measuring probe head:

– The first axis is probed.
– The second axis is traversed at constant speed.
– The third axis controls the path accuracy
– Reclamping: **default** = no reclamping.

Path mode 3



Plane in WP system

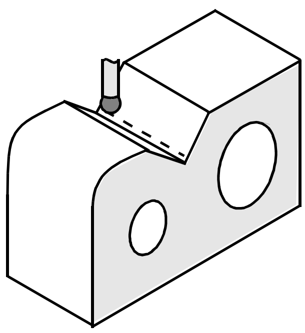
During scanning in workpiece planes, a geometric element is measured whose axis is almost vertical to a plane of the workpiece coordinate system (e.g. circle).

Application: Scanning of geometric elements in a defined intersection plane.

Control response of the measuring probe head:

– The first axis is probed.
– The second axis controls the speed.
– The third axis controls the position of the probe in reference to the section plane
– Reclamping: **default** = automatic reclamping.

Path mode 4



self centering

Scanning with self-centering probing, only with measuring probe head.

Application: Scanning of grooves, edges etc.

Control response of measuring probe head:

– First axis and second axis are probed.
– Third axis travels at a constant speed
– Reclamping: ➤ ***„Self-centering path mode“ on page 19-56***

Path mode 9

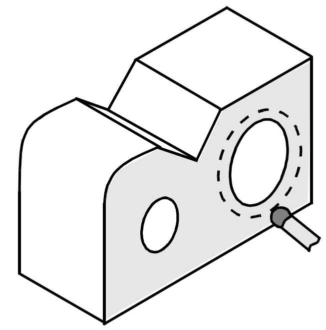
Cylinder surface

Application: Primarily gear measurement, only for experienced users.

Control response of measuring probe head:

– The first axis is probed
– The second axis is traversed at a constant speed in the axial direction
– The third axis controls the distance of the probe relative to the workpiece plane.
– Reclamping: No reclamping

Path mode 12



Circ. path

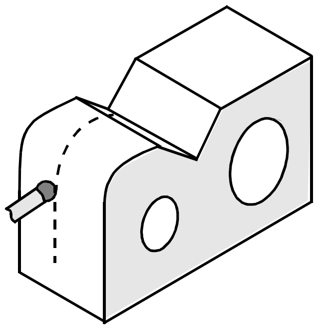
Scanning on circular path (surfaces!).

Application: Scanning of flange surfaces, plane surfaces etc.

Control response of measuring probe head

– The first axis is probed.
– The second axis is traversed at constant speed.
– The third axis controls the path accuracy.
– Reclamping: No reclamping.

Path mode 21 / 22



Scanning according to nominals/ measurement according to nominals

Scanning according to KUM nominals (target values) with known normal direction. The measuring probe head travels with the probe in contact from nominal (target) point to nominal point. The trigger probe head backs away between the nominals.

Application: Scanning any curves with known normal direction in KUM; not for UMESS.

Control response of the measuring probe head:

– As for scanning in workpiece plane.
– Reclamping: By **default**: Reclamping takes place at the nominal point if the nominal direction does not match the probing direction; no reclamping between nominal points. With **automatic** the measuring probe head reclamps as usual.

Measurement according to KUM nominals with known normal direction. The measuring probe head also probes between the nominals. For the trigger probe head this method is identical to **Scanning according to nominals.**

Application: If problems arise with the measuring probe head when **Scanning according to nominals**, e.g. due to a collision during travel with the probe in contact; not for UMESS.

Path mode 98 **controlled laser scanning**

Path mode 99 **rapid laser scanning**

Concerns LTP laser triangular probe, cf. applicable DSE operating instructions.

Scanning speed

Application

This input is possible only with the measuring probe head in the **computer-guided** mode.

Minimum speed: 0.01mm/s.

Maximum speed: See screen display. You can not change this value.

The **Permissible speed** input box accepts any value within these limits.

NOTE

- The speed should be selected depending on the surface and curvature of the workpiece. Too high a speed can overload the control of the measuring probe head and thus cause poor travel response.
- If a lower speed value is displayed after the dialog window is called again, the value originally entered did not match the **Step width**. The program performs this correction automatically.

Intermediate position during scanning

Application

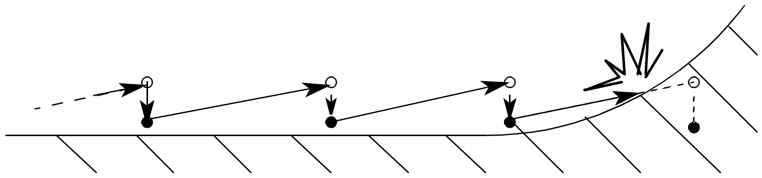
These parameters concern the trigger probe head in general and the measuring probe head only with **Path mode = measurement according to nominals**. If control data for the trigger probe head is used on CMMs with a measuring probe head, please refer to the information on the control data line **SCA BADIST** in ➤***„Learn programming“ on page 19-70***.

Dist. btw. interm. positions before probing

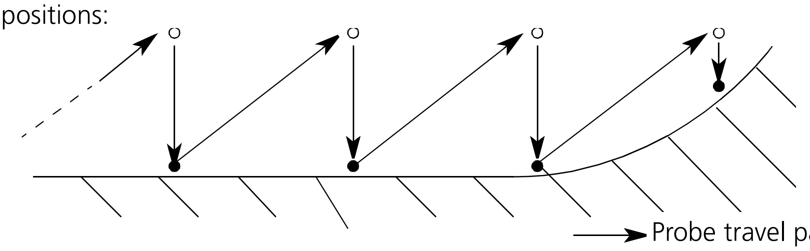
Input of a distance > 0. The program calculates the intermediate position from the input value, the generated probing point and the probing vector.

Important:
When scanning with a large step width, you should choose a distance from the intermediate position of equal size to prevent collisions, cf. sketch sketch.

A small distance between intermediate positions and large step widths will lead to a collision if the surface curvature suddenly changes:



Avoid collisions by selecting a larger distance between the intermediate positions:



→ Probe travel path

○ Intermediate pos.

● Probing

Dist. btw. interm. positions before probing

automatic

- Trigger probe head: Automatically travels to an intermediate position whose distance is displayed on the screen after each probing. If this backaway or retract distance is not sufficient (e.g. when probing soft parts), switch over to **manual** and enter the required value. It is not possible to omit the backaway distance when measuring with a trigger probe head.
- Measuring probe head: After probing travels directly to the next **interm. position before probing**. If an intermediate position is required after probing, switch over to **manual**.

manual

Selection of a backaway path to meet your requirements. Enter a value > 0 when using a trigger probe head and ≥ 0 (= 0 corresponding to **automatic**) for a measuring probe head.

Coarse pos.

Fast positioning without special demands for positioning accuracy (measuring time optimization).

Fine pos.

Exact travel to positions with a higher time requirement. Application for problematical workpieces/areas.

Point density

Measuring probe head

The measuring machine with measuring probe head continually accepts points and the corresponding X, Y, Z coordinates.

Trigger probe head

A measuring machine with a trigger probe head generates the scanning path from probings and intermediate positions. The input value **Step width** determines the distance between the probings (which must be input at the start of the scanning run). If the trigger probe head can not find the generated probing, it will search for the 50% reduced **Step width** beginning with the last intermediate position. If this function fails, it will be repeated max. 9 times and the step width will be reduced another 50% each time.

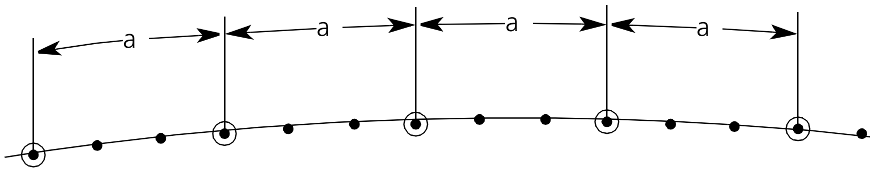
If a collision occurs before the generated probing, the repetition with a 50% reduced **Step width** described above will be performed only once. If the probe then continues to collide, the probing direction and travel direction will be exchanged.

For both types of probe head: The parameter **Point density** decides when a probed point will be stored as a measured value.

The following options are available:

constant

The distance between two stored points is always the same:



- Continuously probed points with measuring probe head (CMM cycle); trigger probe head does not probe here.

⦿ Measuring probe head: points stored as measured values at a constant distance a = **Step width**.

Trigger probe head: generated and stored probings at a constant distance a = **Step width**.

NOTE

Enter **Step width** at the start of the scanning run.

Curvature dependent

The distance between two stored measured points varies depending on the path curvature. At least 3 points must be stored:

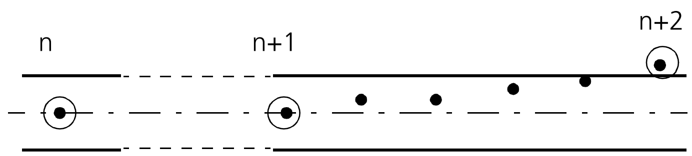
– 1st point: start point;
– 2nd point very near the start point (selected according to program-internal criteria to determine the start position of the tolerance cylinder described below);
– Last point: target point.

Curvature tolerance +/-

A tolerance cylinder decides whether more points will be stored between the 2nd point and the target point. You define its radius with **Curvature tolerance**. The program always places its axis through the two points stored last (n and n+1). The next point stored must fulfill one of the following conditions:

1st possibility

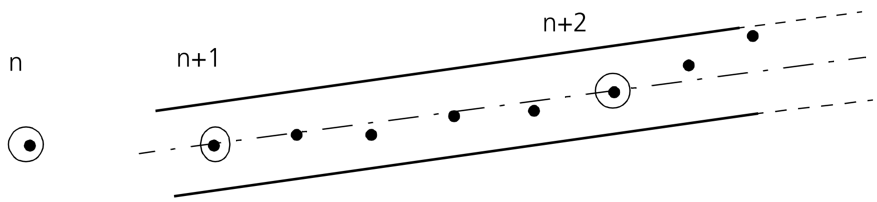
The point must lie outside the tolerance cylinder:



• Continuously probed points; measuring probe head: CMM cycle; trigger probe head: probings generated in distance **Step width**.

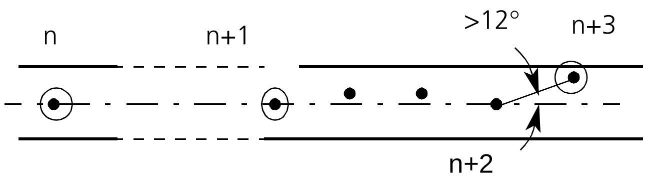
Points stored as a measured value n.

In this case point n+2 is stored. At the same time the tolerance cylinder turns so that the cylinder axis again runs through the last two points stored:



2nd possibility

The angle difference between two points within the tolerance cylinder must be: > 12° (angle criteria)



- Continually probed points; measuring probe head: CMM cycle; trigger probe head: probings generated in distance **Step width**.

⊙ Points stores as measured value n.

In this case point n + 3 is stored. The tolerance cylinder then turns here as well.

The angle criterion ensures that sharp turns in the measured curve (kinks) are measured with a sufficient number of points.

NOTE

The **Step width** must be input at the start of the scanning run.

Define the radius of the tolerance cylinder under **Curvature tolerance**. This value influences the number of points measured per path segment and therefore the accuracy of the measurement.

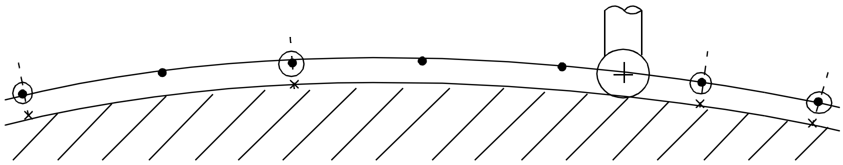
Please note

– Points can also be probed with **Step width** within the tolerance cylinder. In this case, select both **constant** and **Curvature dependent** at the same time.

– Even with very large values for **Curvature tolerance,** the measured result can not be "coarsened" in any way. Due to the angle criterion, the same points are always stored even with large tolerances.

at nom point

This point transfer mode concerns **Path mode = Scanning according to nominals** or **measurement according to nominals** in KUM. The measured point is stored at the nominal point. Nominal point input: See KUM operating instructions. As in KUM the probe center points are stored.



× Nominal points

- Continually recorded points;

  Measuring probe head with **Path mode = Scanning according to nominals**: CMM cycle, travelling with probe in contact.

  Trigger probe head and measuring probe head with **Path mode = measurement according to nominals** do not probe here.

⊙ Measuring probe head with **Path mode = Scanning according to nominals**: points stored as measured value.

Trigger probe head and measuring probe head with **Path mode = measurement according to nominals** probe here and store the measuring value.

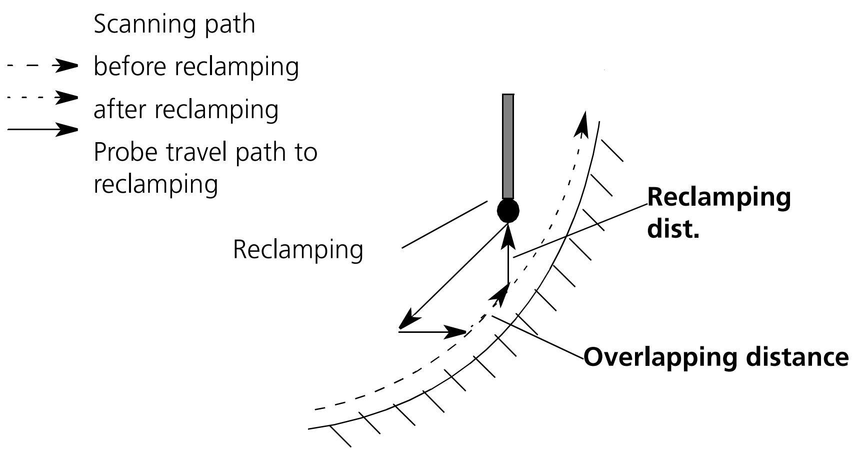
Reclamping

Restriction

Relevant only for the measuring probe head in the **clamped mode**; if you are using control data from the measuring probe head on machines equipped with a trigger probe head, please follow the instructions in ➤***„Learn programming“ on page 19-70***.

Application

When scanning curved contours, the measuring probe head must back away and reclamp once the angle between the probing direction and the workpiece surface has reached a limit value. This limit value equals **roughly** 45°, can, however, also be greater or smaller, depending on the prevailing conditions.



The following parameters influence the reclamping procedure:

Reclamping = default

Reclamping takes place if the **Path mode =**

- **Plane in WP system**,
- **Scanning according to nominals** (at the nominal point, ➤ ***„Path modes“ on page 19-25***),
- **Cylinder surface**

and is omitted in all other cases.

Reclamping = automatic

Regardless of the path mode set, reclamping occurs automatically if the limit value between the probing direction and the workpiece surface is reached.

Reclamping = suppress

Reclamping is always omitted in this setting.

Values to be set

Reclamping dist.

Distance between the workpiece and the position of the probe during the reclamping procedure. The space available in or on the workpiece can thus be taken into account.

Overlapping distance

Defines the path to be scanned again after the reclamping procedure (without point acceptance). Advantage: Improved travel response.

Target code/target window

Application

These parameters specify how the program will be able to recognize the target point.

default

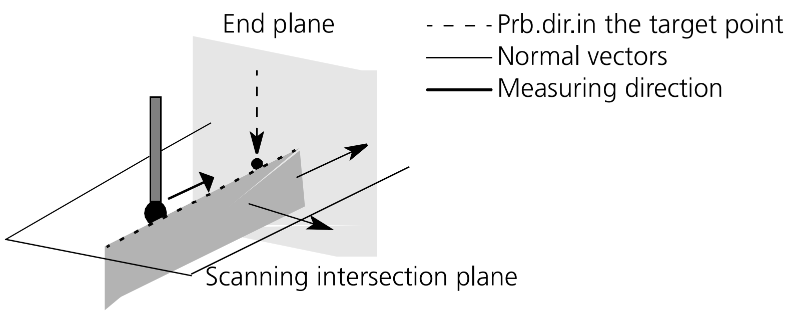
For **Scanning according to nominals** the parameter **Plane** automatically applies. Otherwise the **Window** with default values applies. See this location for explanation.

Plane

Plane is recommended for scanning paths which are not curved (this saves measuring time, since the speed reduction is thus omitted).

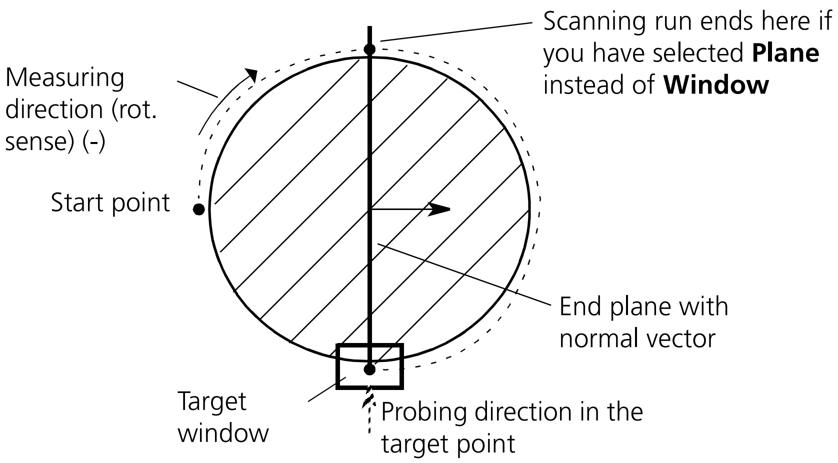
The program calculates an end plane which runs through the target point. The scanning run stops if the probe penetrates the end plane ***in its normal direction***, see also sketch with **Window**.

Calculation according to the "three-finger rule": Normal vector of end plane = cross product of the probing vector in the target point and the normal vector of the scanning intersection plane, multiplied by +1 or -1, depending on the measuring direction (rotational sense) (which must be entered at the start of a scanning run, ➤***„Explanation of the scanning measuring run“ on page 19-39***)



Window

When the probe moves into the target window the speed decreases (speed reduction). The end plane is calculated in the target window (as for **Plane**). The run is stopped when this plane has been penetrated:



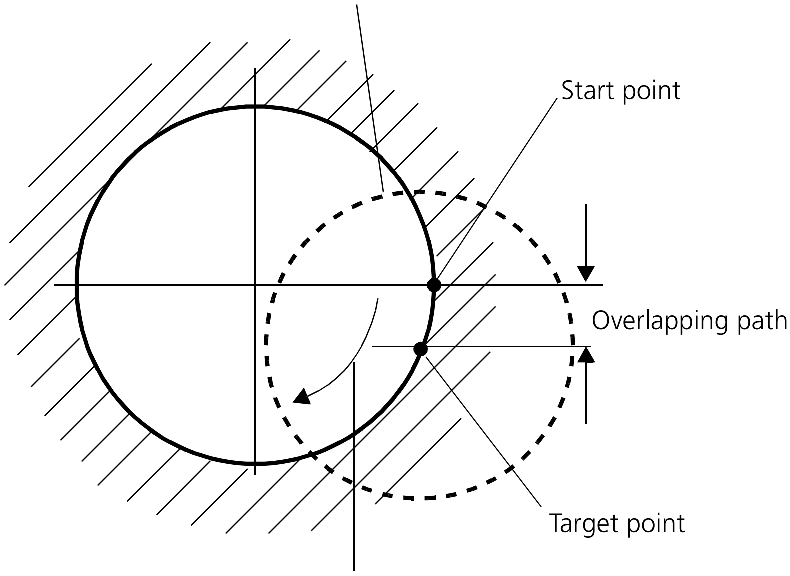
If **Window = *** its size can be defined in the **Trav dir** and **Prb. direction** input boxes. These boxes are preassigned with default values. The **Trav dir** box remains blank in the manual mode.

Plane, Sphere, Cylinder

Space surrounding the target point. Special cases which should be selected depending on the application.

Diameter

The diameter of the target sphere or target cylinder must be greater than the overlapping path, but smaller than the diameter of the contour to be scanned. The probe must exit the diameter once during scanning.



Axis

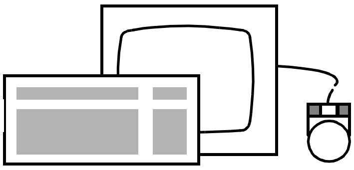
(Workpiece) axis of target cylinder (in X, Y or Z).

Overlapping mode <DI 1176>

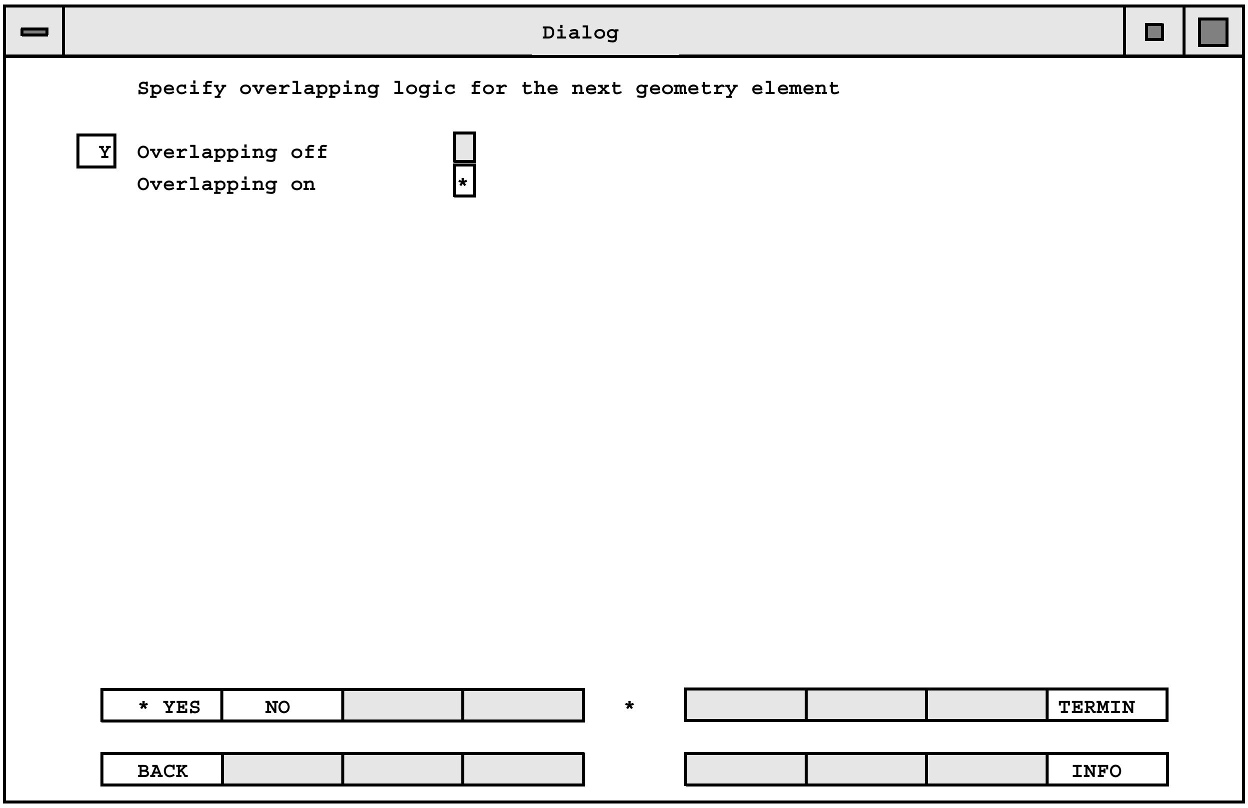
Application

It is normally advisable to scan a travel angle of 450° for a closed contour (e.g. a full circle) to eliminate the starting and braking reaction by overlapping the full circle 90 degrees. However, this may be undesirable for several special applications (e.g. measuring a spiral).

With **<DI 1176>** the overlapping logic can be deactivated for the next element.



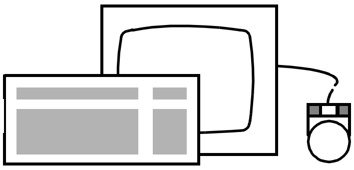
DI	Pull-Down-Menu	Pictogram
1176		



Explanation of the scanning measuring run

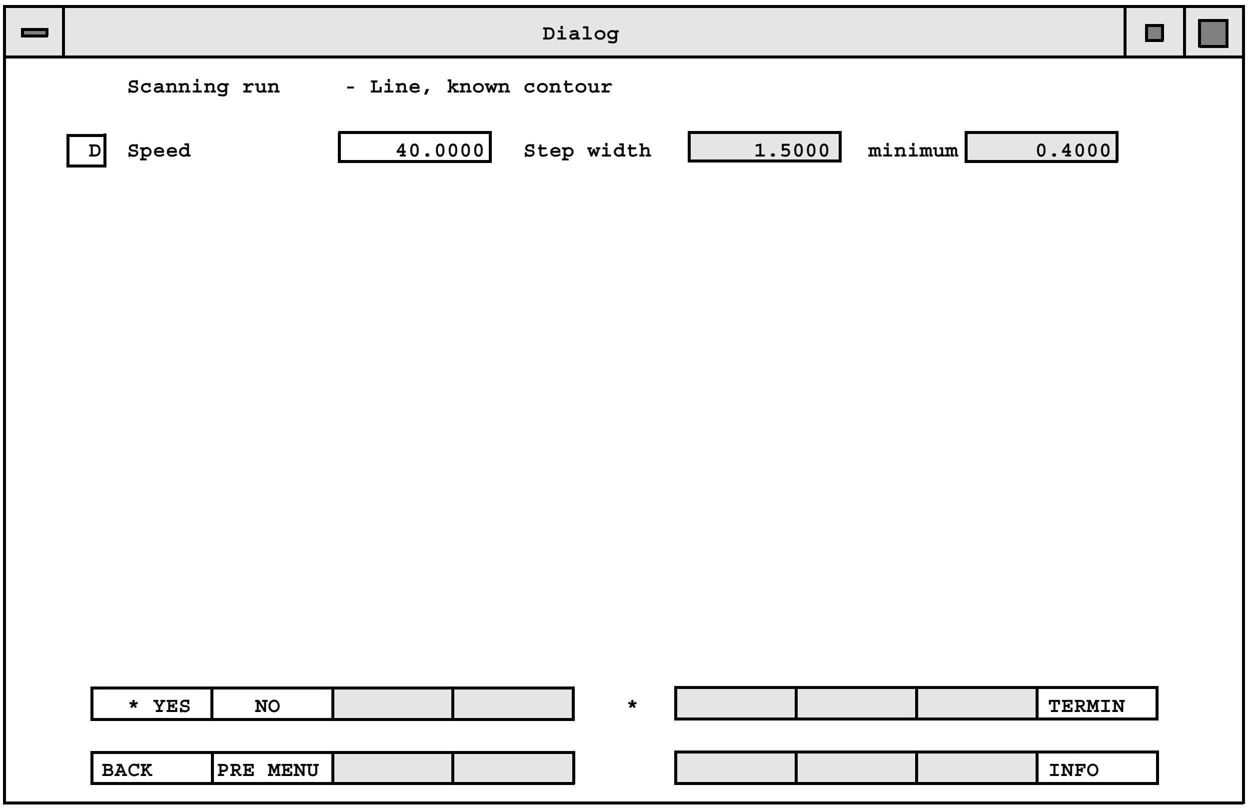
Scanning a known contour

Function call

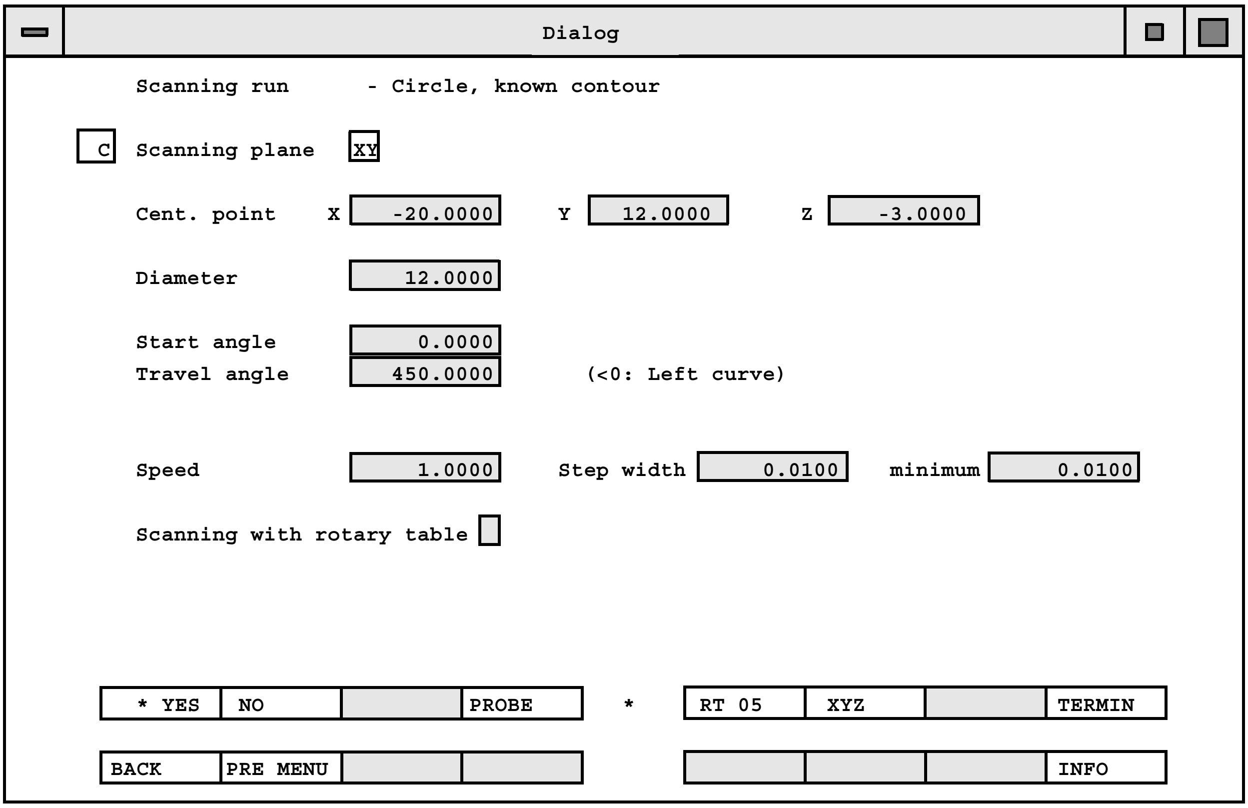


DI	Pull-Down-Menu	Pictogram
	within a geometric element Measure/Eval... Scanning run	

Dialog window for calling from the **<LINE>** element after the start and target point inquiries.



Dialog window for calling from the **<CIRCLE>** element



NOTE

– Following a call within **<CYLINDER>**, **<SPHERE>** or **<TORUS>** a message will appear beforehand prompting you to probe 3 points vertical to the axis (➤***„Scanning cylinder, cone, torus“ on page 19-59***).

– The interrelationship between the scanning speed, the radius of the scanned contour and the accuracy is described in the chapter ➤***„Semiautomatic probe calibration with <DI 15228> (tensor calibration)“ on page 7-19***.

Softkeys

PROBE

After activation, the start point, the target point and - with a large interval - the direction point (for the travel direction) must be probed. Based on this information, the computer then determines the preassignment of the dialog window, which can then be adapted manually.

RT 05

Switch to scanning with the rotary table.

XYZ

Switch to scanning with machine axes.

TERMIN

When the dialog window is terminated, the prompt **Travel to start point!** will be displayed. You can then start the measurement by pressing **<TERMIN>** again.

Data boxes

Speed

With unknown contour, max. 8 mm/s, with known contour max 40 mm/s.

Step width

First value = preset nominal value,

second value = smallest possible step width (depending on the speed).

Scanning plane

Input of measuring plane.

Cent. point

Circle center point for a known contour. Data in workpiece coordinates.

Diameter

Nominal diameter, diameter of circular path.

Start angle

Explanation ➤ ***„Circular path mode“ on page 19-52***

Travel angle

Input of the scanning range in degrees. The measuring direction depends on the +/- sign of the travel angle. A default value of 450° is recommended for full circles. This overlapping of 90° is used to eliminate the starting and braking reaction.

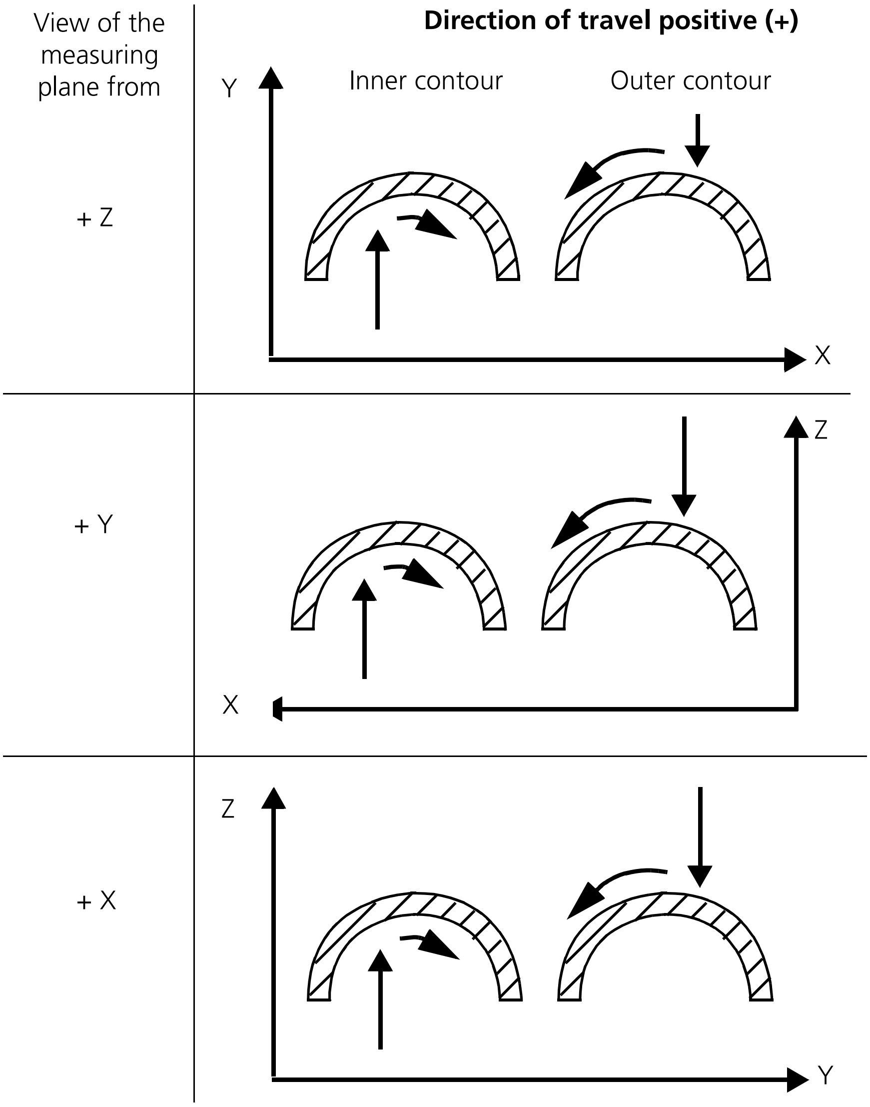
Rot. sense

When scanning unknown contours, the rotational sense results when viewing the measuring plane from the positive direction of the 3rd axis. See the explanation on the next page.

Scanning with rotary table

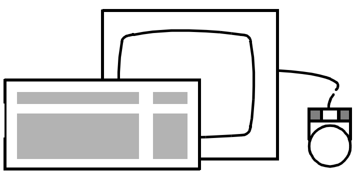
The measuring machine probes the workpiece in the start position. The the rotary table travels the set step size.

Explanation of "rot.sense" (direction of travel)



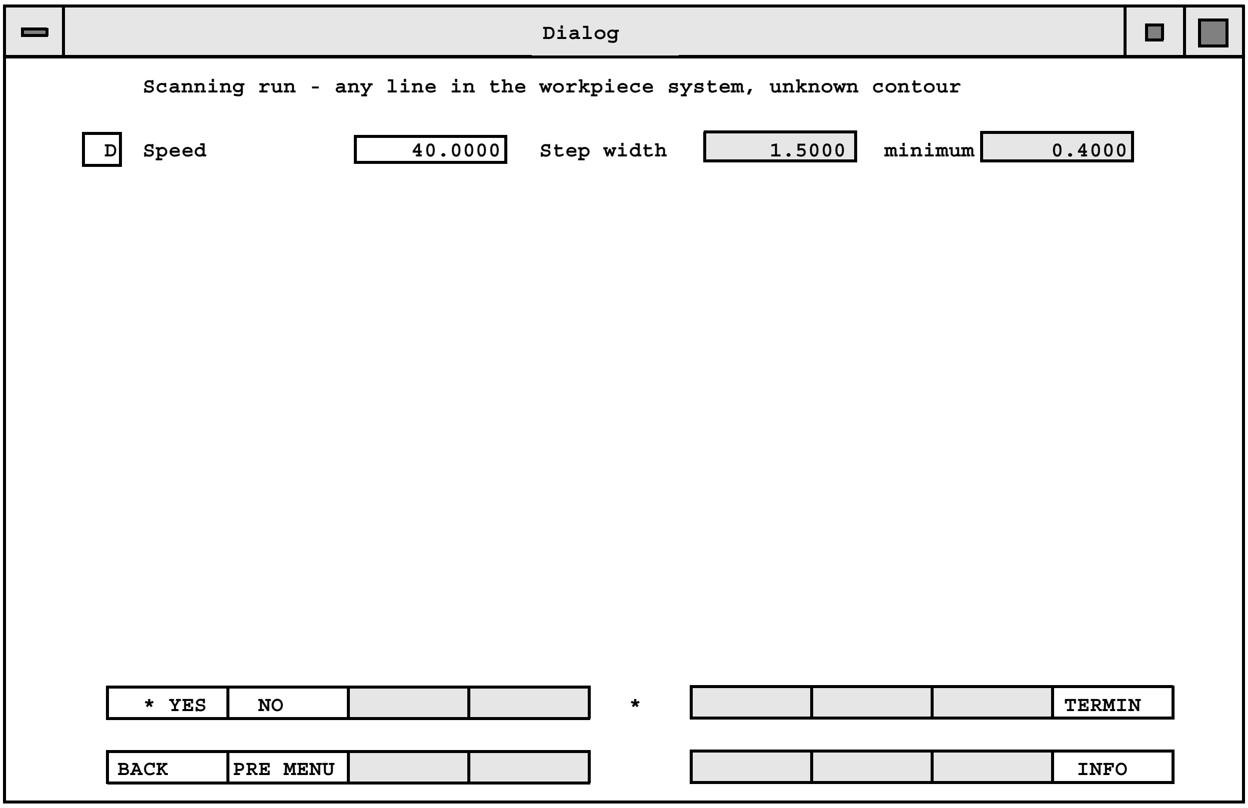
Scanning unknown contours

Funktionsaufruf



DI	Pull-Down-Menu	Pictogram
	Within a geometric element Measure/Eval...	
	Scanning run	

Dialog window for a defined mode **any intersection plane** after the inquiry for start and target point.



Data boxes

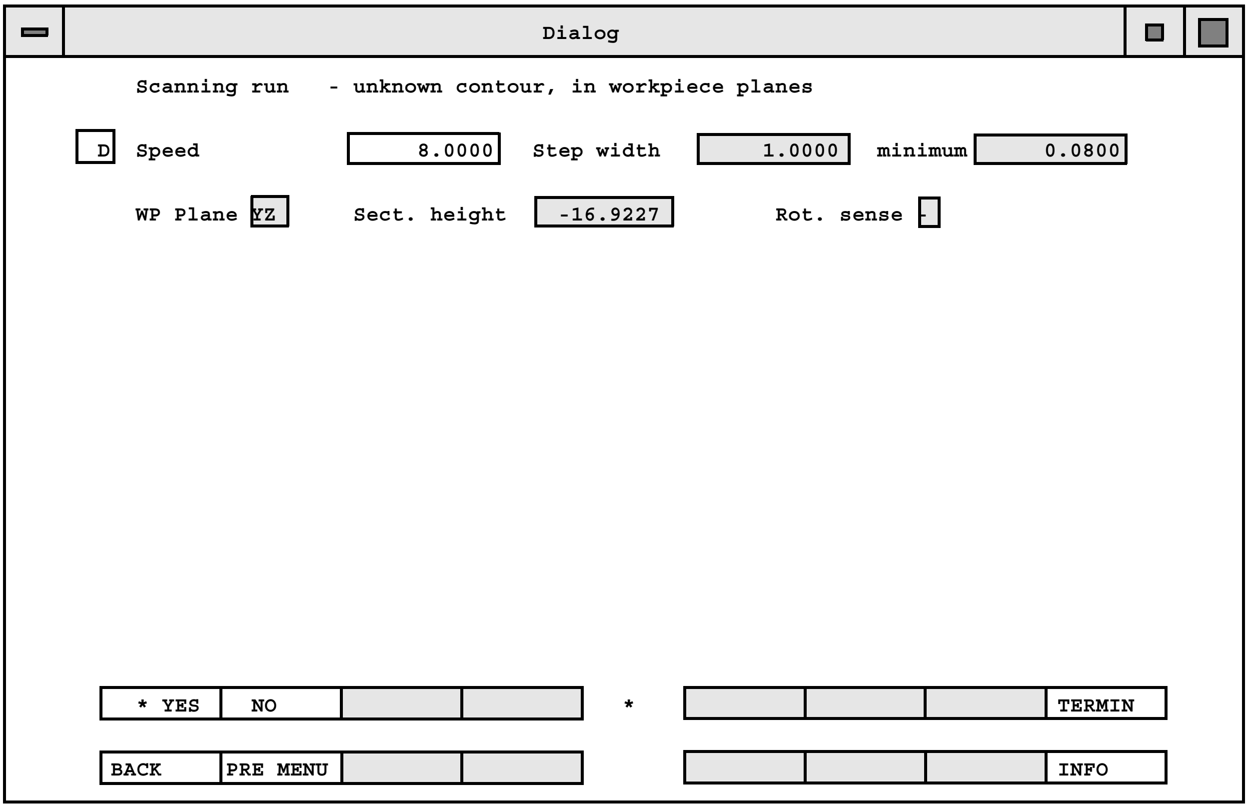
Speed With unknown contour max. 8 mm/s.

Step width / minimum First value = preset nominal value,

second value = smallest possible step width (depending on the speed).

Dialog window

for a defined mode **Intersection plane in WP** after the inquiry for start and target point.



Data boxes

WP Plane

Specification of the workpiece plane in which scanning is to be executed.

Sect. height

Height of the scanning path above the zero point of the workpiece coordinate system.

Rot. sense

When scanning unknown contours, the rotational sense or direction of travel results vwhen viewing the measuring plane from the positive direction of the 3rd axis. Explanation ➤ ***„Scanning unknown contours“ on page 19-42***.

Scanning unknown contours, clamped

Path mode in WP system or workpiece plane

Definition

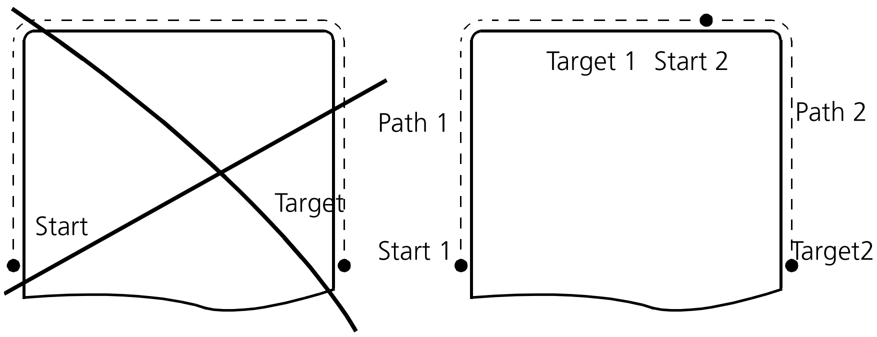
The dialog described here applies to the following parameter settings:

- Operating mode: **computer-guided**;
- Path mode: **Line in WP system** or **Plane in WP system**.

NOTE

If **Path mode = Line in WP system** the following prompt may appear at the end of the dialog: **Please enter start point with new probing direction !**

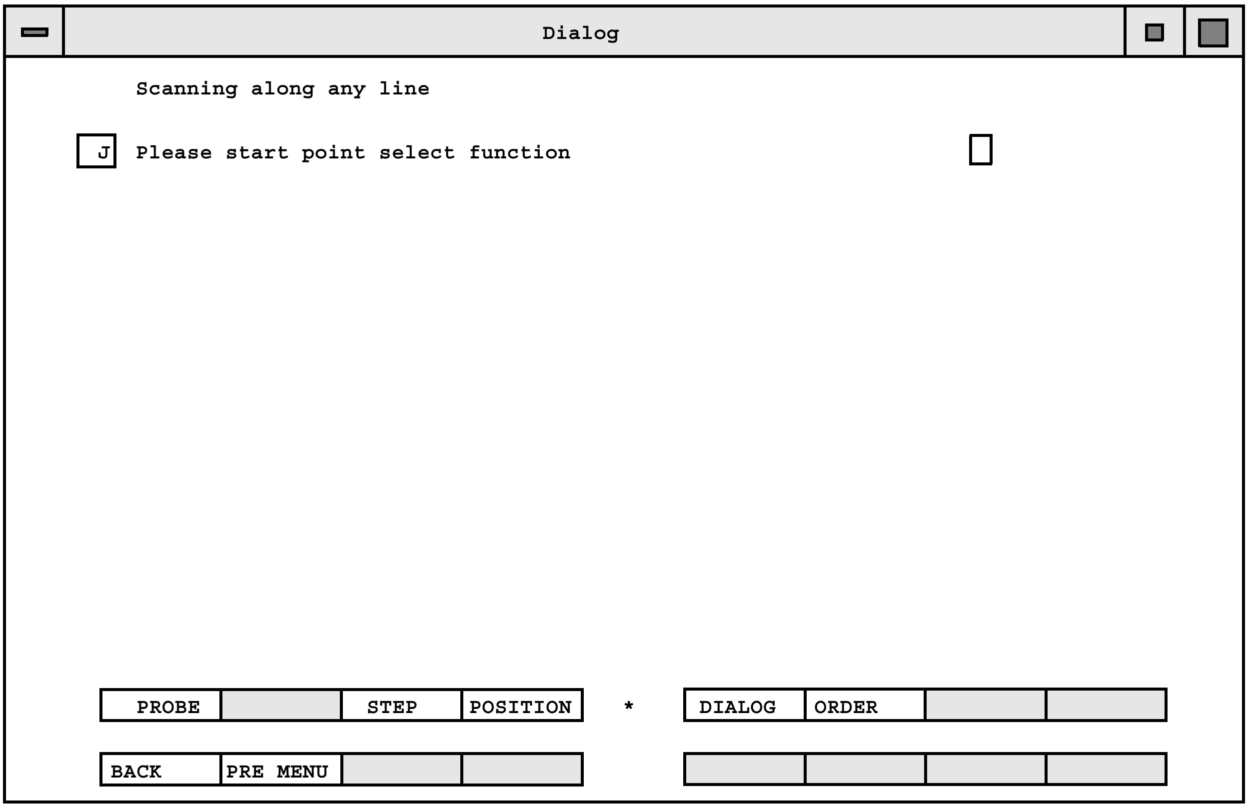
Prerequisite for this prompt: Scanning over edges under unfavorable conditions (the start and target points are probed in the main direction of travel). Probe start point with another probing direction (if possible), otherwise divide the scanning path:



Function call

➤ ***„Branching of dialog windows“ on page 19-10***

Please probe start point/ target point or select function



Softkeys

PROBE

Accepts the current position, if still being probed (only with measuring probe head).

STEP

Travel pf the probe from the current position with or without search run (➤***„Travel from the current position in fixed steps <DI 1515>“ on page 10-41***). If no probing takes place, the request for probing or function selection will be repeated.

POSITION

Fine positioning with or without search run (➤***„Positioning to workpiece coordinates <DI 1511>“ on page 10-37***). If no probing takes place, the request for probing or function selection will be repeated.

DIALOG

Used to enter start/target point as coordinates instead of probing (➤***„Entering a start/target point via dialog“ on page 19-59***).

ORDER

Reverses the sequence of the start and target point input or continues the following run at the target point of the previous run. Remains activated only until the first point has been determined.

Possibilities:

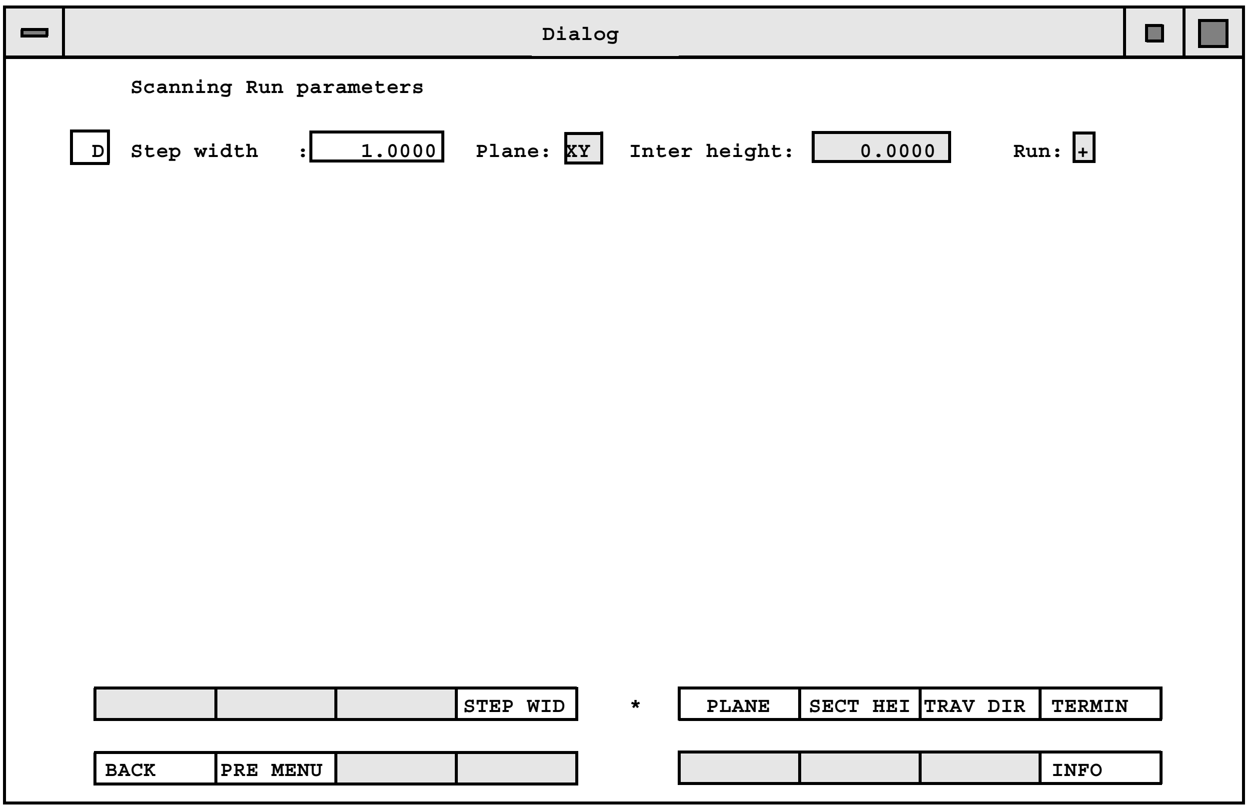
- Press the key once: The order of the points will be reversed and the following message will be displayed:
  Please probe target point or select function.
- Press the key twice: The target point of the previous scanning run will be assigned as the starting point for the next one; the display will read:
  Start point = last target point -> Please probe target point.
- If you press the key three times, the following message will appear again:
  Please probe start point or select function.

The key will be disabled as soon as the first point has been defined.

Prbg. direction

An inquiry will appear only if you selected the **Cartesian coord** option after **<DIALOG>** (➤***„Entering a start/target point via dialog“ on page 19-59***). Select the probing direction via softkey or by typing it in.

Scanning Run parameters



If **Path mode = Line in WP system**, only **Step width** is of interest. The softkey assignment is therefore reduced correspondingly.

The displayed values are currently valid. If they must be changed, press the corresponding softkey and enter the data.

Data boxes

Step width

Measuring probe head: Distance between two points accepted as measured values (➤***„Point density“ on page 19-30***). This input is not evaluated for **Curvature dependent**.

Trigger probe head: Distance between two generated probings (➤***„Point density“ on page 19-30***).

Plane

Workpiece plane where scanning takes place.

Important: Enter plane correctly; otherwise the scanning run will fail.

Inter height

Height of the scanning path above the zero point of the workpiece coordinate system. Pressing the **<SECT HEI>** softkey enters the distance between the zero plane and the target point. Editing is possible. When changing the section height, please note that the starting and target point will be projected into the plane.

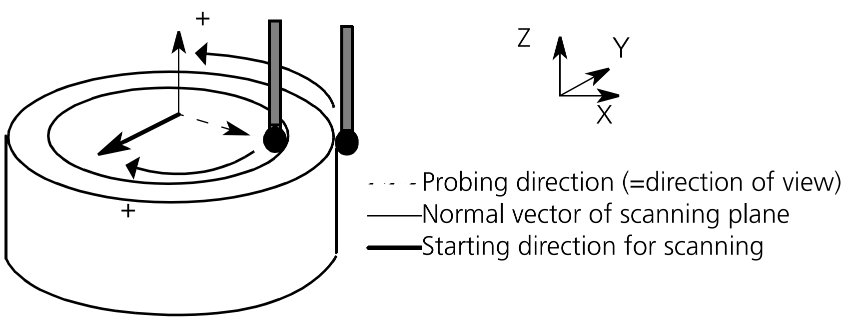
Using this softkey, it is much easier to enter data when scanning multiple parallel sections.

Run

Define the travel direction (rotational sense) of the probe. Definition for positive rotational sense:

When you are looking in the probing direction with your eyes parallel to the normal plane, the probe will start in a clockwise direction (mathematically: starting direction = cross product from probing vector and normal vector).

Example



The travel direction is therefore different for the outer and inner contour.

Input options:

Blank	Determines measuring direction by probing.
+	Positive measuring direction as defined above.
-	negative measuring direction, probe starts to the left

NOTE

IIt is usually a good idea to enter a blank and then probe to save theoretical considerations. The program will then calculate the applicable plus/minus sign based on this input. If parallel sections then follow, the dialog will offer this +/- sign again as the default value. In this case, accept the default value offered.

Scanning in workpiece coordinates
Please probe direction point or select function

Prompt for a direction point appears if **Path mode = Plane in WP system** and a blank has been entered for **Run**. probe or enter the point in the approach direction near the **Start point** (probing direction same as for **Start point**).

Travel to start point!

Position the probe in front of the starting point. **<TERMIN>** starts the scanning run.

Scanning point ...

During scanning the screen shows the number of points stored.

Joystick mode of operation

Definition

The dialog described here applies to **Joystick (free)** or **Joystick (WP plane)**, i.e. manual scanning with a measuring probe head.

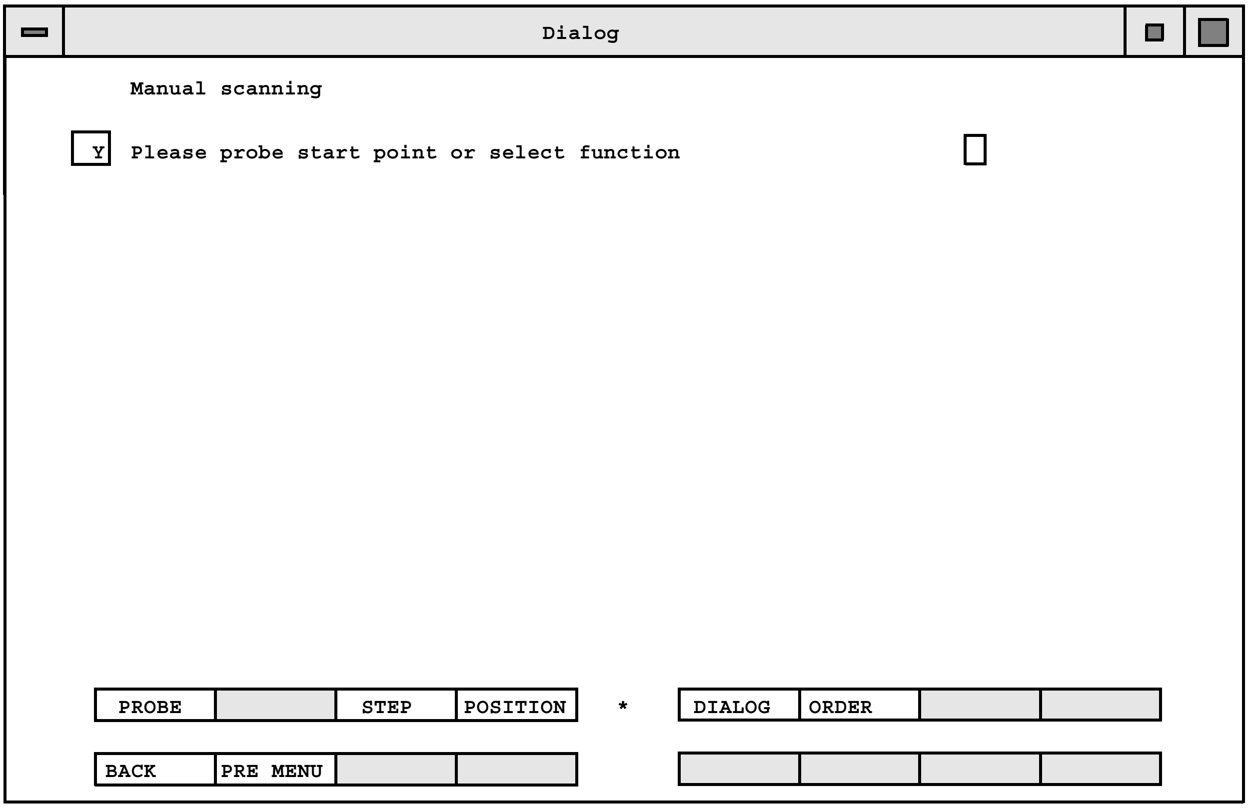
Please note:

No control data can be produced with manual scanning.

Function call

➤*„Branching of dialog windows“ on page 19-10*

Please probe start point /target point or select function



Softkeys

PROBE Accepts the current position if the measuring probe head is still in contact.

STEP Probe travel from current position with or without search run (➤ ***„Travel from the current position in fixed steps <DI 1515>“ on page 10-41***).If no probing takes place, the request for probing or for function selection will be repeated.

POSITION Fine positioning with or without search run (➤ ***„Positioning to workpiece coordinates <DI 1511>“ on page 10-37***). If no probing takes place, the request for probing or for function selection is repeated.

DIALOG Used to enter start point as coordinates instead of by probing (➤ ***„Entering a start/target point via dialog“ on page 19-59***).

ORDER Not activated.

Prbg. direction

The inquiry will appear only if you selected the **Cartesian coordinates** option after **<DIALOG>** (➤***„Entering a start/target point via dialog“ on page 19-59***). Select probing direction via softkey or by typing it in.

Scanning Run parameters

For explanations see ➤***„Path mode in WP system or workpiece plane“ on page 19-44***

Manual scanning Please probe direction point or select function

Prompt for a direction point will appear if **Path mode = Joystick WP system** and a blank was entered for **Run**. Probe or enter the point in the approach direction near the **Start point** (probing direction as for **Start point**).

Scanning point ...

The measuring machine automatically travels to starting point. Manual scanning can then begin. During scanning, the number of points already stored are displayed on the screen. At the same time, the following softkey assignment also appears:

Before pressing any of these softkeys, always back the probe away first and then wait for the **Please select function** prompt (manual scanning then stops). These softkeys are not active as long as the probe is in contact.

Softkeys

STEP WID

Change of the distance between two stored points (➤***„Point density“ on page 19-30***). The current value is offered. The measuring machine then starts probing automatically.

SC_RANGE

Application only for experienced users to change the range of scanning deflection (input in%). The greater the permissible deflection, the more inaccurate the measurement will become. If the permissible deflection is exceeded, an acoustic signal will prompt the operator to scan more slowly.

LAST PNT

Correction possibility, e.g. after a measurement error; back the probe away and probe again on the scanning path. New points will be accepted and old points deleted starting from this position.
This function can also be used for a probe change to check for overlapping.

POSITION

Used to cancel scanning and continue from a new point (e.g. because of a groove). If you inadvertently move the probe back and probe the scanning path again, the points already stored will not be lost (in contrast to **<LAST PNT>**). This will result in overlapping, i.e. a single section will be measured twice.

CANCEL

Cancels a scanning run and returns the program to the calling menu. Any points stored in the meantime will be deleted.

AUTO_CLA

Automatic reclamping (➤***„Reclamping“ on page 19-33***).

MAN_CLAM

Automatically suppresses reclamping (➤***„Reclamping“ on page 19-33***).

After pressing a softkey, continue manual scanning (except for after pressing **<TERMIN>** and **<CANCEL>**).

Circular path mode

Definition

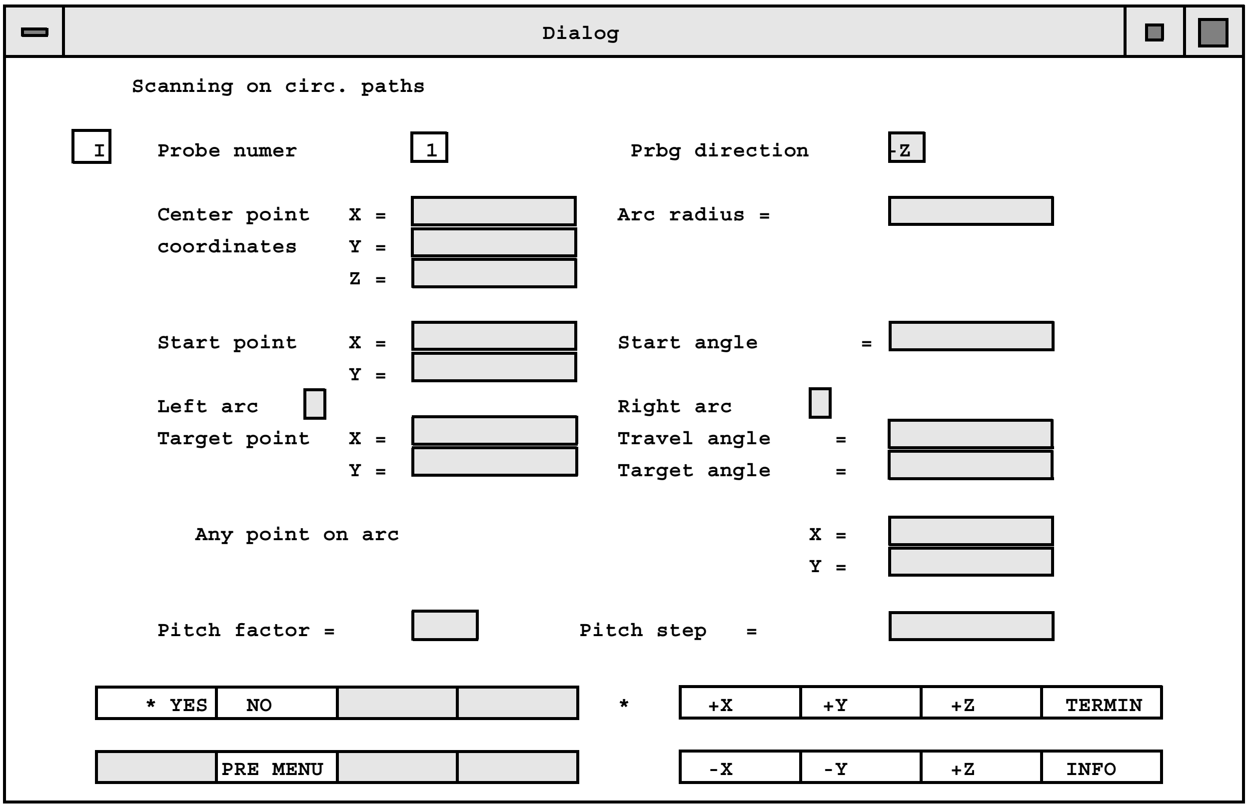
The dialog described here applies to the following parameter setting:

– **Operat.mode**: **computer-guided**;

– **Path mode**: **Circ. path**.

Function call

➤***„Branching of dialog windows“ on page 19-10***



Softkeys

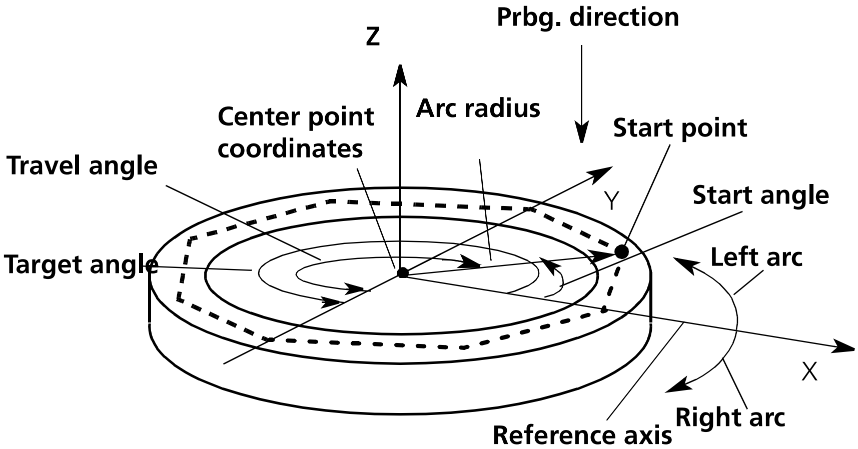
+X -X
+Y -Y
+Z -Z

Entry in **Prbg direction** input box.

TERMIN

Closes the dialog window and stores the values entered, see information under "Procedure".

Data boxes



Scanning path with
Pitch factor = 8
Start angle = 45
Travel angle = 225 or **Target angle = 270**

Probe number — Specify which probe should be used for scanning.

Prbg direction — Type in value or use softkeys; cf. sketch.

Center point coordinates — Position of the circular path in workpiece coordinates, cf. sketch.

Arc radius — Radius of the circle path center, cf. sketch. Input not necessary (blank with space key). In this case, the program will demand input of the coordinates of a point on the circular path in order to calculate the radius later on (see **Any point on arc**).

Start point — Starting point in workpiece coordinates, cf. sketch. An input is not necessary (blank with space key). In this case, the program will jump to **Start angle**.

Start angle

Make an entry in this box if **Start point X = blank.** The starting angle is incremented counterclockwise starting from the reference axis (with a positive sign, cf. sketch) and vice versa with a negative sign. If the **start angle = 0** the starting point lies on the reference axis.

Probing dir.	PCLN	Reference axis
+X, -X	1	+Y
+Y, -Y	2	+Z
+Z, -Z	3	+X

Left arc

– **<* YES>**
  The probe travels to the left in an arc from the starting point, cf. sketch.

– **<NO>**
  Jump to **Right arc**.

Right arc

– **<* YES>**
  The probe travels to the right in an arc from the starting point, cf. sketch.

– **<NO>**
  Jump to **Left arc**.

Target point

Target point in workpiece coordinates, cf. sketch. Input can be omitted (blank with space key). In this case, the program will jump to **Travel angle**.

Travel angle

Make an entry in this box if **Target point X = blank.** The **Travel angle** will be counted starting from the **Start angle** or the **Start point** counterclockwise (with a positive sign, cf. sketch) and clockwise with a negative sign.

Target angle

Make an entry in this box only if **Center point coordinates X = blank, Target point X = blank, Travel angle = blank.**

The **Target angle** will be counted from the reference axis counterclockwise (mathematically positive, cf. sketch) and vice versa with a negative sign.

Any point on arc

Make an entry in this box if **Arc radius = blank.** The program calculates the arc radius from the coordinates entered.

Pitch factor

The sketch shows that the scanning path is composed of short, straight lines (polygon). A large value for the **Pitch factor** causes an approximate circular path. No input is required (blank with space key). In this case, the program jumps to **Pitch step.**

Note for trigger probe head: Only the corner points of the polygon will be probed. You should therefore select a large pitch for a high point numbers. If necessary, the program will modify the value entered depending on the arc radius.

Pitch step

Make an entry in this box if **Pitch factor = blank** as an angle in deg/min/sec. The program will then calculate the corresponding pitch factor based on your entry.

Please observe notes on **Pitch factor**.

Procedure

The program highlights the box where the next input should be made.

– Entering values: Accept data already entered or press **<Delete>** and type in new data, confirm with **<Enter>**.

– **<YES/NO>** boxes: Accept or reject with **<* YES>/<NO>**.

– Select individual boxes or step through: with the ∨ and ∧ cursor keys.

After you close the dialog window with **<TERMIN>** the following dialog will appear:

Travel to start point !

Position probe in front of starting point. **<TERMIN>** starts the scanning run.

Scanning point ...

During scanning, the screen number of points already scanned are displayed on the screen.

e.g.: SURFACE
Please probe point or select function

At the same time the softkey menu for measuring geometric elements is displayed again (➤***„Probing possibilities“ on page 10-5***). Now you can e.g. scan another path with **<Scanning run>** or calculate an element or feature with **<TERMIN>** etc.

Scanning in the path mode and measuring according to nominal values

Definition

The dialog described here applies to the following parameter setting:

– **Op. mode**: **computer-guided;**

– **Path mode**:**Scanning according to nominals** or **Measurement according to nominals.**

Function call

See KUM Operating Instructions.

Data boxes

Scanning/measurement according to nominals Please probe start point/target point or select function

The same functions (softkeys) are available as when **Path mode = Line in WP system/Plane in WP system**, ➤***„Path mode in WP system or workpiece plane“ on page 19-44***.

Difference: With **<DIALOG>** you can use the points from a nominal data file (➤***„Entering a start/target point via dialog“ on page 19-59***).

Scanning/measurement according to nominals Prbg. direction =

An inquiry will appear only if you have checked the **Cartesian coordinates** option after **<DIALOG>** (➤***„Entering a start/target point via dialog“ on page 19-59***). Select the probing direction by softkey or by typing it in.

Scanning/measurement according to nominals Please travel to safety position !

Position probe in front of starting point. Press **<TERMIN>** to start the scanning run.

Scanning/measurement according to nominals Scanning Point ...

During scanning/measurement the number of points already stored is displayed on the screen.

CURVE POINT ... Please probe point or select function

For more details: See KUM Operating Instructions.

Cylinder surface path mode

Definition

The **Cylinder surface path mode** is primarily used to scan tooth flanks (gear measurement) etc. Only trained users should use this technique. For this reason, no description will be provided here.

Self-centering path mode

Definition

The dialog described here applies to self-centering scanning, i.e. to the following parameter settings:

– **Operat.mode**: **computer-guided;**

– **Path mode: self centering.**

Function call

➤***„Scanning in the unknown contour mode“ on page 19-19***

NOTE

<DI 1502>: Vectorial probing must be deactivated.

<DI 1551>: Must not be used for this function.

Data boxes

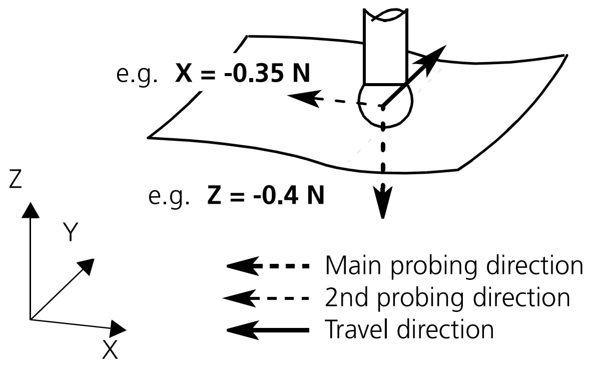
Please enter 2 meas. forces with correct sign X = N, Y = N, Z = N

The probing direction with the highest force is the main probing direction. If both forces are the same, the first probing direction will be assigned as the main one. Messages are displayed following incorrect inputs (excessive values, more than 2 measuring forces, etc.).

NOTE

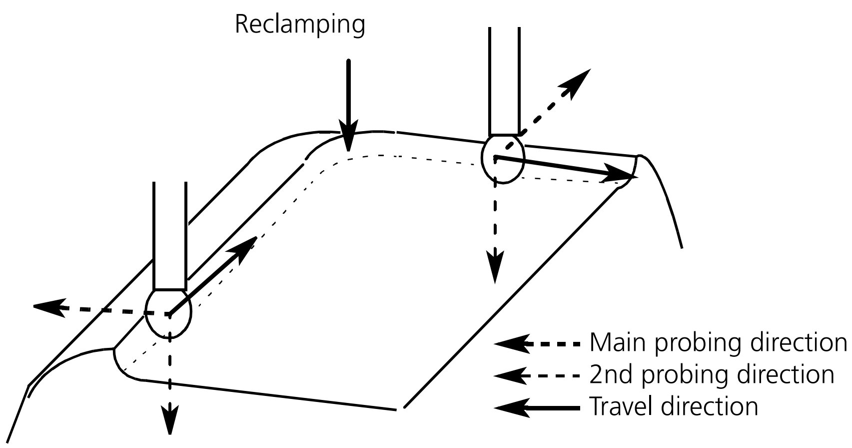
Correct selection of the main probing direction is important with poorly defined edges and/or when reclamping is necessary.

Example 1



If the main probing direction here is -X (or +Y), there is risk of drifting due to the poorly defined edge. The main probing direction should therefore be -Z.

Example 2

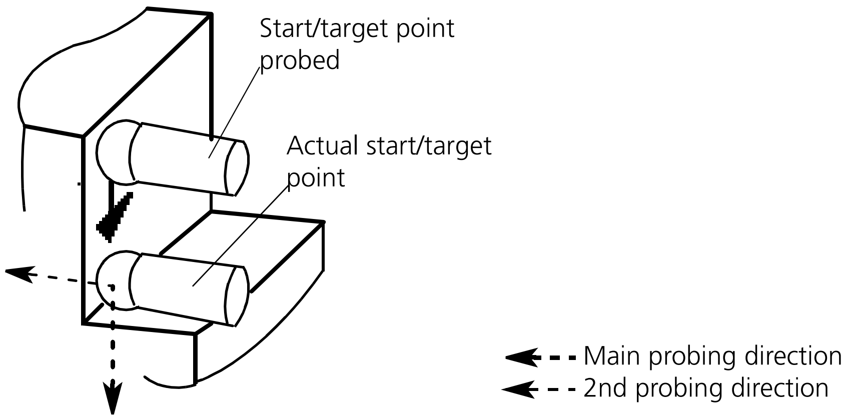


Reclamping exchanges the main probing direction and the travel direction. If the main probing direction is -Z, an exchange between X and Y would not be possible. For this reason, the main probing direction must be -X. If this is not possible (e.g. due to a poorly defined edge) you must scan this path in two sections without raclamping.

This means that a complete circle which is to be measured with self-centering probing should be divided into 4 sections.

Scanning with two measuring forces Please probe start point/target point or select function

As for **Path mode = Plane in WP system, ➤*„Path mode in WP system or workpiece plane" on page 19-44***. If you probe in only one of the directions selected above, the probe automatically travels in the other direction until it reaches an edge.



Scanning with two measuring forces Prbg. direction =

An inquiry will appear only if you have checked the **Cartesian coordinates** option after **<DIALOG>** (➤***„Entering a start/target point via dialog" on page 19-59***). Select the probing direction by softkey or by typing it in.

Scanning with two measuring forces Measuring force selected is set !

This screen message appears if you probe only in one direction when defining the start/target point, see above.

e.g.: LINE Please probe point or select function

As for the corresponding dialog lines of **Path mode = Plane in WP system**, ➤***„Path mode in WP system or workpiece plane" on page 19-44***.

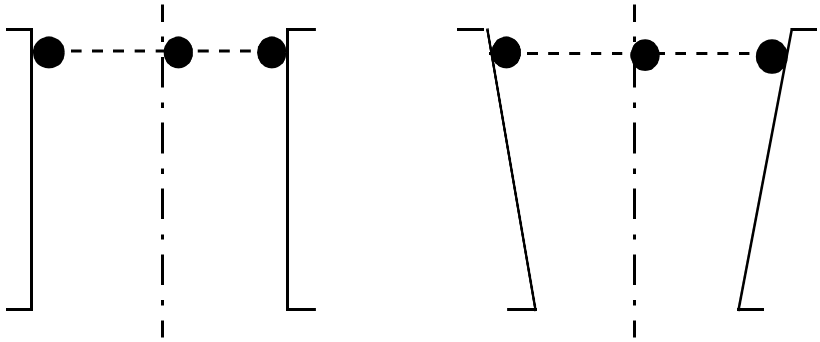
Scanning cylinder, cone, torus

Application

If you use **<Scanning run>** within **<CYLINDER>**, **<CONE>** or **<TORUS>**, the dialog will first prompt you to probe 3 points which lie in a section perpendicular to the axis of the measured element:

Probe 3 points on vertical axis of section

The program calculates the rough direction of the measured element. This advance information considerably shortens the time required to calculate the element from numerous probed points later on:



The **SCANNING RUN** dialog window is then displayed. (➤***„Branching of dialog windows“ on page 19-10***). Continue as described there.

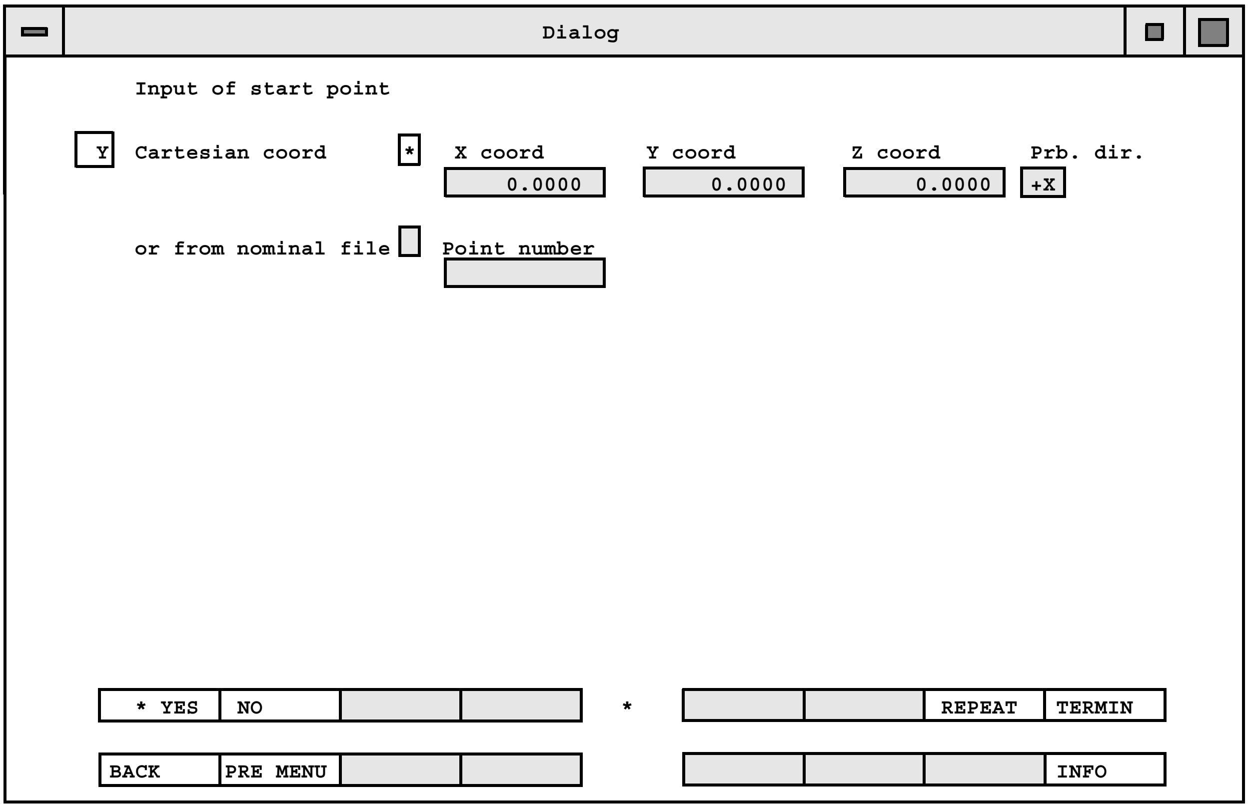
Entering a start/target point via dialog

Application

Within the dialog opened with **<Scanning run>** the start point and/or target point and if necessary the direction pointt can be entered as coordinates or as a point from the KUM nominal data file instead of being probed. This input mode must be selected with the **<DIALOG>** softkey (➤***„Path mode in WP system or workpiece plane“ on page 19-44***, ➤***„Joystick mode of operation“ on page 19-49***, ➤***„Scanning in the path mode and measuring according to nominal values“ on page 19-55***, ➤***„Self-centering path mode“ on page 19-56***).

This type of input is not available for **Path mode = Circ.path.**

DIALOG



Softkeys

REPEAT

Cancels changes (window contents reset to pre-call status). After a nominal point is entered, the applicable coordinates can be displayed with this key, see explanations on **from nominal file**.

TERMIN

Closes the dialog window. The values entered are validated and the dialog is continued.

Data boxes

Cartesian coordinates

Input of start or target point in workpiece coordinates.

from nominal file

Point from the KUM nominal point as start and/or target point. Prerequisite: Nominal data file exists and **Path mode** is **Scanning according to nominals** or **Measurement according to nominals.** After the number has been entered, the applicable coordinates can be displayed with **<REPEAT>**.

Procedure

Select required input type with **<* YES>/<NO>** and enter the data. The dialog continues after **<TERMIN>**, see corresponding chapter.

Scanning an unknown contour manually

Restriction

This scanning method is possible only with the OTM optical probe head.

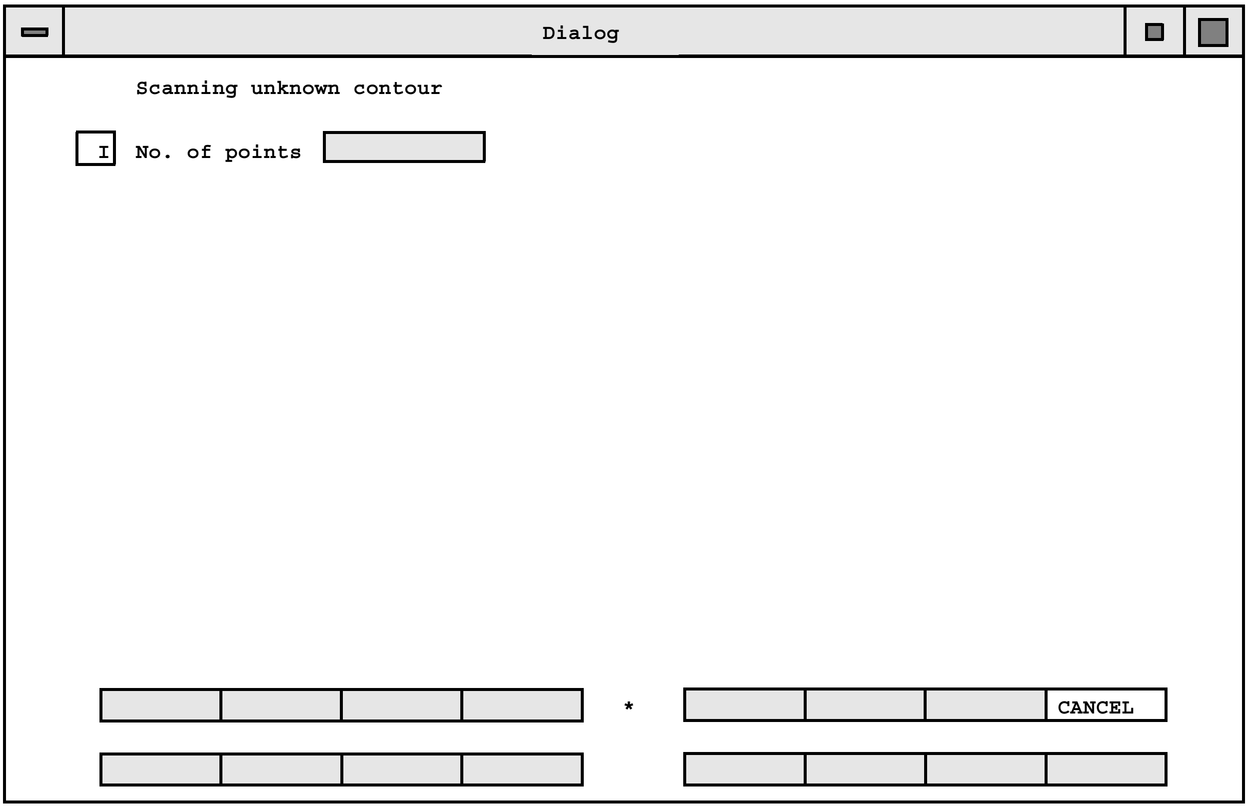
Manual scanning of random lines

Application

With this method you can probe lines arranged randomly in space.

Function call

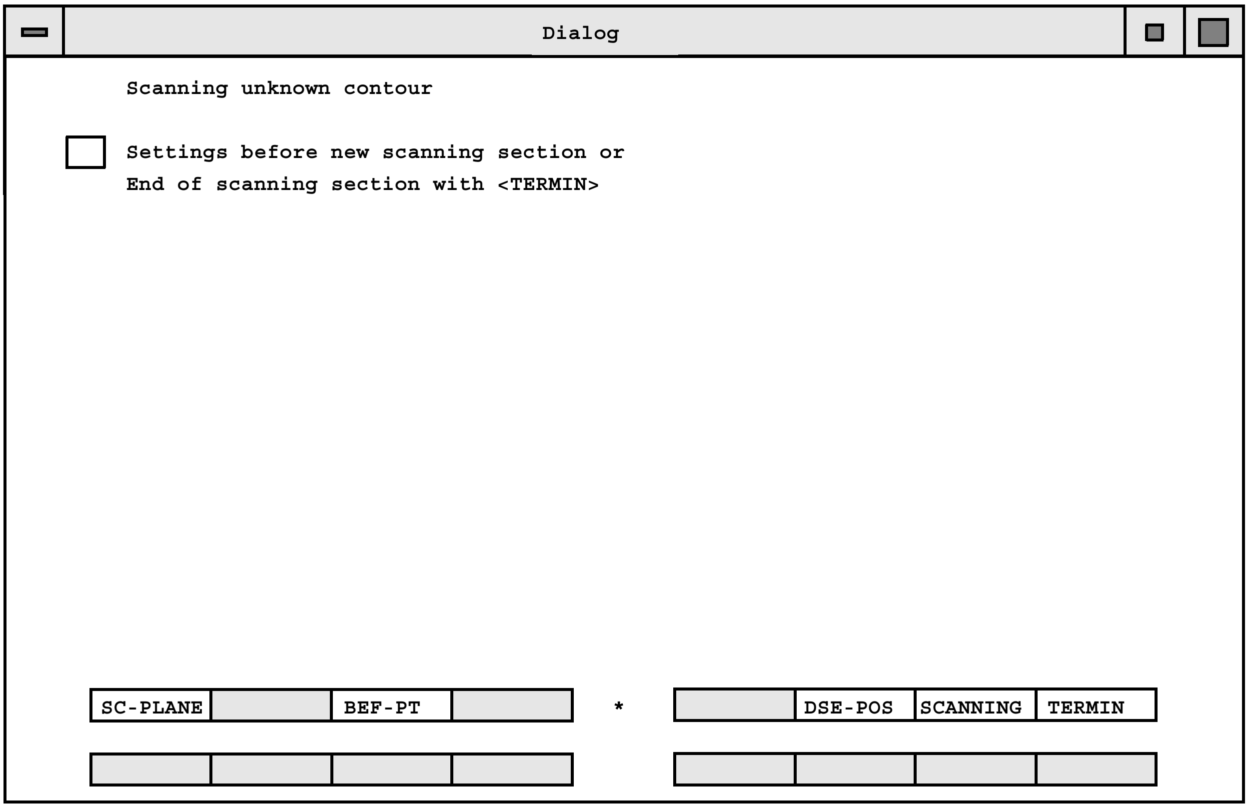
➤*„Branching of dialog windows“ on page 19-10*.



Databox

No. of points

Input of the desired number of points.



Softkeys

SC-PLANE Positioning of the probe to the section plane.

BEF-PT Positioning of the probe with probing at the last measured point.

DSE-POS Branching to the DSE setting routines.

SCANNING Fixing of the laser beam in the scanning plane. Afterwards it is only possible to move and scan in the scanning plane using the joysticks.

TERMIN Exit from scanning mode.

Procedure

- **Probe start and target point**
  The target point is used here only for determining the direction of the scanning path.
- **Travel to (in front of) start(-ing) point**
  Move the probe to an initial position from where the starting point can be reached without a collision.
- The system probes automatically and then releases (i.e. enables) the joysticks in the scanning plane.
- After terminating a section with the **<CANCEL>** softkey, you can e.g. perform travel around an obstacle and then continue manual scanning.

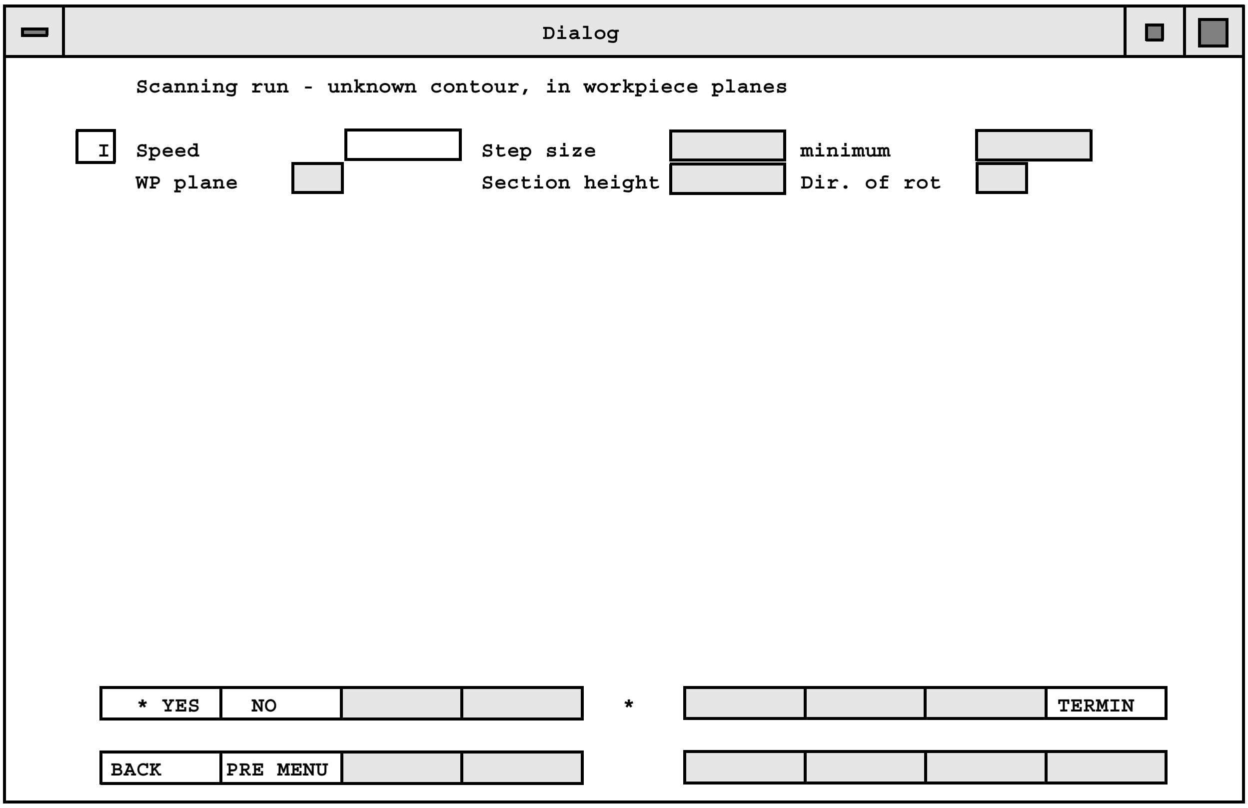
Manual scanning of sections in the workpiece coordinate system

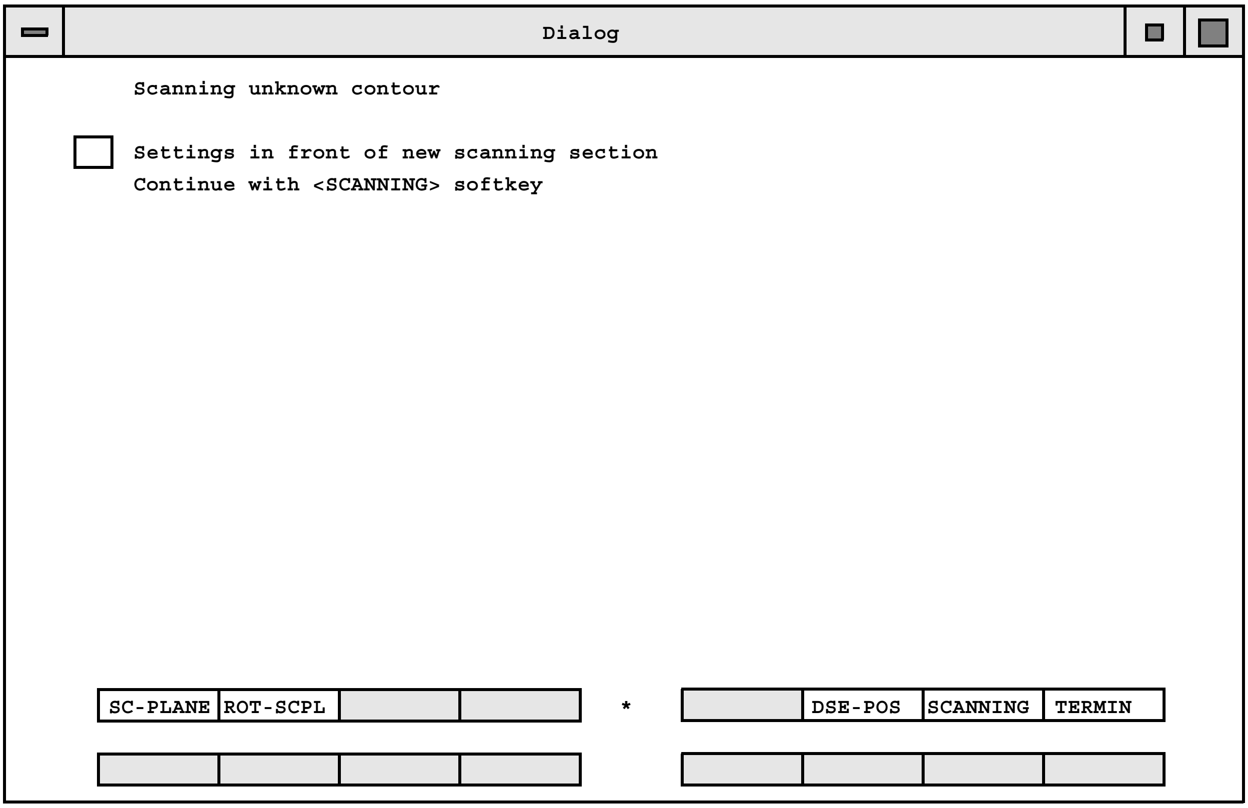
Application

With this method you can manually scan an element whose axis lies roughly perpendicular to a plane of the workpiece coordinate system.

Function call

➤ *„Branching of dialog windows“ on page 19-10*.


Dialog
Scanning run - unknown contour, in workpiece planes
I
Speed
WP plane
Step size
Section height
minimum
Dir. of rot
* YES
NO
*
TERMIN
BACK
PRE MENU


Dialog
Scanning unknown contour
Settings in front of new scanning section
Continue with <SCANNING> softkey
SC-PLANE
ROT-SCPL
*
DSE-POS
SCANNING
TERMIN

Softkeys

SC-PLANE Positioning of the probe into the section plane.

ROT-SCPL Branches to a dialog window for rotation of the scanning plane.
➤***„Manual scanning of radial sections“ on page 19-66***

DSE-POS Branches to the DSE setting routines.

SCANNING Fixing of the laser beam in the scanning plane. Afterwards, travel and scanning are possible only in the scanning plane via joystick control.

TERMIN Closes the dialog window and terminates the scanning mode.

Data boxes

Speed Max. 8mm/s for unknown contour. This speed is reached at maximum deflection of the joystick.

Step size/minimum First value = input nominal,

second value = smallest possible step size (depending on the speed).

WP Plane Specification of the workpiece plane where scanning is to be performed.

Section height Height of the scanning path above the zero point of the workpiece coordinate system.

Dir. of rot. When scanning unknown contours, the direction of rotation always results when viewing the measuring plane from the positive direction of the 3rd axis. Explanation: ➤***„Scanning a known contour“ on page 19-39***.

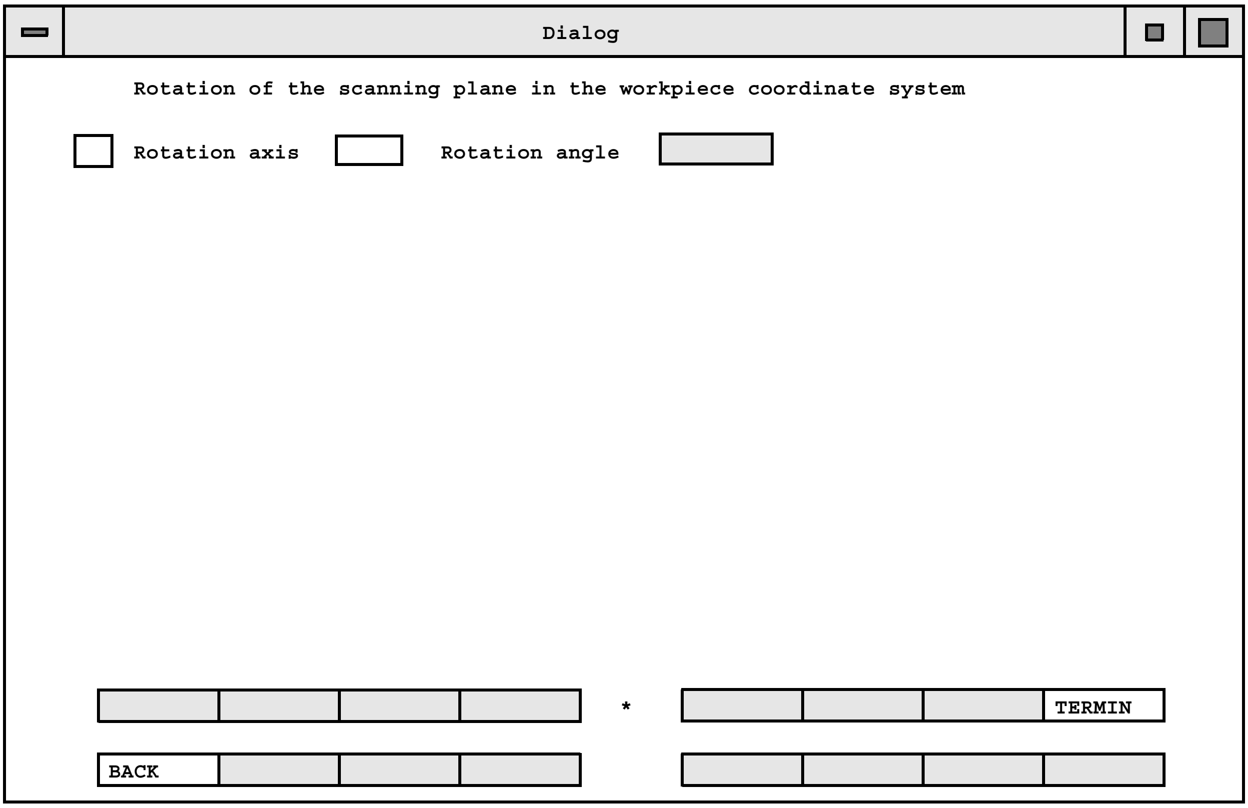
Manual scanning of radial sections

Application

This method is based on **Scanning of sections in the workpiece system.** It differs in that the scanning plane is rotated in comparison with the workpiece plane.

Function call

➤*„Branching of dialog windows“ on page 19-10*.



Data boxes

Rotation axis

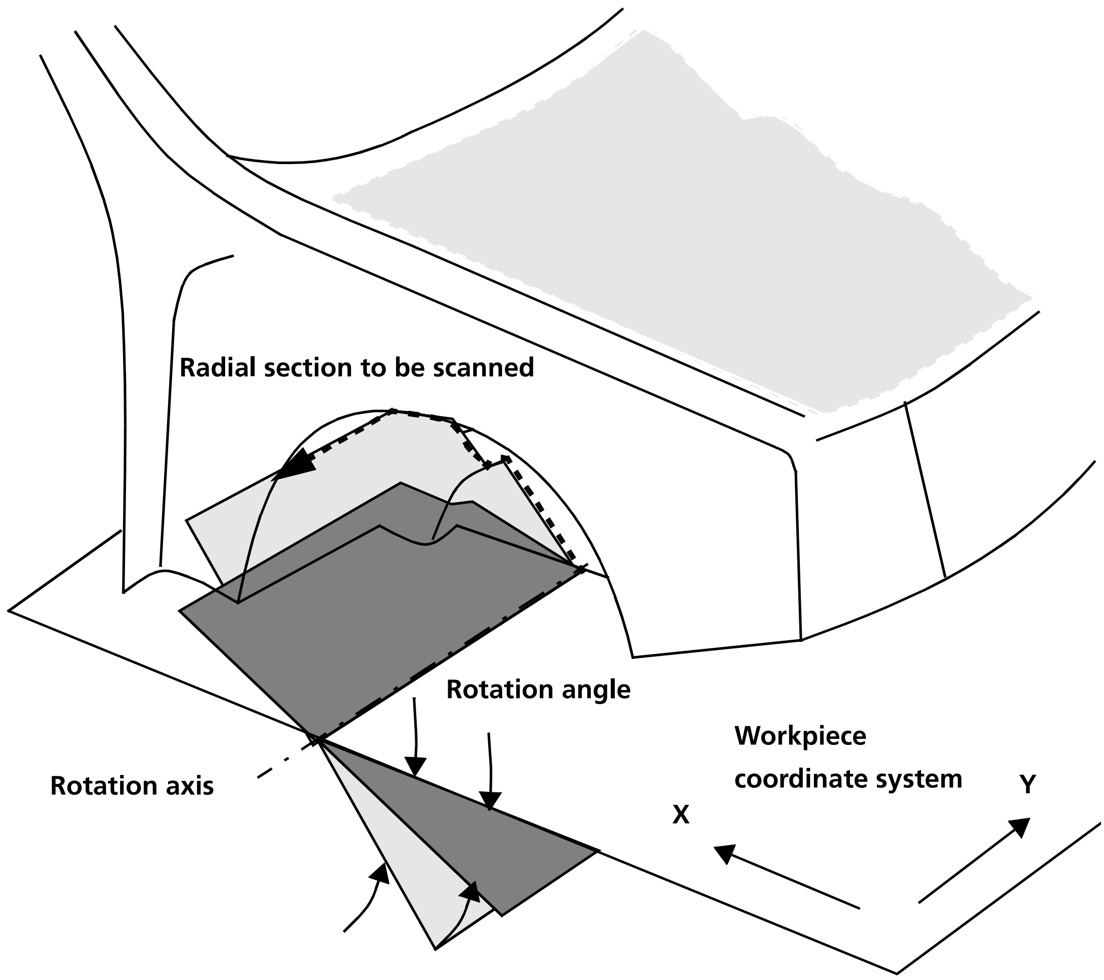
Axis about which the workpiece coordinate system (scanning plane) is tilted. The center of rotation is the current position of the laser beam.

Rotation angle

Angle about which the workpiece coordinate system is tilted.

NOTE

After this dialog window is closed, the computer returns to scanning of sections in the workpiece coordinate system.


Radial section to be scanned
Rotation angle
Workpiece
coordinate system
Rotation axis
X
Y

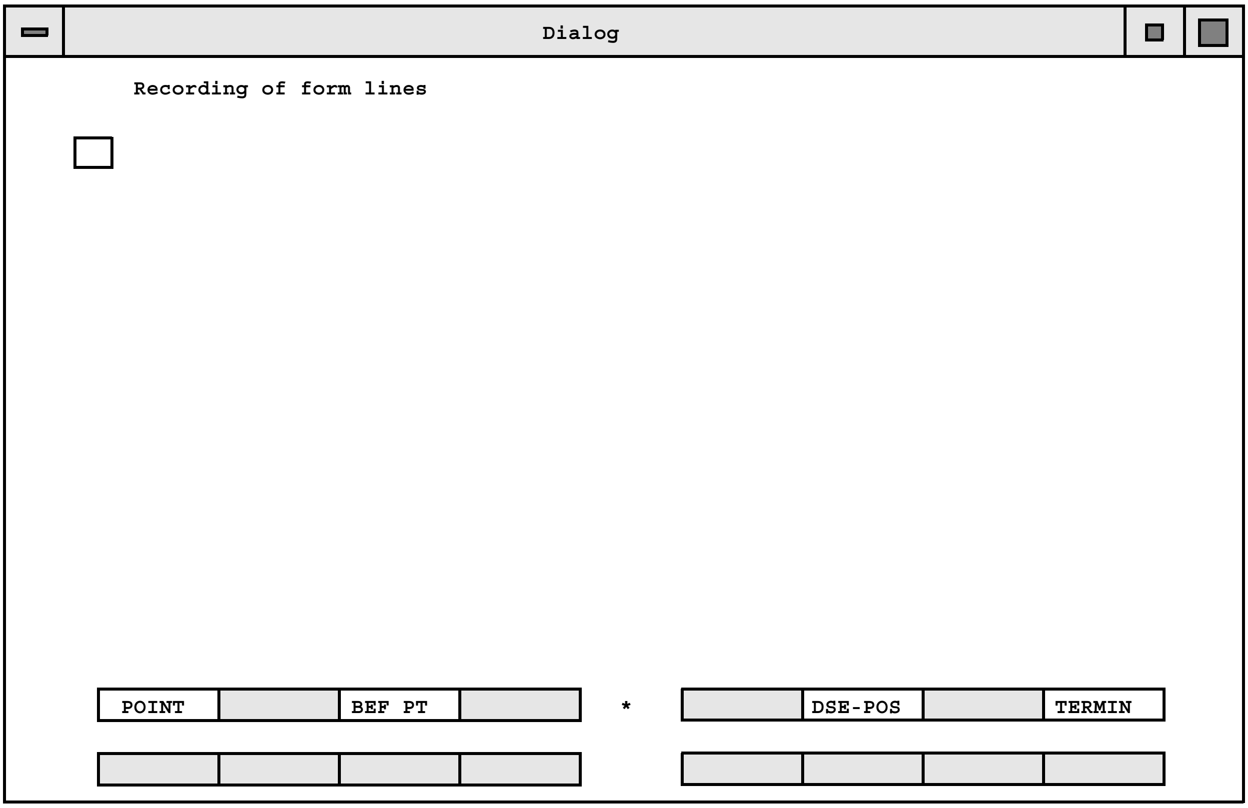
Scanning contour lines

Application

In **CADLINK** you can use this function to manually probe **contour lines** (characterization lines) on car bodies. To do this, insert an OTM laser probe in a DSE. Each probing is transferred to the **HOLOS** software.

Function call

➤*„Branching of dialog windows“ on page 19-10*.



Softkeys

POINT

Transfer of a probing point.

BEF PT

If the laser probe has to be adjusted via DSE-POS during a measurement, you can then travel back to the last probing and continue the measurement from there.

The measuring machine moves the laser probe to a position located 15 mm above the last probing position.

DSE-POS

Branching to program functions for adjusting the DSE.

TERMIN

End of measurement.

Procedure

After calling the function, you can probe with the joysticks. During joystick controlled travel perpendicular to the probing direction, the laser probe is readjusted so that it remains in contact with the measuring surface.

The probe can be backed away from the surface during measurement e.g. to travel around bores or to readjust the DSE.

Learn programming

NOTE

- The control data stores the scanning mode in 3 or 4 related control lines. Changes made in only one of the two der **SCANNING MODE** dialog windows generate all new control data lines.
- The control data codes are easy to interpret. You can list the codes for the path mode after **<MOD TOT>** with the **<INFO>** softkey (➤***„Listing the scanning modes <MOD TOT>" on page 19-9***).
- The control data for the measuring and trigger probe head are basically interchangeable; Exception: Self-centering scanning does not run with the trigger probe head.

Control line **SCA-KLEM-MOD** for the measuring probe head corresponds to control line **SCA-ABTAST** for the trigger probe head:

Measuring probe head:

```
0    3.0000    0.0000    SCA CLAM MOD    5    1    9911    1911
```

Overlapping distance

Backway distance for reclamping

Reclamping mode

Trigger probe head:

```
0    3.0000    0.0000    SCA BADIST    5    1    9911    1911
```

Intermediate position after probing

Intermediate position before probing

Type of intermediate position (fine/rough position)

The data must be adapted accordingly.

- If you scan with a long-term mode (**<RUN x>**) in the learn program, you do not need to program it with **<MODE x>** as well. **<RUN x>** permanently stores the long-term mode used in the control data following error-free scanning.
  If you scan in the learn program with the short-term mode, you must enter it in the control data with **<SCAN MOD>** beforehand or it must be currently valid when the scanning run is started (➤***„Transferring the scanning mode" on page 19-8***).
- The mode used last during learn programming or during a CNC run is always the short-term mode currently valid.

– You must define the workpiece coordinate system by scanning in the learn program (the starting point and target point are stored in the workpiece coordinates).

  If you want to define the workpiece coordinate system by scanning (e.g. with the step sequence (**<SURFACE>**) **<SCAN RUN>, <GDT-PLA>, <RO SPACE>**), first call the W-position into the computer as the workpiece coordinate system with **<DI 1713>**.

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